



Performance Assessment of Bycatch and Discards Governance by Regional Fisheries Management Organizations

Eric Gilman, Kelvin Passfield, Katrina Nakamura





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Cover photos: Onboard observer - adequate onboard observer coverage and data collection protocols are components of effective governance of bycatch, including discards, (photo courtesy U.S. National Marine Fisheries Service Alaska Fisheries Science Center, Marine Observer Program). Circle hook baited with whole mackerel - required by some tuna RFMOs, a gear technology best practice to mitigate problematic bycatch in pelagic longline fisheries (photo courtesy U.S. National Marine Fisheries Service Southeast Fisheries Science Center). Satellite-based vessel monitoring system – adequate resources for surveillance is one component of effective governance of bycatch, including discards (photo E. Gilman). Separating shrimp from discards on a coastal shrimp trawl vessel, North Carolina (photo courtesy U.S. National Marine Fisheries Service). A sailfish, longline-caught retained bycatch, being processed at the Su-ao Fishing Harbor, Taiwan – ensuring sustainable exploitation of all stocks subject to fishing mortality is one component of responsible fisheries and ecosystem-based fisheries management (photo E. Gilman). Trophic functional links of a hypothetical marine ecosystem – management of fisheries broad ecosystem effects considers effects of removals on the abundance and genetic diversity of populations and stocks of bycatch species, and effects on ecosystem processes and structure (image courtesy U.S. National Marine Fisheries Service).

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EXECUTIVE SUMMARY

Status, Deficits & Priorities for Gradual Improvements in RFMO Bycatch Governance

Effective governance of bycatch, including discards, in marine capture fisheries is necessary to avoid adverse ecological and socioeconomic consequences. Marine regional fisheries management organizations (RFMOs) have achieved mixed progress in governing bycatch. There are large gaps in binding measures to control direct and broader indirect adverse consequences of bycatch. A lack of explicit performance standards, in combination with inadequate observer coverage and incomplete data collection, hinders assessing control measures' efficacy. Measures are piecemeal in not considering potential conflicts as well as mutual benefits resulting from their implementation. Through regional observer programs, RFMOs are collecting only half of the minimum information needed to understand and govern ecological effects of bycatch and assess the efficacy of bycatch measures. RFMOs are not collecting data to estimate and account for all sources of bycatch losses, including from sources of unobservable fishing mortality. Observer coverage rates are inadequate in a large majority of RFMO-managed fisheries, and international exchange of observers to maximize data accuracy occurs in a small minority of programs. There is no open access to research-grade primary or amalgamated datasets from RFMO regional observer programs. Ecological risk assessments conducted by RFMOs have focused on assessing effects of fisheries on species groups relatively vulnerable to overexploitation, including bycatch of seabirds, sea turtles, marine mammals and elasmobranchs, and effects of demersal fishing on vulnerable benthic marine ecosystems. Assessments have largely not evaluated broader, more complex and indirect effects of bycatch across facets of biodiversity. There are limited resources for surveillance, and thus compliance is likely low. A lack of transparency and limited and inconsistent reporting of inspection effort, identified infractions, enforcement actions and outcomes further limits the ability to assess the efficacy of bycatch measures in meeting explicit or otherwise implicit objectives. Augmented coordination by RFMOs, including providing for interoperability of observer bycatch datasets across regions, avoiding incompatibilities in bycatch management measures, networking protected sites, and combining resources for research, monitoring, surveillance and enforcement, might address individual RFMO's deficits in governing bycatch.

There has been nominal progress in transitioning to an ecosystem approach to fisheries management, including accounting for broader, indirect ecosystem-level effects of bycatch mortality. The prevailing basis for bycatch governance by RFMOs continues to rely on single-species stock assessments and biological reference points for a small proportion of incidental market bycatch species, and mixed progress in controlling bycatch of species and groups relatively vulnerable to overexploitation and in managing direct habitat effects from fishing. RFMOs are far from understanding and managing broad ecosystem-level effects of fishing, including by developing control measures based on multispecies ecosystem-level models, indicators, and reference points. RFMOs have yet to implement measures to pursue balancing fishery removals across and within trophic levels at sustainable levels according to natural production capacities. Ultimately, RFMO transition to ecosystem-based management of marine resources will involve the holistic, integrated governance of all spatially explicit ocean activities across sectors, achieved by planning uses of marine areas to avoid and minimize conflicts, and to sustain ecosystem functioning and services, including the sustainable production of fishery resources.

Study Aim and Methods

A performance assessment of governance of bycatch, including discards, by 13 RFMOs, regional bodies with the competence to establish conservation and management measures for marine capture fisheries, was conducted. Findings enabled the identification of priority gaps and provide the first comprehensive baseline against which to track future progress in filling identified bycatch governance deficits. RFMOs play a critical role in global fisheries governance. RFMOs provide a formal mechanism for fishing States and States in whose jurisdiction common-property fishery resources managed by an RFMO occur to pursue their agreement and implementation of measures

to sustainably govern international fisheries. A large proportion of global marine fisheries and market species, and most of the high seas, are now covered by at least one RFMO.

Consistent with international guidelines on bycatch management, bycatch was defined broadly for this assessment as being comprised of: (i) retained catch of non-targeted but commercially valuable species; (ii) discard mortality, whether the reason for discarding is economic or regulatory, or results from vessel and gear characteristics; plus (iii) 'unobservable' mortalities, which are sources of fishing mortality that do not facilitate direct observation and are relatively difficult or not possible to estimate in the course of fishing operations.

Performance in governing bycatch was assessed against a suite of five broad criteria. These are (i) data collection for regionally observed fisheries (bycatch data collection protocols, observer coverage rates, and regional observer program dataset quality); (ii) open access to regional observer program datasets; (iii) ecological risk assessment; (iv) conservation and management measures to mitigate problematic bycatch of species relatively vulnerable to fisheries overexploitation due to their life history characteristics and susceptibility to mortality from fishing operations; adverse broad, indirect community-level effects from bycatch losses; ghost fishing mortality; and collateral mortality from discharges of catch, offal and spent bait at sea; and (v) surveillance and enforcement.

The 13 RFMOs included in the assessment were: Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), Commission for the Conservation of Southern Bluefin Tuna (CCSBT), General Fisheries Commission for the Mediterranean (GFCM), Inter-American Tropical Tuna Commission (IATTC), International Commission for the Conservation of Atlantic Tunas (ICCAT), Indian Ocean Tuna Commission (IOTC), Northwest Atlantic Fisheries Organization (NAFO), North Atlantic Salmon Conservation Organization (NASCO), North East Atlantic Fisheries Commission (NEAFC), North Pacific Anadromous Fish Commission (NPAFC), Regional Commission for Fisheries (RECOFI), South East Atlantic Fisheries Organization (SEAFO), and Western and Central Pacific Fisheries Commission (WCPFC).

Aim and Objectives of Governing Bycatch, Including Discards

Marine capture fisheries are a major contribution to food security and livelihoods, supply some of the most valuable globally traded commodities, and if responsibly governed, can contribute to sustainably meeting growing human demand for animal protein. Responsible fisheries conduct requires effective governance of all sources of fishing mortality, including losses from direct and indirect consequences of bycatch and discards. The sustainability of seafood supplied by marine capture fisheries is unequivocally linked to the sustainability of natural production by marine ecosystems. Hence, the management of marine capture fisheries via an ecosystem approach has been prescribed in major international fisheries agreements for over three decades. An overarching aim of governing bycatch is to ensure that impacts do not increase ecosystem susceptibility to reaching threshold regime shift tipping points, do not have a harmful impact across manifestations of marine biodiversity from genetic diversity to broad ecosystem-level structure and function, and do not compromise the ability to maintain the capacity for sustainable ecosystem services, including fisheries yields. Main objectives of governing bycatch include to:

- Maintain biomass and exploitation rates of incidental stocks of market species within ecosystem-level reference points, predicted to sustainably produce maximum multispecies yields.
- Mitigate the bycatch of species that are relatively vulnerable to unsustainable exploitation due to their life history characteristics and susceptibility to mortality in fisheries so as to avoid causing population-level declines and to allow rebuilding and recovery of endangered, threatened, and overexploited units.
- Ensure sustainable fishing mortality of rare, endemic, restricted-range and phylogenetically distinct species.
- Avoid alteration to the evolutionary characteristics of populations, alterations to community and food web structure and processes, and other adverse changes and loss in diversity by balancing fishing mortality, including bycatch losses, across marine ecosystem components at sustainable levels according to intrinsic production capacities.

- Prevent unsustainable exploitation of keystone and foundation species and guilds, which have disproportionate roles in ecosystem regulation.
- Reduce waste from discard mortality and unobservable losses, while considering that the efficacy of measures prescribing full retention in reducing discards may require broad fishing industry support, flexibility in output controls, and extensive resources for surveillance and enforcement.
- Minimize fishing mortality of charismatic, flagship species.
- Minimize reductions in fishing communities' revenue and food security from unsustainable bycatch mortality, including by managing the allocation of fishery resources subject to bycatch through measures that meet scientific recommendations.
- Reduce economic and operational inefficiency of catching and discarding unwanted species and sizes of catch.

Performance Assessment Findings

Fig. ES1 presents RFMO nominal and relative scores resulting from an assessment against the criteria suite evaluating performance in governing bycatch. Nominal scores provide an indication of an RFMO's progress in employing *optimal* best practices to govern bycatch, while relative scores provide an understanding of individual RFMO's progress relative to *current* best practices as defined by the RFMO obtaining the highest mean score across the five criteria.

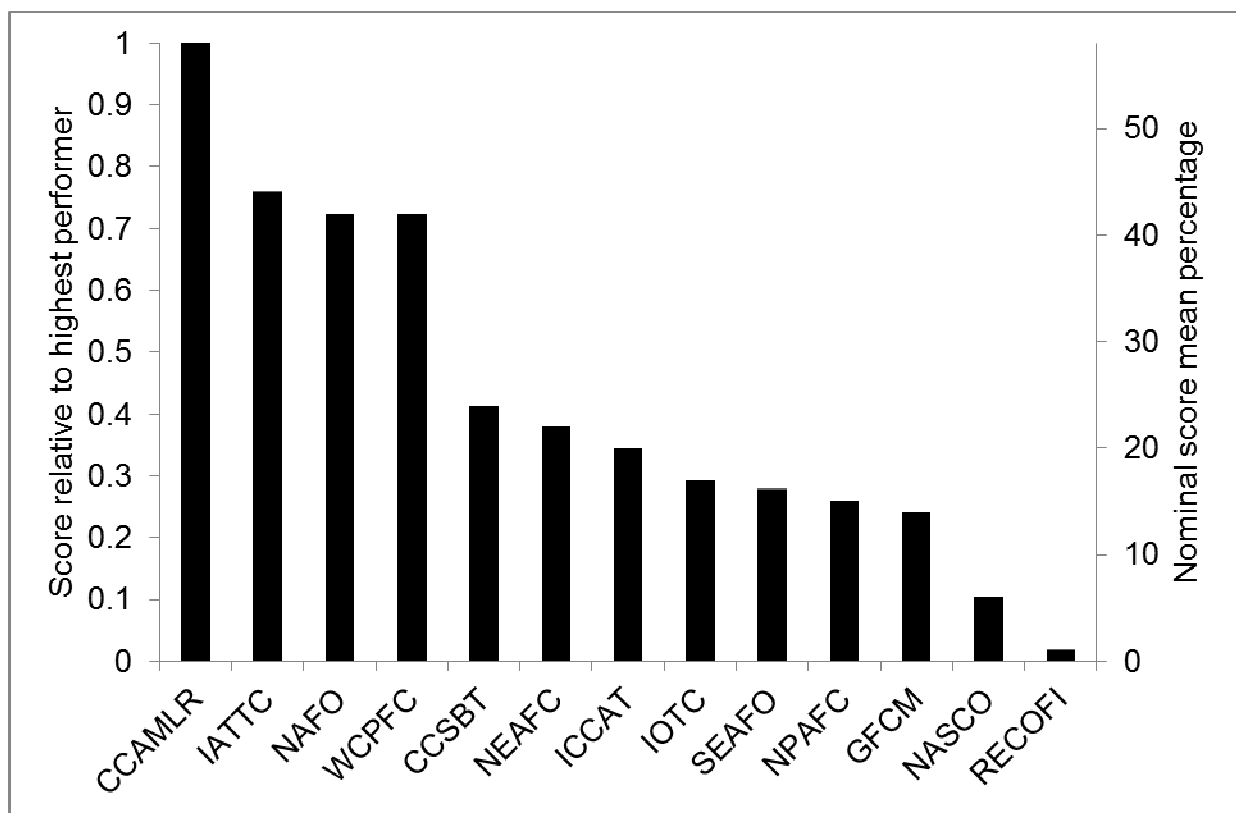


Fig. ES1. RFMO scores resulting from an assessment of performance in governing bycatch, including discards. Primary x-axis scale is the score relative to the highest performer. Secondary x-axis scale is the nominal mean percentage score of five criteria.

Overall scores ranged from 1% (RECOFI) to 58% (CCAMLR). The mean score of 25% ($\pm 16\%$ σ , standard deviation of the population) indicates that collectively RFMOs have substantial deficits in overall bycatch governance. A 64% CV (coefficient of variation, the standard deviation of the population of scores was 64% of the mean), with six RFMO scores falling outside \pm one σ from

the mean, indicates that there was relatively high variability and hence inconsistent performance in governing bycatch across the 13 RFMOs. A deficit in one or more core bycatch governance framework element is likely to compromise an RFMO's ability to achieve sustainable fisheries.

RFMO observer monitoring methods and data quality

The mean score when assessed against a criterion on observer monitoring methods and dataset quality was 31% ($\pm 30\%$ σ). Of the five criteria of the suite, there was least consistency in RFMO performance in observer bycatch data collection protocols, observer coverage rates and dataset quality. Legal instruments establishing international responsibility to conserve associated and dependent species is relatively recent. As a consequence, a substantial proportion (5 of 13) of RFMOs does not include minimizing fisheries impacts on associated and dependent species of non-target fish and non-fish species in their mandate.

Observer data are vital to identifying and understanding trends in bycatch and discard rates and levels, and in assessing performance of control measures in a commercial setting. RFMOs are largely not collecting basic information needed to understand and govern the ecological effects of bycatch, including discards, or information needed to assess the efficacy of binding bycatch measures. Minimum information collected by onboard observers needed to understand and govern bycatch includes: quantity, weight, species, length or other proxy for age class, retained or discarded, disposition of released catch, gear attached to released organisms, date and location caught, and sampling effort. Additional fields are required to assess the efficacy of individual bycatch measures.

Only about a quarter of RFMO-managed fisheries have $\geq 5\%$ onboard observer coverage, likely inadequate to understand rare-event bycatch interactions. The mean RFMO observer coverage rate of 18.5% is encouraging, however, there was high dispersion in coverage rates ($\pm 37\%$ σ , 198% CV): Of 68 active managed fisheries, 47 had no regional observer coverage and 11 had 100% coverage. Observer coverage rates should meet scientific recommendations, which may reflect objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and spatial distribution of bycatch. Only three RFMOs have international exchange of observers, a best practice to optimize the objectivity of observer reporting.

Seven RFMOs lack observer program datasets either because Parties are not required to report observer data (N=3) or otherwise because they do not have a regional observer program (N=4). Only 49% of requisite information needed to assess the performance of bycatch measures is intended to be collected through RFMO observer programs. Only three RFMOs have regional observer program datasets of sufficient time series length to support most rigorous research applications. Six RFMOs are lacking membership of one or more State or entity that operates fisheries under the RFMO's mandate, limiting the RFMO's ability to effectively account for and manage bycatch in regionally managed fisheries. Having all States that operate fisheries as Members or Cooperating-non Members improves dataset quality by achieving the reporting of bycatch data from all relevant fisheries. Unlike data collection in regional observer programs, national observer datasets not a part of a regional program likely do not support pooling. Regional datasets, or pooled domestic datasets collected through standardized collection methods and standardized dataset formatting to enable interoperability, provide larger sample sizes and longer time series. This improves capabilities to determine if observed patterns are long-term trends or cyclical, short-term, serially correlated patterns, and provides broader spatial coverage across RFMO convention areas.

Seven RFMOs collect information on the disposition of released organisms for at least one species or group identified as being relatively vulnerable to fisheries overexploitation, which is partial information needed to estimate post-release mortality. However, RFMOs largely do not estimate and thus cannot accurately account for unobservable sources of fishing mortality. There is a need to employ best practice methods to estimate levels of unobservable removals, account for these losses in ecosystem models, indicators and reference points, and adopt measures to mitigate sources of unobservable mortality.

Observer program dataset open access

Ten RFMOs had scores of 0% when assessed against a criterion on open access to regional observer program datasets. The remaining three RFMOs had scores ranging from 40% to 47%. No RFMO provides open access to primary data. Only WCPFC provides access to amalgamated data records at $\leq 5^\circ$ cell spatial resolution, however this public domain dataset is inadequate for fundamental research applications due to a lack of critical fields, the amalgamation of certain fields such as combining non-target species into a single field, and pooling logbook and observer records without identifying sources for individual records. Unconditional, open access to RFMO-held datasets of research-grade primary or amalgamated records collected by regional observers is necessary for large spatial- and temporal-scale research, peer review, and replication to validate study findings.

Ecological risk assessment

Effective bycatch governance requires knowledge of the direct effects of fishing operations on stocks and populations subject to bycatch, and broader community- and ecosystem-level consequences of bycatch. The RFMOs achieved a mean score of $26\% \pm 17\% \sigma$ when assessed against a criterion on ecological risk assessment. Most (11 of 13) RFMOs have conducted ecological risk assessment of the effects of fishing mortality on selected species subject to bycatch in at least one managed fishery. There has been limited assessment or accounting for broader, indirect risks from bycatch removals: only two RFMOs (CCAMLR and IATTC) have conducted assessments of ecosystem-level effects of bycatch in a subset of their managed fisheries.

RFMO's ecological risk assessments have focused on assessing effects of fisheries on species groups relatively vulnerable to overexploitation, including bycatch of seabirds, sea turtles, marine mammals and elasmobranchs, and effects of demersal fishing on vulnerable benthic marine ecosystems. Assessments have generally not accounted for broader, complex and indirect effects of bycatch across facets of biodiversity, ranging from reducing genetic diversity and evolutionary characteristics of populations subject to selective bycatch fishing mortality, to altering ecosystem regulation or structure through unsustainable bycatch of keystone and foundation species. There have also been no estimates of unobservable removals. RFMO governance of bycatch requires gradual improvements in knowledge to enable effective management of the ecological risks from direct and indirect effects of bycatch across manifestations of marine biodiversity. This is necessary to fully implement ecosystem-based management and a precautionary approach to fisheries management.

Binding control rules

Legally binding conservation and management measures, with measurable, quantitative performance standards, are necessary to mitigate problematic effects of bycatch and guide adaptive management. RFMOs have achieved mixed progress in adopting binding measures to control problematic bycatch, including discards, of vulnerable species and broad ecosystem consequences of bycatch removals, with a mean score of 30% and relatively low consistency across the RFMOs ($\pm 20\% \sigma$). Combined, RFMOs are not managing about two thirds of bycatch problems of species and groups relatively vulnerable to overexploitation. Binding measures are in effect to address a mean of 37% of species vulnerable to overexploitation from bycatch mortality, with large dispersion in scores ($\pm 26\% \sigma$). RFMOs have consistently large deficits in controlling ghost fishing and in managing discharges of catch, offal and spent bait, with mean scores of $15\% \pm 10\% \sigma$ and $8\% \pm 10\% \sigma$, respectively, for assessments against these subcriteria. No RFMO has assessed or accounts for unobservable losses from ghost fishing or from discharges of discarded catch, offal and spent bait. Six RFMOs have adopted a binding measure related to governing ghost fishing. Only CCAMLR has a binding measure managing discharges. Three RFMOs have not adopted any binding measures to control problematic bycatch.

There is a wide range of binding measures to control and mitigate direct and indirect adverse consequences of bycatch. Measures adopted by RFMOs include changes in fishing gear and methods; input and output controls; and time/area restrictions to avoid bycatch hotspots such as at

seamounts and other vulnerable marine ecosystems. Other measures have included handling and release practices to increase the probability of post-release survival; restricting discharges at sea to manage collateral effects; banning gear types with high ghost fishing efficiency; and requiring gear designs, gear marking, and technology to track gear position to mitigate ghost fishing.

Most (80%, N=95) binding bycatch measures lack explicit, measurable performance standards. These measures do not stipulate expected or target outcomes, e.g., stating a target bycatch rate or level for a measure requiring employment of a bycatch mitigation method, or a limit that provides an indicator of performance, such as a minimum sink rate for terminal tackle to avoid seabird interactions. A lack of a standard against which to measure performance, in combination with inadequate observer coverage and incomplete data collection, limits the basis to guide adaptive bycatch governance.

A majority (62%) of RFMOs have an opt out provision, which allows members not to comply with binding measures. However, opt out mechanisms have been used infrequently. Some RFMOs have adopted instruments on objection procedures that require parties who lodge objections to a binding measure to explain the basis for their objection, and establish a formal process to review the basis for the objection. The purpose is to minimize unfounded objections and adapt measures accordingly for objections with merit.

Surveillance and enforcement

To achieve compliance with bycatch control measures, RFMOs require effective surveillance and enforcement frameworks. The RFMOs received the highest average score against a criterion assessing efficacy of surveillance and enforcement (39%), with high inconsistency in RFMO performance ($\pm 21\%$ σ). RFMOs employ 60% of surveillance methods required to assess compliance of binding bycatch measures, with very large variability in this element ($\pm 36\%$ σ). None of the RFMOs met all three of the following fundamental elements of surveillance and enforcement: (i) Members routinely report identified infractions, enforcement actions and conclusions; (ii) the RFMO secretariat routinely makes information on detected infringements and enforcement outcomes publicly available; and (iii) detected infringements of binding bycatch measures regularly result in sanctions.

All of the RFMOs have incomplete or no public reporting on surveillance and enforcement activities. Members do not routinely report surveillance effort, detection of infractions, and enforcement actions and outcomes. While RFMO-prescribed surveillance methods address the majority required to assess compliance with binding bycatch measures, there remains a large 40% deficit, a lack of harmonization of inspection systems may limit efficacy of prescribed surveillance methods, and information is not consistently reported to determine if required surveillance methods are in fact implemented by RFMO Members. RFMOs tend not to prescribe enforcement actions and information is not made public to determine if Members have developed requisite legal frameworks for prosecution. RFMOs also do not prescribe specific sanctions to be assessed in response to detected infringements, and a lack of consistent reporting and transparency prevents a determination of whether sanctions provide a sufficient incentive for compliance. While most RFMOs have formal procedures to routinely assess the performance of surveillance and enforcement activities to support adaptive management, a lack of reporting by Members compromises the efficacy of these compliance review processes. Furthermore, RFMO secretariats tend to lack the authority to impose sanctions against Members found to not be in compliance with RFMO requirements, including binding bycatch measures. RFMO secretariats do not routinely report identified violations made by Members or actions taken, if any, by the RFMO secretariat in response. Due to these deficits in RFMO surveillance and enforcement frameworks, a culture of compliance appears to not exist for most RFMO communities.

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1. INTRODUCTION

1.1. Why Govern Fisheries Bycatch?

Marine capture fisheries are a major contribution to food security and livelihoods, particularly in developing countries. They supply some of the most valuable globally traded commodities, and if sustainably governed, have a high capacity to contribute to sustainably meeting growing human demand for animal protein relative to terrestrial sources (FAO, 2010a; Godfray et al., 2010; Pereira et al. 2010; Pelletier et al., 2011). To avoid adverse ecological and socioeconomic consequences, responsible fisheries conduct requires effective governance of all sources of fishing mortality, including from retained target catch, retained and discarded catch of non-targeted species, and unobservable mortalities (United Nations, 1982, 1995; Hall et al., 2000; FAO, 1995a, 2011a; Gilman, 2011). An integral component of implementing the ecosystem approach to fisheries, this is necessary to contribute to maintaining marine biodiversity, ecosystem structure and functioning, ecosystem services, and is necessary to avoid negative socioeconomic consequences for fishing communities (Hall et al., 2000; FAO, 2003a, 2008a, 2011a). The focus has been on collecting information on and managing only landed target species. However, there has been recent and growing international attention to the need to address this governance deficit (FAO, 2011a; Gilman et al., 2012a).

1.1.1. Defining Bycatch and its Components

While used inconsistently, the term bycatch is defined for this study as being comprised of: (i) the retained catch of non-targeted but commercially valuable species, referred to as 'incidental catch' or 'by-product', which may be landed/transshipped or otherwise consumed by crew, used for bait, or rejected at port; (ii) discard mortality, whether the reason for discarding is economic or regulatory, or results from vessel and gear characteristics; plus (iii) unobservable mortalities, which are sources of fishing mortality that do not facilitate direct observation and are relatively difficult or impossible to estimate in a commercial setting (Alverson et al., 1994; Hall et al., 2000; ICES, 2005; Kelleher, 2005; Broadhurst et al., 2006; FAO, 2011a; Gilman, 2011; Gilman et al., 2012a).

Due to inconsistent use, the term bycatch has resulted in confusion. Because the species, sizes, and sexes that are targeted, secondary targets, incidental catch, or discarded can be highly variable temporally, spatially, within a fleet, and by individual vessels in a fleet due to several complex factors (e.g., Gilman et al., 2008a; Hall et al., 2000), this can cause uncertainty in what the term bycatch is intended to signify. Confusion has also resulted because bycatch has been used synonymously with fishing mortality of protected, endangered and threatened species or with dead discards. Regardless of the terminology and definitions employed, effective fisheries governance requires mechanisms to ensure the ecological and socioeconomic sustainability of total fishing mortality.

From 1992-2001, an average of 7.3 million tonnes of fish were annually discarded, representing 8% of the world catch (Kelleher, 2005). There have been substantial reductions in discard levels in recent years, in part, due to increased retention as a result of the development of markets for previously discarded species and sizes, but also from increased gear selectivity reducing catch rates of unwanted catch (Pascoe, 1997; Kelleher, 2005).

Fishers may discard catch due to market considerations, such as discarding species and sizes lacking markets, with no or relatively low value, damaged catch with low or no value, and species that are incompatible with the rest of the catch during storage (e.g., sharks, which concentrate urea in their blood which is converted by bacteria to ammonia, can contaminate other species in the hold). Another reason for discarding is high-grading, which involves discarding lower-value catch to make room in the hold for higher value catch, when room in the hold is a limiting factor, and the perceived difference in net value between discards and retained catch is greater than the cost to replace the discard (Arnason, 1994; Alverson et al., 1994; Hall, 1996; Vestergaard, 1996; Kelleher, 2005). Quality, including catch that is unfit for human consumption due to spoilage or toxicity, provides another reason to discard part of the catch. Catch may need to be discarded

during the final set of a trip, when there might be insufficient room to retain all the catch from that set (e.g., IOTC, 2009a). Furthermore, output controls can create incentives for discarding. Quota-induced high-grading occurs when a vessel reaches a species-based quota, and discards lower value grades to enable retaining higher value grades. Over quota discarding occurs in multispecies fisheries when a quota for one species is reached, but quotas for other species are not in place or have not been reached, and the vessel discards additional catch of the species for which the quota has been reached. Discarding sublegal individuals can occur to comply with measures for species-based minimum landing sizes. Discarding may be conducted to meet prescribed catch composition (measures setting limits on the percent catch composition by species). And, discarding may be conducted to comply with restrictions on retention by sex, such as in some fisheries for crab (Anderson, 1994; Arnason, 1994; Alverson et al., 1994; Hall, 1996; Kelleher, 2005; Defra, 2006; Coggins et al., 2007; Graham et al., 2007; Poos et al., 2010).

Sources of unobservable fishing mortality can be placed into one of five categories: pre-catch losses, ghost fishing, post-release mortality, collateral sources, and synergistic and cumulative effects of fishing operations (ICES, 2005; Gilman et al., 2012a). Unobservable fishing removals are not routinely accounted for in fisheries management due to a lack of adequate data, and for some components, a lack of methods to provide accurate estimates (Gilman et al., 2012a). International guidance promotes quantifying and reducing impacts of unobservable mortality but does not identify best practice methods to estimate unobserved losses (FAO, 2011a). Unobservable mortalities can lead to adverse impacts on populations and ecosystems, are a source of wastage, reduce the sustainability of fishery resources, and errors result when stock assessments and population models do not account for unobservable fishing mortality (Broadhurst et al., 2006; Gilman et al., 2012a).

Pre-catch losses occur when organisms are caught, or collide with the vessel or gear, and die but are not landed onboard (Chopin and Arimoto, 1995; Gilman et al., 2005; Broadhurst et al., 2006; Watkins et al., 2008; FAO, 2011a,b; Gilman, 2011). For example, catch may die and fall from the gear before retrieval, predators may remove dead catch from the gear, or crew may intentionally release a portion of or the entire catch prior to landing onboard (Misund and Beltestad, 1995; Kaiser et al., 1996; Matsuoka et al., 2005; Gilman et al., 2003, 2006a, 2007a, 2008a; Watkins et al., 2008). Also, organisms may escape from the gear alive but die later due to stress and injury incurred from the interaction (Gilman et al., 2005; Suuronen, 2005; Broadhurst et al., 2006; Ingólfsson et al., 2007).

Post-release mortality occurs when catch is retrieved and then released alive but stressed and injured to a degree that causes it to die later. Post-release mortality may occur due to fatal wounds or increased probability of fatal diseases resulting from injuries incurred through the fishery interaction (Ryer et al., 2004; Davis, 2005; ICES, 2004; Swimmer et al., 2006; Gilman et al., 2006b, 2008a; Snoddy and Williard, 2010; Gilman, 2011).

Ghost fishing occurs when lost, abandoned and discarded derelict fishing gear continues to catch and kill organisms (Fowler, 1987; Matsuoka et al., 2005; FAO, 2011a). There are intentional and unintentional causes of derelict gear, including, for example, gear abandonment when operating illegally and a risk of detection occurs, abandonment due to bad weather, discarding unwanted gear at sea when deemed more practical or economical to disposal onshore, loss when damaged by fishing activity, loss from inclement weather, and gear being snagged on seabed features (Pawson, 2003; UNEP and FAO, 2009; FAO, 2011a). Organisms caught in derelict nets, traps and other gear types, can attract scavengers, which subsequently are caught, causing possible long-term ghost fishing due to this self-baiting (Kaiser et al., 1996; Matsuoka et al., 2005; FAO, 2011a). Ghost fishing is problematic primarily with passive fishing gear (e.g., longlines, gillnets, trammel nets, traps) after being set, where the catching process of set active gears (e.g., purse seine, trawl) generally ceases once the gear is detached from the vessel (ICES, 2005; FAO, 2005a, 2010a; Gilman et al., 2012a). However, ghost fishing has been observed in seine nets, trawl net fragments, and fish aggregating devices (FADs) (Jones, 1995; Donohue et al., 2001; Matsuoka et al., 2005; Gilman, 2011). Ghost fishing mortalities also occur from discarded offal and bait containing hooks (Weimerskirch and Jouventin, 1987).

Collateral sources of unobservable fishing mortality are those that are indirectly caused by various ecological effects of fishing (ICES, 2004, 2005; Broadhurst et al., 2006). Collateral mortality can result, for instance, from the stress or injuries an organism incurs from avoiding fishing gear (ICES, 2004; Broadhurst et al., 2006). Facilitated predation from fishing operations can occur, for example, when organisms are impaired by fishing operations and when predators are attracted to areas disturbed by fishing gear (Kaiser and Spencer, 1994; Goñi, 1998; Ryer, 2002; ICES, 2004; Broadhurst et al., 2006). Loss and degradation of habitat from fishing, including increased suspended sediment loads, altered substrate from direct gear contact, and alteration to the benthic community, cause indirect collateral mortalities, including by increasing predation and competition for shelter (Goñi, 1998; Broadhurst et al., 2006; Kaiser et al., 2006). Several studies have documented changes in benthic community structure and functions from habitat impacts from fishing gear, which may be irreversible or have very long recovery times (e.g., Kaiser et al., 2006). Or, for example, drifting FADs, which aggregate biomass from a surrounding area, may alter the survival probability of species by altering their spatial distributions over in the order of hundreds of kilometers, potentially trapping them in prey-poor habitat, modifying their diet composition and changing their behavior, such as diel vertical migration cycles (Marsac et al., 2000; Menard, 2000; Bromhead et al., 2003; Musyl et al., 2003; Hallier and Gaertner, 2008; Dagorn et al., 2010).

Another example of a collateral source of mortality resulting from fishing operations is from the disposal at sea of offal (processed fish), spent bait and dead catch. These discharges can change foraging behavior, diet, competition amongst coastal and marine species, and community composition (Wassenberg and Hill, 1987; Evans et al., 1994; Blaber et al., 1995; Hall, 1996; Yamamura, 1997; Goñi, 1998; Furness et al., 2007; Franco et al., 2008; Gilman et al., 2012b). Discards can alter food webs and distributions of biomass within an ecosystem (e.g., transferring the biomass of discarded demersal species to surface scavengers, and transferring the biomass of discarded pelagic species to benthic scavengers), and increase levels of organic material in benthic ecosystems. In fisheries where discards are spatially concentrated, and especially in areas of low current flow, discards may cause localized hypoxia or anoxia of the seabed, which, if prolonged, can cause substantial mortalities, alter benthic community composition and ecosystem processes and structure (Wassenberg and Hill, 1987; Evans et al., 1994; Yamamura, 1997; Goñi, 1998; Hall et al., 2000; Gray et al., 2002; Franco et al., 2008; Levin et al., 2009; Haselmair et al., 2010). This is potentially problematic not just in coastal areas, but also for discharges occurring in very deep regions of the ocean, where large proportions of discharges may settle through the water column without being consumed, altering the benthic community, and transferring biomass to bottom currents for centuries before recycling to the euphotic zone of the pelagic ecosystem (Stockton and DeLuca, 1982; Smith, 1985; Hall et al., 2000).

Unobservable mortalities often occur as a consequence of synergistic and cumulative sub-lethal stressors from fishing operations. Cumulative stress and injury from multiple sub-lethal fishing interactions, including for example when an organism repeatedly avoids capture or is repeatedly caught and released alive, may eventually lead to mortality (Gilman et al., 2012a). Interactions among individual stressors from fishing operations can also result in mortality (Davis, 2002; Broadhurst et al., 2006). Mortality may ultimately be the result of predation, lack of prey, disease, secondary infections or a combination of these and other stressors. Some of the interacting stressors may result from chronic effects of fishing, such as anoxia from discards, and habitat degradation and loss from bottom fishing, while others may be the result of acute events, such as from pre-catch escapement and collateral displacement from habitat used for shelter from predators (Gilman et al., 2012a).



Collateral mortality resulting indirectly from fishing operations, such as the bycatch mortality of one albatross of a breeding pair resulting in chick starvation, is one category of unobservable bycatch removals (photos National Marine Fisheries Service).

1.1.2. Aim and Objectives of Governing Bycatch

Overarching Aim - Prevent Adverse Effects Across Manifestations of Marine Biodiversity and Ecosystem Services:

An overarching aim of governing bycatch, achieved through employment of an ecosystem approach to fisheries management, is to ensure that impacts of fishing, including from bycatch removals, on ecosystem structure and function are sustainable. This requires that consequences of fishing operations do not increase ecosystem susceptibility to reaching threshold regime shift tipping points, do not have a harmful impact across manifestations of marine biodiversity, from genetic diversity to broad ecosystem-level effects, and do not compromise the ability to maintain the capacity for sustainable ecosystem services, including sustaining fisheries yields (United Nations, 1995; Lawton, 1999; Gislason et al., 2000; Link et al., 2002; FAO, 2003a,b; Pikitch et al., 2004). Fisheries overexploitation of principal market and bycatch species and broader, more complex and indirect effects of fishery removals are currently the largest drivers of change and loss of global marine biodiversity (Hall, 1996; Pauly et al., 2005; Pereira et al., 2010; Zhou et al., 2010; Rochet et al., 2011; Garcia et al., 2012). At the species- and population-levels of biodiversity, there is documentation of few contemporary marine species extinctions (c. 39 in the past 300 years), with an order of magnitude higher number of documented contemporary extirpations of populations due primarily to overexploitation and habitat degradation, in part, from marine fisheries (Brander, 1981; Carlton et al., 1999; Dulvy et al., 2003; Dulvy, 2006; Gilman et al., 2011a). Instead, marine fisheries, including through bycatch removals, have primarily altered other components of marine biodiversity, from genetic diversity to ecosystem integrity (Hall, 1996; Pauly et al., 2005; Pereira et al., 2010; Zhou et al., 2010; Rochet et al., 2011; Garcia et al., 2012). The last realm for human hunting and gathering, the sustainability of seafood supplied by marine capture fisheries is inherently linked to the sustainability of natural production by marine ecosystems. The management of marine capture fisheries via an ecosystem approach has been included in major international fisheries agreements since the 1980 Convention on the Conservation of Antarctic and Marine Living Resources (CCAMLR, 1982; FAO, 2003a,b).

Ecosystem-based management of marine resources is implemented in part via marine spatial planning and accounting for cumulative, multispecies effects from all marine activities. It involves the holistic, integrated governance of all spatially explicit (place-based) ocean activities, achieved by planning uses of marine areas to avoid and minimize conflicts, and to sustain ecosystem integrity and services. Marine spatial planning is comparable to land-use planning, but in the more complex three-dimensional ocean, with constantly-changing oceanographic and atmospheric features (Ardron et al., 2008; Crowder and Norse, 2008; Ehler and Douvre, 2009; Interagency Ocean Policy Task Force, 2009; Gilman et al., 2011b). Transitioning to ecosystem-based fisheries management will require moving from employing single-species stock assessment and population models to multispecies ecosystem models that enable establishing rigorous ecosystem-level indicators, reference points and control rules. The ecosystem models, indicators and reference points need to define a reference state for the community, account for effects of environmental variation, including from climatic drivers, account for complex food web processes, including the roles of keystone and foundation species and guilds in regulating ecosystem processes and structure, consider individual species' vulnerability to fisheries exploitation based on life history characteristics and susceptibility to fishing operations, and consider effects of fishing operations on phylogenetically distinct species (Paine, 1969, 1980; Constable et al., 2000; Link et al., 2002; Pikitch et al., 2004; Bascompte et al., 2005; Link, 2005; Mangel and Levin, 2005; Rochet et al., 2005; Gilman et al., 2011a). Furthermore, an understanding of all sources of fishing mortality, including direct stock-level effects of fishery removals on biomass and the selectivity (trophic level, species, stock, population, age class, sex, spatial location) of removals, in addition to knowledge of ecosystem structure and functioning, including connectivity between biogeochemical and physical processes, trophic linkages and the strength of interactions between predators and their prey and concomitant stability of the ecosystem in response to fishing pressure, and life histories of higher trophic level species, is fundamental information to produce reliable ecosystem models (Cox et al., 2002; deYoung et al., 2004; Bascompte et al., 2005). Ecosystems with simple

food webs, high specialization, limited interactions among species, low community evenness, and lacking functional redundancy (i.e., few species per trophic level) may be least resistant and resilient to stressors and most susceptible to fisheries alteration, including from bycatch removals (McCann, 2000; Bascompte et al., 2005; Wittebolle et al., 2009).

Sustain Maximum Multispecies Yields: As with target stocks, one objective of bycatch governance is to maintain exploitation rates and biomass of stocks of incidental market species within limits based on ecosystem-level reference points that produce maximum multispecies sustainable yields.

Avoid Population-level Effects of Relatively Vulnerable Species and Allow Rebuilding: An increasingly prominent bycatch management objective is to mitigate the bycatch of species groups that are relatively vulnerable to fisheries overexploitation, resulting from their K-selected life history characteristics and susceptibility to mortality from fishing operations, including by augmenting fishing and gear selectivity (e.g., FAO, 1999a,b, 2010b; Gilman, 2011). Species groups that are relatively vulnerable to fisheries overexploitation that are subject to bycatch in some marine capture fisheries include seabirds, sea turtles, marine mammals, elasmobranchs (sharks, skates and rays) and other fish species, which may have populations that are listed as endangered and threatened under domestic or international frameworks. Populations of these species are particularly vulnerable to overexploitation of older age classes, can decline over short temporal scales (decades and shorter), and are slow to recover from large declines due to their K-selected life-history strategy, characterized by long life spans, slow growth, delayed sexual maturity, low fecundity, and low natural mortality rates of older individuals (Musick, 1999; Hall et al., 2000; Stevens et al., 2000; Lewison et al., 2004; FAO 1999a,b, 2010a; Gilman et al., 2005, 2006a,b,c, 2007a,b, 2008a,b, 2009; Gilman, 2011). While primarily species with a K-selected life-history strategy, endemics with restricted ranges, and species with sporadic recruitment are vulnerable to overexploitation; however, even highly fecund



Objectives of governing bycatch include mitigating bycatch mortality of species relatively vulnerable to fisheries overexploitation, such as sea turtles, so as to prevent population declines and achieve targets for rebuilding and recovery, and controlling bycatch fishing mortality of market species, including sharks, to achieve long-term sustainable exploitation (left National Marine Fisheries Service, right E. Gilman).

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species and those with broad distributions (common, generalist species) can be unsustainably exploited (Casey and Meyers, 1998; Hutchings, 2000; Stevens et al., 2000; Sadovy, 2001; Pauly et al., 2002; Safina and Klinger, 2008; Gilman et al., 2011a).

International guidelines do not explicitly define what constitutes species-level unsustainable bycatch mortality of species groups relatively vulnerable to fishing, including threatened, endangered and protected species. International mechanisms generally recommend or require minimizing, reducing or eliminating bycatch (Section 1.2) (United Nations, 1982 [Article 119], 2010b [(11), VIII(80)]; FAO, 1995a [Article 7.2.2g], 1999a, 2010a, 2011d), or preventing fisheries from causing significant adverse impacts on threatened and endangered species (CBD, 2010). The Marine Stewardship Council, the largest global organization for the certification of wild capture fisheries, includes as one of a suite of criteria a criterion with an objective to avoid and minimize injury and mortality of endangered, threatened and protected species and stocks (Marine Stewardship Council, 2010). The Marine Stewardship Council defines “unacceptable impacts” as those that preclude meeting national or international requirements for protection and rebuilding, and hinder recovery and rebuilding (Marine Stewardship Council, 2012). Some domestic fishery management authorities

have established quotas to limit the bycatch of vulnerable populations, where limits are based upon models that estimate fishing mortality levels that would adversely affect the viability of a population (i.e., cause population declines and concomitant risk of the population reaching a size that results in a high susceptibility of extinction) (e.g., leatherback and loggerhead sea turtle bycatch caps in the Hawaii longline swordfish fishery, Van Houtan, 2011; National Marine Fisheries Service, 2012a). Related more to managing community-level effects from bycatch removals, several RFMOs have adopted binding measures that include explicit definitions for identifying benthic areas as Vulnerable Marine Ecosystems (e.g., seamounts, hydrothermal vents, cold water corals and sponge fields), based on threshold catch rates of live corals and sponges, areas which may be immediately subject to a move-on provision, and later be considered for permanent closure to demersal fisheries (SEAFO, 2009b; CCAMLR, 2010d; NAFO, 2010b; NEAFC, 2010d). International guidance for managing shark fishing mortality, which can be a target, incidental retained bycatch, or discard bycatch species (Gilman et al., 2008a), calls for achieving long-term sustainable exploitation (FAO, 1999b).

Ensure Sustainable Fishery Losses of Rare, Endemic, Restricted-range and Phylogenetically Distinct Species: Other species-level objectives of bycatch governance, and a consideration in implementing an ecosystem approach to fisheries, are to avoid unsustainable removals of rare, endemic, and restricted-range species given that they have relatively low resistance and resilience to anthropogenic stressors. In many cases these are the species that are listed as threatened, endangered and protected under domestic and international legal frameworks (Gilman et al., 2011a). Avoiding unsustainable bycatch mortality of phylogenetically distinct species also requires attention in order to prevent alteration of evolutionary processes (Gilman et al., 2011a). Phylogenetically unique species lack or have few close taxonomic relatives, and thus have relatively distinct genetic diversity that are of relatively high importance for the potential continuation of evolutionary processes (Faith, 1992; Kareiva and Marvier, 2003; Diniz, 2004; Redding and Moores, 2006; Isaac et al., 2007; Gilman et al., 2011a). The loss of entire higher taxonomic groups and evolutionary lineages could alter the evolutionary processes of affected ecosystems (McKinney, 1998; Kareiva and Marvier, 2003; Redding and Moores, 2006; Isaac et al., 2007; Gilman et al., 2011a).

Balance Exploitation: Balancing fishing mortality, including from bycatch losses, across marine ecosystem components at sustainable levels according to natural production capacities is a necessary governance objective to prevent changes in ecosystem structure and processes (Conover and Munch, 2002; Birkeland and Dayton, 2005; Fenberg and Roy, 2008). Maximizing fishery and gear selectivity has been internationally identified as responsibilities for sustainable fisheries and necessary for implementing an ecosystem approach to fisheries (Caddy, 1996; Pitcher and Preikshot, 2001; FAO, 1995a, 2003a,b; United Nations, 2010a,b). This requires revision. Selective fishing and gear, by concentrating fishing mortality on a narrow subset of an ecosystem's components, can cause ecological and evolutionary change and loss, reduce ecosystem stability and alter ecosystem function and structure, compromising ecosystems services including reduced fisheries productivity (Bianchi et al., 2000; Conover and Munch, 2002; Bundy et al., 2005; Frid et al., 2006; Rochet et al., 2009; Zhou et al., 2010). Models predict reduced diversity and biomass within an ecosystem when fishing selectively for a relatively small number of species (Rochet et al., 2009).

Fishery and gear selectivity can be conceptualized as occurring in a nested manner, with selective removals occurring by ecosystem type, habitat type, area, trophic level, assemblage, species, stock, population, and intra-population (size/age class and sex). Selectively removing certain trophic levels, and selective removals within trophic levels of species, stocks, populations, sizes, and sexes, alters their abundance within an ecosystem, reduces genetic diversity, altering the evolutionary characteristics of exploited populations and species, can cause trophic cascades and changes in predation pressure, with concomitant altered ecosystem structure and function (Ulanowicz and Puccia, 1990; Hall, 1996; Casey and Myers, 1998; Stevens et al., 2000; Conover and Munch, 2002; Daskalov, 2002; Pauly et al., 1998, 2002; Bundy et al., 2005; Frid et al., 2006; Bakun et al., 2009; Zhou et al., 2010; Rochet et al., 2011; Garcia et al., 2012).

As a result of fishing gear selecting for large individuals, due to market forces or management measures, marine capture fishing has altered the distribution of fish sizes; favored genotypes for maturation at an earlier age (in particular for fish species with relatively late maturation), smaller size, and slower growth; reduced the proportion of large, fast-growing individuals; reduced the fecundity, duration of the spawning season, as well as survival potential, size and growth rates of larvae, causing reduced reproductive potential and potential for recovery from overexploitation (Heino, 1998; Law, 2000; Stevens et al., 2000; Heino and Godo, 2002; Pauly et al., 2002; Berkeley et al., 2004; Ernande et al., 2004; Birkeland and Dayton, 2005; Swain et al., 2007; Fenberg and Roy, 2008; Heino and Deickmann, 2008; Zhou et al., 2010). This may have caused irreversible changes in the gene pool, altering the evolutionary characteristics of exploited populations and species (Law, 2000; Stevens et al., 2000; Pauly et al., 2002; Frid et al., 2006; Swain et al., 2007; Fenberg and Roy, 2008; Heino and Deickmann, 2008; Zhou et al., 2010). The number of generations subjected to size-selective fishing determines if an evolutionary vs. reversible phenotypic plasticity response occurs, where taxa with shorter lifespans exhibit a more rapid evolutionary response to selectivity, although even long-lived species would eventually experience altered evolutionary characteristics given sufficiently long duration of selective fishing (Conover, 2000; Conover and Munch, 2002; Ernande et al., 2004; Swain et al., 2007; Fenberg and Roy, 2008; Heino and Deickmann, 2008). Size-selectivity has the potential to disrupt the natural observed tendency for an increase in body mass/size as a clade (a single complete branch of the tree of life, an ancestor and all descendants) diversifies, because new species are more likely to evolve from small ancestors (Smith et al., 2004; Fenberg and Roy, 2008).

Selective species removal can alter the community structure and food web. For example, depending on the competitive dominance and territoriality of the exploited species, selective removal of a species, by eliminating its competitive pressure, can increase the abundance of its prey, and/or increase the abundance, growth rate and size of co-occurring non-exploited species that occupy similar trophic levels as the exploited species, with concomitant increased competition for the exploited species (Ulanowicz and Puccia, 1990; Pace et al., 1999; Daskalov, 2002; Guidetti et al., 2004; Fenberg and Roy, 2008; Bakun et al., 2009; Zhou et al., 2010).

Selective removal by sex can result from regulatory measures protecting females to support reproductive potential (e.g., crabs), or one sex may be preferred because it has higher economic value due to larger size or other factor (e.g., larger males in crab and lobster fisheries, sequentially hermaphroditic species [larger/older individuals are of the same sex]) (Fenberg and Roy, 2008; Zhou et al., 2010). Fishing selectivity by sex can create a sex-ratio imbalance, reducing reproductive output, and can contribute to stock collapse (Zhou et al., 2010).

Uneven exploitation of stocks and populations of a species, and concomitant reduced stock and population diversity, can occur due to time/area restrictions, overlap between the distributions of a subset of stocks and fishing grounds, temporal and spatial distribution of fishing effort due to temporal variability in stock distribution proximity to port, and seasonality in market value (Frid et al., 2006; Zhou et al., 2010). Reduced population diversity can reduce species-level resistance and resilience to extrinsic factors such as climate change, and to other anthropogenic stressors (Hilborn et al., 2003; Frid et al., 2006).

Account for Species and Guilds with Primarily Roles in Ecosystem Regulation: Another objective of governing bycatch is to prevent unsustainable exploitation of keystone and foundation species/guilds, which have disproportionate roles in ecosystem regulation. Unsustainable removals of marine keystone and foundation species and guilds alters food webs, can trigger trophic cascades, and increase ecosystem susceptibility to reaching a threshold tipping point where a regime shift occurs, where recovery may be protracted or the change might be irreversible (Paine, 1969; Estes et al., 1998; Pace et al., 1999; Jackson et al., 2001; Hinke et al., 2004; Ward and Myers, 2005; Dobson et al. 2006; Daskalov et al., 2007; Estrada, 2007; Myers et al., 2007; Jordan, 2009; Polovina et al., 2009; Pereira et al. 2010; Gilman et al., 2011a). Keystone species have relatively large roles in regulating an ecosystem's functioning and structure that is disproportionate to their

abundance and/or biomass (i.e., they tend not to be the dominant components of a community or ecosystem), and tend to be of higher trophic levels (Caro and O'Doherty 1999; Kotliar, 2000; Snaith and Beazley, 2002; Estrada, 2007; Jordan, 2009). Ecosystem stability can be compromised by large declines in the biomass of apex predators, including keystones (Pitcher, 1995; Casey and Myers, 1998; Stevens et al., 2000; Friedlander and DeMartini, 2002; Christensen et al., 2003; Bellwood et al., 2004; Essington et al., 2006; Cheung et al., 2007; Gilman et al., 2012b). Foundation species have a relatively large role in regulating ecosystem functioning and structure, various other species depend on foundation species' health such that their extinction can cause extinction cascades, they tend to be of lower trophic levels, and are common at the spatial scale being considered (Ellison et al., 2005). Unlike keystone species, foundation species tend to be numerically dominant components of their ecosystem, and it is this dominance that results in their importance in effecting ecosystem structure and functioning.

Reduce Waste: Discards, and unobservable losses such as from ghost fishing, are a social issue over waste. For example, international guidance on responsible fisheries promotes minimizing fisheries impacts on non-target species without a caveat regarding the consequent population-level effects (FAO, 1995a, 1999a). Hence, another objective of bycatch governance is to avoid and minimize discarded bycatch and unobservable sources of mortality, irrespective of whether mortality levels are ecologically sustainable.

Mitigate Bycatch of Flagship Species: Fishing mortality of flagship, charismatic species has elicited political support for interventions, again, regardless of the ecological basis (Williams et al., 2000; Caro et al., 2004; Gilman et al., 2011a).

Minimize Adverse Socioeconomic Consequences: Unsustainable levels of bycatch can have concomitant negative socioeconomic consequences for fishing communities, as bycatch is an important income source and contribution to food supply in some fisheries and countries (Clucas, 1997; Harrington et al., 2005; Kelleher, 2005; FAO, 2008a, 2009d). Furthermore, early closure of a fishery due to exceeding a bycatch quota results in unrealized economic gains. Overexploitation of commercially important incidental species, including bycatch of juveniles of a commercial species, can cause growth and recruitment overfishing, leading to a decline in future catch levels (Hall et al., 2000; Langley et al., 2009; Sumaila and Bailey, 2011). This can also result in allocation issues between fisheries, for example, where bycatch, including discarded catch, in one fishery can reduce catch levels and revenue in others (Langley et al., 2009; Sumaila and Bailey, 2011). Bycatch of juveniles of economically valuable species is economically inefficient: if left to grow to maturity, they would produce higher yields and larger economic gains (FAO, 2011a; Sumaila and Bailey, 2011). For example, fishing mortality of juvenile bigeye and yellowfin tunas in purse seine sets on FADs is an allocation issue, as there is reduced potential yield by catching young age classes in purse seines instead of as large adults on longlines, and also contributes to the overexploitation status of some stocks of principal market species (Harley et al., 2010; Gilman, 2011).

Reduce Inefficient Fishing Practices: It is economically and operationally inefficient to catch and handle organisms that will subsequently be discarded (FAO, 2011a). Related, unobservable losses are inefficient, for example, when market species die and fall from the gear or escape and later die due to stress and injury incurred during the fishing interaction (Gilman et al., 2012a).

1.2. International Responsibility for Governing Bycatch, Including Discards

Regional fisheries management organizations (RFMOs) are regional bodies with the competence to establish fisheries conservation and management measures (FAO, 2001; Gilman et al., 2007c). RFMOs have played a critical role in global fisheries governance since the first was established in 1923, and while some spatial, fishery and taxonomic gaps remain, a large proportion of global marine fisheries are now managed by one or multiple RFMOs, and most of the high seas is now covered by at least one RFMO (Lodge et al., 2007; FAO, 2011c). RFMOs provide a formal

mechanism for fishing States and States in whose jurisdiction common-property fishery resources managed by an RFMO occur to cooperate to pursue their agreement and implementation of measures to sustainably govern international fisheries (FAO, 1995a [Article 7.1.5]). Relative to coastal ecosystems, high seas ecosystems are still generally pristine (Jackson et al., 2001; Halpern et al., 2008). However, reported landings from the high seas has been accelerating since the mid-20th century, increasing from under two million tonnes in the 1950s to over ten million tonnes in 2008 (FAO, 2010a). As most RFMO areas are primarily on the high seas (Section 2.1), there is still an opportunity for RFMOs to provide for sustainable fishing operations, including from bycatch, in high seas ecosystems.

Legal instruments establishing international responsibility to conserve associated and dependent species are relatively recent. Under the 1982 Law of the Sea Convention, States are obligated to protect and preserve the marine environment (Article 192), and consider the effects of fishing on species associated with or dependent upon commercially exploited species (United Nations, 1982 [Article 119]). This is elaborated further in the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982, Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA), which requires States to minimize bycatch and impacts on associated and dependent species (United Nations, 1995 [Article 5(f)]). This is also addressed in the 1995 Food and Agriculture Organization of the United Nations' (FAO) Code of Conduct for Responsible Fisheries (CCRF), calling for the sustainable use of aquatic ecosystems and requires that fishing be conducted with due regard for the environment (FAO, 1995a). Article 7.2.2d of the CCRF calls for the conservation of aquatic ecosystem biodiversity and endangered species. CCRF Article 6.2 calls for measures that, "not only ensure the conservation of target species but also of species belonging to the same ecosystem or associated with or dependent upon the target species." Article 7.2.2g elaborates on this principle by calling for the adoption of measures so that, "pollution, waste, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species, and impacts on associated or dependent species are minimized," (FAO, 1995a). UNFSA also calls upon RFMOs to, "obtain and evaluate scientific advice, review the status and assess the impact of fishing on non-target and associated or dependent species", and provides specific guidance on data to be collected and reported for both target and non-target species, including discard statistics (United Nations, 1995 [Article 10(d) and Annex 1]).

Calls for action on governing bycatch, including discards, were raised at the 64th Session United Nations General Assembly in 2009. States and international organizations were urged to collect and report data on bycatch, including discarded catch; and reduce or eliminate bycatch, ghost fishing, fish discards and post-catch losses, including juvenile fish (United Nations, 2010b [I(11), VIII(80)]).

The Convention on Biological Diversity adopted a new ten-year strategic plan in October, 2010, which includes a target of having by 2020, "the impacts of fisheries on stocks, species and ecosystems [be] within safe ecological limits," and having, "no significant adverse impacts on threatened species," (CBD, 2010).

FAO has addressed bycatch and discards as an emerging illegal, unreported and unregulated (IUU)-related issue (FAO, 2009b). Related to bycatch, including discards, FAO has developed International Plans of Action for seabirds and sharks, and guidelines to mitigate sea turtle interactions with marine capture fisheries (FAO, 1999a,b, 2011a). The FAO Committee on Fisheries endorsed *International Guidelines for Bycatch Management and Reduction of Discards* in 2011 (FAO, 2011d).

Instruments and guidance related to governing unobservable fishing mortality lack explicit directions for estimating and accounting for these mortality sources. Relevant FAO guidance has lacked specificity, providing broad, general advice in calling for actions to assess and mitigate pre-catch losses and ghost fishing, by identifying this as an objective in fisheries management plans, improving scientific information, and developing technology for assessment and mitigation (FAO, 2011a). Abandoned and lost derelict fishing gear falls under the remit of the International Maritime Organization, which includes the International Convention for the Prevention of Pollution from Ships

(MARPOL, Annex V), which prohibits the disposal into the sea of all plastics, but allowing an exception for, “the accidental loss of fishing nets, providing that all reasonable precautions have been taken to prevent such loss,” (IMO, 1978).

These new instruments and international guidance broadened the mandate of preexisting RFMOs. There has been increasing recognition of the need for RFMOs to improve their governance of fisheries and conservation and management of fishery resources, including for older RFMOs by expanding their mandates from a target-species focus to meet broadened expectations of UNFSA and CCRF for ecosystem-based management and application of a precautionary approach. This has included a call for establishing explicit limits of acceptable impact on fish and non-fish bycatch species, including associated or dependent species and threatened species, and a call for performance reviews of RFMO effectiveness (United Nations, 2006a, 2006b; FAO, 2005b; Fisheries Agency of Japan, 2007; Lodge et al., 2007; Gilman, 2011).

1.3. Approaches to Mitigate Problematic Bycatch, Including Discards, and Considerations

Alternative methods to mitigate problematic bycatch, as well as improve the probability of survival following interaction with fishing operations, are presented in Table 1. Combinations of methods may be appropriate in certain circumstances.

Table 1. Methods to avoid, reduce and offset unwanted bycatch, including discards, and reduce injury and mortality from interactions with marine capture fisheries (adapted from Gilman et al., 2009; Gilman and Lundin, 2010).

Input and output controls	<p>Input controls include limiting the amount of fishing effort or capacity (e.g., limiting vessel numbers of a specified size, prohibiting new entrants, instituting buy-back schemes, capping the number of fishing days or sets per year, limiting the length of gear soak time, eliminating subsidies that contribute to overcapacity) (Pauly et al., 2002, 2005; Beddington et al., 2007; Sumaila et al., 2008). Output controls include limiting catch through, for example, size restrictions/minimum size limits, limit reference points for the rate and quantity of fishing mortality, total allowable catch or quotas of target, incidental or discarded species, and restrictions on catch composition (e.g., limit on the proportion of bycatch-to-target species catch levels) (FAO, 1995a [Article 7.6.9]; Hall, 1996). Individual transferable quotas and rights-based allocation frameworks have been used, for example, to limit catch levels and address overcapacity issues (e.g., Beddington et al., 2007; Costello et al., 2008; FAO, 2010b). Quotas and performance standards for bycatch levels and rates, respectively, have been used to manage bycatch of vulnerable species groups (e.g., Environment Australia, 2006; Gilman et al., 2007b). For instance, purse seine vessels of nations participating in the Inter-American Tropical Tuna Commission's Tuna-Dolphin Program receive individual vessel dolphin bycatch limits, while the Hawaii longline swordfish fishery closes if annual sea turtle catch limits are reached (Hall, 1998; Gilman et al., 2007a). Controls on the amount of passive gear in the water and restrictions on soak time can contribute to reducing the probability of gear loss and concomitant ghost fishing (FAO, 2011a).</p>
Gear technology	<p>Changing the design of fishing gear (e.g., altering hook size and shape) and modifying fishing methods (e.g., changing the time of day of fishing operations) can contribute to mitigating bycatch, by reducing bycatch rates and increasing the probability of organisms surviving the fishery interaction (Gilman et al., 2009; Gilman 2011). For instance, bycatch reduction devices and turtle excluder devices are used in coastal trawl fisheries to reduce bycatch of small fish and sea turtles, respectively (Eavys, 2007; FAO, 2010b). Or, for example, there is a growing number of effective gear technology methods to reduce seabird bycatch in demersal and pelagic longline fisheries, including night setting, dyeing bait blue, using underwater setting devices, retaining offal and other discards, side-setting, increasing the amount of weight and attaching weight closer to hooks, bird-scaring tori lines, and towed objects (Brothers et al., 1999; FAO, 1999a; Gilman et al., 2003, 2005, 2007b, 2008b; Robertson et al., 2010; Gilman, 2011). In passive gillnet and trammel net fisheries, avoiding large mesh size, illuminating the net with lightsticks, decreasing the height of the net so that the net is stiffer and reduces the probability of entangling turtles, and for demersal gear eliminating or increasing the length of tiedowns, are current gear technology best practices to reduce sea turtle bycatch (Price and Van Salisbury, 2007; Gilman et al., 2009; FAO, 2010b; Wang et al., 2010). Modifications to trawl gear designs can reduce stress and injury of escapees, increasing the probability of survival (Suuronen, 1996; Broadhurst et al., 2006). In purse seine fisheries, controlling crowding densities in the net can increase the probability of survival of slipped fish (Huse and Vold, 2010).</p>
Gear restrictions	<p>Restrictions on gear designs, in some cases with spatial or temporal dimensions, can contribute to bycatch mitigation. Restricting mesh size of net gear or FAD sets by purse seine vessels are examples of gear restrictions (e.g., FAO, 1995a [Article 7.6.9]; PNA, 2008).</p>
Compensatory mitigation	<p>Fisheries can meet bycatch mitigation requirements through compensation used to address non-fishery threats, or through a fee and exemption structure, similar to a "polluter pays" system. For instance, governments could reduce or withhold subsidies, charge a higher permit or license fee, or use a higher tax rate if bycatch thresholds are exceeded, or provide a</p>

positive incentive, where a higher subsidy, lower permit or license fee, lower tax, or preferential access applies when bycatch standards are met. Compensatory mitigation programs likely require 100% observer coverage, a substantial limitation. Problems with lack of performance and off-site and out-of-kind mitigation could occur when compensatory mitigation, a longstanding practice in U.S. wetlands management (Environmental Law Institute 2006), is applied to fisheries bycatch, such as when conserving activities are conducted at a nesting colony not part of the population interacting with the fishery, or conserving different age classes than affected by the fishery. The concept holds promise if used to complement and not replace actions to first avoid and minimize bycatch (Zydulis et al., 2009; FAO, 2010b).

Time/area restrictions
 The establishment of time/area restrictions can contribute to addressing the overexploitation of some fish stocks, the protection of areas used for spawning by target species, and the avoidance of areas of relatively high biodiversity importance, such as bycatch hotspots (Crowder and Norse, 2008; Gilman et al., 2011a,b). Reducing or eliminating fishing effort to avoid temporally and/or spatially predictable bycatch hotspots (time/area closures), such as areas determined to have relatively high ratios of bycatch to target catch levels or ratios of discarded to retained catch levels, in Exclusive Economic Zones and on the high seas can contribute to mitigating bycatch and reducing discards, as long as effort is not displaced to areas or periods where bycatch and discards are similar (Cheng and Chen, 1997; Gearhart, 2003; Lee Lum, 2006; Maldonado et al., 2006; Ardron, 2008; Peckham et al., 2007, 2008; FAO, 2011a). Establishing protected areas containing spawning or nursery areas, or seabird or sea turtle nesting colonies and adjacent waters may have a high likelihood of success (FAO, 1995a [Article 7.6.9]). Seasonal closures might also be able to contribute to reversing and preventing the overexploitation of target stocks, such as through closures during peak periods and areas of spawning. The establishment of a representative system of protected area networks on the high seas also holds promise. However, for fisheries targeting highly migratory fish stocks, this will require extensive and dynamic boundaries, defined, in part, by the location of large-scale oceanographic features and short-lived hydrographic features, and would require extensive buffers (e.g., Hyrenbach et al. 2000). Extensive time will be required to resolve legal complications with international treaties, to achieve international consensus and political will, and to acquire requisite extensive resources for surveillance and enforcement. Also, time/area zoning can reduce gear conflicts, reducing the probability of lost gear, as the use of multiple gear types in one area can result in gear being cut and lost (Matsuoka et al., 2005; FAO, 2010a).

Gear marking
 To mitigate ghost fishing, internationally-agreed systems for marking fishing gear have been developed so that the owner of lost and abandoned derelict gear can be identified (IMO, 1978; Caddy, 1996; FAO, 2005a, 2011a).

Technology to avoid gear contact with seabed
 Global Positioning System and seabed mapping technology help to reduce the likelihood of gear loss due to unintended contact with the seabed, contributing to reducing ghost fishing from accidental lost gear (FAO, 2010a).

Technology to track gear position
 Attaching transponders to fishing gear reduces the risk of losing gear and aides in locating lost gear (FAO, 2010a).

Systems to report, retrieve and deliver derelict fishing gear
 Providing accessible and affordable port reception facilities for fishing gear can reduce the incentive for at-sea discarding of fishing gear (IMO, 1978; FAO, 2010a). Management authorities have developed incentives for fishing vessels to retrieve derelict gear at sea and deliver it to port reception facilities, and have created systems to report lost gear (FAO,

to port reception facilities	2010a,b, 2011a).
Degradable gear	Gear technology has been developed to reduce the duration of the fishing power of derelict gear via designs that employ degradable materials (e.g., degradable FADs have been designed; degradable escape mechanisms are required in some trap fisheries) (Chanrachkij et al., 2008; FAO, 2010a,b, 2011a). Degradable escape panels and cords can be used to reduce ghost fishing by traps, which are required in some fisheries, however, industry update of biodegradable net gear has been limited (FAO, 2010a).
Fleet communication	Fleet communication programs can report real-time observations of temporally and spatially unpredictable bycatch hotspots to be avoided by vessels in a fleet (Gilman et al., 2006b). Fleet communication may be appropriate in fisheries where there are strong economic incentives to reduce bycatch, interactions with bycatch species are rare events and adequate onboard observer coverage exists.
Industry self-policing	Self-policing uses peer pressure from within the industry to criticize bad actors and acknowledge good actors (e.g., Fitzgerald et al., 2004). A fishing industry can create a program where information for individual vessel bycatch levels, compliance with relevant regulations, and other relevant information, is made available to the entire industry. This is especially effective where regulations contain industry-wide penalties if bycatch rates or caps are exceeded.
Changing gear	It may be commercially viable to change to a different fishing gear that results in a lower bycatch-to-target catch ratio than the conventional gear (e.g., replace Trinidad gillnet with troll gear) (Eckert and Eckert, 2005; Eckert et al., 2008; FAO, 1995a [Article 7.6.4], 2010b).
Handling and release best practices	For some gear types and species groups, much progress has been made to identify best practice handling and release practices to maximize the probability of post-release survival of bycatch released alive. For example, best practices handling and release methods for seabirds and sea turtles captured in longline fisheries and to release dolphins from purse seines have been developed (Hall, 1998; AIDCP, 2009c; FAO, 2010b). And certain factors that significantly affect finfish post-release probability of mortality can be controlled, such as controlling crowding and aerating the net prior to landing, minimizing the time exposed to air, avoiding adverse environmental conditions on deck (e.g., high air temperature), reducing the risk of barotrauma, employing best practices to remove tackle prior to release, and reducing stress and injury from the method used to release the organism from the deck (Davis, 2002; St. John and Syers, 2005; Broadhurst et al., 2006).
Market-based mechanisms	In some regions, environmental non-governmental organizations (NGOs) are increasingly advocating for seafood sold by retailers and restaurants be procured from ecologically sustainable sources (Leadbitter et al., 2006; FAO, 2008b). In response, market-based mechanisms are increasingly being employed to not only identify ecologically sustainable sources of seafood, but to achieve gradual improvements in governance and fishing practices, including to mitigate problematic bycatch. Market-based approaches include: (i) programs that assess fisheries' ecological sustainability, including seafood eco-label and other certification schemes; (ii) Fishery Improvement Projects (FIPs) to gradually resolve deficiencies in fishing practices and governance; and (iii) ecological sustainability measures in buyers' seafood product

procurement specs (e.g., Johnston et al., 2001; Kaiser and Edwards-Jones, 2006; Leadbitter and Ward, 2007; FAO, 2008b; Gilman, 2008b; IUCN and Western Pacific Fishery Management Council, 2008; Parkes et al., 2010; Sustainable Fisheries Partnership, 2011 a,b,c, 2012).

There has been a recent proliferation of programs assessing the sustainability of individual marine capture fisheries and marine seafood species. Third-party, independent assessment, and in particular those that employ a peer review process, is perceived by some as necessary for credible and transparent verification of the sustainability of a fishery (Gilman, 2008b; Leadbitter and Ward, 2007; Parkes et al., 2010). Third-party assessment programs for marine capture fisheries include eco-labeling programs, such as the Marine Stewardship Council (global), Friend of the Sea (global), Naturland (Germany), KRAV (Sweden), and Bureau Veritas (France). More recently, on behalf of government agencies and fishing industries of Iceland and Alaska, Global Trust, an ISO 65 accredited (the international standard for independent third-party certification bodies) third-party certification body, developed certification schemes that assess marine capture fisheries against select Articles of the United Nation's Code of Conduct for Responsible Fisheries (Global Trust, 2011).

Other third-party assessment programs produce consumer guides, such as those produced by the Blue Ocean Institute (U.S.), Monterey Bay Aquarium (U.S.), New Zealand Forest and Bird (New Zealand), Marine Conservation Society (UK), World Wildlife Fund (global), and Greenpeace (global), amongst others, which rank the relative sustainability of individual seafood species, or rank retailers based on the sustainability of their seafood sourcing practices. In some cases, third-party programs employing inconsistent assessment methods have had conflicting opinions on the sustainability of individual fisheries, creating confusion and diminishing consumer confidence, as well as complicating retailer efforts (Gilman, 2008b; Leadbitter and Ward, 2007; Parkes et al., 2010).

First-party assessment programs, where a fishing industry assesses its own sustainability, include the Marine Eco-label Japan, established in 2007 by Japan Tuna; and Pescanova, Europe's largest fishing company and processor, created a logo that appears on small number of packaged seafood (Gilman, 2008b).

The Agreement on the International Dolphin Conservation Program (AIDCP) is an assessment program administered by the Inter-American Tropical Tuna Commission. The program employs a label and certificate to document compliance by Eastern Pacific Ocean purse seine vessels with prescribed measures to govern dolphin mortality (AIDCP, 2005, 2009c).

Many fisheries are not yet subject to management frameworks and employing practices to enable them to pass an assessment against the principles and criteria of MSC or other sustainability assessment programs. A growing number of North American, European, and Australian retailers and seafood buyers that have committed to sustainable sourcing who need to source from these fisheries have been participating in FIPs (e.g., Sustainable Fisheries Partnership, 2012). Through FIPs, companies within the supply chain of deficient fisheries catalyze and track gradual improvements in fishing practices and governance, typically with a goal to lead to MSC certification. In this regard, the MSC process could be claimed as being influential on the improvement of fisheries that do not currently meet the MSC standard, whereas conservation gains resulting from improvements by deficient fisheries has largely not directly occurred through the MSC assessment and certification processes (Kaiser and Edwards-Jones, 2006; Jacquet and Pauly, 2007; FAO, 2008b; Gulbrandsen, 2009).

Improvements in fishing practices and management, including addressing problematic bycatch, are also being achieved through retailers' and their buyers' adoption and implementation of best practice environmental measures in seafood product procurement specs. For example, the Sustainable Fisheries Partnership has produced procurement

specs for their corporate partners on canned and fresh/frozen tuna supplied by purse seine and longline fisheries, which include measures to address problematic bycatch (Sustainable Fisheries Partnership, 2011b,c).

Rights-based mechanisms

Rights-based fisheries management entails the allocation of rights to a fishery, such as to individual fishers, companies or associations, typically with an aim to avoid exceeding optimal catch levels (Scott, 2000; Allen et al., 2010), but the concept is also of relevance to meeting bycatch mitigation objectives. Limited entry and individual- and/or fishery-based transferable quotas are examples of rights-based mechanisms identified as being suitable for implementation by the tuna RFMOs, where substantial resources for monitoring, control and surveillance would be required for effective implementation (Allen et al., 2010). Instituting rights-based mechanisms in marine capture fisheries could reduce the competitiveness of smaller companies with gradual dominance by larger ones, a socioeconomic cost that deserves consideration when comparing costs and benefits across the suite of bycatch mitigation approaches.

Several considerations are warranted when exploring alternative bycatch mitigation approaches. First, solutions to bycatch problems may be fishery-specific. For instance, while an underwater setting chute has been shown to be very effective at avoiding seabird captures in the Hawaii pelagic longline fleet (Gilman et al., 2003), experience in Australia has been less promising due to the seabird species complex that interacts with the fishing vessels and their bait scavenging abilities and behavioral interactions, the weighting design of the fishing gear, and the use of live bait (Brothers et al., 2000; Gilman et al., 2003).

However, there may be cases where a gear technology approach can be assumed to work across fisheries, when a measure's efficacy is nominally affected by differences between fisheries. For instance, a minimum weighting design or a performance standard for baited hook sink rate, and night setting, might be globally relevant across seabird assemblages, longline fisheries, and regions to reduce the bycatch of surface diving and nocturnal foraging seabird species, respectively (Gilman et al., 2005). Or, for example, using fish instead of squid for bait in longline and other hook-and-line fisheries is likely to reduce sea turtle and shark catch rates across fisheries and regions (Bolton and Bjorndal, 2005; Watson et al., 2005; Gilman et al., 2006b, 2007a, 2008a; Walsh et al., 2009; FAO, 2010b).

Another consideration is the benefits of directly involving the fishing industry in research and development activities. Fishers have a large repository of knowledge, which can be tapped to contribute to finding effective and practical bycatch solutions. Several bycatch reduction methods were developed by fishers, including the bird-scaring tori line for longlining, and technical methods to reduce dolphin mortality for eastern Pacific purse seining (Hall et al., 2000). Perhaps more importantly, participation of fishers can result in industry developing a sense of ownership for bycatch mitigation methods (Gilman et al., 2007d).

There are several considerations related to the efficacy, commercial viability and likelihood of uptake of alternative bycatch mitigation method, which collectively form a suite of criteria that identify an optimal gear technology mitigation method. An obvious filter for prioritizing bycatch mitigation methods is: (i) efficacy at mitigating unwanted, problematic bycatch through methods that, prioritized in the following order, avoid interactions, minimize catch, reduce injury via handling and release best practices, and offset mortality through compensatory mitigation (Gilman et al., 2005). Furthermore, it is critical to consider the commercial viability of bycatch solutions. Given the state of fisheries management frameworks, including limited resources for monitoring, control, surveillance and enforcement, methods shown to be effective in experiments may not be employed as prescribed or at all by fishers if they are not (ii) practical, (iii) safe, and (iv) economically viable, or better yet, provide operational and economic benefits (Gilman et al., 2003, 2005; Gilman, 2011). (v) Methods that require minimal alteration to traditional gear and practices increase the likelihood of fisher acceptance. (vi) A gear technology method must be commercially available. (vii) The cost required for uptake and continued employment is another important consideration. For example, the long-term efficacy of circle hook exchange initiatives may be compromised if the circle hooks are more expensive or are not locally available, causing vessels to revert to using J and tuna hooks when circle hooks require replacement. (viii) Another important consideration is whether or not crew behavior affects the efficacy of the measure. For example, tori line efficacy at mitigating seabird bycatch can be compromised if a crew member does not maintain streamer coverage over the area where baited hooks are being deployed. Conversely, the efficacy of prescribed hook, bait, line weighting and night setting are not subject to crew behavior. (ix) Related to the previous criterion, methods that facilitate surveillance and enforcement are preferable. For example, vessel compliance with night setting can be confirmed via vessel monitoring systems. Prescribed gear designs can be confirmed via dockside inspections. Conversely, use of tori lines or blue-dyed and thawed bait to prescription is not easily enforced. (x) Measures that lend themselves to measurable performance standards without requiring analyses of observer program data, such as a weighting design that achieves a threshold minimum sink rate for hook-and-line terminal tackle, or minimum depth for gear when soaking, are optimal. Finally, (xi) an optimal bycatch mitigation method will not cause increased bycatch of other vulnerable species/sizes, or better yet, will effectively mitigate problematic bycatch of multiple species (Gilman, 2011).

Finally, another important consideration is the effects of a mitigation method across multiple species groups. It is critical to identify known conflicts as well as mutual benefits amongst species groups from bycatch management strategies. For example, use of wider circle hooks in place of narrower J and tuna hooks to reduce turtle bycatch rates and mortality in pelagic longline fisheries has also been found to reduce seabird bycatch rates by about 80%, while use of fish instead of squid for bait to reduce turtle catch rates also significantly reduces shark catch rates by about 30% (ICCAT, 2007b; Gilman et al., 2008a; Gilman and Lundin, 2010). However, for instance, in some regions, setting longlines at night to protect albatrosses and other diurnal foraging seabirds has led to higher bycatch of nocturnal-foraging seabirds (e.g., white-chinned petrels) (Weimerskirch et al., 1999). Restrictions on purse seine sets on dolphins in the eastern Pacific resulted in increased setting on FADs, which increased bycatch of juvenile and undersized tunas, sharks, dolphin fish, sea turtles and marine mammals (Hall, 1998; Molony, 2005; Secretariat of the Pacific Community, 2006). Prohibiting wire leaders in longline gear to reduce shark catch rates (Branstetter and Musick, 1993; Stone and Dixon, 2001; Ward et al., 2008a) could possibly exacerbate seabird bycatch problems: Fishers may be less likely to attach weights close to hooks on branch lines lacking a wire leader due to safety concerns, thus, reducing the baited hook sink rate, and increasing seabird catch rates (Gilman, 2008a). If a longline branchline breaks during hauling, which frequently occurs when sharks are caught and bite off the terminal tackle, or if the hooks pulls free from a caught fish with the line under high tension (the fish 'throws' the hook), the weight can fly back at the vessel at high velocity, infrequently causing serious injury, and in rare cases, killing crew (Gilman, 2008a; Gilman et al., 2008a,b). Potential conflicts resulting from the uptake of alternative discard management methods has received inadequate consideration in past initiatives, which have tended to have a single-species group focus. For instance, existing species group - specific International Plans of Action (sharks, seabirds, FAO, 1999a,b) do not sufficiently provide this more holistic assessment.

Input and output controls may be used to pursue minimizing discards. Several countries and regional fisheries management organizations have prohibited discarding at sea (e.g., Hampton 2003; Peacey, 2003; Graham et al., 2007; IATTC, 2009e; WCPFC, 2009; NEAFC, 2010f; Iceland Ministry of Fisheries, 2011). Ecological and socioeconomic effects from requiring full retention are fishery-specific, and therefore warrant fishery-specific assessment. In some fisheries, banning discards could have a positive effect by creating a strong incentive for fishermen to voluntarily employ effective gear designs and fishing methods to avoid the capture of unmarketable species and sizes of fish and, and eliminating high-grading (Gillis et al., 1995; Graham et al., 2007). For instance, various gear technology approaches can effectively reduce unwanted catches, as can avoiding temporally and spatially predictable hotspots of unwanted catches (Hall et al., 2000; Poos et al., 2010; Gilman et al., 2006c, 2009; Dunn et al., 2011; Gilman, 2011). Full retention may, however, be an ineffective mechanism to deter catch and reduce fishing mortality in some fisheries. For example, in fisheries where non-target species and sizes of fish are close in value to the target species and sizes, a discard ban would provide low incentive for fishers to take measures to reduce their catch of these non-target species and sizes (e.g., juvenile/small bigeye tuna in purse seine fisheries, Gilman, 2011). Measures have been adopted to address this issue: in Norway, a discard ban of fish below a minimum size is in place, and landed undersized fish are sold through sales organizations, but the revenue from the sales do not go to the fisheries, avoiding an incentive to catch small fish (Hall and Mainprize, 2005; Graham et al., 2007), a measure that requires 100% onboard observer coverage to ensure compliance. Similarly, in Iceland, fish that are required to be retained and landed result in a quota reduction of 50% of the landed weight of the fish subject to a discard ban, and in New Zealand, fishers receive half of the value of the fish subject to a discard ban (Elliston et al., 2005; Hall and Mainprize, 2005).

Consideration is also warranted regarding whether required full retention might create markets for species that are relatively vulnerable to overexploitation and/or have a disproportionate role in regulating and maintaining ecosystem function or structure, leading to increased and potentially unsustainable fishing mortality rates. In some fisheries, in combination with measures aimed to minimize rates of bycatch of vulnerable species, measures to maximize post-release survival rates of vulnerable stocks might be more likely to fulfill an aim of reducing fishing mortality of

these stocks than would be a requirement for their full retention: Banning discards may be detrimental for species groups that have even a small post-release survival rate. This requires fishery-specific consideration, as survival rates of discards are highly variable between species groups (e.g., Chopin and Arimoto, 1995; Laptikhovsky, 2004; Suuronen, 2005). For overexploited stocks, if evidence suggests that a high post-release survival rate occurs, then prohibiting retention of these species in combination with best practice handling and release practices, would contribute to stock rebuilding, where required full retention might not reduce fishing mortality of these stocks. Efficacy of a discard ban requires fishing industry ownership of the measure to achieve high compliance, flexibility in output controls to reduce incentives for discarding, or otherwise, extensive resources for surveillance and enforcement (Baulch and Pascoe, 1992; Turner, 1996; Kaufmann et al., 1999; Arnason, 2002; Hall et al., 2000; Peacey, 2003; Poos et al., 2010). Otherwise, a discard ban might result in reduced reporting of discards, resulting in errors in stock assessments and scientific advice, and increase the probability of exceeding reference points (Pascoe, 1997; Crowder and Murawski, 1998; Poos et al., 2010). In fisheries with effective surveillance and enforcement for required full retention, unless markets for currently non-utilized or underutilized species, sizes, and sexes are developed to create demand for their supply at sustainable mortality rates, and logistics for handling and processing the mixture of species and sizes for these products are addressed, retained unwanted bycatch may be dumped following landing (Clucas, 1997; FAO, 1997; Hall et al., 2000; Kelleher, 2005).

In fisheries where resources for monitoring, surveillance and enforcement are relatively low, where a discards ban receives low compliance and reduces reporting fishing mortality from discards, in fisheries where a ban on discards provides little incentive for fishers to avoid and minimize the capture of non-target species and sizes, and in fisheries where vulnerable non-target species and sizes can be released alive and survive, various combinations of other regulatory controls could effectively reduce incentives for discarding and achieve overarching ecological and social goals for reduced fishing mortality of populations in need of protection and reduced wastage. There are numerous case studies demonstrating the efficacy of combinations of control measures in reducing discards that do not necessarily include discard bans, both in fisheries with and without output controls. For example, since 1984 when Individual Transferable Quota (ITQ) management was introduced to Iceland's demersal fisheries, there was no increase in discarding, in part, due to the use of onboard observers to enforce a ban on discarding at sea, an overcatch provision that allows catch to exceed up to 5% of vessel quota annually and be recorded against the quota for the following year, quota substitution arrangements in multispecies fisheries (allows fishers in a multispecies fishery who overcatch a quota species to forfeit the use of uncaught quota of another species, in this case, quota in Iceland demersal fisheries can be converted to 'cod equivalents), and splitting quota into two grades based on fish size (Arnason, 2002; Iceland Ministry of Fisheries, 2011). Similarly, in New Zealand's ITQ fisheries, measures instituted to reduce incentives for discarding include a 10% overcatch provision, provisions for quota substitution (eliminated in 2001 due to persistent exceeding TACs for some bycatch species), and a provision referred to as 'deemed value' where fishers can land and sell overquota catch if they pay a government fee (Baulch and Pascoe, 1992; Kaufmann et al., 1999; Peacey, 2003). The government sets deemed value levels for a species subject to a quota so as to provide a sufficient incentive for fishers to land the catch, but to provide a disincentive for fishers with insufficient quota to target these stocks (Peacey, 2003). Setting species-based quotas by grades as employed in Iceland is an approach to reduce the incentive for high-grading, but would require relatively high institutional resources to implement if quotas are split into a large number of categories of grades, and for multispecies fisheries (Arnason, 1994, 2002). Establishing quotas based on value instead of weight or number of a species can also reduce incentives for discarding via quota induced high-grading in quota-managed fisheries, however, this precludes setting TACs to achieve biologically-based limit reference points due to uncertainty in translating value quotas into fishing mortality levels (Turner, 1996).

1.4. Study Scope, Advancing the State of Knowledge of RFMO Performance in Governing Bycatch

This study comprehensively assessed global marine RFMO performance in governing bycatch, including discards. Study findings provide a benchmark against which to assess future progress. Findings enable RFMO Secretariats and Members to benefit from lessons learned by other RFMOs that are implementing best practices, as well as from the identification of governance deficits to prioritize gradual improvements to fill these gaps.

The design of the criteria suite developed for this assessment, including selection and definitions and scaling of individual criterion, builds off of previous studies, most of which employed clauses from Articles of the CCRF and UNFSA as the basis for designing criteria to assess the ecological sustainability of RFMOs, aggregated fisheries of a nation, and individual fisheries (Caddy, 1996; Pitcher, 1999; Garcia, 2000; Pitcher and Preikshot, 2001; Small, 2005; FAO, 2006; Caddy et al., 2007; Lodge et al., 2007; United Nations, 2007; CCSBT, 2008a,b; NEAFC, 2008; ICCAT, 2009d; IOTC, 2009a; Cullis-Suzuik and Pauly, 2010; Marine Stewardship Council, 2010; SEAFO, 2010a; GFCM, 2011a). There have been a number of evaluations of RFMO performance. However, there are no previous comprehensive assessments of RFMO governance of bycatch, including discards.

Cullis-Suzuki and Pauly (2010) assessed the status of fish stocks under RFMO management and assessed RFMO efficacy against criteria designed to attempt to cover a broad range of core components of RFMO best practice, based on the suite developed by Lodge et al. (2007). Average scores were 49% and 57%, based on the status of target stocks managed by RFMOs and assessment against the criteria suite for RFMO general best practices, respectively (Cullis-Suzuki and Pauly, 2010). Only one criterion included in the suite tangentially addressed governance of bycatch, where full points were awarded if an RFMO has statistics on bycatch, threatened species, habitat, and trophic relationships (Cullis-Suzuki and Pauly, 2010 [Criterion 14]). Scoring was based on the availability of information on bycatch, threatened species, habitats and trophic interactions, and not on the efficacy of governance of these parameters. For example, of a possible 10 points, a score of 1 was awarded to an RFMO if the RFMO had no relevant information, a score of 5 if the RFMO did not conceal bycatch and mention main bycatch species involved, and a full score of 10 if bycatch statistics are given, with an emphasis on threatened species, and the importance of habitat and trophic relationships (Cullis-Suzuki and Pauly, 2010). Scores for this criterion ranged from 20%-90%, with an average of 55% for 18 RFMOs assessed in the study, and an average of 55% for 12 of the 13 RFMOs included in the present study (the previous study did not include the Regional Commission for Fisheries, RECOFI, included in the present study) (Cullis-Suzuki and Pauly, 2010).

Other previous studies assessed the governance of bycatch of selected taxonomic groups, evaluated a subset of the marine RFMOs, or were performance reviews of individual RFMOs via assessment against their governing Conventions and relevant international agreements (NASCO, 2005a; Small, 2005; Gilman et al., 2007c; CCAMLR, 2008a; CCSBT, 2008a,b; NEAFC, 2008; ICCAT, 2009d; IOTC, 2009a; NPAFC, 2010a; SEAFO, 2010a; GFCM, 2011a; Gilman, 2011; NAFO, 2011d; RECOFI, 2011d).

Small (2005) assessed the performance of six RFMOs (Commission for the Conservation of Antarctic Marine Living Resources, CCAMLR; Commission for the Conservation of Southern Bluefin Tuna, CCSBT; Inter-American Tropical Tuna Commission, IATTC; International Commission for the Conservation of Atlantic Tunas, ICCAT; Indian Ocean Tuna Commission, IOTC; and Western and Central Pacific Fisheries Commission, WCPFC) against a suite of 7 criteria and 114 subcriteria. Four criteria focused on general aspects of fisheries management and RFMO operations: stakeholder participation and transparency, data and stock assessments for target fish species, management and status of target fish stocks, and deterring IUU fishing. Three criteria were directly related to bycatch of seabirds, sea turtles, marine mammals, elasmobranchs, and non-target fish: commitment to reduce bycatch, bycatch data collection, and bycatch mitigation measures. Of 14 RFMOs considered, CCSBT, WCPFC, IOTC, ICCAT and CCAMLR had the highest overlap between their Convention Areas and distributions of albatrosses, in the order listed (Small, 2005). CCAMLR

had the best performance when assessed against the criteria suite, followed by IATTC, ICCAT, CCSBT, and IOTC, with WCPFC not receiving a total score due to a partial assessment being made due to the RFMO having only been in existence for a year at the time of the study. For the three bycatch-related criteria of (i) “Commitment to reducing impact of fisheries on non-target species”, “bycatch data collection”, and “bycatch mitigation measures”, resulting scores for the six assessed RFMOs were CCSBT: 60, 26, 4; WCPFC: 53, not assessed, not assessed; IOTC: 33, 8, 0; ICCAT: 55, 31, 13; CCAMLR: 88, 97, 90; and IATTC: 63, 87, 31, respectively (Small, 2005).

FAO Fisheries Circular 1025 reviewed actions to mitigate sea turtle and seabird bycatch in marine capture fisheries taken by regional fishery bodies, including binding conservation and management measures adopted by RFMOs (Gilman et al., 2007c). Gilman (2011) assessed progress of the five tuna-RFMOs (CCSBT, IATTC, ICCAT, IOTC and WCPFC) in adopting best practice gear technology methods for mitigating problematic bycatch of seabirds, sea turtles, marine mammals, sharks and other unmarketable species and sizes of fish, and critiqued onboard observer coverage rates and restrictions from data confidentiality rules.

A North Atlantic Salmon Conservation Organization (NASCO) Working Group, ‘Next Steps for NASCO’, conducted a performance assessment in 2004 and 2005 (NASCO, 2005a). Recommendations for improvement were not made related to NASCO’s bycatch governance (NASCO, 2005a). Recommendations for improvement were grouped into four areas of: (i) Commitments to NASCO’s agreements and review; (ii) Effective and efficient use of NASCO’s time; (iii) Transparency and inclusivity so as to increase stakeholder involvement; and (iv) Raising NASCO’s public and political profile (NASCO, 2005a). NASCO plans to conduct an external performance assessment (NASCO, 2011a).

The North East Atlantic Fisheries Commission (NEAFC) conducted a performance assessment in 2006 (NEAFC, 2008). A criteria suite, with 5 criteria and 17 subcriteria, against which the assessment was conducted, included some measures on aspects of bycatch governance: knowledge of associated or dependent species, adoption of measures to address ecosystem-wide adverse effects of fishing, and adequacy of monitoring, control surveillance and enforcement measures and activities (NEAFC, 2008). A lack of allocation arrangements for several managed fisheries, inadequate transparency in certain management processes, and poor status of target fish stocks were flagged as main deficiencies, while monitoring, enforcement, and international cooperation with RFMOs were identified as areas where strong performance has been achieved (NEAFC, 2008).

CCAMLR undertook a performance assessment in 2008 (CCAMLR, 2008a). A suite of 49 criteria divided into six broad categories were used as the basis for the review. Recommendations and conclusions resulting from the assessment that are of direct or indirect relevance to CCAMLR governance of bycatch included the need to identify South Ocean areas for protection, and take a more proactive role in designating marine protected areas (CCAMLR, 2008a). The review panel also recommended that CCAMLR take a larger role in addressing marine pollution management by fishing vessels (CCAMLR, 2008a). The status of many bycatch species in CCAMLR-managed fisheries was identified as a priority gap in knowledge. A disconnect between decision-making being informed by findings from broad ecosystem monitoring was also identified as problematic (CCAMLR, 2008a).

The North Pacific Anadromous Fish Commission (NPAFC) conducted a performance assessment during 2009 and 2010 (NPAFC, 2010a). The assessment was made against a suite of 13 general criteria: coordination of scientific research programs, development of anadromous stock identification, ecologically-related species, scientific exchanges, cooperation with international organizations, review of scientific research findings, scientific recommendations, functions of the NPAFC Committee on Scientific Research and Statistics, coordination of efforts to prevent unauthorized trafficking in illegally harvested anadromous fish, cooperative mechanisms to detect and deter illegal fishing in the NPAFC Convention Area, NPAFC compliance with regional and global enforcement measures, administration and finance (NASCO, 2010a [Appendix I]). Overall, the performance review found NPAFC to have effectively met most NPAFC Convention objectives, including the near elimination of high seas fishing targeting or with incidental catch of anadromous

fish, and eliminating high seas driftnet fishing by non-contracting parties, soon after the Convention was adopted (NPAFC, 2010a). Deficiencies identified generally relate to redundancy between NPAFC Committees, and reduced importance of Commission objectives and Committee terms of reference in light of the early success in eliminating high seas fishing for anadromous stocks in the North Pacific (NPAFC, 2010a). Specific recommendations offered by the review team included calls for the NPAFC Commission to examine the need for an observer program of fisheries with incidental take of salmon, and to continue to define 'ecologically related species' in vague terms as needed for research projects, however, recognizing that this conflicts with a NPAFC Convention Article (NPAFC, 2010a). The review panel further recommended that the NPAFC Committee on Scientific Research and Statistics examine the issue of incidental takes of salmon in North Pacific fisheries to determine if it is an issue, and if so, provide recommendations for mitigating the problem, and that the Commission rely on the regional fishery body North Pacific Marine Science Organisation (PICES) and other organizations for detailed information on ecologically related species (NPAFC, 2010a). The performance review recommended that the NPAFC Committee on Enforcement explore establishing a NPAFC Cooperating Non-Member status to accommodate the needs of non-contracting parties and better enable their cooperation with the Commission, and explore mechanisms to assist Korea meet NPAFC enforcement obligations (NPAFC, 2010a).

The South East Atlantic Fisheries Organization (SEAFO) conducted a performance review in 2010 (SEAFO, 2010a). A suite of 21 criteria falling into 5 categories were employed for the assessment: conservation and management, compliance and enforcement, decision-making and dispute settlement, international cooperation, and financial and administrative issues (SEAFO, 2010a [Appendix 1]). Poor knowledge of the status and dynamics of target stocks was identified as a main criticism. Improved transparency of scientific data and expanding the database for existing fisheries were recommended (SEAFO, 2010a). The need for supporting conservation and management measures with effective implementation and enforcement frameworks was also highlighted. Improved rules to ensure that the list of authorized vessels better reflects actual capacity in the Convention Area, and processes to determine if Parties are complying with flag and port State obligations were additional identified deficits. Another recommendation was to develop procedures and requirements for following up on alleged infringements. The assessment recommended that the SEAFO IUU List be expanded to recognize IUU vessels included on all relevant RFMO lists (currently SEAFO's IUU list is a compilation of IUU lists from CCAMLR, Northwest Atlantic Fisheries Organization, NAFO, and North East Atlantic Fisheries Commission, NEAFC, [SEAFO, 2008]). Decision-making, dispute resolution and international cooperation were found to be adequate (SEAFO, 2010a).

The Regional Commission for Fisheries (RECOFI) conducted a performance assessment in 2011 (RECOFI, 2011d). Performance was assessed in four areas: (i) statistics and resources survey of the RECOFI convention area; (ii) aquaculture; (iii) fisheries management; and (iv) relationships with other international organizations and non-RECOFI member States. Main findings identified various weaknesses, including inadequate capability to effectively implement its mandate to conserve and manage fisheries resources, inadequate budget, ineffective implementation of agreed projects, lack of agreement by member States on measures to study the status of fish stocks, and data collection (RECOFI, 2011d). The lack of adoption of any binding conservation and management measures since the establishment of RECOFI was identified as a symptom of inadequate communication of information on fisheries management issues (RECOFI, 2011d).

Under UNFSA, a set of recommended minimum criteria were produced for the assessment of RFMO performance (United Nations, 2007 [Annex II]). At the first joint meeting of the five tuna-RFMOs, held in 2007 in Kobe, Japan, there was agreement in concept that RFMOs would undertake regular performance reviews employing a common assessment method employing the UNFSA standardized criteria suite (Fisheries Agency of Japan, 2007 [Appendix 14]).

IOTC conducted a performance review employing the joint tuna-RFMO/UNFSA minimum set of criteria (IOTC, 2009a). The review recommended that the Agreement establishing IOTC be amended or replaced to adhere to modern fisheries management instruments adopted after the IOTC Agreement was adopted. Deficiencies identified with the IOTC Agreement included not

implementing the precautionary approach and ecosystem-based approach to fisheries management, not defining flag or port State obligations, and limiting participation (IOTC, 2009a). Limitation in participation in IOTC is a result of IOTC's legal status as an Article XIV FAO body (IOTC, 2009a).¹ Low compliance with IOTC measures, inadequate enforcement, low data quality and concomitant high levels of uncertainty of stock assessment findings, and insufficient resources preventing developing States from participating fully in Commission activities were additional deficiencies identified by through the performance review (IOTC, 2009a).

ICCAT conducted a performance review also employing the joint tuna-RFMO/UNFSA minimum set of criteria (ICCAT, 2009d). As with the IOTC assessment findings, the ICCAT Convention was found to be in need of modernization to reflect current RFMO best practices (ICCAT, 2009d). The ICCAT Compliance Committee's performance, a lack of data reporting and low accuracy of data reported by members and cooperating non-members, and failure by members and cooperating non-members to implement monitoring, control and surveillance were found to be problematic (ICCAT, 2009d). In particular, lack of compliance was identified as the main cause of ICCAT's failure to prevent and reverse the overexploitation of 7 of the 14 stocks under ICCAT's purview (ICCAT, 2009d).

CCSBT conducted a performance review against the joint tuna-RFMO/UNFSA minimum set of criteria, and also had an independent assessment of the CCSBT self-assessment (CCSBT, 2008a,b). Main findings were that CCSBT has been unsuccessful in preventing overexploitation of southern bluefin tuna, there is underreporting and concomitant high uncertainty in data employed for southern bluefin tuna stock assessment, and there frequently is an inability to reach agreement on annual Total Allowable Catch levels and quota allocations. The assessments also found that there has been limited progress in compliance and enforcement, and, as with the other RFMO conventions that predate UNFSA and other relevant instruments, there is a need to update the CCSBT Convention to meet current RFMO best practice and bring it in line with modern instruments (CCSBT, 2008a,b). As a result of the CCSBT Convention not being in line with modern fisheries management principles, the assessments found that members have disagreed whether the Commission's mandate supports the adoption of binding measures for ecologically related species (CCSBT, 2008b).

The General Fisheries Commission for the Mediterranean (GFCM) conducted a performance review against the joint tuna-RFMO/UNFSA minimum set of criteria (GFCM, 2011a [Appendix 1]). Along with IOTC and RECOFI, GFCM is also an Article XIV FAO body. The GFCM assessment findings called for modernizing the legal framework (GFCM, 2011a). Other recommendations stemming from the GFCM assessment relevant to this study included adopting provisions for international observers; promoting cooperation with non-members; conducting comprehensive fishery assessments to support developing annual stock assessments; limiting conservation and management considerations to fisheries resources involving more than one member; and providing management advice based on geographical areas that are based on meaningful biological units (GFCM, 2011a). A number of improvements in compliance and enforcement were also identified, including the implementation of flag and port State duties, improving Members' provision of required compliance and enforcement information, and mechanisms to enable following-up on infringements of GFCM management measures (GFCM, 2011a).

NAFO conducted a performance assessment in 2011 employing the joint tuna-RFMO/UNFSA criteria suite, with minor modifications (NAFO, 2011d [Appendix II]). Related to consistency with modern instruments and initiatives, the assessment found that the 2007 NAFO Amended Convention brought NAFO into closer alignment with modern international fisheries instruments and initiatives. Recommended improvements included that NAFO continue to incorporate relevant Port State measures and take into account the special requirements of

¹ Because IOTC was established by an agreement under Article XIV of the FAO Constitution, IOTC membership is restricted to members of the UN, its specialized Agencies, or the International Atomic Energy Agency (IOTC, 2009a). This directly conflicts with UNFSA, which calls for open membership (United Nations, 1995 [Articles 8-17]).

developing States (NAFO, 2011d). Related to decision-making and dispute resolution, while an opt out provision is still in effect, decision-making provisions and the dispute resolution process adopted in the 2007 NAFO Amended Convention were identified as likely to reduce the use of the opt out provision. Related to conservation and management, the assessment flagged the overexploitation of several NAFO-managed stocks, with about half of managed stocks being under moratoria in 2009, as problematic. The cause of overexploited stocks was identified as being from inadequate scientific advice, lack of agreement on management strategies, non-compliance with conservation and management measures, and non-Contracting Party fishing activity (NAFO, 2011d). The assessment also identified as deficiencies the lack of monitoring, reporting, concomitant lack of information, and lack of conservation and management measures to manage bycatch of non-target species and species incidentally affected by fishing operations (NAFO, 2011d). Timely reporting of data needed for stock assessments was an additional identified problem. The assessment called for a formal, consistent approach to manage lost, abandoned and discarded fishing gear, highlighting the current absence of requirements to report derelict gear as a deficit (NAFO, 2011d). Related to compliance and enforcement, the assessment found NAFO to have an effective and comprehensive monitoring, control and surveillance system. Timeliness of Contracting Party reporting on the follow-up of infringements was identified as an area requiring improvement: As of March 2011, information on citation status had been provided by relevant Contracting Parties on only 12 of 88 citations issued between 2006 and 2010 (NAFO, 2011d). Furthermore, the assessment recommended that, to improve traceability, NAFO expand the scope of an existing measure (CEM Article 23) to require that all catches be labeled according to the stock area where they were taken (NAFO, 2011d). Related to international cooperation, the performance assessment found that all States operating fisheries in the NAFO Regulatory Area are currently Contracting Parties, and as a result, IUU fishing no longer occurs (NAFO, 2011d). The assessment recommended that the NAFO Scientific Council improve its explanation of its methods and rationale for advice. Related to financial and administrative issues, the performance assessment found these to be adequate and employing best practices, but the lack of timely payment of annual contributions was identified as a problem (NAFO, 2011d).

WCPFC agreed at its December 2010 Commission meeting to conduct a performance assessment in 2011 also by employing the UNFSA minimum set of criteria (WCPFC, 2009b, 2011a [paragraph 436]). Discussed at IATTC Commission meetings since 2007, IATTC has yet to reach an agreed process and schedule to conduct an inaugural performance assessment (IATTC, 2010g).

2. METHODS

2.1. RFMOs Included in Study

The governance of bycatch, including discards, by 13 marine RFMOs was assessed (Table 1). Eight RFMOs were excluded from the study. Of these, one has not had an active managed fishery since the convention came into effect (Convention on the Conservation and Management of the Pollock Resources in the Central Bering Sea), two have not yet entered into force (Southern Indian Ocean Fisheries Agreement and Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean), one has ceased to function (International Baltic Sea Fishery Commission), three are bilateral arrangements (International Pacific Halibut Commission, Joint Norwegian-Russian Fisheries Commission, and Pacific Salmon Commission), and one is not directly involved in managing marine capture fisheries (International Whaling Commission) (Table 1).

RFMOs that are bilateral arrangements, which generally include convention areas that are exclusively or predominately under national jurisdiction, were not included because it is likely that different governance structures are relevant, e.g., for monitoring and surveillance programs to be managed by national authorities vs. the regional organization (Small, 2005; Lodge et al., 2007).

Since CCBSP came into effect in 1995, the biomass of the Aleutian Basin pollock stock in the convention area has remained below the level under the convention that triggers the establishment of an annual “Allowable Harvest Level” and “Individual National Quotas” (CCBSP, 1994 [Annex Part 1(c)]) (i.e., the allowable harvest level in each year has been set at zero, and thus no directed fishing for pollock has been permitted in the RFMO’s convention area of the donut hole high seas area of the Bering Sea) (NPFMC, 2011; CCBSP, 2012). Thus, given the moratorium, an assessment of the performance of governance of bycatch, including discards, of the CCBSP-managed high seas pollock fishery is currently not applicable.

Three of the organizations included in this assessment have remits that are broader than managing regional marine fisheries (CCAMLR, NASCO, NPAFC), but still meet the definition of an RFMO, regional bodies with the competence to establish fisheries conservation and management measures, including measures to control bycatch (FAO, 2001; Gilman et al., 2007c).

2.2. Criteria Suite to Assess RFMO Performance in Governing Bycatch

Basic information on the history, Members, Cooperating Non-Members, managed fisheries and species, whether or not the RFMO mandate includes non-target species, and area of competence, is reported for each RFMO (Appendix 1).

Five broad criteria were used to assess RFMO bycatch governance. Criteria suites employed in previous assessments of RFMO, national and individual fishery ecological sustainability and other publications relevant to assessing the effectiveness of governance of bycatch, including discards, were considered in developing the criteria suite design, definitions and scaling (Caddy, 1996; Pitcher, 1999; Garcia, 2000; Pitcher and Preikshot, 2001; Small, 2005; Caddy et al., 2007; Lodge et al., 2007; United Nations, 2007; CCSBT, 2008a,b; NEAFC, 2008; ICCAT, 2009d; IOTC, 2009a; Cullis-Suzuik and Pauly, 2010; FAO 1995, 2006, 2010b,c; Marine Stewardship Council, 2010).

Information from publicly available materials from RFMO secretariats were sought first to assess RFMOs against the criteria suite, consistent with international standards on transparency in decision-making on environmental issues (UNEP, 1992 [Principle 10]; FAO, 1995a [Articles 6.13, 7.1.9]; United Nations, 1995 [UNFA Article 12], 2006a, 2006b, 2010). Additional information was obtained from peer-reviewed and grey literature and through correspondences with regional experts, including RFMO secretariat staff.

Scaling of criteria was designed to represent the continuum from none or nominal governance to optimal best practice bycatch governance. Scaling was therefore not designed to account for preconceived expectations of RFMO progress, for instance, to facilitate having resulting scores range across the full scale from 0-100%. However, results are also presented

Table 1. Marine regional fisheries management organizations (RFMOs) (adapted from Gilman et al., 2007c; FAO, 2011c).

Marine RFMO	Acronym
Commission for the Conservation of Antarctic Marine Living Resources	CCAMLR
Convention on the Conservation and Management of the Pollock Resources in the Central Bering Sea ¹	CCBSP
Commission for the Conservation of Southern Bluefin Tuna	CCSBT
General Fisheries Commission for the Mediterranean	GFCM
Inter-American Tropical Tuna Commission	IATTC
International Baltic Sea Fishery Commission ²	IBSFC
International Commission for the Conservation of Atlantic Tunas	ICCAT
International Whaling Commission ³	IWC
Indian Ocean Tuna Commission	IOTC
International Pacific Halibut Commission ⁴	IPHC
Joint Norwegian-Russian Fisheries Commission ⁴	JNRFC
Northwest Atlantic Fisheries Organization	NAFO
North Atlantic Salmon Conservation Organization	NASCO
North East Atlantic Fisheries Commission	NEAFC
North Pacific Anadromous Fish Commission	NPAFC
Pacific Salmon Commission ⁴	PSC
Regional Commission for Fisheries	RECOFI
South East Atlantic Fisheries Organization	SEAFO
Southern Indian Ocean Fisheries Agreement ⁵	SIOFA
South Pacific Regional Fisheries Management Organisation ⁶	SPRFMO
Western and Central Pacific Fisheries Commission	WCPFC

¹ Not included in this study. There is no active CCBSP-managed fishery.

² Not included in this study. IBSFC ceased to function as of 1 January 2006; however the organization legally exists with two contracting parties (Poland and Russian Federation) to the Gdansk Convention (FAO, 2011d).

³ Not included in this study. IWC's main function is to govern global whaling with an aim to ensure effective conservation and management of whale stocks; the Commission's mandate does not include the governance of fisheries for marine fish (International Convention for the Regulation of Whaling, 1946).

⁴ Not included in this study. These RFMOs are bilateral arrangements with areas primarily within national jurisdictions, where different governance mechanisms are likely relevant relative to RFMOs with more than two Members.

⁵ Not included in this study. The Southern Indian Ocean Fisheries Agreement has not yet entered into force (FAO, 2011b).

⁶ Not included in this study. The Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean has not yet entered into force (SPRFMO, 2010).

relative to the RFMO with the highest overall score, representing current best practice bycatch governance. Scores for two criteria that contain multiple subcriteria were calculated as the mean of the percent of total possible points achieved against each subcriterion (e.g., if criteria 1A, 1B and 1C scores were 20%, 35% and 70%, then the score for criterion 1 is the mean of the three subcriteria scores, 41.7%). An overall RFMO score was calculated as the average of the scores resulting for criteria 1-5. The five criteria were assigned equal weights, with the rationale that each provides an indicator of a critical, fundamental element of effective bycatch governance.

For each RFMO, the standard deviation of the population (σ) for the mean of five criteria scores was determined. The mean and σ of the 13 RFMOs' scores for each criterion, subcriterion and overall score were also reported. This provides an understanding of the degree of variability in scores within and between RFMOs.

The criteria suite design attempts to include indicators of each of the main objectives for governing bycatch (Section 1.1.2), as it is not feasible to include criteria to comprehensively cover all aspects of bycatch governance. For example, subcriteria 4B and 4C assesses effective

governance of two unobservable mortality sources (ghost fishing and discharges of organic matter from the disposal at sea of offal, spent bait and dead catch), albeit likely of relatively high ecological risk, and does not attempt to assess management performance for all individual unobservable sources of fishing mortality, which are numerous if not infinite (Gilman et al., 2012a). Nominal scores resulting from the assessment provide an indication of an RFMO's progress in employing optimal best practices to govern bycatch, while relative scores are presented in order to provide an understanding of individual RFMO's progress relative to current best practice, as defined by the RFMO obtaining the highest mean score across the five criteria.

2.2.1. Criterion 1: Observer Monitoring Methods and Dataset Quality

Criterion 1 includes three subcriteria covering the following aspects of effective RFMO monitoring of bycatch in marine capture fisheries: data collection protocols, observer coverage rates, and the quality of regional observer program datasets (FAO, 1995a [Articles 6.4, 6.11, 7.2.2, 7.4.1, 7.4.4, 7.7.3, 8.4.3, 12.4]; Caddy, 1996; Pitcher and Preikshot, 2001; United Nations, 1995 [Article 10(f)], 2007; Cullis-Suzuki and Pauly, 2010; Marine Stewardship Council, 2010; Gilman, 2011).

2.2.1.1. Subcriterion 1A. Bycatch Data Collection Protocols: This subcriterion assesses the adequacy of data collection protocols intended to be implemented by regional observers in collecting the following minimum information needed to understand and govern bycatch: quantity, weight, species, length or other proxy for age class, retained or discarded, disposition of released catch, gear attached to released organisms, date and location caught, and sampling effort (Table 2) (FAO, 1995a [Articles 6.4, 6.11, 7.4.4, 8.4.3, 12.4], 2011a; Caddy, 1996; Pitcher and Preikshot, 2001; Kelleher, 2005; Lodge et al., 2007; United Nations, 2007; Gilman et al., 2006b, 2007a, 2008a,b; Cullis-Suzuki and Pauly, 2010; Marine Stewardship Council, 2010; Gilman, 2011). The subcriterion further assesses whether RFMO-specific information needed to assess the efficacy of binding bycatch conservation and management measures are intended to be collected by regional observers (Table 2) (FAO, 1995a [Article 7.4.1], 2010b; Marine Stewardship Council, 2010). A maximum of 25 or 22 points are attainable for assessment against subcriterion 1A for an RFMO that includes vs. does not include hook-and-line fisheries in a regional observer program, respectively.

Table 2. Subcriterion 1A. Assessment of RFMO regional observer program data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are included in the RFMO's mandate.	1
Data for at least 1 individual bycatch species or group but <50% of documented vulnerable bycatch species are intended to be collected in fisheries with regional observer coverage.	1
Data for >50% but <75% of documented vulnerable bycatch species are intended to be collected in fisheries with regional observer coverage.	2
Data for ≥75% of documented vulnerable bycatch species are intended to be collected in fisheries with regional observer coverage.	3
The number and/or weight of at least 1 documented vulnerable bycatch species is intended to be routinely collected by regional observers.	1
At least one item of information but ≤50% of the items of information needed to assess performance standards of relevant binding conservation and management measures is intended to be collected by regional observers.	1
>50% but <75% of the items of information needed to assess performance standards of relevant binding conservation and management measures are intended to be collected by regional observers.	2
≥75% of the items of information needed to assess performance standards of relevant binding conservation and management measures are intended to be	3

collected by regional observers.	
Information on sampled fishing effort is intended to be routinely collected for fisheries with regional observer coverage.	1
Date and location of fishing operations are intended to be routinely captured by regional observers.	1
Information on whether catch is retained or discarded is intended to be routinely captured by regional observers for at least 1 individual bycatch species or group but $\leq 50\%$ of documented vulnerable bycatch species/groups.	1
Information on whether catch is retained or discarded is intended to be routinely captured by regional observers for $>50\%$ but $<75\%$ of documented vulnerable bycatch species/groups.	2
Information on whether catch is retained or discarded is intended to be routinely captured by regional observers for $\geq 75\%$ of documented vulnerable bycatch species/groups.	3
Data records are intended to be to the species-level for at least 1 bycatch species/groups but $\leq 50\%$ of documented vulnerable bycatch species/groups in fisheries with regional observer coverage.	1
Data records are intended to be to the species-level for $>50\%$ but $<75\%$ of documented vulnerable bycatch species/groups in fisheries with regional observer coverage.	2
Data records are intended to be to the species-level for $\geq 75\%$ of documented vulnerable bycatch species/groups in fisheries with regional observer coverage.	3
Information on length or other proxy for age class is intended to be collected by regional observers for at least 1 vulnerable bycatch species/groups but $\leq 25\%$ of identified vulnerable bycatch species/groups.	1
Information on length or other proxy for age class is intended to be collected for $>25\%$ but $<50\%$ of identified vulnerable bycatch species/groups.	2
Information on length or other proxy for age class is intended to be collected for $\geq 50\%$ of identified vulnerable bycatch species/groups.	3
Information on the disposition of discards (e.g., alive vs. dead, and possibly degree of injury) is intended to be collected for at least 1 vulnerable bycatch species but $\leq 50\%$ of identified vulnerable bycatch species/groups.	1
Information on the disposition of discards (e.g., alive vs. dead, and possibly degree of injury) is intended to be collected for $>50\%$ but $<75\%$ of identified vulnerable bycatch species/groups.	2
Information on the disposition of discards (e.g., alive vs. dead, and possibly degree of injury) is collected for $\geq 75\%$ of identified vulnerable bycatch species/groups.	3
For hook-and-line fisheries with regional observer coverage, information on gear attached to individuals of vulnerable species that are discarded alive is intended to be collected for at least 1 vulnerable bycatch species/group but $\leq 50\%$ of identified vulnerable bycatch species/groups.	1
For hook-and-line fisheries with regional observer coverage, information on gear attached to individuals of vulnerable species that are discarded alive is intended to be collected for $>50\%$ but $<75\%$ of identified vulnerable bycatch species/groups.	2
For hook-and-line fisheries with regional observer coverage, information on gear attached to individuals of vulnerable species that are discarded alive is intended to be collected for $\geq 75\%$ of identified vulnerable bycatch species/groups.	3

Information used for assessment:

- Is minimizing adverse impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?
- In fisheries required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

- Does the RFMO's data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected?
- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).
- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected in the regional observer program according to the RFMO's data collection protocols?
- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?
- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?
- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely by observers of the regional observer program?
- Does the RFMO's data collection protocols for the regional observer program call for information on the date and location of fishing operations to be routinely captured?
- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to have records be at the species level?
- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer program? If other information is intended to be routinely collected by regional observers that provides a proxy for age class, identify the measurement method.
- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer program?
- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer program (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

2.2.1.2. Subcriterion 1B. Regional Observer Coverage Rates: This subcriterion assesses the adequacy of regional onboard observer coverage rates to monitor bycatch, including discards (FAO, 1995a [Articles 7.2.2, 7.7.3]; Marine Stewardship Council, 2010) (Table 3). An RFMO scientific body may have recommended a schedule for gradual increase in observer coverage rates, whereby a fishery may be deemed to meet the scientific recommendation if it has a regional coverage rate that complies with the schedule. Subcriterion 1B also considers whether there is international exchange of observers in a regional onboard observer program in order to maximize data accuracy. A maximum of 11 points is possible for assessment against Subcriterion 1B.

Table 3. Subcriterion 1B. Assessment of RFMO onboard observer coverage rates to monitor bycatch, including discards.

Factor	Points for positive response
At least one but <25% of active managed fisheries (fisheries covered by the RFMO) have $\geq 5\%$ regional onboard observer coverage.	1
$\geq 25\%$ but <50% of active managed fisheries have $\geq 5\%$ regional onboard observer coverage.	2
$\geq 50\%$ but <75% of active managed fisheries have $\geq 5\%$ regional onboard observer coverage.	3

≥75% but <100% of active managed fisheries have ≥5% regional onboard observer coverage.	4
All active managed fisheries have ≥5% regional onboard observer coverage.	5
The RFMO's scientific body has recommended regional onboard observer coverage rates for each managed active fishery, and the regional onboard observer coverage rates of active fisheries meet scientific advice for at least 1 managed fishery but <25% of managed fisheries.	1
The RFMO's scientific body has recommended regional onboard observer coverage rates for each managed active fishery, and the regional onboard observer coverage rates of active fisheries meet scientific advice for ≥25% but <50% of managed fisheries.	2
The RFMO's scientific body has recommended regional onboard observer coverage rates for each managed active fishery, and the regional onboard observer coverage rates of active fisheries meet scientific advice for ≥50% but <75% of managed fisheries.	3
The RFMO's scientific body has recommended regional onboard observer coverage rates for each managed active fishery, and the regional onboard observer coverage rates of active fisheries meet scientific advice for ≥75% of managed fisheries.	4
There is international exchange of observers in the regional onboard observer program.	2

Information used for assessment:

- What recommendations on regional observer coverage rates have the RFMO's scientific body or the Commission made for fisheries under the RFMO's mandate?
- Does a regional observer program exist?
- What are regional onboard observer coverage rates in each active fishery managed by the RFMO?
- If there have been recommendations for onboard observer coverage rates by the RFMO's scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body's recommendations? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of bycatch (Hall, 1999; McCracken, 2005; Gilman, 2011)].
- For each fishery under the RFMO's mandate, are international onboard observers assigned through a regional program, or are they assigned by national fisheries management authorities?

2.2.1.3. Subcriterion 1C. Regional Observer Program Dataset Quality and Bycatch

Reporting: This subcriterion assesses the following aspects of data quality of an RFMO's regional observer program dataset: (i) interoperability of national datasets contributed to an RFMO (whether or not there is standardized data collection methods and dataset formatting) so that they can be pooled, or otherwise existence of a single regional database with records collected from observed national fisheries; (ii) time series length; (iii) balanced seasonal distribution of records; (iv) balanced spatial distribution of records; (v) whether Members regularly report their observer program data to the RFMO; and (vi) whether there are countries with fisheries under the RFMO's mandate that are not Members or Cooperating Non-Members, which reduces dataset quality if these Members do not report bycatch data (Pitcher and Preikshot, 2001; Kelleher, 2005; United Nations, 2007; Gilman et al., 2008a,b; NEAFC, 2008; Marine Stewardship Council, 2010; Gilman, 2011) (Table 4).

An RFMO's regional observer program dataset could consist of a single dataset of pooled records from national fisheries, or a set of national observer program datasets that are provided by Members and Cooperating Non-Members to the RFMO. A maximum of 11 points is possible for assessment against subcriterion 1C.

Table 4. Subcriterion 1C. Assessment of RFMO observer program data quality.

Factor	Points for positive response
A regional observer program database with records of bycatch exists.	1
Either (i) the regional observer program database is comprised of records pooled from observed national fisheries; or (ii) individual national observer program datasets reported to the RFMO are in a standardized format that permits pooling.	1
The regional observer program dataset is <5 years long.	1
The regional observer program dataset is >5 but <15 years long.	2
The regional observer program dataset is >15 years long.	3
Seasonal coverage is balanced and there are minor or no gaps in seasonal coverage.	1
Spatial coverage is balanced and there are minor or no gaps in spatial coverage.	1
All countries with fisheries under the RFMO's mandate are Members or Cooperating Non-Members.	1
>50% but <70% of the RFMO's Members reported required observer data to the regional program in each of the previous three years, or for the full duration of the regional observer program, whichever period is shorter.	1
≥70% but <90% of the RFMO's Members submitted data to the regional program in each of the previous three years, or for the full duration of the regional observer program, whichever period is shorter.	2
≥90% of Members submitted data to the regional program in each of the previous three years, or for the full duration of the regional observer program, whichever period is shorter.	3

Information used for assessment:

- Does a regional observer program database exist? If yes, does the database include records on bycatch?
- If there is a regional observer program, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer program, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer program datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer program datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?
- What is the length in years of the regional observer program dataset?
- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?
- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?
- Which countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members?
- For each fishery that is a part of the regional observer program, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995a [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer program, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

2.2.2. Criterion 2. Open Access to Regional Observer Program Datasets

This criterion assesses the provision of unconditional public access to RFMO-held regional observer program datasets of research-grade primary or amalgamated records (Table 5) (FAO, 1995a [Articles 7.1.9, 7.4.2, 7.4.7]; Caddy, 1996; Cullis-Suzuki and Pauly, 2010; Gilman, 2011; Gilman et al., 2011a). A maximum of 15 points is possible for assessment against Criterion 2.

Table 5. Criterion 2. Assessment of RFMO provision of open access to regional observer program datasets.

Factor	Points for positive response
There is a regional observer program dataset containing records of bycatch, and datasets of amalgamated and not primary data records are open access and records are amalgamated by >5 degree cells.	1
There is a regional observer program dataset containing records of bycatch, and datasets of amalgamated and not primary data records are open access and records are amalgamated by ≤5 degree cells.	2
A publically available dataset of amalgamated records collected by regional observers did not eliminate information on fishing effort, fishing gear, fishing methods, date of setting and hauling, or taxonomic information on bycatch.	4
Some but not all data on bycatch collected in the regional observer program that are open access are primary (non-amalgamated) data.	6
All data made open access by the RFMO regional observer program are primary data.	10
Primary or amalgamated observer data for at least 1 but < 50% of fisheries included in the regional observer program are open access.	1
Primary or amalgamated observer data for ≥50% but <75% of fisheries included in the regional observer program are open access.	3
Primary or amalgamated observer data for ≥75% of fisheries included in the regional observer program are open access.	5

Information used for assessment:

- Does a regional observer program dataset containing records on bycatch exist?
- What confidentiality rules have been adopted on access to data on bycatch, including discards, that the RFMO owns or holds as a custodian?
- Are primary or amalgamated data collected in the regional observer program made available as an open public resource? (Data from a regional observer program are considered open access if there are no restrictions on who can access the records, e.g., if the RFMO makes primary observer data records available only after screening requests against rules that restrict data access, then these records are not considered open access, while RFMO publication of primary or amalgamated observer data made available publicly such as via posting to a public, unrestricted website, are considered open access).
- If only a dataset of amalgamated records from the onboard observer program is made publically available, is the dataset of amalgamated records at a resolution of ≤5 degree cells, >5 degree cells, or is information on resolution of records in the publically available dataset not specified?

- If only amalgamated records from a regional onboard observer program are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?
- Of the fisheries that are included in the regional observer program, for how many are primary or amalgamated datasets open access?

2.2.3. Criterion 3: Ecological Risk Assessment

Criterion 3 assesses whether or not an RFMO has conducted adequate ecological risk assessment to understand the effect of fishing activities on bycatch species (FAO, 1995a [Articles 7.2.2, 7.2.3, 12.10], 2011a; Caddy, 1996; Garcia, 2000; Lodge et al., 2007; NEAFC, 2008; Cullis-Suzuki and Pauly, 2010; Marine Stewardship Council, 2010) and to understand indirect, broader, community- and ecosystem-level effects of bycatch removals (NEAFC, 2008; Cullis-Suzuki and Pauly, 2010; Marine Stewardship Council, 2010; Bjorndal et al., 2011) (Table 6). A maximum of 8 points is possible for assessment against Criterion 3.

Ecological risk assessment of the effects of fishing can be undertaken employing a hierarchical approach with three levels along a continuum from a qualitative first order to quantitative rigorous assessment. Level 1 and 2 ecological risk assessments are useful mainly for rapid first order assessments and where there are data deficiencies with the fishery or species being assessed (Kirby, 2006; Coelho et al., 2011). Level 1 involves a qualitative assessment based on expert and stakeholder opinion. Level 2 involves a semi-quantitative assessment, for example, through a productivity – susceptibility analysis (PSA). In a PSA, assessment of productivity considers the natural growth rate of a population in the absence of fishing mortality, which is an indicator of a population’s relative resistance to fishing mortality and ability to recover from depletion. Susceptibility considers whether a population overlaps with the fishery temporally and spatially, what proportion of each age class overlaps the fishery, and what is the probability that this species interacts with fishing vessels, will be captured, and will suffer injury or mortality in the fishery being assessed. Finally, a Level 3 ecological risk assessment is a quantitative assessment documenting population-level effects from mortality levels in a fishery in question, with relatively large data requirements (Sainsbury and Sumaila, 2001; Kirby, 2006; Marine Stewardship Council, 2010; Coelho et al., 2011; Hobday et al., 2007, 2011).

Following this hierarchical approach, a fishery may undergo a Level 1 ecological risk assessment for all species/habitats affected by fishing operations, where findings identify a subset of species and habitats of concern that can then undergo more comprehensive Level 2 assessment. The Level 2 assessment then identifies those of highest risk, which then undergo a Level 3 assessment, with concomitant reductions of uncertainty in separating low from high risk species as one progresses to higher levels in the assessment hierarchy (Hobday et al., 2011).

Table 6. Criterion 3. Ecological risk assessment.

Factor	Points for positive response
Level 1 ecological risk assessment for the effects of fishing on bycatch species and/or the effects of bycatch removals on the integrity of the ecosystem has been conducted for at least 1 fishery but <50% of fisheries managed by the RFMO, results supported more rigorous, quantitative assessment, but Level 2 and 3 assessments have not been conducted.	1
Level 1 ecological risk assessment for the effects of fishing on bycatch species and/or the effects of bycatch removals on the integrity of the ecosystem has been	2

conducted for $\geq 50\%$ of fisheries managed by the RFMO, results supported more rigorous, quantitative assessment, but Level 2 and 3 assessments have not been conducted.	
Level 2 and/or 3 assessment has been conducted for either the effects of fishing on bycatch species or the effects of bycatch removals on the integrity of the ecosystem, but not both, for at least 1 fishery.	2
Level 2 semi-quantitative assessment for both the effects of fishing on bycatch species, and the effects of bycatch removals on the integrity of the ecosystem has been conducted for at least 1 fishery but $< 50\%$ of fisheries managed by the RFMO, with findings suggesting that more rigorous Level 3 assessment is warranted but has not been conducted.	3
Level 2 semi-quantitative assessment for both the effects of fishing on bycatch species, and the effects of bycatch removals on the integrity of the ecosystem has been conducted for $\geq 50\%$ of fisheries managed by the RFMO, with findings suggesting that more rigorous Level 3 assessment is warranted but has not been conducted.	4
Level 1 qualitative assessment for both the effects of fishing on bycatch species, and the effects of bycatch removals on the integrity of the ecosystem has been conducted for at least 1 fishery but $< 50\%$ of fisheries managed by the RFMO, with findings suggesting that more rigorous quantitative assessment is not warranted.	5
Level 2 semi-quantitative assessment for both the effects of fishing on bycatch species, and the effects of bycatch removals on the integrity of the ecosystem has been conducted for at least 1 fishery but $< 50\%$ of fisheries managed by the RFMO, with findings suggesting either that more rigorous Level 3 assessment is not warranted or that Level 3 assessment is warranted and it is planned or in progress.	5
Level 1 qualitative assessment for both the effects of fishing on bycatch species, and the effects of bycatch removals on the integrity of the ecosystem has been conducted for $\geq 50\%$ of fisheries managed by the RFMO, with findings suggesting that more rigorous quantitative assessment is not warranted.	6
Level 2 semi-quantitative assessment for both the effects of fishing on bycatch species, and the effects of bycatch removals on the integrity of the ecosystem has been conducted for $\geq 50\%$ of fisheries managed by the RFMO, with findings suggesting either that more rigorous Level 3 assessment is not warranted or that Level 3 assessment is warranted and it is planned or in progress.	6
Level 3 assessment for both the effects of fishing on bycatch species, and the effects of bycatch removals on the integrity of the ecosystem, has been conducted at least 1 fishery but $< 50\%$ of fisheries managed by the RFMO.	7
Level 3 assessments for both the effects of fishing on bycatch species, and the effects of bycatch removals on the integrity of the ecosystem, have been conducted for $\geq 50\%$ of fisheries managed by the RFMO.	8

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).
- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.
- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

2.2.4. Criterion 4. Conservation and Management Measures to Control Problematic Bycatch, Including Discards

This criterion includes three components related to the control of bycatch in marine capture fisheries. Subcriterion 4A assesses the adequacy of legally binding measures in mitigating problematic bycatch of species that are relatively vulnerable to fisheries exploitation due to their life history characteristics and susceptibility to fishing mortality, and in managing adverse, indirect, broad community- and ecosystem-level effects of bycatch losses, but excluding ecological risks from derelict fishing gear and from discharges of organic matter, covered in the other two subcriteria of criterion 4 (FAO, 1995a [Articles 6.2, 6.4, 7.2.2d, 7.2.2g, 7.5.2, 7.6.9, 7.7.2, 7.7.3]; Garcia, 2000; United Nations, 2007; Marine Stewardship Council, 2010). Subcriterion 4B assesses the adequacy of binding measures in mitigating ecological risks from derelict fishing gear (FAO, 1995a [Article 7.2.2g, 7.6.9]; Caddy, 1996; Garcia, 2000; United Nations, 2007). Subcriterion 4C assesses the adequacy of binding measures in mitigating unobservable mortalities resulting from discharges of discarded catch, offal from processed catch, and spent bait (FAO, 1995a [Article 7.2.2g]; Caddy, 1996; Garcia, 2000; United Nations, 2007).

Scaling considers whether: (i) There are binding measures that mitigate problematic bycatch as identified through ecological risk assessments or other studies, or otherwise are inferred to likely occur based on relevant research conducted in other regions; (ii) binding measures to mitigate bycatch and discards include measurable performance standards; (iii) of binding bycatch and discard measures that contain quantitative performance standards, have the measures been assessed for efficacy; (iv) for binding bycatch and discard measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment), have steps been taken or are steps in progress to improve efficacy; and (v) does the RFMO have provisions that allow Members to opt out of binding measures (FAO, 1995a [Article 7.6.8], 2011a; Gilman, 2011).

2.2.4.1. Subcriterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch, Including Discards: Table 7 is used to assess RFMO performance in adopting binding measures to mitigate problematic bycatch (FAO, 1995a [Articles 6.2, 6.4, 7.2.2d, 7.2.2g, 7.6.9]; Garcia, 2000; Lodge et al., 2007; United Nations, 2007; Marine Stewardship Council, 2010; Gilman, 2011). The subcriterion is intended to account for controls of all identified adverse ecological effects resulting from bycatch, excluding from ghost fishing and from organic matter discharges, covered in subsequent subcriteria. A maximum of 18 points is possible for assessment against subcriterion 4A.

Table 7. Subcriterion 4A. Conservation and management measures to mitigate adverse consequences of bycatch, including discards (excluding from ghost fishing and from discharges of catch, offal and spent bait).

Factor	Points for positive response
One or more bycatch problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in place to mitigate at least one identified problem but <50% of the number of identified problems.	1
One or more bycatch problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in place to mitigate $\geq 50\%$ but <75% of the number of identified problems.	3
One or more bycatch problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in place to mitigate $\geq 75\%$ of the number of identified problems.	5
Ecological risk assessments and other studies assessing bycatch have been conducted, or otherwise information on bycatch in these gear types from other regions is considered, and findings strongly support that there is no problematic bycatch occurring in fisheries managed by the RFMO for which there are no binding conservation and management measures to mitigate bycatch.	6

At least one but <50% of binding measures to mitigate bycatch include measurable performance standards.	1
≥50% but <75% of binding measures to mitigate bycatch include measurable performance standards.	2
≥75% of binding measures to mitigate bycatch include measurable performance standards.	3
Of binding bycatch measures that contain quantitative performance standards, at least one measure but <50% of the measures have been assessed for efficacy.	1
Of binding bycatch measures that contain quantitative performance standards, ≥50% but <75% of the measures have been assessed for efficacy.	2
Of binding bycatch measures that contain quantitative performance standards, ≥75% of the measures have been assessed for efficacy.	3
All binding bycatch measures that contain performance standards have been determined to be effective in meeting the stipulated performance standards.	3
For all binding bycatch measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment), steps have been taken or are in progress to improve efficacy.	2
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.
- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?
- Using Table 8, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).
- From the responses to the first two bullets, list each individual documented bycatch problem.
- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995a [Article 12.13]; Caddy, 1996)?
- What proportion of binding bycatch measures contains quantitative, measurable performance standards?
- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?
- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?
- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the

measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

Table 8. Template table to describe active RFMO legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
Sea turtles			
Marine mammals			
Shark and relatives			
Juvenile and small/undersized target species			
Unmarketable sizes and species of non-target species of fish			
Other or multiple bycatch species group(s)			

2.2.4.2. Subriterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear: Table 9 is used to assess the adequacy of RFMO binding measures to mitigate unobservable mortalities in lost, abandoned and discarded derelict fishing gear (FAO, 1995a [Article 7.2.2g, 7.6.9]; Caddy, 1996; Garcia, 2000; United Nations, 2007). A maximum of 14 points is possible for assessment against subcriterion 4B.

Table 9. Subcriterion 4B. Conservation and management measures to mitigate ghost fishing.

Factor	Points for positive response
For fisheries managed by the RFMO for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are in place for at least one but <50% of these fisheries.	1
For managed fisheries for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are in place for ≥50% but <75% of these fisheries.	2
For managed fisheries for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are in place for ≥75% of these fisheries.	3
Rigorous scientific assessments have been conducted and findings strongly support that there are no adverse ecological effects from bycatch in lost, abandoned, or discarded derelict fishing gear in all of the fisheries managed by the RFMO, and/or there is information that supports that ghost fishing is very unlikely to be a problem in these fisheries, based on information on these gear types from other regions.	Criterion is excluded from this RFMO's assessment
At least one but <50% of binding measures to mitigate ghost fishing include measurable performance standards.	1
≥50% but <75% of binding measures to mitigate ghost fishing include measurable performance standards.	2
≥75% of binding measures to mitigate ghost fishing include measurable performance standards.	3
Of binding ghost fishing mitigation measures that contain quantitative performance standards, at least one measure but <50% of the measures have been assessed for efficacy.	1
Of binding ghost fishing mitigation measures that contain quantitative performance standards, ≥50% but <75% of the measures have been assessed for efficacy.	2
Of binding ghost fishing mitigation measures that contain quantitative performance standards, ≥75% of the measures have been assessed for efficacy.	3
For all binding ghost fishing mitigation measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment), steps have been taken or are in progress to improve efficacy.	2
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information collected to assess RFMOs against this criterion was:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?
- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table 10).
- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?
- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?
- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?
- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Table 10. Template table to describe active RFMO legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)

2.2.4.3. Subcriterion 4C. Conservation and Management Measures to Mitigate Unobservable Fishing Mortality from Discharges of Catch, Offal and Spent Bait During Fishing Operations at Sea:

Table 11 is used to assess the adequacy of RFMO binding measures to control unobservable fishing mortality resulting from discharges at sea of discarded catch, offal from processed catch, and spent bait (FAO, 1995a [Article 7.2.2g]; Caddy, 1996; Garcia, 2000; United Nations, 2007). A maximum of 14 points is possible for assessment against subcriterion 4C.

Table 11. Subcriterion 4C. Conservation and management measures to mitigate unobservable fishing mortality from discharges of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
Research has been conducted to assess the ecological risks from the discharges of catch, offal and spent bait at sea from all RFMO-managed fisheries and findings suggest that adverse effects are likely to result, for example, because fishing grounds occur in areas where adverse pollution effects are likely to result from discharges, and/or discharges are spatially concentrated, or otherwise there is limited understanding of ecological risks from these pollution effects, and binding measures to mitigate pollution are in place for at least one but <50% of these fisheries.	1
Research has been conducted to assess the ecological risks from the discharges of catch, offal and spent bait at sea from all RFMO-managed fisheries and findings suggest that adverse effects are likely to result, for example, because fishing grounds occur in areas where adverse pollution effects are likely to result from	2

discharges, and/or discharges are spatially concentrated, or otherwise there is limited understanding of ecological risks from these pollution effects, and binding measures to mitigate pollution are in place for $\geq 50\%$ but $< 75\%$ of these fisheries.	
Research has been conducted to assess the ecological risks from the discharges of catch, offal and spent bait at sea from all RFMO-managed fisheries and findings suggest that adverse effects are likely to result, for example, because fishing grounds occur in areas where adverse pollution effects are likely to result from discharges, and/or discharges are spatially concentrated, or otherwise there is limited understanding of ecological risks from these pollution effects, and binding measures to mitigate pollution are in place for $\geq 75\%$ of these fisheries.	3
Rigorous scientific assessments have been conducted for all fisheries managed by the RFMO and findings strongly support the conclusion that there are no adverse ecological effects from discharges at sea of discarded catch, offal from processed catch, and spent bait, for example, because fishing grounds do not occur in areas where adverse pollution effects are likely to result from discharges, and/or the fisheries are understood to have nominal levels of discharges that are not spatially concentrated but instead are disbursed over broad areas.	11
At least one but $< 50\%$ of binding measures to mitigate problematic pollution from discharges include measurable performance standards.	1
$\geq 50\%$ but $< 75\%$ of binding measures to mitigate problematic pollution from discharges include measurable performance standards.	2
$\geq 75\%$ of binding measures to mitigate problematic pollution from discharges include measurable performance standards.	3
Of binding discharge pollution mitigation measures that contain quantitative performance standards, at least one measure but $< 50\%$ of the measures have been assessed for efficacy.	1
Of binding discharge pollution mitigation measures that contain quantitative performance standards, $\geq 50\%$ but $< 75\%$ of the measures have been assessed for efficacy.	2
Of binding discharge pollution mitigation measures that contain quantitative performance standards, $\geq 75\%$ of the measures have been assessed for efficacy.	3
For all binding discharge pollution mitigation measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment), steps have been taken or are in progress to improve efficacy.	2
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?
- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?
- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table 12).

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?
- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?
- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?
- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Table 12. Template table to describe active RFMO legally binding conservation and management measures related to discharges of discarded catch, offal from processed catch, and spent bait, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)

2.2.5. Criterion 5. Surveillance and Enforcement

This criterion assesses the adequacy of RFMO measures for surveillance and enforcement of legally binding conservation and management measures on bycatch. The assessment method considers: (i) whether surveillance activities enable assessment of compliance with binding RFMO bycatch measure by Members' vessels; (ii) if the RFMO requires Members to employ specified enforcement procedures; (iii) whether the RFMO requires Members to impose specified penalties/sanctions when Members detect infringements of binding bycatch measures; (iv) whether there is a formal procedure for the RFMO to routinely assess the performance of surveillance and enforcement activities to support adaptive management; (v) whether Members routinely report to the RFMO secretariat on identified infractions, enforcement activities and their conclusions, and does the RFMO secretariat routinely make this information publicly available; (vi) the proportion of detected infringements that result in sanctions; and (vii) if the RFMO has the authority to impose sanctions against Members found to not be in compliance with RFMO bycatch requirements (FAO, 1995a [Articles 6.10, 7.7.3, 7.7.4, 8.1.4]; Caddy, 1996; Garcia, 2000; Small, 2005; Lodge et al., 2007; United Nations, 2007; NEAFC, 2008; Cullis-Suzuki and Pauly, 2010; Marine Stewardship Council, 2010) (Table 13). A maximum of 20 points is possible for assessment against criterion 5.

Table 13. Criterion 5. Measures and resources for surveillance and enforcement.

Factor	Points for positive response
At least 1 but $\leq 25\%$ of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	1
>25% but <50% of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	2
$\geq 50\%$ but <75% of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	3
$\geq 75\%$ of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	4
The RFMO requires parties to report to the RFMO on their enforcement procedures and conclusions.	3
The RFMO requires parties to take specified enforcement procedures when an infraction of a binding conservation and management measure occurs.	3
The RFMO requires parties to impose specified sanctions when an infraction of a binding conservation and management measure occurs.	3
The RFMO has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3
Summary information on detected infringements of binding measures on bycatch are made available by the RFMO, and resulted in sanctions prescribed by the RFMO for >25% but <50% of detected infringements.	1
Summary information on detected infringements of binding measures on bycatch are made available by the RFMO, and resulted in sanctions prescribed by the RFMO for $\geq 50\%$ but <75% of detected infringements.	2
Summary information on detected infringements of binding measures on bycatch are made available by the RFMO, and resulted in sanctions prescribed by the RFMO for >75% but <100% of detected infringements.	3
Summary information on detected infringements of binding measures on bycatch are made available by the RFMO, and resulted in sanctions prescribed by the RFMO for 100% of detected infringements.	4

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programs of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer program data.
- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables 8, 10, and 12)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. Additionally, (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations? Finally, (v) does the RFMO make information publicly available on identified infractions, enforcement actions, and outcomes of the enforcement actions both for infractions by Member and non-Member vessels, and by Member States?
- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?
- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

3. RESULTS

Table 14 presents scores, means and σ of scores from the assessment of RFMO governance of bycatch, including discards, against the criteria suite. Fig. 1 presents the RFMO scores relative to the RFMO with the highest score, and nominal scores. Appendix 1 contains performance assessment reports for the 13 RFMOs included in the study.

Scores ranged from 1% to 58%, with a mean of 25% ($\pm 16\% \sigma$), and 64% CV (coefficient of variation, the standard deviation of the population of scores was 64% of the mean). 54% of scores fell within \pm one σ of the mean. RECOFI received the lowest overall score, and CCAMLR the highest. Of the 13 assessed RFMOs, variability in scores was highest for NAFO (five criteria scores ranged from 0% to 95%) and lowest for RECOFI (five criteria scores ranged from 0% to 4%). The RFMOs received the highest average score against criterion 5 (39%), and lowest against criterion 2 (10%). Criterion 1 had the highest variability in scores across the 13 RFMOs and criterion 4 the lowest (Fig. 1, Table 14).

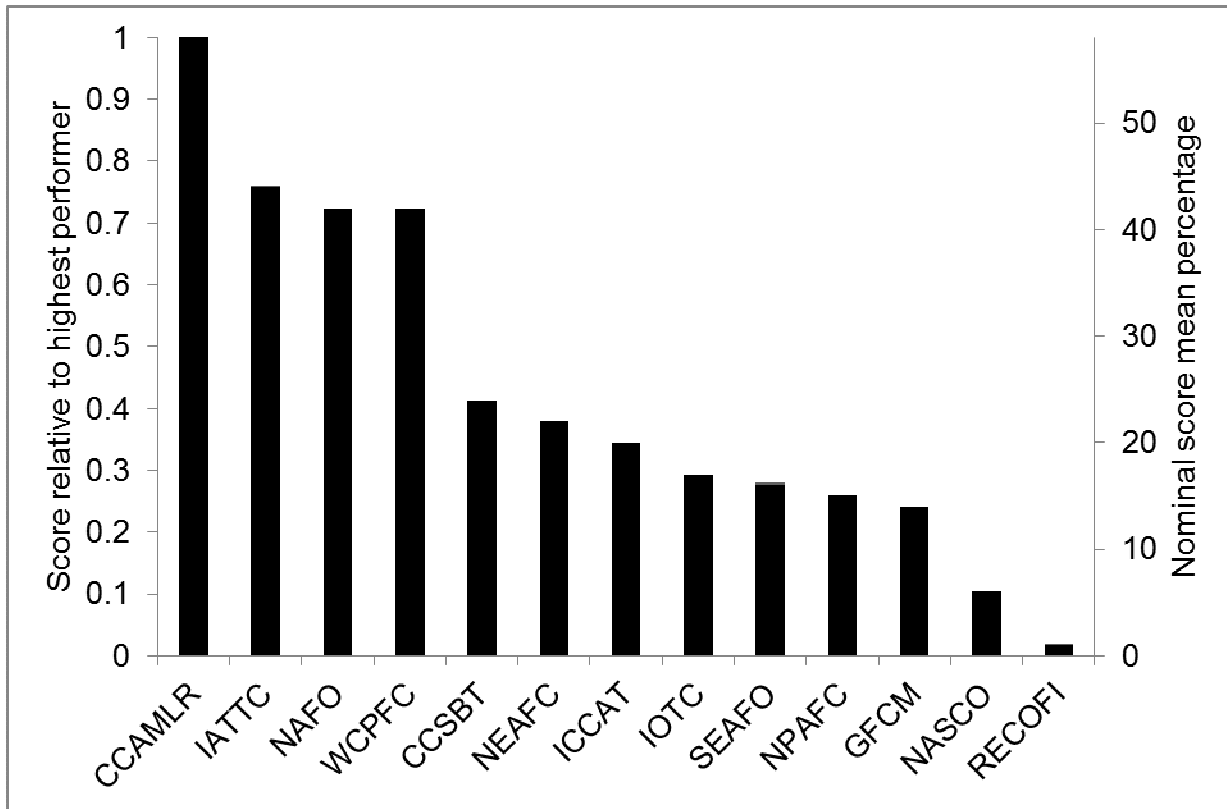


Fig. 1. RFMO scores resulting from an assessment of performance in governing bycatch, including discards. Primary x-axis scale is the score relative to the highest performer. Secondary x-axis scale is the nominal mean percentage score of five criteria.

Fig. 2 presents the relationship between RFMO Membership size and score when assessed against the criteria suite for bycatch governance. Fitting the data series to a linear regression model results in a R^2 of 0.1.

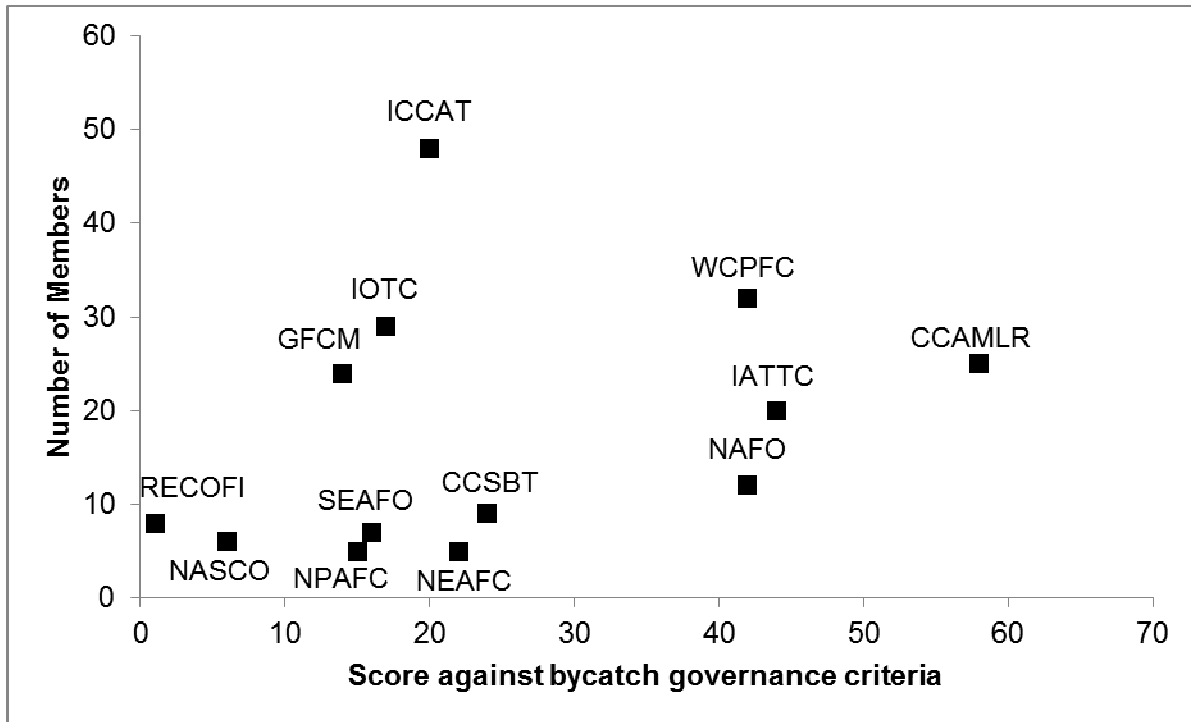


Fig. 2. Relationship between RFMOs' number of Members (States and entities that have the authority to vote in the Commission's decision-making processes) and nominal score for performance in governing bycatch, including discards.

Table 15 presents summary statistics for selected measures assessed through the criteria suite.

Table 14. Results of assessment of RFMO governance of bycatch, including discarded catch, against a suite of five criteria.

RFMO	SCORE (%) ¹										Relative scale score ⁵			
	1 ²	1A	1B	1C	2	3	4 ²	4A	4B	4C		5	Mean (%) ³	σ (%) ⁴
CCAMLR	90	88	100	82	40	75	36	67	21	21	50	58	± 21	1
CCSBT	42	36	55	36	0	25	21	22	21	21	30	24	± 14	0.41
GFCM	3	0	0	9	0	25	13	39	0	0	30	14	± 12	0.24
IATTC	65	76	27	91	40	38	34	61	21	21	45	44	± 11	0.76
ICCAT	36	36	36	36	0	25	7	22	0	0	30	20	± 14	0.34
IOTC	7	20	0	0	0	25	11	11	21	0	45	17	± 22	0.29
NAFO	71	40	82	91	0	25	18	39	14	0	95	42	± 35	0.72
NASCO	0	0	0	0	0	0	0	0	0	0	30	6	± 12	0.10
NEAFC	11	16	9	9	0	25	22	44	21	0	50	22	± 17	0.38
NPAFC	1	4	0	0	0	25	20	17	21	21	30	15	± 12	0.26
RECOFI	4	4	0	9	0	0	0	0	0	0	0	1	± 2	0.02
SEAFO	13	12	0	27	0	25	14	22	21	0	30	16	± 10	0.28
WCPFC	62	96	36	55	47	25	30	39	29	21	45	42	± 13	0.72
Mean	31.2	32.9	26.5	34.2	9.8	26.0	17.4	29.5	14.6	8.1	39.2	24.7	--	0.42
σ	± 30	± 32	± 33	± 34	± 18	± 17	± 11	± 20	± 10	± 10	± 21	± 16	--	± 0.41

¹ Criterion 1: Observer monitoring methods and dataset quality

Criterion 1A. Bycatch data collection protocols

Criterion 1B. Observer coverage rates

Criterion 1C. Dataset quality

Criterion 2. Open access to regional observer program datasets

Criterion 3. Ecological risk assessment

Criterion 4. Conservation and management measures

Criterion 4A. Conservation and management measures to mitigate problematic bycatch, including discards

Criterion 4B. Conservation and management measures to mitigate ghost fishing

Criterion 4C. Conservation and management measures to mitigate unobservable fishing mortality from discharges of catch, offal and spent bait during fishing operations at sea

Criterion 5. Surveillance and enforcement

² Mean of subcriteria scores.

³ Mean of scores for criteria 1, 2, 3, 4 and 5

⁴ Standard deviation of the population of scores

⁵ Score relative to the highest score obtained. A 1 is assigned to the RFMO with the highest nominal score (percent of total possible points obtainable), and other RFMOs' relative scores are calculated as the ratio of the RFMO's nominal score to the score obtained by the RFMO with the highest score.

Table 15. Summary statistics for selected subcomponents of the criteria suite employed in the performance assessment of RFMO governance of bycatch, including discards.

(a) Measures included in Criterion 1A. Bycatch data collection protocols for regionally observed fisheries			
RFMO	Minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species is included in the RFMO's mandate	Percent of information needed to assess efficacy of binding bycatch conservation and management measures that is intended to be collected by regional observers (and number of items of information)	Data collection protocols of regional observers includes recording the disposition of discards of at least one species group relatively vulnerable to overexploitation
CCAMLR	Y	100 (N= 19)	Y
CCSBT	N	33 (N= 3)	Y
GFCM	N	0 (N= 13)	N
IATTC	Y	50 (N= 12)	Y
ICCAT	N	32 (N= 28)	Y
IOTC	N	53 (N= 15)	Y
NAFO	Y	100 (N= 2)	N
NASCO	N	NA, no measures (N= 0)	N
NEAFC	Y	50 (N= 2)	N
NPAFC	Y	NA, no measures (N= 0)	N
RECOFI	Y	NA, no measures (N= 0)	N
SEAFO	Y	35 (N= 17)	Y
WCPFC	Y	75 (N= 20)	Y

(b) Measures included in Criterion 1B. Regional observer coverage rates			
RFMO	A regional observer program exists	Mean regional observer coverage rate of RFMO-managed active fisheries	Is there international exchange of observers in a regional program
CCAMLR	Y	87.5%	Y
CCSBT	Y	ca. 10%	N
GFCM	N	0%	N
IATTC	Y	9%	Y (partial, $\geq 50\%$)
ICCAT	Y	19%	Y (partial, for the Regional Observer Programme for Bluefin Tuna)
IOTC	Y	< 5%	N
NAFO	Y	100%	N
NASCO	N	0%	N
NEAFC	Y	Not publicly reported	N
NPAFC	N	0%	N
RECOFI	N	0%	N
SEAFO	Y	Not publicly reported	N
WCPFC	Y	Ca. 17%	N

(c) Measures included in Criterion 1C. Regional observer program dataset quality

RFMO	The RFMO Secretariat possesses a dataset of records collected by a regional observer program, and the dataset contains records on bycatch, including discards	Length in years of a regional observer program dataset possessed by the RFMO Secretariat	One or more country or entity with fisheries under the RFMO's mandate is not a Member or Cooperating Non-Member (response of N indicates that all relevant countries/entities are Members/Cooperating Non-Members)
CCAMLR	Y	20	N
CCSBT	N	0	N
GFCM	N	0	N
IATTC	Y	33	Y
ICCAT	Y	1	N
IOTC	N	0	Y
NAFO	Y	19	N
NASCO	N	0	Y
NEAFC	N	0	N
NPAFC	N	0	Y
RECOFI	N	0	N
SEAFO	Y	1	Y
WCPFC	Y	4	Y

(d) Measures included in Criterion 2. Open access to regional observer program datasets

RFMO	Primary data records from a regional observer program are publicly available	Amalgamated data records of a spatial resolution $\leq 5^\circ$ cells from a regional observer program are publicly available
CCAMLR	N	N
CCSBT	N	N
GFCM	N	N
IATTC	N	N
ICCAT	N	N
IOTC	N	N
NAFO	N	N
NASCO	N	N
NEAFC	N	N
NPAFC	N	N
RECOFI	N	N
SEAFO	N	N
WCPFC	N	Y

(e) Measures included in Criterion 3. Ecological risk assessment

RFMO	Ecological risk assessment on effects of fishing mortality on bycatch species has been conducted for one or more RFMO-managed fishery	Ecological risk assessment on effects of bycatch mortality on ecosystem functions and structure has been conducted for one or more RFMO-managed fishery
CCAMLR	Y	Y
CCSBT	N	N
GFCM	Y	N
IATTC	Y	Y
ICCAT	Y	N
IOTC	Y	N
NAFO	Y	N
NASCO	N	N
NEAFC	Y	N
NPAFC	Y	N
RECOFI	Y	N
SEAFO	Y	N
WCPFC	Y	N

(f) Measures included in Criterion 4. Conservation and management measures to control problematic bycatch (part 1)

RFMO	Percentage of potential or documented problematic bycatch of vulnerable species for which binding conservation and management measures are in effect (and total number of vulnerable species/groups)	Percentage of binding bycatch measures containing quantitative, measurable performance standards (and total number of relevant binding measures)	The RFMO does not allow Member States to opt out of binding conservation and management measures (a response of N means there is an opt out provision)
CCAMLR	79 (N= 19)	10 (N= 10)	N
CCSBT	25 (N= 4)	0 (N= 1)	Y
GFCM	54 (N= 26)	45 (N= 11)	N
IATTC	50 (N= 12)	33 (N= 6)	Y
ICCAT	65 (N= 20)	11 (N= 9)	Y
IOTC	38 (N= 21)	13 (N= 8)	N
NAFO	40 (N= 20)	23 (N= 13)	N
NASCO	0 (N= 5)	0 (N= 0)	N
NEAFC	13 (N= 16)	9 (N= 11)	N
NPAFC	0 (N= 21)	0 (N= 0)	Y
RECOFI	0 (N= 31)	0 (N= 0)	N
SEAFO	67 (N= 12)	17 (N= 6)	N
WCPFC	47 (N= 19)	50 (N= 8)	Y

(g) Measures included in Criterion 4. Conservation and management measures to control problematic bycatch (part 2)

RFMO	The RFMO has assessed ghost fishing mortality levels/rates in one or more managed fisheries	One or more binding measure related to managing ghost fishing exists	The RFMO has assessed ecological risks from fisheries discharges of discarded catch, offal from processed catch, and spent bait	One or more binding measure related to managing discharges of discarded catch, offal from processed catch, and spent bait exists
CCAMLR	N	Y	N	Y
CCSBT	N	N	N	N
GFCM	N	N	N	N
IATTC	N	N	N	N
ICCAT	N	N	N	N
IOTC	N	Y	N	N
NAFO	N	Y	N	N
NASCO	N	N	N	N
NEAFC	N	Y	N	N
NPAFC	N	N	N	N
RECOFI	N	N	N	N
SEAFO	N	Y	N	N
WCPFC	N	Y	N	N

(h) Measures included in Criterion 5. Surveillance and enforcement

RFMO	Percentage of surveillance methods required to assess compliance with binding bycatch measures (number of requisite methods)	(i) Member States routinely report identified infractions, enforcement actions and the conclusions of these enforcement actions; AND (ii) the RFMO Secretariat routinely makes information publicly available on detected infringements and enforcement outcomes; AND (iii) detected infringements of binding bycatch measures regularly result in sanctions
CCAMLR	100 (N= 5)	N
CCSBT	67 (N= 3)	N
GFCM	0 (N= 5)	N
IATTC	50 (N= 6)	N
ICCAT	50 (N= 4)	N
IOTC	67 (N= 6)	N
NAFO	100 (N= 3)	N
NASCO	NA (no binding measures) (N= 0)	N
NEAFC	75 (N= 4)	N
NPAFC	0 (N= 2)	N
RECOFI	NA (no binding measures) (N= 0)	N
SEAFO	67 (N= 6)	N
WCPFC	67 (N= 6)	N

4. DISCUSSION AND CONCLUSIONS

Findings from this performance assessment provide a benchmark of RFMO progress and identification of priority deficits in the international governance of bycatch, including discards. The mean score of 25% for the 13 RFMOs assessed against the criteria suite (Table 14) indicates that overall, there are substantial deficits in optimal best practice governance of bycatch, including discards. There was relatively high variability in performance in governing bycatch across the 13 assessed RFMOs, as demonstrated by a 64% CV, mean scores ranging from 1% to 58%, with 6 of the RFMO's mean nominal scores falling outside of \pm one σ of the mean (6 scores did not fall between 9% and 41%) (Fig. 1, Table 14). The high dispersion of relative scores (Table 14, mean of $0.42 \pm 0.41 \sigma$, range 0.02 to 1) further documents high inconsistency in RFMO employment of current best practice bycatch governance.

4.1. Observer Monitoring Methods and Dataset Quality

The highest variability in scores occurred for criterion 1 ($\pm 30 \sigma$, scores ranging from 0 to 90), indicating that, of the five criteria, there is least consistency in RFMO performance in observer bycatch data collection protocols, observer coverage rates, and dataset quality. Four RFMOs lack regional observer programs (Table 15b), and as a result received extremely low scores against these subcriteria.

A large proportion (5 of 13) of the RFMOs do not include minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species in their mandate (Table 15a). Several RFMOs were established before UNFSA, and some were established prior to the third Law of the Sea Convention. Many of these older RFMOs lack mandates that are consistent with the new responsibilities assigned to RFMOs under UNFSA (United Nations, 1995 [Article 13]). While some RFMOs have assessed the suitability of their mandates and modernized them if determined to be inadequate (e.g., IATTC adopted the Antiqua Convention in 2003 to modernize its mandate; NEAFC and NAFO assessed their mandates), many of the older RFMOs have not. There is a need to broaden the mandates of these RFMOs to prevent adverse effects of fishing on non-target associated and dependent species, including those that are relatively vulnerable to fisheries exploitation (Lodge et al., 2007).

There were seven RFMOs with regional observer programs for which information on regional observer coverage rates were publicly available, and four RFMOs lacking regional observer coverage for any managed fishery. The average of RFMO mean observer coverage rates was 18.5% ($\pm 36.6\% \sigma$, 198% CV, ranging from 0% to 100% observer coverage rates). While this average coverage rate is encouraging, there was very high variability in observer coverage rates of active fisheries managed by RFMOs: 47 of 68 active managed fisheries have no regional observer coverage, and 11 had 100% coverage. Observer data are key to identifying and understanding any trends in bycatch rates and levels, and in assessing performance of mitigation measures in a commercial setting, where methods for the employment of prescribed bycatch mitigation methods are known to differ from experimental conditions (Cox et al., 2007; Gilman et al., 2005, 2008b). Adequate data collection protocols and observer coverage rates are needed to allow for robust statistical analyses of bycatch interactions, including documentation of bycatch rates, fleet-wide extrapolations, and identification of when and where interactions occur. The objectives of analyses (i.e., required levels of accuracy and precision), the rate of bycatch interactions, amount of fishing effort, and distribution of catch and bycatch determine the requisite onboard observer coverage rate (Hall, 1999; McCracken, 2005; Gilman, 2011). Of the nine RFMOs with regional observer programs, only three have international exchange of observers (Table 15b), a practice needed to optimize the objectivity of observer reporting and thus maximize data quality (Gilman, 2011).

RFMOs collect only about half of requisite information via onboard observer programs needed to assess the performance of bycatch conservation and management measures (Table 15a). Of the 10 RFMOs that have adopted binding conservation and management measures related to bycatch, 49% (67 of 131 items) of items of information needed to assess the efficacy of the

implementation of the measures are not included in regional observer data collection protocols (Table 15a). Of the nine RFMOs with a regional observer program, all but two (NAFO and NEAFC) include the collection of the disposition of released/discarded organisms for at least one species or species group identified as being relatively vulnerable to fisheries overexploitation (Table 15a,b). This information is critical for estimating post-release mortality rates, one of the components of unobservable fishing mortality that needs to be accounted for in estimates of total fishing mortality (Gilman et al., 2012a). In general, most RFMOs do not collect basic information in regional observer programs that is needed to understand ecological effects of bycatch, including quantity, weight, species, age classes, length frequency, disposition when released, and date and location caught (Kelleher, 2005; Gilman et al., 2012a).

Only 3 of the 13 RFMOs have regional observer program datasets of sufficient time series length to support most rigorous research applications (Gilman, 2011; Gilman et al., 2011a). Of the nine RFMOs with regional observer programs, three do not possess observer program datasets (Table 15c). Thus, of the 13 RFMOs, 7 lack observer program datasets either because Parties are not required to report observer data or otherwise because they do not have a regional observer program (Table 15b,c). The time series length of the six regional observer program datasets ranged from 1 to 33 years, with three of the RFMO datasets having very short time series ≤ 4 years, unsuitable for some research applications, and the other three RFMOs having relatively long time series ≥ 19 years, likely sufficient for most research applications (Table 15c). Furthermore, because 6 of the 13 RFMOs are lacking membership of one or more State or entity with fisheries under the RFMO's mandate (Table 15c), this limits the RFMOs' ability to effectively account for and manage bycatch in regional fisheries (FAO, 1995a [Article 7.1.5]; Small, 2005). Unlike data collection in regional observer programs, national observer datasets not a part of a regional program likely do not support pooling. Regional datasets, or pooled domestic datasets collected through standardized collection methods and standardized dataset formatting to enable their interoperability, provide larger sample sizes, which can achieve sufficiently long time series needed to determine if observed patterns are long-term trends or cyclical, short-term, serially correlated patterns, and provide broader spatial coverage across RFMO convention areas (Gilman, 2011).

4.2. Open Access to Regional Observer Program Datasets

Ten of the RFMOs had scores of 0% when assessed against criterion 2, open access to regional observer program datasets. While CCAMLR, ICCAT and WCPFC had scores of 40, 40 and 47, respectively (Table 14), only WCPFC provides access to amalgamated data records at $\leq 5^\circ$ cell spatial resolution and no RFMO provides open access to primary data (Table 15d). The WCPFC public domain dataset is inadequate for fundamental research applications due to a lack of critical fields, the amalgamation of certain fields such as combining non-target species into a single field, and pooling logbook and observer records without identifying sources for individual records.

While only three of the 13 RFMOs had regional observer program datasets with reasonably long time series, and while many RFMO observer datasets lack fields needed to effectively assess binding bycatch measures, Members may possess national observer program datasets of sufficient quality, including national datasets that predate datasets from relatively new regional programs. However, the standardization in data collection methods and format of datasets with a regional program enable pooling observer records from member fisheries, while national observer datasets, especially those that predate a regional program, likely do not. Pooling datasets provides larger sample sizes, which can achieve sufficiently long time series needed to determine if observed patterns are long-term trends or cyclical, short-term, serially correlated patterns, and provide broader spatial coverage across fishing grounds (Gilman, 2011; Gilman et al., 2011a).

Limiting access to research-grade regional observer program datasets with records on bycatch and discards precludes the collegial open access necessary for research, peer review of research employing these datasets, and replication to validate findings of studies. Summary statistics may be publically available, for example, in national annual reports and RFMO summaries of pooled datasets, however, these summaries are not replacements for primary, research-grade data needed for research applications, for example, on level 3 ecological risk assessments, on the

status and trends in discard levels and rates, and for stock assessments of bycatch and discard species. The CCRF calls for the regional pooling of fisheries data and making these datasets available, with the caveat that this be conducted in a manner consistent with applicable confidentiality requirements (FAO, 1995a [Article 7.4.7]). Methods, such as removing data records where a minimum number of unique vessels did not conduct fishing effort, adjusting each recorded position of fishing operations by several degrees, amalgamating data by 5° cell, and removing reference to individual vessels, can avoid disclosing the location of fishing effort, fishing gear and methods of individual vessels, and other information that may be captured in observer datasets that are considered commercially sensitive. Instead of employing such methods and making regional observer datasets openly available, RFMOs are not making research-grade data from regional observer programs available.

Due to the ocean basin-scale distributions of marine megafauna, and because megafauna bycatch occurs in multi-national fleets operating in domestic waters and on the high seas, there is a need for observer data collection over large spatial scales and the ability to access and pool the resulting datasets to support large temporal and spatial scale analyses (Gilman, 2011; Gilman et al., 2011a). Most research-quality fishery-dependent datasets, including RFMO regional observer program datasets, are not in the public domain. Fishery data collected from observer programs are often subject to legal confidentiality measures, and in some cases, for example, are required to be amalgamated or to reduce spatial resolution of geographic references prior to public disclosure to a degree that precludes most research applications. To support robust assessments of bycatch of highly migratory species in marine capture fisheries, there is a need for open access to regional observer program datasets in order to support broader research and validation, such as through publication of datasets to the Ocean Biogeographic Information System data portal and to data repositories such as the recently established Data Observation Network for Earth. Achieving open access will require addressing confidentiality restrictions and other general impediments to providing open access to research data (Arzberger et al., 2004; Gaikwad and Chavan, 2006; Roberts and Chavan, 2008; UNESCO, 2008). Furthermore, there is a need for the cataloguing of rich metadata of fishery-dependent datasets to: (i) enable discovery of relevant datasets; (ii) determine whether pooling individual datasets is merited, and (iii) determine how individual datasets can best be integrated. To provide the requisite information to determine if pooling of various databases is suitable, standards for metadata would benefit by capturing information on sampling effort, data collection methods, and estimates of positional error (Gilman et al., 2011a).

4.3. Ecological Risk Assessment

The mean score against criterion 3 was 26% \pm 17% σ , with a range of 0% to 75%, and with 9 of the 13 RFMOs scoring 25% against this criterion (Table 14). Most (11 of 13) of the RFMOs have conducted ecological risk assessment of the effects of fishing mortality on species subject to bycatch in one or more managed fishery. However, there has been limited assessment or accounting for broad community- and ecosystem-level risks from bycatch removals in RFMO-managed fisheries: only two RFMOs have conducted ecological risk assessments of the broader effects of bycatch mortality on community or ecosystem functions and structure (Table 15e). This global governance deficit is largely due to the limited state of understanding of broader community- and ecosystem-level effects from bycatch (Section 1.1), and a lack of agreed guidance on best practices for management authorities to monitor and account for these broader effects.

CCAMLR accounts for the effects of fishery removal levels and spatial location on ecosystem indicator species of dependent predator populations of the ecosystem regulated by Antarctic krill in developing conservation and management measures. Precautionary reference points are set for both prey and predator species so as to ensure that there are sufficient prey populations to sustain predator populations (Constable et al., 2000; CCAMLR, 2004, 2008a), more related to ecosystem effects from target stock removals than bycatch removals.

IATTC developed a model of the tropical eastern Pacific Ocean pelagic ecosystem to predict how managed pelagic fisheries (pelagic longline, pole-and-line, and purse seine) and climate

variability affect middle and upper trophic levels and to predict trophic cascades from pelagic fishery removals, including of bycatch species (IATTC, 2010e).

Ecological risk assessments conducted by RFMOs have generally focused on assessing effects of fisheries on species groups relatively vulnerable to overexploitation, including bycatch of seabirds, sea turtles, marine mammals and elasmobranchs, and have not accounted for broader, more complex and indirect effects of bycatch across facets of biodiversity, ranging from reducing genetic diversity of populations subject to bycatch fishing mortality, to altering ecosystem regulation or structure due to overexploitation of a bycatch species that is a keystone or foundation species, respectively, to sources of unobservable removals, including indirect, collateral mortalities (Gilman et al., 2011a, 2012a). RFMO governance of bycatch requires gradual improvements in knowledge to enable effective management of the ecological risks from direct and indirect effects of the mortality of bycatch species across manifestations of marine biodiversity. This is necessary to fully implement ecosystem-based management and a precautionary approach to fisheries management.

4.4. Conservation and Management Measures to Control Problematic Bycatch

The lowest variability in scores occurred for criterion 4 ($\pm 11 \sigma$, scores ranging from 0% to 36% with a mean of 17%) as a result of the 13 assessed RFMOs all having relatively low scores/large deficits in controlling problematic bycatch, ghost fishing, and discharge of catch, offal and spent bait (Fig. 1, Table 14). Of the five criteria, criterion 4 had the second-lowest mean score. Three of the 13 RFMOs have yet to adopt any binding measures on bycatch.

Of the three subcriteria, the mean score against 4A, measures to mitigate problematic bycatch, including discards, of vulnerable species and broad ecosystem consequences of bycatch removals, was highest (30%). Mean scores were relatively low for 4B (15%), measures to mitigate bycatch in derelict fishing gear, and 4C (8%), measures to mitigate unobservable mortalities from the discharge of catch, offal and spent bait during fishing operations at sea (Table 14). RFMOs thus have large deficits in adopting effective, binding conservation and management measures to address problematic bycatch, and especially large deficits in managing ghost fishing and discharges of organic material relative to the components covered by the other criteria. The low variability in scores indicates that there is somewhat consistent poor performance across the 13 RFMOs for this criterion.

RFMOs are not managing about two thirds of problematic bycatch of species and groups relatively vulnerable to overexploitation in fisheries under their jurisdiction. Binding conservation and management measures are in effect to address a mean of 37% (84 of ca. 226) of problematic bycatch of species vulnerable to overexploitation from bycatch mortality in fisheries managed by the 13 RFMOs, with large variability in the scores ($\pm 26\% \sigma$), ranging from 0% to 79% (Table 15f). Furthermore, none of the RFMOs have assessed or account for unobservable losses from ghost fishing or from discharges of discarded catch, offal from processed catch, and spent bait (Table 15g). Six RFMOs have adopted a binding measure related to governing ghost fishing, such as banning certain gear types with high ghost fishing efficiency and requiring gear marking. Only CCAMLR has a binding measure related to managing discharges (Table 15g). The substantial deficits in RFMO control measures for bycatch as documented here constitutes unregulated and hence IUU fishing (FAO, 2009b).

Most (77%, 19 of 83) of binding bycatch measures covered under criterion 4A lack quantitative, measurable performance standards (Table 15f). None of the binding measures related to ghost fishing and discharges of organic matter contain performance standards (Appendix 1). A binding measure that lacks measurable performance standards does not stipulate expected, target outcomes, e.g., explicitly stating a catch rate or level for a measure that requires employment of bycatch mitigation gear technology, or standards for indirect performance, such as minimum sink rates for terminal tackle to reduce seabird interactions (Gilman, 2011). In the absence of such measurable, quantifiable standards for the performance of RFMO bycatch measures, comparison of bycatch rates before vs. after mitigation measures, accounting for the influence of other factors with possibly significant effects on bycatch rates, can provide a measure of efficacy (Gilman, 2011; Gilman et al., 2012a). However, data deficiencies due to inadequate monitoring are often an

obstacle to implementing this approach at regional scales. A lack of performance standards, in combination with inadequate observer coverage in a large proportion of regionally managed fisheries and incomplete data collection hinders assessing measures' efficacy. This limits the basis to guide adaptive bycatch governance (Gilman, 2011).

A majority (62%) of the 13 RFMOs have an opt out provision, allowing members to not abide by binding measures (Table 15f). While available, limited information indicates that these opt out measures have been infrequently employed, this mechanism could reduce the effectiveness of regional conservation and management measures. Several RFMOs have adopted instruments on objection procedures that require parties who lodge objections to a binding measure to explain the reasons for their objection, and establish a formal process for the appointment of an expert panel to analyze the rationale of the objection (e.g., WCPFC [Article 20 (4, 6-9)], SEAFO [Article 23], NAFO [Articles XIV, XV]). While the efficacy of these new provisions on objection procedures has not been assessed, the purpose is to minimize unfounded objections and for objections with merit, adapt measures accordingly to address these issues (ICCAT, 2009d).

It was hypothesized that the larger the size of an RFMO's voting membership, the more difficult it is to adopt effective binding conservation and management measures. However, there was no apparent correlation here between number of RFMO Members and efficacy in governing bycatch, where the low R^2 value from the simple linear regression model indicates there is no linear relationship (Fig. 2). Other factors besides number of voting members therefore have a larger effect on performance of RFMO bycatch governance. However, RFMO decision-making, in particular by consensus, is hampered the larger the number of players at the table due to increased difficulty in achieving agreement (ICCAT, 2009d).

The assessment method employed for subcriterion 4A may overestimate deficits in mitigating bycatch problems because there are documented exceptions to the assumption that bycatch problems observed in one region are globally relevant (e.g., longline bycatch of seabirds in longline fisheries occurs primarily in higher latitudes, and sea turtles primarily in lower latitudes, Gilman, 2011). However, the subcriterion underestimates deficits in governance of broad ecosystem effects from bycatch removals. Subcriterion 4A's assessment method was intended to provide a comprehensive assessment of the proportion of bycatch problems that are subject to RFMO binding controls, however, due to deficits in knowledge of broad adverse consequences of bycatch losses on ecosystem processes and structure, the subcriterion provided a de facto assessment of controls of problematic bycatch of species and groups relatively vulnerable to overexploitation from bycatch mortality, and in some cases, controls of adverse habitat effects from fishing operations.

4.5. Surveillance and Enforcement

The RFMOs received the highest average score against criterion 5 (39%). Again there was relatively high variability in the 13 scores ($\pm 21\%$ σ), which ranged from 0% to 95% (Table 14), indicating that there is high inconstancy in RFMO performance of surveillance and enforcement. The 13 RFMOs employ 60% (30 of 50) of surveillance methods required to assess compliance of binding bycatch measures, with large variability in this element across the 13 RFMOs ($\pm 36\%$ σ), ranging from 0% to 100% (Table 15h). None of the 13 RFMOs met all of three of the following fundamental elements of effective surveillance and enforcement: (i) Members routinely report identified infractions, enforcement actions and the conclusions of these enforcement actions; (ii) the RFMO secretariat routinely makes information publicly available on detected infringements and enforcement outcomes; and (iii) detected infringements of binding bycatch measures regularly result in sanctions (Table 15h).

Using CCAMLR as an example, given its scoring highest against the full suite of bycatch governance criteria, a CCAMLR performance review panel concluded that it was not possible to make a quantitative assessment of the proportion of total detected infringements of CCAMLR measures that resulted in sanctions by the CCAMLR Contracting Parties due to incomplete and inconsistent reporting by the Parties of their imposed sanctions (CCAMLR, 2008a). The most current report of the CCAMLR Standing Committee on Implementation and Compliance, while identifying all identified infractions during the most current reporting period, did not include

information on the conclusion of enforcement actions taken in response to identified infractions from the most previous reporting period, nor did the report include information on the results of an assessment of compliance by Members (CCAMLR, 2011w).

To achieve compliance with bycatch control measures, RFMOs require effective surveillance and enforcement frameworks. In most cases, there is incomplete or no public reporting on surveillance and enforcement activities. Members do not routinely report surveillance effort, detection of infractions, and enforcement actions and outcomes. While required surveillance methods address the majority of methods required to assess compliance with binding bycatch measures, there remains a large 40% deficit of required surveillance methods, a lack of harmonization of domestic and regional inspection systems may limit efficacy, and information is not consistently reported to determine if required surveillance methods are in fact implemented by member States. RFMOs tend not to prescribe specific enforcement actions and information is not made public to determine if member States have developed requisite legal frameworks for prosecution. RFMOs also tend not to require specific penalties/sanctions when Members detect infringements of binding bycatch measures, and a lack of consistent reporting and transparency prevents a determination of whether sanctions provide a sufficient incentive for fisher compliance. Most RFMOs do have formal procedures in place to routinely assess the performance of surveillance and enforcement activities to support adaptive management (e.g., through mandated responsibility of an RFMO Compliance Committee), however, lack of reporting by member States compromises the efficacy of these compliance review processes. Furthermore, RFMO secretariats tend to lack the authority to impose sanctions against Members found to not be in compliance with RFMO requirements, including binding bycatch measures, and RFMO secretariats do not routinely report identified violations made by Member States or actions taken, if any, by the RFMO secretariat in response. Due to these deficits in RFMO surveillance and enforcement frameworks, including a prevalent lack of transparency, a culture of compliance appears to not exist for most RFMO communities.

4.6. Comparison with Results of Previous Performance Assessments

Of previous RFMO performance assessments (Section 1.4), two included criteria to assess governance of bycatch: Small (2005) and Cullis-Suzuki and Pauly (2010). Both studies employed sufficiently different criteria definitions from those employed here, and due to substantial changes in governance frameworks of some RFMOs since the previous studies were conducted, this limits the ability to compare consistency in findings between the current and past studies. Cullis-Suzuki and Pauly (2010) included a criterion assessing generally whether an RFMO considers bycatch, threatened species, habitats and ecological interactions, but not assessing performance in governing this subset of issues related to bycatch (Section 1.4) (Cullis-Suzuki and Pauly, 2010). Cullis-Suzuki and Pauly (2010) and the current study had consistent findings in finding highest scores for CCAMLR, IATTC, and WCPFC, in finding NASCO, NPAFC and GFCM to be at the lower end of scores, and in finding ICCAT, SEAFO and CCSBT to score somewhere in the middle of the 12 RFMOs. Findings were inconsistent for NAFO, IOTC, and NEAFC (Cullis-Suzuki and Pauly, 2010). The disparity between mean scores of the present study (25%) and that resulting from assessment against this one criterion related to bycatch that was included in the study by Cullis-Suzuki and Pauly (2010) (55%) suggests that an assessment of availability of information on bycatch, threatened species, habitats and trophic interactions is not a reliable indicator of the core elements of RFMO governance of bycatch, including discards, as assessed in the present study.

Small (2005) assessed performance against a criteria suite that included three criteria evaluating the efficacy of aspects of bycatch governance: commitment to reducing impact of fisheries on non-target species, bycatch data collection, and bycatch mitigation measures, each divided into numerous subcriteria (Small, 2005). Four possible scores of 0, 0.5, 0.75 or 1 were awarded for each subcriterion, representing performance of poor, fair, good and excellent, respectively (Small, 2005). One of six subcriteria under Small's (2005) criteria 'bycatch data collection', which assessed whether member States report data on bycatch for target and non-target fish, elasmobranchs, sea turtles, marine mammals and seabirds, could be expected to provide

similar assessment results as from the RFMO assessment against subcriterion 1A in this study, which included as part of the assessment consideration of what proportion of species relatively vulnerable to bycatch are included in regional observer data collection protocols. Small (2005) awarded mean scores, as percentages of maximum possible scores, of 97%, 27%, 87%, 33%, and 8% for CCAMLR, CCSBT, IATTC, ICCAT, and IOTC, respectively, while scores under criterion 1C here of these RFMOs were somewhat consistent: 84%, 42%, 65%, 36%, and 7%, respectively (Table 14). Small (2005) did not report information used as the basis for awarded scores. Small (2005) may have accounted for the reporting of bycatch data from all sources, including logbook and survey data, in addition to data from regional as well as national observer programs, based on IATTC having been awarded a score of 0.75 ('excellent') against the subcriterion on member State reporting bycatch data on seabirds, this despite there being no regional observer data collection in IATTC-managed fisheries in which seabird interactions are likely to occur (Appendix A1-4).

4.7. Opportunities for Coordinated RFMO Bycatch Governance

There are several currently untapped opportunities for inter-RFMO cooperation, which promise to improve RFMO efficacy in governing bycatch, including discards. For example, RFMOs could standardize data collection protocols and database formats to facilitate pooling across regions (Gilman, 2011; Gilman et al., 2011a). Coordinated RFMO governance could also entail standardizing/avoiding incompatibilities in gear technology and other conservation and management measures. This is necessary to avoid having the fishing industry be subject to conflicting requirements, which at a minimum might prove impractical for vessels that fish in multiple RFMO areas, and with more serious consequences, might cause deviation in employment of prescribed fishing gear and methods, compromising the effectiveness of bycatch mitigation best practices. For example, the first and second joint meetings of the five tuna RFMOs recognized benefits and called for consistency and compatibility in measures employed to manage marine capture fisheries, including bycatch mitigation measures and scientific data collection methods (Fisheries Agency of Japan, 2007; European Community, 2009). By working together, RFMOs could systematically select and govern high seas protected areas designated by RFMOs and other entities to establish a network of protected sites that optimizes ecological properties (representativeness, replication, ecological connectivity, size, and refugia) and administration (Gilman et al., 2011a). RFMOs could combine limited resources for research, monitoring (e.g., the Regional Fishery Bodies Secretariats Network's Fisheries Resource Monitoring System), surveillance (e.g., VMS) and enforcement. RFMOs could globally coordinate the implementation of measures to deter IUU fishing, such as through consolidated regional vessel lists, and harmonized catch documentation schemes, to address excess fishing capacity, and to manage stocks that overlap areas of multiple RFMOs (Fisheries Agency of Japan, 2007; Lodge et al., 2007; European Community, 2009; Gilman, 2011).

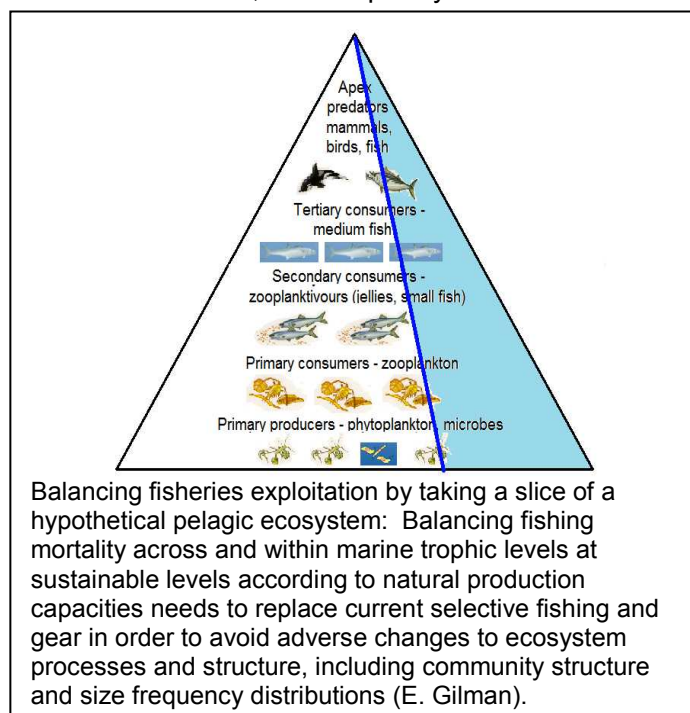
4.8. Meeting Objectives of Governing Bycatch, Including Discards

To achieve ecological and socioeconomic objectives of bycatch governance, as reviewed in Section 1.1.2, optimal bycatch governance will require that RFMOs:

- **Produce multispecies maximum sustainable yields, including for incidental market species:** To maintain exploitation rates and biomass of incidental market species within multispecies ecosystem-based biological reference points, as a prerequisite, RFMOs must collect data and account for all sources of bycatch removals, including from sources of unobservable fishing mortality (Gilman et al., 2012a), and for some species, improve knowledge of basic life history characteristics. In general, RFMOs have not conducted single-species stock assessments or developed biological reference points for most stocks of incidental retained bycatch, data on bycatch (retained, discarded and unobservable) removals are not accurately collected or reported, and for some species fundamental biological information is lacking (e.g., pelagic sharks, Musick et al., 2000; Stevens et al., 2000; Gilman et al., 2008a; Clarke and Harley, 2010; Clarke et al., 2010). RFMOs have yet to adopt binding measures to control fishing mortality for many bycatch species, and discussed below, there has been nominal progress in developing ecosystem-level multispecies models, indicators, reference points and control

measures (Lawton, 1999; Gislason et al., 2000). While fisheries exploitation rates have been effectively reduced in some ecosystems, exploitation rates in most systems, including from bycatch removals, remain substantially higher than those predicted to produce multispecies maximum sustainable yields and to achieve rebuilding of the one third of commercial fish stocks that are overexploited and depleted (Pace et al., 1999; Jackson et al., 2001; Pauly et al., 1998, 2002; Garcia and Grainger, 2005; Beddington et al., 2007; FAO, 2009d; Worm et al., 2009).

- Ensure sustainable bycatch fishing mortality of species groups relatively vulnerable to fisheries overexploitation, and rare, endemic, restricted-range and phylogenetically distinct species:** To avoid causing population declines and to permit rebuilding of species most vulnerable to fishing as a result of their life history characteristics and their susceptibility to capture in marine fisheries, including endangered and threatened species, and to ensure sustainable bycatch of rare, endemic, restricted-range and phylogenetically distinct species, RFMOs need to monitor all sources of fishery removals, and mitigate problematic bycatch, which may be best achieved by augmenting fishing and gear selectivity (e.g., FAO, 1999a,b, 2010b; Gilman, 2011). To prevent unsustainable bycatch removals of phylogenetically distinct species, in concept, RFMOs would identify species that are phylogenetically unique, include these in assessments of ecological risks from fishery interactions, and establish precautionary control rules for their exploitation rates. However, implementation is hampered because the evolutionary history (branching pattern of a phylogenetic tree and length of its branches) is not available for all taxonomic groups (Bininda-Emonds, 2004), and because there is no standardized way to compare the relative taxonomic distinctness of species from unrelated groups (Isaac et al., 2007).
- Estimate, account for and mitigate sources of unobservable fishing mortality:** There is a need to employ best practice methods to estimate levels of unobservable removals, account for these losses in ecosystem models, indicators and reference points, and adopt measures to mitigate sources of unobservable mortality (FAO, 2011a; Gilman et al., 2012a). This is necessary to contribute to avoiding the overexploitation of affected stocks/populations, mitigate broader adverse community- and ecosystem-level effects, reduce wastage, and sustain fishery resource productivity. Improvements in estimation methods are needed for some components of unobservable fishing mortality. While several methods have been developed to estimate pre-catch, post-release and ghost fishing levels and rates of losses, the complexity and indirect link between collateral, cumulative, and synergistic effects of fishing activities and mortalities has generally prevented the development of methods that provide accurate estimates of mortality levels and rates (ICES, 2005; Gilman et al., 2012a).
- Manage broad ecosystem-level effects of bycatch removals by balancing exploitation:** Addressing adverse effects of selective bycatch removals will require RFMO's to balance removals across and within trophic levels, between stocks and populations of a species, between age classes, sexes, and spatial locations, in some cases, by reducing fishing and gear selectivity (Hall, 1996; Zhou et al. 2010; Rochet et al., 2011; Garcia et al., 2012). Instead of fishing selectivity to reduce bycatch, including discards, diluted, balanced fishery removals has been



proposed as a more sustainable, ecosystem-based governance paradigm. In concept, this would preserve community structure and size-frequency distributions of species characteristic of unexploited conditions, accomplished by distributing fishing mortality across marine ecosystem components at sustainable levels according to natural production capacities (Hall, 1996; Garcia et al., 2012). It would be implemented via ecosystem-specific reference points and control rules (Conover and Munch, 2002; Pikitch et al., 2004; Birkeland and Dayton, 2005; Bundy et al., 2005; Fenberg and Roy, 2008; Rochet et al., 2011). In some regions, marine capture fisheries have fished through and down food webs, but typically at unsustainable levels, and still selectively fish within trophic levels (Casey and Meyers, 1998; Pauly et al., 1998; Stevens et al., 2000; Pauly and Palomares, 2005; Essington et al., 2006).² Distributing fishing mortality, including bycatch mortality, equivalently across facets of biodiversity, with sustainable fishing exploitation rates that are in proportion with species', stocks', populations', and trophic level's intrinsic capacity, is more likely to minimize change and loss across manifestations of marine biodiversity, including maintaining the integrity of trophic structure, species richness, and ecosystem structure and functioning, and sustaining ecosystem services – with predicted increased fisheries production (Bundy et al., 2005; Fenberg and Roy, 2008; Zhou et al., 2010). Primarily in developed countries where there are high discard rates due to markets only for a narrow range of species, balanced exploitation will also require developing or augmenting markets for currently non-utilized or underutilized species, sizes, and sexes (e.g., Clucas, 1997) so as to create demand for their supply at sustainable mortality rates, reduce wasteful discards, and address the logistics for handling and processing the mixture of species and sizes for these products (FAO, 1997; Hall et al., 2000). Otherwise, where resources for surveillance are adequate, retained but unwanted bycatch may be dumped following landing (Kelleher, 2005). Minimizing fisheries waste (i.e., discarded catch that is fit for human consumption or that is used as feed for aquaculture or animal industries) is mainly a socioeconomic issue (Section 1.1.2), although developing markets for currently discarded catch with concomitant increased retention could reduce fishing mortality of overexploited stocks, and contribute to achieving balanced exploitation. This recommended paradigm shift from selective to diluted fishing and gears at levels that are sustainable at an ecosystem-level has been proposed for at least 25 years (Caddy and Sharp, 1986; Hall, 1996), and while there has been recent international attention (Garcia et al., 2012), selectivity remains the entrenched prevailing governance approach. Counter to international guidance, and methods employed in previous RFMO assessments (Section 1.4), this study therefore has assessed the effectiveness of RFMO governance of bycatch in part by considering if control measures account for ecosystem-level effects from bycatch, which in some cases requires reducing the selectivity of fishing and gear.

- **Manage broad ecosystem-level effects of bycatch removals by developing ecosystem models and applying ecosystem-level indicators, reference points and control measures:** Single species stock assessments, exploiting stocks of principal market species at levels predicted to produce maximum sustainable yields (MSY), and in some cases, mitigating bycatch

² Since the inception of industrialized fishing, fisheries landings have progressively included a larger proportion of species of lower mean trophic levels. This has largely been due to the development of new markets for the lower-trophic-level species, where these lower trophic level species that were previously discarded are now being retained, or new fisheries targeting these lower-trophic-level species have developed, while catches of upper-trophic-level species continues (fishing through the food web) (Kelleher, 2005; Essington et al., 2006; Branch et al., 2010). To a lesser extent, in some regions, the cause of an increased proportion of landings being comprised of lower mean trophic levels was the sequential replacement of higher-value upper-trophic-level species with less valuable lower trophic-level species as the former are overexploited and depleted to economic extinction (fishing down the food web) (Casey and Meyers, 1998; Pauly et al., 1998; Pauly and Palomares, 2005; Essington et al., 2006; Branch et al., 2010). However, observations of nominal trends in mean trophic levels of reported landings may not reflect actual changes in absolute abundance and exploitation status of species at different trophic levels, as multiple environmental and socioeconomic factors influence nominal catch rates and landings in addition to changes in absolute abundance (de Mutsert et al., 2008; Branch et al., 2010; Sethi et al., 2010; Gilman et al., 2012b).

of species and groups determined to be vulnerable to overexploitation or otherwise are iconic species that draw public and political attention, and addressing direct adverse habitat effects from fishing, remain the prevailing basis for fisheries management (Mace, 2001; Pitcher et al., 2009; Hobday et al., 2011). Implementing single-species MSY fishing rates as an upper limit to all species of an ecosystem is predicted to alter trophic interactions, including the loss of top predators and single-species declines in spawning stock biomass (Mace, 2001; Walters et al., 2005; Hall et al., 2006). Effectively managing broad, ecosystem-level effects of bycatch removals requires moving from basing management on outputs from single-species stock assessments to multispecies ecosystem models that enable establishing rigorous ecosystem-level indicators, reference points and control rules (Lawton, 1999; Gislason et al., 2000; FAO, 2003a; Pikitch et al., 2004; Garcia and Cochrane, 2005; Jorgensen et al., 2007; Worm et al., 2009; Rochet et al., 2011). These ecosystem models will then enable managers to maintain bycatch exploitation rates within levels predicted to produce multispecies maximum sustainable yields and to achieve rebuilding and recovery of depleted stocks and of populations of endangered and threatened species (Pace et al., 1999; Jackson et al., 2001; Pauly et al., 1998, 2002; Garcia and Grainger, 2005; Beddington et al., 2007; FAO, 2009d; Worm et al., 2009).

Rigorous ecosystem models enable managers to account for how fisheries alter complex community and ecosystem functions, structure and services, including the sustainable production of fishery resources (FAO, 2003a; Pikitch et al., 2004; Bundy et al., 2005; Garcia and Cochrane, 2005; Jorgensen et al., 2007; Worm et al., 2009; Rochet et al., 2011). Ecosystem models need to account for effects of environmental variation, including from climatic drivers, account for food web processes, including the roles of keystone and foundation species and guilds in regulating ecosystem processes and structure, and consider effects of fishing operations on phylogenetically distinct species (Paine, 1980; Pikitch et al., 2004; Bascompte et al., 2005; Mangel and Levin, 2005; Gilman et al., 2011a). An understanding of all sources of fishing mortality, including direct stock-level effects of fishery removals on biomass and the selectivity of removals, in addition to knowledge of ecosystem structure and functioning, including connectivity between biogeochemical and physical processes, trophic linkages and the strength of interactions between predators and their prey and concomitant stability of the ecosystem in response to fishing pressure, and life histories of higher trophic level species, is fundamental information to produce reliable community and ecosystem models (Cox et al., 2002; deYoung et al., 2004; Bascompte et al., 2005).

Limited progress in moving to implementing an ecosystem approach to fisheries management is due, in part, to gaps in knowledge of individual ecosystems, where there are few general rules of community ecology applicable across ecosystems, and there is limited knowledge of pre-exploitation conditions with which to define reference points (Lawton, 1999; Gislason et al., 2000). Furthermore, there is typically deficient data on mortality of non-target species, making it difficult to develop accurate inputs to ecosystem models (Hall and Mainprize, 2005; Link, 2005). As fishery data collection protocols are improved to enable augmented accounting for all fishery removals, understanding the broad ecosystem-level effects from these removals, and as the knowledge of marine ecosystems improves, the scientific basis for RFMOs to move closer to implementing ecosystem-based fisheries management, including of bycatch removals, likewise will improve.

- **Implement cross-sectoral marine spatial planning:** Effective transition to implementation of ecosystem-based management requires moving from piecemeal management of human marine activities by sector, species, or issue to a cross-sectoral, spatially explicit (place-based) management framework that accounts for the multiple objectives of various stakeholders (Pikitch et al., 2004; Bianchi and Skjoldal, 2008; Crowder et al., 2008; Crowder and Norse, 2008; Douvre, 2008; Ehler and Douvre, 2009; Gilman et al., 2011b). With growing use of marine areas by a variety of commercial interests, there are increasingly complex risks from environmental impacts and conflicts in the use of marine areas and resources. The combined efforts by only RFMOs, including effectively governing bycatch, will not effectively address environmental impacts of a wide range of ocean industries. For example, in addition to bycatch mortality, sea

turtle, seabird and marine mammal populations are subject to a wide range of other anthropogenic mortality sources, including from pollution, breeding/nesting habitat degradation, poaching at coastal breeding/nesting colonies, reduced abundance of prey species, and incidental and intentional capture in fisheries, where effective governance of all mortality sources can be necessary to prevent or reverse declines (Au and Pitman, 1986; Chaloupka, 2007; Lewison and Crowder, 2007; Snover and Heppell, 2009; FAO, 2010b). There is therefore a growing need to coordinate cross-sectoral interactions among marine industries (Douvre, 2008; Gilman et al., 2011b). Marine spatial planning involves the holistic governance of all spatially explicit ocean activities, achieved by planning uses of marine areas to avoid and minimize conflicts, and sustain ecosystem functioning and services, comparable to land-use planning, but in the more complex three-dimensional ocean, with constantly-changing oceanographic and atmospheric conditions (Ardron et al., 2008; Crowder and Norse, 2008; Douvre, 2008; Ehler and Douvre, 2009; Interagency Ocean Policy Task Force, 2009; Gilman et al., 2011b). For instance, successful mitigation of the main global drivers of change and loss in marine biodiversity that adversely affect the fishing industry but are nominally caused by this industry sector, including marine pollution, climate change, habitat degradation, and the spread of invasive alien species, will require the effective collaboration of multiple industry sectors. For example, climate change, caused primarily by changes in the atmosphere's composition and alterations to land surfaces, is altering the distributions of some marine capture fishery principal market species (e.g., Perry et al., 2005; Tasker, 2008; Cheung et al., 2009). Or, for example, ocean acidification, another outcome of global climate change, threatens the long-term viability of several marine fisheries (Cheung et al., 2009; Cooley et al., 2009).

- **Manage bycatch removals of species with relatively large roles in regulating ecosystem structure and/or functioning:** As an essential part of implementing an ecosystem approach to fisheries, there is a need for improved understanding, monitoring, and management of bycatch removals of keystone and foundation species and guilds as a basic consideration of fisheries management (Caro and O'Doherty 1999; Ellison et al. 2005; Redding and Moores 2006; Jordan 2009; Branch et al. 2010; Gilman et al., 2011a). Ecosystem stability can be compromised by large declines in the biomass of keystones, and in fisheries that have unsustainably fished through and down food webs, through the subsequent overexploitation of fish and invertebrates of decreasing trophic levels, including foundation species (Pitcher, 1995; Casey and Myers, 1998; Pauly et al., 1998; Stevens et al., 2000; Friedlander and DeMartini, 2002; Christensen et al., 2003; Bellwood et al., 2004; Essington et al., 2006; Cheung et al., 2007; Gilman et al., 2011a, 2012b). However, for some ecosystems, there is insufficient understanding of interspecific interactions, the roles of constituent species of each community, links between trophic levels, and factors predominant in regulating some ecosystems, including feedback mechanisms, as well as functional links between ecosystems to enable robust quantitative ranking of individual species based on their importance in regulating and maintaining ecosystems (Snaithe and Beazley, 2002; Mumby et al., 2004; Frederiksen et al., 2006; Jordan, 2009; Gilman et al., 2011a).
- **Avoid unintended adverse consequences of discard control measures:** Measures can effectively reduce incentives for discarding, addressing social concerns over wastage and economic inefficiency, contributing to rebuilding overexploited stocks by incentivizing vessel operators to avoid catching these species, and mitigating adverse ecological consequences from discarding offal, bait, and dead catch (Section 1.1.2). However, fishery-specific assessment is required to avoid unintended adverse ecological and socioeconomic effects of individual input and output controls designed to minimize discards. Efficacy of discard bans may require broad fishing industry support, flexibility in output controls, and/or extensive resources for surveillance and enforcement (Baulch and Pascoe, 1992; Turner, 1996; Kaufmann et al., 1999; Arnason, 2002; Hall et al., 2000; Peacey, 2003; Poos et al., 2010). Measures that reduce revenue to fishers for species/sizes subject to a discard ban can effectively increase the incentive to reduce catch rates of overexploited stocks or vulnerable species (e.g., Hall and Mainprize, 2005). Provisions for overcatch, quota substitution, and species-based quotas by grades, have

effectively reduced incentives for discarding in some ITQ fisheries (Arnason, 1994, 2002; Peacey, 2003; Iceland Ministry of Fisheries, 2011).

- **Manage the allocation of fishery resources subject to bycatch through measures that comply with scientific recommendations on exploitation rates:** Socioeconomic conflicts over the allocation of fishery resources that occur when reductions in exploitation rates are required can result in the adoption of control measures that deviate from rigorous scientific recommendations. This can prevent rebuilding, and in some cases contribute to incentives for overcapacity, to the detriment of all competing interests for the increasingly shrinking resource. Issues over the allocation of bigeye tuna between coastal and distant water fishing nations, and between purse seine fisheries where juvenile bigeye is a bycatch species in sets on FADs and pelagic longline fisheries where adult age classes of bigeye are a target species, provides a relevant example (Grafton et al., 2006; Kompas and Che, 2006; Langley and Hampton, 2006; Paris and Grafton, 2006; Sumaila and Bailey, 2011). Thus, in managing issues over the allocation of fishery resources subject to bycatch, RFMOs need to ensure that control measures meet scientific recommendations. This objective might be achieved through instituting rights-based fisheries management mechanisms (Scott, 2000; Grafton et al., 2006; Allen et al., 2010), however, with due consideration of the potential reduction in competitiveness of smaller companies (Table 1).

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Appendix 1

Individual RFMO Assessment Results



- A1.1. Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)
- A1.2. Commission for the Conservation of Southern Bluefin Tuna (CCSBT)
- A1.3. General Fisheries Commission for the Mediterranean (GFCM)
- A1.4. Inter-American Tropical Tuna Commission (IATTC)
- A1.5. International Commission for the Conservation of Atlantic Tunas (ICCAT)
- A1.6. Indian Ocean Tuna Commission (IOTC)
- A1.7. Northwest Atlantic Fisheries Organization (NAFO)
- A1.8. North Atlantic Salmon Conservation Organization (NASCO)
- A1.9. North East Atlantic Fisheries Commission (NEAFC)
- A1.10. North Pacific Anadromous Fish Commission (NPAFC)
- A1.11. Regional Commission for Fisheries (RECOFI)
- A1.12. South East Atlantic Fisheries Organization (SEAFO)
- A1.13. Western and Central Pacific Fisheries Commission (WCPFC)

A1.1. Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)

SUMMARY	
Criteria Suite Scores	
Overall	58 (± 10 SD of the mean)% ¹
Criterion 1. Data Collection	90% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	88%
Criterion 1B. Regional Observer Coverage Rates	100%
Criterion 1C. Regional Observer Programme Dataset Quality	82%
Criterion 2. Open Access to Regional Observer Programme Datasets	40%
Criterion 3. Ecological Risk Assessment	75%
Criterion 4. Conservation and Management Measures	36% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	67%
Criterion 4B. Conservation and Management Measures to Govern Bycatch in Lost, Abandoned and Discarded Gear	21%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	21%
Criterion 5. Surveillance and Enforcement	50%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The Convention on the Conservation of Antarctic Marine Living Resources (CAMLR Convention) came into force in 1982, pursuant to Article IX of the Antarctic Treaty, and established the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) (CCAMLR, 2012b). The Antarctic Treaty entered into force in 1961; Article IX of the Antarctic Treaty allows Parties with consultative status to take measures regarding the preservation and conservation of living resources in Antarctica (CCAMLR, 2008a). The CAMLR Convention remains an integral part of the Antarctic Treaty System (CCAMLR, 2008a). The CAMLR Convention's primary objective is the conservation of marine living resources with the understanding that conservation includes rational use (CCAMLR, 2008a). CCAMLR was established to address concerns that an increase in krill catches in the Southern Ocean could adversely affect populations of krill, seabirds, seals, fish and other marine life that depend on krill as their main source of food (CCAMLR, 2012b).

MEMBERSHIP

There are 25 CCAMLR Members: Argentina, Australia, Belgium, Brazil, Chile, China, European Union, France, Germany, India, Italy, Japan, Republic of Korea, Namibia, New Zealand, Norway, Poland, Russia, South Africa, Spain, Sweden, Ukraine, United Kingdom, United States of America, and Uruguay (CCAMLR, 2012a).

Ten States that have acceded to the CAMLR Convention but are not Commission Members: Bulgaria, Canada, Cook Islands, Finland, Greece, Mauritius, Netherlands, Pakistan, Peru and Vanuatu (CCAMLR, 2012a).

MANAGED SPECIES AND FISHERIES

The CCAMLR convention applies to the Antarctic marine living resources defined by the convention as, “the populations of finfish, molluscs, crustaceans, and all other species of living organisms, including birds, found south of the Antarctic Convergence,” (CCAMLR, 1982). The Convention excludes coverage of whales and seals, as these are the subject of the International Convention for the Regulation of Whaling and the Convention for the Conservation of Antarctic Seals (CCAMLR, 2012b).

There are four categories of CCAMLR-regulated fisheries: (i) trawl (pelagic, mid-water and demersal) for icefish (*Chamsocephalus gunnari*) and Patagonian toothfish (*Dissostichus eleginoides*); (ii) trawl for Antarctic krill (*Euphausia superba*); (iii) pot for toothfish; and (iv) demersal longline for toothfish (Patagonian toothfish, *D. eleginoides* and Antarctic toothfish, *D. mawsoni*) (CCAMLR, 2012c; Eric Appleyard, CCAMLR Secretariat, personal communication, 10 May 2012). During the 2010/11 fishing season, CCAMLR Members reported catches of target species of krill, toothfish and icefish (CCAMLR, 2011w). There had previously been a CCAMLR-managed pot fishery for crabs (*Paralomis* spp.) and a jig fishery for squid (*Martialia hyadesi*) but these are no longer active (CCAMLR, 2012c,w). During the 2010/11 fishing season, there were no active CCAMLR-managed fisheries targeting crabs or squid, and no notification by Members to fish for these species in the 2011/12 fishing season (CCAMLR, 2011w).

A 2008 CCAMLR Performance Review identified the following species as retained bycatch in CCAMLR-managed fisheries: Antarctic krill, mackerel icefish (*Chamsocephalus gunnari*), other species of icefish (*Channichthys rhinoceratus*, *Chaenocephalus aceratus* and *Pseudochaenichthys georgianus*), two species of toothfish (*Dissostichus eleginoides* and *D. mawsoni*), species of rockfish (*Notothenia rossii*, *Gobionotothen gibberifrons*, *Lepidonotothen squamifrons* and *Patagonotothen guntheri*), whiptails (*Macrourus* spp.), crabs and squid (CCAMLR, 2008a).

The review identified discarded bycatch species in CCAMLR-managed fisheries as seabirds, seals, skates, rays, sharks, a large number of other fish species and a large number of invertebrate species (CCAMLR, 2008a). Dependent species that are not necessarily caught but that could be indirectly affected by CCAMLR-managed fisheries were identified as marine mammals and many of the seabird and fish species that are taken as bycatch (CCAMLR, 2008a).

CCAMLR defines “new, exploratory or developing fisheries” as those where there is an assessment based on preliminary information and/or information from similar stocks that is sufficient to establish a precautionary catch limit but that is not necessarily sufficient to estimate stock size and stock status directly (CCAMLR, 2008a, 2010a, 2011b). Fisheries for krill in all areas in which they are fished, and for toothfish in some of the areas in which they are fished are categorized as exploratory or developing fisheries (CCAMLR, 2008a). Despite being classified as exploratory, some toothfish fisheries target stocks that have undergone rigorous stock assessments (CCAMLR, 2008a).

CCAMLR defines “established fisheries” as those that have been in progress for a number of years and for which assessments are available that are sufficient to directly estimate stock size, stock status and the catches consistent with achieving management objectives (CCAMLR, 2008a). Mackerel icefish and some of the toothfish fisheries are classified as established fisheries (CCAMLR, 2008a).

Table A1.1-1. Assessment of CCAMLR regional observer programme data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are included in CCAMLR's mandate.	1
Data for $\geq 75\%$ of documented vulnerable bycatch species are intended to be collected in fisheries with regional observer coverage.	3
Information on the number and/or weight of at least 1 documented vulnerable bycatch species is intended to be routinely collected by regional observers.	1
$\geq 75\%$ of the items of information needed to assess performance standards of relevant binding conservation and management measures are intended to be collected by regional observers.	3
Information on fishing effort is intended to be routinely collected for fisheries with regional observer coverage.	1
Date and location of fishing operations are intended to be routinely captured by regional observers.	1
Information on whether catch is retained or discarded is intended to be routinely captured by regional observers for $\geq 75\%$ of documented vulnerable bycatch species/groups.	3
Data records are intended to be to the species-level for $\geq 75\%$ of documented vulnerable bycatch species in fisheries with regional observer coverage.	3
Information on length or other proxy for age class is intended to be collected for $\geq 50\%$ of identified vulnerable bycatch species/groups.	3
Information on the disposition of discards (e.g., alive vs. dead, and possibly degree of injury) is intended to be collected for 56% of identified vulnerable bycatch species/groups.	2
For longline toothfish fisheries (the one CCAMLR-managed hook-and-line fishery, which has 100% regional observer coverage), information on gear attached to individuals of vulnerable species that are discarded alive is intended to be routinely collected for 25% of these species groups.	1

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

Yes, Article II.3(b) and (c) of the CAMLR Convention call for the maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources and the restoration of depleted populations to levels that ensure stable recruitment (CCAMLR, 2008a). The CAMLR Convention, Article II, also includes provisions calling for an ecosystem approach and adopting the precautionary principle, calling for the prevention of changes or minimisation of the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades, with the aim of making possible the sustained conservation of Antarctic marine living resources (CCAMLR, 2008a). In summary, CCAMLR's broad mandate is to:

- (i) Ensure that ecological relationships are maintained among harvested, dependent and associated species (which encompasses a very large number of species and arguably most species in the Convention Area);
 - (ii) Ensure that direct and indirect changes due to fishing are potentially reversible within 20–30 years (which implies the changes are not large, especially for low- productivity species);
 - (iii) Take into account environmental changes.
- In fisheries required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

All fisheries that are required to have scientific observer coverage are subject to observer data collection protocols that include capturing information on bycatch species that are relatively vulnerable to overexploitation. As described in the response to the third bullet under Criterion 1B, CCAMLR requires 100% onboard scientific observer coverage of all longline, trawl finfish, and pot finfish fisheries, and $\geq 50\%$ coverage of trawl krill vessels (CCAMLR, 2011b,v,w).

CCAMLR observer 'logbook' forms for each CCAMLR-managed fishery requires observers to record the number and weight of retained and discarded bycatch for a large number of species and groups, including species and groups of seabirds, marine mammals, Vulnerable Marine Ecosystem (VME) indicator species, finfish (including sharks and relatives), and other invertebrates (CCAMLR, 2008f, 2012f,g,h,i).

The CCAMLR *Scientific Observers Manual* describes data collection protocols intended to be carried out by CCAMLR scientific observers (CCAMLR, 2011y). There is a CCAMLR observer *Cruise Report* form to be used for all six CCAMLR-managed fisheries (longline, trawl for both finfish and krill, jig, and pot for both crab and finfish fisheries) (CCAMLR, 2012e), and individual electronic logbook forms for each managed fishery (CCAMLR, 2008f, 2012f,g,h,i).

- Does the RFMO's data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected?

Yes, the CCAMLR observer logbook forms call for recording both the number and weight of retained and discarded catch during 'tally' sampling periods (an observed subset of the catch during the trip) (2008f, 2012f,g,h,i). The form for trawl finfish fisheries includes the caveat that observers should record the number retained/discarded "if possible" (CCAMLR, 2012g).

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).

The minimum data requirements to assess the performance of CCAMLR CMs, collated from Tables A1.1-7, 9, and 11 (Sub-criteria 4A-C), are:

- Timing of initiating and ending setting operations, for longline vessels not exempt from night setting;
- Line sink rate (results of TDR or bottle test) for longline vessels seeking exemption from night setting;

- Number of seabirds caught by longline vessels targeting *Dissostichus* spp. in Subarea 48.4 and by trawl fishery for *Champscephalus gunnari* in Subarea 48.3;
 - Offal management practices of longline and trawl vessels;
 - Bird exclusion devices employed during hauling for longline vessels operating in specified areas of the Convention Area where these devices are required;
 - Trawl vessel presence/absence of net monitor cables and net mesh size;
 - Trawl vessel method for deck lighting (trawl vessels are required to arrange the location and level of lighting so as to minimise the illumination directed out of the vessel);
 - Trawl vessel practices to remove fish tangled in the net;
 - Trawl vessel practices to minimise the time the net is at or near the surface;
 - Use of net binding by trawl vessels targeting *Champscephalus gunnari* in Subarea 48.3;
 - Longline and trawl vessel location;
 - Shark release practices by vessels in all CCAMLR-managed fisheries;
 - Crab handling/release practices by longline *D. eleginoides* vessels in Subarea 48.3;
 - Use of prohibited deep-water gillnets and trammel nets;
 - Retained and discarded catch by individual haul;
 - Marking of marker buoys and other floating gear;
 - Vessel discarding practices of gear, catch, offal and spent bait when south of 60°S;
 - Geo-spatial location and date of fishing operations by vessels in all CCAMLR-managed fisheries;
 - List of vessels authorized to fish in the CCAMLR Convention Area.
- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected in the regional observer programme according to the RFMO's data collection protocols?

A crosscheck between information needed to assess performance of binding bycatch CCAMLR conservation measures and observer data collection protocols found that observers are tasked with data collection protocols that address all information needed to assess performance of bycatch CMs.

The CCAMLR *Scientific Observer Cruise Report* form, which is to be used for all CCAMLR-managed fisheries, includes a section for observers to record information on gear weighting design for longliners (amount of weight and distance between weights), streamer line details used in longline and trawl fisheries during setting, streamer line details during longline hauling, details of all other seabird mitigation devices used on trawl vessels, and offal discharge practices on longliners and trawlers (CCAMLR, 2012e). The Cruise Report form also includes a section for observers to record information on marine mammal bycatch mitigation measures employed including a trotline cetacean avoidance device (trotline gear is similar to longline), and a section for recording information on incidences discarding and loss of fishing gear (CCAMLR, 2012e).

The observer logbook form for demersal longliners also calls for observer collection of data on longline gear weighting design, deck lighting during setting, streamer line description, bird scaring device used during hauling, seabird abundance by species during setting, offal discard practices during setting and hauling, gear loss and discards, and trotline cetacean avoidance device (CCAMLR, 2012f). The logbook form further requires observer records of seabird activity for vessels that set at day, results of TDR or bottle test (to determine gear sink rate), information on handling and fate of caught skates (e.g., retained, discarded after landing, escaped at the surface, disposition upon

discarding, hooks removed before release for majority of skates), and specific protocols for quantifying bycatch rates of VME indicator organisms (CCAMLR, 2012f). CCAMLR defines VMEs, as they pertain to the CCAMLR Convention Area, as including seamounts, hydrothermal vents, cold water corals and sponge fields (CCAMLR, 2010c).

Similarly, the observer logbook forms for trawl finfish and krill fisheries call for observer collection of data on gear design, vessel lighting, offal discard practices during shooting and hauling, gear loss and discards, information on handling and fate of caught skates and rays, and seabird interactions with trawl warps (CCAMLR, 2012g,h).

The observer logbook form for pot fisheries calls for observer collection of data on gear design, gear loss and discards, and information on handling and fate of caught skates and rays (CCAMLR, 2012i).

The observer logbook form for jig fisheries calls for observer collection of data on gear design, and gear loss and discards (CCAMLR, 2012f).

While outside the scope of the assessment under this criterion, there are two categories of information needed to assess CM performance that are not met for vessels participating in CCAMLR-managed fisheries that lack an onboard observer. As summarized under the third bullet of Criterion 1B, there is partial ($\geq 50\%$) observer coverage of trawl krill fisheries, and 100% coverage of all other (longline, trawl, and pot finfish) fisheries. There were no active jig squid or pot crab fishing vessels in the 2010/11 fishing season (CCAMLR, 2011w). The gaps in data collection for unobserved fishing vessels are:

- Retained and discarded catch by haul and date for CCAMLR-managed fisheries lacking onboard observer coverage (currently a subset of trawl krill vessels).
 - Seven fishing practices (offal management practices; discarding of gear; discarding of catch, offal and spent bait when south of 60°S; deck lighting; practices to remove fish tangled in the net; practices to minimise the time the net is at or near the surface; and shark release practices) by trawl krill vessels lacking onboard observers.
- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?

Yes, all bycatch information required to be collected by CCAMLR CMs, as summarized in Tables A1.1-7, 9, and 11 (Sub-criteria 4A-C), is intended to be collected by CCAMLR observers.

Related to the quality of observer data collection, CCAMLR has agreed to develop a CCAMLR Observer Training Accreditation Scheme (COTPAS) (CCAMLR, 2011aa [Paragraph 7.19; SC-CAMLR-XXX/8]).

- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?

Yes, the CCAMLR *Scientific Observer Cruise Report* form, which is to be used for all CCAMLR-managed fisheries, calls for observers to collect information on fishing effort (CCAMLR, 2012e). Individual observer logbook forms also require the collection of information on fishing effort (CCAMLR, 2008f, 2012f,g,h,i).

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely

by observers of the regional observer programme?

CCAMLR observers are intended to collect information on whether bycatch is retained or discarded for all of the bycatch species in observed CCAMLR-managed fisheries that are understood to be relatively vulnerable to population declines, as summarized in the fourth bullet of Criterion 4A.

The observer logbook forms call for the collection of data on the number and weight of retained and discarded bycatch species and the fate of discards (e.g., dead, injured, alive not injured for seabirds and marine mammals) for numerous species, including seabirds, marine mammals, finfish (including skates, rays, and other elasmobranchs), VME indicator species, and other invertebrates (CCAMLR, 2008f, 2012f,g,h,i).

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

Yes, the CCAMLR observer logbook forms require observers to record the date and location of individual fishing operations (i.e., date/time/location of start and end of sets and hauls / jig drifts) (CCAMLR, 2008f, 2012f,g,h,i).

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to record at the species level?

Observer logbook forms allow for observations at species level, however, codes allow for the use of higher taxonomic levels if the observer requires their use (CCAMLR, 2008f, 2012f,g,h,i).

According to the 2008 CCAMLR Performance Review, for some retained bycatch species, scientific observers have difficulty recording at the species level due to unresolved taxonomic definitions and difficulty in distinguishing between certain species (CCAMLR, 2008a).

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is intended to be routinely collected by regional observers that provides a proxy for age class, identify the measurement method.

Information on length and proxies is intended to be collected by regional observers for all bycatch species relatively vulnerable to overexploitation. The CCAMLR *Scientific Observer Cruise Report* form, which is to be used for all CCAMLR-managed fisheries, includes a section for observers to record information on the length, weight, maturity, and otoliths (CCAMLR, 2012e). Individual observer logbook forms also call for the recording of information on length of specified dimensions of organisms, weight, gonad weight, and sex and maturity stage, to be collected for a sampled subset of the observed catch (e.g., 35 organisms per set in pot fisheries) (CCAMLR, 2008f, 2012f,g,h,i).

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

The disposition of discards of 9 of 16 bycatch species/groups relatively vulnerable to population declines are intended to be collected by regional observers.

There are 16 bycatch species/groups identified as being relatively vulnerable to population declines from fishery removals, summarized in the fourth bullet of criterion 4A. The CCAMLR *Scientific Observer Cruise Report* form, which is to be used for all CCAMLR-managed fisheries, requires observers to record information on the disposition of all caught seabirds and marine mammals (CCAMLR, 2012e). The logbook forms for longline, pot and jig vessels call for observers to capture the disposition of all identified discard species (CCAMLR, 2008f, 2012f,i). The logbook form for observers on trawl finfish vessels calls for capturing the disposition of discards of seabirds, marine mammals, skates and rays, but not for other bycatch species (CCAMLR, 2012g). The logbook form for trawl krill vessels calls for observers to record the disposition of discarded seabirds and marine mammals, but not other bycatch species (CCAMLR, 2012h). Thus, observers are not intended to capture the disposition of discards of 7 of 16 bycatch species/groups relatively vulnerable to population declines from fishery removals:

Observers are not tasked to record the fate of discards of the following species/groups in trawl finfish fisheries : finfish of overexploited stocks, crabs, and species of vulnerable benthic ecosystems (including VME indicator species). There is an expectation of 0% survival for sessile benthos (VME) species once they reach the surface (Antony Miller, CCAMLR Secretariat, personal communication, 11 May 2012).

Observers are not tasked to record the fate of discards of the following species/groups in trawl krill fisheries : finfish of overexploited stocks, crabs, elasmobranchs, and species of vulnerable benthic ecosystems (including VME indicator species).

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

Information on terminal tackle remaining attached upon release is intended to be collected by CCAMLR observers for 1 of 4 of bycatch species groups identified as vulnerable to overexploitation in CCAMLR demersal longline fisheries. The observer logbook form for use on demersal longline vessels calls for CCAMLR observers to record the number of skates and rays cut off at the surface still retaining the hook and snood (branchline) (CCAMLR, 2012e,f). As summarized in the fourth bullet of Criterion 4A, CCAMLR demersal longline fisheries may have problematic bycatch of finfish of overexploited stocks, elasmobranchs, seabirds, cetaceans, and species of vulnerable benthic ecosystems (VMEs). However, VME species are not considered as having the potential to retain terminal longline tackle upon discarding: CCAMLR 'VME indicator organism', listed in the CCAMLR VME Taxa Classification Guide, include marine invertebrate taxa, which would likely be entangled in line and not hooked, and would require disentanglement to be released (CCAMLR, 2010d), and there is an expectation of 0% post-release survival rate of VME species, as stated above.

Criterion 1B. Regional Observer Coverage Rates

Score: 11 of 11 possible points, 100%.

Table A1.1-2 provides details on the assessment outcome for criterion 1B.

Table A1.1-2. Assessment of CCAMLR onboard observer coverage rates to monitor discards and retained and transshipped bycatch.

Factor	Points for positive response
All active CCAMLR-managed fisheries have $\geq 5\%$ regional onboard observer coverage.	5
The RFMO's scientific body has recommended regional onboard observer coverage rates for each managed active fishery, and the regional onboard observer coverage rates of active fisheries meet scientific advice for $\geq 75\%$ of managed fisheries.	4
There is international exchange of observers in the regional onboard observer programme - CCAMLR uses national observers who are exchanged under a bilateral agreement with the receiving State.	2

Information used for assessment:

- What recommendations on regional observer coverage rates have the RFMO's scientific body or the Commission made for fisheries under the RFMO's mandate?

The Scientific Committee recommended that, in order to determine the requisite observer coverage rate for krill fisheries, "to deliver adequate data for its assessments of the impact of the krill fishery on the ecosystem, an initial comprehensive and systematic approach to observer coverage, such as a 100% observer coverage on krill vessels for a period of two fishing seasons," be implemented (CCAMLR, 2011v). CCAMLR's *Scheme of International Scientific Observation* calls for 100% scientific observer coverage of vessels in fisheries targeting finfish (CCAMLR, 2011w).

- Does a regional observer programme exist?

Yes, there is a regional observer programme, under CCAMLR's Scheme of International Scientific Observation (CCAMLR, 2011w).

- What are regional onboard observer coverage rates in each active fishery managed by the RFMO?

Four active CCAMLR-managed fisheries of trawl finfish, trawl krill, pot finfish and demersal longline have 100%, 50%, 100% and 100% onboard regional observer coverage, respectively.

CCAMLR requires 100% onboard scientific observer coverage of all longline, trawl and pot finfish fisheries and pot crab fisheries (in some cases a second scientific observer is recommended "where possible" or otherwise is required); and current target minimum coverage rate of 50% of vessels operating in the krill fishery, increasing to 100% coverage over a two-year period (CCAMLR, 2010c, 2011h,i,l,m,n,o,p,q,r,s,t). All exploratory fisheries are required to have a regional scientific observer onboard (CCAMLR, 2011b).

CCAMLR scientific observers were deployed on all finfish-targeting vessels in the 2010/11 fishing season (CCAMLR, 2011w). During the 2010/11 fishing season, there were no active CCAMLR-managed fisheries targeting crabs or squid, and no notification by Members to fish for these species in the 2011/12 fishing season (CCAMLR, 2011w).

Until recently, CCAMLR had not require regional observer coverage of krill fisheries, in conflict with the CCAMLR Scientific Committee recommendations

(CCAMLR, 2008a). A target coverage rate of no less than 50% of vessels in krill fisheries is in effect for the 2011-2012 season, and all vessels are to be observed at least once every two fishing seasons, with an aim to increase the rate to 100% vessel coverage (CCAMLR, 2011v; Eric Appleyard, CCAMLR Secretariat, personal communication, 4 August 2011). Of the krill vessels with a scientific observer, at least 20% of hauls are to be observed (CCAMLR, 2011v).

Each vessel participating in exploratory fisheries for Antarctic krill during the 2011/12 season are required to have one observer appointed in accordance with the CCAMLR Scheme of International Scientific Observation and, where possible, one additional scientific observer, on board throughout all fishing activities within the fishing season (CCAMLR, 2011u).

- If there have been recommendations for onboard observer coverage rates by the RFMO’s scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body’s recommendations? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

The recommended observer coverage rates by the CCAMLR Scientific Committee are being met, as of the most current reported fishing season.

- For each fishery under the RFMO’s mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

Yes, CCAMLR uses international observers who are exchanged under a bilateral agreement between the Designating State (deploying the observer) and the Receiving State (CCAMLR, 2008a).

Criterion 1C. Regional Observer Programme Dataset Quality

Score: 9 of 11 possible points, 82%.

Table A1.1-3 provides details on the assessment outcome for criterion 1C.

Table A1.1-3. Assessment of CCAMLR observer programme data quality.

Factor	Points for positive response
A regional observer programme database with records of bycatch exists.	1
A CCAMLR Secretariat observer programme database is comprised of records pooled from observed national fisheries.	1
The regional observer programme dataset is >15 years long.	3
Scientific observer coverage of krill fisheries may not be balanced across seasons with minor or no gaps in seasonal coverage.	0

Scientific observer coverage of krill fisheries may not be spatially balanced across fishing grounds with minor or no gaps in spatial coverage.	0
All countries with fisheries under CCAMLR's mandate are Members or Cooperating Non-Members.	1
The CCAMLR SCIC most current report did not identify lack of compliance by any Convention Parties with regional observer coverage and reporting requirements, suggesting that $\geq 90\%$ of Members submitted data to the regional programme in each of the previous three years, or for the full duration of the regional observer programme, whichever period is shorter.	3

Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include records on bycatch?

Yes, CCAMLR has established an observer programme database and mandates observers to collect records on bycatch (CCAMLR, 2011y).

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

The CCAMLR Secretariat Data Centre is the custodian of and manages a pooled, centralized repository of data records collected through the Scheme of International Scientific Observation (CCAMLR, 2012d). Observer data are submitted to the CCAMLR Secretariat electronically (CCAMLR, 2012d), using standardized fishery-specific CCAMLR observer logbook forms completed by observers, submitted via national technical coordinators to the CCAMLR Secretariat (CCAMLR, 2008f, 2011y, 2012f,g,h,i).

- What is the length in years of the regional observer programme dataset?

Ca. 20 years: The Commission adopted a Scheme of International Scientific Observation at its 1992 Meeting, and was initiated for the 1992-3 fishing season (CCAMLR, 2011y).

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

The three active CCAMLR-managed finfish fisheries have 100% observer coverage and thus have even coverage across seasons. It is unclear if the krill fishery, with ca. 50% observer coverage, has even seasonal coverage. The CCAMLR *Scientific Observers Manual* does not address the temporal distribution of coverage of observed vessels (CCAMLR, 2011y).

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

Consistent with the response to the previous bullet, the CCAMLR-managed finfish fisheries with 100% onboard scientific observer coverage achieve balanced coverage spatially across fishing grounds, however, it is unclear if observer coverage of the krill fishery is likewise balanced spatially.

- Which countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members?

The 2008 Performance Review did not identify countries with CCAMLR-managed fisheries operating in the CCAMLR Convention Area that are not Convention Parties (CCAMLR, 2008a).

There are ten States that have acceded to the CAMLR Convention but are not Commission Members, which may operate fisheries in the Convention Area (CCAMLR, 2008a, 2012b). These acceding States are not party to CCAMLR decision-making and are not responsible for contributing to the Commission budget. However, both Members and acceding States (collectively referred to as Convention Parties) are bound by the obligations of relevant CCAMLR conservation measures (CCAMLR, 2008a).

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

No, there are no vessel classes in CCAMLR-managed fisheries that are required to have observer coverage that are exempt from participating in the Scheme of International Scientific Observation (CCAMLR, 2010c, 2011h,i,l,m,n,o,p,q,r,s,t).

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

The CCAMLR SCIC most current report did not identify lack of compliance by any Convention Parties with regional observer coverage and reporting requirements, however the SCIC report did not systematically report on detected compliance violations; i.e., the lack of CCAMLR reporting on lack of compliance could be a result of a lack of SCIC assessment and reporting on this activity (CCAMLR, 2011w).

Criterion 2. Open Access to Bycatch Data

Score: 6 of 15 possible points, 40%.

Table A1.1-4 provides details on the assessment outcome for criterion 2.

Table A1.1-4. Assessment of CCAMLR provision of open access to regional observer programme datasets.

Factor	Points for positive response
There is a regional observer programme dataset containing records of bycatch, and datasets of amalgamated and not primary data records are open access and records are amalgamated by >5 degree cells.	1
Amalgamated observer data, but combined with records from research activities, for $\geq 75\%$ of fisheries included in the CCAMLR regional observer programme are open access.	5

Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

Yes, a CCAMLR scientific observer programme database exists and includes records on bycatch.

- What confidentiality rules have been adopted on access to data on bycatch and discards that the RFMO owns or holds as a custodian?

The CCAMLR *Rules for Access and Use of CCAMLR Data* stipulates that the owners/originators of data reported to and held by the CCAMLR Data Centre have the right to approve the level of detail revealed in documents that use their data, and release of data held by CCAMLR to the public are to be approved in writing by the relevant data owner/originator, who may inform the requestor of the data of any rules governing access to and use of the requested data (CCAMLR, 2003f). CCAMLR-held, “Data may be released only under specific, clearly defined protocols and in support of CCAMLR’s scientific programs,” (CCAMLR, 2012d).

- Are primary or amalgamated data collected in the regional observer programme made available as an open public resource?

CCAMLR annually publishes in the *Statistical Bulletin* aggregated data from CCAMLR-managed fisheries and research activities (CCAMLR, 2012d). CCAMLR does not make primary observer programme data records publicly available in the *Statistical Bulletin* or other publications (CCAMLR, 2011x, 2012d).

CCAMLR primary scientific observer data can be made available by the CCAMLR Secretariat under processes and restrictions defined in the *Rules for Access and Use of CCAMLR Data*, however, this does not constitute an open access resource as defined for this performance assessment (Section 2.2.2, bullet 3 of the assessment report).

- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤ 5 degree cells, >5 degree cells, or is information on resolution of records in the publically available dataset not specified?

CCAMLR *Statistical Bulletin* summary statistics are reported by statistical areas/subareas/divisions (Table 1.1, CCAMLR, 2011x), most or all of which are >5

degree cells. Amalgamated data records do not distinguish the source of individual records as being from observed fishing effort vs. research activities.

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

The summary statistics reported in the CCAMLR *Statistical Bulletin* is not primary research-grade data; most fundamental research applications are not feasible employing the amalgamated summary statistics. For example, the spatial resolution and lack of fields on gear designs and fishing methods are insufficient to model standardized catch rates to determine relative abundance.

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

Amalgamated data on all CCAMLR-managed fisheries are included in the annual CCAMLR *Statistical Bulletin* (CCAMLR, 2011x, 2012d).

Criterion 3: Ecological Risk Assessment

Score: 6 of 8 possible points, 75%.

Table A1.1-5 provides details on the assessment outcome for criterion 3.

Table A1.1-5. Assessment of CCAMLR ecological risk assessment.

Factor	Points for positive response
Level 2 semi-quantitative assessment for the effects of fishing on bycatch species but not on the effects of bycatch removals on the integrity of the ecosystem has been conducted for $\geq 50\%$ of fisheries managed by the RFMO. Level 3 assessment of the effect of fishery removals on ecosystem integrity has been conducted for new and exploratory fisheries, but not on the effect of fishery removals on bycatch species.	6

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

CCAMLR assessed the risk from bycatch on potentially vulnerable shark species, including sleeper sharks (*Somniosus* spp.), possibly representing a Level 2 assessment (CCAMLR, 2008a).

CCAMLR benthic impact assessments represent a partial (susceptibility risk) Level 2 ERAs. To participate in new and exploratory fisheries, CCAMLR Members are required to assess the impacts of bottom fishing on VMEs by fishery and area, culminating in an estimate of the cumulative benthic impacts of individual fisheries (Sharp et al., 2009; CCAMLR, 2012k). CCAMLR (2012k) also estimated the cumulative benthic impacts of all bottom fisheries within areas of the Convention Area covered by CM 22-06. The methodology employed includes characterizing the fragility of VME taxa present in a fisheries' grounds (Sharp et al., 2009; CCAMLR, 2012k).

All proposed new fisheries, and exploratory fisheries, are required to comply with a Data Collection Plan developed and updated by the CCAMLR Scientific Committee, which shall be sufficient to evaluate, "the ecological relationships among harvested, dependent and related populations and the likelihood of adverse impacts," (CCAMLR, 2010a, 2011b). This might represent a Level 3 ERA for new and exploratory fisheries that assesses the effects of fishery removals, including bycatch removals, on ecosystem integrity.

The process for determining the risk to seabirds associated with CCAMLR-managed fisheries, and associated mitigation requirements, is based on a level 2 ecological risk assessment conducted by the CCAMLR Working Group on Incidental Mortality Associated with Fishing (WG-IMAF) of the Scientific Committee (Waugh et al., 2008). Small (2005) conducted a partial Level 2 risk assessment, by assessing the overlap of 14 RFMO areas with albatross distributions.

CCAMLR consider effects of fishery removal levels and spatial location on indicator species of dependent predator populations (CCAMLR, 2004, 2008a). CCAMLR considers trends in populations of four species of penguins, three species of flying birds and two species of seals, which are predators of the ecosystem regulated by Antarctic krill, in developing CMs for krill and other CCAMLR-managed fisheries (Constable et al., 2000; CCAMLR, 2004, 2008a), more related to effects from target species removals than bycatch removals.

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

The CCAMLR risk assessment of fisheries bycatch of sharks is applicable across CCAMLR-managed fisheries (CCAMLR, 2008a).

The assessment of bottom fishing effects on benthic taxa is relevant to longline, trawl finfish and pot finfish demersal fisheries (Sharp et al., 2009; CCAMLR, 2012k).

The assessments of new and exploratory fishery effects of fishery removals on ecosystem integrity (CCAMLR, 2010a, 2011b) are applicable to fisheries for squid and crabs for all areas in which they are permitted to be fished, for krill in all areas in which they are fished, and for toothfish in some of the areas in which they are fished (CCAMLR, 2008a).

The risk assessment by Waugh et al. (2008) and Small (2005) are applicable to CCAMLR-managed fisheries where seabird interactions occur: trawl and longline fisheries.

The effects of bycatch removals in CCAMLR fisheries on krill ecosystem predators is relevant to all CCAMLR-managed fisheries (CCAMLR, 2004, 2008a).

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more

rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

Bycatch removals in some CCAMLR-managed fisheries may affect trophic processes so as to reduce prey availability to dependent predator populations (CCAMLR, 2004, 2008a). However, the ability to infer causation of fishery removals, including bycatch fishing mortality, on indicator population trends is limited due to data quality limitations (CCAMLR, 2008a). Declines in some seabird populations have been linked to mortality in Southern Ocean fisheries, however, these likely are occurring in IUU and not CCAMLR-managed fisheries. A performance review recommended that CCAMLR develop and implement a more comprehensive, consistent monitoring programme for non-retained bycatch species to enable understanding of their status (CCAMLR, 2008a).

Certain CCAMLR-managed bottom fisheries in some areas pose a risk to VMEs (CCAMLR, 2012k).

CCAMLR determined that there are low risks to shark species from bycatch in CCAMLR-managed fisheries (CCAMLR, 2008a).

Small (2005) found that CCAMLR was one of the top five RFMOs of 14 assessed in terms of overlap with albatross distribution.

Indirectly related, a CCAMLR review panel identified the status of many bycatch species in CCAMLR-managed fisheries as a priority gap in knowledge (CCAMLR, 2008a).

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch

Score: 12 of 18 possible points, 67%

Table A1.1-6 provides details on the assessment outcome for criterion 3.

Table A1.1-6. Assessment of CCAMLR conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
19 bycatch problems have been identified to occur in CCAMLR-managed fisheries, and binding measures are in place to mitigate $\geq 75\%$ (15 of 19) of the identified problems.	5
At least one but $< 50\%$ of binding measures to mitigate bycatch include measurable performance standards.	1
Of binding bycatch measures that contain quantitative performance standards, $\geq 75\%$ of the measures have been assessed for efficacy.	3
All binding bycatch measures that contain performance standards have been determined to be effective in meeting the stipulated performance standards.	3
There is a provision that allows CCAMLR Members to opt out of binding measures.	0

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.

Bycatch removals in some CCAMLR-managed fisheries may adversely affect dependent predators and ecosystem integrity (CCAMLR, 2004, 2008a, 2010a, 2011b). Demersal (bottom fish) fisheries can adversely affect VMEs and their constituent benthic species (CCAMLR, 2012k). Longline and trawl fisheries overlap with the distributions of seabirds that are subject to bycatch (Small, 2005).

- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

There are several finfish stocks that have been overfished since prior to the establishment of CCAMLR, and the fisheries that targeted these stocks are categorized by CCAMLR as “lapsed fisheries” (CCAMLR, 2008a). Conservation Measures prohibit directed fishing for these stocks and retained bycatch levels are subject to limits (Table A1.1-7) (CCAMLR, 2008a).

Discarded bycatch species in CCAMLR-managed fisheries include seabirds, seals, skates, rays, sharks, a large number of other fish species and a large number of invertebrate species, including crabs in pot fisheries targeting toothfish (CCAMLR, 2008a, 2011i,z). Problematic bycatch of seabirds, marine mammals, skates and rays in CCAMLR-managed demersal longline, trawl and pot fisheries has occurred (CCAMLR, 2008a, 2011z).

Fisheries that contact the seabed, including CCAMLR-managed demersal longline and trawl fisheries, may adversely affect VMEs, including seamounts, hydrothermal vents, cold-water corals and sponge fields (CCAMLR, 2010c, 2012k).

The status of many species and groups subject to bycatch fishing mortality has not been assessed or are only occasionally assessed (CCAMLR, 2008a). Furthermore, for many retained bycatch species, there is little or no ‘trend information’ available from CCAMLR-managed fisheries, where available trends information is in the form of time series of nominal catch rates (CCAMLR, 2008a), which precludes accurate assessment of trends in relative or absolute abundance (Gilman et al., 2012). However, according to the CCAMLR performance review, “While for most by-catch species there is no formal assessment of the status of the resource populations, the combination of the assessments that are available, the low levels of by-catch, and the management measures that are in place provide a good basis to expect that the by-catch species are not significantly depleted by fishing,” and because the catch levels of these retained bycatch species are low, “compared to the probable biomass and productivity of the species,” (CCAMLR, 2008a). However, CCAMLR (2008a) clarifies that, “in many cases, this is essentially an assumption.” In addition, it is worth considering that even highly fecund species can be overexploited (Sadovy, 2001; Gilman et al., 2011a), and even if a stock is depleted due primarily to mortality sources other than fishing mortality, low bycatch removals in CCAMLR-managed fisheries might still be problematic.

In general, the gear types used in CCAMLR-managed fisheries in higher latitudes are associated with the following problematic bycatch:

- Trawl finfish and krill fisheries: Finfish of overexploited stocks (including *Gobionotothen gibberifrons*, *Nototothenia rossii*, *Lepidonotothen squamifrons*, *Pseudochaenichthys georgianus* and *Chaenocephalus aceratus*), crabs, marine mammals, seabirds, elasmobranchs, species of vulnerable benthic ecosystems, including seamounts, hydrothermal vents and cold-water corals and sponge fields (Armstrong et al., 1993; Fertl and Leatherwood, 1997; Goni, 1998; Robbins et al., 1999; Hall-Spencer et al., 2002; Freiwald et al., 2004; Read et al., 2006; Eayrs, 2007; FAO, 2010a; CCAMLR, 2010c, 2011z, 2012k).
- Pot fisheries for crab and finfish: Finfish of overexploited stocks, species of vulnerable benthic ecosystems including seamounts, hydrothermal vents and cold-water corals and sponge fields, crabs, marine mammals, elasmobranchs (Stevens, 1996; Freiwald et al., 2004; Tallack, 2007; Zollett, 2009; SEAFO, 2009b, 2010d,e; CCAMLR, 2010c, 2011i, 2012k).
- Demersal longline fisheries: Finfish of overexploited stocks, elasmobranchs, seabirds, cetaceans, species of vulnerable benthic ecosystems, including seamounts, hydrothermal vents and cold-water corals and sponge fields (Pierpoint and Penrose, 1999; Melvin et al., 2001; MacAlister Elliott and Partners, 2003; Freiwald et al., 2004; Purves et al., 2004; Gilman et al., 2005, 2006a; Petersen et al., 2007; Moreno et al., 2008; Valenzuela et al., 2008; CCAMLR, 2010c, 2012k).
- Jig squid fisheries: Likely no problematic bycatch. Seabird bycatch may occur, but is likely a low risk, where there is the potential for vessel and gear strikes due to seabird attraction to vessel lights (Cooper, 1995; Rowe, 2010).
- Using Table A1.1-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

This information has been recorded in Table A1.1-7.

Bycatch limits are in place in those areas of the CCAMLR Convention Area where substantial bycatch levels are expected. Directed fishing is required to stop in an area if the bycatch limit for any species or species group is reached, and vessels are required to move their fishing location by at least 5 nautical miles if bycatch rates exceed set limits (CCAMLR, 2008a). These bycatch conditions apply to all new or exploratory fisheries, to established icefish fisheries and to demersal fisheries. In addition, the catch limits for some species are further subdivided spatially (CCAMLR, 2008a).

ATCM measures are not reviewed in this performance assessment. Article V.2 of the CAMLR Convention calls for Contracting Parties to observe measures of the ATCM; there have been no ATCM measures adopted related specifically to the protection of Antarctic marine living resources since 1977 (CCAMLR, 2008a).

- From the responses to the first two bullets, list each individual documented bycatch problem.

Problematic bycatch in CCAMLR-managed fisheries, as determined from ecological risk assessments (Criterion 3) and documented in other studies, is summarized as follows:

- Trawl finfish and krill fisheries: Finfish of overexploited stocks, crabs, marine mammals, seabirds, elasmobranchs, species of vulnerable benthic ecosystems, and adverse effects on ecosystem integrity, including dependent predators, from bycatch removals.
 - Pot crab and finfish fisheries: Finfish of overexploited stocks, species of vulnerable benthic ecosystems, crabs, marine mammals, elasmobranchs, and adverse effects on ecosystem integrity, including dependent predators, from bycatch removals.
 - Demersal longline fisheries: Finfish of overexploited stocks, elasmobranchs, seabirds, cetaceans, species of vulnerable benthic ecosystems, and adverse effects on ecosystem integrity, including dependent predators, from bycatch removals.
 - Jig squid fisheries: Likely no problematic bycatch or adverse ecosystem effects from bycatch removals.
- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

Of the 19 potential problematic bycatch in managed fisheries, summarized in the previous bullet, the following 4 are not addressed by a binding, active CCAMLR CM:

- Demersal trawl fisheries: Crabs.
- Pot fisheries: Crabs, marine mammals.
- Demersal longline fisheries: Cetaceans.

As summarized in the 2008 CCAMLR Performance Review, “CMs that give increased confidence that such risks are being managed (i.e. the precautionary and default catch limits on by-catch species and ‘move-on’ provisions from locations giving high by-catch rates) are not applied to all fisheries and fishing areas” (CCAMLR, 2008a), i.e., bycatch management measures are applied inconsistently to CCAMLR-managed fisheries and areas.

Certain areas in the Convention Area that are under national jurisdiction, including the marine area around Kerguelen Islands, Crozet Islands and Prince Edward Islands, are exempt from certain CMs, including minimisation of incidental mortality of seabirds and marine mammals, and bycatch limitations, and general measures for toothfish fisheries, in new or exploratory fisheries (CCAMLR, 2008a).

- What proportion of binding bycatch measures contain quantitative, measurable performance standards?

One of the ten binding, active CMs includes quantitative, measurable performance standards (the CM’s for the identification of potential VMEs) (Table A1.1-7).

The CCAMLR review panel identified that CMs establishing catch limits for bycatch species or groups, in particular for discarded bycatch, and including bycatch of species whose stocks are depleted, are not explicitly based upon a specified

performance goal, such as an acceptable level of risk to the affected populations, and do not provide a basis for having selected species to aggregate into groups for which the bycatch limits apply: “it is unclear what the limits are intended to achieve at the species level within these groups, what the acceptable limits of impact are, and whether the aggregate limits are likely to give a high probability of achieving the desired protection,” (CCAMLR, 2008a).

More broadly, CCAMLR has been criticized for not having identified targets or activities to recover depleted stocks. CCAMLR has not developed a recovery plan for depleted finfish stocks, and the 2008 Performance Review recommended that CCAMLR needs to develop an explicit strategy to achieve rebuilding, monitor stock status trends for depleted stocks, and report on progress (CCAMLR, 2008a). While there are no explicit recovery plans for these fisheries, there has been a prohibition on directed fishing and also bycatch limits in place for almost two decades. Furthermore, CCAMLR Members undertake research surveys in the relevant areas to determine stock status and report these findings to the Scientific Committee (Keith Reid, CCAMLR Secretariat, personal communication, 16 May 2012).

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

The Scientific Committee conducts periodic assessments of the performance of CMs related to notifying CCAMLR of encounters with potential VMEs, preliminary assessments of bottom fishing impacts on VMEs, and assessment of cumulative effects of bottom fishing on VMEs (CCAMLR, 2011aa).

There are also assessments of CMs that lack explicit performance standards. For example, based on assessments of fishery-dependent bycatch data records and from scientific trawl surveys, despite CMs that prohibit directed fishing for depleted stocks of finfish and create retained bycatch limits, there has been no indication of recovery of these stocks (CCAMLR, 2008a).

Preliminary assessments of the population status have been conducted for some species, such as skates and rays, and some CCAMLR areas (CCAMLR, 2008a). However, the efficacy of CMs in preventing the overexploitation of retained bycatch species has not been explicitly assessed for most bycatch species, and there is, “very limited ability to detect departures from management intent in relation to by-catch species,” (CCAMLR, 2008a). For many retained bycatch species, there is limited or no information on trends information (CCAMLR, 2008a), such as trends in catch levels, nominal or standardized catch rates, and relative or absolute abundance. In reference to the efficacy of CCAMLR CMs at preventing the overexploitation of bycatch species, the CCAMLR performance review concluded, “there is very limited ability to determine trends objectively in stock status and consequently whether the precautionary catch levels are protecting the by-catch species as intended. Furthermore, there is very limited ability to identify the causes of any trends, and to separate the effects of fishing from those of other human activities (e.g. climate change) and natural variability,” (CCAMLR, 2008a).

Regional observer monitoring of seabird bycatch rates in CCAMLR-managed longline and trawl fisheries have documented substantial declines in seabird bycatch rates in these fisheries, “achieved by a combination of improved compliance with Conservation Measure 25-02 and by delaying the start of fishing until the end of the breeding season of most albatross and petrel species,” (CCAMLR, 2007b). Although seabird mortality is near zero for CCAMLR fisheries, it is still high in the French EEZ of the Crozet and Kerguelen Islands (Delord et al., 2010).

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

The Scientific Committee's most recent assessment review of CM protocols for notifying CCAMLR of encounters with potential VMEs, preliminary assessments of bottom fishing impacts on VMEs, and assessment of cumulative effects of bottom fishing on VMEs did not explicitly state if the CM is effective, e.g., by assessing if Scientific Committee recommendations for restrictions on bottom fishing to avoid adverse effects on VMEs have been implemented via CCAMLR adoption of relevant CMs (CCAMLR, 2011aa). However, it is assumed that CCAMLR adoption of area closures to bottom fishing to protected 'registered' VMEs is demonstration of effective implementation of the CM that establishes the notification and assessment protocols.

CMs have been adopted to address bycatch of seabirds and seals in CCAMLR-managed trawl and longline fisheries, and as a result of these measures, bycatch levels of seabirds and marine mammals in CCAMLR-managed fisheries have been substantially reduced and remain very low (CCAMLR, 2008a). Seabird bycatch in IUU toothfish fisheries, employing demersal longlines and gillnets, is however an issue remaining to be resolved (CCAMLR, 2012j).

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

Scientific Committee assessment of the CM has not resulted in identification of lack in efficacy (CCAMLR, 2011aa). The Scientific Committee's most current assessment of CMs that establish protocols for the identification and assessment of impacts of bottom fishing on VMEs included only minor recommendations for changes to procedures, such as simplification of the form used to provide preliminary assessment of bottom fishing impacts on newly identified potential VMEs, annual update of cumulative impact assessment, and Member reporting bottom fishing vessel-specific gear descriptions (CCAMLR, 2011aa).

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

Articles IX.6(c) and (d) of the Convention provide CCAMLR Parties with an ability to opt out of binding conservation measures. CCAMLR regulatory conservation measures are subject to an objection procedure, where Parties can place a formal reservation on any measure (CCAMLR, 1982, 2008a; Lugten, 2010). The CCAMLR performance review documented employment of the opt-out provision only twice in their reviewed 28 year-period (CCAMLR, 2008a).

However, according to the CCAMLR performance review, because the CAMLR Convention includes a statement by the Chairman made in 1980 that recognized State sovereignty over areas within the extended area of application of the Convention, including the waters adjacent to Kerguelen and Crozet over which

France has jurisdiction, and waters adjacent to other sub-Antarctic islands within the Convention area (CCAMLR, 1982), there has been a tendency for some States to invoke the Chairman's Statement, such that any CCAMLR Conservation Measure that might have implications for maritime jurisdictions controlled by these States results in a formal reservation of the measure (CCAMLR, 2008a).

Table A1.1-7. Active CCAMLR legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
<p>Longline vessels are required to comply with: (i) a minimum line sink rate (for vessels with manually attached weights, minimum of 0.3m/s average sink rate from the surface to 10m or 15m depth, depending on the test employed – bottle test vs TDR monitoring, respectively; for integrated weighted lines, a minimum of 0.2m/s sink rate as determined by either TDR or bottle test) (CCAMLR, 2008e); (ii) night setting and minimal lighting if the minimum sink rate is not met; (iii) no offal discharge while setting, discharge on the opposite side of the vessel where hauling is conducted, and removal of fish hooks from offal prior to</p>	<p>There are no explicit performance standards stated for the seabird bycatch mitigation measures for longline and trawl vessels in terms of anticipated seabird bycatch rates or levels.</p>	<p>Timing of initiating and ending setting operations, for longline vessels not exempt from the requirement for night setting; Line sink rate (results of TDR or bottle sink rate test), for longline vessels seeking exemption from night setting; Number of seabirds caught by longline vessels targeting <i>Dissostichus</i> spp. in Subarea 48.4 and by trawl fishery for <i>Champscephalus gunnari</i> in Subarea 48.3; Offal management practices of longline and trawl vessels; Bird exclusion devices employed during hauling for longline vessels</p>	<p>c, d, e</p>

<p>discharging; (iv) use of streamer lines while setting; and (v) 'Bird exclusion devices' are required to be employed during hauling in specified areas of the Convention Area (CCAMLR, 2009f). Vessels that are not able to either retain offal onboard or otherwise discharge offal on the opposite side of the vessel to where hauling occurs are to not be authorised to fish in the Convention Area (CCAMLR, 2009f). Demersal longline vessels that wish to be exempt from required night setting must meet the minimum line sink rate, and a CCAMLR scientific onboard observer is to conduct regular monitoring of longline sink rate (CCAMLR, 2008e). CCAMLR (2009f) provides one example of a suitable Bird exclusion device that meets the two requirements of the Conservation Measure of deterring birds from flying directly into the area where the line is being hauled and preventing birds that are sitting on the surface from swimming into</p>		<p>operating in specified areas of the Convention Area where these devices are required; Trawl vessel presence/absence of net monitor cables; Trawl vessel deck lighting; Trawl vessel practices to remove fish tangled in the net; Trawl vessel practices to minimise the time the net is at or near the surface; Use of net binding by trawl vessels targeting <i>Champscephalus gunnari</i> in Subarea 48.3; Longline and trawl vessel location; List of longline and trawl fishing vessels authorized to fish in the CCAMLR Convention Area.</p>	
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<p>the hauling bay area: two booms mounted fore and aft of the hauling bay with streamers suspended from each boom and a line of purse seine floats tethered between the two booms (CCAMLR, 2009f).</p> <p>Longline vessels targeting <i>Dissostichus</i> spp. in Subareas 48.4, 48.6, or 88.1, or in Division 58.4.2, or Divisions 58.4.3a and b outside areas of national jurisdiction that are exempt from night setting but catch three seabirds must immediately revert to employing night setting (CCAMLR, 2011j,k,l,m,n,p,q).</p> <p>Trawl vessels are required to eliminate net monitor cables, minimise lighting, not discharge offal during setting or hauling, remove fish tangled in the net, and minimise the time the net is at or near the surface (CCAMLR, 2011d). The trawl fishery for <i>Champscephalus gunnari</i> in Subarea 48.3 is required to employ net binding and consider adding weight to the codend in order to</p>			
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<p>mitigate petrel and albatross bycatch, and if any vessel catches 20 seabirds it shall cease fishing and shall be excluded from further participation in the fishery in the 2011/12 season (CCAMLR, 2011s).</p> <p>CM 41-08 requires longline <i>Dissostichus eleginoides</i> vessels in Division 58.5.2 to employ integrated weighted lines in combination with paired streamer lines (CCAMLR, 2011o).</p> <p>Longline, pot and trawl vessels are required to report the number of seabirds of each species caught and released or killed (CCAMLR, 2000a).</p> <p>These measures do not apply in the areas of national jurisdiction around Kerguelen, Crozet and Prince Edward Islands.</p>			
<p>Indirectly related (the measure is not a bycatch mitigation measure, but provides an incentive to avoid and minimize seabird interactions), for the longline fishery for <i>D. eleginoides</i> in Statistical Subarea 48.3, the season is based on the</p>	<p>NA - not a bycatch mitigation measure</p> <p>No performance standard is stated.</p>	<p>NA - not a bycatch mitigation measure</p> <p>Number and date of seabird captures per vessel; List of longline fishing vessels authorized to fish in the CCAMLR Statistical Subarea 48.3.</p>	<p>NA - not a bycatch mitigation measure</p> <p>d, e</p>

average number of seabirds captured per vessel and the total number of caught seabirds (CCAMLR, 2011i).			
Sea turtles			
None	NA	NA	NA
Marine mammals			
Trawl vessels are required to eliminate net monitor cables, minimise lighting, not discharge offal during setting or hauling, remove fish tangled in the net, and minimise the time the net is at or near the surface (CCAMLR, 2011d). These measures do not apply in the areas of national jurisdiction around Kerguelen, Crozet and Prince Edward Islands.	No performance standards are stipulated.	Trawl vessel presence/absence of net monitor cables; Trawl vessel fishing methods during setting and hauling (deck lighting, remove fish entangled in net, minimise time net is at or near the surface); List of trawl fishing vessels authorized to fish in the CCAMLR Convention Area.	a, d, e
Shark and relatives			
Directed fisheries for sharks are prohibited and caught sharks must be released alive if possible (CCAMLR, 2006a).	No performance standards are stated. The implicit aim of the measure is to prevent the unsustainable exploitation of shark species in the CCAMLR Convention Area.	Fishing gear and methods (however, noting that the CM does not define what gear or fishing methods constitute directed fishing for sharks); Shark release practices; List of fishing vessels authorized to fish in the CCAMLR Convention Area.	a, d, e

Juvenile and small/undersized target species			
None	NA	NA	NA
Unmarketable sizes and species of non-target species of fish			
None	NA	NA	NA
Other or multiple bycatch species group(s)			
<p>Bycatch limits exist for established, new and exploratory fisheries, in all areas where they occur.</p> <p>CMs establish bycatch limits by fishery and statistical area, and in some cases by small-scale research units (SSRUs), by weight of species or species group (individual and combined species of a genus of icefish [<i>Chaenocephalus aceratus</i>, <i>Channichthys rhinoceratus</i>, <i>Gobionotothen gibberifrons</i>, <i>Lepidonotothen squamifrons</i>, <i>Notothenia rossii</i>, <i>Pseudochaenichthys georgianus</i>, combined <i>Macrourus</i> spp.], combined species of the shark genus <i>Somniosus</i>, combined skates and rays, and all other bycatch fish species combined that are not subject to bycatch limits in another CM) per specified</p>	<p>The main CM establishing bycatch limits does not state performance standards (CCAMLR, 1995a). CCAMLR (2008a) states that the limits for bycatch are set at levels that are thought to pose a low risk of over-depletion, however, this is not explicitly stated in the measures.</p> <p>The CM calling generally for a bycatch limit for <i>Notothenia rossii</i> states that the aim is generally to achieve "Optimum" recruitment to the stock (CCAMLR, 1985a).</p>	<p>Catch (both retained and discarded) per haul of all species and groups for which bycatch limits have been established, in areas and fisheries for which they apply;</p> <p>For vessels participating in a new or exploratory fishery, in all areas, catch of combined skates and rays, combined <i>Macrourus</i> spp., and combined other bycatch species on a per-haul basis, and catch of <i>Macrourus</i> spp. in 10-day periods;</p> <p>Vessel fishing method;</p> <p>Vessel location when fishing;</p> <p>List of fishing vessels authorized to fish in the CCAMLR Convention Area.</p>	c, d, e

<p>fishing season, and in some cases the limits are defined as the total and/or proportion of the total fish or target fish species catch by weight per haul or set, where a move-on rule is triggered when a limit is reached (vessels must not fish within 5 nautical miles of the location where the limit was exceeded for at least 5 days, and for new and exploratory fisheries, if the bycatch of combined <i>Macrourus</i> spp. taken by a single vessel in any two 10-day periods in a single SSRU exceeds 1,500 kg in each 10-day period and exceeds 16% of the catch of <i>Dissostichus</i> spp. by that vessel in that SSRU in those periods, the vessel shall cease fishing in that SSRU for the remainder of the season) (CCAMLR, 1985a, 1995a, 2011f,g,i,j,p,q,s).</p>			
<p>There are limitations on commercial bottom trawling, including a prohibition of bottom trawling in exploratory fisheries in depths less than 550 m (CCAMLR, 2009e),</p>	<p>There is no explicitly stated performance standard. The intention is to limit trawling to the areas where it had been used prior to 2007 (CCAMLR, 2008a).</p>	<p>Spatial location of bottom trawl fishing effort; List of bottom trawl fishing vessels authorized to fish in the CCAMLR Convention Area.</p>	<p>c, e</p>

<p>prohibition of bottom trawling in high-seas areas not covered by a relevant CM (CCAMLR, 2008d), and VME measures (CCAMLR, 2010c) described in the following entry, below. These measures do not apply to the areas of national jurisdiction around Kerguelen, Crozet and Prince Edward Islands.</p>			
<p>Any new fisheries after 2008 in the Convention Area (excluding areas under the national jurisdiction of France and South Africa) may not use fishing methods that interact with the seabed and VMEs, until the proposed fishing has been reviewed by CCAMLR's Scientific Committee (CCAMLR, 2010c). The review by the Scientific Committee addresses the potential adverse impacts on seabed organisms and, if these cannot be acceptably mitigated, the fishing activity is not permitted. When such fishing is permitted, a data collection plan is developed and observers are required so as to support and verify</p>	<p>A stated performance standard is to protect "VMEs from significant adverse impacts" from bottom fishing, where there is a quantitative method for the identification of potential VMEs (CCAMLR, 2010c), against which to assess the efficacy of the measure, by evaluating if mechanisms to protect VMEs identified through this CM process as requiring controls from bottomfishing are effectively occurring .</p>	<p>Fishing gear; Vessel location during fishing operations; Location of VMEs; Location of Risk Areas, Catch of VME indicator organisms per unit of effort; List of bottom fishing vessels authorized to fish in the CCAMLR Convention Area.</p>	<p>c, d, e</p>

<p>collection of these data (CCAMLR, 2010c,d).</p> <p>If a vessel of a Contracting Party encounters a VME in the course of fishing activities that has not been reported under CM 22-07 (CCAMLR, 2010d), then, under CM 22-06, the vessel is required to cease bottom fishing in that location (CCAMLR, 2010c).</p> <p>An area is identified as a 'potential' VME and a 'Risk Area' when ten or more VME 'indicator units' are recovered within a 'single line segment' (CCAMLR, 2010d). A 'VME indicator unit' is defined either as 1 litre of VME 'indicator organisms' that can be placed into a 10-litre container, or one kg of VME indicator organisms that do not fit into a 10-litre container (CCAMLR, 2010d). A 'VME indicator organism' is any benthic organism listed in the CCAMLR VME Taxa Classification Guide (CCAMLR, 2010d). A 'single line segment' for demersal longline gear is a 1,000-hook section of line or</p>			
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<p>1,200 m section of line, whichever is shorter, and for pot lines is a 1,200 m section of line (CCAMLR, 2010d).</p> <p>These measures do not apply to the areas of national jurisdiction around Kerguelen, Crozet and Prince Edward Islands.</p>			
<p>CCAMLR has adopted numerous conservation measures that establish time/area restrictions on fishing, including a prohibition on finfish fishing within Subareas 48.1 and 48.2 (Antarctic Peninsula and South Orkney Islands, respectively), prohibition of directed fishing for <i>Notothenia rossii</i>, <i>Gobionotothen gibberifrons</i>, <i>Chaenocephalus aceratus</i>, <i>Pseudochaenichthys georgianus</i>, <i>Lepidonotothen squamifrons</i>, <i>Patagonotothen guntheri</i>, and <i>Electrona carlsbergi</i> in Subarea 48.3 (around South Georgia), prohibition on directed fishing for <i>Lepidonotothen squamifrons</i> in Division 58.4.4 (Ob and Lena Banks), prohibition on</p>	<p>No performance standards are stated in these measures.</p>	<p>Spatial location and date of fishing operations; List of vessels authorized to fish in the CCAMLR Convention Area.</p>	<p>c, e</p>

<p>directed fishing for <i>Dissostichus eleginoides</i> and other <i>Dissostichus</i> spp. in multiple statistical areas and seasons, no directed fishing for any species other than <i>Dissostichus eleginoides</i> and <i>Champocephalus gunnari</i> in Statistical Division 58.5.2 in the 2011/12 fishing season, prohibition on fishing for <i>Dissostichus</i> spp. within 10 nautical miles of the coast of the Balleny Islands in Statistical Subarea 88.1, and the establishment of two closed areas to bottomfishing in order to protect two , 'registered' VMEs (CCAMLR, 1985a, 1997a, 1998b,c,d, 1999a, 2002a,b, 2003a,b,c,d,e, 2008a, 2009h, 2011e,f,p).</p>			
<p>Use of deep-water gillnets and trammel nets are prohibited (CCAMLR, 2010b).</p>	<p>No explicit performance standard is stated. The implicit aim of the measure is to avoid fishing mortality of non-target species, including shark species, in the CCAMLR Convention Area, and also to avoid ghost fishing by derelict gillnet gear (CCAMLR, 2008a, 2010b).</p>	<p>Use of deep-water gillnets and trammel nets; List of vessels authorized to fish in the CCAMLR Convention Area.</p>	<p>c, e</p>

<p>Minimum mesh sizes are established for pelagic and demersal trawl nets (120mm for fisheries targeting <i>Notothenia rossii</i> and <i>Dissostichus eleginoides</i>, 80mm for those targeting <i>Gobionotothen gibberifrons</i>, <i>Notothenia kempfi</i>, <i>Lepidonotothen squamifrons</i> and 90mm for those targeting <i>Champsocephalus gunnari</i>) (CCAMLR, 1984a, 1990a). The measure for <i>Champsocephalus gunnari</i> excludes waters adjacent to Kergulen and Crozet Islands (CCAMLR, 1990a).</p>	<p>No performance standard is stated. The implicit purpose of the measures is to reduce the catch of small target and incidental species of fish.</p>	<p>Trawl vessel's net mesh size; List of trawl vessels authorized to fish in the CCAMLR Convention Area.</p>	<p>a, e</p>
<p>Crabs caught by longline vessels targeting <i>D. eleginoides</i> in Subarea 48.3 are to be released alive (CCAMLR, 2011i).</p>	<p>No performance standard is stated.</p>	<p>Longline vessel handling and release practices for crabs; Spatial location of longline <i>D. eleginoides</i> vessels; List of longline fishing vessels authorized to fish in the CCAMLR Statistical Subarea 48.3.</p>	<p>c, d, e</p>

Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 3 of 14 possible points, 21%

Table A1.1-8 provides details on the assessment outcome for criterion 3.

Table A1.1-8. Assessment of CCAMLR conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
For managed fisheries for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are in place for $\geq 75\%$ of these fisheries.	3
Relevant binding measures to mitigate ghost fishing do not include measurable performance standards.	0
There is a provision that allows CCAMLR Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

There are a large number of reports submitted to the CCAMLR Scientific Committee documenting wildlife and fish interactions with derelict fishing gear, including via ingestion, hooking or entanglement (CCAMLR, 2008a). It is not known what proportion of derelict gear in the Convention Area is derived from CCAMLR-regulated fisheries vs. IUU fisheries occurring in the Convention Area, or from fisheries outside the CCAMLR area. The CCAMLR review panel recommended that CCAMLR assess the scale and impacts from derelict fishing gear (CCAMLR, 2008a).

The CCAMLR review panel explained that the contribution of derelict fishing gear to the mortality of Antarctic ecosystem organisms has been occasionally examined through CCAMLR Working Groups, but this issue has not been routinely or comprehensively assessed (CCAMLR, 2008a). In addition, the CCAMLR review panel recommended that CCAMLR take a larger role in addressing marine pollution management by fishing vessels. Furthermore, indirectly related, the review panel highlighted that, despite reference to the risk of the introduction of alien species in the Convention (Article II.3(c)), CCAMLR and its Scientific Committee have paid little attention to this issue, including risks of introductions through fishing activities such as derelict fishing gear (CCAMLR, 2008a).

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear

types from other regions?

In general, fisheries that employ passive fishing gear (e.g., pelagic and demersal longlines, gillnets, trammel nets, traps) are likely to cause ghost fishing, while fisheries that employ active gear (e.g., purse seine, trawl) are less likely to result in ghost fishing as the catching process of active gears ceases when the gear is no longer attached to the vessel (NEAFC, 2008a; NAFO, 2008; SEAFO, 2009e; FAO, 2005a, 2010d). However, there are many exceptions. For instance, ghost fishing has been observed in seine nets and there is evidence of marine mammal entanglement in trawl net fragments, and coastal habitat degradation from derelict trawl nets (Jones, 1995; Donohue et al., 2001; Matsuoka et al., 2005). In conclusion, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in CCAMLR-managed fisheries.

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table A1.1-9);

This has been summarized in Table A1.1-9.

Under Paragraph 2(xii) of the Functions and Tasks of International Scientific Observers on Board Vessels Engaged in Scientific Research or Harvesting of Marine Living Resources; Annex 1 to the CCAMLR Scheme of International Scientific Observation, observers are required to record information on fishing gear loss at sea (CCAMLR, 2008b); however, a performance review found that in recent years there has been a lapse in the reporting of this information (CCAMLR, 2008a). In addressing this, the reporting of fishing gear at sea is now the responsibility of the vessel and the amount of information provided in recent years has increased. Furthermore, in 2011, the Scientific Committee considered the estimation of fishing mortality due to lost gear and reiterated the importance of fully reporting the loss of gear as part of the catch and effort reporting.

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

Three relevant binding measures, summarized in Table A1.1-9, are a prohibition of discarding fishing gear and other garbage, which is applicable for all CCAMLR-managed fisheries, a requirement for marking gear such as marker buoys, applicable to pot finfish and crab fisheries, and a ban on the use of deep-water gillnets and trammel nets.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

The three CMs do not contain quantitative performance standards (Table A1.1-9). CCAMLR has not undertaken a systematic or comprehensive assessment of fishing mortality caused by derelict fishing gear (CCAMLR, 2008a).

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous

assessment) have steps been taken or are in progress to improve efficacy?

The three CMs do not contain quantitative performance standards (Table A1.1-9).

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, CCAMLR binding conservation measures are subject to an opt out measure under Articles IX.6(c) and (d) of the Convention (CCAMLR, 1982). Furthermore, CCAMLR Members can invoke a CAMLR Convention statement by the Chairman made in 1980 that recognized State sovereignty over areas within the extended area of application of the Convention (CCAMLR, 1982), causing any CCAMLR Conservation Measure that might have implications for maritime jurisdictions controlled by these States results in a formal reservation of the measure (CCAMLR, 2008a).

Table A1.1-9. Active CCAMLR legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
<p>CCAMLR prohibits the dumping and discharge of ‘garbage’ and other identified materials, which might be interpreted to include fishing gear, by vessels fishing south of 60°S (CCAMLR, 2009g). The measure does not apply to the areas of national jurisdiction around Kerguelen, Crozet and the Prince Edward Islands.</p>	<p>No performance standards are stated.</p>	<p>Vessel discarding practices of gear and other garbage; Vessel location; List of vessels authorized to fish in the CCAMLR Convention Area.</p>	<p>c, d, e</p>
<p>There is a requirement to mark fishing vessels and gear that floats on the surface intended to</p>	<p>No performance standards are stated.</p>	<p>Marking of marker buoys and similar gear.</p>	<p>a, b</p>

<p>indicate the location of fixed or set gear, such as marker buoys, except in the areas of national jurisdiction around Kerguelen and Crozet Islands (CCAMLR, 1998a).</p>			
<p>Use of deep-water gillnets and trammel nets are prohibited (CCAMLR, 2010b).</p>	<p>No explicit performance standard is stated. The implicit aim of the measure includes avoiding ghost fishing by derelict gillnets and trammel nets (CCAMLR, 2008a, 2010b).</p>	<p>Use of deep-water gillnets and trammel nets; List of vessels authorized to fish in the CCAMLR Convention Area.</p>	<p>b, e</p>

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea

Score: 3 of 14 possible points, 21%

Table A1.1-10 provides details on the assessment outcome for criterion 3.

Table A1.1-10. Assessment of CCAMLR conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed fisheries, and binding measures to mitigate pollution are in place for $\geq 75\%$ of these fisheries.	3
The one relevant binding measures to mitigate problematic pollution from discharges does not include quantitative, measurable performance standards.	0
There is a provision that allows CCAMLR Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

No relevant assessments were identified. A CCAMLR review panel recommended that CCAMLR should consider the ecological risks from the introduction of bait into the Convention Area, such as through the introduction of diseases or parasites (CCAMLR, 2008a). A CCAMLR review panel recommended that CCAMLR take a larger role in addressing marine pollution management by fishing vessels (CCAMLR, 2008a).

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from the these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

CCAMLR has not assessed the risks from pollution from discards from managed fisheries (CCAMLR, 2008a, 2011a).

In general, large inputs of organic matter from discards at sea can increase natural nutrient levels in nutrient-poor benthic ecosystems, and in fisheries where discards are spatially concentrated, and especially in areas of low current flow, may cause localized hypoxia or anoxia of the seabed, which, if prolonged, causes

avoidance and mortalities, alters benthic community composition, and alters ecosystem processes and structure (FAO, 1995 [Article 7.2.2g]; Goñi, 1998; Hall et al., 2000; Stevens et al., 2000; Gray et al., 2002; FAO, 2003a,b; Franco et al., 2008; Levin et al., 2009; Haselmair et al., 2010). This is potentially problematic not just for fisheries discharges occurring in coastal areas, but also for fisheries discharges occurring in very deep regions of the ocean, where a large proportion of discharges may settle through the water column without being consumed, altering the benthic community, and transferring and locking biomass up in bottom currents for centuries before recycling to the euphotic zone of the pelagic ecosystem (Hall et al., 2000).

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table A1.1-11).

One relevant CM has been entered in Table A1.1-11. In addition, CMs that limit bycatch levels or rates (Sub criterion 4A) contribute to reducing the volume of discards.

Under Paragraph 2(xii) of the Functions and Tasks of International Scientific Observers on Board Vessels Engaged in Scientific Research or Harvesting of Marine Living Resources; Annex 1 to the CCAMLR Scheme of International Scientific Observation, observers are required to record information on garbage disposal by fishing vessels at sea; however, a 2008 Performance Review found that there had been a lapse in the reporting of this information (CCAMLR, 2008a). However, subsequent to this review, there has been a significant increase in the reporting of this information by scientific observers (Antony Miller, CCAMLR Secretariat, personal communication, 11 May 2012).

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

One CM of relevance to this criterion prohibits the dumping and discharge of offal, bait, and discards by vessels fishing south of 60°S, applicable to all CCAMLR-managed fisheries (Table A1.1-11).

No relevant information was identified for managed fisheries documenting problematic pollution, or are identified as being likely to cause problematic pollution.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

The one relevant CM does not contain quantitative performance standards (Table A1-1-11).

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous

assessment) have steps been taken or are in progress to improve efficacy?

The one relevant CM does not contain quantitative performance standards (Table A1-1-11).

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, CCAMLR binding conservation measures are subject to an opt out measure under Articles IX.6(c) and (d) of the Convention (CCAMLR, 1982). Furthermore, CCAMLR Members can invoke a CAMLR Convention statement by the Chairman made in 1980 that recognized State sovereignty over areas within the extended area of application of the Convention (CCAMLR, 1982), causing any CCAMLR Conservation Measure that might have implications for maritime jurisdictions controlled by these States results in a formal reservation of the measure (CCAMLR, 2008a).

Table A1.1-11. Active CCAMLR legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
CCAMLR prohibits the dumping and discharge of offal, bait, and discards by vessels fishing south of 60°S (CCAMLR, 2009g, 2011k,r). The measure does not apply to the areas of national jurisdiction around Kerguelen, Crozet and the Prince Edward Islands.	No performance standards are stated.	Vessel practices for discarding catch, offal and spent bait; Vessel location; List of fishing vessels authorized to fish in the CCAMLR Convention Area.	c, d, e

Criterion 5. Surveillance and Enforcement

Score: 10 of 20 possible points, 50%

Table A1.1-12 provides details on the assessment outcome for criterion 5.

Table A1.1-12. Assessment of CCAMLR measures and resources for surveillance and enforcement.

Factor	Points for positive response
≥75% of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that CCAMLR requires member States to employ.	4
CCAMLR Members are required to report to the Secretariat on their enforcement procedures and conclusions.	3
CCAMLR does not require Members to take specified enforcement procedures when an infraction of a binding conservation and management measure occurs.	0
CCAMLR does not require Members to impose specified sanctions when an infraction of a binding conservation and management measure occurs and is identified.	0
CCAMLR is in the process of developing a compliance evaluation procedure – CCAMLR is thus developing a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3
Due to incomplete and inconsistent reporting by the Parties of their imposed sanctions, the CCAMLR performance review panel concluded that it was not possible to make a quantitative assessment of the proportion of total detected infringements of CCAMLR measures that resulted in sanctions being assessed by CCAMLR Members. Under at least 3 binding CMs, if a Member, or vessel authorised to report directly to the CCAMLR Secretariat, does not comply with data reporting requirement, then the CCAMLR Secretariat is to notify the Member State of the closure of the fishery to their vessels that failed to supply required data; however, the Standing Committee on Implementation and Compliance has not reported identified infractions and CCAMLR Secretariat imposition of closures as authorized under these CMs.	0

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

CCAMLR has established a 'white list' of vessels licensed to fish in CCAMLR waters (CM 10-02), as well as a 'black list' of IUU vessels of both contracting Parties (CM 10-06, CCAMLR, 2008c) and non-contracting Parties (CM 10-07, CCAMLR, 2009c). CCAMLR has a centralised VMS programme, where reporting requirements vary among fisheries (Contracting Party Flag States of some fisheries, including all krill

fisheries and fisheries operating in South African and French jurisdiction waters, are not required to report collected VMS data to CCAMLR) (CCAMLR, 2008a, 2011a). In 1999, CCAMLR adopted a catch documentation scheme for Patagonian toothfish (CCAMLR, 2009a,b). There is a requirement to mark all fishing vessels and marker buoys and similar gear, except in the areas of national jurisdiction around Kerguelen and Crozet Islands (CCAMLR, 1998a). Article XXIV of the Convention provided the basis for the CCAMLR System of Inspection (CCAMLR, 2007a). Onboard observers fill a scientific data collection role only and do not directly contribute to surveillance, where indirectly, and post-deployment, observer reports may enable the detection of non-compliance (CCAMLR, 2008a,b).

The CCAMLR performance assessment considered the VMS requirement (CM 10-04, CCAMLR, 2011a) as having the potential to detract from effective delivery of MCS information, and recommended that all VMS reporting be conducted real-time directly to the Secretariat so that VMS data are available in real time to support surveillance and enforcement (CCAMLR, 2008a). The current CM allows Contracting Parties to forward VMS reports to the CCAMLR Secretariat up to 10 working days following departure from the Convention Area for fisheries other than exploratory longline fisheries, and within 4 hours for exploratory longline fisheries, and excluding vessels licensed under French or South African domestic law in the EEZs adjacent to Kerguelen, Crozet, and Prince Edward Islands (CCAMLR, 2011a). Currently, VMS data from some fisheries are relayed to the Secretariat via the Flag State, where the Flag State retains the right to decide which data records to transfer to the Secretariat, and there can be a substantial delay in reporting the data (CCAMLR, 2008a). As a result, planned surveillance activities, including at-sea inspections, and the verification of CDS information through centralised VMS data, could, in concept, be obstructed if a Flag State denies access to VMS data from its vessels (CCAMLR, 2008a).

The performance assessment concluded that the CCAMLR System of Inspection (CCAMLR, 2007a) is not an effective MCS tool because the Convention Area is so large, real-time VMS data may be unavailable to support the detection of vessels so that they can then be inspected, and because the inspections that do occur only provide an understanding of the vessel's actions at that point-in-time when inspected, which combined has resulted in very few inspections, and few detected infractions (CCAMLR, 2008a).

Effective monitoring and control of IUU fishing in the CCAMLR Convention Area remain priority threats to CCAMLR's ability to achieve its aims (CCAMLR, 2008a). For example, deficiencies in the efficacy of the toothfish CDS in deterring entry of IUU toothfish into the supply chain have been identified, for instance via ports in Singapore and Malaysia (CCAMLR, 2008a, 2011w). Furthermore, the efficacy of implementation of the IUU black-list (CM-10-06) was identified as being hampered by certain CCAMLR Members denying consensus to prevent their flag vessels from being included on the IUU list (CCAMLR, 2008a, 2011w).

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.1-7, A1.1-9, and A1.1-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

The following are minimum surveillance methods to determine compliance with the binding, active CMs identified in Tables A1.1-7, A1.1-9, and A1.1-11:

- Dockside inspection (all managed fisheries)
- At-sea inspection (gear marking for pot fisheries)
- VMS (all managed fisheries)
- Onboard observers (all managed fisheries)
- Vessel list (all managed fisheries)

As described in the first bullet, with identified limitations, all of these minimum required surveillance methods are supported by CCAMLR, except that trawl krill fisheries currently have ca. 50% onboard regional observer coverage.

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

Relevant to (i) and (ii), CM 10-08 promotes compliance by Contracting Party nationals with CCAMLR CMs, calling for Contracting Parties to take “appropriate actions” if infractions are identified, but without defining what might constitute appropriate actions under different acts of non-compliance (CCAMLR 2009d).

Regarding (iii) the CCAMLR performance assessment concluded that, “Harmonising and clarifying reporting arrangements for catch, CDS, C-VMS and port inspection would facilitate and improve the timely exchange of information between CPs and the Secretariat,” (CCAMLR, 2008a). Several conservation measures and the CCAMLR System of Inspection require contracting Parties to take enforcement actions in response to detected infractions of CCAMLR measures, and also require that they report to the Commission any sanctions that they imposed (CCAMLR, 2008a). However, while Contracting Parties have submitted such reports to the Commission on several occasions, the CCAMLR performance review panel concluded that it was not possible to make a quantitative assessment of the proportion of detected infringements that resulted in sanctions, and of these, which were then reported to the Commission (CCAMLR. 2008a).

Regarding (iv), under CMs 23-01, 23-04 and 23-05, if a Contracting Party, or vessel authorised to report directly to the CCAMLR Secretariat, does not comply with the catch and effort data reporting requirement of either measure within the stipulated time period, then the Executive Secretary is to notify the Contracting Parties of the closure of the fishery to vessels of the Contracting Party that has failed to supply required data (CCAMLR, 2000a,b, 2005b).

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing

efficacy of measures on surveillance and enforcement?

In response to its recognition of the importance of assessing compliance, in 1987 CCAMLR created the Standing Committee on Observation and Inspection (SCOI), later in 2002 replacing it with the Standing Committee on Implementation and Compliance (SCIC), which included in its terms of reference assessing the efficacy of relevant conservation measures and compliance. As of the most recent CCAMLR Commission meeting, CCAMLR is in the process of developing a compliance evaluation procedure (CCAMLR, 2011w).

- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

From 1997-2007, under the CCAMLR System of Inspection, there were 110 at-sea inspections, resulting in the detection of 18 violations of CCAMLR measures, resulting in sanctions imposed on 10 of these vessels (CCAMLR, 2008a). However, the CCAMLR performance review panel concluded that it was not possible to make a quantitative assessment of the proportion of total detected infringements of CCAMLR measures that resulted in sanctions by the CCAMLR Contracting Parties due to incomplete and inconsistent reporting by the Parties of their imposed sanctions (CCAMLR, 2008a).

SCIC reported that eight vessels had been reported as not having complied with two environmental Conservation Measures (CMs 25-02 and 26-01), of which six were found to not have been violations, and for the remaining two cases, SCIC was awaiting additional information from Members (one involving the distance between weights on demersal longlines by a Korean vessel, and the other involving not using a bird exclusion device during all hauls and discarding hooks in offal by a South African vessel) (Annex 6, CCAMLR, 2011w). The most current SCIC report did not include information on the conclusion of enforcement actions taken in response to identified infractions from the most previous reporting period (CCAMLR, 2011w).

SCIC reported that there had been no cases of non-compliance with conservation measures reported during the 2010/11 fishing season as a result of at sea inspections under the CCAMLR System of Inspection (CCAMLR, 2011w).

The SCIC recommended that the Commission include a Korean-flagged vessel on the CP-IUU Vessel List based on evidence of intentional overcatch of toothfish and continuing to make sets after being notified of an area closure, however, the Republic of Korea objected to the listing based on the argument that Korea's having applied a substantial penalty to the company owning the vessel (prohibiting all of its vessels from fishing in the 2011/12 fishing season), and thus due to lack of consensus, the Commission did not implement the SCIC recommendation (CCAMLR, 2011w).

According to the CCAMLR performance review, lack of compliance with CMs by vessels flagged to Members and Acceding States appears to be primarily due to technical infractions and not "blatant acts of illegal fishing", but that, "specific information on these activities [infractions] is hard to come by," (CCAMLR, 2008a). IUU fishing for toothfish is understood to be conducted primarily by vessels of non-contracting parties (CCAMLR, 2008a). Indirectly related, a deficiency of Flag State measures, some vessel owners and operators of vessels flagged to contracting parties still exploit loopholes to circumvent CCAMLR regulations as enacted into

domestic law, such as through reflagging and through ownership arrangements (CCAMLR, 2008a).

A1.2. Commission for the Conservation of Southern Bluefin Tuna (CCSBT)

SUMMARY	
Criteria Suite Scores	
Overall	24 (± 7 SD of the mean)% ¹
Criterion 1: Data Collection	42% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	36%
Criterion 1B. Regional Observer Coverage Rates	55%
Criterion 1C. Regional Observer Programme Dataset Quality	36%
Criterion 2. Open Access to Regional Observer Programme Datasets	0%
Criterion 3. Ecological Risk Assessment	25%
Criterion 4. Conservation and Management Measures	21% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	22%
Criterion 4B. Conservation and Management Measures to Govern Bycatch in Lost, Abandoned and Discarded Gear	21%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	21%
Criterion 5. Surveillance and Enforcement	30%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The Commission for the Conservation of Southern Bluefin Tuna (CCSBT) was established by the Convention for the Conservation of Southern Bluefin Tuna, signed by Australia, Japan and New Zealand in Canberra, Australia, on 10 May 1993 and entered into force on 20 May 1994.

CCSBT RELATION TO OTHER TUNA RFMOS

While this CCSBT performance assessment is based on CCSBT governance of bycatch and discards, in practice, currently, all CCSBT southern bluefin tuna fisheries are subject to binding conservation and management measures of IOTC, WCPFC and ICCAT when occurring in their Convention Areas. CCSBT has entered agreements with the other RFMOs to clarify that CCSBT has primary competence for the management of southern bluefin tuna (CCSBT, 2008a). Currently, all fishing for southern bluefin tuna occurs within the Convention Areas of IOTC, WCPFC and ICCAT. Currently all fishing for southern bluefin tuna occurs within the Convention Areas of IOTC, WCPFC and ICCAT, where an estimated 80%, 12% and 8% of southern bluefin tuna catch comes from the IOTC, WCPFC and ICCAT areas, respectively (Gilman, 2011). Currently, all CCSBT Members and Cooperating Non-Members, excluding the Fishing Entity of Taiwan, which is not permitted to join IOTC, are also currently parties and thus subject to binding measures of IOTC, WCPFC and ICCAT, and Taiwan has committed to voluntarily comply with IOTC measures. Vessels of CCSBT members that are also members of IOTC, WCPFC and ICCAT are subject to binding measures of the other three tuna RFMOs when fishing in their Convention Areas. Hence, in practice, all CCSBT Members/Cooperating Non-Members excluding Taiwan are subject to binding measures of these three other tuna RFMOs.

MEMBERSHIP

Member of CCSBT is only open to States. The *Resolution to Establish and Extended Commission and an Extended Scientific Committee*, established in 2001, allows fishing entities to be admitted as members (CCSBT, 2003b). Taiwan was admitted to the Extended Commission and Extended Scientific Committee as a fishing entity in 2002. Decisions of the ECCSBT are reported to the CCSBT and become decisions of CCSBT unless CCSBT agrees otherwise (CCSBT, 2008a). Membership of the Extended Commission for the Conservation of Southern Bluefin Tuna and the Extended Scientific Committee also includes all parties to the Convention.

Members of the Extended Commission comprise: Australia, the Fishing Entity of Taiwan, Indonesia, Japan, Republic of Korea and New Zealand. Cooperating Non-Members comprise: the Philippines, South Africa and the European Union (CCSBT, 2011a).

MANAGED SPECIES AND FISHERIES

The convention mandate covers southern bluefin tuna (*Thunnus maccoyii*) (CCSBT, 1993 [Articles 1, 3]). CCSBT is also responsible for collecting information on “ecologically related species” defined in the convention as living marine species that are associated with SBT, including but not restricted to both predators and prey of southern bluefin tuna. The primary market for all southern bluefin tuna fisheries is the Japanese sashimi market (CCSBT, 2011b). An Australian purse seine fishery catches southern bluefin tuna, tows the catch to an area near Australia where they are then placed in floating anchored cages, where they are fattened for several months before being sold to the Japanese sashimi market (tuna ranching) (CCSBT, 2008a; Gilman, 2011). Other fisheries for southern bluefin tuna employ pelagic longline gear (CCSBT, 2010c [Attachment 12]). Pole-and-line fishing was previously employed to catch southern bluefin tuna but declined when purse seine fishing commenced and is no longer a gear type employed to catch southern bluefin tuna (personal communication, Robert Kennedy, CCSBT, 8 July 2011).

AREA OF APPLICATION

The CCSBT convention does not identify a specific geographical area to be covered by its Provisions, however, given the convention mandate, it is assumed that CCSBT’s Convention Area is the distribution of southern bluefin tuna, shown in Fig. A1.2-1. Southern bluefin tuna constitute a single stock, which spawns in a single area, south of Java (CCSBT, 2008a). Juveniles migrate from the spawning area east through the southern part of the Australian Fishing Zone towards New Zealand. Some juveniles migrate west through the Indian Ocean towards South Africa.

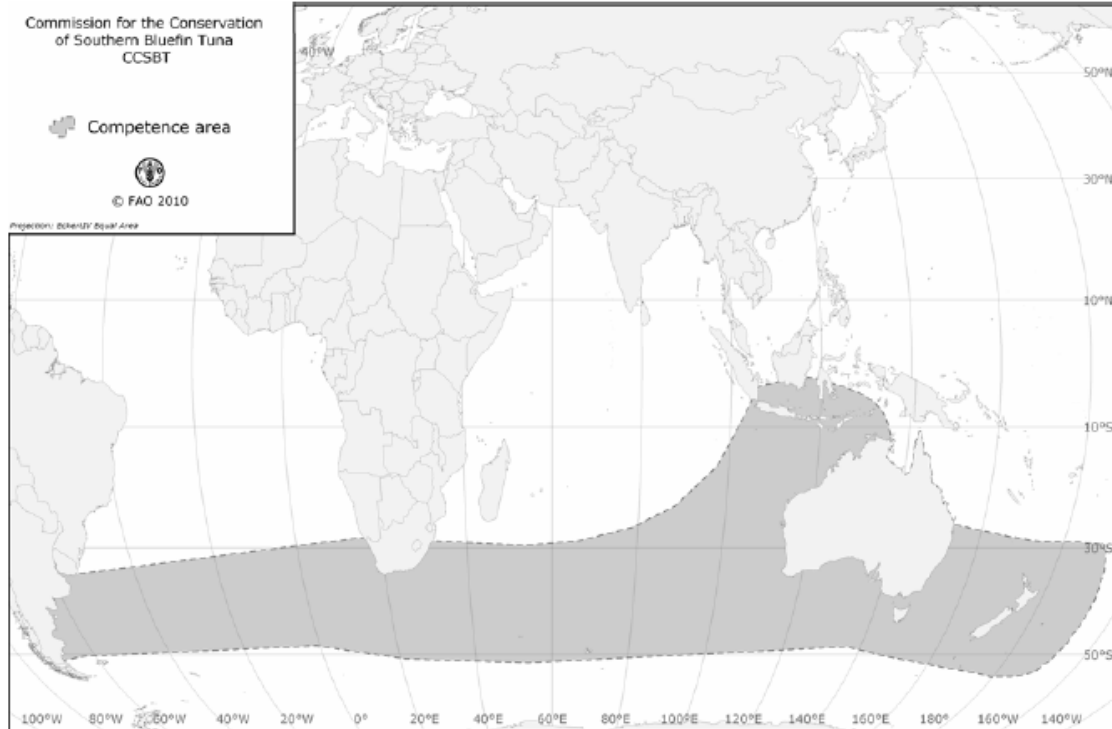


Fig. A1.2-1. CCSBT convention area, based on the distribution of southern bluefin tuna (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH, INCLUDING DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries

Score: 9 of 25 possible points, 36%.

Table A1.2-1 provides details on the assessment outcome for criterion 1A.

Table A1.2-1. Assessment of CCSBT regional observer programme data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
There is as yet unresolved disagreement amongst CCSBT members regarding whether or not CCSBT's mandate includes the conservation of ecologically related bycatch species.	0
Data for $\geq 75\%$ of documented vulnerable bycatch species are intended to be collected in fisheries with regional observer coverage. (However, only five of nine Members and Cooperating Non-Members reported information on catch levels of three of four vulnerable bycatch species groups to the most recent meeting of the CCSBT Ecologically Related Species Working Group).	3
Information on the number of individuals of documented vulnerable bycatch	1

species was collected and reported by five of nine CCSBT Members and Cooperating Non-Member national observer programmes.	
One of three items of information needed to assess performance of a binding measure requiring the use of tori lines is collected. Some Members and Cooperating Non-Members collect and report information on observed combined seabird species catch levels and observed fishing effort. Information was not identified to determine if CCSBT Members and Cooperating Non-Members collect or report information on compliance with required employment of a tori line by longline southern bluefin tuna vessels when fishing south of 30° S. latitude, and whether seabird interactions are recorded to the species level.	1
Information on fishing effort is intended to be routinely collected for fisheries with regional observer coverage.	1
Information on the disposition of discards (e.g., alive vs. dead, and possibly degree of injury) is intended to be collected for $\geq 75\%$ of identified vulnerable bycatch species.	3

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

While the collection and exchange of information on ecologically related species is within the CCSBT mandate, it remains to be resolved whether or not CCSBT's mandate includes the conservation of ecologically related bycatch species (living marine species that are associated with southern bluefin tuna fisheries). CCSBT members have disagreed over whether or not CCSBT's mandate supports the adoption of binding measures for ecologically related species, and a performance assessment referred to this discrepancy as an example to highlight the need to amend or replace the Convention to bring it in line with modern instruments (CCSBT, 2008a,b). To date, CCSBT has adopted only one binding measure, on mitigating seabird bycatch in longline southern bluefin tuna fisheries (CCSBT, 1997), which requires seabird avoidance practices that are now considered to fall short of best practice gear technology methods to address this bycatch problem due to the area where it is required, and due to the gear technology measure required (CCSBT, 2008a,b; Baker, 2010; Gilman, 2011).

- In fisheries required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

Information presented in Criterion 3 and Criterion 4A document the following potentially problematic bycatch species/groups in CCSBT-managed fisheries:

- Pelagic longline southern bluefin fisheries: Seabirds (primarily albatrosses and large petrels), sharks, sea turtles, and small swordfish (Small, 2005; CCSBT, 2008a, 2009b; Gilman, 2011). Available evidence suggests that cetacean bycatch is not problematic in fisheries targeting southern bluefin tuna (personal communication, Robert Kennedy, CCSBT, 8 July 2011).
- Australia purse seine southern bluefin fishery: No problematic bycatch identified (AFMA, 2005; CCSBT, 2009b [Attachment 4]).

Five of nine CCSBT members/cooperating non-members reported summaries of observed interactions with three of four problematic bycatch species groups (seabirds, sharks and sea turtles) to the most currently available meeting report of the CCSBT Ecologically Related Species Working Group (Indonesia, European Union, Philippines and South Africa did not report this information) (CCSBT, 2009b [Attachment 4]). The CCSBT performance review reported that there are, “Gaps in collection and reporting of data on the catch of ecologically related species,” (CCSBT, 2008a). Datasets available via the CCSBT website do not contain records of non-southern bluefin tuna catches (CCSBT, 2011c). The *CCSBT Scientific Observer Program Standards* specifies that members’ observer programmes should collect data on the observed catch of all non-target species to the extent possible, and prioritizes data collection on southern bluefin tuna before that of other tunas, billfishes, *Gasterochisma* and sharks, before that of other species (CCSBT, 2003a). The CCSBT Compliance Committee recommended the collection and reporting of all southern bluefin tuna discards levels and disposition (CCSBT, 2010a). A 2009 binding resolution required the preparation of Action Plans by CCSBT members to explain how they will verify catch data of target as well as ecologically related species as reported by fishermen, “through scientific observers on fishing vessels of coverage of 10% in terms of effort and actual inspection of catches by authorities of those flag Members and cooperating Non-Members”, however, the resolution lacks details on what information on catches of ecologically related species are required to be collected and reported (CCSBT, 2009a).

- Does the RFMO’s data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected?

Five of nine CCSBT Members and Cooperating Non-Members reported information on the number of individuals of combined species of seabirds, sharks and sea turtles observed caught (CCSBT, 2009b [Attachment 4]). The *CCSBT Scientific Observer Program Standards* call for data to be collected on the number of individuals by species caught, and the proportion that is retained vs. discarded, to be recorded (CCSBT, 2003a [Annex 1]).

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).

This information has been recorded in Table A1.2-7. There is only one relevant binding measure, requiring the employment of tori lines by CCSBT longline vessels when fishing south of 30° S. The measure lacks performance standards (e.g., there is no target seabird bycatch level or rate). Information on (i) seabird interaction levels and nominal catch rates, (ii) species affected, and (iii) compliance with the binding tori line measure, is minimal information needed to assess the efficacy of the measure. No recommendation for a minimum onboard observer coverage rate of longline vessels to provide a robust estimate of seabird bycatch rates has been made by the CCSBT Scientific Committee.

- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected in the regional observer programme according to the RFMO’s data collection protocols?

Information on seabird species-level catches is called for in the *CCSBT Scientific Observer Program Standards* but collection of data on seabirds is placed in the lowest, third priority category (CCSBT, 2003a [Annex 1]). While summary information on observed combined seabird species catch levels and observed effort has been reported by some Members and Cooperating Non-Members, information was not found to determine if seabird species-level information is being collected. Information was also not found to determine if compliance with the binding tori line measure has been routinely collected or reported to CCSBT.

- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?

Yes, because there are no required data collection protocols for bycatch and discards. The one binding bycatch measure does not require the collection or reporting of data on seabird interactions (CCSBT, 1997). A non-binding measure calls for the collection and reporting of data on ecologically related species, but does not specify what information is to be collected and reported (CCSBT, 2008a). However, CCSBT's *Scientific Observer Program Standards* recommends that the scientific observer program collect data on the retained and discarded catch of southern bluefin tuna and of other tuna and tuna-like species, and recommends data collection on other bycatch species (CCSBT, 2001c; CCSBT, 2003a [Annex 1]).

- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?

Yes. Fishing effort for southern bluefin tuna is a required reporting requirement of observers (CCSBT, 2003a). Six of nine Members and Cooperating Non-Members reported total and observed fishing effort to the most current meeting of the CCSBT Ecologically Related Species Working Group (CCSBT, 2009b [Attachment 4]).

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely by observers of the regional observer programme?

While the *CCSBT Scientific Observer Program Standards* call for data to be collected on the number of individuals by species caught, and the proportion that is retained vs. discarded, to be recorded (CCSBT, 2003a [Annex 1]), material available via the CCSBT website did not include information on data collection protocols implemented by CCSBT national observer programmes. Reported summary statistics on interactions with ecologically related species did not include information on the proportion of shark and swordfish catch that is retained vs. discarded (CCSBT, 2009b [Attachment 4]).

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

This information is identified as a data collection protocol for onboard observers in CCSBT-managed fisheries (CCSBT, 2003a). However, material available via the CCSBT website did not include information on data collection protocols implemented by CCSBT national observer programmes.

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to record at the species level?

Material available via the CCSBT website did not include information on data collection protocols implemented by CCSBT national observer programmes.

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is intended to be routinely collected by regional observers that provides a proxy for age class, identify the measurement method.

Material available via the CCSBT website did not include information on data collection protocols implemented by CCSBT national observer programmes.

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

Three of four. Five of nine Members and Cooperating Non-Members reported information on seabird, shark and sea turtle total observed catch and proportion of the total that was dead to the most current meeting of the CCSBT Ecologically Related Species Working Group (CCSBT, 2009b [Attachment 4]). The *CCSBT Scientific Observer Program Standards* call for data to be collected on the number of individuals by species caught, and the proportion that is retained vs. discarded, to be recorded (CCSBT, 2003a [Annex 1]).

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

The *CCSBT Observer Program Standards* do not mention data collection on gear remaining attached to discarded organisms (CCSBT, 2003a). Material available via the CCSBT website did not include information on data collection protocols implemented by CCSBT national observer programmes.

Criterion 1B. Regional Observer Coverage Rates

Score: 6 of 11 possible points, 55%.

Table A1.2-2 provides details on the assessment outcome for criterion 1B.

Table A1.2-2. Assessment of CCSBT onboard observer coverage rates to monitor bycatch, including discards.

Factor	Points for positive response
Ca. 70% of Member and Cooperating Non-Member's southern bluefin tuna	3

fisheries have $\geq 5\%$ regional onboard observer coverage.	
The RFMO's scientific body has recommended target onboard observer coverage rates for each managed fishery, and the regional onboard observer coverage rates meet scientific advice for ~70% of Members/Cooperating Non-Members southern bluefin tuna fisheries.	3
There is no international exchange of observers.	0

Information used for assessment:

- What recommendations on regional observer coverage rates have the RFMO's scientific body or the Commission made for fisheries under the RFMO's mandate?

CCSBT's scientific observer program standards identify a target observer coverage rate of 10% (CCSBT, 2008a). The scientific rationale for this coverage rate was not identified.

- Does a regional observer programme exist?

Yes, CCSBT member States are required to provide 10% onboard observer coverage of CCSBT-managed fisheries (CCSBT, 2008a). A recommendation to establish a regional observer programme administered by CCSBT has been introduced (paper CCSBT-CC/1010/BGD02) (CCSBT, 2010a).

- What are regional onboard observer coverage rates in each active fishery managed by the RFMO?

Most current year observer coverage rates as reported to the most recent meeting of the CCSBT Ecologically Related Species Working Group were 31.2% for New Zealand longline fishery, 5.7% for Japan longline fishery, 11.9% and 11.3% for Australia purse seine and longline fisheries, respectively, 6.7% Taiwan longline fishery, 3.8% Korean longline fishery, and 14% and 100% for the South Africa domestic and charter longline fisheries, respectively (CCSBT, 2009b [Attachment 4]). Indonesia, European Union and the Philippines did not report information on observer coverage rates.

Australia reported in 2010 to have a target onboard observer coverage rate of 10% for purse seine and cage towing operations, and a minimum of 10% coverage of longline vessels in zones where southern bluefin tuna catch is likely to occur (CCSBT, 2010a [Attachment 5]). Japan reported having 10% coverage of CCSBT-managed fisheries in 2010 (CCSBT, 2010a [Attachment 5]), however, reports having <10% coverage of longline vessels in 2009 (7.4% of vessels, 4.8% of hooks, 4.6% of southern bluefin tuna catch) (CCSBT, 2010c). New Zealand reported their 2009 onboard observer coverage rates to be 10% of catch and effort for the New Zealand domestic southern bluefin tuna fleet, and 82% of effort and 89% of catch for the charter fleet (CCSBT, 2010a [Attachment 5]). Korea reports that they maintain > 10% coverage of CCSBT-managed fisheries (CCSBT, 2010a [Attachment 5]). Taiwan reported in CCSBT (2010c) having 11.8% coverage of vessels and 10.2% of hooks in 2009. European Union's reports to the 2010 meeting of the CCSBT Compliance Committee did not identify onboard observer coverage rates of their CCSBT-managed fisheries (CCSBT, 2010a [Attachment 5]). In their opening statement to the 2010 Extended Commission of the Seventeenth Annual Meeting of the Commission, South Africa states that onboard observer coverage exceeds 10% (CCSBT, 2010b).

There was no information on onboard observer coverage rates of Indonesia and the Philippines (CCSBT, 2010a [Attachment 5], 2010c). Indonesia reported, “Scientific observer performance in 2010 reveals a lower coverage compared to subsequent years,” but does not report what the coverage rate was (CCSBT, 2010c).

CCSBT (2008a) reported that data collection and reporting requirements have, “not been implemented very well”. The CCSBT Compliance Committee reported in 2010 the need for CCSBT members and cooperating non-members to report observer coverage rates, suggesting that, to date, information on compliance with agreed observer coverage rates has not always been reported by some members (CCSBT, 2010a).

- If there have been recommendations for onboard observer coverage rates by the RFMO’s scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body’s recommendations? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

7 of 10 of Members/Cooperating Non-Members southern bluefin tuna fisheries are in compliance. Based on information presented in CCSBT (2010a [Attachment 5], 2010b, and 2010c), 6 CCSBT Members/Cooperating Non-members are in compliance (Australia, Japan, New Zealand, South Africa, Taiwan, Korea) comprising a total of 7 fisheries (Australia having two southern bluefin fisheries, one purse seine, one longline) and information was not available to determine if 3 other members/cooperating non-members are in compliance with required onboard observer coverage rates (European Union, Indonesia, Philippines).

- For each fishery under the RFMO’s mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

National observers are placed by member States on their vessels. The *CCSBT Scientific Observer Program Standards* recommends the international exchange of observers (CCSBT, 2003a), however this has not been implemented to date (CCSBT, 2008a,b).

Criterion 1C. Regional Observer Programme Dataset Quality

Score: 4 of 11 possible points, 36%.

Table A1.2-3 provides details on the assessment outcome for criterion 1C.

Table A1.2-3. Assessment of CCSBT observer programme data quality.

Factor	Points for positive response
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A regional observer programme exists comprised of national observer programmes, with records of bycatch and possibly with information on whether non-target catch is retained vs. discarded. CCSBT members are obligated to maintain a target of 10% observer coverage of CCSBT-managed southern bluefin tuna fisheries, and to collect data on non-target species retained and discarded catch.	1
There is no regional observer programme database comprised of records pooled from observed national fisheries; and individual national observer programme datasets are not reported to CCSBT.	0
CCSBT requirement for members to maintain observer programmes has existed for 8 years.	2
All countries with fisheries under the RFMO's mandate are Members or Cooperating Non-Members.	1

Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include records on bycatch?

Members and Cooperating Non-Members are required to collect onboard observer data in accordance with the CCSBT scientific observer program standards, which calls for data collection on all species of retained and discarded bycatch, however, these national observer programme datasets are not reported to CCSBT or pooled (CCSBT, 2008a). Australia and New Zealand report observed catch and effort for all bycatch species, and Taiwan reports catch and effort for a subset of bycatch species (personal communication, Robert Kennedy, CCSBT, 8 July 2011). The most current report of the CCSBT Ecologically Related Species Working Group provides summary statistics on observed catches of some bycatch species (seabirds, seas turtles, sharks), but not information on the proportion of catch that was retained vs. discarded for relevant groups (sharks), where this information was reported for 5 of 9 Members and Cooperating Non-Members (CCSBT, 2009b [Attachment 4]).

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

Onboard observer data collected by CCSBT member States are not reported to CCSBT, "unless it is included in papers submitted by that member to the scientific committee or its working groups," (CCSBT, 2008a).

- What is the length in years of the regional observer programme dataset?

Eight years. The CCSBT Scientific Observer Program was initiated in 2003 (personal communication, Robert Kennedy, CCSBT, 8 July 2011). However, noting that national observer programme datasets are not reported to the RFMO Secretariat.

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

While the *CCSBT Observer Program Standards* call for representative distribution of observer coverage (CCSBT, 2003a), information on onboard observer coverage seasonal distribution by CCSBT members' national observer programmes was not available via the CCSBT website.

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

While the *CCSBT Observer Program Standards* call for representative spatial distribution of observer coverage (CCSBT, 2003a), information on onboard observer coverage distribution by CCSBT members' national observer programmes was not available via the CCSBT website.

- Which countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members?

The main coastal States and fishing nations for southern bluefin tuna are now all either CCSBT members or cooperating non-members (CCSBT, 2008a). Information was not found identifying additional States with fisheries for southern bluefin tuna that are not already CCSBT members.

In the recent past, the lack of participation by some fishing States was identified as a problem. An Action Plan was adopted in 2000 to address the problem of non-members fishing for southern bluefin tuna not implementing CCSBT conservation and management measures, and subsequently, four resolutions adopted from 2000-2002 identified Belize, Cambodia, Equatorial Guinea, Honduras, and Indonesia as non-member States fishing for southern bluefin tuna (CCSBT, 2000a,b, 2001a,b, 2002).

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

CCSBT does not exempt vessel classes from the target 10% onboard observer coverage rate (CCSBT, 2003a).

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

CCSBT members are not required and do not routinely report primary data collected by national observer programmes of CCSBT-managed fisheries to the Secretariat.

Criterion 2. Open access to bycatch data

Score: 0 of 15 possible points, 0%.

Table A1.2-4 provides details on the assessment outcome for criterion 2.

Table A1.2-4. Assessment of CCSBT provision of open access to a regional observer programme datasets.

Factor	Points for positive response
There are no publically available datasets of amalgamated or primary data records with information on bycatch from CCSBT Member and Cooperating Non-Member national observer programs for southern bluefin tuna fisheries.	0

Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

Yes, some of the CCSBT Member and Cooperating Non-Member national observer programmes are documented to collect information on some or all bycatch species (CCSBT, 2009b [Attachment 4]). Datasets available via the CCSBT website do not contain records of non-southern bluefin tuna catches (CCSBT, 2011c).

- What confidentiality rules have been adopted on access to data on bycatch, including discards, that the RFMO owns or holds as a custodian?

CCSBT does not receive national onboard observer programme datasets. In 2010, CCSBT adopted *Rules and Procedures for the Protection, Access to, and Dissemination of Data Compiled by the CCSBT* to deal with the release of data from the CCSBT central database (CCSBT, 2010d), which superseded a *Data Confidentiality Policy* (CCSBT10 report/2003) (CCSBT, 2008a).

- Are primary or amalgamated data collected in the regional observer programme made available as an open public resource?

CCSBT provides open access to amalgamated summary statistics of target southern bluefin tuna landings (not discarded catches) (CCSBT, 2011c).

- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤ 5 degree cells, > 5 degree cells, or is information on resolution of records in the publically available dataset not specified?

Not applicable, there are no publically available observer programme datasets, and records that are available via CCSBT do not include landed and discarded non-target species (CCSBT, 2011c).

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

Not applicable, there are no publically available observer programme datasets and records that are available via CCSBT do not include landed and discarded non-target species (CCSBT, 2011c).

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

0 of 2; no publically available observer programme datasets were identified for purse seine or longline southern bluefin tuna fisheries and records that are available via CCSBT do not include landed and discarded non-target species (CCSBT, 2011c).

Criterion 3: Ecological risk assessment

Score: 2 of 8 possible points, 25%.

Table A1.2-5 provides details on the assessment outcome for criterion 3.

Table A1.2-5. Assessment of CCSBT ecological risk assessment.

Factor	Points for positive response
Level 2 and/or 3 assessment has been conducted for either the effects of fishing on bycatch species or the effects of bycatch removals on the integrity of the ecosystem, but not both, for at least 1 CCSBT Member/Cooperating Non-Member fishery.	2

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

Neither CCSBT nor its subsidiary bodies have conducted ecological risk assessments of effects of CCSBT-managed fisheries on ecologically related species, or considered the wider impacts of southern bluefin tuna fishing mortality on the living marine resources and marine ecosystems (CCSBT, 2008a). Identifying this gap, the CCSBT performance assessment report recommended that, “CCSBT needs to at the very least assess and have ongoing monitoring of the risks and impacts of SBT fisheries on ERS species and adopt an appropriate mitigation strategy to address those risks and impacts,” (CCSBT, 2008a).

AFMA (2005) conducted a Level 1 ecological risk assessment of the Australia purse seine southern bluefin tuna fishery, and a more rigorous assessment was identified as being planned.

Small (2005) conducted a partial Level 2 risk assessment, by assessing the overlap of 14 RFMO areas with albatross distributions.

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

The assessment conducted by the Australian government of the Australia purse seine southern bluefin tuna fishery used to supply ranching facilities assessed risks the fishery poses on species subject to bycatch, but did not assess the ecosystem effects of bycatch removals (AFMA, 2005). Small (2005) assessed the risk to one vulnerable species group by CCSBT pelagic longline fisheries. No other assessments were identified that investigate the risk of CCSBT-managed longline fisheries to other vulnerable species, or the effects of bycatch removals on ecosystem integrity.

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

The Australia purse seine southern bluefin tuna fishery was documented to have extremely low bycatch levels with no problematic bycatch identified (AFMA, 2005). The fishery has documented bycatch of skipjack and yellowfin tunas, and rare event interactions with sharks and marine mammals during cage towing (AFMA, 2005). The assessment did not evaluate the ecosystem effects from removals of bycatch species, however, hypothesized that these are nominal due to low bycatch levels (AFMA, 2005).

Small (2005) determined that, of 14 evaluated RFMOs, CCSBT had the highest overlap with albatross distributions.

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch

Score: 4 of 18 possible points, 22%

Table A1.2-6 provides details on the assessment outcome for criterion 3.

Table A1.2-6. Assessment of CCSBT conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
One or more bycatch problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in place to mitigate at least one identified problem but <50% of the number of identified problems (1 of 4, 25%).	1
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.

From criterion 3, ecological risk assessments identified the following problematic bycatch and discards in CCSBT-managed fisheries:

- Pelagic longline southern bluefin fisheries: Seabirds (primarily albatrosses and large petrels) (Small, 2005).
 - Australia purse seine southern bluefin fishery: No problematic bycatch identified (AFMA, 2005).
- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

Seabirds, sharks, marine mammals and other tuna species are known to interact with both purse seine and longline southern bluefin tuna fisheries (CCSBT, 2008a). Marine mammal interactions are understood to not be problematic in southern bluefin tuna longline fisheries (personal communication, Robert Kennedy, CCSBT, 8 July 2011). In general, in longline tuna fisheries, there can be problematic bycatch of certain seabird species, sea turtles, sharks, cetaceans, small swordfish, and other non-targeted fish (Gilman, 2011). In general, in purse seine tuna fisheries, there can be problematic bycatch of certain shark species, sea turtles, whales, juvenile/small non-target species of tunas, and other non-target fish, primarily for sets made on floating objects (Gilman, 2011). The Australian purse seine southern bluefin tuna fishery does not employ FADs (AFMA, 2005), suggesting that CCSBT measures are not likely needed to address bycatch in the Australia purse seine fishery (Gilman, 2011).

In summary, potential problematic bycatch/discards in CCSBT-managed fisheries, identified via studies other than ecological risk assessments, are seabirds, sea turtles, sharks, and small swordfish in pelagic longline southern bluefin fisheries (CCSBT, 2008a; Gilman, 2011).

- Using Table A1.2-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

This information has been recorded in Table A1.2-7.

- From the responses to the first two bullets, list each individual documented bycatch problem.

A summary of identified or potential problematic bycatch and discard problems in CCSBT-managed fisheries are:

- Pelagic longline southern bluefin fisheries: Seabirds, sea turtles, sharks, and small swordfish (Small, 2005; CCSBT, 2008a; Gilman, 2011).
- Australia purse seine southern bluefin fishery: None.

- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

One of the four bycatch problems: one binding CCSBT measure aims to mitigate seabird bycatch in longline southern bluefin tuna fisheries.

- What proportion of binding bycatch measures contain quantitative, measurable performance standards?

0 of 1. The CCSBT seabird measure does not include a performance standard.

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

Not applicable, the one relevant binding measure does not include performance standards.

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

Not applicable, none of the relevant binding measures contain performance standards. The CCSBT seabird bycatch mitigation measure has been critiqued to not meet best practices due to the area where it is required, and due to the gear technology measure required (CCSBT, 2008a,b; Baker, 2010; Gilman, 2011).

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

Not applicable, none of the relevant binding measures contain performance standards. While the CCSBT seabird bycatch mitigation measure has been critiqued to not meet best practices (CCSBT, 2008a,b; Baker, 2010; Gilman, 2011), an amended binding measure has not been proposed to address deficiencies/improve efficacy.

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

The CCSBT Convention does not allow for Members to opt out of binding measures or provisions of the Convention (CCSBT, 1993 [Article 19]).

Table A1.2-7. Active CCSBT legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
In 1997, required pelagic longline vessels to employ bird scaring (tori) lines south of 30° S. (CCSBT, 1997), In 1999, adopted non-binding guidelines on the best practice design and use of tori lines, recommending avoiding the discard of offal during setting and hauling, and recommending the use of thawed baits by pelagic longline vessels (CCSBT, 1999).	No performance standards are stipulated.	Longline vessel position during fishing operations; Tori line deployment when longline southern bluefin vessels are fishing south of 30°S; Authorized vessel list.	c, b or d, e
Sea turtles			
NA – no binding measures. A non-binding recommendation calls for CCSBT member compliance with measures aimed at protecting ecologically related species adopted by IOTC and WCPFC when fishing in	NA	NA	NA

their respective convention areas (CCSBT, 2008c).			
Marine mammals			
NA – no binding measures. A non-binding recommendation requires compliance with IOTC and WCPFC measures on protecting ecologically related species when fishing in the IOTC and WCPFC areas (CCSBT, 2008c), however, neither of these two RFMOs have relevant measures in place (Gilman, 2011).	NA	NA	NA
Shark and relatives			
NA – no binding measures. A non-binding recommendation calls for CCSBT member compliance with measures aimed at protecting ecologically related species adopted by IOTC and WCPFC when fishing in their respective convention areas (CCSBT, 2008c).	NA	NA	NA
Juvenile and small/undersized target species			
NA – no measures on bycatch of juvenile and small southern bluefin tunas.	NA	NA	NA

Unmarketable sizes and species of non-target species of fish			
NA – no measures on bycatch of unmarketable species and/or sizes of non-target fish species. A non-binding recommendation calls for CCSBT member compliance with measures aimed at protecting ecologically related species adopted by IOTC and WCPFC when fishing in their respective convention areas (CCSBT, 2008c).	NA	NA	NA
Other or multiple bycatch species group(s)			
NA – no relevant measures.	NA	NA	NA

Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 3 of 14 possible points, 21%

Table A1.2-8 provides details on the assessment outcome for criterion 3.

Table A1.2-8. Assessment of CCSBT conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
For fisheries managed by the RFMO for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are not in place.	0
There is no provision that allows CCSBT Members to opt out of binding measures.	3

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

No CCSBT assessments of ghost fishing in CCSBT-managed fisheries were identified.

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

In general, ghost fishing is problematic with passive fishing gear such as pelagic longline, gillnets, trammel nets, and traps, while the catching process of active gears, such as trawls and seines, ceases when the gear is no longer attached to the vessel (FAO, 2005a, 2010d). Ghost fishing has been observed in seine nets (Matsuoka et al., 2005). While ghost fishing from FADs used by purse seine and other gear types has been documented to be problematic (Chanrachkij et al., 2008; Gilman, 2011), the one CCSBT-managed purse seine fishery operated by Australia does not employ FADs (AFMA, 2005). In conclusion, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in CCSBT-managed fisheries.

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table A1.2-9);

There are no relevant binding measures. CCSBT has not adopted any measures to minimise pollution, waste, discards, or catch by lost or abandoned gear (CCSBT, 2008a).

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

0 of 2 (ghost fishing might be problematic in pelagic longline and purse seine southern bluefin tuna fisheries), there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures in place.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures in place.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

The CCSBT Convention does not allow for Members to opt out of binding measures or provisions of the Convention (CCSBT, 1993 [Article 19]).

Table A1.2-9. Active CCSBT legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	NA	NA	NA

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea

Score: 3 of 14 possible points, 21%

Table A1.2-10 provides details on the assessment outcome for criterion 4C.

Table A1.2-10. Assessment of CCSBT conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed fisheries, and no relevant binding measures are in place.	0
There is no provision that allows CCSBT Members to opt out of binding measures.	3

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

No relevant research on ecological risks from organic discharges from CCSBT-managed fisheries was identified.

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from the these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

No information was identified on risks from pollution from discards (discarded catch, offal and spent bait) from managed fisheries. Discharges from CCSBT-managed fisheries likely occur in deep regions of the ocean. An unknown proportions of these discharges may settle through the water column without being consumed, altering the benthic community, and transferring and locking up biomass in bottom currents for centuries before recycling to the euphotic zone of the pelagic ecosystem (Hall et al., 2000).

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table A1.2-11).

There are no relevant binding measures.

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

No relevant research was identified for effects of pollution from discharges from managed fisheries, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

The CCSBT Convention does not allow for Members to opt out of binding measures or provisions of the Convention (CCSBT, 1993 [Article 19]).

Table A1.2-11. Active CCSBT legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	NA	NA	NA

Criterion 5. Surveillance and enforcement

Score: 6 of 20 possible points, 30%

Table A1.2-12 provides details on the assessment outcome for criterion 3.

Table A1.2-12. Assessment of CCSBT measures and resources for surveillance and enforcement.

Factor	Points for positive response
≥50% but <75% of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	3
CCSBT has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

CCSBT maintains a list of vessels authorised to fish for southern bluefin tuna, and a list of authorised carrier vessels – vessels that receive at-sea transshipments of southern bluefin tuna from longline vessels. Vessels not on the lists are deemed to have undertaken IUU fishing (CCSBT, 2008a,f). CCSBT also maintains a list of authorised farms for southern bluefin tuna (CCSBT, 2010e). CCSBT Members and Cooperating Non-Members are required to not allow the trade of southern bluefin tuna sourced from fishing vessels and farms, or transshipped to carrier vessels that are not on these CCSBT authorised lists. CCSBT requires Members and Cooperating Non-Members to implement VMS systems for fishing vessels catching southern bluefin tuna, but there is no regional VMS system managed by CCSBT (CCSBT, 2006, 2008a,d). A CCSBT Scientific Observer Program Standard has a target of 10% observer coverage (CCSBT, 2008a). CCSBT has monitored since 2009 the transshipments by large-scale longline fishing vessels to carrier vessels authorised to receive transshipments at sea from these vessels (CCSBT, 2008e). A CCSBT, ICCAT, or IOTC observer is required to be onboard carrier vessels during transshipments from longline vessels (CCSBT, 2008e).

CCSBT implemented a southern bluefin tuna Trade Information Scheme (also referred to as a Statistical Document Programme) since 2000, but it was limited in that it only tracked international trade (CCSBT, 2008a). A CCSBT Catch Documentation Scheme for southern bluefin tuna came into effect on 1 January 2010 and replaced the Trade Information Scheme, which tracks the landing of all southern bluefin tuna regardless of whether they are traded domestically or internationally (CCSBT, 2010f).

There is no CCSBT boarding or inspection scheme, or CCSBT IUU list.

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.2-7, A1.2-9, and A1.2-11)? For example, measures to support

surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

This information has been recorded in Table A1.2-7. Surveillance methods to enable an assessment of compliance of the one binding measure on seabird bycatch are (i) authorised list of longline vessels, (ii) VMS (to determine when a longline vessel is fishing south of the northern boundary below which longline SBT vessels must employ a tori line), and (iii) either 100% onboard observer coverage or aerial or boat-based at-sea inspections to determine if longline vessels deploy tori lines in the required area. Of these minimum surveillance methods, CCSBT has an authorised vessel list and VMS requirement, but does not provide 100% observer coverage or have a process for at-sea inspections (2 of 3).

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

No. CCSBT has no provisions requiring members to report on their enforcement procedures and conclusions, or for penalising infringements of its measures (CCSBT, 2008a).

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

Yes. CCSBT has a Compliance Committee, which held its inaugural formal meeting in 2006 (CCSBT, 2008a). The Compliance Committee is tasked to: (i) monitor, review and assess compliance with conservation and management measures, (ii) exchange information on compliance, and (iii) report and provide recommendations to CCSBT on addressing non-compliance (CCSBT, 2008a). However, to date, the Compliance Committee has not, “undertaken routine assessment of member and cooperating non-member compliance with CCSBT measures,” (CCSBT, 2008a).

- Is there evidence that detected infringements of the RFMO’s legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

No. No information was identified to determine if surveillance occurs to determine compliance with the one binding measure related to bycatch mitigation, and no

information was identified documenting a reported infringement of this measure. In 2006 CCSBT determined that reported southern bluefin tuna landings over the past one to two decades were underreported, but no indication of sanctions to address this infringement were identified (CCSBT, 2008a,b).

A1.3. General Fisheries Commission for the Mediterranean (GFCM)

SUMMARY	
Criteria Suite Scores	
Overall	14 (± 6 SD of the mean)% ¹
Criterion 1: Data Collection	3% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	0%
Criterion 1B. Regional Observer Coverage Rates	0%
Criterion 1C. Regional Observer Programme Dataset Quality	9%
Criterion 2. Open Access to Regional Observer Programme Datasets	0%
Criterion 3. Ecological Risk Assessment	25%
Criterion 4. Conservation and Management Measures	13% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	39%
Criterion 4B. Conservation and Management Measures to Govern Bycatch in Lost, Abandoned and Discarded Gear	0%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	0%
Criterion 5. Surveillance and Enforcement	30%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The General Fisheries Commission for the Mediterranean (GFCM) is an FAO body. It was established by an agreement under Article XIV of the FAO Constitution, which was approved by the FAO Conference in 1949. The agreement entered into force in 1952 and was subsequently amended in 1963, 1976 and 1997. The amendments changed the RFMO's name (previously named the General Fisheries Council for the Mediterranean) and added new obligations for contracting parties, including their contributions to an autonomous budget for the functioning of the Commission. The amendments came into force in 2004 (GFCM, 2011b).

MEMBERSHIP

GFCM's 24 members are Albania, Algeria, Bulgaria, Croatia, Cyprus, Egypt, European Union, France, Greece, Israel, Italy, Japan, Lebanon, Libyan Arab Jamahiriya, Malta, Monaco, Montenegro, Morocco, Romania, Slovenia, Spain, Syrian Arab Republic, Tunisia, Turkey (GFCM, 2011a,b). The GFCM agreement does not include provisions relating to the cooperation of non-Members (GFCM, 1963, 2011a). Membership is open to both Mediterranean coastal states and regional economic organizations as well as to United Nations member states whose vessels engage in fishing in Mediterranean waters (GFCM, 1963, 2011b).

MANAGED SPECIES AND FISHERIES

All living marine resources in the GFCM area of application are managed by GFCM (GFCM, 2011b). GFCM manages fisheries for small pelagics, bottomfish fisheries for mixed demersal

fish and invertebrate species employing small mesh trawls, gillnets, trammel nets, traps, pots and dredges, and fisheries for large pelagics (GFCM, 2011a). Sardine, anchovy, and spart comprise about half of Mediterranean catches of small pelagic. More than 100 demersal species are caught in bottomfish fisheries. The main large pelagic species are bluefin tuna and swordfish (GFCM, 2011a). The GFCM Scientific Advisory Committee has identified 38 shared stocks (stocks of fish and invertebrates with a distribution that overlaps domestic waters of two or more countries or occur on the high seas) (GFCM, 2006a [Appendix H]). The following 13 GFCM fisheries categories have been identified as under the management of GFCM: (i) polyvalent (use multiple gear) small-scale vessels <12m in overall length without an engine; (ii) polyvalent small-scale vessels <6m in overall length with an engine; (iii) polyvalent small-scale vessels 6-12m in overall length with engines; (iv) more than half of effort operating with a demersal trawl for vessels <12m in overall length; (v) more than half of effort operating with a demersal trawl for vessels 12-24m in overall length; (vi) more than half of effort operating with a demersal trawl for vessels >12m in overall length; (vii) more than half of effort operating with a purse seine for vessels 6-12m in overall length; (viii) more than half of effort operating with a purse seine for vessels >12m in overall length but excluding vessels that use a tuna seine during any time of the year; (ix) more than half of effort operating with a longline for vessels >6m in overall length; (x) more than half of effort operating with a pelagic trawl for vessels >6m in overall length; (xi) vessels that operate with a tuna seine for any length of time during the year; (xii) more than half of effort operating with a dredge for vessels >6m in overall length; (xiii) polyvalent vessels that use different gears with no clear predominance of one gear or that use a gear not included in defined, for vessels >12m in overall length (GFCM, 2009a [Annex 1]).

AREA OF APPLICATION

The GFCM area of application consists of the Mediterranean Sea, Black Sea and connecting waters (Fig. A1.3-1) (GFCM, 2011a). All Black Sea coastal States have declared EEZs, and thus all of the GFCM area of application in the Black Sea is under national jurisdiction. Most Mediterranean Sea coastal States have not declared EEZs, and thus a large portion of the Mediterranean is high seas (GFCM, 2011a).

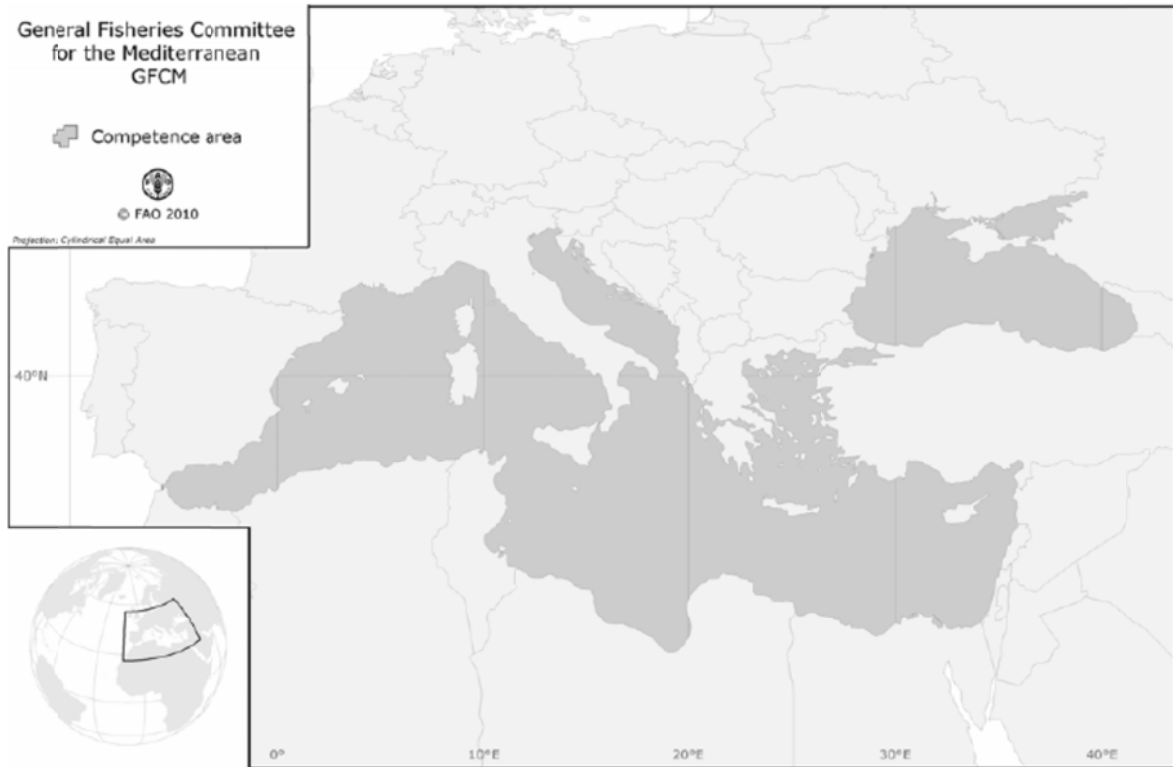


Fig. A1.3-1. GFCM convention area (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH, INCLUDING DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries

Score: 0 of 25 possible points, 0%.

Table A1.3-1 provides details on the assessment outcome for criterion 1A.

Table A1.3-1. Assessment of GFCM regional observer programme data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are not included in the RFMO's mandate.	0
There is no regional onboard observer programme. Data on bycatch species or groups are not collected by a regional observer programme..	0

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

All living marine resources in the GFCM area of application are managed by GFCM (GFCM, 2011b). However, the GFCM Agreement does not include consideration of non-target species (GFCM, 2011a). The Subcommittee on Marine Environment and Ecosystems includes working groups on selectivity and bycatch (GFCM, 2011a).

- In fisheries required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

There is no GFCM regional observer programme (GFCM, 2011a). The prescribed format for National Reports to GFCM does not include reporting information on catch or landings of non-target species (GFCM, 2007a). GFCM Members are required to report data and information under 13 frameworks, including for regional Fleet Register (vessel characteristics, gears used, fishing grounds), Licenses (date of validity, vessel identification, gears used, fishing grounds), Sales Notes (volume of fish sold by species and value), VMS (VMS data provides an indication of fishing effort), Logbooks and other catch and effort reporting mechanisms (catch activity) (GFCM, 2010k). GFCM National Reports do not include catch or landings of non-target species (GFCM, 2007a). Logbook data capture information on fishing effort and catch of GFCM priority species (GFCM, 2010i). Catch data have been collected for species complexes and spatial assessment units used for statistical purposes may not correspond to meaningful biological units (GFCM, 2011a). The Programme of Work for the Intersessional Period 2010 called for the development of a form for the collection of data on bycatch of endangered species (GFCM, 2010i). A limited GFCM onboard observer programme was implemented from 2003-2009 on French demersal and pelagic trawlers as part of a programme to evaluate options for reporting catches in the GFCM logbook, where catches were reported on a per-trip basis, and while both retained and discarded catch were recorded, only retained catch was included in analyses (Vigneau, 2010).

- Does the RFMO's data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected?

There is no GFCM regional observer programme (GFCM, 2011a).

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).

This has been recorded in Tables A1.3-7, 9 and 11.

- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected in the regional observer programme according to the RFMO's data collection protocols?

31% (4 out of 13) of requisite information is routinely collected. However, none of the information needed to assess the performance of binding GFCM Recommendations is collected via a regional onboard observer programme. However, member vessel logbooks are required to include the following four pieces of information, which are part of

the suite of information needed to assess binding measure performance: (i) the quantity of retained catch by species above 50kg in live weight, (ii) date of capture, (iii) location of capture, and (iv) gear employed (GFCM, 2010b). Information required to assess the performance of binding measures that is not required to be collected and reported is: (i) shark handling and release practices, (ii) gear design, (iii) bathymetry of fishing grounds, (iv) amount of fishing effort occurring on FADs, (v) total catch composition and weight by species (retained and discarded catch), (vi) composition of catch that is retained and transshipped, (vii) fishing effort by gear type by GFCM statistical area, (viii) date of fishing effort (e.g., date and time of the start and end of sets and hauls), and (ix) location of fishing effort.

- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?

There is no GFCM regional observer programme (GFCM, 2011a). The GFCM SCMEET and the 13th meeting of the GFCM Coordination Meeting of the Sub-Committees recommended that the recording and submission of data on the bycatch of elasmobranchs, gelatinous zooplankton and algae, and red coral (a commercially targeted precious coral) be required of GFCM Members (GFCM, 2010l, 2010o), but this recommendation has not been implemented through a binding GFCM Recommendation.

- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?

There is no GFCM regional observer programme (GFCM, 2011a). The GFCM SAC recommended the establishment of a GFCM Regional Fleet Register in order to enable monitoring of fishing capacity, such as vessel gross tonnage and power, but did not recommend the collection of information on fishing effort (GFCM, 2011a). GFCM (2010b) established required information to be reported on fishing effort for vessels $\geq 15\text{m}$ in overall length.

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely by observers of the regional observer programme?

There is no GFCM regional observer programme (GFCM, 2011a).

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

There is no GFCM regional observer programme (GFCM, 2011a).

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to record at the species level?

There is no GFCM regional observer programme (GFCM, 2011a).

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is

intended to be routinely collected by regional observers that provides a proxy for age class, identify the measurement method.

There is no GFCM regional observer programme (GFCM, 2011a).

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

There is no GFCM regional observer programme (GFCM, 2011a).

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

There is no GFCM regional observer programme (GFCM, 2011a).

Criterion 1B. Regional Observer Coverage Rates

Score: 0 of 11 possible points, 0%.

Table A1.3-2 provides details on the assessment outcome for criterion 1B.

Table A1.3-2. Assessment of GFCM onboard observer coverage rates to monitor bycatch, including discards.

Factor	Points for positive response
No GFCM-managed fisheries have regional onboard observer coverage.	0
No recommendations from the GFCM SAC or other committee were identified related to regional onboard observer coverage rates. The Control and Enforcement Scheme may support future GFCM Recommendations that establish a regional onboard observer programme (GFCM, 2011a).	0
There is no international exchange of observers in a regional onboard observer programme.	0

Information used for assessment:

- What recommendations on regional observer coverage rates have the RFMO's scientific body or the Commission made for fisheries under the RFMO's mandate?

No recommendations from the GFCM SAC or other committee were identified related to regional onboard observer coverage rates. The Control and Enforcement Scheme may support future GFCM Recommendations that establish a regional onboard observer programme (GFCM, 2011a). Related, GFCM (2010n) discusses alternatives for standardizing data collecting via at-sea surveys.

- Does a regional observer programme exist?

There is no GFCM regional observer programme (GFCM, 2011a). However, vessels of Member States of ICCAT fish in the GFCM area for GFCM-managed species and fisheries.

Refer to Appendix A1.6 for information on ICCAT regional onboard observer coverage, summarized as follows: In 2008, ICCAT adopted a resolution calling for the establishment of a regional observer program for eastern Atlantic bluefin tuna fisheries and ranching operating in the eastern Atlantic and Mediterranean Sea, as part of the multiannual bluefin tuna recovery plan, which is not yet operative (ICCAT, 2008a, AIDCP, 2009a). Full coverage is planned for ICCAT purse seine vessels with length > 24 m during a two month open season period, and for all purse seiners involved in joint fishing operations regardless of the vessel length. The program will be coordinated by the Secretariat, and operated by private fisheries monitoring companies (ICCAT, 2008a, AIDCP, 2009a). Under the resolution, ICCAT Contracting Parties are to ensure 20% coverage of bluefin-targeting longline vessels and 20% coverage of purse seine vessels between 15-24 m in overall length; ICCAT Members are responsible for providing observers to meet this target, with no requirements for international exchange of observers or pooling Member datasets (AIDCP, 2009a).

- What are regional onboard observer coverage rates in each active fishery managed by the RFMO?

There is no GFCM regional observer programme (GFCM, 2011a).

- If there have been recommendations for onboard observer coverage rates by the RFMO's scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body's recommendations? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

Not applicable - there were no identified recommendations for regional onboard observer coverage rates in GFCM-managed fisheries.

- For each fishery under the RFMO's mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

There is no GFCM regional observer programme (GFCM, 2011a).

Criterion 1C. Regional Observer Programme Dataset Quality

Score: 1 of 11 possible points, 9%.

Table A1.3-3 provides details on the assessment outcome for criterion 1C.

Table A1.3-3. Assessment of GFCM observer programme data quality.

Factor	Points for positive response
A regional observer programme database with records of bycatch does not exist.	0
All countries with fisheries under the RFMO's mandate are Members or Cooperating Non-Members.	1

Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include records on bycatch?

No, there is no GFCM regional observer programme (GFCM, 2011a). The prescribed format for National Reports to GFCM does not include reporting information on catch or landings of non-target species (GFCM, 2007a).

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

GFCM does not receive or pool Member's national-level observer programme datasets. A standardized questionnaire designed for reporting production data was in effect for three years, expiring in 2010, however, most Members did not employ the standardized format to report their catch data (GFCM, 2010g). The Medlem database includes about 1,000 records of the occurrence of sharks and their relatives, of which about 40% are documented as derived from fisheries catch data (Baino et al., 2010).

- What is the length in years of the regional observer programme dataset?

Not applicable, there is no GFCM regional observer programme (GFCM, 2011a). Summary statistics, from 1970 onwards, on the volume of reported landed (but not discarded) catch by country or territory of capture, by species or a higher taxonomic level, in the Mediterranean Sea, and year for all commercial, industrial, recreational and subsistence purposes are available through the GFCM website (<http://www.gfcm.org/fishery/statistics/GFCM-capture-production/query/en>).

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

Not applicable, there is no GFCM regional observer programme (GFCM, 2011a).

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

Not applicable, there is no GFCM regional observer programme (GFCM, 2011a).

- Which countries with fisheries under the RFMO’s mandate are not Members or Cooperating Non-Members?

GFCM membership is set out in Article I of the Agreement and is governed by the FAO Basic Texts. This prevents membership or cooperation by States and fishing entities that do not meet the criteria (contrary to the open membership advocated in Articles 8-17 of UNFSA) (GFCM, 2011a). Despite this, GFCM (2006e) established a mechanism for the designation of Co-operating Non-Contracting Parties known to be fishing in the GFCM Area for species under GFCM competence. There was no information indicating that countries with fisheries managed by GFCM are not Members of Cooperating Non-Members.

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

Not applicable, there is no GFCM regional observer programme (GFCM, 2011a).

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

Not applicable, there is no GFCM regional observer programme (GFCM, 2011a).

Criterion 2. Open access to bycatch data

Score: 0 of 15 possible points, 0%.

Table A1.3-4 provides details on the assessment outcome for criterion 2.

Table A1.3-4. Assessment of GFCM provision of open access to a regional observer programme datasets.

Factor	Points for positive response
There is no regional observer programme dataset containing records of bycatch.	0

Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

No, there is no GFCM regional observer programme (GFCM, 2011a). The prescribed format for National Reports to GFCM does not include reporting information on catch or landings of non-target species (GFCM, 2007a).

- What confidentiality rules have been adopted on access to data on bycatch, including discards, that the RFMO owns or holds as a custodian?

Not applicable, there is no GFCM regional observer programme (GFCM, 2011a).

- Are primary or amalgamated data collected in the regional observer programme made available as an open public resource?

No, data from a regional onboard observer programme are not available in primary or amalgamated form. Summary statistics on landed catch from the Mediterranean Sea are available through the GFCM website (<http://www.gfcm.org/fishery/statistics/GFCM-capture-production/query/en>).

- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤ 5 degree cells, >5 degree cells, or is information on resolution of records in the publically available dataset not specified?

Data from a regional onboard observer programme are not available.

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

Data from a regional onboard observer programme are not available.

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

Not applicable, there is no GFCM regional observer programme (GFCM, 2011a).

Criterion 3: Ecological risk assessment

Score: 2 of 8 possible points, 25%.

Table A1.3-5 provides details on the assessment outcome for criterion 3.

Table A1.3-5. Assessment of GFCM ecological risk assessment.

Factor	Points for positive response
Level 2 assessment has been conducted only for the effects of fishing on elasmobranch species, and not for the effects of bycatch on the integrity of the ecosystem, for at least 1 fishery.	2

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

Tonachella (2010) provides a review of the life history characteristics and conservation status of five elasmobranch species listed as GFCM-SAC Priority Species (one Vulnerable and four Critically Endangered as listed by IUCN), explaining that certain shark species are target and retained incidental bycatch species in some GFCM fisheries, including pelagic and demersal longline, pelagic and bottom trawl, driftnet, gillnet, tuna trap, purse seine, trammel net, lobster tangle net, and handline fisheries. Bradai et al. (2010) provides a broader review of the life history characteristics, conservation status and temporal trends in GFCM fisheries catches of elasmobranchs, identifying pelagic artisanal longline and gillnet fisheries and demersal trawl fisheries as the main sources of shark fishing mortality. Bradai et al. (2010) and Tonachella (2010) might represent a Level 2 semi-quantitative ecological risk assessments of selected elasmobranch species.

The *Transversal Expert Meeting on Elasmobranchs in the Mediterranean and Black Sea* concluded that, based on assessment against selected criteria, seven species of elasmobranchs are a priority for preparing stock assessments and conducting training in age identification (GFCM, 2010j). This might constitute a Level 1 ecological risk assessment (assuming that the meeting involved a qualitative assessment based on expert and stakeholder opinion). Serena (No date) provided a review of the conservation status and management frameworks for the protection of sharks and rays in the Mediterranean, but this study does not constitute an ecological risk assessment for these groups.

Assessments of ecological risks from interactions with GFCM fisheries for bycatch species groups other than elasmobranchs were not identified. Assessments of adverse ecological effects from bycatch removals in GFCM-managed fisheries were also not identified.

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

Risk assessments were conducted for one species group (elasmobranchs) across various fisheries, and not for individual fisheries. The fisheries that were identified in the assessments were: pelagic and demersal longline, pelagic and bottom trawl, driftnet, gillnet, tuna trap, purse seine, trammel net, lobster tangle net, and handline fisheries (Bradai et al., 2010; Tonachella, 2010).

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

GFCM (2010j) called for stock assessments of prioritized elasmobranch species, constituting a recommendation for Level 3 assessments. The two Level 2 assessments (Bradai et al., 2010; Tonachella, 2010) did not include recommendations related to further more rigorous assessment.

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch
Score: 7 of 18 possible points, 39%

Table A1.3-6 provides details on the assessment outcome for criterion 3.

Table A1.3-6. Assessment of GFCM conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
One or more bycatch problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in place to mitigate $\geq 50\%$ but $< 75\%$ of the number of identified problems.	3
At least one but $< 50\%$ (5 of 11) of binding measures to mitigate bycatch include measurable performance standards.	1
Of binding bycatch measures that contain quantitative performance standards, $\geq 75\%$ of the measures have been assessed for efficacy.	3
GFCM Members can opt out of binding measures.	0

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.

From the ecological risk assessments identified and reviewed under criterion 3, several elasmobranch species are subject to problematic bycatch in the following GFCM-managed fisheries: pelagic and demersal longline, pelagic and bottom trawl, driftnet, gillnet, tuna trap, purse seine, trammel net, lobster tangle net, and handline fisheries.

- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

GFCM convened a workshop in 2010 on improving selectivity and reducing bycatch, which identified the occurrence of bycatch of elasmobranchs in deepwater trawl,

purse seine, and pelagic longline fisheries; marine mammals, sea turtles and jellyfish in trawls; and sturgeons in Black Sea trawl, set net and purse seine fisheries, however, the workshop report did not produce findings on the ecological risk to these bycatch species from fisheries interactions (GFCM, 2010j, 2010m, 2011c). Catch and bycatch of primarily juvenile bluntnose six gill sharks (*Hexanchus griseus*), listed as Near Threatened by IUCN, is caught in the Maltese demersal longline fishery (Vella and Vella, 2010). Seabird bycatch is identified as problematic in some GFCM longline and troll fisheries (GFCM, 2010j). There is also documented problematic bycatch of juvenile target and non-target species in various GFCM-managed fisheries, including in demersal and bottom trawl, and fisheries making sets on FADs; however, many GFCM fisheries target juveniles (they are not bycatch) (GFCM, 2010i; 2011c). GFCM (2010i) mentions the need to assess bycatch of cetaceans in Black Sea fisheries. Other studies have also documented problematic bycatch of sea turtles and elasmobranchs in Mediterranean pelagic longline, gillnet and trawl fisheries (Gilman et al., 2008a; Wallace et al., 2010). Small (2005) found that there was no overlap between albatross distributions and the GFCM area. Bycatch of juvenile bluefin tuna, swordfish and dolphin fish is also documented as being problematic (GFCM, 2005c, 2006b, 2007d, 2008, 2009h, 2009i, 2010d). Other studies have documented problematic bycatch of sea turtles and elasmobranchs in Mediterranean pelagic longline, gillnet and trawl fisheries (Gilman et al., 2008a; Wallace et al., 2010).

No information was identified assessing the effects of bycatch removals on ecosystem functioning and structure.

The vulnerable species groups identified as bycatch in GFCM fisheries is deemed comprehensive; evidence from other regions of bycatch of vulnerable species is consistent.

To summarize, the following is a list of identified problematic bycatch and discards, both from ecological risk assessments and other studies:

- Elasmobranchs and seabirds on pelagic and demersal longlines;
 - Elasmobranchs, marine mammals, sea turtles, and sturgeons in pelagic and bottom trawls;
 - Elasmobranchs in driftnets;
 - Elasmobranchs and sea turtles in gillnets;
 - Elasmobranchs in tuna traps;
 - Elasmobranchs and sturgeons in purse seines;
 - Elasmobranchs in trammel nets;
 - Elasmobranchs in lobster tangle nets;
 - Elasmobranchs on handlines;
 - Sturgeons in set nets; and
 - Seabirds in troll fisheries.
- Using Table A1.3-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace,

2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

This information has been recorded in Table A1.3-7.

- From the responses to the first two bullets, list each individual documented bycatch problem.

Problematic shark bycatch was identified to occur in 11 fisheries through ecological risk assessments. GFCM measures restrict shark finning practices, encourage live release of sharks, and prohibit the retention and requiring live release of bigeye thresher sharks partially address this bycatch problem.

Measures address 3 of 15 problematic bycatch problems not identified in ecological risk assessments. For the non-elasmobranch bycatch problems the following three are addressed by a binding GFCM measure: juvenile bluefin tuna in all fisheries, juvenile swordfish in all fisheries, and juvenile dolphin fish for fisheries using FADs. The following 12 non-elasmobranch bycatch problems are not addressed by a binding GFCM measure: seabirds on pelagic and demersal longlines; marine mammals, sea turtles, and sturgeons in pelagic and bottom trawls; sea turtles in gillnets; sturgeons in purse seines and set nets; and seabirds in troll fisheries.

- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

Binding measures address 14 of a total of 26 identified bycatch and discard problems.

- What proportion of binding bycatch measures contain quantitative, measurable performance standards?

5 of 11. The five measures deemed to have quantitative performance standards relate to goals of achieving B_{msy} for bluefin and swordfish stocks, and the measure on shark finning. The GFCM SCMEP noted in 2010 the absence of, "information and mechanisms that could allow the SAC to assess the effects of current regulations on the FRAs," (GFCM, 2010j) providing one example of the adverse effects on governance from the lack of inclusion of performance standards in binding conservation and management measures.

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

4 of 5. Stock assessments are regularly conducted for bluefin tuna and swordfish stocks.

Insufficient monitoring, in particular in pelagic longline fisheries, hampers efforts to assess compliance and hence achievement of the shark measure's stipulated standard. Furthermore, the form of the fins (frozen vs. dried) and form of the carcass (whole weight, dressed or partially dressed) is not specified in the measure, which precludes defining a clear method to assess compliance (Fowler and Seret, 2010). Furthermore, the 5% limit of ratio of weight of retained shark fins to

carcasses, even if it did lend itself to being monitored for compliance, may not achieve the measure's explicit objective of achieving sustainable shark fishing mortality if there is market demand for shark meat, as has been documented to be increasing in some regions (Gilman et al., 2008a; Gilman, 2011).

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

1 of 4 ($B < B_{msy}$ for bluefin tuna and $> B_{msy}$ for the north Atlantic swordfish stocks [it is assumed that there is a single population of swordfish in the Mediterranean Sea and adjacent waters of the Atlantic Ocean]). Related, GFCM members have exhibited low compliance with the implementation of some binding measures, for example, in submitting a list of vessels fishing in Fisheries Restricted Areas (GFCM, 2010g).

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

GFCM Recommendations controlling bycatch of juvenile bluefin have been periodically amended to pursue improved probability of attaining the B_{msy} goal, however, it is not understood if the amendments have resulted in reduced juvenile fishing mortality levels. The measure restricting shark finning does not require the employment of gear technology best practices to mitigate shark bycatch rates and has limited potential to control shark fishing mortality, except for fisheries with extensive resources for surveillance and enforcement, and where there are limited markets for shark meat (Gilman, 2011). No evidence from materials available on the GFCM website indicated that steps are planned or in progress to improve the efficacy of the GFCM binding measures on sharks.

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

Yes, GFCM members can opt out of binding Recommendations. Under GFCM Agreement Article V, "Recommendations on Management Measures", sets out the decision-making process for binding Recommendations. Members have 120 days to object to such measures, and are not required to provide a justification for objecting to the measure. Other Members have sixty days to respond to that objection. Members are not required to give effect to the measure if more than one-third of the Members objected to that measure. Therefore, measures enter into force only if two-thirds of the Members have not objected (GFCM, 1963, 2011a).

Table A1.3-7. Active GFCM legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
None	na	na	na
Sea turtles			
None	na	na	na
Marine mammals			
Comply with measures of the Pelagos Sanctuary for the Conservation of Marine Mammals, including European Community regulations on pelagic drift gillnets (GFCM, 2007c).	No performance standards are stated in the Recommendation.	Location of fishing effort; Fishing gear.	a, c, e
Shark and relatives			
Vessels must: (i) keep all parts of retained sharks, excluding head, guts and skins, to the point of first landing; and (ii) have onboard fins that total $\leq 5\%$ of the weight of sharks onboard, up to the first point of landing, or otherwise	5% limit of ratio of weight of retained shark fins to carcasses.	Shark handling and release practices; Landed catch composition.	a, d, e

<p>ensure compliance with the 5% rule through certification, observer monitoring or other method (GFCM, 2005e). In fisheries that are not directed at sharks, CPCs shall encourage the release of live sharks, especially juveniles, to the extent possible, that are caught incidentally and are not used for food and/or subsistence (GFCM, 2005e). One objective of the measure is to reduce North Atlantic shortfin mako (<i>Isurus oxyrinchus</i>) fishing mortality (GFCM, 2006g).</p>			
<p>The retention, transshipment or landing of bigeye thresher sharks is prohibited and the live release of bigeye thresher sharks is required, excluding a small-scale Mexican coastal fishery (GFCM, 2010f).</p>	<p>No performance standards are stated in the Recommendation.</p>	<p>Shark handling and release practices; Landed catch composition.</p>	<p>a, d, e</p>
<p>Juvenile and small/undersized target species</p>			
<p>Minimum mesh size (≥ 40mm square mesh or ≥ 50mm diamond mesh) in the codend of demersal trawl nets, to reduce the catch of juveniles of several</p>	<p>No performance standards are stated in the Recommendation.</p>	<p>Gear design.</p>	<p>a, e</p>

species and to reduce discarding (GFCM, 2005b, 2007b, 2009d).			
Prohibit bottom trawling below 1000m to protect vulnerable habitat (GFCM, 2005b).	No performance standards are stated in the Recommendation.	Location of fishing effort; Bathymetry of fishing grounds; Fishing gear.	c, e
Establishment of an annual closed season from 1 January to 14 August for dolphin fish fisheries using Fish Aggregating Devices, in part, to reduce the catch of small dolphin fish (GFCM, 2006b). An exception is permissible, where, if a Member demonstrates that due to bad weather, fishermen of this Member were unable to utilise their normal fishing days, then the Member can carry over days lost by this fleet in FAD fisheries until 31 January of the following year (GFCM, 2006b).	No performance standards are stated in the Recommendation. The Recommendation requests the SAC to evaluate the effect of the measure on dolphin stocks, but does not define a performance target (GFCM, 2006b).	Fishing effort occurring on FADs.	b, e
Prohibit the catch, the retaining on board, landing and/or transshipment of any bluefin tuna weighing less than 30 kg (GFCM, 2007d, 2009i). A minimum size of 8 kg applies for bluefin tuna caught by baitboats and trolling boats in the eastern Atlantic, for bluefin tuna	The goal of this and other measures in the recommendation is to achieve B_{msy} , with greater than 50% probability (GFCM, 2007d, 2009i).	Catch composition; Transshipment composition; Landing catch composition.	a, b, e

<p>caught in the Adriatic Sea for ranching, and bluefin tuna caught in the Mediterranean by a coastal artisanal fishery for fresh fish by baitboats, longliners and handliners (GFCM, 2007d, 2009i).</p>			
<p>A maximum of 5% of bluefin tuna can weigh between 10-30kg for vessels targeting bluefin. This percentage is calculated as the total number of 10-30kg bluefin tuna relative to the total bluefin tuna catches of these vessels per landing, or their equivalent in percentage in weight. Vessels not targeting bluefin can retain bluefin tuna up to a maximum of 5% of the total catch by weight and/or number of fish. Bycatch must be deducted from the quota of the flag State CPC. The discard of dead fish shall be prohibited and shall be deducted from the quota (GFCM, 2007d, 2009i).</p>	<p>The goal of this and other measures in the recommendation is to achieve B_{msy}, with greater than 50% probability (GFCM, 2007d).</p>	<p>Retained (landed) catch composition and weight; Discarded catch composition and weight.</p>	<p>a, d, e</p>
<p>Fishing for swordfish in the Mediterranean is prohibited (swordfish cannot be retained on board, transshipped or landed) from 1 October to 30</p>	<p>No explicit performance standards are containing in the Recommendation. An implicit goal of the measure is to move the stock toward the Convention objective of</p>	<p>.Fishing gear; Composition of landed catch.</p>	<p>a, e</p>

November in order to reduce juvenile swordfish mortality (GFCM, 2005c, 2008, 2009h, 2010d).	biomass levels which could support MSY (GFCM, 2009h)		
Unmarketable sizes and species of non-target species of fish			
None	na	na	na
Other or multiple bycatch species group(s)			
Established three Fisheries Restricted Areas (Lophelia reef off Capo Santa Maria di Leuca, Nile delta area cold hydrocarbon seeps, and Eratosthemes seamount) where fishing with towed dredges and bottom trawl nets is prohibited, in order to protect spawning aggregations and deep sea sensitive habitats, including deep water coral reefs, cold hydrocarbon seeps, and seamount ecosystems (GFCM, 2006c). Established a fourth Fisheries Restricted Area (Gulf of Lions) where the fishing effort for demersal stocks by vessels employing towed nets, bottom and mid-water longlines, and bottom-set nets is not to exceed the level that occurred in the area in 2008 (GFCM, 2009c).	No performance standards are stated in the two Recommendations.	Location of fishing effort; Fishing effort; Fishing gear.	a, c, e

<p>Annual closed fishing seasons for large longliners, purse seiners, baitboats, pelagic trawlers, and recreational and sport fishing vessels fishing for bluefin tuna in the eastern Atlantic and Mediterranean (GFCM, 2007d, 2009i, 2010e).</p>	<p>The goal of this and other measures in the recommendation is to achieve B_{msy}, with greater than 50% probability (GFCM, 2007d).</p>	<p>Location of fishing effort; Fishing gear.</p>	<p>a, c, e</p>
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Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 0 of 14 possible points, 0%

Table A1.3-8 provides details on the assessment outcome for criterion 3.

Table A1.3-8. Assessment of GFCM conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
For managed fisheries for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are in place for none of these fisheries.	0
There is a provision that allows RFMO Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

No relevant studies by GFCM were identified. No information was identified that described the degree of ghost fishing occurring in GFCM managed fisheries.

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

In general, ghost fishing is problematic with passive fishing gear such as pelagic longline, gillnets, trammel nets, and traps, while the catching process of active gears, such as trawls and seines, ceases when the gear is no longer attached to the vessel (FAO, 2005a, 2010d). However, lost and abandoned Fish Aggregating Devices (FADs) used by purse seine vessels have been observed to result in ghost fishing (Chanrachkij et al., 2008; Gilman, 2011) and ghost fishing has been observed in seine nets (Matsuoka et al., 2005). In conclusion, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in GFCM-managed fisheries.

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table A1.3-9).

There are no relevant binding measures.

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

0%, there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures in place.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures in place.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, GFCM members can opt out of binding Recommendations. Under GFCM Agreement Article V, “Recommendations on Management Measures”, sets out the decision-making process for binding Recommendations. Members have 120 days to object to such measures, and are not required to provide a justification for objecting to the measure. Other Members have sixty days to respond to that objection. Members are not required to give effect to the measure if more than one-third of the Members objected to that measure. Therefore, measures enter into force only if two-thirds of the Members have not objected (GFCM, 1963, 2011a).

Table A1.3-9. Active GFCM legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	NA	NA	NA

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea

Score: 0 of 14 possible points, 0%

Table A1.3-10 provides details on the assessment outcome for criterion 3.

Table A1.3-10. Assessment of GFCM conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed fisheries, and no relevant binding measures are in place.	0
There is a provision that allows RFMO Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

No relevant assessments were identified.

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from the these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

No information was identified on risks from pollution from discards from managed fisheries.

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table A1.3-11).

There are no relevant binding measures.

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding

measures been adopted to mitigate pollution effects from discharges?

No relevant information was identified for managed fisheries documenting problematic pollution, or are identified as being likely to cause problematic pollution, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, GFCM members can opt out of binding Recommendations. Under GFCM Agreement Article V, "Recommendations on Management Measures", sets out the decision-making process for binding Recommendations. Members have 120 days to object to such measures, and are not required to provide a justification for objecting to the measure. Other Members have sixty days to respond to that objection. Members are not required to give effect to the measure if more than one-third of the Members objected to that measure. Therefore, measures enter into force only if two-thirds of the Members have not objected (GFCM, 1963, 2011a).

Table A1.3-11. Active GFCM legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	na	na	na

Criterion 5. Surveillance and enforcement

Score: 6 of 20 possible points, 30%

Table A1.3-12 provides details on the assessment outcome for criterion 3.

Table A1.3-12. Assessment of GFCM measures and resources for surveillance and enforcement.

Factor	Points for positive response
Of 5 requisite surveillance methods, there is a GFCM Authorized Vessel List and Regional Fleet Register, but these have been determined to be of limited utility due to lack of reporting by many Members. And GFCM is developing a VMS programme but to date no GFCM members submitted information on their progress in implementing the VMS measure, and the Secretariat flagged insufficient human and financial resources to implement the establishment of a database to receive VMS data.	0
The RFMO requires parties to report to the RFMO on their enforcement procedures and conclusions.	3
The RFMO has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer

programme data.

There is a GFCM Authorized Vessel List (GFCM Record of Vessels over 15 Metres Authorized to Operate in the GFCM Area) (GFCM, 2005a, 2009f) and Regional Fleet Register (GFCM, 2009e), however, due to lack of reporting by many Members, the List and Register are of limited use (GFCM, 2010h). For example, in 2010 the failure by some Members to update data on license renewal resulted in about half of the vessels in the Authorized Vessel List being placed on a dormant list (GFCM, 2010h, 2011a). There is also a GFCM IUU List established via GFCM (2006d, 2009b), however, "No reports have been received by the GFCM Secretariat on vessels presumed to have carried out Illegal, Unreported or Unregulated (IUU) fishing activities in the GFCM area," (www.gfcm.org/gfcm/topic/166233/en, accessed 11 May 2011).

Vessels included in the GFCM Authorized Vessel List (2005a, 2009f) are required to participate in the GFCM's Vessel Monitoring System, where GFCM Parties and Cooperating non-Contracting Parties are required to implement a satellite-based VMS by the end of 2012 (GFCM, 2009g). However, implementation of the VMS programme to date has been slow: GFCM (2010g) reported that no GFCM members submitted information on their progress in implementing the VMS measure, and the Secretariat flagged insufficient human and financial resources to implement the establishment of a database to receive VMS data.

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.3-7, A1.3-9, and A1.3-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

This information has been recorded in Table A1.3-7. A summary of the requisite surveillance measures follows.

Dockside inspection is needed to determine if vessels are complying with Pelagos Sanctuary regulations related to pelagic drift gillnets, to determine compliance with rules on shark finning landing restrictions, to determine compliance with the prohibition on landing bigeye threshers, determine demersal trawl net mesh size, determine compliance with weight limits and ratios for landed bluefin tuna, determine compliance with a seasonal ban on swordfish retention, and determine compliance with a seasonal closure for bluefin tuna targeting vessels.

At-sea inspection is necessary to determine compliance with a seasonal prohibition on the use of FADs and weight limit on transshipping bluefin tuna.

VMS enables surveillance of implementation of Pelagos Sanctuary regulatory-required measures, prohibition on bottom trawling below 1000m, compliance with gear and effort restrictions of three Fisheries Restricted Areas, and compliance with a seasonal closure for bluefin tuna targeting vessels.

Onboard observers are required to conduct surveillance of required shark handling and release practices, including for the required live release of bigeye threshers, and to determine compliance with a prohibition on discarding dead bluefin tuna.

A GFCM vessel list is necessary to identify vessels required to employ GFCM binding measures, and authorized to fish in the GFCM area.

Explained in the first bullet, of these 5 requisite surveillance methods, there is a GFCM Authorized Vessel List but it is of limited utility, and a VMS programme is being developed but to date no GFCM members submitted information on their progress in implementing the VMS measure, and the Secretariat flagged insufficient human and financial resources to implement the establishment of a database to receive VMS data.

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

GFCM Members and Cooperating Non-Members are required to report on enforcement activities, and the GFCM Compliance Committee is tasked with identifying Members and Cooperating Non-Members have not complied with GFCM measures (GFCM, 2010c). No information was identified specifying that GFCM requires Members to undertake specific enforcement and prosecution methods, or impose specific sanctions.

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

Yes. GFCM has established a Compliance Committee (GFCM, 2006f, 2010a). The committee's terms of reference includes reviewing compliance with measures, and reviewing implementation of measures for surveillance and enforcement, including implementation of the GFCM Control and Inspection Scheme (GFCM, 2010a, 2011a).

- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

GFCM has not reviewed flag State investigation of, follow-up to, and reporting of actions taken in response to alleged violations of GFCM conservation and management measures (GFCM, 2011a). GFCM (2011a) reports that, "The extent to which the GFCM, its Members and cooperating non-members follow up on infringements to conservation and management measures is difficult to assess, based on the failure of many, if not most, Members to provide information on the status of GFCM decisions," and, as an example, "no Member has proposed the inclusion of vessels on the IUU Vessel List, nor has any Member notified its port State measures." Furthermore, GFCM (2010h) reported that few GFCM Members submit reports

summarizing national implementation of GFCM decisions, hampering Secretariat assessment of compliance.

A1.4. Inter-American Tropical Tuna Commission (IATTC)

SUMMARY	
Criteria Suite Scores	
Overall	44 (± 5 SD of the mean)% ¹
Criterion 1: Data collection	68% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	76%
Criterion 1B. Regional Observer Coverage Rates	27%
Criterion 1C. Regional Observer Programme Dataset Quality	91%
Criterion 2. Open access to regional observer programme datasets	40%
Criterion 3. Ecological risk assessment	38%
Criterion 4. Conservation and management measures	34% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	61%
Criterion 4B. Conservation and Management Measures to Govern Lost and Abandoned Gear	21%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	21%
Criterion 5. Surveillance and enforcement	45%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The Inter-American Tropical Tuna Commission (IATTC) was created by the 1949 Convention for the Establishment of an Inter-American Tropical Tuna Commission, which entered into force in 1950. In 2008, the IATTC convention was replaced by the Antigua Convention, which came into effect in 2010 (IATTC, 2008).

IATTC serves as the Secretariat for the International Dolphin Conservation Program and its working groups and panels, and coordinates the Onboard Observer Program and Tuna Tracking and Verification System. In 1992 the Agreement for the Conservation of Dolphins, which created the International Dolphin Conservation Program, was adopted. In 1998, the Agreement on the International Dolphin Conservation Program (AIDCP), which built on and formalized the provisions of the 1992 Agreement, was signed, and entered into force in 1999.

MEMBERSHIP

The following are members of IATTC: Belize, Canada, China, Colombia, Costa Rica, Ecuador, El Salvador, European Union, France, Guatemala, Japan, Korea, Mexico, Nicaragua, Panama, Peru, Chinese Taipei, United States, Vanuatu, and Venezuela. Cook Islands and Kiribati are cooperating non-parties (www.iattc.org, accessed 9 Feb. 2011). Bolivia operates purse seine tuna fisheries in the eastern Pacific but is not an IATTC member of cooperating non-party (Martin Hall, IATTC, personal communication, 7 May 2011).

Costa Rica, Ecuador, El Salvador, the European Union, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, United States, Vanuatu, and Venezuela are Parties to AIDCP, and Bolivia and Colombia are applying it provisionally (IATTC, 2009b).

MANAGED SPECIES AND FISHERIES

Fish stocks covered by IATTC are, “stocks of tunas and tuna-like species and other species of fish taken by vessels fishing for tunas and tuna-like species in the Convention Area,” (IATTC, 2003a [Article I.1]). A stated function of the Commission is to control the effects of fishing on species that are dependent on or associated with the fish stocks covered by the Convention, and on non-target fish and non-fish species, including endangered species (IATTC, 2003a [Article VII.f, VII.g]). The objectives of the AIDCP are to ensure the sustainability of the tuna stocks in the eastern Pacific Ocean, to progressively reduce the incidental mortalities of dolphins in the tuna fishery of the eastern Pacific Ocean to levels approaching zero, and to minimize bycatch and discards of juvenile tunas and non-target species, taking into consideration the interrelationships among the species in the ecosystem (AIDCP, 2009c). The Antigua Convention does not specify individual covered fisheries (IATTC, 2003), but presumably includes all fisheries for managed species that occur within the Convention Area, which includes the following gear types: purse seine, pelagic longline, trap, gillnet, harpoon, pole-and-line, troll, hook and line, and trawl (IATTC, 2010e).

AREA OF APPLICATION

IATTC’s convention area is bounded by the coastline of North, Central and South America and (i) the 50°N parallel from the coast of North America to its intersection with the 150°W meridian; (ii) the 150°W meridian to its intersection with the 50°S parallel; and (iii) the 50°S parallel to its intersection with the coast of South America (Fig. A1.4-1) (IATTC, 2003a [Article III]). The Agreement Area of the AIDCP differs from the IATTC Convention Area in that AIDCP employs 40°N and S latitude as the northern and southern boundaries, respectively, while the IATTC area employs 50°N and S (AIDCP, 2009c [Annex I]). A portion of the IATTC Convention Area overlaps with that of WCPFC (bounded by 150 degrees longitude W, 130 degrees longitude W, 4 degrees latitude S, and 50 degrees latitude S); vessels of WCPFC members that are not also IATTC members are not subject to IATTC measures when fishing in this overlap zone (IATTC and WCPFC, 2011).

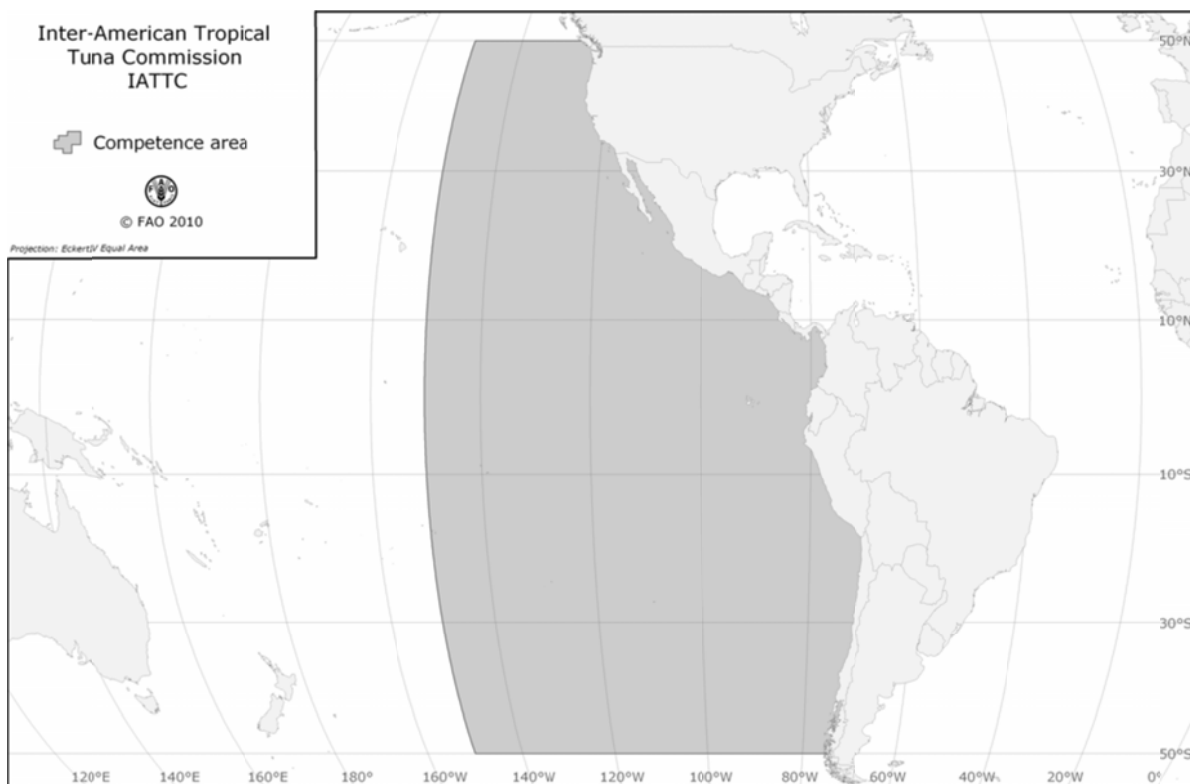


Fig. A1.4-1. IATTC convention area (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH, INCLUDING DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries

Score: 19 of 25 possible points, 76%.

A maximum of 25 points are attainable for assessment against sub-criterion 1A for an RFMO that includes hook-and-line fisheries in a regional observer programme.

Table A1.4-1 provides details on the assessment outcome for criterion 1A.

Table A1.4-1. Assessment of IATTC regional observer programme data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are included in the RFMO's mandate.	1
Data for $\geq 75\%$ of documented vulnerable bycatch species are intended to be collected in fisheries with regional observer coverage.	3
Information on the number and/or weight of at least 1 documented vulnerable bycatch species is intended to be routinely collected by regional observers.	1
At least one item of information but $< 50\%$ of the items of information	1

needed to assess performance standards of relevant binding conservation and management measures is intended to be collected by regional observers.	
Information on fishing effort is intended to be routinely collected for fisheries with regional observer coverage.	1
Date and location of fishing operations are intended to be routinely captured by regional observers.	1
Information on whether catch is retained or discarded is intended to be routinely captured by regional observers for $\geq 75\%$ of documented vulnerable bycatch species.	3
Data records are intended to be to the species-level for $\geq 75\%$ of documented vulnerable bycatch species in fisheries with regional observer coverage.	3
Information on length or other proxy for age class is intended to be collected for $>25\%$ but $<50\%$ of identified vulnerable bycatch species.	2
Information on the disposition of discards (e.g., alive vs. dead, and possibly degree of injury) is intended to be collected for $\geq 75\%$ of identified vulnerable bycatch species.	3

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

Yes, the Antigua Convention calls for the adoption of measures, "for species belonging to the same ecosystem and that are affected by fishing for, or dependent on or associated with, the fish stocks covered by this Convention " and "to avoid, reduce and minimize waste, discards, catch by lost or discarded gear, catch of non-target species (both fish and non-fish species) and impacts on associated or dependent species, in particular endangered species" (IATTC, 2003a [Articles VII(f), VII(g)]). AIDCP aims to minimize bycatch and discards of non-target species in purse seine fisheries (AIDCP, 2009c).

- In fisheries required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

100%. Large purse seine vessels are the only vessels with IATTC regional observer coverage. In the IATTC region, purse seine fisheries can have problematic bycatch of dolphins, sharks (primarily silky [*Carcharhinus falciformis*] and oceanic white tip sharks [*C. longimanus*]), sea turtles (olive ridley [*Lepidochelys olivacea*], green [*Chelonia mydas*], leatherback [*Dermodochelys coriacea*], hawksbill [*Eretmochelys imbricate*], and loggerhead [*Caretta caretta*]), and juvenile bigeye and yellowfin tunas (IATTC, 2010f; Gilman, 2011). The regional observer programme collects information on all identified vulnerable bycatch species groups in the covered large purse seiners. Purse seine vessels > 363 metric tons participating in AIDCP are required to report mortalities of dolphins by stock and estimated catch of tunas by species, length frequency, and set type (AIDCP, 2009c; IATTC, 2003b, 2009). In late 1992 IATTC observers onboard large purse seine vessels began to collect data on sharks, sea turtles and other bycatch species other than mammals and principal market species of tunas (Roman-Verdosoto and Orozco-Zoller, 2005; IATTC, 2008; IATTC, 2010f).

- Does the RFMO's data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected?

Yes, purse seine vessels > 363 metric tons participating in AIDCP are required to report mortalities of dolphins by stock (IATTC, 2003b, 2009), and data on bycatch of sea turtles, other marine mammals, and fish discards have been collected by observers since 1993 (IATTC, 2010e,f). Information on the number of sharks discarded dead began in 1993, and data collection protocols were amended in 2005 to include all discarded sharks, alive and dead (Román-Verdesoto and Orozco-Zöller, 2005). A non-binding resolution on data provision recommends the collection and provision of information on total catch in numbers and in weight if available (IATTC, 2003c).

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).

One binding measure, to manage dolphin mortality by purse seine vessels participating in the AIDCP, stipulates quantitative performance measures. To assess performance of this measure, the following information is required for vessels participating in the AIDCP: (i) Vessel-specific number of dolphin mortalities by stock; (ii) Gear design (dolphin-safety Medina panel); (iii) Fishing practices (type of set, backdown, day-setting); (iv) Dolphin safety/rescue equipment; (v) List of vessels operating under the AIDCP (vessels that have requested a dolphin mortality limit for that year); and (vi) AIDCP list of qualified captains.

Other binding measures that do not stipulate measurable performance standards were assessed to require the following information in order to assess efficacy: (i) Longline gear design, including turtle release equipment onboard; (ii) longline fishing practices; (iii) location of fishing effort by all vessels; (iv) vessel list for longline vessels not propelled by an outboard motor and all member longline vessels; (v) weight of landed shark fins and weight of remainder of shark carcasses by all vessels of fisheries managed by IATTC; (vi) handling and release practices for discarded sharks and tunas by all vessels, and handling and release practices by purse seine vessels of discards of all non-target species (Tables A1.4-7, A1.4-9, and A1.4-11).

- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected in the regional observer programme according to the RFMO's data collection protocols?

50% (6 of 12 identified information items). All of the AIDCP information requirements are required to be provided by the AIDCP Parties (AIDCP, 2009c). Data on bycatch of sea turtles, marine mammals, and fish discards by purse seine vessels with carrying capacities > 363 metric tons have been collected by observers since 1993 (IATTC, 2010e,f). Other than the AIDCP information, none of the information required for the assessment of performance of relevant measures is routinely required for all relevant classes of vessels and fisheries. Data on landings for some incidental commercially valuable species are unreported, in particular from artisanal and recreational fisheries, and data on discards are unreported for all but large purse seine vessels (Hinton, 2008; AIDCP, 2009c; IATTC, 2010e). For example, numbers of vessels participating in artisanal longline fisheries are not documented or reported, and therefore vessel lists are

incomplete (IATTC, 2008b). Data have been collected since 2004 on turtle interactions from a limited number of longline vessels participating in the IATTC Eastern Pacific Regional Sea Turtle Program (IATTC, 2008b).

- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?

Yes. The regional onboard observer coverage of large purse seine vessels is the only mandatory observer coverage specified in a measure related to mitigation bycatch and discards (AIDCP, 2009c).

- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?

Regional fishing effort by large purse seine vessels is routinely collected, but not for smaller purse seiners or other fisheries. A non-binding resolution on data provision recommends the collection and provision of information on fishing effort (IATTC, 2003c).

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely collected by observers of the regional observer programme?

100%. Data on bycatch of sea turtles, marine mammals, and shark discards are collected by observers for purse seine vessels > 363 metric tons (IATTC, 2009, 2010e,f). Data on discards is not routinely collected in other fisheries and by smaller purse seine vessels.

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

Yes, the regional observer programme data collection includes date and location of sets and hauls (IATTC, 2009). A non-binding resolution on data provision recommends the collection and provision of information on the location of the start and end of the set associated with data on the length or weight of individual fish (IATTC, 2003c).

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to record at the species level?

Yes, the IATTC regional observer program data collection protocols pursue species-level identification. Dolphin bycatch by large purse seine vessels is identified to the stock level (IATTC, 2003b, 2009). Historical observer misidentification of some shark species (e.g., identifying silky sharks [*Carcharhinus falciformis*] as blacktip sharks [*C. limbatus*]) has been identified and is being addressed (Román-Verdesoto and Orozco-Zöllner, 2005). No information was identified describing the taxonomic level of records in the IATTC regional database for other vulnerable species subject to bycatch in IATTC tuna fisheries.

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is intended to be routinely collected by regional observers that provides a proxy for age

class, identify the measurement method.

33% (one of three vulnerable species groups). Lengths of fish species, including estimates of total length of sharks, are collected for large purse seiners (Román-Verdesoto and Orozco-Zöllner, 2005), but information was not identified on whether or not lengths of marine mammals and sea turtles is routinely collected (IATTC, 2010f). A non-binding resolution on data provision recommends the collection and provision of information on length or weight of individual fish (IATTC, 2003c).

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

100%. Information on whether released dolphins, sharks and sea turtles are alive vs. dead is collected (Román-Verdesoto and Orozco-Zöllner, 2005; IATTC, 2003b, 2009).

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

This data collection protocol is not relevant for purse seine fisheries, which is the only gear type included in the IATTC regional observer programme.

Criterion 1B. Regional Observer Coverage Rates

Score: 3 of 11 possible points, 27%.

Table A1.4-2 provides details on the assessment outcome for criterion 1B.

Table A1.4-2. Assessment of IATTC onboard observer coverage rates to monitor bycatch, including discards.

Factor	Points for positive response
At least one but <25% of active managed fisheries have \geq 5% onboard observer coverage.	1
There is international exchange of observers in the regional onboard observer programme.	2

Information used for assessment:

- What recommendations on observer coverage rates have been made by the RFMO's scientific body or the Commission for fisheries under the RFMO's mandate?

Other than the 100% coverage of purse seine vessels >363 metric tons carrying capacity (AIDCP, 2009c), no other recommendations for observer coverage of smaller purse seiners or other gear types were identified.

- Does a regional observer programme exist?

Yes, for all purse seine vessels of capacity greater than 363 metric tons (AIDCP, 2009c; IATTC, 2009a).

- What are regional onboard observer coverage rates in each active fishery managed by the RFMO?

Since 1992 there has been nearly 100% onboard observer coverage of purse seine vessels > 363 metric tons fish carrying capacity (Roman-Verdosoto and Orozco-Zoller, 2005; IATTC, 2009a). Vessels of less than 363 metric tons carrying capacity found to have violated AIDCP can be required to carry an observer (AIDCP, 2002). There is no regional observer coverage of longline vessels, but there is 100% onboard observer coverage of carrier vessels that receive transshipments at sea from longline vessels, which has been in effect since 2009, and IATTC is reviewing a draft resolution that will establish regional observer coverage of a percentage of longline vessels (Compean, 2011).

There is no regional onboard observer coverage of other managed gear types fisheries. No list of fisheries that fall under the management of IATTC was identified (IATTC, 2010f). There are an estimated 11 managed fisheries: large and small scale purse seine, large and small scale longline, trap, gillnet, harpoon, pole-and-line, troll, other hook and line, and trawl (IATTC, 2010e). Therefore, only 1 of 11 (9%) of the estimated number of managed fisheries has $\geq 5\%$ regional onboard observer coverage with an average of 9% coverage rate across the 11 fisheries.

- If there have been recommendations for onboard observer coverage rates by the RFMO's scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body's recommendations? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

Recommended target onboard observer coverage rates were identified for two managed fishery: large purse seine vessels (100% coverage) and longline vessels (5% coverage). The recommended 100% coverage of large purse seine vessels participating in the AIDCP is met, but there is no regional observer coverage of longline vessels. IATTC (2007b) recommended that Parties, "Implement observer programs for fisheries under the purview of the Commission that may have impacts on sea turtles and are not currently being observed, taking into consideration economic and practical feasibility." This would include all longline and purse seine fisheries (Gilman, 2011). IATTC (2010a) also encourages national observer coverage of longline vessels to address seabird bycatch problems. However, these measures did not specify specific onboard observer coverage rates (IATTC, 2007b, 2010a). Regional onboard observer coverage exists only for large purse seine vessels.

- For each fishery under the RFMO’s mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

Under the IATTC-administered AIDCP, at least 50% of observers assigned to national fleets are IATTC observers (IATTC, 2009).

Criterion 1C. Regional Observer Programme Dataset Quality

Score: 10 of 11 possible points, 91%.

Table A1.4-3 provides details on the assessment outcome for criterion 1C.

Table A1.4-3. Assessment of IATTC observer program data quality.

Factor	Points for positive response
A regional observer programme dataset with records of bycatch exists.	1
The regional programme database is comprised of records pooled from observed national fisheries.	1
The regional observer programme dataset is >15 years long.	3
Seasonal coverage is balanced and there are minor or no gaps in seasonal coverage.	1
Spatial coverage is balanced and there are minor or no gaps in spatial coverage.	1
≥90% of Members submitted data to the regional programme in each of the previous three years, or for the full duration of the regional observer programme, whichever period is shorter.	3

Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include records on bycatch?

Yes, purse seine vessels > 363 metric tons participating in AIDCP are required to report mortalities of dolphins by stock and estimated catch of tunas by species and set type (AIDCP, 2003; IATTC, 2003b, 2009). Public domain amalgamated datasets include information on landed non-target fish species, but appear to not include information on discards (IATTC, 2009c.d, 2010d).

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties’ vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the

datasets)?

Vessels participating in AIDCP employ standardized data collection protocols and data are collected by observers from a regional IATTC-coordinated programme (AIDCP, 2003; IATTC, 2009).

A non-binding measure calls for the provision of primary or otherwise amalgamated catch, effort and length frequency data (IATTC, 2003c).

- What is the length in years of the regional observer programme dataset?

The AIDCP regional observer programme began in 1979 (Roman-Verdosoto and Orozco-Zoller, 2005).

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

Yes, the 100% AIDCP onboard observer coverage of large purse seine vessels has provided complete coverage of temporal distribution of effort.

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

Yes, the 100% AIDCP onboard observer coverage of large purse seine vessels has provided complete coverage of spatial distribution of effort.

- Which countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members?

Bolivia operates purse seine tuna fisheries in the eastern Pacific but is not an IATTC member of cooperating non-party (Martin Hall, IATTC, personal communication, 7 May 2011).

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

Yes, purse seine vessels \leq 363 metric tons and longline vessels are not required to carry onboard observers (IATTC, 2009). There are no binding measures requiring the provision of catch data from vessels other than those participating in AIDCP. There is a non-binding resolution on data provision that does not exclude certain fisheries or vessel classes (IATTC, 2003c).

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

The IATTC-coordinated regional observer programme for the AIDCP for large purse seine vessels ensures regional collection of onboard observer data. IATTC does not

require the provision of bycatch and discards data from smaller purse seine vessels or other gear types.

Criterion 2. Open access to bycatch data

Score: 6 of 15 possible points, 40%.

Table A1.4-4 provides details on the assessment outcome for criterion 2.

Table A1.4-4. Assessment of IATTC provision of open access to a regional observer programme dataset.

Factor	Points for positive response
There is a regional observer programme dataset containing records of bycatch, and datasets of amalgamated and not primary data records are open access and records are amalgamated by >5 degree cells (no spatial information is available in the public domain datasets).	1
Primary or amalgamated data for $\geq 75\%$ of fisheries included in the regional observer programme are open access.	5

Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

Yes, IATTC coordinates the onboard observer programme for the AIDCP (IATTC, 2009b). Based on a review of the public domain amalgamated dataset, the dataset includes records of some non-target bycatch species. It is not clear if information on just landed bycatch or both landed and discarded bycatch is included in the amalgamated and primary datasets.

- What confidentiality rules have been adopted on access to data on bycatch, including discards, that the RFMO owns or holds as a custodian?

Confidentiality provisions are stipulated in the IATTC Rules of Procedure, and also in the AIDCP Rules of Confidentiality (AIDCP, 2001). Summary statistics on annual catches of species covered by the Convention, by flag and gear type, are reported by IATTC annually. Categories containing \leq two vessels or companies are pooled (IATTC, 2004 [Resolution C-04-10]). Information on vessel position, catches, type of set, dolphin mortality by individual vessels and companies, any information revealing fishing grounds and strategies used by individual vessels or groups of vessels, and other information is specifically identified as to be treated as confidential (AIDCP, 2001).

- Are primary or amalgamated data collected in the regional observer programme made available as an open public resource?

IATTC makes non-confidential (Public Domain) amalgamated data from fishery-dependent data and from data collected from scientific surveys available to the public (IATTC, 2009c, 2010d). Also, IATTC publishes an annual report of the Compliance Committee, which contains aggregated data on bycatch species identified in Resolution C-04-05, Consolidated Resolution on Bycatch (IATTC, 2006; Compean, 2011).

- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤ 5 degree cells, >5 degree cells, or is information on resolution of records in the publically available dataset not specified?

There is a lack of spatial information (IATTC, 2009c, 2010d) One IATTC Public Domain dataset amalgamates total annual catch weight by species per year, and does not provide positional information for individual fishing operations (IATTC, 2010d). A second IATTC public domain dataset contains information on the size frequency of landed target tuna species (yellowfin, skipjack or bigeye) by year and month, 12 sub-regional areas (>5 degree cells), and one of four gear categories (pole-and-line or purse seine set on floating object, marine mammal, or unassociated) (IATTC, 2009c). A third IATTC public domain dataset contains information on the size frequency of billfish caught by purse seine tuna vessels by year and month and 5 degree cell (IATTC, 2009d).

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

The information in the amalgamated datasets prevents a large proportion of research applications that would be possible using the primary datasets. Three public domain amalgamated datasets lack information on discarded bycatch, do not provide information on fishing effort, lack information on individual sets/hauls/trips, and lack details on gear designs and details on fishing methods beyond which fishing method was employed. One of the three public domain datasets lacks information on the spatial distribution of effort, and amalgamates temporal distribution into annual summaries.

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

100%. There is only one fishery included in the regional onboard observer programme, large purse seine vessels, and amalgamated data from this programme are made publically available.

Criterion 3: Ecological risk assessment

Score: 3 of 8 possible points, 38%.

Table A1.4-5 provides details on the assessment outcome for criterion 3.

Table A1.4-5. Assessment of IATTC ecological risk assessment.

Factor	Points for
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	positive response
Level 2 semi-quantitative assessment for both the effects of fishing on bycatch species, and the effects of bycatch removals on the integrity of the ecosystem has been conducted for at least 1 fishery but <50% of fisheries managed by the RFMO, with findings suggesting that more rigorous Level 3 assessment is warranted but has not been conducted.	3

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

IATTC conducted a Level 2 productivity and susceptibility analysis for three purse seine fisheries, focusing on 26 species of sea turtles, marine mammals and fish that comprise the majority of catch by large purse seiners (IATTC, 2010e). This IATTC assessment did not include the ecological effects caused by removals in these purse seine fisheries on marine ecosystems. Instead, the assessment defined, “vulnerability...as the potential for the productivity of a stock to be diminished by direct and indirect fishing pressure,” (IATTC, 2010e). IATTC has developed a model of the tropical eastern Pacific Ocean pelagic ecosystem to predict how fishing (longline, pole-and-line, and purse seine sets on dolphins, floating objects and on unassociated schools of tuna) and climate variability affect middle and upper trophic levels (IATTC, 2010e). The model was used, in part, to determine which components of the ecosystem might be susceptible to top-down effects from fishing. Ecological risk assessments for other IATTC managed fisheries were not identified. IATTC held a Shark Stock Assessment workshop in 2009 to review elasmobranch stock assessment methods and review available information to assess ecological risks to shark populations in the IATTC area (Compean, 2011). IATTC has also assessed the effects of FADs on juvenile tunas in the IATTC area (Compean, 2011).

Small (2005) conducted a partial Level 2 risk assessment, by assessing the overlap of RFMO areas with albatross distributions, and determined that IATTC was one of the top five of 14 evaluated RFMOs in terms of overlap with albatrosses.

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

Ecological risk assessments have been conducted in purse seine fisheries, but not in other managed fisheries (pelagic longline, trap, gillnet, harpoon, pole-and-line, troll, hook and line, and trawl).

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

Some shark species and giant manta were found to have the highest vulnerability to adverse population-level effects from mortality from large purse seine vessels (IATTC,

2010e). Bigeye trevally and yellowtail amberjack had the highest susceptibility in unassociated purse seine sets, while black marlin had the highest susceptibility in purse seine sets on floating-objects (IATTC, 2010e). This IATTC assessment was labeled a 'preliminary' assessment, and stated that further level 2 assessment would occur (IATTC, 2010e), but information on whether or not level 3 assessment was deemed to be warranted was not found. The ecosystem modeling main findings were that, in general, species with relative low turnover rates are influenced more by fishing, while species with relatively high turnover rates are more influenced by environmental variability (IATTC, 2010e).

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch

Score: 11 of 18 possible points, 61%

Table A1.4-6 provides details on the assessment outcome for criterion 4A.

Table A1.4-6. Assessment of IATTC conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
One or more bycatch problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in place to mitigate $\geq 50\%$ but $< 75\%$ of the number of identified problems.	3
33% (at least one but $< 50\%$) of binding measures to mitigate bycatch include measurable performance standards.	1
Of binding bycatch measures that contain quantitative performance standards, 50% (one of two) of the measures have been assessed for efficacy.	2
None of the measures have been documented to not be effective. For all of the binding bycatch measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment), steps have been taken or are in progress to improve efficacy.	2
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.

Low turnover, long-lived pelagic species have the potential to be affected by pelagic fisheries for tunas and tuna-like species (IATTC, 2010e). Certain pelagic shark species, giant manta, bigeye trevally, yellowtail amberjack and black marlin have the highest susceptibility to certain purse seine fisheries (IATTC, 2010e). The risk assessment identified bycatch problems are lumped into two categories of problematic bycatch of (i) sharks and their relatives, and (ii) other fish species in purse seine fisheries.

- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

In purse seine tuna fisheries across vessel classes, there can be problematic bycatch of dolphins, certain shark species, sea turtles, juvenile/small bigeye and yellowfin tunas, and other non-target fish (Gilman, 2011). In longline tuna fisheries, there can be problematic bycatch of certain seabird species, sea turtles, sharks, cetaceans, small swordfish, and other non-targeted fish (Gilman, 2011). Bycatch in trap, gillnet and trawl fisheries, can be problematic for various vulnerable species groups (e.g., Gilman et al., 2009). Of these 12 bycatch problems, IATTC risk assessments identified two.

- Using Table A1.4-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

This information has been recorded in Table A1.4-7.

- From the responses to the first two bullets, list each individual documented bycatch problem.

12 bycatch problems are identified in the first two bullets.

- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

Of the 12 bycatch problems identified in the first 2 bullets, binding measures are in place to address half of them. There is one binding measures to address one of the two potential purse seine bycatch problems identified through IATTC ecological risk assessment (there is a binding measure on shark bycatch in purse seine fisheries, but no measure on bycatch of other non-target fish species). The purse seine shark measures (IATTC, 2005a, 2006) do not require employment of purse seine gear best practices to mitigate problematic shark bycatch (Gilman, 2011). IATTC has coordinated research on sorting grids and other gear technology methods, with an objective to reduce bycatch of juvenile tunas in purse seine sets on FADs (Compean, 2011), which has the potential to eventually lead to regulatory measures.

There are binding measures in place for 5 of 10 potential bycatch problems not identified via IATTC ecological risk assessment. Binding measures are in place for dolphins, turtles, and juvenile/undersized tunas in purse seine fisheries, and turtles and sharks in longline fisheries, but not for the other 5 problems.

There is a need for an improved legally binding measure requiring best practices to mitigate sea turtle interactions in pelagic longline fisheries. The current measure requires the possession and use of turtle handling and release equipment, but does not require actions to avoid and minimize turtle captures (IATTC, 2007b).

The measure restricting shark finning practices in pelagic longline tuna fisheries has limited potential to control shark fishing mortality levels, as some IATTC managed fisheries have been identified as having growing markets for shark meat and limited resources for surveillance and enforcement (Gilman et al., 2008a; Gilman, 2011). The shark measure does not require employment of longline or purse seine gear technology best practices to mitigate problematic shark bycatch (Gilman, 2011).

To determine if cetacean bycatch mitigation measures are needed in longline fisheries, monitoring is required to determine cetacean interaction levels and identify affected populations (Gilman et al., 2006a).

Lacking information on whether problematic bycatch of small swordfish occurs in managed pelagic longline tuna fisheries, precautionary adoption of best practice measures to mitigate longline tuna fishery bycatch of small swordfish is warranted but lacking.

- What proportion of binding bycatch measures contain quantitative, measurable performance standards?

Two of six binding measures have quantitative performance standards.

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

50% (1 of 2 measures). It is not clear if the shark measure standard of the 5% limit of ratio of weight of retained shark fins to carcasses is being implemented in IATTC-managed fisheries due to insufficient monitoring.

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

One of the two measures with quantitative performance standards has been determined to be meeting the stipulated standard. Through 100% onboard observer coverage, direct dolphin mortality levels by large purse seiners have been documented to have significantly declined by 98% (Hall, 1998; IATTC, 2007c).

Insufficient monitoring, in particular in pelagic longline fisheries, hampers efforts to assess compliance and hence achievement of the shark measure's stipulated standard. Furthermore, the form of the fins (frozen vs. dried) and form of the carcass (whole weight, dressed or partially dressed) is not specified in the measure, which precludes defining a clear method to assess compliance (Fowler and Seret, 2010). Additionally, the 5% limit of ratio of weight of retained shark fins to carcasses, even if it did lend itself to being monitored for compliance, may not achieve the measure's explicit objective of achieving sustainable shark fishing mortality in IATTC-managed fisheries if there is market demand for shark meat, as

has been documented to be increasing in some regions (Gilman et al., 2008a; Gilman, 2011).

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

None of the bycatch and discard measures were identified as not being effective. No information was identified documenting the efficacy of IATTC binding measures that lack quantitative performance standards.

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

No, there is no opt out provision/provision for reservations (IATTC, 2003a [Article IX(7), XXXIII]; AIDCP, 2009c [Article IX, XXVII]).

Table A1.4-7. Active IATTC legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
<p>A 2005 binding resolution on seabirds (IATTC, 2005b) was replaced in 2010 by a non-binding recommendation (IATTC, 2010a). The non-binding measure stipulates that longline vessels must employ at least two mitigation measures selected from eight alternatives, in specified areas of the convention area. Exempts vessels propelled by outboard motors (IATTC, 2010a).</p>	<p>None - no performance standards to assess the effectiveness of the measure.</p> <p>Note – non-binding.</p>	<p>Gear design (e.g., amount of weighted swivel, location of attachment of weighted swivel on branchline);</p> <p>Fishing practices (e.g., timing of fishing operations to determine if night setting, stern vs. side setting, offal retention/discharge practices, bait dyed blue to prescription, employ tori line over area where baited hooks are deployed);</p> <p>Location of fishing effort (bycatch mitigation measures are required to be used in designated areas);</p> <p>List of member’s longline vessels not propelled by outboard motors.</p>	<p>b and e</p> <p>Note – non-binding.</p>

		Note – non-binding.	
Sea turtles			
IATTC requires purse seine vessels to: (i) avoid encirclement of sea turtles to the extent practicable; (ii) monitor FADs for entangled turtles; (iii) release turtles observed entangled in FADs; and (iv) conduct research and development of new designs of FADs to reduce turtle entanglement (IATTC, 2007b). Vessels must rescue turtles sighted in purse seine nets before they become entangled, and when turtles are entangled in the net, the vessel must stop net roll as soon as the turtle comes out of the water, and not start again until the turtle has been released (IATTC, 2006). Longline vessels must: (i) carry and use turtle releasing equipment; and (ii) conduct trials of combinations of circle hooks and bait, depth and other turtle bycatch mitigation measures (IATTC, 2007b).	None – no performance standards to assess the effectiveness of the measure.	Turtle release equipment on longline vessels; Fishing practices (e.g., purse seine vessels stop net roll when turtle comes out of water; longline vessels use turtle release equipment); List of member’s longline vessels.	b and e
Marine mammals			

<p>In purse seine fisheries, vessels operating in the Eastern Pacific Ocean of nations that are contracting parties to the Agreement on the International Dolphin Conservation Program (AIDCP, administered by IATTC), receive annual, individual vessel dolphin mortality limits, there is an annual cap of 5,000 total dolphin mortalities in the fishery, as well as annual mortality caps for individual dolphin stocks, established at 0.1 to 0.2 percent of each stock's minimum estimated abundance (IATTC, 2007c; AIDCP, 2009c [Annex III(1)]; Gilman, 2011). When making dolphin-associated sets, participating vessels allocated individual dolphin mortality limits are also required to have an onboard observer, use a Medina dolphin safety panel, complete backdown no later than thirty minutes after sunset (prohibition on night setting), conduct backdown after dolphins are captured, deploy at least one rescuer during backdown, have three speedboats, a raft to</p>	<p>Yes – measurable. Individual vessel and fleet-wide annual total dolphin mortality quotas, and annual fleet-wide dolphin stock-based quotas.</p>	<p>Vessel-specific number of dolphin mortalities by stock; Gear design (Medina panel); Fishing practices (type of set, backdown, day-setting), Dolphin safety/rescue equipment; List of vessels operating under the AIDCP; AIDCP list of qualified captains.</p>	<p>d and e and f (AIDCP vessels and captains)</p>
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<p>observe and rescue dolphins, facemasks, floodlight, and carry other specified dolphin safety/rescue equipment, and other measures (AIDCP, 2009c,d; Gilman, 2011). Captains on vessels operating under the AIDCP who have committed two or more night set infractions are required to attend an instructional seminar (AIDCP, 2004a). Vessels with a carrying capacity of \leq 363 metric tons are prohibited from making intentional sets on dolphins (AIDCP, 2009c).</p>			
<p>Shark and relatives</p>			
<p>IATTC requires members' vessels to: (i) keep all parts of retained sharks, excluding head, guts and skins, to the point of first landing; (ii) have onboard fins that total \leq 5% of the weight of sharks onboard, up to the first point of landing, or otherwise ensure compliance with the 5% rule through certification, observer monitoring or other method (IATTC, 2005a). Purse seine vessels are</p>	<p>5% limit of ratio of weight of retained shark fins to carcasses.</p>	<p>Weight of landed shark fins and weight of remainder of shark carcasses; Shark discard practices.</p>	<p>a and b and e</p>

required to release all sharks unharmed to the extent practicable (IATTC, 2006).			
Juvenile and small/undersized target species			
Time/area closure (73 days in 2011) to all purse seine tuna vessels in an area off the Galapagos Islands where relatively high levels of bigeye tuna bycatch occurs. Prohibits purse seine vessels from discarding bigeye, yellowfin and skipjack tunas, except during the final set of a trip when well space remaining may be insufficient to accommodate all tuna caught in that set. Excludes purse seine vessels with ≤182 metric tons carrying capacity and longline vessels < 24m overall length (IATTC, 2009e). Expires the end of 2011; a Recommendation was adopted that continues these measures through 2013 but it is non-binding (IATTC, 2010b).	None - no performance standards to assess the effectiveness of the measure.	Purse seine vessel location of fishing effort; Tuna discard practices; List of member's purse seine vessels >182 metric tons carrying capacity.	b and c and e
Unmarketable sizes and species of non-target species of fish			
None	NA	NA	NA

Other or multiple bycatch species group(s)			
A measure that prohibits fishing within 1 nautical mile of data buoys, which act like FADs in aggregating pelagic species, reduces bycatch associated with fishing on aggregations associated with FADs (IATTC, 2010c).	None – no performance standards to assess the effectiveness of the measure.	Location of fishing effort; Location of data buoys; List of member's vessels	b and e
IATTC requires purse seine vessels to release all non-target species unharmed to the extent practicable (IATTC, 2006).	None - no performance standards to assess the effectiveness of the measure.	Fishing practices (practices to handle and release non-target species).	b and e

Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 3 of 14 possible points, 21%

Table A1.4-8 provides details on the assessment outcome for criterion 3.

Table A1.4-8. Assessment of IATTC conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
For fisheries managed by the RFMO for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are in place for none of these fisheries.	0
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

No relevant studies by IATTC were identified. No information was identified that described the degree of ghost fishing occurring in IATTC managed fisheries.

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

In general, IATTC-managed fisheries that employ passive fishing gear (pelagic longlines, gillnets, traps) are likely to cause ghost fishing, while purse seine, trawl and other fisheries that employ active gear are less likely to result in ghost fishing (FAO, 2005). However, lost and abandoned Fish Aggregating Devices (FADs) used by purse seine vessels have been observed to result in ghost fishing (Chanrachkij et al., 2008; Gilman, 2011) and ghost fishing has been observed in seine nets (Matsuoka et al., 2005). In conclusion, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in IATTC-managed fisheries for tuna and tuna-like species.

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table A1.4-9);

There are no relevant binding measures.

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

0%, there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures in place.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures in place.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

No, there is no opt out provision/provision for reservations (IATTC, 2003a [Article IX(7), XXXIII]; AIDCP, 2009c [Article IX, XXVII]).

- Table A1.4-9. Active IATTC legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	NA	NA	NA

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea

Score: 3 of 14 possible points, 21%

Table A1.4-10 provides details on the assessment outcome for criterion 3.

Table A1.4-10. Assessment of IATTC conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed fisheries, and no relevant binding measures are in place.	0
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

No relevant assessments were identified.

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from the these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

No information was identified on risks from pollution from discards from managed fisheries.

Purse seine fisheries on FADs can have relatively large levels of discharges at sea. Discharges from pelagic fisheries in deep sea areas may result in problematic alterations to benthic communities, and locking biomass up in bottom currents for centuries before recycling to the euphotic zone of the pelagic ecosystem (Hall et al., 2000). Small-scale gillnet and other coastal fisheries may also result in ecological problems from discharges. In general, large inputs of organic matter from discards at sea can increase natural nutrient levels in nutrient-poor benthic ecosystems, and in fisheries where discards are spatially concentrated, and especially in areas of low current flow, may cause localized hypoxia or anoxia of the seabed, which, if prolonged, causes avoidance and mortalities, alters benthic community composition, and alters ecosystem processes and structure (FAO, 1995 [Article 7.2.2g]; Goñi,

1998; Hall et al., 2000; Stevens et al., 2000; Gray et al., 2002; FAO, 2003a,b; Franco et al., 2008; Levin et al., 2009; Haselmair et al., 2010).

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table A1.4-11).

There are no relevant binding measures.

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

No relevant information was identified for managed fisheries documenting problematic pollution, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

No, there is no opt out provision/provision for reservations (IATTC, 2003a [Article IX(7), XXXIII]; AIDCP, 2009c [Article IX, XXVII]).

- Table A1.4-11. Active IATTC legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, and describe data requirements for performance assessment.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	na	na	na

Criterion 5. Surveillance and enforcement

Score: 9 of 20 possible points, 45%

Table A1.4-12 provides details on the assessment outcome for criterion 3.

Table A1.4-12. Assessment of IATTC measures and resources for surveillance and enforcement.

Factor	Points for positive response
≥50% but <75% of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	3
The RFMO requires parties to report to the RFMO on their enforcement procedures and conclusions.	3
The RFMO has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

IATTC maintains positive and negative vessel lists, an AIDCP list of qualified captains, and list of vessels operating under the AIDCP (IATTC, 2000, 2007a; AIDCP, 2004c, 2009c). The positive list for longliners is for vessels ≥ 24 m overall length authorized to fish for tuna and tuna-like species in the Convention Area (IATTC, 2007a). IATTC requires vessels ≥ 24 m in overall length to employ VMS (IATTC, 200b). Vessels assigned a dolphin mortality limited under the AIDCP are required to undergo two annual inspections for compliance with dolphin safety gear and equipment, and to have an onboard observer to collect information required to assess compliance with AIDCP measures (AIDCP, 2004b, 2009c). Observer data form the basis for determining if a vessel has violated AIDCP measures (AIDCP, 2009c).

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.4-7, A1.4-9, and A1.4-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

The following are minimum methods identified to permit effective surveillance of binding measures identified in Tables A1.4-7, A1.4-9, and A1.4-11:

- (i) Dockside inspection (all vessels, for shark landing fin restrictions);
- (ii) At-sea inspection (longline and purse seine vessels);
- (iii) VMS (purse seine vessels > 182 metric tons carrying capacity);
- (iv) Vessel list (longline and purse seine vessels);
- (v) List of vessels and captains participating in the AIDCP;
- (vi) Onboard observer coverage (purse seine vessels with a carrying capacity of > 363 metric tons)

Of these, iii, v and vi are surveillance methods required by IATTC. Dockside inspections/recording of landings does not occur for all fisheries, in particular, for artisanal fisheries. IATTC regional observer coverage of all carrier vessels that receive at-sea transshipments from longline vessels and the ability of observers to board and inspect longline vessels for compliance with various measures (Compean, 2011), comprises the extent of regional resources for at-sea surveillance. Complete lists of parties' artisanal longline vessels are not available.

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

Regarding bullet iii, the Antigua Convention includes a provision requiring Parties to report their, "legal and administrative provisions, including those regarding infractions and sanctions, applicable to compliance with conservation and management measures" (IATTC, 2003a [Article XVIII(3)(a)]). There are also procedures established for parties to report on enforcement actions taken to address infractions of the AIDCP (AIDCP, 2009b,c [Article XVI(5)]). No information was identified related to items i and ii.

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

Yes, IATTC has established a Working Group on Compliance with a mandate that includes reviewing compliance with measures and recommending actions to promote compliance (IATTC, 1999a). The Committee for the Review of Implementation of Measures Adopted by the Commission, established by the Antigua Convention, includes a mandate to review compliance with measures and recommend actions to promote compliance (IATTC, 2003a [Annex 3]). The AIDCP International Review Panel is mandated to identify infractions, and recommend measures to meet the AIDCP objectives (AIDCP, 2009c [Annex VII]).

- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

AIDCP and IATTC receive information on the application of sanctions taken by Members when Members report their punitive actions during IRP and Compliance Committee meetings (Compean, 2011). Some of this information is open to the public in annual IRP reports (Compean, 2011). Information was not identified to enable a determination of what proportion of detected violations of bycatch and discard measures resulted in punitive measures as required by the measures.

A1.5. International Commission for the Conservation of Atlantic Tunas (ICCAT)

SUMMARY	
Criteria Suite Scores	
Overall	20 (± 7 SD of the mean)% ¹
Criterion 1. Data Collection	36% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	36%
Criterion 1B. Regional Observer Coverage Rates	36%
Criterion 1C. Regional Observer Programme Dataset Quality	36%
Criterion 2. Open Access to Regional Observer Programme Datasets	0%
Criterion 3. Ecological Risk Assessment	25%
Criterion 4. Conservation and Management Measures	7% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	22%
Criterion 4B. Conservation and Management Measures to Govern Bycatch in Lost, Abandoned and Discarded Gear	0%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	0%
Criterion 5. Surveillance and Enforcement	30%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The International Commission for the Conservation of Atlantic Tunas (ICCAT) was established by the International Convention for the Conservation of Atlantic Tunas, signed in Rio de Janeiro, Brazil, on 14 May 1966 and entered into force on 21 March 1969. The convention was amended in 1984 and 1992 (ICCAT, 2009d).

MEMBERSHIP

Currently there are 48 ICCAT Contracting Parties: Albania, Algeria, Angola, Barbados, Belize, Brazil, Canada, Cape Verde, China, Côte d'Ivoire, Croatia, Equatorial Guinea, Egypt, European Union, France (Saint Pierre and Miquelon), Gabon, Ghana, Guatemala, Guinea, Honduras, Iceland, Japan, Libyan Arab Jamahiriya, Mexico, Morocco, Namibia, Nicaragua, Nigeria, Norway, Panama, Philippines, Republic of Korea, Russian Federation, Saint Vincent and the Grenadines, Sao Tome and Principe, Senegal, Syrian Arab Republic, South Africa, Trinidad and Tobago, Tunisia, Turkey, United Kingdom (Overseas Territories), United States of America, Uruguay, Vanuatu and the Bolivarian Republic of Venezuela (ICCAT, 2009d). There are four Cooperating non-Contracting Parties, Entities or Fishing Entities: Chinese Taipei, Colombia, Curacao, and Guyana (ICCAT, 2011a).

MANAGED SPECIES AND FISHERIES

ICCAT manages tuna and tuna-like species, (the Scombriformes with the exception of the families Trichiuridae and Gempylidae and the genus *Scomber*) and such other species of fishes

exploited in tuna fishing in the convention area that are not under investigation by another international organization (ICCAT, 2009d; Lugten, 2010). ICCAT has about 30 stocks of tuna, sharks and billfishes under its purview and has adopted recommendations for the following 13 species/stocks (ICCAT, 2009d):

- Bluefin tuna in the eastern Atlantic and Mediterranean
- Bluefin tuna in the western Atlantic
- Bigeye tuna
- Swordfish in the North Atlantic
- Swordfish in the South Atlantic
- Yellowfin tuna
- Blue Marlin
- White marlin
- Albacore in the North Atlantic
- Albacore in the South Atlantic
- Skipjack tuna
- Shortfin mako; and
- Blue shark.

There are 16 other target and bycatch fish species managed by ICCAT, and ICCAT also manages vulnerable bycatch species, including sharks, sea birds and turtles (ICCAT, 2009d). ICCAT manages fisheries that catch these target and non-target fish species in the Convention Area. Main gear types managed by ICCAT are: purse seine, longline, gillnet, trawl, pole-and-line, rod-and-reel, harpoon, trap, and baitboat (ICCAT, 2009h).

AREA OF APPLICATION

The ICCAT area of competence is defined as “all waters of the Atlantic Ocean, including the adjacent seas,” and generally includes the western Atlantic, the eastern Atlantic and the Mediterranean Sea (ICCAT, 2009d). There is no precise delimitation of this area by lines of longitude and latitude. For statistical purposes, the area is set between 70°W and 20°W in the South Atlantic (ICCAT, 2009d). The broad definition was established in order to encompass all waters of the Atlantic Ocean in which tunas are likely to be found (Lugten, 2010).

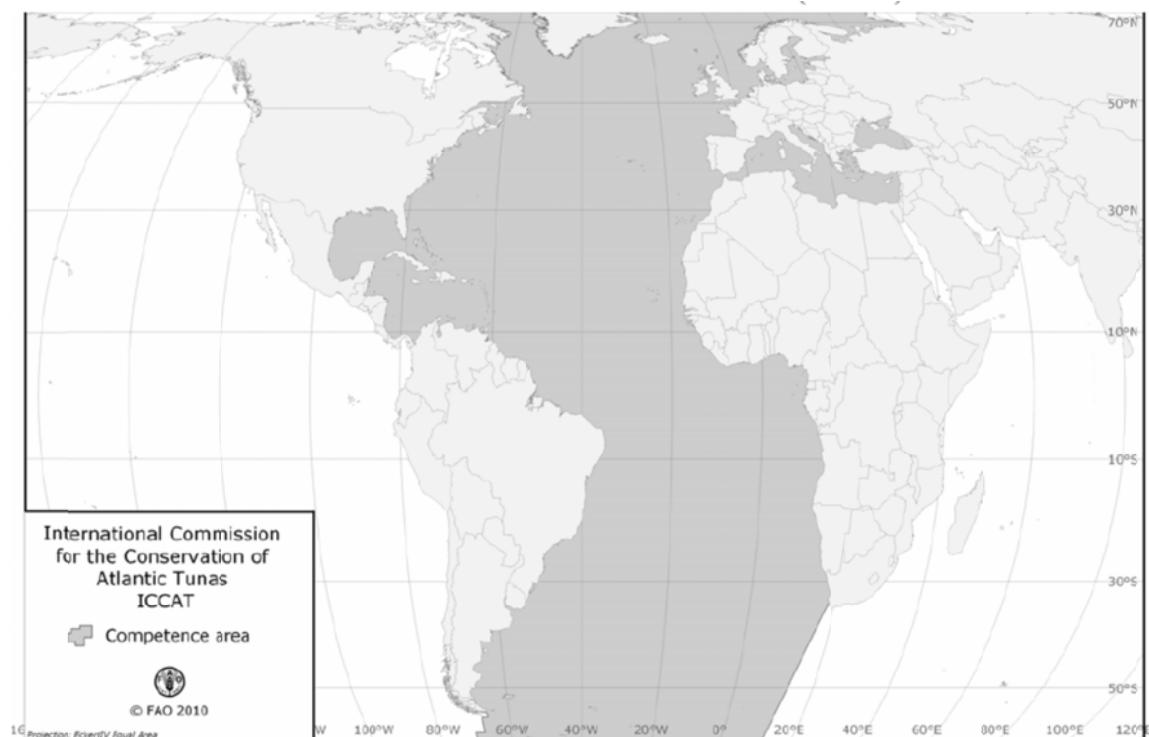


Fig. A1.5-1. ICCAT convention area (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH AND DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries

Score: 9 of 25 possible points, 36%.

Table A1.5-1 provides details on the assessment outcome for criterion 1A.

Table A1.5-1. Assessment of ICCAT regional observer programme data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
Data for >50% but <75% (4 of 7) of documented vulnerable bycatch species are intended to be collected in fisheries with regional observer coverage.	2
At least one item of information but ≤50% of the items of information needed to assess performance standards of relevant binding conservation and management measures is intended to be collected by regional observers.	1
Information on fishing effort is intended to be routinely collected for fisheries with regional observer coverage.	1
Date and location of fishing operations are intended to be routinely captured by regional observers.	1

Information on whether catch is retained or discarded is intended to be routinely captured by regional observers for at least 1 individual bycatch species or group but $\leq 50\%$ of documented vulnerable bycatch species.	1
Data records are intended to be to the species-level for at least 1 bycatch species but $\leq 50\%$ of documented vulnerable bycatch species in fisheries with regional observer coverage.	1
Information on length or other proxy for age class is intended to be collected by regional observers for at least 1 vulnerable bycatch species but $\leq 25\%$ of identified vulnerable bycatch species.	1
Information on the disposition of discards (e.g., alive vs. dead, and possibly degree of injury) is intended to be collected for at least 1 vulnerable bycatch species but $\leq 50\%$ of identified vulnerable bycatch species.	1

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

No, the ICCAT Convention is a pre-UNCLOS instrument, and as such does not include language calling for consideration of effects of fishing on associated and dependent species (ICCAT, 2009d). However, binding measures have been adopted with controls for non-target species (summarized under sub-criterion 4A).

- In fisheries required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

4 of 7. The following are documented problematic bycatch species groups: seabirds, elasmobranchs, juvenile bigeye tuna, juvenile bluefin tuna, juvenile swordfish, sea turtles, marine mammals (from ecological risk assessments, Criterion 3, and other assessments, Sub-criterion 4A). Of these 7, catch data are assumed to be collected for 4: juvenile bluefin, bigeye and swordfish, and primary pelagic shark species in large purse seine vessels targeting bluefin tuna, and on bluefin- and bigeye-targeting longline vessels. However, no information was found identifying standardized, routine data collection protocols conducted by the Regional Observer Programme for Bluefin Tuna or by national observer programmes as required by ICCAT binding measures. Based on a review of a sample form for ICCAT observers on small scale longline vessels, information is likely collected for primary shark species, and not for other vulnerable bycatch species (Miyake, 1990 [Appendix 4]). Delegates to the ICCAT Working Group on Integrated Monitoring Measures identified concern over a lack of collection of data on bycatch in ICCAT fisheries (ICCAT, 2010d). A draft Recommendation by ICCAT to Establish Minimum Standards for Fishing Vessel Scientific Observer Programs [MON-08C/2010], which specifies the need for representative temporal and spatial coverage and identifies specific data collection including of vulnerable bycatch species, was first introduced at the ICCAT Compliance Committee in 2009 and again at a 2010 meeting of the Working Group on Integrated Monitoring Measures (ICCAT, 2010d), but has not been adopted. Data sources for available ICCAT summary statistics are reported as being derived from statistics reported by the ICCAT Parties, and supplemental data sources, including port data collection on landings, trade data, a Statistical Document Program, and the Fishery Information, Data and Statistics Service of the Food and Agriculture Organization of the

United Nations, with no mention of the ICCAT regional observer programme for bluefin tuna as being one of the data sources (ICCAT, 2010b). Compliance with data reporting requirements has been poor (ICCAT, 2009d).

- Does the RFMO's data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected?

No, this is not routinely collected for all 7 vulnerable bycatch species groups. Maybe yes, for 4 of 7 bycatch species groups. No information was found identifying data collection protocols by the Regional Observer Programme for Bluefin Tuna, or by national observer programmes required by ICCAT binding measures. Based on review of a sample form for ICCAT observers on small scale longline vessels, information on the number, length or weight of landed catch is likely collected by regional observers for juveniles of target bluefin and bigeye tunas and swordfish, and main pelagic shark species, and not for other vulnerable bycatch species (Miyake, 1990 [Appendix 4]).

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).

This information has been recorded in Tables A1.5-7, A1.5-9, and A1.5-11.

- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected in the regional observer programme according to the RFMO's data collection protocols?

9 of 28 for the Regional Observer Program for Bluefin Tuna and for national observer programmes as required by binding ICCAT measures.

8 of the 14 data information needs, listed below, to assess the performance of binding ICCAT bycatch measures, information was available documenting that data collection protocols by the ICCAT Regional Observer Program for Bluefin Tuna for large purse seine bluefin vessels include iii, iv, vi, ix, x, xi, xiii, xiv.

Except for xiv, no other information on data collection protocols was identified for national observer programmes as required by binding ICCAT measures, resulting in 1 of 14 data needs are potentially being met by combined national observer programmes of ICCAT Parties.

- i. Longliners deploy tori line when fishing south of boundary;
- ii. Timing of fishing operations and gear design by longline swordfish vessels;
- iii. Timing and location of fishing effort by purse seiners and baitboats
- iv. Timing and location of fishing effort by purse seine, pelagic longline, baitboat, troll, pelagic trawl and recreational and sport fishing vessels for bluefin tuna
- v. Location of fishing effort in relation to the location of western Atlantic bluefin spawning areas;
- vi. Timing and location of fishing effort in the Mediterranean;
- vii. Species composition of catch by longline and purse seine vessels
- viii. Weights, lengths and species composition of all landed catch;
- ix. Species composition of transshipments;
- x. Weight of landed shark fins and carcasses;
- xi. Landed catch species composition – any prohibited bigeye threshers in the catch;

- xii. Shark release practices;
 - xiii. Traceability to vessel and date of catch;
 - xiv. List of vessels authorized to fish in the Convention Area.
- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?

Of 4 data collection protocols (seabird interactions, shark CPUE, shark lengths, discarded bigeye thresher sharks disposition) required by ICCAT binding measures, 3 are implemented (data on sharks).

ICCAT (2007a) requires Parties to submit data on interactions of their fleets with seabirds, but the measure did not identify specific data collection methods; all "available" information on seabird interactions is to be reported, and the ICCAT SCRS reported that, during their 2009 seabird assessment, only a limited number of parties reported detailed information on seabird interactions (ICCAT, 2010f). A non-binding resolution (Res. 03-11) similarly encouraged Parties to report data on sea turtle interactions. ICCAT (2009e) requires the collection and reporting of Task I and II (nominal catch and catch/effort and length frequency) data for *Alopias spp.* of sharks other than *A. superciliosus* (bigeye thresher sharks, prohibited from being retained), and requires the collection and reporting of the number and disposition (live or dead) of bigeye thresher sharks that are discarded. ICCAT (2007c) requires Parties to report Task I and II data, including number of dead discards and length frequency, for sharks.

- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?

Assumed to be yes for both the Bluefin Tuna Regional Observer Program and national programmes. Yes for the Bluefin Tuna Regional Observer Program. The ICCAT Sub-Committee on Statistics reported in 2010 that the Bluefin Tuna Regional Observer Program is to collect information on fishing effort, including the temporal and spatial distribution of effort (ICCAT, 2010c). Information on data collection protocols was not identified for national observer programmes required by binding ICCAT measures. ICCAT requires reporting of effort statistics, which may be estimates and/or derived from data collected by observers (ICCAT, 2009h).

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely collected by observers of the regional observer programme?

3 of 14. 3 of 7 for the Bluefin Tuna Regional Observer Program, and 0 of 7 for national observer programmes required by ICCAT binding measures. Based on binding ICCAT measures and protocols in ICCAT data collection forms, of 7 identified problematic bycatch species groups (elasmobranchs, juvenile bigeye tuna, juvenile bluefin tuna, juvenile swordfish, sea turtles, marine mammals), information on retention vs. discarding of catch are assumed to be collected for 3 (juvenile bluefin and bigeye tunas, and primary pelagic shark species) in large purse seine vessels targeting bluefin tuna included in the Bluefin Tuna Regional Observer Program. However, specific information on the data collection and reporting protocols on the retention vs. discarding of vulnerable bycatch species was not identified for national observer programmes required by binding ICCAT measures. The Sub-Committee on Statistics reported that there are no specific forms or

submission formats for ICCAT parties to report bycatch, and as a result, it is not possible to determine if the lack of inclusion of bycatch of vulnerable species by a party is a result of their not collecting and reporting these observations or a result of no bycatch of these species (ICCAT, 2010c).

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

Assumed to be yes for both the Bluefin Tuna Regional Observer Program and national observer programmes required by ICCAT binding measures. Data collection protocols of ICCAT observer programmes were not identified. The *Recommendation Concerning the Recording of Catch by Fishing Vessels in the ICCAT Convention Area* [Rec. 03-13] created a mandatory data recording system for all fishing vessels authorized to fish species under the purview of ICCAT in the Convention area, and made it obligatory for all commercial fishing vessels of CPCs over 24 m overall length to keep a logbook recording the information required in the *ICCAT Manual*.

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to record at the species level?

3 of 14. 3 (juvenile bluefin and bigeye tunas, and some pelagic shark species) of 7 (don't know for seabirds, sea turtles, marine mammals and juvenile swordfish) for the Bluefin Tuna Regional Observer Program, and 0 of 7 for national observer programmes required by ICCAT binding measures. The Sub-Committee on Statistics reported that there are no specific forms or submission formats for ICCAT parties to report bycatch, and as a result, it is not possible to determine if the lack of inclusion of bycatch of vulnerable species by a party is a result of their not collecting and reporting these observations or a result of no bycatch of these species having been observed (ICCAT, 2010c).

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is intended to be routinely collected by regional observers that provides a proxy for age class, identify the measurement method.

3 of 14. For the Bluefin Tuna Regional Observer Program, of 7 vulnerable bycatch species groups, length frequency or weight data are assumed to be collected and reported for primary pelagic shark species, bluefin tuna, and bigeye tuna (ICCAT, 2010c). No information on data collection protocols was identified for national observer programmes required by binding ICCAT measures.

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

1 of 14 (1 of 7 for the Bluefin Tuna Regional Observer Program, and 0 of 7 for national programmes). The Bluefin Tuna Regional Observer Program is assumed to collect information on the disposition of discarded sharks, in compliance with two ICCAT binding measures (ICCAT, 2007c, 2009e). Information on discards of non-target species, including vulnerable bycatch species, is not reported by ICCAT parties to the ICCAT Secretariat (ICCAT, 2010c).

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

0 of 7. No information was identified on data collection protocols of the Bluefin Tuna Regional Observer Program or of national observer programmes required by binding ICCAT measures. It is assumed that the ICCAT-administered regional observer programme does not collect information on gear attached to live discards as no ICCAT measures mention this data collection protocol. Information on bycatch, including information on gear attached to released catch, is not routinely reported to ICCAT (ICCAT, 2010c).

Criterion 1B. Regional Observer Coverage Rates

Score: 4 of 11 possible points, 36%.

Table A1.5-2 provides details on the assessment outcome for criterion 1B.

Table A1.5-2. Assessment of ICCAT onboard observer coverage rates to monitor bycatch, including discards.

Factor	Points for positive response
At least one but <25% of active managed fisheries (fisheries covered by the RFMO) have $\geq 5\%$ regional onboard observer coverage.	1
The RFMO's scientific body has recommended target (5-10% minimum) onboard observer coverage rates for all ICCAT-managed fisheries, and the regional onboard observer coverage rates meet scientific advice for at least 1 managed fishery but <25% of managed fisheries.	1
There is international exchange of observers in one regional onboard observer programme.	2

Information used for assessment:

- What recommendations on regional observer coverage rates have the RFMO's scientific body or the Commission made for fisheries under the RFMO's mandate?

There have been several assessments related to optimum observer coverage rates to estimate bycatch, presented to the ICCAT SCRS Sub-Committee on Ecosystems (ICCAT, 2010e). Conclusions generally stated that the level of observer coverage depends on the objective of the programme, the fleet-specific frequency of occurrence of bycatch events for each bycatch species of interest, the variability in the catch/discard rate of bycatch events, the desired coefficient of variation of bycatch estimates (i.e., the acceptable level of precision of bycatch rate estimates), and other factors (ICCAT, 2007e, 2010e). Based on these inconclusive assessments, the Subcommittee recommended the adoption of a minimum observer coverage rate for all ICCAT fleets of 5-10% (ICCAT, 2010e).

- Does a regional observer programme exist?

Yes. The *Recommendation on a Multi-Year Conservation and Management Program for Bigeye Tuna* [Rec. 04-01] requires national (not regional) onboard observers on at least 5% of longline vessels over 24 meters fishing for bigeye in order to obtain data on the composition of the catches relative to the fishing areas and seasons.

However, there is no binding requirement for parties to report observer data to ICCAT (ICCAT, 2010e). Parties reporting catch/effort data do not distinguish data from logbooks vs. observer programmes (ICCAT, 2010e). *Recommendation Establishing a Regional Programme for Transshipment* [Rec. 06-11] established a regional observer program, whereby each CPC is required to ensure that all carrier vessels transshipping at sea have an ICCAT observer onboard, in accordance with the ICCAT regional observers programme, in Annex 2 of the Recommendation. The *Recommendation by ICCAT Amending the Recommendation by ICCAT to Establish a Multi-Annual Recovery Plan for Bluefin Tuna in the Eastern Atlantic and Mediterranean* [Rec. 08-05] amended the Regional Observer Programme for Bluefin Tuna requiring 100% coverage of purse seine vessels over 24 m during the open season for bluefin, all purse seiners involved in joint fishing operations regardless of the vessel length, and during all transfer of bluefin to cages and harvest of fish from the cage (ICCAT, 2008a, 2011c). The Regional Observer Programme for Bluefin Tuna, as of April 2010, is operated on behalf of ICCAT by a consortium between Marine Resources Assessment Group and Cofrepeche, who train and deploy the observers (ICCAT, 2011c). Furthermore, ICCAT Contracting Parties are to ensure coverage of bluefin-targeting vessels as follows: (i) 20% coverage of active longline vessels, (ii) 20% coverage of purse seine vessels between 15-24 m in overall length, (iii) 20% of pelagic trawlers, (iv) 20% of active baitboats, and (v) 100% coverage during the harvesting of tuna traps; ICCAT Members are responsible for providing national observers to meet these targets, with no requirements for international exchange of observers or pooling Member datasets (ICCAT, 2008a; Gilman, 2011).

To recap, binding measures require the following observer coverage of ICCAT fisheries:

- (i) 100% international coverage of purse seine bluefin tuna vessels >24m under the Regional Observer Program for Bluefin Tuna;
 - (ii) ≥5% national coverage of longline bigeye vessels > 24m;
 - (iii) 100% international coverage of carrier vessels transshipping at sea;
 - (iv) 100% international coverage of purse seiners involved in joint bluefin fishing operations, during all transfer of bluefin to cages and during the harvest of bluefin from cages
 - (v) 20% national coverage of bluefin-targeting longline vessels;
 - (vi) 20% national coverage of purse seine bluefin vessels 15-24 m in length,
 - (vii) 20% national coverage of bluefin pelagic trawlers
 - (viii) 20% national coverage of active bluefin baitboats; and
 - (ix) 100% coverage during the harvesting of tuna traps
- What are regional onboard observer coverage rates in each active fishery managed by the RFMO?

Information was not identified reporting actual observer coverage rates for large purse seine vessels covered by the Regional Observer Programme for Bluefin Tuna. By the 2010 SCRS meeting, only Japan and Morocco documented compliance with ICCAT

requirements for national observer coverage, where Japan reported having 20.1% coverage of relevant national fisheries, and Morocco 100% of tuna traps during harvesting (ICCAT, 2010f). Information on actual coverage rates by other national observer programmes of small purse seiners, longliners, trawlers, baitboats and traps was not identified due to ICCAT Parties not reporting this information to the secretariat. In conclusion, international observer coverage of large purse seine bluefin tuna vessels is likely approaching or has already achieved the required 100% coverage; information was not identified for actual national coverage of ICCAT fisheries.

If we employ ICCAT required onboard observer coverage rates from the previous bullet, then the average observer coverage rate of ICCAT-managed fisheries is 19%, based on the following:

- 100% observer coverage rate of large purse seine and bluefin
 - 20% observer coverage rate of medium size purse seine
 - 0% observer coverage rate of small purse seine
 - 5% observer coverage rate of large longline
 - 0% observer coverage rate of small longline
 - 20% observer coverage rate of longline BFT
 - 20% observer coverage rate of bluefin trawl
 - 20% observer coverage rate of bluefin baitboat
 - 100% observer coverage rate of tuna trap
 - 0% observer coverage rate of other trawl
 - 0% observer coverage rate of other baitboat
 - 0% observer coverage rate of gillnet
 - 0% observer coverage rate of pole-and-line
 - 0% observer coverage rate of rod-and-reel
 - 0% observer coverage rate of harpoon.
- If there have been recommendations for onboard observer coverage rates by the RFMO's scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body's recommendations? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

1 of 13. The SCRS Sub-Committee on Ecosystems recommended a minimum onboard observer coverage rate of 5-10% for all ICCAT fisheries (ICCAT, 2010e). International observer coverage of large purse seine bluefin tuna vessels is likely approaching or has already achieved the required 100% coverage; information was not identified for actual national coverage of ICCAT fisheries due to ICCAT Parties not reporting this information to the secretariat (ICCAT, 2010f).

Of 13 ICCAT fisheries (purse seine bluefin $\geq 15\text{m}$, purse seiners bluefin $< 15\text{m}$, purse seine non-bluefin, longline bigeye $> 24\text{m}$, longline bigeye $\leq 24\text{m}$, longline bluefin, gillnet, trawl, pole-and-line, bluefin baitboat, rod-and-reel, harpoon, and trap), binding measures require $\geq 5\%$ onboard observer coverage for 6 (purse seine bluefin tuna vessels $\geq 15\text{m}$, longline bigeye vessels $> 24\text{m}$, bluefin-targeting longline vessels, bluefin

pelagic trawlers, bluefin baitboats, tuna traps during harvesting). Information on actual observer coverage rates of all ICCAT-managed fisheries was not identified; bullet two summarizes binding obligations for observer coverage by ICCAT parties.

- For each fishery under the RFMO’s mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

International observers are assigned only for the Regional Observer Programme for Bluefin Tuna.

Criterion 1C. Regional Observer Programme Dataset Quality

Score: 4 of 11 possible points, 36%.

Table A1.5-3 provides details on the assessment outcome for criterion 1C.

Table A1.5-3. Assessment of ICCAT observer programme data quality.

Factor	Points for positive response
A regional observer programme database with records of bycatch exists.	1
The regional observer programme database for the ICCAT Regional Observer Program for Bluefin Tuna is comprised of records pooled from observed national fisheries. Individual national observer programme datasets are not reported to the RFMO in a standardized format that permits pooling.	1
The regional observer programme dataset is <5 years long.	1
Available information indicates that all countries with fisheries under the RFMO’s mandate are Members or Cooperating Non-Members.	1

Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include records on bycatch?

A regional observed programme database exists for data collected for the Regional Observer Program for Bluefin Tuna, which is for large purse seine bluefin tuna vessels. Data collection protocols for the Regional Observer Program for Bluefin Tuna were not found, however it is assumed that data on main pelagic shark species, bluefin tuna, and bigeye tuna are collected by the international observers based on these being the species for which data are included in ICCAT catch/effort and size databases (ICCAT, 2010c, 2011d). No information on data collection protocols was identified for national observer programmes required by binding ICCAT measures. Regarding national observer programme data collection, the Sub-Committee on Statistics reported that there are no specific forms or submission formats for ICCAT parties to report bycatch, and as a result, it is not possible to determine if the lack of inclusion of bycatch of vulnerable species by a party is a result of their not collecting

and reporting these observations or a result of no bycatch of these species having been observed (ICCAT, 2010c).

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

The Regional Observer Program for Bluefin Tuna is regionally coordinated, and data are presumably compiled into a regional ICCAT-owned database. No information was identified indicating that databases from national observer programmes required by ICCAT binding measures are submitted to the ICCAT secretariat, are regionally pooled, or are in standardized formats. It is assumed that there is no regional database of data collected by national observers for which ICCAT is the custodian.

- What is the length in years of the regional observer programme dataset?

About 1 year, assuming that a database for the Regional Observer Program for Bluefin Tuna began in about April 2010, when it began to be operated on behalf of ICCAT by a consortium between Marine Resources Assessment Group and Cofrepeche (ICCAT, 2011c).

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

Yes for 3 of 13 ICCAT fisheries requiring observer coverage. Yes for the Regional Observer Program for Bluefin Tuna, for which there is intended to be 100% coverage. Information on actual observer coverage rates and seasonal distribution of coverage by national programmes was not identified. Based on available information, repeated from a previous criterion in the paragraph below, a maximum of 2 of 12 national observer programmes required by ICCAT binding measures might have balanced temporal coverage.

By the 2010 SCRS meeting, only Japan and Morocco documented compliance with ICCAT requirements for national observer coverage, where Japan reported having 20.1% coverage of relevant national fisheries, and Morocco 100% of tuna traps during harvesting (ICCAT, 2010f). Information on actual coverage rates by other national observer programmes of small purse seiners, longliners, trawlers, baitboats and traps was not identified due to ICCAT Parties not reporting this information to the secretariat.

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

Yes for 3 of 13 ICCAT fisheries for which observer coverage is required. The same basis and assumptions as described in the previous bullet apply here.

- Which countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members?

No information was identified documenting countries, entities, or fishing entities (Chinese Taipei), with fishing activities in the ICCAT Convention area that are not Parties or Cooperating Non-Members (ICCAT, 2009d).

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

For fisheries that are a part of ICCAT-managed fisheries, observer coverage is not required for the following two vessel size classes:

- (i) Purse seine bluefin tuna vessels $\leq 15\text{m}$; and
- (ii) Longline bigeye vessels $\leq 24\text{m}$;

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

ICCAT Members consistently neglect to comply with data reporting requirements (ICCAT, 2009d). For example, the ICCAT 2007-07 Biennial Report states that data were available only from Canada and the US with preliminary estimates from Japan, and that significant underestimate misreporting occurs (ICCAT, 2009d). The Sub-Committee on Statistics reported in 2010 that 24 parties neglected to report Task I (nominal catch) data, and 28 parties did report these data, while 21 parties neglected to report Task II (catch/effort and length frequency) data, and 29 parties did report these data (ICCAT, 2010c). Most ICCAT parties do not comply with a binding measure [Rec. 04-10] creating shark data reporting requirements (ICCAT, 2009d). Information on data reporting by individual Members was not identified.

Criterion 2. Open Access to Bycatch Data

Score: 0 of 15 possible points, 0%.

Table A1.5-4 provides details on the assessment outcome for criterion 2.

Table A1.5-4. Assessment of ICCAT provision of open access to a regional observer programme datasets.

Factor	Points for positive response
There is a regional observer programme dataset containing records of	0

bycatch, however, neither datasets of amalgamated nor primary data records are open access.	
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Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

Yes – refer to the response under the first bullet of the previous criterion.

- What confidentiality rules have been adopted on access to data on bycatch, including discards, that the RFMO owns or holds as a custodian?

No confidentiality policy was identified. The ICCAT Secretariat provided a proposed data confidentiality agreement to the Commission, which then passed it to the Working Group on the Future of ICCAT (ICCAT, 2010d).

- Are primary or amalgamated data collected in the regional observer programme made available as an open public resource?

No. ICCAT identified a national observer programme dataset collected by the US for the US longline fleet for the period 1992-2000 as being the only publically available observer data as being available publicly, however, neither this national dataset nor the ICCAT regional dataset for the Regional Observer Programme for Bluefin Tuna were accessible via the ICCAT website (ICCAT, 2011d).

- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤ 5 degree cells, > 5 degree cells, or is information on resolution of records in the publically available dataset not specified?

Not applicable; no publically available datasets of records collected by observer programmes were identified. Primary data, including data collected via onboard observer programmes, reported to ICCAT are required to be of 5x5 degree resolution for longline vessels and 1x1 degree resolution for all other gear types (ICCAT, 2010c).

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

Not applicable; no publically available datasets of records collected by observer programmes were identified.

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

None.

Criterion 3: Ecological Risk Assessment

Score: 2 of 8 possible points, 25%.

Table A1.5-5 provides details on the assessment outcome for criterion 3.

Table A1.5-5. Assessment of ICCAT ecological risk assessment.

Factor	Points for positive response
Level 2 and/or 3 assessment has been conducted for either the effects of fishing on bycatch species (seabirds) or the effects of bycatch on the integrity of the ecosystem, but not both, for at least 1 fishery.	2

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

ICCAT conducted a six-stage seabird assessment, including an assessment of the degree of overlap between the distribution of albatrosses, petrels and shearwaters and ICCAT longline fishing effort (Phillips and Small, 2007; ICCAT, 2010e). ICCAT’s ecological risk assessment of seabird populations subject to bycatch in pelagic longline fisheries corresponds to assessment levels 1-3 depending on the species assessed (Phillips and Small, 2007). Small (2005) conducted a partial Level 2 ecological risk assessment primarily assessing risk to seabirds.

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

1 of 9. Of 9 gear types managed by ICCAT (purse seine, longline, gillnet, trawl, pole-and-line, rod-and-reel, harpoon, trap, and baitboat), an ecological risk assessment for the effects on seabird populations has been conducted for one gear type, longline. Studies assessing the ecosystem effect of bycatch removals by ICCAT-managed fisheries were not identified.

Although progress has been limited, ICCAT recognizes the importance of knowledge of effects of fishery removals on ecosystem integrity: The ICCAT Subcommittee on Ecosystems was tasked in 2005 with monitoring interactions with vulnerable species groups, conducting research to characterize levels and disposition of incidental catches, and developing reference points and indicators, “that explicitly incorporate ecosystem considerations” (ICCAT, 2005).

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

Findings from the ICCAT seabird ecological risk assessment were as follows (ICCAT, 2010e):

“Of the 10 species (13 populations) included in the analysis, the three populations (Balearic Islands, Canary Islands and the Azores) of cory’s shearwater (*Calonectris diomedea*), tristan albatross (*Diomedea dabbenena*), and Atlantic yellow-nosed albatross (*Thalassarche chlororhynchos*) all had extremely high overlap (>93%) with the ICCAT fishing area in all four quarters of the year. Sooty albatross *Phoebetria fusca* from Gough Island, black-browed albatross (*Thalassarche melanophris*) from the Falkland Islands (Malvinas) and black-browed albatross and white-chinned petrel (*Procellaria aequinoctialis*) from South Georgia all had high overlap with the ICCAT fishing area, black-browed albatrosses and white-chinned petrels having particularly high degrees of overlap with ICCAT fishing effort during their non-breeding season (April-September).”

In 2008, the ICCAT SCRS Sub-Committee on Ecosystems was assessing ICCAT tuna fishing mortality effects on seabirds and sea turtles (ICCAT, 2009d).

Small (2005) concluded that ICCAT-managed fisheries have substantial overlap with albatross distributions.

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch

Score: 4 of 18 possible points, 22%

Table A1.5-6 provides details on the assessment outcome for criterion 3.

Table A1.5-6. Assessment of ICCAT conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
One or more bycatch problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in place to mitigate $\geq 50\%$ but $< 75\%$ of the number of identified problems.	3
At least one but $< 50\%$ of binding measures to mitigate bycatch include measurable performance standards.	1
One binding bycatch measure on sharks contains quantitative performance standards, and it has not been assessed for efficacy in terms of meeting the stipulated performance standard.	0
The ICCAT shark measure is the only binding bycatch measures that contains performance standards, and available evidence suggests that it is not effective in meeting the explicit objective of reducing shark fishing mortality.	0
There is a provision that allows ICCAT Members to opt out of binding measures.	0

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.

Bycatch of certain populations of seabirds was documented through ecological risk assessments to be problematic in ICCAT-managed pelagic longline fisheries (Small, 2005; Phillips and Small, 2007; ICCAT, 2010e).

- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

The following is a list of documented problematic bycatch species groups for each of 9 ICCAT-managed gear types/fishery, identified through assessments other than the ecological risk assessments reviewed under Criterion 3:

- Purse seine: Juvenile bigeye and bluefin tunas; elasmobranches, blue and white marlin.
- Longline: Juvenile swordfish, bigeye tuna and bluefin tuna; elasmobranches; sea turtles; seabirds, blue and white marlin.
- Gillnet: Elasmobranches; sea turtles; marine mammals.
- Trawl: Sea turtles; marine mammals.
- Pole-and-line: No problematic bycatch identified.
- Rod-and-reel: No problematic bycatch identified.
- Harpoon: No problematic bycatch identified.
- Trap: No problematic bycatch identified.
- Baitboat: Reef fish and juvenile target baitfish.

Target catch and bycatch of juvenile swordfish on pelagic longlines and bigeye tuna and bluefin tuna on both longlines and in purse seines is problematic (ICCAT, 2004a, 2006b 2008a,b,c, 2009a,b,c).

An estimated 350 species of pelagic and coastal shark species and 12 species of skates and rays are taken as bycatch and target catch in ICCAT fisheries, including longline, purse seine and gillnet fisheries (ICCAT, 2009d,h). Of these affected sharks, stock assessments have been conducted for Atlantic blue and shortfin mako sharks (ICCAT, 2011b). Overexploitation of some shark stocks in the ICCAT area has been demonstrated (Ferretti et al., 2008).

Loggerhead sea turtle bycatch has been documented as problematic in Mediterranean pelagic longline, demersal trawl, gillnet and trammel net fisheries (Alessandro and Antonello, 2010). Five sea turtle species (loggerhead, green, leatherback, hawksbill, and Kemps Ridley) are documented as having been caught in ICCAT longline, gillnet, purse seine, harpoon, and trap fisheries (ICCAT, 2009h). 36 seabird species have been documented being caught in ICCAT longline fisheries, including albatross and petrel species (ICCAT, 2009h). Problematic seabird bycatch in longline and other gear types in the ICCAT area has been documented (Cooper et al., 2003; Gilman, 2011). Cetacean and pinniped bycatch in gillnet and trawl fisheries is documented as being problematic (Read et al., 2006). 26 species of marine mammals are documented to have been caught in ICCAT longline, gillnet, purse

seine, harpoon and trap fisheries (ICCAT, 2009h). Bycatch observed in tuna traps did not include vulnerable species groups, and consists primarily of high market value finfish species (mostly Scianidae and Sparidae) and discard are nominal (less than 1%) (Neves dos Santos et al., 2001). Bycatch of reef fish and juvenile classes of target baitfish species is flagged as a potential understudies issue in baitfish fisheries that supply live bait to pole-and-line tuna fisheries (Gilman, 2011).

- Using Table A1.5-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

This information has been recorded in Table A1.5-7. The assessment is current as of the information on binding recommendations in the 2010 ICCAT *Compendium Management Recommendations and Resolutions Adopted by ICCAT for the Conservation of Atlantic Tunas and Tuna-Like Species*.

- From the responses to the first two bullets, list each individual documented bycatch problem.

The following 13 bycatch problems are addressed via binding measures:

- Purse seine: Juvenile bigeye and bluefin tunas; elasmobranches, blue and white marlin.
- Longline: Juvenile swordfish, bigeye tuna and bluefin tuna; elasmobranches; seabirds, blue and white marlin.
- Gillnet: Elasmobranches

The following 7 bycatch problems are not addressed via a binding ICCAT measure:

- Longline: Sea turtles.
 - Gillnet: Sea turtles; marine mammals.
 - Trawl: Sea turtles; marine mammals.
 - Baitboat: Reef fish and juvenile target baitfish.
- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

Binding measures address 13 of a total of 20 identified bycatch and discard problems, summarized in the response to the previous bullet.

- What proportion of binding bycatch measures contain quantitative, measurable performance standards?

One of nine: the CMM on sharks contains quantitative performance standards.

Problematic shark bycatch has been identified to occur in some pelagic longline, purse seine and other ICCAT-managed fisheries. ICCAT measures restricting shark finning practices, encouraging live release of sharks, and prohibiting the retention and requiring live release of bigeye thresher sharks partially address this bycatch problem. The measure restricting shark finning does not require the employment of gear technology best practices to mitigate shark bycatch rates and has limited potential to control shark fishing mortality, except for fisheries with extensive resources for surveillance and enforcement, and where there are limited markets for shark meat (Gilman, 2011).

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

None. Insufficient monitoring, in particular in pelagic longline fisheries, hampers efforts to assess compliance and hence achievement of the shark measure's stipulated standard. Furthermore, the form of the fins (frozen vs. dried) and form of the carcass (whole weight, dressed or partially dressed) is not specified in the measure, which precludes defining a clear method to assess compliance (Fowler and Seret, 2010). Furthermore, the 5% limit of ratio of weight of retained shark fins to carcasses, even if it did lend itself to being monitored for compliance, may not achieve the measure's explicit objective of achieving sustainable shark fishing mortality if there is market demand for shark meat, as has been documented to be increasing in some regions (Gilman et al., 2008a; Gilman, 2011).

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

None. The ICCAT shark measure is the only measure containing a quantitative performance standard. Available evidence suggests that the measure is not meeting the explicit objective of reducing shark fishing mortality. Data quality has been identified as having limited the quality of stock assessments conducted for Atlantic blue shortfin mako sharks (ICCAT, 2009d). ICCAT (2009d) asserts that ICCAT objectives are not being met for large sharks.

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

Information on the efficacy of ICCAT measures to mitigate problematic bycatch was not identified. ICCAT (2009d) asserts that ICCAT objectives are not being met for large sharks – i.e., shark stocks are overexploited.

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out

provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

Yes, ICCAT members can opt out of binding Recommendations (ICCAT, 2009d). using this provision, six ICCAT Parties have presented and confirmed objections to three Recommendations (ICCAT, 2009d). Under Article VIII, paragraphs 2 and 3 of the ICCAT Convention, recommendations become effective for all Contracting Parties six months after the date of the notification from the Commission, except where an objection to the recommendation is presented by any Party within six months of the notification. In this case, the recommendation does not become effective for an additional 60 days. During this 60-day period, or within 45 days of the date of the notification of an objection made by another Party within the additional 60 days whichever date is the latter. The recommendation becomes effective at the end of the extended period or periods for objection, except for those Parties that have presented an objection. However, *if a recommendation has met with an objection presented by only one or less than one-fourth of the Parties*, then the Commission notifies the Party or Parties that objected that it is to be considered as having no effect. Such Party or Parties will then be given an additional period of 60 days to reaffirm their objection. At the end of this period, the recommendation becomes effective, except for Parties that presented an objection and reaffirmed it. If a recommendation has met with objection from more than one-fourth but less than the majority of the Parties, then the recommendation becomes effective for the Parties that have not objected. *In the final scenario where objections are made by a majority of the Parties*, the recommendation does not become effective. Any Party objecting to a recommendation may at any time withdraw their objection, and the recommendation shall become effective for this Party immediately, if it is already in effect, or at such time as it may become effective (ICCAT, 2007d, 2009d).

Table A1.5-7. Active ICCAT legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
Pelagic longline vessels are required to carry and use tori lines when fishing south of 20°S, and are required to collect and report data on seabird bycatch (ICCAT, 2007a). Longline vessels targeting swordfish using monofilament longline gear that set their gear between nautical dusk and dawn, and using a minimum swivel weight of 60g within 3m of the hook, may be exempt (ICCAT, 2007a).	None.	Longliners deploy tori line when fishing south of boundary; Longline swordfish vessels timing of fishing operations and gear design; List of vessels authorized to fish in the Convention Area.	a, c, d, e
Sea turtles			
No binding measures.	NA	NA	NA
Marine mammals			
No binding measures.	NA	NA	NA
Shark and relatives			
Requires vessels to: (i) keep	5% limit of ratio of weight of	Landed shark fins and	a, e

all parts of retained sharks, excluding head, guts and skins, to the point of first landing; (ii) have onboard fins that total $\leq 5\%$ of the weight of sharks onboard, up to the first point of landing, or otherwise ensure compliance with the 5% rule through certification, observer monitoring or other method (ICCAT, 2004b). Subsequent recommendations adopted in 2006 and 2007 reminded contracting parties of requirements for the provision of shark catch data (ICCAT, 2006a, 2007c).	retained shark fins to carcasses.	carcass weights; List of vessels authorized to fish in the Convention Area.	
Prohibited the retention, transshipment or landing of bigeye thresher sharks and requires their live release to the extent practicable, excluding a small-scale Mexican coastal fishery (ICCAT, 2009e).	None.	Landed catch species composition; Shark release practices; List of vessels authorized to fish in the Convention Area.	a, d, e
Juvenile and small/undersized target species			
To reduce catches of juvenile bigeye tuna, an area is closed to purse seine and baitboat fishing during November-January of each year (ICCAT,	No performance standard stipulated. Objective is inferred to contribute to meeting the ICCAT objective of achieving a B_{MSY} target reference point	Timing and location of fishing effort by purse seiners and baitboats; List of vessels authorized to fish in the Convention Area.	c, e

2004a, 2008c, 2009b).	for the managed bigeye tuna stock.		
Limits on swordfish and bluefin tuna minimum weight and length, percentage of small swordfish and bluefin in landings, and percent of bluefin retained in non-bluefin targeting fisheries (ICCAT, 2006b, 2008a, 2008b).	No performance standard stipulated. Objective is inferred to contribute to meeting the ICCAT objective of achieving B_{MSY} target reference points for managed stocks.	Weight, lengths and species composition of landed catch; List of vessels authorized to fish in the Convention Area.	a, e
Time/area closures in the eastern Atlantic and Mediterranean for purse seine, pelagic longline, baitboat, troll, pelagic trawl and recreational and sport fishing vessels for bluefin tuna (ICCAT, 2008a, 2009a).	No performance standard stipulated. Objective is inferred to contribute to meeting the ICCAT objective of achieving a B_{MSY} target reference point with greater than 50% probability for the managed bluefin stock.	Timing and location of fishing effort for purse seine, pelagic longline, baitboat, troll, pelagic trawl and recreational and sport fishing vessels for bluefin tuna; List of vessels authorized to fish in the Convention Area.	c, e
Annual two-month (October and November) closure for the retention, transshipment and landing of swordfish in the Mediterranean (ICCAT, 2009c).	No performance standard stipulated. Objective is inferred to contribute to meeting the ICCAT objective of achieving a B_{MSY} target reference point for Mediterranean swordfish stock.	Timing and location of fishing effort in the Mediterranean; Traceability to vessel and date of catch; Transshipment species composition; Landed catch species composition; List of vessels authorized to fish in the Convention Area.	c, d, e
Prohibition on fishing in western Atlantic bluefin	No performance standard stipulated. Objective is	Location of western Atlantic bluefin spawning areas;	c, e

spawning areas, “such as the Gulf of Mexico.” (ICCAT, 2008b).	inferred to contribute to meeting the ICCAT objective of achieving a B_{MSY} target reference point with greater than 50% probability for the managed bluefin stock.	Location of fishing effort; List of vessels authorized to fish in the Convention Area.	
Limits on blue and white marlin landings by longline and purse seine vessels and requires data collection on discards of these species (ICCAT, 2006c).	No performance standard stipulated. Objective is inferred to contribute to meeting the ICCAT objective of achieving a B_{MSY} target reference point for managed stocks.	Catch and landings species composition of longline and purse seine vessels; List of vessels authorized to fish in the Convention Area.	d, e
Unmarketable sizes and species of non-target species of fish			
No binding measures.	NA	NA	NA
Other or multiple bycatch species group(s)			
No binding measures.	NA	NA	NA

Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 0 of 14 possible points, 0%

Table A1.5-8 provides details on the assessment outcome for criterion 3.

Table A1.5-8. Assessment of ICCAT conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
For managed fisheries for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are not in place for any of these fisheries.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

No ICCAT assessments of ghost fishing in ICCAT-managed fisheries were identified.

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

In general, ghost fishing is problematic with passive fishing gear such as pelagic longline, gillnets, trammel nets, and traps, while the catching process of active gears, such as trawls and seines, ceases when the gear is no longer attached to the vessel (FAO, 2005a, 2010d). However, lost and abandoned Fish Aggregating Devices (FADs) used by purse seine vessels have been observed to result in ghost fishing (Chanrachkij et al., 2008; Gilman, 2011) and ghost fishing has been observed in seine nets (Matsuoka et al., 2005). In conclusion, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in ICCAT-managed fisheries.

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table A1.5-9);

There are no relevant binding measures. The assessment is current as of the information on binding recommendations in the 2010 ICCAT *Compendium Management Recommendations and Resolutions Adopted by ICCAT for the Conservation of Atlantic Tunas and Tuna-Like Species*.

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

0%, there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures in place.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures in place.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, under Article VIII, paragraphs 2 and 3 of the ICCAT Convention, members can opt out of binding Recommendations (ICCAT, 2007d, 2009d).

Table A1.5-9. Active ICCAT legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	NA	NA	NA

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea

Score: 0 of 14 possible points, 0%

Table A1.5-10 provides details on the assessment outcome for criterion 3.

Table A1.5-10. Assessment of ICCAT conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed fisheries, and no relevant binding measures are in place.	0
Members can opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

No relevant assessments were identified.

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from the these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

No information was identified via materials available on the ICCAT website on risks from pollution from discards from managed fisheries. Problematic discharges may occur in ICCAT-managed gillnet fisheries, where large volumes of discharges may occur in concentrated areas. Relatively large levels of discharges are known to occur in purse seine FAD fisheries.

In general, large inputs of organic matter from discards at sea can increase natural nutrient levels in nutrient-poor benthic ecosystems, and in fisheries where discards are spatially concentrated, and especially in areas of low current flow, may cause localized hypoxia or anoxia of the seabed, which, if prolonged, causes avoidance and mortalities, alters benthic community composition, and alters ecosystem processes and structure (FAO, 1995 [Article 7.2.2g]; Goñi, 1998; Hall et al., 2000; Stevens et al., 2000; Gray et al., 2002; FAO, 2003a,b; Franco et al., 2008; Levin et al., 2009; Haselmair et al., 2010). This is potentially problematic not just for fisheries discharges occurring in coastal areas, but also for fisheries discharges occurring in very deep regions of the ocean, such as purse seine FAD fisheries, where a large proportion of discharges may settle through the water column without being consumed, altering the benthic community, and transferring and locking biomass up in bottom currents for centuries before recycling to the euphotic zone of the pelagic ecosystem (Hall et al., 2000).

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent

bait, and identify any quantitative performance standards included in each measure (Table A1.5-11).

There are no relevant binding measures. The assessment is current as of the information on binding recommendations in the 2010 ICCAT *Compendium Management Recommendations and Resolutions Adopted by ICCAT for the Conservation of Atlantic Tunas and Tuna-Like Species*.

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

No relevant information was identified for managed fisheries assessing problematic pollution, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, under Article VIII, paragraphs 2 and 3 of the ICCAT Convention, members can opt out of binding Recommendations (ICCAT, 2007d, 2009d).

Table A1.5-11. Active ICCAT legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	na	na	na

Criterion 5. Surveillance and Enforcement

Score: 6 of 20 possible points, 30%

Table A1.5-12 provides details on the assessment outcome for criterion 3.

Table A1.5-12. Assessment of ICCAT measures and resources for surveillance and enforcement.

Factor	Points for positive response
≥50% but <75% of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	3
The RFMO has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

Yes (vessel and trap lists, VMS, and some port State measures). The ICCAT Secretariat maintains an ICCAT Record of Vessels for vessels over 20m registered by flag States to fish in the ICCAT Convention area, ICCAT Record of BFT Catching Vessels for vessels authorized to fish for Bluefin tuna, ICCAT Record of BFT Other

Vessels listing all other non-catching fishing vessels authorized to operate for Bluefin tuna, ICCAT Record of SWO-MED Vessels listing vessels authorized to catch swordfish in the Mediterranean, and also maintains a list of vessels presumed to have engaged in IUU fishing activity (ICCAT, 2008a, 2009c,d,e,f,g). ICCAT also maintains an ICCAT Record of Carrier Vessels, listing vessels authorized to receive transshipments of tuna and tuna-like species in the ICCAT Convention Area from large-scale tuna longline vessels (ICCAT, 2006d). ICCAT Members are also required to annually report a list of traps authorized to fish for Atlantic and Mediterranean Bluefin tuna (ICCAT, 2008a), and information on vessels participating in joint operations for bluefin tuna (ICCAT, 2008a, 2010a [Paragraph 18 of Rec. 08-05 and Paragraph 20 of Rec. 10-04]). ICCAT does not currently maintain a list of vessels/traps *actively* fishing in the Convention Area (ICCAT, 2009d).

ICCAT (2003) requires VMS for all CPCs' commercial fishing vessels exceeding 20 meters between perpendiculars or 24 meters length overall.

Under the *Recommendation by ICCAT Amending the Recommendation by ICCAT to Establish a Multi-Annual Recovery Plan for Bluefin Tuna in the Eastern Atlantic and Mediterranean* [08-05], ICCAT Members are required to implement the ICCAT Scheme of Joint International Inspection (ICCAT, 2008a [Annex 8]). ICCAT's port State measures require mandatory inspection of non-Contracting Parties' vessels only, and measures for transshipment in port apply only to Members' large-scale tuna vessels (ICCAT, 2009d). ICCAT does not have a binding measure calling for high seas inspection and boarding of non-flag vessels, other than for stateless vessels (ICCAT, 2009d).

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.5-7, A1.5-9, and A1.5-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

This information has been recorded in Tables A1.5-7, A1.5-9, and A1.5-11.

2 of 4. Of the minimum requisite surveillance methods (dockside inspection, VMS, onboard observers, and vessel list), ICCAT requires all of these surveillance methods for some managed fisheries. However, the following two requisite surveillance methods are not required:

- 100% onboard observer coverage to ensure tori lines are deployed south of the designated boundary for longline vessels, compliance with prohibition on transshipment and required live release as possible for bigeye thresher sharks, and collection of data on all marlin discards;
 - VMS on vessels <24m (needed in order to know the timing and location of fishing effort by several ICCAT fisheries).
- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on

the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

No. ICCAT has not adopted measures regarding the imposition of sanctions for violations of sufficient severity so as to secure compliance, as required by UNFSA and the FAO Compliance Agreement (ICCAT, 2009d). Some fishing vessels, including some engaged in IUU fishing, have been documented to repeat their offences, presumably because severe sanctions are lacking (ICCAT, 2009d). ICCAT Parties have not effectively enforced ICCAT measures as well as the ICCAT basic texts, and ICCAT does not have provisions in place to apply penalties to Parties that do not comply with binding ICCAT measures (ICCAT, 2009d). The ICCAT Compliance Committee reviews domestic measures to implement ICCAT measures.

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

Yes. ICCAT established a Compliance Committee via Resolution 95-15, with terms of reference charging the Committee to review the implementation of ICCAT conservation and management measures, review domestic measures taken to implement the ICCAT measures, and review port inspection and other domestic programs that identify non-compliance. ICCAT (2009d) found that the Compliance Committee, while annually reporting to the Commission, does not make decisions that, "improve compliance in any meaningful way." Lacking measures to apply penalties, the Committee is without requisite resources to augment ICCAT Party's compliance with data reporting requirements and binding measures (ICCAT, 2009d).

- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

Information was not identified enabling an assessment of whether detected infringements routinely result in sanctions being assessed.

A1.6. Indian Ocean Tuna Commission (IOTC)

SUMMARY	
Criteria Suite Scores	
Overall	17 (± 11 SD of the mean)% ¹
Criterion 1: Discard data collection	7% ²
Criterion 1A. Bycatch and Discards Data Collection Protocols	20%
Criterion 1B. Observer Coverage Rates	0%
Criterion 1C. Data Quality	0%
Criterion 2. Open access to discards data	0%
Criterion 3. Ecological risk assessment	25%
Criterion 4. Conservation and management measures	11% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch and Discards	11%
Criterion 4B. Conservation and Management Measures to Govern Lost and Abandoned Gear	21%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	0%
Criterion 5. Surveillance and enforcement	45%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The Indian Ocean Tuna Commission (IOTC) was established by an agreement under Article XIV of the Constitution of the Food and Agriculture Organization of the United Nations (FAO) and was adopted by the FAO Council in 1993. The agreement entered into force in 1996 (IOTC, 2009; Lungten, 2010). The Indo-Pacific Tuna Programme was the UNDP/FAO programme that preceded IOTC as the primary tuna management and development organization in the Indian Ocean.

MEMBERSHIP

Current members are: Australia, Belize, China, Comoros, Eritrea, European Community, France Overseas Territories, Guinea, India, Indonesia, Iran (Islamic republic of), Japan, Kenya, Korea (Republic of), Madagascar, Malaysia, Maldives, Mauritius, Oman (Sultanate of), Pakistan, Philippines, Seychelles, Sierra Leone, Sri Lanka, Sudan, Tanzania, Thailand, United Kingdom Overseas Territories, and Vanuatu (IOTC, 2011c). Cooperating Parties are: Mozambique, Senegal, and South Africa (IOTC, 2011c).

MANAGED SPECIES AND FISHERIES

IOTC is mandated to manage tuna and tuna-like species. The IOTC Agreement specifies 16 tuna, billfish and neritic tuna species, of which the major commercial stocks are: albacore, bigeye, yellowfin, and skipjack tunas and swordfish (IOTC, 2009a). IOTC subsequently adopted

resolutions and recommendations calling upon Members to collect and report data on certain target, associated and dependent species affected by tuna fisheries (IOTC, 2009a). Main industrial fishing gears employed are purse seine and pelagic longline (IOTC, 2010b). Main artisanal gears employed include gillnet, troll, and pole-and-line (IOTC, 2011b).

AREA OF APPLICATION

The IOTC Convention Area is defined as the Indian Ocean and adjacent seas, north of the Antarctic Convergence, in so far as it is necessary to cover such areas for the purpose of conserving and managing stocks that migrate into or out of the Indian Ocean (Lungten, 2010) (Fig. A1.6-1). In 1999, IOTC extended the western boundary of the IOTC statistical area from 30°E to 20°E in order to eliminate a gap in coverage between areas covered by IOTC and ICCAT (IOTC, 2009a). For the purpose of the Agreement that established IOTC, IOTC's area of competence is defined as FAO statistical areas 51 and 57 (IOTC, 2009a).

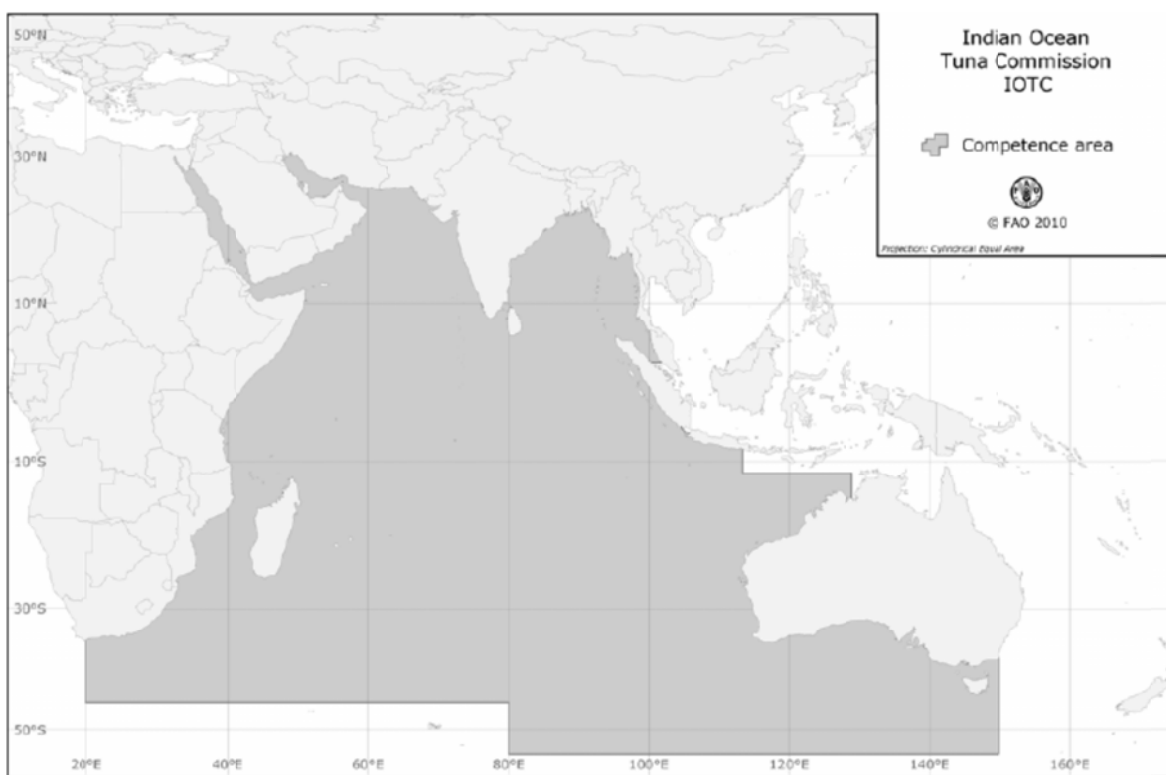


Fig. A1.6-1. IOTC convention area (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH AND DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries
Score: 20 of 25 possible points, 80%.

Table A1.6-1 provides details on the assessment outcome for criterion 1A.

Table A1.6-1. Assessment of IOTC regional observer programme data collection protocols for bycatch, including discards, and performance of conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are included in the RFMO's mandate.	1
Data for $\geq 75\%$ of documented vulnerable bycatch species are collected in fisheries that have regional observer coverage.	3
Information on the number and/or weight of at least 1 of documented vulnerable bycatch species is routinely collected for the regional observer programme.	1
At least one item of information but $\leq 50\%$ of the items of information needed to assess stated performance standards of relevant conservation and management measures is collected.	1
Information on fishing effort is routinely collected for fisheries covered by the regional observer programme.	1
Date and location of fishing operations are routinely captured for the regional observer programme.	1
Records collected for the regional observer programme routinely capture whether catch is retained or discarded for $\geq 75\%$ of documented vulnerable bycatch species.	3
Data records are to the species-level for $\geq 75\%$ of documented vulnerable bycatch species in fisheries that have regional observer coverage.	3
Information on length or other proxy for age class is collected for $\geq 50\%$ of identified vulnerable bycatch species.	3
Information on the disposition of discards (e.g., alive vs. dead, and possibly degree of injury) is collected for $\geq 75\%$ of identified vulnerable bycatch species.	3
For hook-and-line fisheries included in the regional observer programme, information on gear attached to individuals of vulnerable species that are discarded alive is not intended to be routinely collected.	0

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

While the IOTC Agreement does not explicitly mandate IOTC to provide for the conservation of ecologically related species, the Working Party on Ecosystems and Bycatch was established in 2005 to provide advice to the Commission on relevant issues, and IOTC has subsequently adopted binding resolutions and non-binding recommendations for certain target, associated and dependent species affected by tuna fisheries (IOTC, 2009a).

- In fisheries that are required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

IOTC observer data collection protocols call for the collection of retained and discarded catch of all fish, marine mammals, seabirds and seas turtles (IOTC, 2010b).

Resolution 10/04 assigned the task of developing an observer working manual, including minimum data fields, Trip Template Report, and training programme, to the

IOTC Scientific Committee, to be used as a guide by the IOTC Members and Co-operating Non-contracting Parties (CPCs) (IOTC, 2010b,c). A minimum set of data fields, and draft Observer Trip Report Template are included in IOTC (2010b [Appendices VI and VII]), which are grouped into the following categories (according to the forms on which they would be captured) with examples of data fields included in each category related to bycatch and discards:

- Vessel and trip information (e.g., main gear, weight by species transhipped at sea and onboard at disembarkation)
- Vessel-specific gear (e.g., purse seine net length; pole-and-line max number of operational poles; gillnet max deployable length of net per day; longline length of mainline, leader material, hook types/sizes, tori line design)
- Surface fishery (purse seine and pole-and-line) daily activity (e.g., time, position and activity – recorded each time activity changes)
- Fishing events (e.g., date and location of setting and hauling; purse seine set type, retained catch per species, released and discarded catch per species; pole-and-line association type, estimated total catch weight per species, retained catch, released and discarded catch; pole-and-line bait fishing estimated total weight of bait loaded, predominant three species; pelagic longline total number of hooks set, bait species, bait dyed, mainline and branchline weight used, distance of branchline weight from hook, light sticks used, tori line used, number tori lines used, offal management during hauling, position of offal disposal, tori line used at hauler)
- Weather
- Retained fish catch (e.g., species, processing code, number of fish, total processed weight)
- Fish discarded and released (e.g., species, number/estimated weight of fish, fate, reason for discarding)
- Marine mammal depredation (e.g., predator species, depredation on bait, depredation on fish, mitigation measures)
- Incidental catch of seabirds, mammals and sea turtles (e.g., species, number caught, reason for capture, use of dehooker and line cutter, release fate, resuscitation, turtle and marine mammal length)
- Biological data (e.g., species, length, weight, sex, maturity)
- Waste management (waste category, storage/disposal method).

Furthermore, Resolution 11/04 *on a Regional Observer Scheme* requires observers on purse seine vessels to record the composition of bigeye tuna at unloading, and calls for “Field Samplers” to monitor landings upon unloading by artisanal vessels, with a view to estimate the size of landed catch by species, and type of boat and gear (IOTC, 2011d).

The IOTC performance review concluded that, “IOTC is very weak in terms of provisions on data requirements for non-target species,” (IOTC, 2009a). The list of shark species for which data collection is required by IOTC Members in non-binding Recommendation 08/04 does not apply to all gear types or include five shark species (blue, shortfin mako, silky, scalloped hammerhead, and oceanic whitetip) as recommended by the IOTC Scientific Committee (IOTC, 2009a). The IOTC Working Party on Ecosystems and Bycatch recommended amending the current seabird bycatch mitigation Resolution in order to make reporting seabird interactions mandatory (IOTC, 2011g).

- Does the RFMO’s data collection protocols call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected for the

regional observer programme?

Yes, the IOTC minimum set of data fields and draft Observer Trip Report Template call for the collection of the number and weight of all retained and discarded catch (IOTC, 2010b).

- Describe data requirements to assess the performance of legally binding conservation and management measures for the mitigation of bycatch (record this information in Tables A1.6-7, A1.6-9, and A1.6-11)

Data requirements to assess the efficacy of relevant IOTC CMMs are (Tables A1.6-7 and A1.6-9):

- Longline fishing gear terminal tackle design
 - Longline vessel presence onboard and design of bird mitigation equipment (e.g., tori pole and line, blue dye)
 - Longline vessel fishing practices (e.g., timing of setting, offal discharge practices)
 - Longline and purse seine vessel required turtle handling and release equipment onboard
 - Longline and purse seine sea turtle handling and release practices
 - Purse seine fishing practices when turtles are observed in a school/aggregation, and when a caught turtle is observed
 - Weight of landed shark fins and weight of remainder of shark carcasses
 - Species of retained sharks by vessels on the IOTC Record of Authorised Vessels and recreational and sport fishing vessels
 - Thresher shark handling and release practices by vessels on the IOTC Record of Authorised Vessels and recreational and sport fishing vessels
 - Design of driftnet gear in use and/or stowed onboard
 - Location of data buoys
 - Timing of longline and purse seine fishing operations
 - Location of fishing effort
 - Gear marking
 - List of vessels authorized to fish in the Convention Area.
- Identify gaps in collected information required for assessment of the performance of bycatch and discards conservation and management measures: What percent of required information to assess the performance of bycatch measures is not intended to be routinely collected according to the RFMO's data collection protocols?

Of the 15 requisite data records, the following 7 items of information are not stipulated in protocols for data collection (IOTC, 2010b):

- Longline offal discharge management during setting;
- Longline presence onboard of sea turtle dip nets;
- Purse seine fishing practices when turtles are observed in a school/aggregation, and when a caught turtle is observed (Form 9 calls for the collection of information on the reason for the capture of sea turtles, but does not specifically call for observer collection of observations of practices to address setting on aggregations when turtles are observed, and practices following the observation of captured turtles, as required in the binding Resolution);
- Thresher shark handling and release practices (Form 7 collects information on the disposition of discards, but not on handling/release practices);

- Design of stored drift gillnet;
 - Location of set in relation to known position of data buoy(s);
 - Presence and format of gear marking.
- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements as explicitly stated in binding conservation and management measures?

Yes, the data collection measures as specified in the current Resolution 11/04 *on a Regional Observer Scheme* (IOTC, 2011d) and proposed minimum set of data fields and draft Observer Trip Report Template (IOTC, 2010b) meet the data collection methods of bycatch-related CMMs, described under criterion 4A.

Herrera and Pierre (2011) summarized bycatch-related data collection and reporting requirements of IOTC CPCs as stipulated in binding CMMs: (i) required catch and effort, size frequency, and estimates of dead discards for "most common" shark species and where possible for "less common" shark species; (ii) required incidental catches of seabirds in longline fisheries (but no requirement to identify to the species level or area where captured); (iii) required interactions with sea turtles (but no requirement to identify to the species level or area where captured); and (iv) voluntary collection and reporting data on seabird interactions in non-longline fisheries, and other incidentally caught species.

- Does the RFMO's protocols for observer data collection call for the routine collection of information on fishing effort for fisheries covered by the regional observer programme?

Yes, fishing effort is intended to be captured by the IOTC Regional Observer Scheme (IOTC, 2010b, 2011d).

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely collected under the regional observer programme?

Data collection protocols of IOTC regional observers are intended to include the capture of information on whether all caught organisms (fish, marine mammal, seabird, sea turtle) were retained vs. discarded (IOTC, 2010b).

- Does the RFMO's data collection protocols under the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

Yes, the date and location of fishing operations are required to be collected per the current Resolution 11/04 *on a Regional Observer Scheme* (IOTC, 2011d) and in the proposed minimum set of data fields and draft Observer Trip Report Template (IOTC, 2010b).

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) is information intended to be collected to the species level under the regional observer programme?

The IOTC data collection protocols for regional observers call for the collection of species-level records (number caught by species) for all fish, marine mammal, seabird and sea turtle capture events (IOTC, 2010b [Appendix VII]).

Of identified vulnerable bycatch species in IOTC-managed fisheries, species-level catch data are required, per binding Resolutions, to be collected only for “most common” but not for “less common” shark species; species-level records are not required to be collected for seabirds, sea turtles, or marine mammals (Herrera and Pierre, 2011).

- For what proportion of identified vulnerable species groups is information on the lengths of individuals intended to be collected under the regional observer programme? If other information is intended to be collected that provides a proxy for age class, identify the measurement method, and explain if this information is called for being routinely collected.

Length and weight of all catch, both retained and discarded, are intended to be collected by onboard regional observers (IOTC, 2010b).

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

The disposition of discarded catch is intended to be collected by IOTC regional observers for all species (IOTC, 2010b).

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

IOTC observer data collection protocols do not explicitly call for observers to observe and record information on terminal tackle remaining attached to discarded organisms (e.g., Forms 7, 9, IOTC, 2010b).

Criterion 1B. Regional Observer Coverage Rates

Score: 0 of 11 possible points, 0%.

Table A1.6-2 provides details on the assessment outcome for criterion 1B.

Table A1.6-2. Assessment of IOTC onboard observer coverage rates to monitor discards and retained and transshipped bycatch.

Factor	Points for positive response
No IOTC-managed fishery has been determined to have reached $\geq 5\%$ regional onboard observer coverage.	0
There is no international exchange of observers in the regional onboard observer programme.	0

Information used for assessment:

- What recommendations on observer coverage rates have been made by the RFMO's scientific body or the Commission for fisheries under the RFMO's mandate?

IOTC CPCs are required to provide 5% coverage under the IOTC Regional Observer Scheme based on the number of sets by gear type for all vessels fishing in the IOTC Convention Area, for all vessels ≥ 24 m in overall length, and also for vessels <24 m if they fish on the high seas (IOTC, 2011d). For vessels <24 m fishing on the high seas, the 5% coverage rate is to be achieved by January 2013 (IOTC, 2011d). The 5% coverage of artisanal vessels is to "progressively increase", but the Resolution does not stipulate a deadline by which the coverage rate is to be achieved (IOTC, 2011d).

- Does a regional observer programme exist?

Yes. In 2009, the Commission adopted Resolution 09/04 *on a Regional Observer Scheme* in order to collect verified catch data and other scientific data related to the fisheries for tuna and tuna-like species in the IOTC area, as well as for bycatch (IOTC, 2009b). In 2010, Resolution 09/04 was superseded by Resolution 10/04 *on a Regional Observer Scheme*, which modified the observer programme's implementation for artisanal fisheries (IOTC, 2010c). Finally, in 2011, Resolution 11/04 *on a Regional Observer Scheme* superseded Resolution 10/04, increasing the scientific data to be collected under the scheme (IOTC, 2011d).

- What are regional onboard observer coverage rates in each fishery managed by the RFMO?

Japan reported plans to achieve 5% onboard observer coverage of the Japan longline fleet operating in the Indian Ocean (IOTC, 2010b). Taiwan (not an IOTC member) similarly reported plans for 5% coverage of their fisheries operating in the Indian Ocean (IOTC, 2010b). Korea reported that they are building up to 5% coverage of their longline tropical tuna and southern bluefin tuna fisheries (IOTC, 2010b). Seychelles and Thailand reported plans to deploy observers to meet the required 5% coverage (IOTC, 2010b). EU and Seychelles purse seiners have not had observer coverage since 2009 due to the placement of armed guards on the vessels to address piracy in the region, which has prevented the placement of observers on these vessels due to a lack of space (IOTC, 2010b). Neither the IOTC Secretariat report of the most recent Commission meeting nor the Secretariat summary report on CPC compliance report regional observer coverage rates in IOTC-managed fisheries, and the latter report explained that no observer report had been submitted to the IOTC Secretariat, thus precluding the Secretariat from assessing CPC compliance with implementation of the regional observer scheme (IOTC, 2011j,k). Based on this limited available information, it is inferred that no IOTC CPCs currently have achieved required onboard observer coverage rates.

- If there have been recommendations for onboard observer coverage rates by the RFMO's scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet stated RFMO scientific advice for onboard observer coverage rates? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final target level, but might meet the rate specified in

the recommended schedule for gradual increase. Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch and discard interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011).

Available information indicates that no IOTC-managed fishery has obtained $\geq 5\%$ regional onboard observer coverage (IOTC, 2010b). The relevant IOTC Resolution requirement for 5% regional onboard observer coverage for IOTC-managed fisheries operating in the IOTC Area of competence for vessels $\geq 24\text{m}$ in overall length is currently in effect (IOTC, 2011d). The observer coverage rate for vessels $< 24\text{m}$ that fish outside their EEZ is not required until Jan. 2013 (IOTC, 2011d).

- For each fishery under the RFMO's mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

The IOTC Regional Observer Scheme is based on national implementation (IOTC, 2010b,c). A recommendation was made that IATTC provide accreditation to recognize observers participating in the OPTC Regional Observer Scheme (IOTC, 2010b).

Criterion 1C. Dataset Quality

Score: 0 of 11 possible points, 0%.

Table A1.6-3 provides details on the assessment outcome for criterion 1C.

Table A1.6-3. Assessment of IOTC observer program data quality.

Factor	Points for positive response
A centralized, regional observer programme database with records of bycatch or discards has not yet been established.	0
Individual national observer programme datasets are not required to be reported to IOTC – instead, CPCs report amalgamated data and summary information. A regional observer programme database, if developed, would not be comprised of records pooled from observed national fisheries.	0
All countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members (e.g., Taiwan, Yemen).	0
To date, no CPC has submitted an observer report to IOTC.	0

Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include information on the capture of bycatch and discards?

A regional observer programme has been established and protocols call for the collection and reporting of specified bycatch data. However, as of September 2011, Herrera and Pierre (2011) reported that no IOTC Parties had reported required observer bycatch data on sharks or seabirds, only China had reported observer data on sea turtle bycatch, and the IOTC Secretariat reported that no CPC had submitted

an observer report (IOTC, 2011j). Therefore, the IOTC Secretariat has not yet been able to add records to a regional observer programme database.

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

No, the IOTC Secretariat has not yet received observer reports from CPCs (IOTC, 2011j), and CPCs are not required to report primary, raw observer data records (IOTC, 2010c). The CPCs are required to submit the IOTC Regional Observer Scheme Trip Reports (IOTC 2010b [Appendix VII]) by CPCs to the IOTC Secretariat in 1°x1° format, and not raw data (IOTC, 2010c). National observer programmes of IOTC CPCs are obligated to design data collection protocols to capture the IOTC minimum set of data fields identified by IOTC (IOTC, 2010b). The participants of the Technical Meeting on the IOTC Regional Observer Scheme recommended that the Secretariat develop a database that CPCs could use to enter and store data collected by observers participating in the regional programme, and that, although not required under the binding resolution, that CPCs report the detailed observer data to IOTC and that the Secretariat retain the data in a centralized repository (IOTC, 2010b).

- What is the length in years of the regional observer programme dataset?

The regional observer programme was initiated on 1 July 2010 (IOTC, 2009b). However, as explained previously, the IOTC secretariat has yet to receive observer reports from any CPC (IOTC, 2011j), and thus a centralized database would not yet contain any observer-collected records.

- Have observer data been collected evenly across seasons for observed fisheries?

The IOTC Secretariat has yet to receive observer reports from CPCs (IOTC, 2011j), and therefore lacks requisite information on implementation of the Regional Observer Scheme to determine the seasonal distribution of observed effort by IOTC-managed fisheries.

- Have observer data been collected evenly across fishing grounds for each observed fishery?

The IOTC Secretariat has yet to receive observer reports from CPCs (IOTC, 2011j), and therefore lacks requisite information on implementation of the Regional Observer Scheme to determine the spatial distribution of observed effort by IOTC-managed fisheries.

- Which countries with fisheries under the RFMO’s mandate are not Members or Cooperating Non-Members?

In general, limitation in IOTC membership has been explained to be a result of IOTC’s legal status as an Article XIV FAO body (IOTC, 2009a). Taiwan conducts a substantial level of fishing for IOTC-managed species in the IOTC Convention Area, however, as a fishing entity, Taiwan is not eligible to become an IOTC member because the IOTC Agreement, as an Article XIV FAO body, does not provide for membership or cooperation with fishing entities (IOTC, 2009a). Yemen is a non-cooperating non-Member that operates fisheries for IOTC-managed species (IOTC, 2009a). Taiwan and Yemen do not report data to IOTC (IOTC, 2009a). There are also several Indian Ocean coastal States that do not operate IOTC-managed fisheries that are not IOTC members (IOTC, 2009a).

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

Vessels under 24m in overall length that fish only within their EEZ are not required to be a part of the regional observer programme (IOTC, 2009b).

Data are, “difficult to obtain from artisanal fleets,” which account for over half of the total catch of IOTC-managed species (IOTC, 2009a). Alternative data collection methods such as port sampling has been recommended for IOTC Member artisanal fisheries where onboard observer coverage is not practicable (IOTC, 2009a).

- Which Member States do not routinely report to the RFMO bycatch and discards data collected by regional onboard observers (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in the last four years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

Herrera and Pierre (2011) reported that, as of September 2011, no IOTC Parties had reported required observer bycatch data on sharks or seabirds, and only China had reported observer data on sea turtle bycatch. IOTC (2011j) reported that no CPCs had reported observer reports.

In general, according to the IOTC performance review, several Members do not comply with data collection or reporting obligations (IOTC, 2009a).

Criterion 2. Open access to bycatch data

Score: 0 of 15 possible points, 0%.

Table A1.6-4 provides details on the assessment outcome for criterion 2.

Table A1.6-4. Assessment of IOTC provision of open access to regional bycatch and discards datasets.

Factor	Points for positive response
There is currently no IOTC regional observer programme dataset as no CPCs have submitted observer reports to the Secretariat.	0

A regional observer programme dataset made open access will not likely contain any primary data, as CPCs are not required to report primary data to the Secretariat.	0
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Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch and/or discards, exist?

No. As previously explained, regional observer programme has been established and protocols call for the collection and reporting of specified bycatch data. However, as of September 2011, Herrera and Pierre (2011) reported that no IOTC Parties had reported required observer bycatch data on sharks or seabirds, and only China had reported observer data on sea turtle bycatch, and the IOTC Secretariat reported that no CPC had submitted an observer report (IOTC, 2011j). Therefore, the IOTC Secretariat has not yet been able to add records to a regional observer programme database.

- What confidentiality rules have been adopted on access to data on bycatch and discards that the RFMO owns or holds as a custodian?

Resolution 11/04 *on a Regional Observer Scheme* states that confidentiality rules as set out in *Resolution 98/02 Data Confidentiality Policy and Procedures* for fine-scale data applies to data collected under the IOTC Regional Observer Scheme (IOTC, 2011d). The participants of the Technical Meeting on the IOTC Regional Observer Scheme recommended that use of data collected via the IOTC Regional Observer Scheme be subject to the IOTC rules on confidentiality and that a protocol be adopted so that authorization by CPCs be required for the release of individual CPC observer records (IOTC, 1998, 2010b).

Resolution 98/02 requires that “Catch-and-effort and length-frequency data grouped by 5° longitude by 5° latitude by month for longline and 1° longitude by 1° latitude by month for surface fisheries stratified by fishing nation are considered to be in the public domain, provided that the catch of no individual vessel can be identified within a time/area stratum. In cases when an individual vessel can be identified, the data will be aggregated by time, area or flag to preclude such identification, and will then be in the public domain,” (IOTC, 1998).

- Are primary or amalgamated data available as an open public resource?

There currently is no IOTC regional database of pooled CPC national observer programme datasets in existence to be made publically available. However, in concept, according to IOTC’s data confidentiality policy, amalgamated observer data could be made publically available (IOTC, 1998).

CPCs are not required to report raw observer data, but instead are obligated to report amalgamated data in Trip Reports to the IOTC Secretariat (IOTC, 2011d). Hence, even the Secretariat-managed regional observer program dataset does not consist of primary data records.

- If only datasets of amalgamated records from onboard observer programmes are made available to the public, is the dataset of amalgamated data at a resolution of ≤ 5 degree cells, >5 degree cells, or is there a lack of spatial information?

Not applicable, a public domain version of an IOTC regional observer scheme database is not available (IOTC, 2011h).

- If only datasets of amalgamated records from onboard observer programmes are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible if the primary data were available? Is the resolution of amalgamated data insufficient to identify spatial trends in bycatch or discards, or has information on any factors known to significantly affect bycatch and discard catch rates been eliminated from the primary data records (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

Not applicable, a public domain version of an IOTC regional observer scheme database is not available (IOTC, 2011h).

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

Not applicable, a public domain version of an IOTC regional observer scheme database is not available (IOTC, 2011h).

Criterion 3: Ecological risk assessment

Score: 2 of 8 possible points, 25%.

Table A1.6-5 provides details on the assessment outcome for criterion 3.

Table A1.6-5. Assessment of IOTC ecological risk assessment.

Factor	Points for positive response
Level 1 ecological risk assessment for the effects of fishing on sharks, but not other bycatch species nor on the effects of bycatch on the integrity of the ecosystem, has been conducted for $\geq 50\%$ of fisheries managed by IOTC, results supported more rigorous, quantitative assessment, but Level 2 and 3 assessments have not been conducted for sharks.	2

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007), Kirby (2006), and Sainsbury and Sumaila (2001).

The IOTC Working Party on Ecosystems and Bycatch, based on a desktop (qualitative Level 1) assessment of life history characteristics, assessed the vulnerability of selected shark species to overexploitation (IOTC, 2011g).

Coelho et al. (2011) observed the condition (alive/dead) of different shark species at haulback in an Indian Ocean longline swordfish fishery, findings that could support a level 2 PSA ERA of pelagic sharks in Indian Ocean pelagic longline fisheries.

Small (2005) conducted a partial Level 2 risk assessment (not a full Productivity-Susceptibility Analysis), by assessing the overlap of 14 RFMO areas with albatross distributions.

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

The IOTC shark ERAs were applicable to all IOTC-managed fisheries (Coelho et al., 2011; IOTC, 2011g). Small (2005) was applicable to IOTC-managed pelagic longline tuna and swordfish fisheries. No quantitative stock assessments for non-target species have been undertaken by the IOTC Working Party on Ecosystems and Bycatch due to data limitations (IOTC, 2009a, 2011g).

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

The IOTC WPEB identified blue, oceanic white tip, scalloped hammerhead, shortfin mako, silky, bigeye thresher and pelagic thresher sharks as being data deficient and, based on their life history characteristics, vulnerable to overexploitation (IOTC, 2011g).

Coelho et al. (2011) found that a relatively large proportion of landed manta rays, pelagic stingrays and blue sharks were alive, while a large proportion of smooth hammerheads, silky sharks and bigeye thresher sharks were dead in an Indian Ocean longline swordfish fishery. These findings support level 2 PSA ecological risk assessment of pelagic sharks in Indian Ocean pelagic longline fisheries.

Small (2005) found that CCSBT, followed by WCPFC, IOTC, ICCAT, and CCAMLR were the top five RFMOs in terms of overlap with albatross distribution.

The IOTC Commission requested that an ERA approach be applied to the various shark species considered at risk by fishing activities in the Indian Ocean, and for the IOTC Working Party on Ecosystems and Bycatch to undertake ERAs (IOTC, 2011k).

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch and Discards

Score: 2 of 18 possible points, 11%

Table A1.6-6 provides details on the assessment outcome for criterion 3.

Table A1.6-6. Assessment of IOTC conservation and management measures to mitigate bycatch and discards, and efficacy.

Factor	Points for positive response
One or more bycatch and discard problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in	1

place to mitigate at least one identified problem but <50% of the number of identified problems.	
One binding bycatch measure includes measurable performance standards.	1
There is a provision that allows IOTC Members to opt out of binding measures.	0

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch and discard problem for each fishery managed by the RFMO.

Based on their life history characteristics, blue, oceanic white tip, scalloped hammerhead, shortfin mako, silky, bigeye thresher and pelagic thresher sharks were determined to be vulnerable to overexploitation in IOTC-managed fisheries (IOTC, 2011g). Albatrosses were determined to be vulnerable to bycatch in IOTC-managed pelagic longline fisheries (Small, 2005).

- List bycatch and discard problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?
 - Purse seine: Sharks (primarily silky and oceanic white tip), juvenile bigeye and yellowfin tunas, other unmarketable species and sizes of fish, sea turtles (primarily loggerhead and leatherbacks), cetaceans (Clarke, 2011a,b; Clarke et al., 2011; Amade et al., 2011; Gilman, 2011; Herrera and Pierre, 2011; Lawson, 2011).
 - Pelagic longline fisheries for tunas and tuna-like species: Elasmobranchs, seabirds (albatrosses, petrels and shearwaters in vessels operating south of 25°S.), sea turtles (primarily loggerhead and leatherbacks), cetaceans, juvenile swordfish, other species of non-targeted fish (Petersen et al., 2007; Bugoni et al., 2008; Williams et al., 2009; FAO, 2010a; Coelho et al., 2011; Gilman, 2011; Herrera and Pierre, 2011; Promjinda and Chanrachkij, 2011; Rahombanjanahary, 2011).
 - Gillnet: Sea turtles (primarily loggerhead and leatherbacks), elasmobranchs, marine mammals, coastal seabirds, waterbirds (Melvin et al., 2001; Read et al., 2006; Gilman et al., 2009; Kiszka et al., 2009; Zydalis et al., 2009; FAO, 2010a; Herrera and Pierre, 2011; Rahombanjanahary, 2011).
 - Pole-and-line: Seabirds (Bugoni et al., 2008), and possibly problematic bycatch of reef fish and juvenile classes of target species in baitfish fisheries that supply live bait to pole-and-line fisheries (Gilman, 2011).
 - Trolling: Seabirds and sharks (Bugoni et al., 2008; Rahombanjanahary, 2011).
- Using Table A1.6-7, summarize active legally binding conservation and management measures that mitigate bycatch and discards, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the

impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

This information has been recorded in Table A1.6-7.

- From the responses to the first two bullets, list each individual documented bycatch and discard problem.

Problematic bycatch in IOTC-managed fisheries, based on limited ERAs and documented in relevant studies, are:

- Purse seine: Sharks, juvenile bigeye and yellowfin tunas, other unmarketable species and sizes of fish, sea turtles, and cetaceans.
 - Pelagic longline: Elasmobranchs, seabirds (south of 25°S.), sea turtles, cetaceans, juvenile swordfish, other species of non-targeted fish.
 - Gillnet: Sea turtles, elasmobranchs, marine mammals, coastal seabirds, waterbirds.
 - Pole-and-line: Seabirds, and reef fish and juvenile classes of target species in baitfish fisheries that supply live bait.
 - Trolling: Seabirds and sharks.
- For what proportion of potentially existing or documented bycatch and discard problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

Of the 21 identified bycatch problems, 8 (38%) are addressed in binding measures (Table A1.6-7); the following 13 are not addressed in IOTC binding measures:

- Purse seine: Juvenile bigeye and yellowfin tunas, other unmarketable species and sizes of fish, and cetaceans.
 - Pelagic longline: Cetaceans, juvenile swordfish, other species of non-targeted fish.
 - Gillnet: Marine mammals, coastal seabirds, waterbirds.
 - Pole-and-line: Seabirds, and reef fish and juvenile classes of target species in baitfish fisheries that supply live bait.
 - Trolling: Seabirds.
- What proportion of binding bycatch and discard mitigation measures contain quantitative, measurable performance standards?

One of 8 binding measures contains quantitative performance standards (the 5% shark fin to body ratio).

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

An assessment of compliance with the measure requiring a 5% shark fin to body ratio was not identified via IOTC materials. The IOTC Working Party on Ecosystems and Bycatch recommended amending the Resolution to require all landed sharks have fins attached, as a way to augment reducing or avoiding shark finning and encourage full utilization (IOTC, 2011g).

- For each binding bycatch and discard measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

Insufficient monitoring, in particular in pelagic longline fisheries, hampers efforts to assess compliance and hence achievement of the shark measure's stipulated standard. Furthermore, the form of the fins (frozen vs. dried) and form of the carcass (whole weight, dressed or partially dressed) is not specified in the measure, which precludes defining a clear method to assess compliance (Fowler and Seret, 2010). Additionally, the 5% limit of ratio of weight of retained shark fins to carcasses, even if it did lend itself to being monitored for compliance, may not achieve the measure's explicit objective of achieving sustainable shark fishing mortality in IOTC-managed fisheries if there is market demand for shark meat, as has been documented to be increasing in some regions (Gilman et al., 2008a; Gilman, 2011).

- Of the binding bycatch and discard measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

There was no documentation of a lack of efficacy of any IOTC binding measure, as none of undergone a formal assessment of efficacy.

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

Yes, the IOTC Agreement objection procedure allows members to opt out of any measure; under the Agreement, members are not required to provide a justification for their decision to opt out of a measure (IOTC, 2009a). Individual members objecting to a binding conservation and management measure are not bound by that measure. If more than one third of the Commission Members object to a measure, then the other Members are not bound by that measure (IOTC, 2011a).

Table A1.6-7. Active IOTC legally binding conservation and management measures related to the mitigation of problematic bycatch and discards, identify any performance standards and assess if these are quantitative and measureable or not, and describe data requirements for performance assessment.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed for Implementation	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
<p>Longline vessels, when in areas south of 25° S. latitude, must employ at least two seabird bycatch mitigation measures from a list of eight alternatives, one of which must be either: (i) night setting (no setting between nautical dawn and dusk) plus minimum deck lighting, (ii) tori lines per stipulated specifications, or (iv) weighted branch lines per stipulated specifications of weight amount and distance from the hook. The second method can be a second measure from this first list, or otherwise one of the following must be selected: (iv) blue-dyed squid bait (mixed for a minimum of 20 minutes in 0.5% solution of food</p>	<p>No performance standards are stipulated to assess the measure's effectiveness.</p>	<p>Longline fishing gear terminal tackle design; Longline vessel presence onboard and design of bird mitigation equipment (e.g., tori pole and line, blue dye); Longline vessel fishing practices (e.g., timing of setting, offal discharge practices); Location of longline fishing vessels when operating; List of longline vessels authorized to fish in the Convention Area.</p>	<p>a, b, c, e</p>

<p>additive E133), (v) mainline shooter (set so that the line is set slack, and avoid setting in the propwash), (vi) control of offal discharge (no discharge during setting, avoid discharge during hauling or otherwise discharge from the opposite side of the vessel from where gear hauling is occurring) (IOTC, 2010j). Vessels ≤ 24m in overall length fishing north of 23° N. latitude are exempt (IOTC, 2010j). CPCs shall report information on seabird bycatch</p>			
<p>Sea turtles</p>			
<p>CPCs are required to: (i) employ best practice handling and release methods for caught hard shelled sea turtles; (ii) have onboard all necessary equipment for the release of turtles; (iii) report data on their vessels' interactions with sea turtles; (iv) require gillnet, longline, and purse seine vessels to record in logbooks all turtle interactions; (v) require longline vessels to carry line cutters and de-hookers and</p>	<p>No performance standards are stipulated to assess the measure's effectiveness.</p>	<p>Longline and purse seine vessel required turtle handling and release equipment onboard; Longline and purse seine sea turtle handling and release practices; Purse seine fishing practices when turtles are observed in an school/aggregation, and when a caught turtle is observed; List of longline, purse seine and gillnet vessels authorized to fish in the</p>	<p>a, d, e</p>

<p>use these devices following IOTC Guidelines; (vi) require purse seine vessels to avoid encircling turtles; if a turtle is encircled or entangled, employ practicable measures to safely release the turtle; if a turtle is observed entangled in a FAD, release them to the extent practicable; if a turtle is entangled in the net, stop net roll as soon as the turtle exits the water, disentangle the turtle before resuming net roll, and assist the recovery of the turtle before returning it to the water; carry and use dip nets when appropriate to handle turtles (IOTC, 2009c).</p>		<p>Convention Area.</p>	
<p>Marine mammals</p>			
<p>NA – no relevant Resolutions have been adopted.</p>	<p>NA</p>	<p>NA</p>	<p>NA</p>
<p>Shark and relatives</p>			
<p>CPCs are required to: (i) annually report data on shark catches; (ii) keep all parts of retained sharks, excluding head, guts and skins, to the point of first landing; (iii) have onboard</p>	<p>5% limit of ratio of weight of retained shark fins to carcasses.</p>	<p>Weight of landed shark fins and weight of remainder of shark carcasses.</p>	<p>a, e</p>

fins that total $\leq 5\%$ of the weight of sharks onboard, up to the first point of landing, or otherwise ensure compliance with the 5% rule through certification, observer monitoring or other method (IOTC, 2005).			
Ban on the retention of all species of thresher sharks and required unharmed release, and encourages recording incidental catches of thresher sharks, applicable to all vessels on the IOTC Record of Authorised Vessels and all recreational and sport fishing vessels (IOTC, 2010e). Recreational and sport fishing vessels with high risk of catching thresher sharks are to carry instruments for the live release of thresher sharks (IOTC, 2010e).	No performance standards are stipulated to assess the measure's effectiveness.	Species of retained sharks by vessels on the IOTC Record of Authorised Vessels and recreational and sport fishing vessels; Thresher shark handling and release practices by vessels on the IOTC Record of Authorised Vessels and recreational and sport fishing vessels; List of vessels authorized to fish in the Convention Area.	a,d,e,f (observe at-sea transshipment of sharks)
Juvenile and small/undersized target species			
NA – no relevant binding measures. A non-binding Recommendation calls upon CPCs to encourage purse seine vessels to implement full retention of bigeye, skipjack and yellowfin tunas	NA	NA	NA

(IOTC, 2010d).			
Unmarketable sizes and species of non-target species of fish			
NA – no binding measures. A non-binding Recommendation calls upon CPCs to encourage purse seine vessels to implement full retention of non-targeted species (other tunas, rainbow runner, dolphinfish, triggerfish, billfish, wahoo, and barracuda) (IOTC, 2010d).	NA	NA	NA
Other or multiple bycatch species group(s)			
IOTC CPCs are prohibited from intentionally fishing within 1 nm or interacting with a data buoy in the IOTC Area of competence (IOTC, 2011d). The explicit purpose of the measure is to prevent damage to the data buoys. However, an implicit objective may be to reduce bycatch fishing mortality associated with sets made on floating objects that aggregate pelagic species (e.g., WCPFC, 2009f).	No performance standards are stipulated to assess the measure's effectiveness.	Location of fishing effort; Location of data buoys; List of vessels authorized to fish in the Convention Area.	c, e
Closure to longline and purse seine vessels for one month during 2011 and 2012 in an area off Somalia,	No performance standards are stipulated to assess the measure's effectiveness. The explicit purpose of the	Timing of longline and purse seine fishing operations; Location of longline and purse seine fishing	c, e

applicable to all vessels ≥ 24 m in overall length and < 24 m if the vessel fishes outside their EEZ (IOTC, 2010k).	measure is stated to be to reduce fishing mortality of bigeye and yellowfin tunas in order to avoid exceeding MSY levels.	operations; List of vessels authorized to fish in the Convention Area.	
Ban on large-scale (> 2.5 km in length) high seas driftnets (IOTC, 2009d).	No performance standards are stipulated to assess the measure's effectiveness.	Design of driftnet gear in use and/or stowed onboard; Location of fishing effort; List of vessels authorized to fish in the Convention Area.	b, c, e
CPCs are encouraged to participate in a survey of predation (depredation) of longline caught fish (IOTC, 2000), which provides information on unobserved pre-catch fishing mortality.	No performance standards are stipulated to assess the measure's effectiveness.	NA	NA

Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 3 of 14 possible points, 21%

Table A1.6-8 provides details on the assessment outcome for criterion 3.

Table A1.6-8. Assessment of IOTC conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
For managed fisheries for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are in place for $\geq 75\%$ of these fisheries.	3
The two relevant binding measures do not include measurable performance standards.	0
There is a provision that allows IOTC Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

Ghost fishing via entanglement in the appendages of abandoned, lost and discarded FADs used by purse seine and other gear types has been identified as problematic in some regions (e.g., Chanrachkij et al., 2008; Gilman, 2011). However, the rate of FAD abandonment, loss and discarding in the Indian Ocean and other regions is poorly understood (FAO, 2009e). Pelagic longline operators are hypothesized to routinely deliberately discard tangled and damaged line at sea during setting operations (FAO, 2009e). Otherwise, information on the ecological risk from ghost fishing by IOTC-managed fisheries is not well understood.

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

Of IOTC-managed fisheries, ghost fishing may be problematic in pelagic longline fisheries, purse seine FADs, gillnet fisheries, but not likely from purse seine nets, troll gear, or offshore pole-and-line gears (FAO, 2009e; Gilman, 2011). However, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in IOTC-managed fisheries.

In general, fisheries that employ passive fishing gear (e.g., pelagic and demersal longlines, gillnets, trammel nets, traps) are likely to cause ghost fishing, while fisheries that employ active gear (e.g., purse seine, trawl) are less likely to result in ghost fishing

as the catching process of active gears ceases when the gear is no longer attached to the vessel (NEAFC, 2008a; NAFO, 2008; SEAFO, 2009e; FAO, 2005a, 2010d). However, there are many exceptions to this general rule. For instance, ghost fishing has been observed in seine nets and there is evidence of marine mammal entanglement in trawl net fragments, and coastal habitat degradation from derelict trawl nets (Jones, 1995; Donohue et al., 2001; Matsuoka et al., 2005). Lost and abandoned Fish Aggregating Devices (FADs) used by purse seine vessels have been observed to result in ghost fishing (Chanrachkij et al., 2008; Gilman, 2011).

In conclusion, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in IOTC-managed fisheries.

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table A1.6-9);

A binding measure requires gear marking (IOTC, 2001a). While the purpose of the measure is to deter fishing by vessels not included on the IOTC authorized vessel list (IOTC, 2001a, 2009a), the gear marking requirement could be employed for surveillance and enforcement of measures regulating lost, abandoned and discarded fishing gear. Another measure bans large-scale (>2.5 km in length) high seas driftnets, in part, to avoid ghost fishing by this gear (IOTC, 2009d).

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

The measure requiring gear marking is applicable to all IOTC-managed fisheries (IOTC, 2001a).

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, the measures do not contain quantitative performance standards (IOTC, 2001a, 2009d).

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, the measure does not contain quantitative performance standards and an assessment of compliance with and the efficacy of the measure has not been undertaken (IOTC, 2001a, 2009a,d).

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, the IOTC Agreement objection procedure allows members to opt out of any measure (IOTC, 2009a).

- Table A1.6-9. Active IOTC legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed for Implementation	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Fishing gear are required to be marked (IOTC, 2001a).	NA – no performance standards are stated	Authorized vessel list; Gear marking.	a, e
Ban on large-scale (>2.5 km in length) high seas driftnets, in part, to avoid ghost fishing by this gear (IOTC, 2009d).	NA – no performance standards are stated	Design of driftnet gear in use and/or stowed onboard; Location of fishing effort; List of vessels authorized to fish in the Convention Area.	b, c, e

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea

Score: 0 of 14 possible points, 0%

Table A1.6-10 provides details on the assessment outcome for criterion 3.

Table A1.6-10. Assessment of IOTC conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed fisheries, and no relevant binding measures are in place.	0
There is a provision that allows IOTC Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

No relevant assessments were identified.

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries occur in areas where adverse pollution effects from the these discharges are likely to result, and/or the fisheries are understood to have potentially problematic levels of these discharges that are discharged in spatially concentrated locations?

No information was identified via materials available on the RFMO's website on risks from pollution from discards from managed fisheries. There are no binding measures to mitigate pollution from discharges of catch, bait and offal at sea from IOTC-managed fisheries. For IOTC-managed gillnet and other artisanal fisheries, it is possible that these fisheries could result in problematic pollution effects because discharges of discarded catch, offal from processed catch and spent bait during fishing operations at sea from these fisheries could be spatially concentrated, be large quantities, and could occur in vulnerable areas. Discharges from pelagic fisheries occurring in deep waters, including purse seine and longline fisheries, might result in problematic pollution, because discharges occur in areas where adverse pollution effects are likely to result, and the fisheries are understood to have potentially problematic levels of these discharges.

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent

bait, and identify any quantitative performance standards included in each measure (Table A1.6-11).

There are no relevant binding measures.

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

No relevant information was identified for managed fisheries documenting problematic pollution, or are identified as being likely to cause problematic pollution, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, the IOTC Agreement objection procedure allows members to opt out of any measure (IOTC, 2009a).

- Table A1.6-11. Active IOTC legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, and describe data requirements for performance assessment.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed for Implementation	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	na	na	na

Criterion 5. Surveillance and enforcement

Score: 9 of 20 possible points, 45%

Table A1.6-12 provides details on the assessment outcome for criterion 5.

Table A1.6-12. Assessment of IOTC measures and resources for surveillance and enforcement.

Factor	Points for positive response
≥50% but <75% of requirements of binding measures on bycatch and discards that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	3
The RFMO requires parties to report to the RFMO on their enforcement procedures and conclusions.	3
The RFMO does not require parties to take specified enforcement procedures when an infraction of a binding conservation and management measure occurs.	0
The RFMO does not require parties to impose specified sanctions when an infraction of a binding conservation and management measure occurs.	0
The RFMO has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3
Summary information on detected infringements of binding bycatch measures was not made available to the RFMO to determine the proportion of identified infractions that resulted in sanctions.	0

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch and discards conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

IOTC established an IOTC Record of Vessels identifying fishing vessels authorized to fish in the IOTC Convention Area for IOTC-managed species (IOTC, 2007a), a list of active vessels (IOTC, 2010h), Record of Licensed Foreign Vessels fishing for tunas and swordfish in the IOTC area (IOTC, 2010i), and an IUU list (IOTC, 2006a, 2011e). IOTC adopted a VMS requirement for vessels >15 m in length that are registered on the IOTC Record of Vessels (IOTC, 2006b). IOTC regional observers are placed on large-scale tuna vessels that conduct at-sea transshipment (IOTC, 2009a). Transshipment at sea is prohibited on all vessels except for large-scale tuna vessels that participate in the IOTC Regional Observer Programme (IOTC, 2009a). IOTC established a Bigeye Tuna Statistical Document Programme in order to track exports and re-exports of frozen tuna (IOTC, 2001b, 2009a). The bigeye tuna statistical document scheme has not been implemented for purse seine and pole-and-line catch destined for canneries (IOTC, 2009a).

IOTC does not have an inspection and boarding scheme (IOTC, 2009a).

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch and discards (record this information in Tables A1.6-7, A1.6-9, and A1.6-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

This information has been recorded in Tables A1.6-7 and 9. In combination, the binding measures require the following surveillance methods to be employed: dockside inspection, at-sea inspection, VMS, onboard observers, authorised vessel list, and observer coverage of at-sea transshipment to assess compliance with a ban on retention of thresher sharks. Of these six methods, IOTC does not support two: (i) VMS on vessels $\leq 15\text{m}$ in overall length (IOTC, 2006b); (ii) at-sea inspection and boarding (IOTC, 2009a);

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

CPCs are required to submit completed Compliance Committee forms to the IOTC Compliance Committee, however, the IOTC secretariat has explained that there is low compliance by some CPCs in not meeting their obligations to provide information under the various Conservation and Management Measures covered in the report (IOTC, 2011i).

IOTC does not require CPCs to undertake specific enforcement procedures or impose specific sanctions in response to identified infractions of IOTC binding measures. IOTC *Resolution 10/10 Concerning Market Related Measures* provides a mechanism for the IOTC Compliance Committee to identify IOTC Members and Co-operating Non-Contracting Parties that repeatedly fail to meet obligations under the IOTC Agreement in implementing IOTC CMMs and identify non-Contracting Parties who fail to meet obligations under international law to co-operate with IOTC in implementing CMMs, and allows for recommending the adoption of market-related measures that are consistent with the World Trade Organization, such as reduction of quotas or catch limits for CPCs (IOTC, 2010f). Prior to this, *Resolution 07/01 to Promote Compliance by Nationals of Contracting Parties and Cooperating Non-Contracting Parties with IOTC Conservation and Management Measures* required CPCs to investigate alleged IUU fishing, take action upon verified IUU violations, and report on these investigations and actions to the IOTC Secretariat (IOTC, 2007b).

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding

measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

Yes, IOTC established a Compliance Committee whose mandate includes reviewing all aspects of CPCs individual compliance with IOTC conservation and management resolutions, and to develop a scheme of incentives and sanctions and a mechanism for their application to encourage CPC compliance (IOTC, 2010g). The Terms of Reference of the Compliance Committee was revised in 2010 (Resolution 10/09, IOTC, 2010g) and provides for the assessment of compliance by CPCs. The Secretariat, via the Compliance Section, maintains contact with national officers to determine the reasons for non-compliance, in particular, concerning data reporting (IOTC, 2011i). The IOTC Compliance Committee, established in 2002, reports, inter alia, to the Commission on the status of member compliance with a range of Compliance and Enforcement related management measures (IOTC, 2002a, 2009a).

- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

Information on the number of detected infringements of IOTC CMMs by CPCs and subsequent follow-up by imposing sanctions has not been routinely reported to the IOTC Secretariat, and while the IOTC Secretariat has documented substantial CPC infringements of CMMs (e.g., only 35% of CPCs reported some information on catch and effort data of shark species, and no CPCs submitted observer reports, IOTC, 2011j), IOTC does not currently have a sanction mechanism for CPC non-compliance (IOTC, 2009a, 2011i). The Compliance Committee, under its 2010 revised terms of reference, intends to develop a scheme of incentives and sanctions and a mechanism for their application to encourage compliance by all CPCs (IOTC, 2011i).

A1.7. Northwest Atlantic Fisheries Organization (NAFO)

SUMMARY	
Criteria Suite Scores	
Overall	42 (± 18 SD of the mean)% ¹
Criterion 1. Data Collection	71% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	40%
Criterion 1B. Regional Observer Coverage Rates	82%
Criterion 1C. Regional Observer Programme Dataset Quality	91%
Criterion 2. Open Access to Regional Observer Programme Datasets	0%
Criterion 3. Ecological Risk Assessment	25%
Criterion 4. Conservation and Management Measures	18% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	39%
Criterion 4B. Conservation and Management Measures to Govern Bycatch in Lost, Abandoned and Discarded Gear	14%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	0%
Criterion 5. Surveillance and Enforcement	95%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The Northwest Atlantic Fisheries Organization (NAFO) was established by the Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries signed on 24 October 1978 in Ottawa, Canada, and entered into force on 1 January 1979. In 2007, NAFO adopted significant amendments to its convention including a new Convention title “Convention on Cooperation in the Northwest Atlantic”. The amendments have yet to be approved by all contracting parties and will become binding once three-quarters of contracting parties formally approve the changes (Lugten, 2010).

MEMBERSHIP

NAFO members are Canada, Cuba, Denmark (in respect of the Faroe Islands and Greenland), European Union, France (in respect of Saint Pierre and Miquelon), Iceland, Japan, Norway, Republic of Korea, Russian Federation, Ukraine and United States of America (NAFO, 2011a,d).

MANAGED SPECIES AND FISHERIES

NAFO manages all fishery resources in the Convention Area with the following exceptions: salmon, tunas and marlins, cetacean stocks managed by the IWC or any successor organization, and sedentary species of the continental shelf (i.e., organisms which, at the harvestable stage, either are immobile on, or under, the seabed, or those organisms unable to move except in constant physical contact with the seabed or the subsoil (*NAFO Convention*

Article I) (NAFO, 2011d). NAFO-managed species, identified in Annex 1 of the NAFO Conservation and Enforcement Measures (NCEM), include: Atlantic cod (*Gadus morhua*), Atlantic redfishes (*Sebastes spp.*), American plaice (*Hippoglossoides platessoides*), witch flounder (*Glyptocephalus cynoglossus*), yellowtail flounder (*Limanda ferruginea*), Greenland halibut (*Reinhardtius hippoglossoides*), white hake (*Urophycis tenuis*), thorny skate (*Amblyraja radiata*), capelin (*Mallotus villosus*), shortfinned squid (*Illex illecebrosus*), and northern shrimp (*Pandalus spp.*) (NAFO, 2011a).

NAFO-managed fisheries include bottom and midwater trawl, demersal longline, demersal gillnet, and demersal handline (NAFO, 2008). The vast majority of fishing effort in the NAFO Regulatory Area is bottom trawl for groundfish and shrimp, and to a lesser extent, a seasonal midwater pelagic trawl fishery for redfish; Longline, gillnets and handlines targeting non-tuna species have nominal effort, typically accounting for less than 1% of total effort in the NAFO Regulatory Area (Personal communication, 13 November 2011, Dr. Ricardo Federizon, Fisheries Commission Coordinator, NAFO). Therefore, this performance assessment assesses NAFO governance of bycatch, including discards, for demersal and midwater trawl fisheries.

AREA OF APPLICATION

The NAFO Convention Area is defined as “the waters of the Northwest Atlantic Ocean north of 35°N latitude and west of a line extending due north from 35°N latitude and 42°W longitude to 59°N latitude, thence due west to 44°W longitude, and thence due north to the coast of Greenland, and the waters of the Gulf of Saint Lawrence, Davis Strait and Baffin Bay south of 78°10'N latitude” (Fig. A1.7-1). The convention provides for the establishment of a regulatory area, which is that part of the convention area lying beyond the areas under the fisheries jurisdiction of the coastal States (i.e., waters outside EEZs).



Fig. A1.7-1. NAFO convention area (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH, INCLUDING DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries

Score: 10 of 25 possible points, 40%.

Table A1.7-1 provides details on the assessment outcome for criterion 1A.

Table A1.7-1. Assessment of NAFO regional observer programme data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are included in the RFMO's mandate.	1
Data for at least 1 individual bycatch species or group but $\leq 50\%$ of documented vulnerable bycatch species are intended to be collected in fisheries with regional observer coverage.	1
Information on the number and/or weight of 27% of documented vulnerable bycatch species is intended to be routinely collected for the regional observer programme.	1
$\geq 75\%$ of the items of information needed to assess stated performance standards of relevant conservation and management measures are intended to be collected.	3
Information on fishing effort is intended to be routinely collected for fisheries covered by the regional observer programme.	1
Date and location of fishing operations are intended to be routinely captured for the regional observer programme.	1
Records collected for the regional observer programme are intended to routinely capture whether catch is retained or discarded for at least 1 individual bycatch species or group but $\leq 50\%$ of documented vulnerable bycatch species.	1
Data records are intended to be to the species-level for at least 1 bycatch species but $\leq 50\%$ of documented vulnerable bycatch species in fisheries that have regional observer coverage.	1

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

Yes. The main objective of the Organization as stipulated in the amended NAFO convention (Article II) is "to ensure the long term conservation and sustainable use of the fishery resources in the Convention Area and, in so doing, to safeguard the marine ecosystems in which these resources are found," (NAFO, 2011d). Furthermore, Article III of the NAFO Amended Convention states that NAFO is to, 'Take due account of the need to minimize pollution and waste originating from fishing vessels as well as minimize discards, catch by lost or abandoned gear, catch of species not subject to a directed fishery and impacts on associated or dependent species, in particular endangered species'. The preamble of the amended NAFO convention also highlights the necessity for a precautionary approach and includes a commitment to apply an Ecosystem Approach to Fisheries in the Northwest Atlantic that includes safeguarding the marine environment, conserving its marine biodiversity, minimizing the risk of long-term or

irreversible adverse effects of fishing activities, and taking account of the relationship between all components of the ecosystem (Lugten, 2010).

- In fisheries required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

The following summarizes identified bycatch in NAFO-managed fisheries based on the outcomes of ecological risk assessments (criterion 3, bullet 3) and from studies other than ecological risk assessments (sub-criterion 4A bullet 2): Demersal and midwater trawl fisheries may have problematic bycatch of live cold water corals and sponges and sympatric species, juvenile/undersized fish and shrimp, jellyfish, crabs, seaweed, sea turtles, marine mammals, seabirds, and bycatch of overexploited principal market species (Fertl and Leatherwood, 1997; Goni, 1998; Robbins et al., 1999; Read et al., 2006; Eayrs, 2007; FAO, 2010a; NAFO, 2008, 2011c).

Bycatch data are routinely collected only for live coral and sponges, and for non-target but marketable species in each of the managed fisheries (Article 5bis NAFO, 2010b, 2011d). Thus, catch data are collected for 3 of the 11 categories of bycatch (27%).

Data for live coral and sponges brought on board the vessel are required to be collected in new and existing fisheries (Article 5bis NAFO, 2010b). In new fishing areas, Contracting Parties are to develop a mitigation plan to 'prevent significant adverse impact to vulnerable marine ecosystems' and to report information sufficiently detailed to conduct an assessment of activity, should it later be required (Annex XXV(IV) NAFO, 2010b). In existing fisheries, observers are to identify catch composition, monitor discards, bycatch and the taking of undersized fish (Article 28 NAFO, 2010b). However, compliance with data collection protocols for live coral and sponge bycatch is not well understood: In 2010, the NAFO Scientific Council identified a general lack of availability of data on coral and sponges catches, making it problematic to determine VME encounter protocols (NAFO, 2011d). And, more broadly, the NAFO Scientific Council reported that because, "observer reports do generally not contain the information specified, e.g. on catch composition and discard by haul, the reports are of limited value to Scientific Council," for stock assessment purposes, but also for understanding bycatch composition (NAFO, 2011c).

The provisions of Article 62 (Daily Reports) and Annex X (Format for Communication of Catches and Reports by Fishing Vessels) of NAFO Conservation and Enforcement Measures Chapter VII (Electronic Reporting, Satellite Tracking and Observers) mandate the reporting of retained bycatch species and the amount of discarded fish, and all fish discards are required to be reported to the species-level (NAFO, 2011d). There is no consolidated list of bycatch species in any NAFO measure other than those identified in Article 12.(1), which may result in inconsistent data collection monitoring protocols for bycatch (NAFO, 2011d). For non-fish discarded bycatch, "NAFO does not have any specific strategy, or associated monitoring process, in place to assess...fishery interactions with non-fish species (e.g. seabirds) that result in an incidental bycatch" (NAFO, 2011d). Contracting Parties are requested to report to the NAFO Secretariat observer data, including catch and effort for each haul, location of fishing, depth, soak time, catch composition and discards (NAFO, 2011d). A 2011 performance assessment identified the lack of monitoring bycatch of non-target species and species incidentally affected by fishing operations as a deficiency (NAFO, 2011d).

- Does the RFMO's data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected?

Catches in weight of live coral and sponges are required to be collected and reported for both new and existing fisheries (Article 5bis NAFO, 2010b). Data on catches of non-target but marketable species are also routinely collected by regional onboard observers (NAFO, 2011d). Data are not routinely collected for discarded bycatch of non-marketable species (NAFO, 2011d).

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).

Refer to Tables A1.7-7, A1.7-9, and A1.7-11. Data requirements to assess measures containing performance standards are:

- Weight of retained bycatch and retained target catch (to determine if limits on retained bycatch have been exceeded) (Article 12(1), NAFO, 2010b).
- Catch weight of live corals and sponges per haul (Article 5bis(1-3) NAFO, 2010b).

- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected in the regional observer programme according to the RFMO's data collection protocols?

All requisite information to assess performance standards of binding bycatch measures is collected by regional onboard observers.

- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?

Data collection protocols by regional observers do not enable assessment of the efficacy of binding measures that require information on discards of non-marketable fish and non-fish species (NAFO, 2011d). Observer data collection protocols required by binding NAFO measures are: (i) total shark catches (retained and discarded) (Article 17(1,2) NAFO, 2010b); (ii) Weight of landed shark fins and weight of remainder of retained shark carcasses (Article 17(3) NAFO, 2005b); (iii) mesh sizes for gear employing nets; (iv) location of any hard corals encountered in seamount exploratory fisheries (Article 15(9) NAFO, 2010b); (v) weight of retained target and non-target catch by species (Article 12(1, 2a,b) NAFO, 2010b); (vi) weight of live coral and live sponge per haul (Article 5bis(1) NAFO, 2010b). Of these, only the first item is likely not in compliance due to lack of routine collection of information on discards of shark species (NAFO, 2011d).

Information was not identified to determine the frequency of implementation of required observer data collection protocols (Article 28 (4-6) NAFO, 2010b). The Scientific Council indicated that data required to be collected by observers, especially Article 28(4), are very valuable to the Council, but are not always collected, and that because, "observer reports do generally not contain the information specified, e.g. on catch composition and discard by haul, the reports are of limited value to Scientific Council," (NAFO, 2011c).

- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?

Yes, Article 28 (4b) requires observers to record catch and effort data for each haul (NAFO, 2010b). Categorical effort is included in one of NAFO's online datasets (21b) and effort is frequently discussed by the Scientific Council (NAFO, 2011b,c) and in the annual compliance review (NAFO, 2010a), but it is not clear if summary statistics on effort from logbook data or observer data are employed for these purposes.

However, compliance is generally low: not all observers under Article 28 report catch and effort on a haul basis (Personal communication, 13 November 2011, Dr. Ricardo Federizon, Fisheries Commission Coordinator, NAFO).

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely by observers of the regional observer programme?

Data on discards of corals, sponges, and of marketable species are likely collected by observers in each of the four managed fisheries (Article 5bis NAFO, 2010b, 2011d), covering 12 of 31 identified bycatch groups (39%).

The species of discarded fish to be recorded are not specified (NAFO, 2011d), and for non-fish discarded bycatch, "NAFO does not have any specific strategy, or associated monitoring process, in place to assess...fishery interactions with non-fish species (e.g. seabirds) that result in an incidental bycatch" (NAFO, 2011d). Though listed as an observer duty (Article 28(4a)ii) NAFO, 2010b), it has been noted that, "reporting of discards is poor and there was again concern over the accuracy of some of the provisional catch reports" (NAFO, 2011b).

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

Yes, observers are to record the location and time when the vessel is engaged in fishing (Article 28 NAFO, 2010b).

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to record at the species level?

Bycatch data on corals, sponges, and of marketable species are likely routinely collected by observers to the species level in each of the four managed fisheries (Article 5bis NAFO, 2010b, 2011d), covering 12 of 31 identified bycatch groups (39%). However, NAFO measures do not specify what species of discarded fish are to be recorded, nor are protocols in place calling for data collection on non-fish discarded bycatch species (NAFO, 2011d).

When fishing in new areas, Contracting Parties are required to present a list of all organisms, retained and bycatch, brought onboard to the lowest identifiable taxonomic unit (NAFO, 2006, Article 5bis (2a), 17 NAFO, 2010b). Since the VME measures went into force, no vessel or Contracting Party has fished in new areas, and thus no information on compliance with this requirement is available (Personal communication, 13 November 2011, Dr. Ricardo Federizon, Fisheries Commission Coordinator, NAFO).

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is intended to be routinely collected by regional observers that provides a proxy for age class, identify the measurement method.

0%. No information was identified from materials available via the NAFO website whether or not regional observers collect length data of catch or employ other methods to determine ages. NAFO Resolution 1/06 requested Contracting Parties to record 'relevant biological information' (NAFO, 2006b), but did not specifically call for measuring lengths. Data on some species of catch have been sexed and had lengths measured (NAFO, 2002).

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

Information was not identified via material available on the NAFO website to determine if the disposition of discarded individuals is recorded by onboard regional observers. Resolution 1/06 instructed Contracting Parties to provide details of sea turtle bycatch interaction with fisheries, including 'fate and condition at release' but did not stipulate that regional observers were to be tasked with collecting this information (NAFO, 2006b).

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

0%. Regional observer data collection protocols do not include the collection of information on terminal tackle attached to discards (NAFO, 2010b, 2011d).

Criterion 1B. Regional Observer Coverage Rates

Score: 9 of 11 possible points, 82%.

Table A1.7-2 provides details on the assessment outcome for criterion 1B.

Table A1.7-2. Assessment of NAFO onboard observer coverage rates to monitor bycatch, including discards.

Factor	Points for positive response
All managed fisheries have $\geq 5\%$ regional onboard observer coverage.	5
The regional onboard observer coverage rates meet scientific advice for $\geq 75\%$ of managed fisheries.	4
There is no international exchange of observers in the regional onboard observer programme.	0

Information used for assessment:

- What recommendations on observer coverage rates have been made by the RFMO's scientific body or the Commission for fisheries under the RFMO's mandate?

The NAFO regional observer programme's main objective is for monitoring compliance (except provisions on VMEs per Chapter Ibis of the NCEM, the observer has mainly a scientific purpose), and hence recommendations for design of the observer programme have not been made by the NASCO scientific body (Personal communication, 13 November 2011, Dr. Ricardo Federizon, Fisheries Commission Coordinator, NAFO).

- Does a regional observer programme exist?

Yes, NAFO requires at least one independent observer be onboard all fishing vessels within the Regulatory Area (NAFO, 2011d). It is the responsibility of Contracting Parties to supply observers for their NAFO-managed fisheries (Article 28(1) NAFO, 2010b). A summary of the history of the observer programme is as follows (NAFO, 2011d):

- **1992.** An 18-month pilot project for a NAFO Observer Scheme was implemented. The observers would monitor a vessel's compliance with the NAFO Conservation and Enforcement Measures.
- **1994.** The Pilot Project for a NAFO Observer Scheme be extended to 31 December 1995.
- **1995.** The existing "Pilot Project for a NAFO Observer Scheme" is replaced with "Pilot Project for Observers and Satellite Tracking. Observers would be required on all fishing vessels. This is the precursor of the current Article 28 concerning the Observer Program.
- **2003.** Introduction of Pilot Project on Observers, Satellite Tracking and Electronic Reporting. The elements of the Observer Program are subject to review and revision for application in 2005 and subsequent years.
- **2004.** In the overhaul of the NAFO CEM, for 2004, the Observer Program became its own Article 22 of the 2004 CEM. Also, the beginning of the separate Chapter VII, Electronic Reporting, Satellite Tracking and Observers with a CP's ability to remove the observer for no more than 50% of the time the vessel spends in the RA. (Article 46.4)
- **2005.** It was agreed to extend the Chapter VII Pilot Project on Observers, Satellite Tracking and Electronic Reporting would be extended through 2006.
- **2006.** Starting in 2007 the Chapter VII Pilot Project on Observers, Satellite Tracking and Electronic Reporting became a permanent measure, titled Chapter VII Electronic Reporting, Satellite Tracking and Observers. This included a change to CEM 2007 Article 53.4 that CP's applying the provisions shall withdraw the observer for no more than 75% of the time the vessel spends in the NRA during the year.
- **2007 to 2011.** No further changes.

Contracting Parties have the option to apply either Article 28 or Chapter VII in their fishing fleets.

- What are regional onboard observer coverage rates in each active fishery managed by the RFMO?

100% of fishing vessels within the Regulatory Area are to carry at least one observer (Article 28(1), NAFO, 2010b).

- If there have been recommendations for onboard observer coverage rates by the RFMO’s scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body’s recommendations?
Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

Information could not be found to identify if recommendations on regional observer coverage rates were made by the Scientific Council or General Council and Fisheries Commission. However, given that there is 100% onboard observer coverage, this by default meets or exceeds any recommended coverage rate.

- For each fishery under the RFMO’s mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

NAFO Contracting Parties operate and manage observer programmes, and observers are supplied by Contracting Parties (Article 28 (1) NAFO, 2010b). If a Contracting Party is unable to place an observer on a vessel, if agreement is obtained from the original Contracting Party, another Contracting Party may place an observer (meeting the above criteria) on the vessel (Article 28(2) NAFO, 2010b).

Criterion 1C. Regional Observer Programme Dataset Quality

Score: 10 of 11 possible points, 91%.

Table A1.7-3 provides details on the assessment outcome for criterion 1C.

Table A1.7-3. Assessment of NAFO observer programme data quality.

Factor	Points for positive response
A regional observer programme database with records of bycatch exists.	1
Data records collected in national observer programmes are not reported to NAFO in datasets separate from other fishery-dependent records. Furthermore, because observer reports are not submitted in a standardized format, and due to lack of directions on which bycatch species observers are to monitor, observer datasets reported to the RFMO are not in a standardized format that permits pooling.	0
The regional observer programme dataset is >15 years long.	3
As there is 100% coverage in the NAFO Regulatory Area, there are minor or no gaps in seasonal coverage.	1
As there is 100% coverage in the NAFO Regulatory Area, there are minor or no gaps in spatial coverage.	1

All countries with fisheries under NAFO's mandate are Members or Cooperating Non-Members.	1
All 12 NAFO Members submitted data to the regional programme in one of the most recent four years.	3

Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include records on bycatch?

Yes, a regional observer programme database exists, and records on bycatch, including discarded catch, for some species, are included. However, information on bycatch, including discarded bycatch, is not routinely collected, given the main role of observers is related to compliance evaluation and not collecting scientific data: the NAFO Scientific Council reported that because, "observer reports do generally not contain the information specified, e.g. on catch composition and discard by haul, the reports are of limited value to Scientific Council," (NAFO, 2011c).

Observers are required on 100% of all vessels fishing within the Regulatory Area (NAFO, 2011d). The NAFO Observer Program is directed at compliance evaluation, where observers are tasked with monitoring vessel compliance, collecting catch and effort data on each haul, identifying catch composition, recording gear type and design details, verifying entries in logbooks, monitoring discards, and recording the taking of undersized fish (Article 28(4) NAFO, 2010b, 2011d). No publically available datasets contained information on bycatch and/or discards. STATLANT 21a, and 21b datasets are derived from commercial catches (landings), stock-by-stock research vessel surveys are from survey data, and the sampling dataset may include (scientific) observer recorded data (NAFO, 2001, 2002, 2011b). NAFO is also a member of Fisheries Resources Monitoring System (FIRMS), a web-based information management tool operated by FAO which shares information on status and trends of fishery resources. It was noted that the accuracy of some provisional catch reports is poor, reporting of discards is poor and the need for explicit information in discards for catch data used by STACFIS was discussed (NAFO, 2011b). A 2011 performance assessment identified the lack of monitoring and reporting data on bycatch of non-target species and species incidentally affected by fishing operations as a deficiency (NAFO, 2011d).

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

Data collected in the regional observer program may be pooled and integrated into the STATLANT21a and 21b databases. Observer-derived data are differentiated for some Contracting Parties in the sampling data (NAFO, 2002). The NAFO Secretariat has the remit to receive, disseminate and archive STATLANT 21 statistics. STATLANT 21 is the official submission of the flag States fishing in FAO Statistical

Area 21 (which is the same areas as the NAFO Convention Area) on their catch and effort information in Area 21. Flag States are not required to explain how they derive the fisheries statistics STATLANT 21 submission. Presumably, the summary statistics are derived from port landings reports, vessel logbooks, and possibly the domestic observer reports as well as the NAFO observer reports.

The 21a database includes information on annual catches (by species), subareas, country and year while the 21b database contains monthly catch and effort information by year, country, gear, tonnage, main species, division and year. Effort and weight appear to be categorical (i.e. ranges) values. Observer reports are not submitted in a standardized format (NAFO, 2010a).

- What is the length in years of the regional observer programme dataset?

19 years. The NAFO Observer Scheme was initiated in 1992 for an initial pilot period (see the second bullet under Criterion 1B). All Contracting Parties fishing within the Regulatory Area were required to have observers beginning in 1999 (NAFO, 1998).

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

Yes, 100% onboard observer coverage is required on all vessels across seasons (Article 28(1) NAFO, 2010b).

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

100% onboard observer coverage is required on all vessels in all fishing grounds (Article 28(1) NAFO, 2010b).

- Which countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members?

None. There currently are no non-Contracting Parties (cooperating or otherwise) operating in the NAFO Regulatory Area (NAFO, 2011d).

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

No vessel classes are exempt from onboard observer coverage. However, if a Contracting Party opts for Chapter VII (25% observer coverage), instead of Article 28 (100% coverage), this can be construed to constitute an exemption, but not based on vessel class (see the second bullet under Criterion 1B).

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

The Secretariat reviewed which member states contributed fishery dependent data to the STATLANT 21a and 21b datasets in 2007, 2008 and 2009. Excluding parties that did not fish in the NRA during these years, Greenland did not report required data in any of these three years, while Lithuania reported less than half of required datasets (NAFO, 2011b; personal communication, 13 November 2011, Dr. Ricardo Federizon, Fisheries Commission Coordinator, NAFO). It was noted that submission of STATLANT 21a data, necessary 'to provide the best scientific advice', continues to be a problem, causing the accuracy of officially reported provisional statistics to be questionable (NAFO, 2011c).

All 12 NAFO members reported at least partial required fishery-dependent data during the period for which information was available. One NAFO members, Denmark in respect of Greenland, met partial reporting requirements.

Criterion 2. Open Access to Bycatch Data

Score: 0 of 15 possible points, 0%.

Table A1.7-4 provides details on the assessment outcome for criterion 2.

Table A1.7-4. Assessment of NAFO provision of open access to regional bycatch and discards datasets.

Factor	Points for positive response
There is a regional observer programme dataset containing records of bycatch and discards, however, no datasets from NAFO member state national observer programmes are not publically available as amalgamated records nor as primary data records.	0
Neither primary nor amalgamated data from observer programmes are open access from any NAFO-managed fishery.	0

Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

Yes. Refer to information under criterion 1C, bullet one.

- What confidentiality rules have been adopted on access to data on bycatch, including discards, that the RFMO owns or holds as a custodian?

Observer data, as defined in Article 28 of the NAFO Conservation and Enforcement Measure, are not publically available (NAFO, 2011d). Furthermore, reports and messages will only be made available by the Executive Secretary to parties explicitly specified in Article 26(8) of the Conservation and Enforcement Measures. One year after submission, original reports and messages are deleted by the Executive Secretary and kept only at the Secretariat. These messages and reports can not be associated to an individual vessel (Annex XIX(3) NAFO, 2010b).

- Are primary or amalgamated data collected in the regional observer programme made available as an open public resource?

No, no primary or amalgamated records from observer programmes of NAFO members are publically available (NAFO, 2011d). Data collected by national observer programmes of NAFO members are not reported in separate databases from other fishery-dependent data. However, NAFO monthly and yearly amalgamated catch data are available to the public via the NAFO website. NAFO provides two amalgamated datasets, 21A (annual catches by species, subareas, country, and year) and 21B (monthly catch and effort information by year, country, gear, tonnage, main species, Division, and year). Sampling and survey data are also available online in PDF format.

- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤ 5 degree cells, > 5 degree cells, or is information on resolution of records in the publically available dataset not specified?

Not applicable, no data from observer programmes of NAFO members are publically available (NAFO, 2011d).

STATLANT datasets (available at <http://www.nafo.int/fisheries/frames/fishery-stats.html>) are available from 1960 to 2009 and sampling and survey data from 1990 to 2002 and 2003, respectively. Cell size and shape are based off of divisions which can be $<$ or $>$ 5 degrees. While some records within sampling datasets (sampling and survey datasets are available at: <http://www.nafo.int/science/frames/res-data.html>) are derived from observers (NAFO, 2002), these records are not separated from other fishery-dependent records within the dataset.

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

Not applicable, no data from observer programmes of NAFO members are publically available (NAFO, 2011d).

No information on bycatch, including discarded bycatch, is available in NAFO open access STATLANT and sampling/survey datasets, which may include records from national observer programmes. The level of amalgamation in these datasets precludes most research applications.

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

No datasets from domestic observer programmes of NAFO Member States are open access. Datasets of amalgamated data records are likely derived primarily from logbook data and port monitoring of landings, and not from data collected by onboard observers.

Criterion 3: Ecological Risk Assessment

Score: 2 of 8 possible points, 25%.

Table A1.7-5 provides details on the assessment outcome for criterion 3.

Table A1.7-5. Assessment of NAFO ecological risk assessment.

Factor	Points for positive response
Level 2 assessment has been conducted for all managed demersal fisheries on the effects of fishing on bycatch species but not on the effects of bycatch removals on the integrity of the ecosystem.	2

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

NAFO's assessment method to identify vulnerable marine ecosystems (VMEs) (Article 5bis NAFO, 2010b) can loosely be construed as constituting a Level 2 assessment of the ecological risk for the effects of demersal fisheries on bycatch species and habitat, which employs live corals and sponges as indicator species.

Small (2005) conducted a partial Level 2 risk assessment, by assessing the overlap of 14 RFMO areas with albatross distributions (Small, 2005).

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

The protocol to identify VMEs applies to all NAFO-managed fisheries (Article 5bis, NAFO, 2010b).

NAFO has not evaluated trends in the status of dependent and associated species (NAFO, 2011d), assessed the effects of managed fisheries on vulnerable bycatch species, nor assessed the effects of removals of bycatch species on ecosystem functioning and structure.

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

Live cold water corals and sponges are vulnerable from demersal fisheries in the NAFO Regulatory Area (NAFO, 2008). The weight of live corals and sponges caught per set serve as indicators to identify VMEs within existing and new fishing areas (Article 5bis NAFO, 2010b). NAFO has developed maps of the Regulatory Area identifying the location of identified VMEs and potential VMEs (Article 4bis NAFO, 2010b). According to the Scientific Council, of the three main demersal fisheries in the Regulatory Area (longline, trawl and gillnet), the direct impact of bottom trawls on benthic VMEs are the most destructive, exemplified by damaged cold-water corals west of Ireland and northwest of Scotland. Longlines were noted as potentially

impacting hard and soft corals through anchoring, loss of line and snagging and breaking off corals (NAFO, 2008). The Scientific Council also noted that trawl fishing in areas within a NAFO closed area showed evidence of large-scale trawling damage (Waller et al., 2007).

Small (2005) found that NAFO's convention area does not overlap with the distribution of albatross populations (no albatross population occurs in the North Atlantic).

In 2010 it was recommended that increased information be collected on discards, including the weight, number, and size distribution of redfish discarded in SA 1 and M3 shrimp fishery, the distribution of bycaught finfish in shrimp fisheries in M3 be studied to facilitate bycatch mitigation and that data on beaked and golden redfishes (size distribution, catch estimates) be separated in Division M3. Aside from revising redfish catch and length sampling into golden and beaked redfish by main fleet, no progress was made by the 2011 Scientist Committee Meeting in meeting the other recommendations (NAFO, 2011b). Though bycatch of deep-sea species is known to occur in shrimp fisheries in the North Sea, its effect on the ecosystem has not been assessed via an ecological risk assessment or other method (NAFO, 2011b). The Scientific Council Working Group on Ecosystem Approaches to Fisheries Management is currently comparing different geospatial approaches to quantify the impacts of fisheries on Essential Fish Habitat and sessile taxa (NAFO, 2011c).

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch

Score: 7 of 18 possible points, 39%

Table A1.7-6 provides details on the assessment outcome for criterion 3.

Table A1.7-6. Assessment of NAFO conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
One or more bycatch problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in place to mitigate at least one identified problem but <50% of the number of identified problems.	1
At least one but <50% of binding measures to mitigate bycatch include measurable performance standards.	1
Of binding bycatch measures that contain quantitative performance standards, >75% of the measures have been assessed for efficacy.	3
For all binding bycatch measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment), steps have been taken or are in progress to improve efficacy.	2
There is a provision that allows RFMO Members to opt out of binding measures.	0

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.

NAFO's ecological risk assessment process employs the bycatch of live corals and sponges in bottomfish fisheries as indicators of potential VMEs (Article 5bis NAFO, 2010b).

- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

Based on information other from ecological risk assessments, the following problematic bycatch may occur in NAFO-managed demersal and midwater trawl fisheries: Juvenile/undersized fish and shrimp, jellyfish, crabs, seaweed, sea turtles, marine mammals, seabirds, and bycatch of overexploited principal market species (Fertl and Leatherwood, 1997; Goni, 1998; Robbins et al., 1999; Read et al., 2006; Eayrs, 2007; FAO, 2010a; NAFO, 2011c).

Bycatch of overexploited principal market species in NAFO-managed fisheries targeting other species occurs (NAFO, 2011c). For managed species, the bycatch of mainly juvenile cod has increased ca. 10 fold since 1995, juvenile redfish are bycatch in Greenland halibut fisheries while American plaice are bycatch in Greenland halibut and skate fisheries. Significant witch flounder bycatch also occurs (Rosenberg et al., 2005). It was further noted that reported bycatch tends to exceed bycatch limits outside of moratorium areas while remaining below in moratorium areas for Contracting Parties targeting redfish, skate, Greenland halibut and rougheaded grandier and that some Contracting Parties reported substantially lower bycatch rates than others involved in the same fishery (Rosenberg et al., 2005). These and additional potential non-target vulnerable bycatch species are

- Using Table A1.7-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

This information has been recorded in Table A1.7-7.

- From the responses to the first two bullets, list each individual documented bycatch problem.

A total of 20 bycatch problems were identified via risk assessment or documented to occur in other regions:

- Bycatch of overexploited principal market species in two (demersal and midwater trawl) NAFO-managed fisheries targeting other species (2);

- Bycatch of live coral, sponges and sympatric species in both NAFO-managed fisheries (6);
 - Seabird/waterbird bycatch in both trawl fisheries (2);
 - Sea turtle bycatch in both trawl fisheries (2);
 - Marine mammal bycatch in both trawl fisheries (2).
 - Discards of non-marketable species, sizes and sexes of fish, jellyfish, crustacean and other groups in both trawl fisheries (6).
- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

A total of 8 of 20 bycatch problems are addressed via binding measures:

- Bycatch of overexploited principal market species in both NAFO-managed fisheries targeting other species (2);
 - Bycatch of live coral, sponges and sympatric species in both NAFO-managed fisheries (6).
- What proportion of binding bycatch measures contain quantitative, measurable performance standards?

23% (3/13) (see table A1.7-7).

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

100% (3 of 3). The performance standards are limits on bycatch weight or a ratio limit, and as such assessment of efficacy is equivalent to ensuring vessel compliance with the measures.

The performance standards do not identify targeted ecosystem effects of the measures, for example, limit fishing mortality rates and biomass of affected shark stocks. Or, for example, the VME measure performance standard employs catch rates of live corals and sponges to potentially result in the establishment of new closed areas to bottom fishing, but does not specify, for instance, how efficacy is to be measured regarding whether or not the employment of live coral and sponge catch rates as an indicator of the presence of deep-sea VMEs is adequately protecting areas according to FAO (2009d) criteria. The 'encounter' catch weight threshold values for live coral and sponges have been critiqued as not being ecologically based: A report of the ICES/NAFO Joint Working Group on Deep-water Ecology emphasized that 'bycatch in a commercial trawl is not an appropriate basis for estimating the damage occurring on the seabed' (ICES, 2010c).

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

67% (2 of 3). Again, the performance standards are limits on bycatch weight or a ratio limit, and as such assessment of efficacy is equivalent to ensuring vessel compliance with the measures. However, as explained in the previous bullet point,

the NAFO 'encounter' catch weight threshold values for live coral and sponges have been critiqued as being inadequate (ICES, 2010c).

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

One of one. The 'encounter' catch weight threshold values for live coral and sponges have been critiqued as not being ecologically based (ICES, 2010c). As a result, the Scientific Committee was tasked with reviewing current encounter threshold values (NAFO, 2011b). The Joint Working Group on Deep-water Ecology suggested the development of protocols employing a risk-based framework as opposed to numbers which must be species, area, gear and temporally based (ICES, 2010c).

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

Yes. Measures are not binding on Members who present an objection (NAFO, 2004 [Article XII(1)]). If objections have been presented and maintained by a majority of commission members, the proposal shall not become binding, unless any or all of the Commission members agree to be bound by it on a specified date. Measures are also not binding to those with a Commission member who gives a notice to the Executive Secretary of its intent not to be bound by the measure after one year from the date that a measure enters into force (Article XIII (3) NAFO, 2004).

Information was not identified from a review of materials available via the NAFO website to determine how many times NAFO members have employed the opt out provisions and why. Findings from a 2011 performance assessment hypothesized that decision-making provisions and the dispute resolution process adopted in the 2007 NAFO Amended Convention are likely to reduce use of the opt out provision (NAFO, 2011d).

Table A1.7-7. Active NAFO legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
None	na	na	na
Sea turtles			
There is no binding measure. There is a non-binding Resolution: When practicable, Contracting parties are to implement the FAO “Guidelines to Reduce Sea Turtle Mortality in Fishing Operations” (FAO, 2010a), provide information on sea turtle interactions, cooperate to develop bycatch reduction measures as appropriate and collect fishery interaction data (NAFO, 2006b).	NA-no performance standards are stated	Authorized vessel list Gear design	na (no binding measure, and the voluntary Resolution does not call for implementation of specific bycatch mitigation measures).
Marine mammals			
None	na	na	na
Shark and relatives			
Contracting Parties shall	NA-no performance	Authorized vessel list	d, e

report all shark catches and fully utilize their entire catches of sharks, excluding the head, guts and skin (Article 17(1,2) NAFO, 2010b).	standards are stated	Discarding practices for sharks	
When not the target species nor used as a food source/subsistence, Contracting Parties are encouraged to release sharks live, particularly juveniles, to the extent practicable (Article 17(6) NAFO, 2010b)	NA-no performance standards are stated	Authorized vessel list Discarding practices for sharks	d, e
NAFO Contracting Parties are prohibited from having shark fins onboard that exceed 5% of the weight of sharks carried aboard until the first point of landing (Article 17(3) NAFO, 2005b).	Yes, measurable performance standards: limit of the ratio of retained shark fins to total weight of retained sharks	Authorized vessel list Weight of retained shark fins and total retained shark weight (green or processed not stipulated, NAFO, 2011d)	a, e
Juvenile and small/undersized target species			
Article 14 and Annex III of the NCEM includes a purpose of protecting juveniles of target species.	NA-no performance standards are stated	Authorized vessel list Lengths of landed catch	a, e
Unmarketable sizes and species of non-target species of fish			
Minimum net mesh sizes for various fisheries in the Regulatory Area include: (i) 40 mm for shrimps and prawns; (ii) 60 mm for short	NA-no performance standards are stated	Gear design Location of fishing effort Target species	a, c, e

<p>finned squid (<i>Illex</i>); (iii) 280 mm in the codend and 220 mm in all other parts of the trawl for skate; (iv) 130 mm for groundfish; (v) 100 mm for pelagic <i>Sebastes mentella</i> (oceanic redfish) in Subarea 2 and Divisions 1F and 3K; (vi) 90 mm for redfish in the fishery using mid-water trawls in Division 3O (Article 13(1) NAFO, 2010b).</p>			
<p>Other or multiple bycatch species group(s)</p>			
<p>Vessels partaking in exploratory fisheries must submit a notice of intent to undertake exploratory fishery and a trip report to the Secretariat and Scientific Council, including (not limited to) vessel name and flag state, locations fished, fishing activities, depths encountered, total hours/area fished, gear types used in each area fished, VMEs identified, mitigation measures taken, list of all retained and bycatch species to lowest taxonomic unit by location, and list of organisms retained for biological sampling if any (Annex XXV</p>	<p>NA-no performance standards are stated</p>	<p>Gear design Authorized vessel list Location of fishing effort Species composition of catch</p>	<p>c, d, e</p>

NAFO, 2010b). The Executive Secretary must be notified of the location of any hard corals encountered in seamount exploratory fisheries (Article 15(9) NAFO, 2010b).			
Eleven areas of Higher Sponge and Coral Concentration are closed on an interim basis to all bottom fishing activities from 1 January 2010 to 31 December 2011 (Article 16(3) NAFO, 2010b).	NA – no performance standards are stated	Authorized vessel list Location of fishing effort Timing of fishing effort	c, e
Time/area closure of a Coral Closure polygon within Division 3O is closed to all bottom fishing activities from 1 January 2008 – 31 December 2012 as (Article 16 (1) NAFO, 2010b)	NA – no performance standards are stated	Authorized vessel list Location of fishing effort Timing of fishing effort	c, e
A section of 3M is closed to shrimp fishing 1 June – 31 December (Article 15(1-3) NAFO, 2010b).	NA – no performance standards are stated	Authorized vessel list Location of fishing effort Timing of fishing effort	c, e
Sections of Fogo Seamounts 1 and 2, Orphan Knoll, Corner Seamounts, Newfoundland Seamounts and New England Seamounts are closed to all bottom fishing activities from 1 January 2007 to 31 December 2014 (recently extended from 31	NA – no performance standards are stated	Authorized vessel list Location of fishing effort Timing of fishing effort Scientific observer	c, e

<p>December 2010) (Article 15 (5) NAFO, 2010b). Some exploratory fishing is permitted with scientific observers on board and with the requirement that if hard corals are encountered, the vessel notify the Executive Secretary of the location, to be temporarily closed to all Contracting Parties (Article 15 (8,9) NAFO, 2010b)</p>			
<p>Vessels of a Contracting Party shall limit their retained bycatch to a maximum of 2500 kg or 10% of the total retained catch, whichever is greater, for each species of a managed stocks with no quota allocated to the Contracting Party in that Division (Article 12(1) NAFO, 2010b). See exceptions below.</p>	<p>Yes, measurable performance standard: TAC or % total catch weight for bycatch of managed stocks.</p>	<p>Authorized vessel list Location of fishing effort Retained catch weights across all hauls Retained bycatch weight</p>	<p>c, e</p>
<p>For cod in Division 3M, redfish in Divisions 3LN, and “in cases where a ban on fishing is in force or an ‘Others’ quota has been fully utilized”, bycatch retained onboard is limited to the greater of 1250 kg or 5% of the total catch retained on board</p>	<p>Yes, measurable performance standard: TAC or % total catch weight for three bycatch species groups (cod, redfish, shrimp)</p>	<p>Authorized vessel list Location of fishing effort Retained catch weights across all hauls Retained bycatch weight Ratio of retained bycatch weight to total retained catch weight</p>	<p>c, e</p>

<p>excluding catches of shrimp in calculations of groundfish species bycatch levels (Article 12 (1a,b) NAFO, 2010b). If a single haul exceeds the bycatch limits listed above or if groundfish bycatch subject to quota in the shrimp fishery exceeds 5% by weight in Division 3M or 2.5% in Division 3L, the vessel must move \geq 10 nautical miles from the previous tow and throughout the next tow. If this is repeated at the new location, “the vessel must leave the Division and not return for at least 60 hours” (Article 12(2a,b) NAFO, 2010b).</p>			
<p>In new and existing fishing areas, an encounter (catch per set) of > 60 kg live coral and/or 800 kg live sponge (Article 5bis(3), NAFO, 2010b), must be immediately reported to the flag state, then informing the Executive Secretary. The vessel must move \geq 2nm before engaging in further fishing (Article 5bis(1) NAFO, 2010b). If</p>	<p>Yes, measurable performance standard: TAC for two bycatch species groups (live corals, sponges)</p>	<p>Authorized vessel list Location of fishing effort Catch weight of live coral and sponge for all sets</p>	<p>c, d, e</p>

such an encounter occurs in a 'new' area, a 2 mile radius around the reporting position will be temporally closed (Article 5bis(2) NAFO, 2010b).			
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¹ Active and legally binding NAFO measures, pursuant of NAFO Conservation and Enforcement Measures (NAFO, 2010). Downloaded from <http://www.nafo.int/fisheries/frames/regulations.html> on 16 July 2011.

Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 2 of 14 possible points, 14%

Table A1.7-8 provides details on the assessment outcome for criterion 3.

Table A1.7-8. Assessment of NAFO conservation and management measures to mitigate bycatch in lost, abandoned and discarded gear.

Factor	Points for positive response
For managed fisheries for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are in place for >50% but <75% of these fisheries.	2
The one relevant NAFO binding measure to mitigate ghost fishing does not include measurable performance standards.	0
There is a provision that allows RFMO Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

While it was noted that gillnets, traps and other lost gears can result in ‘ghost fishing’ for months or years in deep-water fisheries (NAFO, 2008), NAFO has not conducted research to assess levels of derelict fishing gear nor concomitant fishing mortality caused by derelict fishing gear by trawl or other gear types occurring within the NAFO Regulatory Area.

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

In general, fisheries that employ passive fishing gear (e.g., pelagic and demersal longlines, gillnets, trammel nets, traps) are likely to cause ghost fishing, while fisheries that employ active gear (e.g., purse seine, trawl) are less likely to result in ghost fishing as the catching process of active gears ceases when the gear is no longer attached to the vessel (NEAFC, 2008a; NAFO, 2008; SEAFO, 2009e; FAO, 2005a, 2010d). However, there are many exceptions to this general rule. For instance, ghost fishing has been observed in seine nets and there is evidence of marine mammal entanglement in trawl net fragments, and coastal habitat degradation from derelict trawl nets (Jones, 1995; Donohue et al., 2001; Matsuoka et al., 2005). In conclusion, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in NAFO-managed trawl or other fisheries.

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table A1.7-9);

Marker buoys and similar surface floating objects indicating a fixed gear location must display the vessel registration number (Article 22 NAFO, 2010b). There is no performance standard stipulated for this measure. The measure is not applied as fixed gears are rare if not non-existent in the NRA (Personal communication, 13 November 2011, Dr. Ricardo Federizon, Fisheries Commission Coordinator, NAFO).

A 2011 performance assessment identified the absence of requirements to report derelict gear, or other measures to obtain information on derelict gear, as a NAFO governance deficit (NAFO, 2011d).

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

50% (2 of 4). The binding measure for marking buoys of fixed gear is applicable to demersal gillnet and demersal longline gear, but not relevant to demersal trawl or purse seine gear. Problematic ghost fishing has been documented to occur from all four of these gear types.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

NA, the measure does not contain performance standards.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

No information was identified on the efficacy of the measure, and the measure does not contain performance standards.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes. Measures are not binding to members who have presented objection at the end of the extended period or periods for objecting (Article XII (1) NAFO, 2004). If objections have been presented and maintained by a majority of commission members, the proposal shall not become binding, unless any or all of the Commission members agree to be bounded by it on a specified date. Measures are also not binding to those with a Commission member who gives a notice to the Executive Secretary of its intent not to be bound by the measure after one year from the date that a measure enters into force (Article XIII (3) NAFO, 2004).

Table A1.7-9. Active NAFO legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Marker buoys and similar surface floating objects used within the Regulatory Area which indicate a fixed gear location must display the vessel registration number (Article 22, NAFO, 2010b).	NA – no performance standards are stated	Authorized vessel list including registration numbers Gear marking	a, e

¹ Active and legally binding NAFO measures, pursuant of NAFO Conservation and Enforcement Measures (NAFO, 2010). Downloaded from <http://www.nafo.int/fisheries/frames/regulations.html> on 16 July 2011.

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea
Score: 0 of 14 possible points, 0%

Table A1.7-10 provides details on the assessment outcome for criterion 3.

Table A1.7-10. Assessment of NAFO conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed fisheries, and no relevant binding measures are in place.	0
There is a provision that allows RFMO Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

No, NAFO has not assessed adverse environmental impacts from pollution resulting from the discharge of organic matter (catch, offal, and bait) at sea in managed fisheries.

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from the these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

No information was identified via materials available on NAFOs website on risks from pollution from discards from managed fisheries.

In general, large inputs of organic matter from discards at sea can increase natural nutrient levels in nutrient-poor benthic ecosystems, and in fisheries where discards are spatially concentrated, and especially in areas of low current flow, may cause localized hypoxia or anoxia of the seabed, which, if prolonged, causes avoidance and mortalities, alters benthic community composition, and alters ecosystem processes and structure (FAO, 1995 [Article 7.2.2g]; Goñi, 1998; Hall et al., 2000; Stevens et al., 2000; Gray et al., 2002; FAO, 2003a,b; Franco et al., 2008; Levin et al., 2009; Haselmair et al., 2010).

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table A1.7-11).

There are no relevant binding measures.

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

No relevant information was identified for managed fisheries documenting problematic pollution, or are identified as being likely to cause problematic pollution, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes. Measures are not binding to members who have presented objection at the end of the extended period or periods for objecting (Article XII(1) NAFO, 2004), nor to those with a Commission member who gives a notice to the Executive Secretary of its intent not to be bound by the measure after one year from the date that a measure enters into force (Article XIII(3) NAFO, 2004).

Table A1.7-11. Active NAFO legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	na	na	na

¹ Active and legally binding NAFO measures, pursuant of NAFO Conservation and Enforcement Measures (NAFO, 2010). Downloaded from <http://www.nafo.int/fisheries/frames/regulations.html> on 16 July 2011.

Criterion 5. Surveillance and Enforcement

Score: 19 of 20 possible points, 95%

Table A1.7-12 provides details on the assessment outcome for criterion 3.

Table A1.7-12. Assessment of NAFO measures and resources for surveillance and enforcement.

Factor	Points for positive response
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≥75% of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	4
The RFMO requires parties to report to the RFMO on their enforcement procedures and conclusions.	3
The RFMO requires parties to take specified enforcement procedures when an infraction of a binding conservation and management measure occurs.	3
The RFMO requires parties to impose specified sanctions when an infraction of a binding conservation and management measure occurs.	3
The RFMO has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3
Summary information on detected infringements of binding measures on bycatch and discards are made available by the RFMO, and resulted in sanctions prescribed by the RFMO for ≥75% but <100% of detected infringements.	3

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

Yes. There are relevant protocols for both NAFO Contracting and Non-Contracting Parties. For Contracting Parties, vessels are required to be equipped with VMS (Article 26 (1) NAFO, 2010b) and must have 100% observer coverage (Article 28 NAFO, 2010b). There is daily VMS reporting to the Secretariat (NAFO, 2011d). Following their assignment to the Joint Inspection and Surveillance Scheme, (Chapter IV NAFO, 2010b) vessels are subject to inspection. If inspector observations do not correspond with VMS or recent catch reports, the inspector is to complete a surveillance report and board the vessel (Article 32 NAFO, 2010b). Vessels fishing within the Regulatory Area must offload or land their catches in authorized ports of Contracting Parties, where inspectors check logbook records, mesh size, and the size of fish retained onboard (Article 46 NAFO, 2010b), in accordance with the NAFO Port State Control Scheme. All vessels over 50 gross tons are required to be included in a vessel register (Article 20 NAFO, 2010b).

Under the scheme to promote compliance by non-Contracting Parties, all non-Contracting Party vessels fishing within the Regulatory Area or involved in transshipment (within or outside) are presumed to be undermining the effectiveness of Conservation and Enforcement Measures (Article 52 NAFO, 2010b). At sea, inspectors can request permission to board non-Contracting Party vessels (Article 53 NAFO, 2010b) and the landing and transshipment of all fish from non-Contracting Party vessels is prohibited in all Contracting Ports unless the vessel demonstrates that the fish subject to the NAFO convention were caught outside of the Regulatory Area or otherwise that they have employed all relevant Conservation and Enforcement Measures (Article 55 NAFO, 2010b). Vessels must request entry ports of Contracting Parties where, if allowed to enter, is subject to inspection (Article 54

NAFO, 2010b). For vessels of non-Contracting Parties presumed to be engaged in IUU activities, the NAFO Secretariat adds the vessel name to an IUU Provisional List and contacts the flag State. If unable to demonstrate that the vessel did not take part in IUU fishing, if the vessel has been permanently re-assigned, or if the vessel has been adequately sanctioned, then the vessel is to be placed on the NAFO IUU list. If the contrary is found, then the vessel is to be removed from either the Provisional or IUU List (Article 57 NAFO, 2010b).

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.7-7, A1.7-9, and A1.7-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

100% of surveillance measures identified as being required in binding measures are employed. Dockside inspection, VMS, observers and a vessel list are employed by NAFO Member States.

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

Yes. Depending on the offence and in agreement with national law, Contracting Parties may impose a range of sanctions including the following: fines, seizure of illegal fishing gear and catches, sequestration of the vessel, suspension or withdrawal of authorization to fish and/or reduction or withdrawal of the fishing quota on vessels flying its flag which have committed a serious infringement (listed in Article 38 NAFO, 2010b). The flag state is also required to notify the Executive Secretary of the measures taken (Article 40 NAFO, 2010b). Timeliness of Contracting Party reporting on the follow-up of infringements was identified in a 2011 performance assessment as an area requiring improvement; as of March 2011, information on citation status had been provided by relevant Contracting Parties on only 12 of 88 citations issued between 2006 and 2010 (NAFO, 2011d).

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

Yes, the NAFO Standing Committee on International Control (STACTIC), a subsidiary body of the Fisheries Commission, is tasked with reviewing the efficacy of the

Monitoring, Control and Surveillance (MCS) Program, and making recommendations to the Fisheries Commission on needed improvements in Conservation and Enforcement Measures (NAFO, 2011d). The review and evaluation of the NAFO Contracting Parties' activities relating to compliance and the follow-up of infringements has been performed annually by STACTIC (NAFO, 2011d). Submission of annual Compliance Reviews enables the comparison of citation rates of at-sea and port inspections for different violations (NAFO, 2010a).

- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

Yes, infringements identified by inspectors typically result in sanctions (NAFO, 2011d). It is the duty of the flag state to further investigate and proceed with legal prosecution when an inspector issues a citation, while keeping the Secretariat informed (NAFO, 2010a). Under Article 42 of the NCEM, Contracting Parties are required to report to the Secretariat the action taken concerning infringements notified to it (NAFO, 2011d). NAFO (2011d) summarizes the rate of port and at-sea inspections that result in citations. Most cases of detected infringements are resolved within two years (NAFO, 2011d). The percent of citations with no follow-up has increased over the last few years; it was suggested that follow-up may have occurred but was not reported to the NAFO Secretariat (NAFO, 2010a).

A1.8. North Atlantic Salmon Conservation Organization (NASCO)

SUMMARY	
Criteria Suite Scores	
Overall	6 (± 6 SD of the mean)% ¹
Criterion 1: Data Collection	0% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	0%
Criterion 1B. Regional Observer Coverage Rates	0%
Criterion 1C. Regional Observer Programme Dataset Quality	0%
Criterion 2. Open Access to Regional Observer Programme Datasets	0%
Criterion 3. Ecological Risk Assessment	0%
Criterion 4. Conservation and Management Measures	0% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	0%
Criterion 4B. Conservation and Management Measures to Govern Lost and Abandoned Gear	0%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	0%
Criterion 5. Surveillance and Enforcement	30%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The Convention for the Conservation of Salmon in the North Atlantic Ocean entered into force on 1 October 1983 and created the North Atlantic Salmon Conservation Organization (NASCO) (NASCO, 1983, 2012a). The Convention created a large area closed to targeted fisheries for Atlantic salmon, including the high seas, and in areas beyond 12 nautical miles from the baseline of coastal States, excluding an area around West Greenland (up to 40 nautical miles from the baseline) and within the area of fisheries jurisdiction of the Faroe Islands (NASCO, 1983).

NASCO's aim is to contribute to the conservation, restoration, enhancement and rational management of salmon stocks in the North Atlantic Ocean. NASCO-member States in whose waters salmon stocks originate retain their management of salmon fisheries in their national homewaters (NASCO, 1983; Crozier et al., 2004). However, distant-water salmon fisheries, which are fisheries that take salmon originating from another Party, are regulated by NASCO binding measures. Hence, a main objective of NASCO is to provide mechanisms to minimize catches in the area of fisheries jurisdiction of one Party of salmon originating in the rivers of another Party (NASCO, 1983). Distant-water fisheries under the NASCO Convention have occurred off Greenland and Faroe Islands.

Regulatory measures establishing salmon total allowable catch limits have been established for the distant water fisheries in most years since NASCO's establishment. The total catch in distant water fisheries has been reduced to about 25 tonnes annually, down from about 3 000 tonnes before NASCO was established (Lugten, 2010; NASCO, 2011b). NASCO measures restrict West Greenland salmon catches to the amount used for internal consumption, and prohibits the commercial export of salmon (NASCO, 2008a, 2009a). At the Faroe Islands,

there has been no commercial fishery for salmon since the early 1990s, no non-commercial salmon fishing since 2000, and NASCO has not set a quota for the salmon fishery since 2000 (NASCO, 2010a, 2011b).

The NASCO Convention Area is divided into three regions, each managed by a Commission which has the authority to propose regulatory measures: North American Commission, West Greenland Commission, and North-East Atlantic Commission (NASCO, 1983 [Article 3(4)]). Of the 2010 total reported North Atlantic salmon catches by NASCO Parties of 1,589 tonnes, 1,400 tonnes was from the North-East Atlantic Commission area, 149 tonnes from the North American Commission area, and 40 tonnes (11,747 salmon) from the West Greenland Commission area (NASCO, 2011b). Thus, based on 2010 reported catches by weight, the one active NASCO-managed fishery, at West Greenland, accounted for 2.5% of total reported North Atlantic salmon catches. In the late 1980s and early 1990s, NASCO acted through diplomatic channels to eliminate fishing for salmon in international waters by vessels of non-NASCO Parties; there have been no reports of such activities since the early 1990s (NASCO, 2012b).

In addition to managing distant water salmon fisheries, currently limited to the one relatively minor West Greenland gillnet salmon fishery in terms of proportion of total volume of reported landings, NASCO has gradually expanded its activities to address a suite of threats to North Atlantic salmon stocks. This broad suite of activities includes: catalyzing Parties to adopt effective management measures for salmon homewater fisheries, habitat protection and restoration, bycatch of salmon in pelagic trawl non-salmon fisheries, and aquaculture and related activities such as introductions, transfers and transgenics, preventing the spread of the parasite *Gryodactylus salaris*, and stock building programmes (NASCO, 2012b).

In summary, the West Greenland surface gillnet salmon fishery is the one active NASCO-managed fishery (NASCO, 1983, 2005b, 2010a) and this fishery catches a very small proportion of the total North Atlantic salmon catch (NASCO, 2011b). No data on bycatch exist for the one active NASCO-managed fishery (NASCO, 2011b; personal communication, Malcolm Windsor, NASCO Secretariat, 6 February 2012), and the NASCO Convention does not include a mandate to consider effects of directed salmon fisheries on ecologically related species or broader ecosystem effects (NASCO, 1983). NASCO does not have management authority over fisheries where salmon is non-target incidental bycatch (NASCO, 1983, 2005b). It is important to clarify that NASCO management of distant-water salmon-targeted fisheries represents but one small component of NASCO's broad, comprehensive North Atlantic salmon conservation activities, and that rod-and-reel gear, the predominant method employed to catch the majority of North Atlantic salmon but not employed in NASCO-managed fisheries, has nominal problematic bycatch.

MEMBERSHIP

NASCO has six Parties: Canada, Denmark (in respect of the Faroe Islands & Greenland), the European Union, Norway, the Russian Federation and the United States of America (NASCO, 2012a).

MANAGED SPECIES AND FISHERIES

NASCO manages salmon stocks that migrate beyond areas of fisheries jurisdiction (beyond 12 nautical miles) of coastal States of the Atlantic Ocean north of 36°N latitude throughout their migratory range (NASCO, 1983).

NASCO is responsible for managing distant-water mixed-stock salmon fisheries in Faroese and Greenlandic waters (NASCO, 1983, 2005b). The West Greenland salmon fishery, which is primarily a distant water fishery (there is one salmon river in Greenland, and stocks

exploited in Greenland fisheries mainly originate from other countries [NASCO, 2008a]) employs nearshore surface gillnets (Crozier et al., 2004; NASCO, 2011b). The West Greenland salmon fishery is regulated in the Greenland Home Rule Executive Order No 21 of 10 August 2002 on the Salmon Fishery, which distinguishes between (i) commercial fishery for Atlantic salmon to be landed at fish plants, (ii) subsistence fishery by residents of Greenland, and (iii) rod fishery by tourists/non-residents (NASCO, 2011f).

There currently is no active salmon fishery in the Faroe Islands (NASCO, 2010a). Scientific research fishing in areas where salmon fishing is prohibited by the NASCO Convention may be conducted by NASCO Parties, subject to certain conditions (NASCO, 1996); there were no applications to conduct scientific research fishing in the Convention area during 2011 (NASCO, 2011e).

AREA OF APPLICATION

The NASCO Convention applies to the salmon stocks that migrate beyond areas of fisheries jurisdiction of coastal States of the Atlantic Ocean north of 36°N throughout their migratory range (NASCO, 1983). The NASCO area of competence is the combined areas of its three Commissions (Fig. A1.9-1): (i) the North Atlantic Commission covers all maritime waters within areas of fisheries jurisdiction of coastal States off the east coast of North America; (ii) the West Greenland Commission covers all maritime waters within the area of fisheries jurisdiction off the coast of West Greenland west of a line drawn along 44°W south to 59°N, thence due east to 42°W and thence due south; and (iii) the North East Atlantic Commission covers all maritime waters east of 36°N (NASCO, 1983).



Fig. A1.9-1. NASCO convention area (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH AND DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries

Score: 0 of 22 possible points, 0%.

A maximum of 22 points are attainable for assessment against sub-criterion 1A (one criterion relevant only to hook-and-line fisheries in a regional observer programme is not applicable to NASCO).

Table A1.8-1 provides details on the assessment outcome for criterion 1A.

Table A1.8-1. Assessment of NASCO regional observer programme data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are not included in NASCO's mandate.	0
There is no NASCO regional observer programme for the one active NASCO-managed fishery at West Greenland, and there are no binding conservation and management measures related to governing bycatch, including discarded catch.	0

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

No. The NASCO Convention text does not explicitly include non-salmon species in its mandate (NASCO, 1983). The stated goals for NASCO's management of salmon fisheries are to promote the diversity and abundance of salmon stocks and to maintain all stocks above conservation limits, and a goal of research on salmon at sea includes understanding the bycatch of salmon in non-salmon targeted fisheries; there is no explicit identification of a goal to minimize bycatch and impacts on associated and dependent species by NASCO-managed directed salmon fisheries (NASCO, 2005b). NASCO and Parties adopted a Precautionary Approach, and a Decision Structure to implement the Precautionary Approach, which aims to have management measures maintain all NASCO-managed salmon stocks above their conservation limit, and does not call for sustainable bycatch in NASCO-managed salmon fisheries (NASCO, 1998, 2002).

- In fisheries required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

None, as there is no regional observer coverage of NASCO-managed fisheries, including for the one active NASCO-managed fishery.

- Does the RFMO's data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely

collected?

No, as there is no regional observer programme.

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).

None, as there are no binding conservation and management measures relevant to the governance of bycatch, including discarded catch.

- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected by in the regional observer programme according to the RFMO's data collection protocols?

None, as there are no relevant binding measures.

- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?

No, as there is no regional observer programme and there are no relevant binding measures.

- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?

No, as there is no regional observer programme.

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely by observers of the regional observer programme?

None, as there is no regional observer programme.

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

No, as there is no regional observer programme.

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to have records be at the species level?

None of the species relatively vulnerable to overexploitation identified as potentially being bycatch in the West Greenland salmon fishery are recorded at the species level, as there is no regional observer programme.

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is intended to be routinely collected by regional observers that provides a proxy for age

class, identify the measurement method.

Neither lengths nor other relevant variables are recorded for any of the species relatively vulnerable to overexploitation identified as potentially being bycatch in the West Greenland salmon fishery; there is no regional observer programme.

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

Information on disposition upon release is not recorded for any species in the West Greenland salmon fishery; there is no regional observer programme.

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

Hook-and-line gear is not reported to be employed in the one NASCO-managed fishery at West Greenland.

Criterion 1B. Regional Observer Coverage Rates

Score: 0 of 11 possible points, 0%.

Table A1.8-2 provides details on the assessment outcome for criterion 1B.

Table A1.8-2. Assessment of NASCO onboard observer coverage rates to monitor discards and retained and transhipped bycatch.

Factor	Points for positive response
There is no regional observer coverage of NASCO-managed fisheries.	0
NASCO's scientific advisory body (ICES) has not recommended regional onboard observer coverage rates for NASCO-managed fisheries, and there is no NASCO regional observer programme.	0
There is no international exchange of observers in a NASCO regional onboard observer programme.	0

Information used for assessment:

- What recommendations on regional observer coverage rates have the RFMO's scientific body or the Commission made for fisheries under the RFMO's mandate?

Advice on the status of stocks, on the effectiveness of management measures, on monitoring needs and research requirements, and on catch options (or alternative management advice) is provided annually by the International Council for the Exploration of the Sea (ICES) (NASCO and ICES, 2007). ICES has not recommended observer coverage rate for NASCO-managed fishery at West Greenland, not for the currently

inactive fishery at the Faroe Islands, nor was this identified as needed in the NASCO performance assessment findings (NASCO, 2005a,b, 2011b,d).

- Does a regional observer programme exist?

No. There is no onboard observe coverage, regional or domestic, of Greenlandic salmon fisheries (NASCO, 2008a).

- What are regional onboard observer coverage rates in each fishery managed by the RFMO?

There is no regional onboard observer coverage of the Greenlandic salmon fishery, the one active NASCO-managed fishery (NASCO, 2008a).

- If there have been recommendations for onboard observer coverage rates by the RFMO’s scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body’s recommendations?
Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

ICES has not recommended an onboard observer coverage rate for either of the NASCO-managed fisheries, and there is no NASCO regional observer programme.

- For each fishery under the RFMO’s mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

No, as there is no regional observer programme.

Criterion 1C. Regional Observer Programme Dataset Quality

Score: 0 of 11 possible points, 0%.

Table A1.8-3 provides details on the assessment outcome for criterion 1C.

Table A1.8-3. Assessment of NASCO observer programme data quality.

Factor	Points for positive response
There is no NASCO regional observer programme or NASCO observer programme database.	0
Iceland has salmon fisheries under NASCO’s mandate but withdrew from being a NASCO Party due to financial considerations, and indicated the intention to re-accede to the Convention when their economic situation improves. France (in respect of Saint Pierre and Miquelon) also has a	0

fishery for Atlantic Salmon but is not a NASCO Party.	
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Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include records on bycatch?

No, there is no NASCO regional observer programme or observer database.

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

No, the NASCO Secretariat does not own or serve as the custodian of a dataset of observer-collected records from NASCO-managed fisheries. The one active NASCO-managed fishery at West Greenland does not have domestic or regional onboard observer coverage (NASCO, 2008a).

- What is the length in years of the regional observer programme dataset?

0 years.

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

There is no regional observer programme.

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

There is no regional observer programme.

- Which countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members?

Iceland withdrew from NASCO with effect from 31 December 2009 because of financial considerations, but has indicated that it intends to re-accede to the Convention when the economic situation improves (NASCO, 2012a). France (in respect of Saint Pierre and Miquelon), a State of origin of Atlantic Salmon, is an additional country of relevance to the Convention that is not a NASCO Party, but has observer status to the NASCO North American Commission (NASCO, 2011b,c). The Islands of Saint Pierre and Miquelon reported a total catch of 2.78 t in combined commercial and recreational fisheries in 2010 (NASCO, 2011b,c).

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

There is no regional observer programme.

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

NASCO Parties are not required to report

Criterion 2. Open access to bycatch data

Score: 0 of 15 possible points, 0%.

Table A1.8-4 provides details on the assessment outcome for criterion 2.

Table A1.8-4. Assessment of NASCO provision of open access to regional observer programme datasets.

Factor	Points for positive response
There is no regional observer programme dataset containing records of bycatch.	0

Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

No, there is no NASCO regional observer programme nor a dataset of observer records collected from NASCO-managed fisheries.
- What confidentiality rules have been adopted on access to data on bycatch and discards that the RFMO owns or holds as a custodian?

None.
- Are primary or amalgamated data collected in the regional observer programme made available as an open public resource?

No, there is no relevant observer programme dataset.
- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤ 5 degree cells, >5 degree cells, or is information on resolution of records in the publically available dataset not specified?

There is no relevant observer programme dataset.

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

There is no relevant observer programme dataset.

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

There is no NASCO regional observer programme or dataset of records collected by observers of NASCO-managed fisheries.

Criterion 3: Ecological risk assessment

Score: 0 of 8 possible points, 0%.

Table A1.8-5 provides details on the assessment outcome for criterion 3.

Table A1.8-5. Assessment of NASCO ecological risk assessment.

Factor	Points for positive response
No ecological risk assessments on the effects of NASCO-managed fisheries on bycatch species or on the effects of bycatch in NASCO-managed fisheries on the integrity of the ecosystem have been conducted.	0

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

NASCO has not conducted assessments of the risks of NASCO-managed salmon fisheries to bycatch species and/or the effects of bycatch on the integrity of the ecosystem.

NASCO was one of five RFMOs determined to have convention areas that do not overlap with the distribution of any albatross population (Small, 2005), which is expected given that no albatrosses occur in the North Atlantic.

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

No relevant ecological risk assessments were identified.

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

No relevant ecological risk assessments were identified.

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch

Score: 0 of 18 possible points, 0%

Table A1.8-6 provides details on the assessment outcome for criterion 3.

Table A1.8-6. Assessment of NASCO conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
Problematic bycatch is likely to occur in the one active NASCO-managed fishery, the West Greenland salmon gillnet fishery; no binding measures are in place to mitigate bycatch in this fishery. Both the domestic fisheries authority and NASCO’s scientific advisory body (ICES) have reported that they lack information on bycatch in this fishery.	0
There is a provision that allows RFMO Members to opt out of binding measures.	0

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.

No relevant ecological risk assessments were identified.

- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

NASCO is responsible for managing the distant-water, mixed-stock salmon fisheries in Faroese and Greenlandic waters (NASCO, 1983, 2005a). According to ICES most current information to NASCO, nearshore surface gillnet gear currently is the only gear type used in the West Greenland salmon fishery (Crozier et al., 2004; NASCO, 2011b). There currently is no active salmon fishery in the Faroe Islands (NASCO, 2010a). For the one active NASCO-managed fishery, the West Greenland nearshore surface gillnet fishery, ICES most current advice on ecosystem effects of the fishery is that, “There is no information on bycatch of other species with this gear” (NASCO, 2011b), suggesting that ICES finds the fishery to be data-deficient for information on bycatch. The lack of data on bycatch in this fishery was confirmed by the NASCO

Secretariat (personal communication, Malcolm Windsor, NASCO Secretariat, 6 February 2012). While NASCO has stated that, “ICES considers that salmon fisheries probably have ‘no or only minor influences on the marine ecosystem’ (NASCO, 2012c), this ICES advice is on the ecosystem effects of North American and Northeast Atlantic salmon fisheries, and not the NASCO-managed West Greenland salmon gillnet fishery (NASCO, 2011b). The domestic fisheries management authority of the West Greenland salmon fisheries stated that the fisheries’ selectivity was “NA” (NASCO, 2008a), and based on their not being onboard observer coverage, suggests that there is a lack of information on bycatch by domestic management authorities as well.

In general, surface gillnet fisheries can have problematic bycatch of elasmobranchs, marine mammals, seabirds, waterbirds, sharks, unmarketable species and sizes of finfish, and sea turtles primarily in the tropics and subtropics (Northridge, 1991; Goni, 1998; Silvani et al., 1999; Melvin et al., 2001; Uhlmann et al., 2005; Read et al., 2006; Gilman et al., 2009; Kiszka et al., 2009; Zydels et al., 2009; FAO, 2010a). The West Greenland salmon gillnet fishery has documented bycatch of harbor seals (Waring et al., 1998) and historically, murre and guillemots (Tull et al., 1972; Christensen and Lear, 1977).

In addition, bycatch of salmon in other North Atlantic fisheries, such as the Icelandic mackerel trawl fishery, has been documented (ICES, 2004; NASCO, 2011b), but these are not NASCO-managed fisheries.

- Using Table A1.8-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

This information has been recorded in Table A1.8-7. There are no NASCO measures, in effect or expired, on bycatch in NASCO-managed fisheries (NASCO, 2009b, 2012d).

NASCO fulfills its mandate to manage distant-water fisheries for wild salmon off West Greenland and the Faeroe Islands through management measures that are based on scientific recommendations from ICES. For the one active NASCO-managed fishery, the conservation and management measure in effect for the West Greenland salmon fisheries required the 2009-2011 catch to be restricted to the amount used for internal consumption in Greenland and bans commercial salmon export (NASCO, 2009b).

- From the responses to the first two bullets, list each individual documented bycatch problem.

Bycatch of marine mammals and coastal seabirds has been documented to occur in the past in the West Greenland salmon gillnet fishery, and bycatch of waterbirds, sharks, unmarketable species and sizes of finfish may also occur.

- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

No relevant measures have been adopted by NASCO.

- What proportion of binding bycatch measures contain quantitative, measurable performance standards?

No relevant measures have been adopted by NASCO.

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

No relevant measures have been adopted by NASCO.

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

No relevant measures have been adopted by NASCO.

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

No relevant measures have been adopted by NASCO.

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

The NASCO Convention allows for Parties to prevent binding measures from coming into effect: "Any member in whose area of fisheries jurisdiction a regulatory measure would apply may, within 60 days of the date specified in the Secretary's notification, lodge an objection to it. In this case the regulatory measure shall not become binding on any member," (NASCO, 1983 [Article 13(3)]). Furthermore, the NASCO Convention provides a mechanism for Parties to terminate binding measures after they come into effect: "After the expiration of one year from the date on which a regulatory measure becomes binding, any member in whose area of fisheries jurisdiction the regulatory measure applies may denounce it by written notice to the Secretary. The Secretary shall immediately inform the other members of such denunciation. The regulatory measure shall cease to be binding on all members 60 days after the date of receipt by the Secretary of the notice of denunciation or, if a

later date is indicated by the member, on such date” (NASCO, 1983 [Article 13(4)]).
To date, these opt-out measures have not been employed by a NASCO Party.

Table A1.8-7. Active NASCO legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed for Implementation	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
None	NA	NA	NA
Sea turtles			
None	NA	NA	NA
Marine mammals			
None	NA	NA	NA
Shark and relatives			
None	NA	NA	NA
Juvenile and small/undersized target species			
None	NA	NA	NA
Unmarketable sizes and species of non-target species of fish			
None	NA	NA	NA
Other or multiple bycatch species group(s)			
None	NA	NA	NA

Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 0 of 14 possible points, 0%

Table A1.8-8 provides details on the assessment outcome for criterion 3.

Table A1.8-8. Assessment of NASCO conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
There is limited knowledge of the ecological risks from ghost fishing by the West Greenland salmon surface gillnet fishery; no relevant binding measures have been adopted by NASCO.	0
There is a provision that allows RFMO Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

Assessments of effects of ghost fishing by the one active NASCO-managed fishery, the West Greenland salmon gillnet fishery, have not been conducted.

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

In general, fisheries that employ passive fishing gear (e.g., pelagic and demersal longlines, gillnets, trammel nets, traps) are likely to cause ghost fishing, while fisheries that employ active gear (e.g., purse seine, trawl) are less likely to result in ghost fishing as the catching process of active gears ceases when the gear is no longer attached to the vessel (NEAFC, 2008a; NAFO, 2008; SEAFO, 2009e; FAO, 2005a, 2010d). A study of ghost fishing mortality levels in anchored gillnets estimated the fishing duration of this gear when lost, abandoned or discarded is between 15 and 20 weeks, after which the effective fishing area of netting was reduced as the height of the net was reduced due to deformation, accumulated detritus, and colonized by macrophytes and other species (Erzini et al., 1997). A study that modeled the shape of drift surface gillnets and bottom gillnets found that the drift gillnets deformed only slightly with bending only at the two horizontal ends of the net, while a demersal gillnet would be colonized and settle to the seafloor within 25 days (Takagi et al., 2007).

In conclusion, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in the NAFO-managed West Greenland salmon gillnet fishery.

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table A1.8-9);

There are no relevant binding measures.

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

0%, there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

There are no relevant binding measures in place.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

There are no relevant binding measures in place.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, the NASCO Convention allows for Parties to prevent binding measures from coming into effect and for Parties to terminate binding measures after they come into effect (NASCO, 1983 [Article 13(3) and (4)]).

Table A1.8-9. Active NASCO legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed for Implementation	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	NA	NA	NA

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea

Score: 0 of 14 possible points, 0%

Table A1.8-10 provides details on the assessment outcome for criterion 3.

Table A1.8-10. Assessment of NASCO conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
The West Greenland surface gillnet salmon fishery, the one active NASCO-managed fishery, has not been assessed to understand ecological risks from the discharge of discarded catch, offal from processed catch, and spent bait. No relevant binding measures have been adopted.	0
There is a provision that allows RFMO Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

There have been no relevant assessments of ecological risks from discarding in the one active NASCO-managed fishery, the West Greenland surface gillnet salmon fishery.

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from the these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

Research has not been conducted to provide an understanding of ecological risks from pollution from discards from the one active NASCO-managed fishery.

In general, large inputs of organic matter from discards at sea can increase natural nutrient levels in nutrient-poor benthic ecosystems, and in fisheries where discards are spatially concentrated, and especially in areas of low current flow, may cause localized hypoxia or anoxia of the seabed, which, if prolonged, causes avoidance and mortalities, alters benthic community composition, and alters ecosystem processes and structure (FAO, 1995 [Article 7.2.2g]; Goñi, 1998; Hall et al., 2000; Stevens et al., 2000; Gray et al., 2002; FAO, 2003a,b; Franco et al., 2008; Levin et al., 2009; Haselmair et al., 2010).

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table A1.8-11).

There are no relevant binding measures.

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

No relevant information was identified for managed fisheries documenting problematic pollution, or are identified as being likely to cause problematic pollution, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

There are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, the NASCO Convention allows for Parties to prevent binding measures from coming into effect and for Parties to terminate binding measures after they come into effect (NASCO, 1983 [Article 13(3) and (4)]).

Table A1.8-11. Active NASCO legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed for Implementation	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard
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			observers, (e) vessel list, (f) other (specify)
None	na	na	na

Criterion 5. Surveillance and Enforcement

Score: 6 of 20 possible points, 30%

Table A1.8-12 provides details on the assessment outcome for criterion 5.

Table A1.8-12. Assessment of NASCO measures and resources for surveillance and enforcement.

Factor	Points for positive response
There are no NASCO binding conservation and management measures governing bycatch, including discarded catch, and hence there are no requisite surveillance methods to assess compliance with bycatch measures.	0
NASCO requires parties to report to the RFMO on their enforcement procedures and conclusions.	3
NASCO does not require parties to take specified enforcement procedures when an infraction of a binding conservation and management measure occurs.	0
NASCO does not require parties to impose specified sanctions when an infraction of a binding conservation and management measure occurs.	0
NASCO has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted, through Parties' Implementation Plans, and written annual reports and focus area reports.	3
Summary information on detected infringements of binding measures on bycatch are not made available by NASCO as there are no relevant binding measures governing bycatch.	0

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

NASCO Parties contribute to surveillance activities for illegal fishing for salmon in international waters in the Convention Area. No sightings of vessels fishing for salmon by non-Parties have been made since the early 1990s (NASCO, 2012b).

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.8-7, A1.8-9, and A1.8-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

There are no relevant binding measures.

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

Re (iii), the NASCO Convention requires Parties to submit to the Council an annual statement on the imposition of penalties for violations of NASCO binding measures (NASCO, 1983 [Article 14(2)]). NASCO has not prescribed that Parties employ specific enforcement and prosecution processes nor that they assess specific penalties for identified infractions.

The NASCO Council's *Guidelines for the Preparation of Implementation Plans and for Reporting on Progress* calls for Parties to report to the Council on their implementation of their Implementation Plans in two formats: written annual reports and focus area reports (FARs). NASCO Parties submitted final Implementation Plans in 2007, and they are intended to apply for at least five years (NASCO, 2011d). The main purpose of Annual Reports is to provide a summary of all the actions that have been taken under the Implementation Plan in the previous year., as well as any significant changes to the status of stocks, factors affecting stocks and the management regime in place (NASCO, 2011d). FARs are expected to provide a more in-depth assessment of actions taken under one of NASCO's three Focus Areas (salmon fisheries management, salmon habitat protection and restoration, salmon aquaculture and related activities), providing the basis for review of management actions taken by each Party over more than one year to meet the objectives of the Implementation Plan and their efficacy in addressing NASCO objectives (NASCO, 2011d).

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

There are annual reports on enforcement of regulatory measures. In relation to salmon fishing, the Parties report to NASCO on the level of unreported catches and

through their Implementation Plan the jurisdictions report on the enforcement measures in place and measures taken to minimise unreported catch.

- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

NASCO has no binding measures on bycatch, including discarded catch.

A1.9. North East Atlantic Fisheries Commission (NEAFC)

SUMMARY	
Criteria Suite Scores	
Overall	22 (± 8 SD of the mean)% ¹
Criterion 1. Data Collection	11% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	16%
Criterion 1B. Regional Observer Coverage Rates	9%
Criterion 1C. Regional Observer Programme Dataset Quality	9%
Criterion 2. Open Access to Regional Observer Programme Datasets	0%
Criterion 3. Ecological Risk Assessment	25%
Criterion 4. Conservation and Management Measures	22% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	44%
Criterion 4B. Conservation and Management Measures to Govern Bycatch in Lost, Abandoned and Discarded Gear	21%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	0%
Criterion 5. Surveillance and Enforcement	50%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The North East Atlantic Fisheries Commission (NEAFC) was established by the Convention on Future Multilateral Cooperation in North-East Atlantic Fisheries, which was opened for signature in 1980 and entered into force in 1982 (NEAFC, 2007, 2008a).

MEMBERSHIP

Current Contracting Parties are Denmark (in respect of the Faroe Islands and Greenland), European Union, Iceland, Norway, and Russian Federation. Cooperating Non-Contracting Parties are Belize, Canada, Cook Islands, Japan and New Zealand (NEAFC, 2011a).

MANAGED SPECIES AND FISHERIES

The Commission covers fishery resources of fish, mollusks, crustaceans, and including sedentary species, of the Northeast Atlantic, excluding, insofar as they are dealt with by other international agreements, highly migratory species and anadromous stocks (NEAFC, 2007). Regulated resources include redfish (*Sebastes mentella*), Norwegian spring spawning herring (Atlanto Scandian) (*Clupea harengus harengus*), blue whiting (*Micromesistius poutassou*), mackerel (*Scomber scombrus*), rockall haddock (*Melanogrammus aeglefinus*) and there are 49 regulated deep-sea species (NEAFC, 2011b). Five main fisheries are: (i) pelagic trawl fishery for redfish; (ii and iii) pelagic mid-water trawl and purse seine fisheries for Norwegian spring spawning herring, blue whiting, and mackerel; (iv) demersal trawl fishery for rockall haddock, and (v) fisheries for deep-sea species (combination of multiple gears, including, for example,

trawl, longline, gillnet, tangle net), defined as fisheries occurring in depths greater than 400m (NEAFC, 2008a).

AREA OF APPLICATION

Fig. A1.9-1 shows NEAFC’s Convention Area, defined as the waters within those parts of the Atlantic and Arctic Oceans and their dependent seas that lie north of 36°N and between 42°W and 51°E, within that part of the Atlantic Ocean north of 59°N and between 44°W and 42°W. The Baltic Sea and the Belts and the Mediterranean Sea and its dependent seas are excluded from the Commission’s area of competence (NEAFC, 2008a). This area of competence coincides with most of FAO Statistical Area 27. A Regulatory Area is also delineated, which includes four areas of international waters that occur within the NEAFC’s Convention Area. Some NEAFC measures apply to the entire Convention Area, others just to the Regulatory Area.

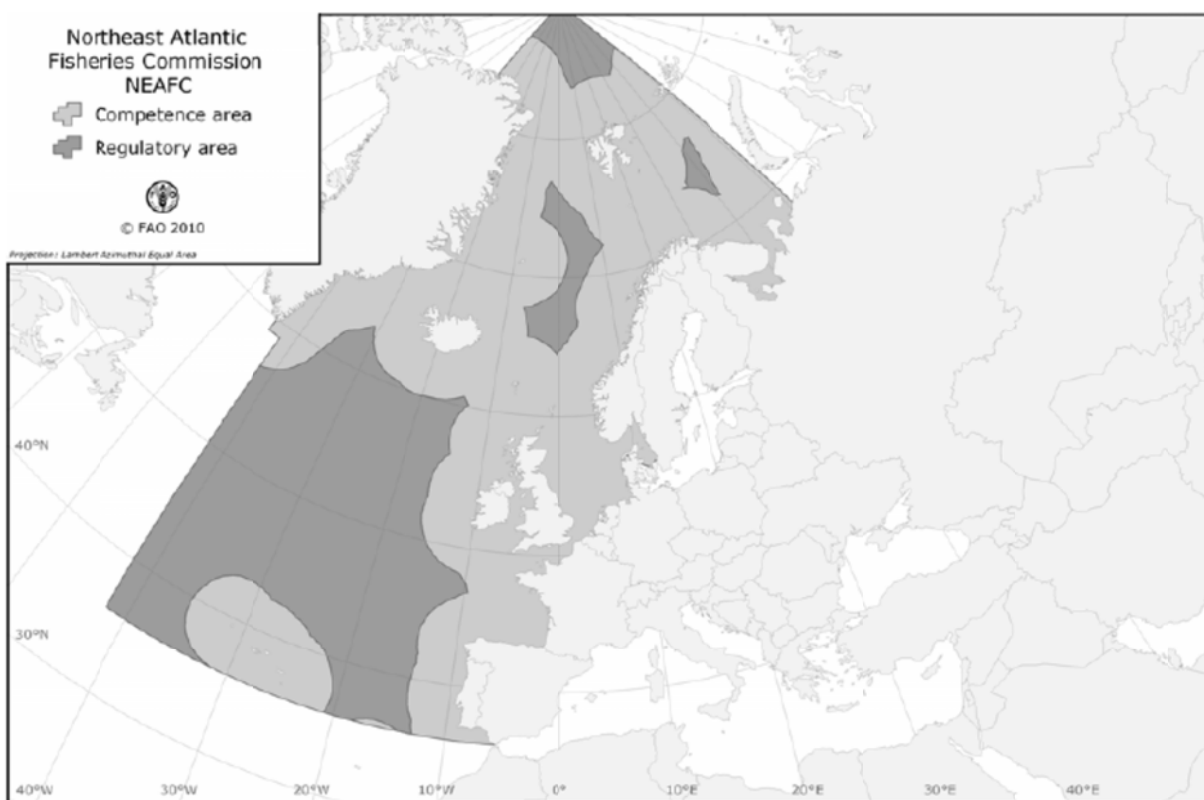


Fig. A1.9-1. NEAFC convention and regulatory areas (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH, INCLUDING DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries

Score: 4 of 25 possible points, 16%.

Table A1.9-1 provides details on the assessment outcome for criterion 1A.

Table A1.9-1. Assessment of NEAFC regional observer programme data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are included in the RFMO's mandate.	1
Data for at least 1 individual bycatch species or group but $\leq 50\%$ of documented vulnerable bycatch species are intended to be collected in fisheries with regional observer coverage.	1
At least one item of information but $\leq 50\%$ of the items of information needed to assess performance standards of relevant binding conservation and management measures is intended to be collected by regional observers.	1
Data records are intended to be to the species-level for at least 1 bycatch species but $\leq 50\%$ of documented vulnerable bycatch species in fisheries with regional observer coverage.	1

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

Yes, Article 4(c) of the Convention accounts for, "the impact of fisheries on other species and marine ecosystems", (NEAFC, 2007).

- In fisheries required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

40%. Data for 2 bycatch species groups (live corals and sponges) but not for seabirds, sharks or marine mammals, is collected in the one fishery with required regional observer coverage. Data on bycatch and discards are not routinely collected or reported in any of the NEAFC-managed fisheries, except for bycatch of live corals and sponges in exploratory bottom fishing (but not likely in bottom fishing in existing areas) (NEAFC, 2008a, 2011c). NEAFC (2011d) requires reporting of monthly and annual summary statistics of catches for specific species. Vessels operating in the Regulatory Area are required to record, "the amount of fish discarded," (NEAFC, 2011b), presumably in logbooks. Data collection protocols for observers onboard bottomfish vessels conducting exploratory fishing have been adopted, which includes recording and reporting all species caught, and collecting information on, "evidence of VMEs and the presence of vulnerable marine species", where "The recording/reporting of catch shall be sufficiently detailed to conduct an assessment of activity, if required" (Hoydal, 2008; NEAFC, 2008b, 2011c). Vessels are to quantify the catch of VME indicator species, and observers are directed to identify corals, sponges and other organisms to the lowest possible taxonomic level (NEAFC, 2009b).

- Does the RFMO's data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely

collected?

Data collection protocols for observers of exploratory bottom fishing fisheries do not call for regular collection of data on catches of live corals, sponge or other vulnerable species (NEAFC, 2008b). No information was identified calling for data collection on sharks, seabirds or marine mammal catches. Bottom fishing vessels categorized as conducting exploratory fishing (fishing in new areas and/or employing new gear, conduct, or technology) are required to have an observer onboard, in order to collect information needed to assess ecological risks to Vulnerable Marine Ecosystems (NEAFC, 2008b, 2011c). A NEAFC “Interim Vulnerable Marine Ecosystem (VME) Data Collection Protocol” for observers on bottom fishing vessels requires the collection of information on all caught species, including vulnerable species ([Annex 2] 2008b, 2011c). NEAFC (2011g,i) explains that catch rates of basking sharks and porbeagle are not available, suggesting that records of discards of these and other unmarketable species are not collected and/or reported. Given the available information identified, it is not clear if records of levels (number and/or weight) of bycatch and discards are recorded.

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).

Refer to Tables A1.9-7, A1.9-9, and A1.9-11. There is one measure with measurable performance standards, where information on the catch weight of live coral and sponge for all sets and an authorized vessel list is required for assessment of performance.

- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected in the regional observer programme according to the RFMO’s data collection protocols?

50%. None of the requisite information is routinely collected in bottom fishing fisheries occurring in existing areas, and all of requisite information is collected in exploratory bottom fishing fisheries. The VME encounter threshold is applicable in existing and new bottom fishing areas, however, regional onboard observer coverage is prescribed only for exploratory fisheries, and not for bottom fishing in existing areas, or for other fisheries.

- Does the information intended to be collected by onboard observers per the RFMO’s data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?

Information was not identified to determine if Contracting Parties have been collecting and reporting retained and discarded non-target catches in bottom fishing fisheries.

- Does the RFMO’s protocol for observer data collection call for the routine collection of information on fishing effort?

No, fishing effort is not identified as a required component of information collected and reported for exploratory bottom fishing fisheries, which is the one component of a managed fishery required to have onboard observers (NEAFC, 2008b, 2011c).

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely collected by observers of the regional observer programme?

None. Data collection protocols for the regional observer programme for exploratory bottom fishing fisheries do not require the collection of information on discarding vs. retention of non-target species (NEAFC, 2008b, 2011c).

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

No, data collection protocols for the regional observer programme for exploratory bottom fishing fisheries do not require the collection of information on the date and location of fishing operations (NEAFC, 2008b, 2011c). When a Vulnerable Marine Ecosystem encounter occurs, observers are directed to the date and position coordinates for that set, but, based on a review of the data collection protocol, this information is not routinely collected (NEAFC, 2008b).

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to record at the species level?

40%. Information on catches of live corals and sponges is collected by observers in exploratory bottom fishing fisheries. No information was identified calling for data collection on sharks, seabirds or marine mammal catches.

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is intended to be routinely collected by regional observers that provides a proxy for age class, identify the measurement method.

0%. No information was identified calling for data collection on sharks, seabirds or marine mammal catches, including length frequency. No information was identified for data collection to estimate the age of live coral or sponge colonies.

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

0%. No information was identified on the collection of information on discarded catch, or the disposition of discards, by observers on bottom fishing vessels participating in exploratory fishing (NEAFC, 2008b, 2011c).

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

0%. Observer data collection protocols in exploratory bottom fishing fisheries do not stipulate the collection of information on terminal tackle attached to discards (NEAFC, 2008b, 2011c).

Criterion 1B. Regional Observer Coverage Rates

Score: 1 of 11 possible points, 9%.

Table A1.9-2 provides details on the assessment outcome for criterion 1B.

Table A1.9-2. Assessment of NEAFC onboard observer coverage rates to monitor bycatch, including discards.

Factor	Points for positive response
At least one but <25% of active managed fisheries (fisheries covered by the RFMO) have $\geq 5\%$ regional onboard observer coverage.	1

Information used for assessment:

- What recommendations on regional observer coverage rates have the RFMO’s scientific body or the Commission made for fisheries under the RFMO’s mandate?

No recommendations for onboard observer coverage rates were identified by ICES, NEAFC Secretariat or other body.
- Does a regional observer programme exist?

The NEAFC requires onboard observer coverage only of exploratory bottom fishing fisheries (NEAFC, 2008b, 2011c).
- What are regional onboard observer coverage rates in each active fishery managed by the RFMO?

No information was identified documenting onboard observer coverage rates in any NEAFC-managed fisheries.
- If there have been recommendations for onboard observer coverage rates by the RFMO’s scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body’s recommendations? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

No recommendations for onboard observer coverage rates were identified by ICES, NEAFC Secretariat or other body.

- For each fishery under the RFMO’s mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

Observers are assigned by Contracting Parties (NEAFC, 2008b).

Criterion 1C. Regional Observer Programme Dataset Quality

Score: 1 of 11 possible points, 9%.

Table A1.9-3 provides details on the assessment outcome for criterion 1C.

Table A1.9-3. Assessment of NEAFC observer programme data quality.

Factor	Points for positive response
A regional observer programme database with records of bycatch does not exist.	0
All countries with fisheries under the RFMO’s mandate are Members or Cooperating Non-Members.	1

Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include records on bycatch?

Bottom fishing vessels categorized as conducting exploratory fishing (fishing in new areas and/or employing new gear) are required to have an observer onboard, in order to collect information needed to assess ecological risks to Vulnerable Marine Ecosystems (NEAFC, 2008b, 2011c). However, no information on the existence of a regional database of records collected by onboard observers in this one NEAFC-managed fishery was identified.

ICES maintains a regional observer programme database; ICES provides scientific advice to NEAFC under a MoU (NEAFC, 2008a). Information was not identified to determine if the one NEAFC-managed fishery with regional onboard observer coverage contributes data on bycatch and discards to ICES or other regional database.

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties’ vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

No information on the pooling of data collected by national onboard observers in NEAFC-managed fisheries was identified.

Except for logbook records, only landings data are available, in some cases representing estimates, and data on discards and landings of some non-regulated species are typically not available (NEAFC, 2008a). NEAFC compiles provisional data on monthly reported landings, as provided by Contracting Parties, including records for some non-regulated species (NEAFC, 2008a). NEAFC does not compile information on effort, but fishing effort information is provided to International Council for the Exploration of the Seas (ICES) by Flag States (NEAFC, 2008a). ICES is a Regional Fishery Body that provides scientific advice to NEAFC (NEAFC, 2008a). In the Norwegian spring spawning herring fishery, NEAFC (2008a) reports that there are no available data on levels of discards of target species. Estimates of discarding due to high-grading are also not available from most Parties for mackerel fisheries (NEAFC, 2008a).

- What is the length in years of the regional observer programme dataset?

No information on the existence of a regional database containing data collected by onboard observers in NEAFC-managed fisheries was identified.

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

Onboard observers are required on vessels that are participating in exploratory bottom fishing fisheries (NEAFC, 2008b, 2011c), interpreted to mean that 100% onboard observer coverage is required in exploratory bottom fishing fisheries. However, no information on the existence of a regional database containing data collected by onboard observers in NEAFC-managed fisheries was identified, and thus it was not possible to confirm if Contracting Parties have been complying with the requirement, and if data collection has been balanced by season.

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

No information on the existence of a regional database containing data collected by onboard observers in NEAFC-managed fisheries was identified, and thus it was not possible to confirm if Contracting Parties have been complying with the requirement, and if data collection has been balanced across fishing grounds of the exploratory bottom fishing fishery.

- Which countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members?

All countries with NEAFC-managed fisheries are Members.

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

The requirement for onboard observer coverage is limited to exploratory bottom fishing; vessels in this fishery operating in existing grounds are exempt from the requirement to have an onboard observer (NEAFC, 2008b, 2011c).

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

Data on bycatch and discards are typically not collected and/or reported (NEAFC, 2008a). Individual vessels are required to report to ICES, however, NEAFC (2008a) reports that individual vessels do not always file reports, and there is substantial IUU fishing in some of the NEAFC-managed fisheries. No information was identified on the proportion of vessels in fisheries managed by NEAFC that did not follow prescribed reporting requirements.

Criterion 2. Open Access to Bycatch Data

Score: 0 of 15 possible points, 0%.

Table A1.9-4 provides details on the assessment outcome for criterion 2.

Table A1.9-4. Assessment of NEAFC provision of open access to a regional observer programme datasets.

Factor	Points for positive response
There is no regional observer programme dataset containing records of bycatch and discards.	0

Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

Bottom fishing vessels categorized as conducting exploratory fishing are required to have an observer onboard (NEAFC, 2008b, 2011c), however, no information on data collected by onboard observers in NEAFC-managed fisheries was identified, and no information on whether data collected by onboard observers in this NEAFC-managed fishery are included in a regional database.

ICES open access datasets contain information primarily on principal market species, with nominal information on catches of non-target retained species, and no information on discards (ICES, 2010a,b). No information was identified on the source of the amalgamated ICES regional datasets, i.e., whether these are derived from logbooks, observations of landings, or via onboard observers, or from which individual fisheries the data are pooled. Catch statistics are also available via the NEAFC website (<http://www.neafc.org/catch>), by regulated species, by ICES area, by country, from 2000-2009, but no information on catches of non-target species are provided, and it is not documented whether or not amalgamated records are derived from onboard observers.

- What confidentiality rules have been adopted on access to data on bycatch, including discards, that the RFMO owns or holds as a custodian?

The ICES data access policy does not include confidentiality restrictions (ICES, 2006). No information was identified related to data confidentiality measures or policy adopted by the NEAFC.

- Are primary or amalgamated data collected in the regional observer programme made available as an open public resource?

ICES provides a public portal to amalgamated data (ICES, 2010a,b).

- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤ 5 degree cells, >5 degree cells, or is information on resolution of records in the publically available dataset not specified?

ICES provides catch statistics from 1903-2009, with summary statistics available by country, year, catch levels by principal market species (live weight equivalent of landings, discards excluded) amalgamated by ICES statistical area. The dataset spatial resolution is >5 degree cell (ICES, 2010a,b). It is not clear if any of the records comprising the amalgamated summary statistics are derived from onboard observers versus other sources (e.g., logbooks, survey data).

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

It was not possible to confirm if a regional dataset includes records from the one NEAFC-managed fishery required to have onboard observers. There is no information on discards and nominal information on catches of bycatch species. Amalgamation precludes most research applications.

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

No information on the existence of a regional database containing data collected by onboard observers in NEAFC-managed fisheries was identified, and thus it was not possible to determine if there is open access to observer data collected from NEAFC-managed fisheries.

Criterion 3: Ecological Risk Assessment

Score: 2 of 8 possible points, 25%.

Table A1.9-5 provides details on the assessment outcome for criterion 3.

Table A1.9-5. Assessment of NEAFC ecological risk assessment.

Factor	Points for positive response
Level 2 and/or 3 assessment has been conducted for either the effects of fishing on bycatch species or the effects of bycatch removals on the integrity of the ecosystem, but not both, for at least 1 fishery.	2

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

NEAFC has identified “Vulnerable Marine Ecosystems”, resulting in the adoption of area closures and bans on certain gear types in designated areas in order to mitigate bycatch of juvenile fish and avoid degradation of sensitive habitat, (Hoydal, 2009). The process employed to identify VMEs constitutes a Level 2 assessment of ecological risk for the effects of bottom fishing on bycatch species and habitat. NEAFC plans to continually conduct assessments of effects of bottom fishing on vulnerable marine ecosystems in the Convention Area (NEAFC, 2008b, 2011c). Live coral and sponge catch limits per set and move-on provisions have been adopted, where these two species groups are employed as indicators for possible identification of Vulnerable Marine Ecosystems (NEAFC, 2009b, 2010d).

Environmental impact assessment of deep sea fisheries in existing fishing grounds was explicitly exempted from NEAFC procedures and rules to assess the potential for significant adverse impacts of bottom fishing in new areas on vulnerable marine ecosystems, and impacts from fisheries employing significant changes in gear and technology (NEAFC, 2010a,c). Ecological risk assessment focus has been on identifying Vulnerable Marine Ecosystems as a precursor to determining if deep sea fishing activities are likely to cause significant adverse impact, to determine if areas where bottom fishing does not currently occur should be closed from expansion of fishing grounds (FAO, 2009d; NEAFC, 2010a). Stock assessment findings are understood to have high uncertainty due to, “problems with data from fisheries (dubious catch data, lack of discard data)”, (Hoydal, 2008).

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

Ecological risk assessments for the effects of bottom fishing have been conducted, but not for other NEAFC-managed fisheries.

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

NEAFC (2008a) and Hoydal (2008) identified the potential for high levels of shark bycatch in managed fisheries, and in deep-sea fisheries shark catch levels are

hypothesized to be unsustainable, however, the basis for this hypothesis was not explained. Bycatch of seabirds and marine mammals occur in deep sea fisheries (Hoydal, 2008). Norwegian spring-spawning herring are understood to have a disproportionate role in ecosystem regulation, such that overexploitation of target and non-target age classes of this species could result in adverse ecosystem-level effects (NEAFC, 2008a). Non-target catches of live corals and sponges occurs in demersal gears that come into contact with the seafloor (Hoydal, 2008). Bycatch of marine mammals in pelagic trawl and gillnet fisheries, seabirds in demersal longline fisheries, and sharks in various gear types of the North-East Atlantic has also been documented (Perrin et al., 1994; Brothers et al., 1999; Morizur et al., 1999; Dunn and Steel, 2001; MacAlister Elliott and Partners, 2003; Lewison et al., 2004). NEAFC has adopted procedures and rules to assess the potential for significant adverse impacts of bottom fishing in new areas on vulnerable marine ecosystems, and impacts from fisheries employing significant changes in gear and technology, but due to a lack of information, plans more thorough ecological risk assessment as more information becomes available (NEAFC, 2010a,c).

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch
Score: 8 of 18 possible points, 44%

Table A1.9-6 provides details on the assessment outcome for criterion 3.

Table A1.9-6. Assessment of NEAFC conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
One or more bycatch problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in place to mitigate at least one identified problem but <50% of the number of identified problems.	1
At least one but <50% of binding measures to mitigate bycatch include measurable performance standards.	1
All binding bycatch measures that contain performance standards have been determined to be effective in meeting the stipulated performance standards.	3
Of binding bycatch measures that contain quantitative performance standards, $\geq 75\%$ of the measures have been assessed for efficacy.	3

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.

NEAFC's ecological risk assessment processes employs the bycatch of live coral and sponge in demersal bottom fishing fisheries as indicators for possible identification of Vulnerable Marine Ecosystems (NEAFC, 2009b, 2010d).

- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and

the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

Problematic shark, seabird, marine mammal, and sea turtle catches may occur in various gears employed in deep-sea fisheries, with documented bycatch of marine mammals in pelagic trawl and gillnet fisheries, seabirds in pelagic and demersal longline fisheries, and sharks and leatherback sea turtles in various gear types of the North-East Atlantic has also been documented. There is limited documentation of sea turtle (primarily leatherback) bycatch in Northeast Atlantic fisheries, including some gear types managed by NEAFC of trawl, gillnet, purse seine and longline fisheries (Pierpoint and Penrose, 1999; MacAlister Elliott and Partners, 2003).

- Using Table A1.9-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

This information has been recorded in Table A1.9-7.

- From the responses to the first two bullets, list each individual documented bycatch problem.

2 of 2 bycatch problems identified via NEAFC ecological risk assessment are addressed by binding measures. Ecological risk assessment identified problematic bycatch of live coral and sponge in two NEAFC-defined managed fisheries of demersal trawl fishery for rockall haddock, and fisheries for deep-sea species (NEAFC, 2009b, 2010d). Binding measures are in place related to these two identified bycatch problems (Table A1.9-7).

Using the NEAFC-defined five main managed fisheries (NEAFC, 2008a), the following bycatch problems were identified via non-NEAFC-ecological risk assessments:

- (i) Sharks, marine mammals and sea turtles in pelagic trawl fishery for redfish;
- (ii) Sharks, marine mammals and sea turtles in pelagic mid-water trawl for Norwegian spring spawning herring, blue whiting, and mackerel;
- (iii) Sharks, marine mammals and sea turtles in purse seine fisheries for Norwegian spring spawning herring, blue whiting, and mackerel;
- (iv) Sharks in demersal trawl fishery for rockall haddock;
- (v) Sharks, seabirds, marine mammals and sea turtles in fisheries for deep-sea species (combination of multiple gears, including, for example, trawl, longline, gillnet, tangle net), defined as fisheries occurring in depths greater than 400m.

0 of these 14 bycatch problems are addressed in active, binding measures. There is a binding measure addressing only the discard practice for spurdog (spiny dogfish, *Squalus acanthias*) (NEAFC, 2011h).

- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

A total of 2 of the total of 16 bycatch problems summarized in the previous bullet are addressed via binding measures.

- What proportion of binding bycatch measures contain quantitative, measurable performance standards?

1 of 11.

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

1 of 1. The performance standards for catches of live coral and sponge trigger evaluation for the potential designation of new Vulnerable Marine Ecosystems. NEAFC assessment of catches of these indicator species groups has resulted in time/area restrictions.

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

1 of 1. The one measure that contains a performance standard has been used to establish time/area restrictions. However, while full points are awarded, the performance standard does not allow for monitoring effects of demersal fishing on habitat to determine if the outcome of the measure (designation of VMEs) are achieving objectives.

A measure closing 54% of fishable area located between Iceland and the Azores is claimed to contribute to bycatch reduction (NEAFC, 2010a), however, empirical evidence was not identified; for example, it is not known if effort that might otherwise occur in this closed area might result in the same bycatch composition and rates.

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

None of the measures have been identified as lacking in effectiveness. The NEAFC Permanent Committee on Management and Science is tasked with reviewing the effectiveness of management measures (NEAFC, no date). A report from the September/October 2010 meeting of this committee did not include discussion of reviews of the efficacy of NEAFC measures (NEAFC, 2010c).

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is

information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

Yes, under Article 12 of the Convention, Contracting Parties may lodge an objection to proposed binding recommendations, and measures are not binding on these parties (NEAFC, 2007, 2008a). Related, if three or more Contracting Parties object to a recommendation, then the measure is not binding on any NEAFC Party (NEAFC, 2007 [Article 12]). There have been repeated objections to management measures for redfish and mackerel by two Contracting Parties (NEFAC, 2008a).

Table A1.9-7. Active NEAFC legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
None	NA	NA	NA
Sea turtles			
None	NA	NA	NA
Marine mammals			
None	NA	NA	NA
Shark and relatives			
Incidental catches of spurdog (spiny dogfish, <i>Squalus acanthias</i>) are required to be released unharmed to the extent possible (NEAFC, 2011h).	NA – no performance standards are stated	Authorized vessel list Discarding practices for spurdog	d, e
Juvenile and small/undersized target species			
Vessels operating in the Regulatory Area are prohibited from discarding target species (redfish, Norwegian spring spawning herring, blue whiting, mackerel, haddock –	NA – no performance standards are stated	Authorized vessel list Discarding practices by species Location of fishing effort	c, d, e

species listed in Annex I (A) of the NEAFC Scheme of Control and Enforcement (NEAFC, 2010f, 2011b).			
Unmarketable sizes and species of non-target species of fish			
A minimum mesh size of 16mm is required when vessels fish for capelin in the Regulatory Area (NEAFC, 1984).	NA – no performance standards are stated	Gear design Location of fishing effort Target species	a, c, e
A minimum mesh size of 35mm is required when pelagic trawl vessels fish for blue whiting in the Regulatory Area (NEAFC, 1986).	NA – no performance standards are stated	Gear design Location of fishing effort Target species	a, c, e
Other or multiple bycatch species group(s)			
Contracting Parties will develop maps of existing bottom fishing areas. After 1 January 2009, bottom fishing in any new areas or employing new gear are subject to measures stipulated in an Exploratory Bottom Fisheries Protocol, including a requirement to evaluate risks to Vulnerable Marine Ecosystems (NEAFC, 2008b, 2011c). Vessels conducting exploratory fishing are required to have an onboard observer, who is tasked to,	NA – no performance standards are stated	Gear design Authorized vessel list Location of fishing effort Species composition of catch	c, d, e

“Monitor any set for evidence of VMEs and the presence of vulnerable marine species” (NEAFC, 2008b, 2011c).			
For bottom fishing vessels fishing in existing or new areas, an encounter with primary VME indicator species is defined as > 60kg of live coral and/or 800kg of live sponge per set (NEAFC, 2010d). If these thresholds are reached in existing or new fishing areas, the vessel must cease fishing and move at least 2nm from the position (NEAFC, 2009b). If these thresholds are reached in new fishing areas, a temporary closure will apply within a 2 mile radius around the reporting position (NEAFC, 2009b).	Yes, measurable performance standard – TAC for two bycatch species groups	Authorized vessel list Catch weight of live coral and sponge for all sets	c, d, e
Area closures for bottom fishing (NEAFC, 2009a,b; 2010d, 2011j)	NA – no performance standards are stated	Authorized vessel list Location of fishing effort	c, e
With an aim of protecting the target haddock stock, NEAFC established an area closure for all gear types excluding longline in a portion of the Regulatory Area outside of national jurisdiction, valid 2011-2012	NA – no performance standards are stated	Authorized vessel list Location of fishing effort	c, e

(NEAFC, 2011f).			
Two-month-per-year time/area closure in the Regulatory Area for demersal trawl, demersal longline and demersal gillnet fisheries, valid 2010-2012 (NEAFC, 2010g).	NA – no performance standards are stated	Authorized vessel list Location of fishing effort Timing of fishing effort	c, e
Time/area closure in the Regulatory Area for fisheries for redfish, closing the fishery in designated areas for 8.5 months in 2011, and establishing a target species 2011 TAC during the 3.5 month open period (NEAFC, 2011e). Limit of 1% bycatch of redfish in fisheries not targeting this species in ICES Sub-areas I and II (NEAFC, 2011e).	NA – no performance standards are stated	Authorized vessel list Location of fishing effort Timing of fishing effort Redfish target catch weight Ratio of redfish bycatch weight to target catch weight	c, e
Gillnets, entangling nets and trammel nets are prohibited within the Regulatory Area in areas deeper than 200m based on the charted depth (NEAFC, 2006).	NA – no performance standards are stated	Gear Authorized vessel list Location of fishing effort	a, c, e

¹ Active and legally binding NEAFC measures, pursuant to Article 12 of the Convention (NEAFC, 2007), as identified by NEAFC via website (<http://www.neafc.org/current-measures-list>) accessed 15 March 2011.

Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score:3 of 14 possible points, 21%

Table A1.9-8 provides details on the assessment outcome for criterion 3.

Table A1.9-8. Assessment of NEAFC conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
For managed fisheries for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are in place for $\geq 75\%$ of these fisheries.	3
Members can opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

No relevant studies were identified. Ghost fishing by gillnets is hypothesized to be problematic (NEAFC, 2008a).

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

In general, fisheries that employ passive fishing gear (demersal longlines, gillnets) are likely to cause ghost fishing, while purse seine, trawl and other fisheries that employ active gear are less likely to result in ghost fishing (FAO, 2005a). However, ghost fishing has been observed in seine nets (Matsuoka et al., 2005). In conclusion, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in NEAFC-managed fisheries.

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table A1.9-9).

In 2006 NEAFC prohibited fisheries with gillnets, entangling nets and trammel nets in depths below 200 m and introduced measures to remove and dispose of unmarked or illegal fixed gear and retrieve lost gear to minimise ghost fishing (NEAFC, 2011b). Gear used by vessels fishing in the Regulatory Area is required to comply with gear marking requirements (NEAFC, 2011b). Performance standards are not stipulated for these measures.

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

Assuming that ghost fishing is problematic for NEAFC-managed fisheries employing passive gear, which includes several gear types used in fisheries for deep-sea species (one of the five categories of NEAFC-managed fisheries), about 75% of the passive gear types are addressed in the binding measure prohibiting gillnets, entangling nets and trammel nets in waters >200m (but not demersal longline).

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

The measures do not contain performance standards.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

No information was identified on the efficacy of the measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, under Article 12 of the Convention, Contracting Parties may lodge an objection to proposed binding recommendations, and measures are not binding on these parties (NEAFC, 2007, 2008a).

Table A1.9-9. Active NEAFC legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Prohibits fisheries with gillnets, entangling nets and	NA – no performance standards are	Gear type; Authorized vessel list;	a,c,e

trammel nets in depths below 200 m and requires removal and disposal of unmarked or illegal fixed gear and retrieval of lost gear in order to minimise ghost fishing (NEAFC, 2011b).	stated	Location of fishing effort.	
Gear used by vessels fishing in the Regulatory Area is required to comply with gear marking requirements (NEAFC, 2011b).	NA – no performance standards are stated	Authorized vessel list; Gear marking.	a,e

¹ Active and legally binding NEAFC measures, pursuant to Article 12 of the Convention (NEAFC, 2007), as identified by NEAFC via website (<http://www.neafc.org/current-measures-list>) accessed 15 March 2011.

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea

Score: 0 of 14 possible points, 0%

Table A1.9-10 provides details on the assessment outcome for criterion 3.

Table A1.9-10. Assessment of NEAFC conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed fisheries, and no relevant binding measures are in place.	0
Members can opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

No relevant assessments were identified.

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from the these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

No information was identified on risks from pollution from discards from managed fisheries.

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table A1.9-11).

There are no relevant binding measures.

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

No relevant information was identified for managed fisheries documenting problematic pollution, or are identified as being likely to cause problematic pollution, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, under Article 12 of the Convention, Contracting Parties may lodge an objection to proposed binding recommendations, and measures are not binding on these parties (NEAFC, 2007, 2008a).

Table A1.9-11. Active NEAFC legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the

measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	na	na	na

¹ Active and legally binding NEAFC measures, pursuant to Article 12 of the Convention (NEAFC, 2007), as identified by NEAFC via website (<http://www.neafc.org/current-measures-list>) accessed 15 March 2011.

Criterion 5. Surveillance and Enforcement

Score: 10 of 20 possible points, 50%

Table A1.9-12 provides details on the assessment outcome for criterion 3.

Table A1.9-12. Assessment of NEAFC measures and resources for surveillance and enforcement.

Factor	Points for positive response
≥75% of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	4
The RFMO requires parties to report to the RFMO on their enforcement procedures and conclusions.	3
The RFMO has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

There are two schemes for monitoring and control: One scheme is a Control and Enforcement Scheme for Contracting Party fishing vessels operating in the NEAFC Regulatory Area, which includes a satellite-based VMS programme, and port control measures (Hoydal, 2008; NEAFC, 2008a, 2011b). VMS is required for vessels exceeding 20 m between perpendicular or >24 m in overall length that fish in the Regulatory Area (NEAFC, 2008a, 2011b). Any Contracting Party with >10 vessels fishing in the Regulatory Area for regulated stocks should have inspection vessels in the Regulatory Area, or otherwise cooperate with another Contracting Party to jointly operate an inspection vessel (NEAFC, 2008a). Contracting Parties are to notify the NEAFC Secretariat of all fishing vessels authorized to fish in the Regulatory Area, and vessels must employ vessel and gear marking requirements (NEAFC, 2011b). Surveillance and inspection methods, including the process following the detection of infringements, are stipulated in the *Scheme of Control and Enforcement* (NEAFC, 2011b).

A second Scheme promotes compliance by Non-Contracting Party vessels and addresses IUU fishing issues, including the establishment of negative lists (a list of vessels that operated in contravention of Commission regulations is referred to as the 'A' list, while a 'B' list comprises confirmed IUU vessels) and port control measures that regulate the entry and exit of IUU vessels in port (NEAFC, 2008a). Cooperating non-contracting parties are required to notify the NEAFC Secretariat of all fishing vessels authorized to fish in the Regulatory Area (NEAFC, 2011b).

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.9-7, A1.9-9, and A1.9-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

75% of surveillance methods are in use. Dockside inspection, VMS, onboard observers, and vessel list are identified as required surveillance methods for binding measures. Of these, regional onboard observers are not required in all relevant fisheries.

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

No information was identified related to prescribed enforcement procedures or sanctions. Although called for in Articles 15(2) and 16 of the NEAFC Convention (NEAFC, 2007), no mechanism has been established for the regular transmission of information from Contracting Parties on their national measures and decisions (NEAFC, 2008a).

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

Yes. There is a Permanent Committee on Control and Enforcement, tasked, in part, with monitoring, reviewing, and evaluating the effectiveness of implementation of two control and enforcement schemes (NEAFC, 2001, 2008a). Compliance by Contracting Parties and follow up on results of inspections and reported infringements are reviewed by this committee annually, and reported to the NEAFC Commission Annual Meetings (NEAFC, 2008a). NEAFC (2008a) reports that there are typically a small number of reported infringements. Consistent with this claim, NEAFC (2010b), a report of an October 2010 meeting of the Permanent Committee on Control and Enforcement, except for discussions of removing one vessel from the IUU B List, did not identify any reported infractions or enforcement thereof.

- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

Information on the outcomes of detected infringements was not identified (e.g., NEAFC, 2010b).

A1.10. North Pacific Anadromous Fish Commission (NPAFC)

SUMMARY	
Criteria Suite Scores	
Overall	15 (± 6 SD of the mean)% ¹
Criterion 1: Data Collection	1% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	4%
Criterion 1B. Regional Observer Coverage Rates	0%
Criterion 1C. Regional Observer Programme Dataset Quality	0%
Criterion 2. Open Access to Regional Observer Programme Datasets	0%
Criterion 3. Ecological Risk Assessment	25%
Criterion 4. Conservation and Management Measures	20% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	17%
Criterion 4B. Conservation and Management Measures to Govern Bycatch in Lost, Abandoned and Discarded Gear	21%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	21%
Criterion 5. Surveillance and Enforcement	30%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The North Pacific Anadromous Fish Commission (NPAFC) was established by the Convention of Anadromous Stocks in the North Pacific Ocean, which entered into force on 16 February 1993 (NPAFC, 2012a). It replaced the International Convention for the High Seas Fisheries of the North Pacific, which had been in force since 1952 (NPAFC, 2012b). The Convention's broad aim is to promote the conservation of anadromous stocks in the Convention Area.

The NPAFC convention prohibits directed high-seas fishing for North Pacific salmon, and soon after the NPAFC Convention was adopted, successfully ended high seas salmon fishing by the Parties in the North Pacific and reduced to nominal levels illegal trafficking of salmon (NPAFC, 1992, 2010a, 2012a). NPAFC was established primarily to contribute to the United Nations General Assembly 1991 resolution that banned large-scale pelagic drift-net fishing, as directed fishing for salmon in high seas areas of the North Pacific Ocean had been mainly conducted using this gear type (NPAFC, 1992 [Article III]).

The Convention further prohibits the retention of incidentally-caught anadromous fish, and requires that, "fisheries for non-anadromous fish shall be conducted in such times, areas and manners as to minimize the incidental taking of anadromous fish to the maximum extent practicable to reduce such incidental taking to insignificant levels" (NPAFC, 1992). NPAFC Parties are also required to submit scientific research programs involving directed fishing for, or incidental takes of significant levels of, anadromous fish in the Convention Area (NPAFC, 1992).

MEMBERSHIP

NPAFC member States are Canada, Japan, Republic of Korea, Russian Federation and United States of America (NPAFC, 2010a).

MANAGED SPECIES AND FISHERIES

NPAFC-managed species are chum salmon, coho salmon, pink salmon, sockeye salmon, Chinook salmon, cherry salmon, and steelhead trout (NPAFC, 1992, 2012a,c).

The NPAFC Convention does not explicitly identify managed fisheries. As the Convention calls for minimized incidental catch of anadromous fish, this implies that all fisheries occurring in the Convention Area that have incidental catch of anadromous fish are managed under the Convention. Gear types used in commercial fisheries to target salmonids include troll, drift gillnet, and seine nets (Muse, 1999; Beamish et al., 2000; Fukuwaka et al., 2010; North Pacific Fishery Management Council, 2011; Washington State Government, 2012). However, as the NPAFC Convention prohibits directed high-seas fishing for North Pacific salmonids (NPAFC, 1992), there are no legal salmon fisheries managed by NPAFC. Incidental capture of anadromous species occurs predominantly in driftnet, demersal longline (groundfish), and surface and midwater trawl fisheries (NPAFC, 2010a; National Marine Fisheries Service, 2012). Therefore, for the purpose of this performance assessment, NPAFC-managed fisheries are interpreted to include driftnet, demersal longline, and surface and midwater trawl fisheries that occur in the Convention area and that have incidental capture of anadromous species.

AREA OF APPLICATION

The NPAFC Convention Area is defined as the waters of the North Pacific Ocean and its adjacent seas, north of 33°N, beyond 200 nautical miles zones of coastal States (Fig. A1.10-1) (NPAFC, 1992, 2012a). It is understood that activities under the convention, for scientific purposes, may extend further southward in the North Pacific Ocean and its adjacent seas.

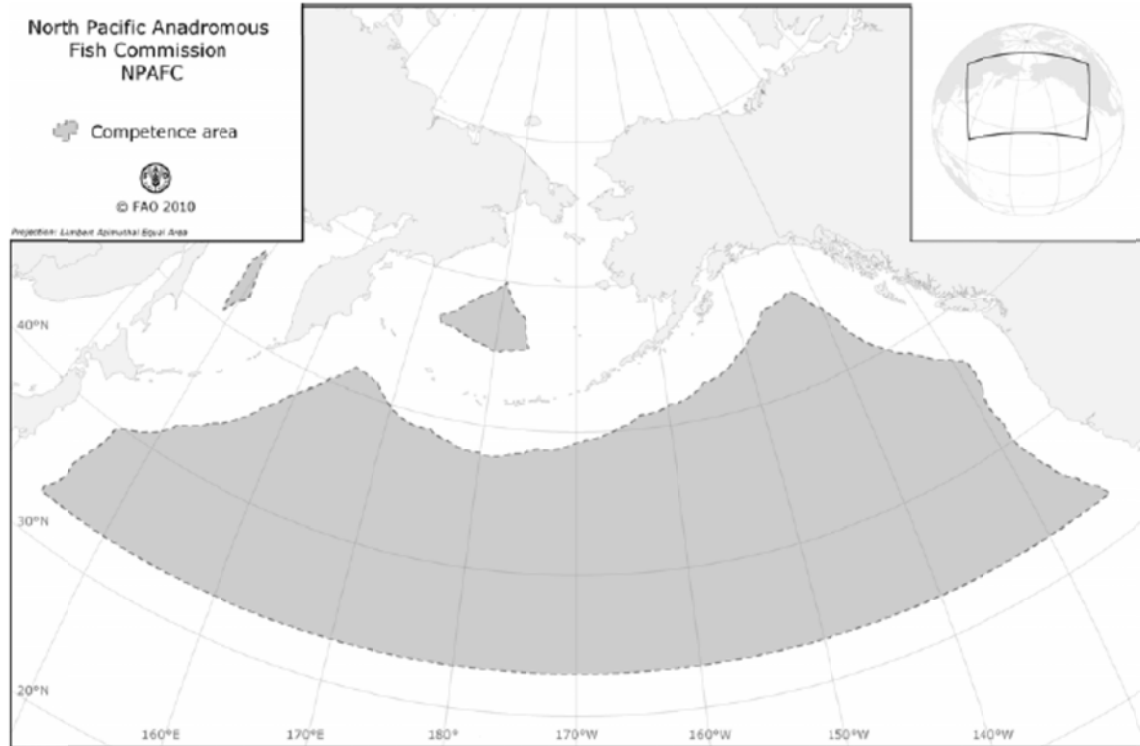


Fig. A1.10-1. NPAFC convention area (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH, INCLUDING DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries

Score: 1 of 25 possible points, 4%.

Table A1.10-1 provides details on the assessment outcome for criterion 1A.

Table A1.10-1. Assessment of NPAFC regional observer programme data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are included in the RFMO's mandate.	1
There is no regional onboard observer coverage of member State fisheries that occur in the Convention area and that have incidental capture of anadromous species.	0

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

Yes. Under the NPAFC Convention, the Commission has the authority to, "recommend to the Parties measures for the conservation of anadromous stocks and ecologically

related species in the Convention Area,” (NPAFC, 1992 [IX(1)]). The terms of reference for the NPAFC scientific body, the Committee on Scientific Research and Statistics (CSRS), require the CSRS to “ensure the availability of scientific information and views on ecologically-related species, including the impact of by-catches in related fisheries of species of concern designated by the Commission” (NPAFC, 2010a).

- In fisheries required to have regional observer coverage, for what proportion do the RFMO’s data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

There is no NPAFC regional observer programme.

A performance review of NPAFC included a recommendation to examine the need for an observer programme of fisheries that have incidental take of salmon (NPAFC, 2010a).

Catch data for bycatch species groups are reported in some annual statistical yearbooks for some NPAFC Parties, but not consistently by species, year, or country. For example, Canada and the U.S. reported bycatch of groundfish, pelagic fish, sharks, skates and dogfish, shrimp, crab, squids, octopus, and other species in directed salmon fisheries in 2009 (NPAFC, 2009).

- Does the RFMO’s data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected?

No, there is no NPAFC regional observer programme.

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).

There are no NPAFC binding measures on bycatch, including discards, in NPAFC-managed fisheries.

- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected in the regional observer programme according to the RFMO’s data collection protocols?

There is no regional observer programme. Information that would need to be collected by regional observers in NPAFC-managed fisheries to assess efficacy of the NPAFC Convention prohibition on the retention of incidentally-caught anadromous fish, minimization of incidental taking of anadromous fish, and effects of managed fisheries on ecologically related species (NPAFC, 1992) is the timing and location of fishing effort in relation to temporal and spatial hotspots of anadromous species bycatch, fishing gear and methods, catch composition, and composition of retained catch. NPAFC relies on members to independently regulate national fisheries. There are no NPAFC requirements for Parties to report salmonid and other bycatch, including discards, and NPAFC Statistical Yearbooks will no longer include reporting of non-anadromous species catches (NPAFC, 2011a). Lacking data on retained and discarded bycatch, NPAFC is unable to assess performance in meeting these three Convention measures.

- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?

There is no regional observer programme, and there are no data collection protocols stipulated in any binding NPAFC measures.

- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?

There is no regional observer programme.

Article VII of the Convention makes it mandatory for member countries to participate in "collecting, reporting and exchanging statistics and biological information, fisheries data, including catch and fishing effort statistics, biological samples and other relevant data," (NPAFC, 1992). Fishing effort statistics are not included in NPAFC annual yearbooks and information on fishing effort is not required to be reported by NPAFC Parties.

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely by observers of the regional observer programme?

None; there is no regional observer programme.

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

No; there is no regional observer programme.

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to record at the species level?

None; there is no regional observer programme.

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is intended to be routinely collected by regional observers that provides a proxy for age class, identify the measurement method.

There is no regional observer programme.

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

There is no regional observer programme. NPAFC does not receive information on discarded catch from NPAFC-managed fisheries.

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear

remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

There is no regional observer programme. NPAFC does not receive information on discarded catch from NPAFC-managed fisheries.

Criterion 1B. Regional Observer Coverage Rates

Score: 0 of 11 possible points, 0%.

Table A1.10-2 provides details on the assessment outcome for criterion 1B.

Table A1.10-2. Assessment of NPAFC onboard observer coverage rates to monitor discards and retained and transshipped bycatch.

Factor	Points for positive response
There is no NPAFC regional observer coverage of NPAFC-managed fisheries (demersal longline, and surface and midwater trawl fisheries that occur in the Convention area and that have incidental capture of anadromous species).	0
NPAFC’s scientific body has not recommended regional onboard observer coverage rates.	0
There is no international exchange of observers in an NPAFC regional onboard observer programme.	0

Information used for assessment:

- What recommendations on regional observer coverage rates have the RFMO’s scientific body or the Commission made for fisheries under the RFMO’s mandate?

The NPAFC Convention calls for the Parties to, “develop appropriate cooperation programs, including scientific observer programs, to collect fishing information in the Convention Area for the purpose of scientific research on anadromous stocks and, as appropriate, ecologically related species,” (NPAFC, 1992 [Article VII(4)]. However, no recommendations have been made by the NPAFC scientific body on observer programs: Discussion on observer programs was an agenda item at the meetings of the NPAFC Committee on Scientific Research and Statistics (CSRS) from 1993 to 1997, but was tabled each year and meeting reports indicated that the topic was “not considered” or “no recommendations were made” (NPAFC, 2010a). While there are no legal directed fisheries for anadromous fish in the Convention Area, there are fisheries that have incidental take of NPAFC-managed species. There are also NPAFC Party scientific research fishing that takes anadromous fish (NPAFC, 2010a). To date there has been no discussion or recommendations by the NPAFC CSRS related to establishing a regional observer program for fisheries that incidentally take anadromous species or for research vessels that take anadromous species (NPAFC, 2010a). However, the NPAFC performance assessment recommended that the Commission examine whether an observer program for fisheries that take salmon incidentally is needed (NPAFC, 2010a).

- Does a regional observer programme exist?

No, there is no NPAFC regional observer programme.

- What are regional onboard observer coverage rates in each fishery managed by the RFMO?

There is no NPAFC regional observer programme.

- If there have been recommendations for onboard observer coverage rates by the RFMO's scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body's recommendations? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

The NPAFC CSRS has not made recommendations related to onboard observer coverage, and there is no NPAFC regional observer programme.

- For each fishery under the RFMO's mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

There is no regional observer programme, and hence no international exchange of observers on NPAFC-managed fisheries (fisheries that occur in the Convention area and that have incidental capture of anadromous species).

Criterion 1C. Regional Observer Programme Dataset Quality

Score: 0 of 11 possible points, 0%.

Table A1.10-3 provides details on the assessment outcome for criterion 1C.

Factor	Points for positive response
A regional observer programme database with records of bycatch does not exist.	0
All countries with fisheries under the RFMO's mandate are not NPAFC Members and there is no NPAFC Cooperating Non-Members status.	0

Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include records on bycatch?

NPAFC Parties provide data to the NPAFC CSRS Working Group on Stock Assessment, which are subsequently published in the NPAFC Statistical Yearbook. Data include information on salmon catches in national waters (there is no legal fishing for salmonids on the high seas in the Convention Area), and data on catches of ecologically-related species has been reported by some Parties, but no data on discards (NPAFC, 2010a). The NPAFC performance assessment reported that lack of a clear definition of which species are included as 'ecologically-related' has resulted in inconsistent reporting by countries (when they are reported (NPAFC, 2010a). However, NPAFC Statistical Yearbooks are to discontinue the inclusion of reporting retained catches of non-anadromous species (NPAFC, 2011a).

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

There is no NPAFC regional observer programme. Country-level data for salmon catches, and in some cases for ecologically related species, outside the convention area are pooled in NPAFC's annual statistical yearbooks (NPAFC, 2010a).

- What is the length in years of the regional observer programme dataset?

0 years: there is no dataset of records collected via a NPAFC regional observer programme.

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

No, as there has been no NPAFC regional onboard observer coverage.

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

No, as there has been no NPAFC regional onboard observer coverage.

- Which countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members?

There are commercial fisheries for Pacific salmon in North Korea domestic waters, but North Korea is not a Party to NPAFC (NPAFC, 2010a). Also, NPAFC has annually issued invitations to China but it has not yet indicated any interest in joining the NPAFC (NPAFC, 2010a). There are also likely several countries that are not States of origin of North Pacific anadromous fish that operate commercial fisheries within the distribution of North Pacific anadromous fish that have incidental catch of

anadromous fish are also not NPAFC members. NPAFC currently does not have a Cooperating Non-Member membership category, however, in 2009, the US delegation proposed its creation, and the other NPAFC Parties indicated a need for time to consider the proposal (NPAFC, 2010a).

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

There is no NPAFC regional onboard observer coverage.

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

There is no NPAFC regional observer programme. Some parties do not routinely report incidental salmonid catches in their North Pacific fisheries to NPAFC (NPAFC, 2010a).

Criterion 2. Open access to bycatch data

Score: 0 of 15 possible points, 0%.

Table A1.10-4 provides details on the assessment outcome for criterion 2.

Table A1.10-4. Assessment of NPAFC provision of open access to regional observer programme datasets.

Factor	Points for positive response
There is no NPAFC regional observer programme or dataset.	0

Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

There is no NPAFC regional observer programme or dataset.

- What confidentiality rules have been adopted on access to data on bycatch, including discards, that the RFMO owns or holds as a custodian?

NPAFC has not adopted confidentiality rules on access to NPAFC-held fisheries data, including data on bycatch (NPAFC, 1992, 2010a,b).

Country-level data for salmon catches, and in some cases for ecologically related species, outside the convention area are pooled in NPAFC’s annual statistical yearbooks (NPAFC, 2010a). An undocumented proportion of these amalgamated records may be from national onboard observer programmes of NPAFC member states. Otherwise, NPAFC does not serve as a custodian for fishery-dependent datasets.

- Are primary or amalgamated data collected in the regional observer programme made available as an open public resource?

There is no NPAFC regional observer programme or dataset.

- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤ 5 degree cells, >5 degree cells, or is information on resolution of records in the publically available dataset not specified?

There is no NPAFC regional observer programme or dataset.

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

There is no NPAFC regional observer programme or dataset.

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

There is no NPAFC regional observer programme or dataset.

Criterion 3: Ecological risk assessment

Score: 2 of 8 possible points, 25%.

Table A1.10-5 provides details on the assessment outcome for criterion 3.

Table A1.10-5. Assessment of NPAFC ecological risk assessment.

Factor	Points for positive response
A partial Level 2 ecological risk assessment has been conducted for the effects of NPAFC-managed fisheries on one bycatch species groups (albatrosses).	2
Ecological risk assessment of broader ecosystem effects of bycatch removals has not been conducted.	0

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

NPAFC has not conducted ecological risk assessments of the effects of NPAFC-managed fisheries on bycatch species vulnerable to overexploitation, or the broader ecosystem-level effects of fishery removals (NPAFC, 2010a,b).

Small (2005) conducted a partial Level 2 risk assessment, by assessing the overlap of 14 RFMO areas with albatross distributions, finding that the NPAFC Convention Area does overlap with the distribution of one or more albatross population, and that NPAFC was not one of the top five RFMOs in terms of overlap with albatross distribution (Small, 2005).

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

NPAFC has not conducted ecological risk assessment of NPAFC-managed fisheries. The NPAFC science plan for 2011-2015 focuses on non-fishing-related threats to the productivity of salmon in the North Pacific Ocean (NPAFC, 2010b).

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

NPAFC has not conducted ecological risk assessment of NPAFC-managed fisheries.

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch

Score: 3 of 18 possible points, 17%

Table A1.10-6 provides details on the assessment outcome for criterion 3.

Table A1.10-6. Assessment of NPAFC conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
One or more bycatch problem has been identified to occur in the three NPAFC-managed fisheries, but no NPAFC binding measures have been adopted.	0
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.

Albatross bycatch may be problematic in some NPAFC-managed fisheries (Small, 2005).

- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

A recommendation resulting from the NPAFC performance assessment was to have the NPAFC Committee on Scientific Research and Statistics investigate whether the incidental take of salmon in North Pacific fisheries is problematic, and if so, make recommendations for mitigation (NPAFC, 2010a, 2011a). This suggests that NPAFC has not determined if incidental bycatch of salmon is problematic. Incidental takes of anadromous species have been reported by some States, including in U.S demersal (groundfish) fisheries (NPAFC, 2010a). NPAFC has not documented bycatch, including discard, problems in NPAFC-managed fisheries operating in the Convention Area. Some research has been done by Member Countries on bycatch and discards of salmonids and/or vulnerable species in the North Pacific. For the most part this research has been conducted outside of the Convention area (personal communication, Nancy Davis, NPAFC, 11 July 2011).

Furthermore, NPAFC has not identified ecologically-related species of concern, and CSRS has not provided recommendations for conservation and management measures for ecologically-related species of concern (NPAFC, 2010a).

NPAFC (2009) identified the incidental catch of elasmobranchs, other pelagic and demersal fish, shrimp, crab, squids, octopus and other fish and invertebrates, in Canada and US directed salmon fisheries. Fukuwaka et al. (2010) documented predominant bycatch species in gillnet and longline salmon fisheries to include Pacific saury (*Cololabis saira*), neon flying squid (*Ommastrephes bartrami*), Pacific pomfret (*Brama japonica*), and Japanese anchovy (*Engraulis japonicus*).

Incidental capture of anadromous species occurs predominantly in driftnet, demersal longline (groundfish), and surface and midwater trawl fisheries (NPAFC, 2010a; National Marine Fisheries Service, 2012). In the North Pacific, some salmon species incidentally caught in these fisheries have endangered subpopulations. For example the sockeye subpopulations of Cultus and Sackinaw are listed as Endangered by the Committee on the Status of Endangered Wildlife in Canada (IUCN, 2011) which also lists pink, chum and coho salmon in BC and the Pacific region as high priority candidates for endangered species designation, as well as steelhead salmon in BC and chinook salmon in BC, the Yukon and Pacific region (COSEWIC, 2011).

Problematic bycatch in gear types employed in NPAFC-managed fisheries has been documented to include:

- Drift gillnet: Sea turtles, elasmobranchs, marine mammals, pelagic and coastal seabirds, waterbirds, unmarketable species and sizes of finfish, salmon and other anadromous fish (Northridge, 1991; Goni, 1998; Melvin and Parrish, 1999; Silvani et al., 1999; Melvin et al., 2001; Uhlmann et al., 2005; Read et al., 2006; Gilman et al., 2009; Kiszka et al., 2009; Zydalis et al., 2009; FAO, 2010a; NPAFC, 2010a; National Marine Fisheries Service, 2012).
- Demersal longline: Elasmobranchs, seabirds, sea turtles, cetaceans, salmon and other anadromous fish (Melvin and Parrish, 1999; Pierpoint and Penrose, 1999; Hall et al, 2000; Melvin et al., 2001; MacAlister Elliott and Partners, 2003; Gilman et al., 2005, 2006a; Petersen et al., 2007; Valenzuela et al., 2008; NPAFC, 2010a; National Marine Fisheries Service, 2012).

- Trawl: Juvenile/undersized fish and shrimp, jellyfish, crabs, seaweed, sea turtles, marine mammals, seabirds, salmon and other anadromous fish (Fertl and Leatherwood, 1997; Goni, 1998; Robbins et al., 1999; Hall et al, 2000; Read et al., 2006; Eayrs, 2007; FAO, 2010a; NPAFC, 2010a; National Marine Fisheries Service, 2012).
- Using Table A1.10-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

NPAFC has not adopted any conservation and management measures (Table A1.10-7). However, the NPAFC Convention prohibits the retention of incidentally-caught anadromous fish, and requires that, “Fisheries for non-anadromous fish shall be conducted in such times, areas and manners as to minimize the incidental taking of anadromous fish to the maximum extent practicable to reduce such incidental taking to insignificant levels” (NPAFC, 1992 [Annex II(1)]). Fishing for scientific research is exempt from these provisions (NPAFC, 1992 [Article iii(2)]). Both Committees on Enforcement and on Scientific Research and Statistics are mandated in the Convention Terms of Reference to make recommendations to the Commission to avoid or reduce incidental taking of anadromous fish in the Convention Area (NPAFC, 1992).

- From the responses to the first two bullets, list each individual documented bycatch problem.

Problematic bycatch in gear types employed in NPAFC-managed fisheries has been documented to include:

- Drift gillnet: Sea turtles, elasmobranchs, marine mammals, pelagic and coastal seabirds, waterbirds, unmarketable species and sizes of finfish, salmon and other anadromous fish
- Demersal longline: Elasmobranchs, seabirds, sea turtles, cetaceans, salmon and other anadromous fish.
- Trawl: Juvenile/undersized fish and shrimp, jellyfish, crabs, seaweed, sea turtles, marine mammals, seabirds, salmon and other anadromous fish.
- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

None, as no NPAFC binding measures have been adopted.

- What proportion of binding bycatch measures contain quantitative, measurable performance standards?

None; no NPAFC binding measures have been adopted. In addition, the NPAFC Convention prohibition on the retention of incidentally-caught anadromous fish does not contain performance standards (NPAFC, 1992 [Annex II(1)])

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

0%; no NPAFC binding measures have been adopted.

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

No NPAFC binding measures have been adopted.

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

None; no NPAFC binding measures have been adopted.

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

No. Decisions of the Commission on all 'important matters' (as determined by any one Party that is a State of origin of anadromous stocks which migrate into the Convention Area) are taken by consensus among all parties that are States of origin of anadromous stocks which migrate into the Convention Area. NPAFC decision on other (non-important) matters are by simple majority of the votes of all Parties casting affirmative or negative votes (NPAFC, 1992 [Article VIII(10)]).

Table A1.10-7. Active NPAFC legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed for Implementation	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
None	NA	NA	NA
Sea turtles			
None	NA	NA	NA
Marine mammals			
None	NA	NA	NA
Shark and relatives			
None	NA	NA	NA
Juvenile and small/undersized target species			
None	NA	NA	NA
Unmarketable sizes and species of non-target species of fish			
None	NA	NA	NA
Other or multiple bycatch species group(s)			
None	NA	NA	NA

Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 3 of 14 possible points, 21%

Table A1.10-8 provides details on the assessment outcome for criterion 3.

Table A1.10-8. Assessment of NPAFC conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
For NPAFC-managed fisheries, there is limited knowledge of the degree of ecological risk from ghost fishing, and no binding measures have been adopted.	0
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

NPAFC has not conducted an assessment of adverse ecological effects of ghost fishing by NPAFC-managed fisheries, and none are planned (NPAFC, 2010a,b).

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

Entanglement of northern fur seals in trawl netting has been documented in areas of Alaska (Fowler, 1987). In general, fisheries that employ passive fishing gear (e.g., pelagic and demersal longlines, gillnets, trammel nets, traps) are likely to cause ghost fishing, while fisheries that employ active gear (e.g., purse seine, trawl) are less likely to result in ghost fishing as the catching process of active gears ceases when the gear is no longer attached to the vessel (NEAFC, 2008a; NAFO, 2008; SEAFO, 2009e; FAO, 2005a, 2010d). However, there are many exceptions to this general rule. For instance, ghost fishing has been observed in seine nets and there is evidence of marine mammal entanglement in trawl net fragments, and coastal habitat degradation from derelict trawl nets (Jones, 1995; Donohue et al., 2001; Matsuoka et al., 2005). Lost and abandoned Fish Aggregating Devices (FADs) used by purse seine vessels have been observed to result in ghost fishing (Chanrachkij et al., 2008; Gilman, 2011).

In conclusion, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in NPAFC’s managed fisheries.

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table A1.10-9);

No NPAFC binding measures have been adopted. However, the NPAFC prohibition of driftnet use in the Convention Area has likely substantially reduced ghost fishing in this area.

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

0%, there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

There are no relevant binding measures in place.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures in place.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

No, the NPAFC Convention does not provide an opt-out provision (NPAFC, 1992 [Article VIII(10)]).

Table A1.10-9. Active NPAFC legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed for Implementation	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	NA	NA	NA

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea

Score: 3 of 14 possible points, 21%

Table A1.10-10 provides details on the assessment outcome for criterion 3.

Table A1.10-10. Assessment of NPAFC conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed fisheries, and no relevant binding measures are in place.	0
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

No relevant assessments have been conducted (NPAFC, 2010a,b).

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from the these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

No information on risks from pollution from discards from managed fisheries was identified.

In general, large inputs of organic matter from discards at sea can increase natural nutrient levels in nutrient-poor benthic ecosystems, and in fisheries where discards are spatially concentrated, and especially in areas of low current flow, may cause localized hypoxia or anoxia of the seabed, which, if prolonged, causes avoidance and mortalities, alters benthic community composition, and alters ecosystem processes and structure (FAO, 1995 [Article 7.2.2g]; Goñi, 1998; Hall et al., 2000; Stevens et al., 2000; Gray et al., 2002; FAO, 2003a,b; Franco et al., 2008; Levin et al., 2009; Haselmair et al., 2010). This is potentially problematic not just for fisheries discharges occurring in coastal areas, but also for fisheries discharges occurring in very deep regions of the ocean, where a large proportion of discharges may settle through the water column without being consumed, altering the benthic

community, and transferring and locking biomass up in bottom currents for centuries before recycling to the euphotic zone of the pelagic ecosystem (Hall et al., 2000).

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table A1.10-11).

There are no relevant binding measures (Table A1.10-11).

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

No relevant information was identified for managed fisheries documenting problematic pollution, or are identified as being likely to cause problematic pollution, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

No, the NPAFC Convention does not provide an opt-out provision (NPAFC, 1992 [Article VIII(10)]).

Table A1.10-11. Active NPAFC legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed for Implementation	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea
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			inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	na	na	na

Criterion 5. Surveillance and Enforcement

Score: 6 of 20 possible points, 30%

Table A1.10-12 provides details on the assessment outcome for criterion 5.

Table A1.10-12. Assessment of NPAFC measures and resources for surveillance and enforcement.

Factor	Points for positive response
NPAFC members are not required to employ surveillance methods necessary to implement a NPAFC Convention ban on retention of anadromous species, and requirement for non-anadromous fish shall be conducted in such times, areas and manners as to minimize the incidental taking of anadromous fish to the maximum extent practicable.	0
NPAFC requires parties to report their enforcement procedures and conclusions.	3
NPAFC does not require parties to take specified enforcement procedures when an infraction of a binding conservation and management measure occurs.	0
NPAFC does not require parties to impose specified sanctions when an infraction of a binding conservation and management measure occurs.	0
NPAFC has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3
There are no NPAFC binding conservation and management measures related to bycatch. NPAFC Parties are obligated to minimise bycatch of anadromous species, but no information on related infringements were identified.	0

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

Under the NPAFC Convention, each NPAFC Party may board and inspect vessels of other Parties which, “can be reasonably believed to be engaged in directed fishing for or incidental taking of anadromous fish,” (NPAFC, 1992 [Article V(2)(a)]).

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.10-7, A1.10-9, and A1.10-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

No NPAFC binding measures have been adopted. Effective surveillance of the NPAFC Convention prohibition on the retention of incidentally-caught anadromous fish, including the requirement that, “Fisheries for non-anadromous fish shall be conducted in such times, areas and manners as to minimize the incidental taking of anadromous fish to the maximum extent practicable to reduce such incidental taking to insignificant levels” (NPAFC, 1992 [Annex II(1)]), would require either VMS or onboard observers to document the timing and location of fishing effort, and depending on the prescribed fishing methods and gear to minimize incidental catch of anadromous fish, would require either dockside or onboard observer coverage. None of these surveillance methods are required to be employed by NPAFC members.

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

NPAFC Party enforcement activities are coordinated through the NPAFC ENFO’s annual Enforcement Evaluation and Coordination Meetings (NPAFC, 2010a). Japan and Russia employ air and at-sea surveillance to patrol their domestic and high seas vessels (NPAFC, 2010a). Canada contributes air surveillance while the United States employs both aircraft and vessels. Korea has yet to participate in enforcement activities in the NPAFC Convention Area (NPAFC, 2010a). Canada, the United States and Japan also monitor satellite imagery (Nancy Davis, personal communication, NPAFC, 11 July 2011).

Related to item (i), the Convention provides the authority for each NPAFC Party to board, inspect and detain fishing vessels of other Parties found operating in violation of the Convention, however, only authorities of the Party to which the violating person or vessel belongs is able to try the offense and assess penalties (NPAFC, 1992 [Article V]). Despite Article IX of the Convention stating that one responsibility of NPAFC is to, “consider and make proposals for the enactment of schedules of equivalent penalties for activities contrary to the provisions of the Convention”, there is no specification of the penalties to be assessed for violations of

the Convention or binding measures, except that imposed penalties shall be commensurate with the seriousness of the infraction (NPAFC, 1992 [Article V]).

Related to item (iii), the NPAFC Convention requires that, “The Parties shall cooperate in the exchange of information on enforcement action regarding anadromous fish taken contrary to the provisions of this Convention, and on the disposition of cases,” and of any, “any directed fishing for and any incidental taking of anadromous fish in the Convention Area by nationals, residents and vessels of any State or entity not party to this Convention,” (NPAFC, 1992 [Article VI(2) and (3)]).

Under the NPAFC Convention, following specified procedures, the Commission can suspend a Party’s fishery if determined to be in violation of the requirement for minimizing incidental capture of anadromous fish by fisheries operating in the Convention Area (NPAFC, 1992 [Annex II(2)]).

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

NPAFC established a Committee of Enforcement, which has as a core function the review and evaluation of the enforcement actions taken by the NPAFC Parties, pursuant to Article IX(5) of the Convention (NPAFC, 1992, 2010a). There is an annual interim enforcement meeting of the Enforcement Evaluation and Coordination Group under the Committee of Enforcement (ENFO) of the Commission. The meeting is held to evaluate, plan and coordinate the enforcement activities of the Commission for the year. However, a performance review critiqued the Committee as having not ever made any substantive recommendations to the NPAFC Commission, rather, the Committee provides a forum for discussion, cooperation and building trust and confidence between national enforcement agencies of the NPAFC Parties (NPAFC, 2010a).

- Is there evidence that detected infringements of the RFMO’s legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

There are no NPAFC binding conservation and management measures related to bycatch. NPAFC Parties are obligated to minimise bycatch of anadromous species, but no information on related infringements were identified (NPAFC, 2010a). While the NPAFC Committee on Enforcement’s mandate includes reviewing and evaluating measures to avoid or reduce incidental taking of salmon, there are no NPAFC binding measures to address this issue. A handful of detections and 18 apprehensions of illegal high seas large-scale driftnet fishing vessels, primarily from China, have been reported by the NPAFC Parties since 1993 (NPAFC, 2010a, 2012d).

A1.11. Regional Commission for Fisheries (RECOFI)

SUMMARY	
Criteria Suite Scores	
Overall	1 (± 1 SD of the mean)% ¹
Criterion 1. Data Collection	4% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	4%
Criterion 1B. Regional Observer Coverage Rates	0%
Criterion 1C. Regional Observer Programme Dataset Quality	9%
Criterion 2. Open Access to Regional Observer Programme Datasets	0%
Criterion 3. Ecological Risk Assessment	0%
Criterion 4. Conservation and Management Measures	0% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	0%
Criterion 4B. Conservation and Management Measures to Govern Bycatch in Lost, Abandoned and Discarded Gear	0%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	0%
Criterion 5. Surveillance and Enforcement	0%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The Regional Commission for Fisheries (RECOFI) was established by the FAO Council in 1999 as an international agreement under the aegis of FAO (Article XIV of the FAO Constitution). The Agreement for the Establishment of the Regional Commission for Fisheries replaced the Committee for the Development and Management of the Fisheries Resources of the Gulfs (referred to as the 'Gulfs Committee'), which was a subsidiary of the now-abolished Indian Ocean Fisheries Commission. The Agreement entered into force on 26 February 2001 (FAO, 1999c; RECOFI, 2009d).

MEMBERSHIP

RECOFI's member States are Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates.

MANAGED SPECIES AND FISHERIES

All fisheries resources in the RECOFI area of competence are under RECOFI's mandate, with the exception of internal waters. In addition to capture fisheries, RECOFI pursues the sustainable development of aquaculture, and a regional aquaculture information system has been developed (Lugten, 2010; RECOFI, 2011a). RECOFI (2008a [Appendix G]) identified the following RECOFI-managed marine capture fisheries as being conducted by member States: trawl shrimp fisheries, trap fisheries for crabs and fishfish, nets and ladle for jellyfish, beach seine fisheries for finfish, gillnet for finfish, driftnet fisheries for finfish, and longlines for finfish

(did not specify if this was demersal or pelagic longline, but assumed to be the latter based on an assessment of tunas being included as identified target species). RECOFI (2008a [Appendix N], 2009b [Table 2]) identified the following as being main target species of marine fisheries in the RECOFI area: Penaeid shrimps, blue swimming crab, Pharaoh cuttlefish, *Stolephorus* anchovies, Indian oil sardine, bludger, Jacks, golden trevally, Indian mackerel, snubnose emperor, pink ear emperor, orangefinned emperor, redspot emperor, spangled emperor, coral hind, coral (bluespotted) grouper, orange-spotted grouper, white-spotted spinefoot, rabbitfish, king (narrow-barred Spanish) mackerel, longtail (tongol) tuna, and requiem sharks.

AREA OF APPLICATION

The RECOFI area of competence consists of the Persian Gulf and the Gulf of Oman, an area that is bounded in the south by the following rhumb lines: from Ras Dhabat Ali in 16°39'N, 53°3'30"E, then to a position in 16°00'N, 53°25'E), then to a position in 17°00'N, 56°30'E, then to a position in 20°30'N, 60°00'E), then to Ras Al-Fasteh in 25°04'N, 61°25'E (Fig. A1.11-1).

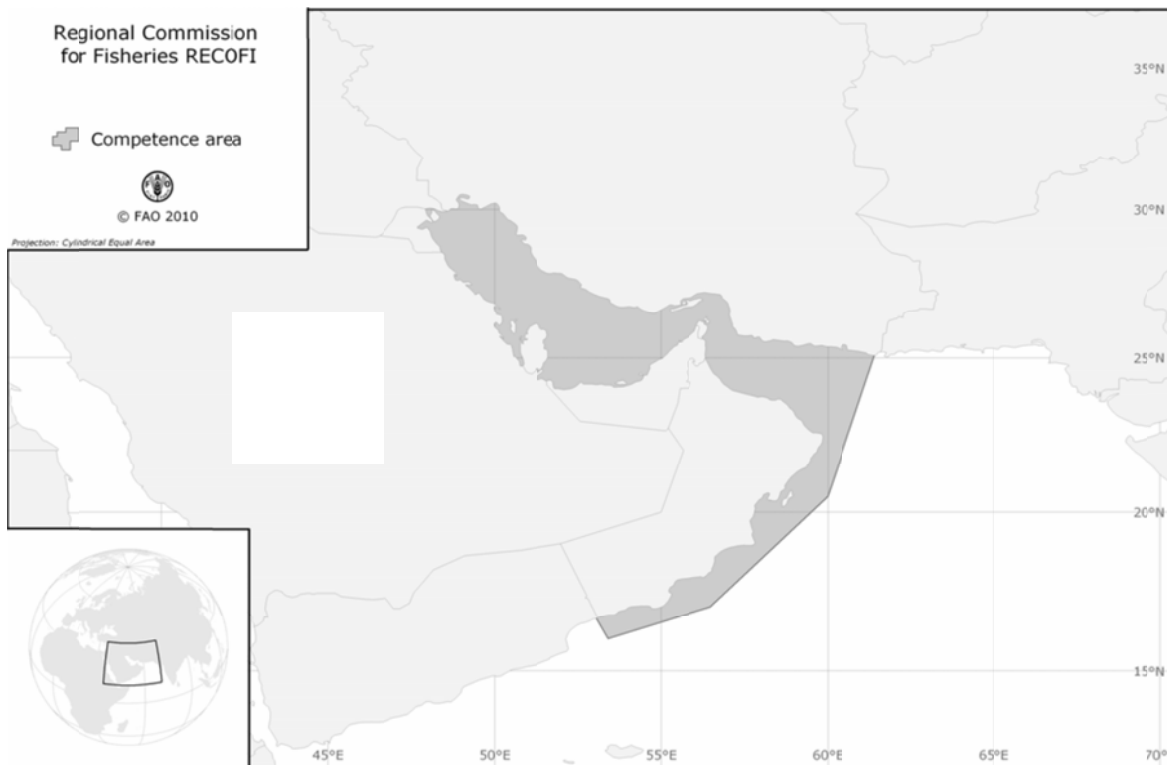


Fig. A1.11-1. RECOFI convention area (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH, INCLUDING DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries
Score: 1 of 25 possible points, 4%.

Table A1.11-1 provides details on the assessment outcome for criterion 1A.

Table A1.11-1. Assessment of RECOFI regional observer programme data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are included in the RFMO's mandate.	1
There is no RECOFI regional observer programme. The RECOFI capture production database does not include records of discarded bycatch, and does not include records of reported landings of non-principal market species.	0
RECOFI has not adopted binding conservation and management measures related to the governance of bycatch, including discarded catch.	0

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

Yes. RECOFI covers all living marine resources, including aquaculture, in the sea area, with the exception of internal waters (RECOFI, 2009d). The RECOFI Working Group on Fisheries Management is responsible for recommendations to RECOFI on the adoption of conservation and management measures to manage and regulate bycatch and discards, including the promotion of gear types to mitigate bycatch and environmental impacts (RECOFI, 2009a).

- In fisheries required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

There is no regional observer coverage of RECOFI-managed fisheries (RECOFI, 2009c,e). RECOFI member States do not have national observer programmes for RECOFI-managed fisheries (RECOFI, 2009e). RECOFI member countries employ census-based methods to collect fisheries data directly from vessel operators as a part of the licensing process, primarily for industrial and semi-industrial fisheries, and employ sample-based methods to collect fisheries data from small-scale fisheries, which tend to be in large numbers and highly spatially dispersed (RECOFI, 2009e). These methods have not provided catch and effort statistics by gear type (RECOFI, 2009e). The RECOFI catch database does not include records of discarded bycatch (RECOFI, 2009b).

- Does the RFMO's data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected?

Not applicable; there is no regional observer programme (RECOFI, 2009e). The RECOFI capture production database includes records for priority species and groups of species identified by the Working Group on Fisheries Management (RECOFI, 2009b), which does not include non-principal market species.

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).

Not applicable; RECOFI has not adopted measures related to bycatch and discards.

- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected in the regional observer programme according to the RFMO's data collection protocols?

Not applicable; RECOFI has not adopted measures related to bycatch and discards.

- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?

Not applicable; RECOFI has not adopted measures related to bycatch and discards.

- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?

There is no regional observer programme (RECOFI, 2009e). RECOFI (2008a) reported plans to expand the existing RECOFI database for capture fisheries to include information on fishing effort, suggesting that this information had not previously been routinely included in the database.

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely by observers of the regional observer programme?

Not applicable; there is no regional observer programme. The RECOFI catch database does not include records of discarded bycatch (RECOFI, 2009b).

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

Not applicable; there is no regional observer programme.

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to record at the species level?

Not applicable; there is no regional observer programme. The RECOFI capture production database includes records for priority species and groups of species identified by the Working Group on Fisheries Management (RECOFI, 2009b), which does not include non-principal market species.

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is intended to be routinely collected by regional observers that provides a proxy for age

class, identify the measurement method.

Not applicable; there is no regional observer programme. The RECOFI capture production database includes records for priority species and groups of species identified by the Working Group on Fisheries Management (RECOFI, 2009b), which does not include non-principal market species.

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

Not applicable; there is no regional observer programme. The RECOFI capture production database does not include records of discarded bycatch (RECOFI, 2009b).

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

Not applicable; there is no regional observer programme. The RECOFI capture production database does not include records of discarded bycatch (RECOFI, 2009b).

Criterion 1B. Regional Observer Coverage Rates

Score: 0 of 11 possible points, 0%.

Table A1.11-2 provides details on the assessment outcome for criterion 1B.

Table A1.11-2. Assessment of RECOFI onboard observer coverage rates to monitor bycatch, including discards.

Factor	Points for positive response
There is no RECOFI regional observer programme.	0
None of the RECOFI-managed fisheries have $\geq 5\%$ regional onboard observer coverage.	0
The RFMO's scientific body has not recommended target onboard observer coverage rates for any RECOFI-managed fishery.	0
There is no international exchange of observers in a regional onboard observer programme.	0

Information used for assessment:

- What recommendations on regional observer coverage rates have the RFMO's scientific body or the Commission made for fisheries under the RFMO's mandate?

The RECOFI Working Group on Fisheries Management has not made recommendations related to onboard observer coverage rates (RECOFI, 2009a). The Working Group on Fisheries Management is responsible for providing scientific advice to RECOFI, including recommendations on the adoption of conservation and

management measures (RECOFI, 2009a). This working group was established via a 2004 RECOFI decision to rename the Working Group on Statistics to the current title (RECOFI, 2008a). Terms of reference for the new Working Group on Fisheries Management were adopted in 2008 (RECOFI, 2008a).

- Does a regional observer programme exist?

There is no RECOFI regional observer programme (RECOFI, 2009e). RECOFI (2009a) planned to develop a regional prototype database of integrated fishery dependent data. Information was not identified to determine if this database would include records collected by onboard observers. The “Summary Report of Improving the Utility and diffusion of fisheries statistical data among RECOFI Members (RECOFI, 2008a [Appendix E], 2009e) reviewed RECOFI member State national data collection methods, and did not identify the existence of a regional or any domestic onboard observer programmes.

- What are regional onboard observer coverage rates in each active fishery managed by the RFMO?

Not applicable; there is no RECOFI regional observer programme (RECOFI, 2009e).

- If there have been recommendations for onboard observer coverage rates by the RFMO’s scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body’s recommendations? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

Not applicable; there is no RECOFI regional observer programme (RECOFI, 2009e).

- For each fishery under the RFMO’s mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

Not applicable; there is no RECOFI regional observer programme (RECOFI, 2009e).

Criterion 1C. Regional Observer Programme Dataset Quality

Score: 1 of 11 possible points, 9%.

Table A1.11-3 provides details on the assessment outcome for criterion 1C.

Table A1.11-3. Assessment of RECOFI observer programme data quality.

Factor	Points for positive response
A regional observer programme database with records of bycatch does not exist.	0
There is no: (i) regional observer programme database comprised of records pooled from observed national fisheries; nor are (ii) individual national observer programme datasets reported to the RFMO.	0
All countries with fisheries under the RFMO's mandate are Members or Cooperating Non-Members.	1

Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include records on bycatch?

No, there is no regional observer programme coverage of RECOFI-managed fisheries (RECOFI, 2009c,e). A RECOFI capture production database includes records for priority species and groups of species identified by the Working Group on Fisheries Management, and does not include non-principal market species nor records of discarded bycatch (RECOFI, 2009b).

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

There is no regional observer programme dataset for which the RECOFI secretariat serves as custodian, and RECOFI member States do not have national observer programmes (RECOFI, 2009e).

- What is the length in years of the regional observer programme dataset?

Not applicable, there is no regional or national observer coverage of RECOFI-managed fisheries (RECOFI, 2009e).

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

Not applicable, there is no regional or national observer coverage of RECOFI-managed fisheries (RECOFI, 2009e).

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

Not applicable, there is no regional or national observer coverage of RECOFI-managed fisheries (RECOFI, 2009e).

- Which countries with fisheries under the RFMO’s mandate are not Members or Cooperating Non-Members?

All countries in the RECOFI region are members.

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

Not applicable, there is no regional or national observer coverage of RECOFI-managed fisheries (RECOFI, 2009e).

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

Not applicable, RECOFI members do not report observer data to RECOFI (RECOFI, 2009e).

Criterion 2. Open Access to Bycatch Data

Score: 0 of 15 possible points, 0%.

Table A1.11-4 provides details on the assessment outcome for criterion 2.

Table A1.11-4. Assessment of RECOFI provision of open access to a regional observer programme datasets.

Factor	Points for positive response
There is no regional observer programme dataset. A RECOFI capture production database includes records for priority species and groups of species identified by the Working Group on Fisheries Management, and does not include non-principal market species nor records of discarded bycatch.	0

Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

No, there is no regional observer programme dataset for which the RECOFI secretariat serves as custodian, and RECOFI member States do not have national observer programmes (RECOFI, 2009e). A RECOFI capture production database includes

records for priority species and groups of species identified by the Working Group on Fisheries Management, and does not include non-principal market species nor records of discarded bycatch (RECOFI, 2009b).

- What confidentiality rules have been adopted on access to data on bycatch, including discards, that the RFMO owns or holds as a custodian?

Not applicable, there is no RECOFI regional observer programme dataset.

- Are primary or amalgamated data collected in the regional observer programme made available as an open public resource?

Not applicable, there is no regional observer programme or database.

- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤ 5 degree cells, >5 degree cells, or is information on resolution of records in the publically available dataset not specified?

Not applicable, there is no regional observer programme or database.

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

Not applicable, there is no regional observer programme or database.

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

Not applicable, there is no regional observer programme or database. Available fishery-dependent catch and effort data are not collected and reported by individual fishery and gear type (RECOFI, 2009e).

Criterion 3: Ecological Risk Assessment

Score: 0 of 8 possible points, 0%.

Table A1.11-5 provides details on the assessment outcome for criterion 3.

Table A1.11-5. Assessment of RECOFI ecological risk assessment.

Factor	Points for positive response
RECOFI has not conducted ecological risk assessments for the effects of fishing on bycatch species and/or the effects of bycatch removals on the integrity of the ecosystem for managed fisheries. There are tentative plans to conduct an assessment of ecosystem effects of RECOFI-managed shrimp fisheries and to evaluate and promote gear types found to have relatively lower adverse ecosystem effects.	0

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

RECOFI has not implemented an ecological risk assessment for any managed fisheries (RECOFI, 2009a). There are tentative plans to conduct an assessment of ecosystem effects of RECOFI-managed shrimp fisheries and to evaluate and promote gear types found to have relatively lower adverse ecosystem effects (RECOFI, 2011b).

Small (2005) conducted a partial Level 2 risk assessment, by assessing the overlap of 14 RFMO areas with albatross distributions.

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

Not applicable, RECOFI has not conducted an ecological risk assessment for any managed fisheries (RECOFI, 2009a).

Although RECOFI was not included in the Small (2005) assessment, IOTC was, the Convention Area of IOTC overlaps with that of RECOFI, and IOTC was found to have the third highest overlap with albatross distributions of the 14 assessed RFMOs (Small, 2005).

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

Not applicable, RECOFI has not conducted an ecological risk assessment for any managed fisheries (RECOFI, 2009a).

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch
Score: 0 of 18 possible points, 0%

Table A1.11-6 provides details on the assessment outcome for criterion 3.

Table A1.11-6. Assessment of RECOFI conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
No RECOFI binding conservation and management measures have been adopted.	0
There is a provision that allows RECOFI Members to opt out of binding measures.	0

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.

RECOFI has not conducted ecological risk assessments of managed fisheries (RECOFI, 2009a).

- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

The Kuwait intertidal stakenet fishery has been observed to have bycatch of seabirds and the practice of discarding unwanted species (RECOFI, 2003). Regional shrimp trawl fisheries have been documented to have a high ratio of discarded catch to retained catch (highest being 125:1 in Kuwait) (RECOFI, 2003).

RECOFI plans to convene a bycatch reduction and management regional workshop in 2012, likely with a focus on mitigating bycatch in coastal shrimp trawl fisheries (RECOFI, 2011b).

The following problematic bycatch has been documented to occur in the gear types employed by RECOFI-managed fisheries:

- Trawl shrimp fisheries: juvenile fish and shrimp, jellyfish, crabs, seaweed, sea turtles, marine mammals, seabirds (Goni, 1998; Robbins et al., 1999; Read et al., 2006; Eayrs, 2007; FAO, 2010a).
- Trap fisheries for crabs and fishfish: Live coral and sponges, small/unmarketable sizes or sexes of target crabs, non-target crab species, whales (Tallack, 2007; Zollett, 2009; SEAFO, 2009b, 2010d,e).
- Nets and ladle for jellyfish: Seabirds, marine mammals (Goni, 1998; RECOFI, 2003).
- Beach-seine fisheries for finfish: Unmarketable species and sizes of finfish (Hutchings and Lamberth, 2002; Gray and Kennelly, 2003).
- Gillnet for finfish: sea turtles, sharks, marine mammals, coastal seabirds, waterbirds (Melvin et al., 2001; Read et al., 2006; Gilman et al., 2009; Zydalis et al., 2009; FAO, 2010a).

- Driftnet fisheries for finfish: sharks, cetaceans and other marine mammals, seabirds, sea turtles, sharks, unmarketable species and sizes of finfish (Northridge, 1991; Goni, 1998; Silvani et al., 1999; Uhlmann et al., 2005).
- Pelagic longline fisheries for tunas and other pelagic species: sharks, sea turtles, cetaceans, juvenile swordfish, other species of non-targeted fish (not seabirds in lower latitudes) (FAO, 2010a; Gilman, 2011).
- Using Table A1.11-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

Since its establishment, no binding “recommendations” (conservation and management measures) have been adopted by RECOFI (RECOFI, 2011d). A draft binding measure on stock status reporting was proposed at the Fourth Meeting of the Working Group on Fisheries Management, “Draft Recommendation RECOFI/6/2011/1 on Minimum Data Reporting in the RECOFI Area”, which would include species composition of bycatch, including discarded bycatch, in shrimp trawl fisheries, if available, and the amount of discards in other fishing gear types (RECOFI, 2011c [Appendix 4]). RECOFI (2009a) included in a workplan the, “promotion of gear types to mitigate bycatch and ecosystem impacts”.

- From the responses to the first two bullets, list each individual documented bycatch problem.

As there are no RECOFI binding conservation and management measures, none of the identified problematic bycatch and discard problems have been addressed.

- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

No RECOFI binding conservation and management measures have been adopted.

- What proportion of binding bycatch measures contain quantitative, measurable performance standards?

Not applicable, no RECOFI binding conservation and management measures have been adopted.

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

Not applicable, no RECOFI binding conservation and management measures have been adopted.

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

Not applicable, no RECOFI binding conservation and management measures have been adopted.

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

Not applicable, no RECOFI binding conservation and management measures have been adopted.

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

Yes, members are able to opt out of recommendations, in which case the recommendation is not binding upon that member (FAO, 1999c; RECOFI, 2009d). No information was available from the RECOFI website indicating that a RECOFI member has employed the opt out provision.

The legal framework for RECOFI is comprised of the Agreement for the Establishment of the Regional Commission for Fisheries and the Rules of Procedure, which were approved by RECOFI at its First Session in 2001 (RECOFI, 2009d).

Table A1.11-7. Active RECOFI legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
NA – RECOFI has not adopted a relevant binding measure.			
Sea turtles			
NA – RECOFI has not adopted a relevant binding measure.			
Marine mammals			
NA – RECOFI has not adopted a relevant binding measure.			
Shark and relatives			
NA – RECOFI has not adopted a relevant binding measure.			
Juvenile and small/undersized target species			
NA – RECOFI has not adopted a relevant binding measure.			

Unmarketable sizes and species of non-target species of fish			
NA – RECOFI has not adopted a relevant binding measure.			
Other or multiple bycatch species group(s)			
NA – RECOFI has not adopted a relevant binding measure.			

Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 0 of 14 possible points, 0%

Table A1.11-8 provides details on the assessment outcome for criterion 3.

Table A1.11-8. Assessment of RECOFI conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
There are no binding measures to mitigate ghost fishing for managed fisheries, and there is no knowledge of the degree of ecological risk from ghost fishing in managed fisheries.	0
There is a provision that allows RFMO Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

No relevant studies were identified.

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

In general, fisheries that employ passive fishing gear (e.g., pelagic and demersal longlines, gillnets, trammel nets, traps) are likely to cause ghost fishing, while fisheries that employ active gear (e.g., purse seine, trawl) are less likely to result in ghost fishing as the catching process of active gears ceases when the gear is no longer attached to the vessel (NEAFC, 2008a; NAFO, 2008; SEAFO, 2009e; FAO, 2005a, 2010d). However, there are many exceptions to this general rule. For instance, ghost fishing has been observed in seine nets and there is evidence of marine mammal entanglement in trawl net fragments, and coastal habitat degradation from derelict trawl nets (Jones, 1995; Donohue et al., 2001; Matsuoka et al., 2005). Lost and abandoned Fish Aggregating Devices (FADs) used by purse seine vessels have been observed to result in ghost fishing (Chanrachkij et al., 2008; Gilman, 2011).

In conclusion, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in this RECOFI’s managed fisheries.

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any

quantitative performance standards included in each measure (Table A1.11-9);

RECOFI has not adopted any binding measures, including to address ghost fishing.

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

0%, there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures in place.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures in place.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, under the Agreement for the Establishment of the Regional Commission for Fisheries and the Rules of Procedure, RECOFI members can opt out of measures (FAO, 1999c; RECOFI, 2009d).

Table A1.11-9. Active RECOFI legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
NA – RECOFI has not adopted a relevant binding measure.	NA	NA	NA

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea

Score: 0 of 14 possible points, 0%

Table A1.11-10 provides details on the assessment outcome for criterion 3.

Table A1.11-10. Assessment of RECOFI conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed fisheries, and no relevant binding measures are in place.	0
There is a provision that allows RFMO Members to opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

No relevant assessments were identified via materials available from the RECOFI website.

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from the these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

No information was identified on risks from pollution from discards from managed fisheries.

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table A1.11-11).

RECOFI has not adopted any binding measures, including to address pollution from discards.

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem

(fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

No relevant information was identified for managed fisheries documenting problematic pollution, or are identified as being likely to cause problematic pollution, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, under the Agreement for the Establishment of the Regional Commission for Fisheries and the Rules of Procedure, RECOFI members can opt out of measures (FAO, 1999c; RECOFI, 2009d).

Table A1.11-11. Active RECOFI legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
NA – RECOFI has not adopted a relevant binding measure.	na	na	na

Criterion 5. Surveillance and Enforcement

Score: 0 of 20 possible points, 0%

Table A1.11-12 provides details on the assessment outcome for criterion 3.

Table A1.11-12. Assessment of RECOFI measures and resources for surveillance and enforcement.

Factor	Points for positive response
There are no binding measures to govern bycatch, and thus the RFMO does not require member states to employ surveillance methods to implement these measures.	0
RECOFI does not require parties to report to the RFMO on their enforcement procedures and conclusions.	0
RECOFI does not require parties to take specified enforcement procedures when an infraction of a binding conservation and management measure occurs.	0
RECOFI does not require parties parties to impose specified sanctions when an infraction of a binding conservation and management measure occurs.	0
RECOFI has not established a formal procedure to review and assess the effectiveness of surveillance and enforcement activities nor to adapt surveillance and enforcement methods if warranted.	0
Summary information on detected infringements of binding measures are not made available by RECOFI, sanctions have not been prescribed by RECOFI, and RECOFI has not adopted any binding measures.	0

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

No. RECOFI member states are not subject to any binding measures and no information was identified via review of materials available on the RECOFI website indicating that RECOFI members and cooperating non-members are obligated to implement specified surveillance activities. RECOFI (2003) noted the difficulty of implementing VMS in the RECOFI region due to the large number of small vessels. RECOFI (2010 [Appendix 1]) proposed the creation of a record of IUU fishing violations.

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.11-7, A1.11-9, and A1.11-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to

determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

Not applicable, RECOFI has not adopted any binding measures.

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

RECOFI does not require members and cooperating non-members to employ specific enforcement or prosecution procedures, impose specified sanctions in response to identified violations, nor report to RECOFI on these.

RECOFI planned to conduct a review of members' fisheries legislation and fisheries programmes (RECOFI, 2009a), potentially to document compliance with RECOFI measures.

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

RECOFI has not established a compliance committee, and does not have formal procedures in place to review the efficacy of surveillance or enforcement activities.

- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

Not applicable, RECOFI has not adopted any binding measures.

A1.12. South East Atlantic Fisheries Organization (SEAFO)

SUMMARY	
Criteria Suite Scores	
Overall	16 (± 5 SD of the mean)% ¹
Criterion 1. Data Collection	13% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	12%
Criterion 1B. Regional Observer Coverage Rates	0%
Criterion 1C. Regional Observer Programme Dataset Quality	27%
Criterion 2. Open Access to Regional Observer Programme Datasets	0%
Criterion 3. Ecological Risk Assessment	25%
Criterion 4. Conservation and Management Measures	14% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	22%
Criterion 4B. Conservation and Management Measures to Govern Bycatch in Lost, Abandoned and Discarded Gear	21%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	0%
Criterion 5. Surveillance and Enforcement	30%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The Convention on the Conservation and Management of Fishery Resources in the South East Atlantic Ocean was signed on 20 April 2001 by Angola, the European Community, Iceland, Namibia, Norway, Republic of Korea, South Africa, United Kingdom (on behalf of St. Helena and its dependencies of Tristan da Cunha and Ascension Islands) and the United States of America. It entered into force on 13 April 2003 after the deposit of instruments of ratification by Namibia and Norway and approval by the European Community (SEAFO, 2011b). SEAFO is the first RFMO to be modeled on the United Nations Law of the Sea (Article 118) and the United Nations Fish Stocks Agreement (UNFSA), and goes beyond the UNFSA mandate by extending its application to include discrete (non-straddling and non-highly migratory fish stocks) high seas species in its Convention Area (SEAFO, 2010a). States that participated in the negotiations but have not signed the Convention are the Russian Federation and Ukraine (SEAFO, 2011a,b).

MEMBERSHIP

The seven ratified parties to SEAFO are: Angola, European Union, Japan, Korea, Namibia, Norway and South Africa (SEAFO, 2011a).

MANAGED SPECIES AND FISHERIES

The convention covers all fishery resources (fish, molluscs, crustaceans and other sedentary species) within the convention area but excluding: (i) sedentary species subject to fishery jurisdiction of coastal States pursuant to Article 77 paragraph 4 of the UNCLOS, and (ii) highly

migratory species listed in Annex 1 of the UNCLOS (Lugten, 2010). Under Article 6(12) of the Convention, SEAFO excludes coverage of species managed by an existing RFMO; in the case of the SEAFO Convention Area, this applies to species managed by ICCAT and IWC (SEAFO, 2010a). There are 42 species/groups included in the Revised SEAFO Fisheries Resources list (SEAFO, 2011f). The following species are caught by fisheries managed by SEAFO: alfonsino (targeted by bottom trawls), orange roughy (targeted by bottom trawls), tuna and tuna like species (targeted by bottom and pelagic trawls and also bycatch in longlines), deep sea red crab (harvested by pots), deep water shrimps (bycatch in bottom trawls), swordfish, wreckfish, Patagonian toothfish, Argentines, boarfish, grunts (African striped & bigeye), octopus and lobster (SEAFO, 2010a). Of these managed species, SEAFO has adopted TACs for four: Patagonian toothfish orange roughy, alfonsino, and deep-sea red crab (SEAFO, 2010a, 2010f).

SEAFO-managed fisheries are (i) demersal longline Patagonian toothfish fishery (occurs for a few months per year primarily at Meteor and Discovery seamounts as vessels transit to grounds in CCAMLR waters); (ii) deep-sea red crab trap fishery; and (iii) bottom trawl for demersal species including orange roughy, alfonsinos, and deepwater (Lopez-Abellan et al., 2010; SEAFO, 2010a, 2011d). In 2009 fishing capacity under SEAFO management included only four vessels, comprised of two trap fishing vessels for red crabs, and two longline vessels for Patagonian toothfish. This does not include an additional four vessels (two each from Japan and Korea) targeting species subject to SEAFO conservation and management measures, when, in 2009, these countries were not yet SEAFO Parties (SEAFO, 2010a). Pelagic longline for tunas and sharks, purse seine for tunas and sharks, longline for Patagonian toothfish and pelagic sharks, bottom trawl for demersal species including orange roughy, alfonsinos, and deepwater sharks, and pot (trap) fisheries for red crab (*Chaceon* spp.) are fleets that operate in the Convention Area; pole-and-line is an additional gear type employed by vessels included on the SEAFO list of Authorized Vessels (Lopez-Abellan et al., 2010; SEAFO, 2010a, 2011d). Of these, the tuna-targeting vessels are under ICCAT and not SEAFO management. Bottom trawl fishing ceased in 2007 due to low catch rates (SEAFO, 2010a). A trap fishery for spiny lobster *Jasus tristani* at Vema seamount ceased in 2007 when SEAFO created a closed area at the seamount (Lopez-Abellan et al., 2010).

AREA OF APPLICATION

The SEAFO Convention Area comprises all waters beyond areas of national jurisdiction in the area bounded by a line joining the following points along parallels of latitude and meridians of longitude: beginning at the outer limit of waters under national jurisdiction at a point 6°S parallel to the meridian 10°W, thence due north along the 10°W meridian to the equator, thence due west along the equator to 20°W, thence due south along the 20°W meridian to 50°South, thence due east along the 50°S parallel to 30°E, thence due north along the 30°E meridian to the coast of the African continent (SEAFO, 2003 [Article 4]) (Fig. A1.12-1). The SEAFO Convention Area is the high seas area adjacent to the EEZs of the coastal states of Angola, Namibia, South Africa and the United Kingdom (in respect of St. Helena and its dependencies of Accession Islands and Tristan da Cunha) (SEAFO, 2010a).

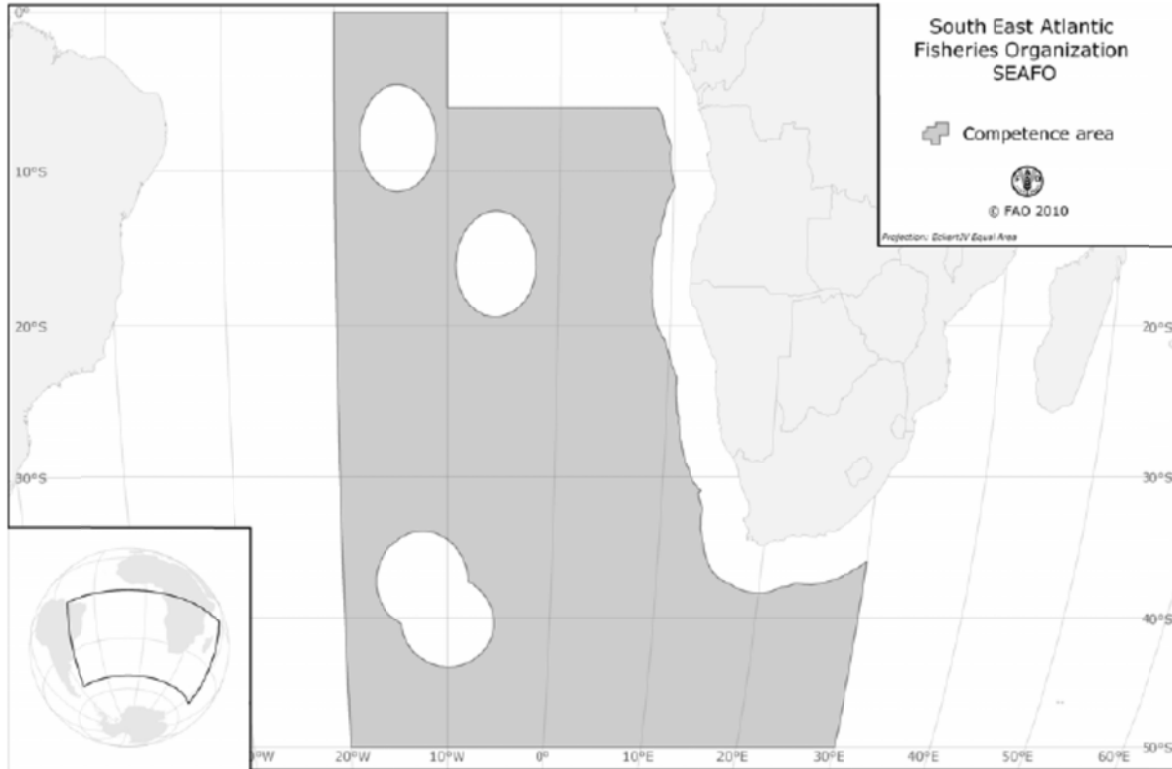


Fig. A1.12-1. SEAFO convention area (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH, INCLUDING DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries

Score: 3 of 25 possible points, 12%.

Table A1.12-1 provides details on the assessment outcome for criterion 1A.

Table A1.12-1. Assessment of SEAFO regional observer programme data collection protocols for bycatch, including discards, and to assess the performance of relevant binding conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are included in the RFMO's mandate.	1
At least one item of information but $\leq 50\%$ of the items of information needed to assess performance standards of relevant binding conservation and management measures is intended to be collected by regional observers.	1
Information on the disposition of discards (e.g., alive vs. dead, and possibly degree of injury) is intended to be collected for sea turtle species.	1

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

Yes, under Article 3(c) and 3(d) of the Convention (SEAFO, 2003 [Article 3(c,d)]).

- Of known bycatch species groups in fisheries that have regional observer coverage, for what proportion are catch data (i.e., data on both retained and discarded non-target species) routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

Although required by a binding measure and prescribed in SEAFO observed data collection forms, no information was found disclosing what data are routinely collected by onboard observers on vessels participating in SEAFO-managed fisheries.

Summarized from the responses to sub-criterion 4A, problematic bycatch species groups in SEAFO-managed fisheries are as follows:

- Demersal longline: Live coral and sponges, seabirds;
- Demersal trawl: Live coral and sponges, seabirds, sea turtles, marine mammals;
- Crab pot: Undersized target species, live coral and sponges, whales.

SEAFO (2006a) requires 100% national onboard observer coverage of all vessels fishing for SEAFO-managed species. In 2008 SEAFO introduced mandatory sampling forms for catches and other fishing details for collection by onboard observers, including discards, benthos, seabirds, and mammals, and that all bycatch data be at a species-level and be collected on a per set basis (SEAFO, 2010a). The forms were first implemented in 2009 (SEAFO, 2010a). In addition, SEAFO (2009b) requires exploratory bottom fishing vessels to implement an authorized, "catch monitoring plan that includes recording/reporting of all species caught," and, "A data collection plan to facilitate the identification of vulnerable marine ecosystems/species in the area fished".

Information on actual observer coverage rates and data routinely collected by onboard observers were not identified. The SEAFO Scientific Committee has identified a lack of compliance in reporting some required information collected via onboard observers (SEAFO, 2009e, 2010a). The Scientific and Compliance Committees' 2010 reports did not address Party compliance with the requirement for 100% national onboard observer coverage (SEAFO, 2010d).

- Does the RFMO's data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected?

SEAFO data forms produced for use by onboard observers call for the collection of data on the weight of discards by species, and weight of birds, mammals, turtles, coral and sponges and length frequency of catch (SEAFO, 2008b,c,d,e). However, no information was identified on observer data collected by member States reported to SEAFO. The SEAFO Scientific Committee identified there being a general lack of compliance in reporting biological information, including length data (SEAFO, 2010a).

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4).

This information has been recorded in Tables A1.12-7, A1.12-9, and A1.12-11. Information required to assess compliance and efficacy of the binding measures are:

- List of vessels authorized to fish in the SEAFO Convention Area;
 - Longline vessel geospatial position;
 - Tori line and line weighting design meeting technical specifications is deployed during setting;
 - Back-up tori lines onboard;
 - Longline vessel offal discard practices during setting and hauling;
 - Hooks removed from discards on longline vessels;
 - Trawl nets cleaned between sets;
 - Sea turtle bycatch events for each set;
 - Condition of turtles upon release;
 - Gear design.
 - Weight of landed shark fins and weight of remainder of shark carcasses.
 - Location of fishing effort.
 - Catch composition (weight of live coral and sponges per set - to identify candidate Vulnerable Marine Ecosystems includes a threshold of 60 kg of live coral and/or 800 kg of live sponge caught per set).
 - Gear type (ban on gillnets).
 - Equipment to retrieve lost gear is onboard;
 - Practices undertaken to retrieve lost gear;
 - Gear markings to trace lost/abandoned gear to the vessel.
- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What percent of required minimum information is not intended to be routinely collected in the regional observer programme according to the RFMO's data collection protocols?

11 of 17 requisite information items are not routinely collected and reported. Of the information needed to assess efficacy of each binding measure, the following information is not routinely collected and reported to SEAFO (SEAFO, 2008b,c,d,e; 2010a):

- Longline vessel geospatial position;
 - Tori line and line weighting design meeting technical specifications is deployed during setting;
 - Back-up tori lines onboard;
 - Longline vessel offal discard practices during setting and hauling;
 - Hooks removed from discards on longline vessels;
 - Trawl nets cleaned between sets;
 - Condition of turtles upon release;
 - Gear design.
 - Weight of landed shark fins and weight of remainder of shark carcasses.
 - Equipment to retrieve lost gear is onboard;
 - Practices undertaken to retrieve lost gear.
- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in

binding conservation and management measures (described in Criterion 4)?

Yes, observer forms prepared by SEAFO (SEAFO, 2008b,c,d,e) meet required observed data collection protocols per SEAFO measures (Tables A1.12-7, A1.12-9, and A1.12-11).

- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?

Information on actual observer coverage rates and data routinely collected by onboard observers were not identified. Although SEAFO measures and SEAFO observer data forms call for the collection of fishing effort, this information has not routinely been reported to SEAFO (e.g., SEAFO, 2009e). The SEAFO Scientific Committee identified there being a general lack of compliance in reporting fishing effort (SEAFO, 2010a). No information was identified on whether or not fishing effort information is routinely collected as a part of individual parties' national onboard observer programmes.

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely collected by observers of the regional observer programme?

Information on actual observer coverage rates and data routinely collected by onboard observers were not identified. The SEAFO Scientific Committee has identified a lack of compliance in reporting some required information collected via onboard observers (SEAFO, 2009e, 2010a).

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

Information on actual observer coverage and data collected by onboard observers was not identified. Although SEAFO measures and SEAFO observer data forms call for the collection of the date and location of fishing effort, this information has not routinely been reported to SEAFO (e.g., 2009 catch positions of crab vessels not reported, SEAFO, 2009e).

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to record at the species level?

Not known. While a binding measure requires the collection of bycatch data to the species level (SEAFO, 2006a), information on data routinely collected by onboard observers was not identified. The SEAFO Scientific Committee has identified a lack of compliance in reporting some required information collected via onboard observers (SEAFO, 2009e, 2010a).

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is intended to be routinely collected by regional observers that provides a proxy for age class, identify the measurement method.

Not known. SEAFO data forms produced for use by onboard observers call for the collection of data on the length frequency of catch (SEAFO, 2008b,c,d,e). However, no

information was identified on observer data collected by member States reported to SEAFO. The SEAFO Scientific Committee identified there being a general lack of compliance in reporting biological information, including length data (SEAFO, 2010a).

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

Member States are required to report sea turtle interactions collected by observers, including the disposition and condition upon release (SEAFO, 2009c). However, no information was identified on observer data collected by member States reported to SEAFO. The SEAFO Scientific Committee identified there being a general lack of compliance in reporting biological information (SEAFO, 2010a).

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

Information on gear remaining attached to discarded vulnerable species in demersal longline Patagonian toothfish fisheries managed by SEAFO is not required to be collected and reported (SEAFO, 2008c).

Criterion 1B. Regional Observer Coverage Rates

Score: 0 of 11 possible points, 0%.

Table A1.12-2 provides details on the assessment outcome for criterion 1B.

Table A1.12-2. Assessment of SEAFO onboard observer coverage rates to monitor bycatch, including discards.

Factor	Points for positive response
No information was identified on national onboard observer coverage rates of SEAFO-managed fisheries.	0
There is no international exchange of observers in the regional onboard observer programme.	0

Information used for assessment:

- What recommendations on regional observer coverage rates have the RFMO's scientific body or the Commission made for fisheries under the RFMO's mandate?

SEAFO (2006a) requires 100% national onboard observer coverage of all vessels fishing for SEAFO-managed species.

- Does a regional observer programme exist?

SEAFO (2006a) requires 100% national onboard observer coverage for SEAFO-managed fisheries. SEAFO established a “scientific observer program” for all vessels fishing in the Convention Area, which calls for the collection of information on all species that are brought onboard (SEAFO, 2010a). However, no information was identified on actual onboard observer coverage of SEAFO-managed fisheries; the SEAFO Scientific Committee has identified a lack of reporting observer data as problematic (SEAFO, 2008f).

- What are regional onboard observer coverage rates in each active fishery managed by the RFMO?

No information was identified on actual national onboard observer coverage rates (SEAFO, 2010a).

- If there have been recommendations for onboard observer coverage rates by the RFMO’s scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body’s recommendations? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

No information on onboard observer coverage rates was identified. With only four active vessels operating in the Convention Area in 2009, high coverage rates are realistic.

- For each fishery under the RFMO’s mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

No. SEAFO measures do not provide for the placement of observers from one Party on vessels of other Parties, although this was called for in the Convention text, Articles 14(3)(g) and 16(3)(c) (SEAFO, 2010a).

Criterion 1C. Regional Observer Programme Dataset Quality

Score: 3 of 11 possible points, 27%.

Table A1.12-3 provides details on the assessment outcome for criterion 1C.

Table A1.12-3. Assessment of SEAFO observer programme data quality.

Factor	Points for positive response
SEAFO Member States are required to place national onboard observers on all vessels participating in SEAFO-managed fisheries, and there is evidence of some collection and reporting of national observer data, which includes information on bycatch, including discards.	1

Individual national observer programme datasets are required to be reported to the RFMO in a standardized format that permits pooling.	1
The regional observer programme dataset is <5 years long.	1

Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include records on bycatch?

Yes, SEAFO (2006a) requires national onboard observer coverage. There is evidence of collection and reporting of observer data, for example, by a Spanish longline trip fishing for Patagonian toothfish in 2010, which includes information on bycatch and discards (SEAFO, 2010d).

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

No information was identified indicating that SEAFO has established and manages a database of pooled national observer programme datasets. SEAFO has issued directions for the reporting of observer data in a standardized format, however, the SEAFO Scientific Committee has identified a lack of compliance with the prescribed standardized format (SEAFO, 2009e, 2010a).

- What is the length in years of the regional observer programme dataset?

Ca. 1 year. Regional onboard observer coverage was first required in a SEAFO conservation measure in 2005; however, detailed data collection protocols for bycatch species began in 2009 (SEAFO, 2010a).

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

No information was identified to determine if observer data have been collected evenly across seasons for SEAFO-managed fisheries.

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

No information was identified to determine if observer data have been collected evenly spatially across the SEAFO Convention Area for SEAFO-managed fisheries.

- Which countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members?

The United Kingdom (on behalf of St. Helena and its dependencies, Tristan da Cunha and Ascension Island) is a coastal State in the region that is not currently a Party (SEAFO, 2010a). Furthermore, Russia and United States are identified as having distant water fishing interests in the region, but also are not Parties (SEAFO, 2010a). Iceland, Poland and Ukraine participated in the original negotiations to establish the RFMO, due to having interests in fisheries covered by SEAFO, but also are not SEAFO Parties (SEAFO, 2010a). SEAFO recognizes this gap, and “The Commission is urging States and fishing entities with “real interest” in the fisheries of the region to become Party to Convention or to fully comply with conservation and management measures adopted,” (SEAFO, 2011b). However, fishing by vessels from non-Contracting Parties is described as not being a large problem (SEAFO, 2010a).

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

No. No vessels classes within SEAFO-managed fisheries are exempt from the SEAFO requirement for 100% nation observer coverage, nor are SEAFO Member States exempt from reporting observer data from any vessel classes of SEAFO-managed fisheries.

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

No information on the collection or reporting of required 100% national onboard observer coverage of all vessels participating in SEAFO-managed fisheries was found.

Criterion 2. Open access to bycatch data

Score: 0 of 15 possible points, 0%.

Table A1.12-4 provides details on the assessment outcome for criterion 2.

Table A1.12-4. Assessment of SEAFO provision of open access to a regional observer programme datasets.

Factor	Points for positive response
SEAFO member States collect and report observer programme datasets containing records of bycatch, including discards, however, there are no open access SEAFO datasets.	0

Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

Yes, there is evidence of some compliance with a requirement for 100% national observer coverage of SEAFO-managed fisheries and the collection and reporting of all catch, including retained and discarded bycatch.

- What confidentiality rules have been adopted on access to data on bycatch, including discards, that the RFMO owns or holds as a custodian?

SEAFO (2010d) includes a draft document, Rules for Access and Use of SEAFO Data, which proposes a process for SEAFO to address requests for data held by SEAFO to be forwarded to the data owner/originator for approval. SEAFO (2006a) states that each SEAFO Contracting Party shall provide observer data to the Executive Secretary, "taking account of the need to maintain confidentiality of non-aggregated data." Responding to a recommendation included in the SEAFO performance assessment calling for augmented transparency of scientific data, the Scientific Committee commented that providing public access to, "more disaggregated biological data and observer data, is likely to result in problems regarding confidentiality and data ownership," (SEAFO, 2010d).

- Are primary or amalgamated data collected in the regional observer programme made available as an open public resource?

No publically available datasets containing observer programme data were identified. SEAFO (2010d) identified plans to create a members only section on the SEAFO website for access to a SEAFO database.

- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤ 5 degree cells, > 5 degree cells, or is information on resolution of records in the publically available dataset not specified?

Not applicable, no publically available datasets containing observer programme data were identified.

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

Not applicable, no publically available datasets containing observer programme data were identified.

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

None; no publically available datasets containing observer programme data were identified.

Criterion 3: Ecological Risk Assessment

Score: 2 of 8 possible points, 25%.

Table A1.12-5 provides details on the assessment outcome for criterion 3.

Table A1.12-5. Assessment of SEAFO ecological risk assessment.

Factor	Points for positive response
Level 2 and/or 3 assessment has been conducted for either the effects of fishing on bycatch species or the effects of bycatch removals on the integrity of the ecosystem, but not both, for at least 1 fishery.	2

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

SEAFO has identified “Vulnerable Marine Ecosystems”, resulting in the adoption of area closures in order to avoid degradation of sensitive habitat, (Table A1.12-7, SEAFO, 2009b, 2010e). The process employed to identify VMEs constitutes a Level 2 assessment of ecological risk for the effects of demersal fisheries on bycatch species and habitat. Live coral and sponge catch limits per set and move-on provisions have been adopted, where these two species groups are employed as indicators for identification of candidate Vulnerable Marine Ecosystems (SEAFO, 2009b, 2010e).

The Scientific Committee has classified SEAFO-managed species by vulnerability to overexploitation, constituting a Level 1 ecological risk assessment (SEAFRC, 2010a).

Small (2005) conducted a partial Level 2 risk assessment, by assessing the overlap of RFMO areas with albatross distributions, and determined that the SEAFO Convention Area does overlap with albatross distributions, but was not one of the top five of 14 evaluated RFMOs in terms of overlap with albatrosses.

Lopez-Abellan and Serralde (2010) produced a draft SEAFO document that, if completed, could fulfill a Level 2 assessment for ecological risks posed by fisheries for Patagonian toothfish.

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

A Level 1 ecological risk assessment of effects of fisheries on individual species subject to fishing mortality covers all SEAFO-managed fisheries (SEAFRC, 2010a). The protocol to assess the presence of candidate Vulnerable Marine Ecosystem sites is an assessment of SEAFO fisheries on bycatch species (coral and sponge species) (SEAFO, 2009b, 2010e). No risk assessments were identified that assess the effects of bycatch removals on ecosystem processes and structure.

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous assessment was recommended, has it been conducted, in progress, or planned to be conducted?

The Scientific Committee has classified SEAFO-managed species by vulnerability to overexploitation. Findings were that most species on the SEAFO list have low productivity and high longevity and therefore can sustain low fishing mortality rates. Other SEAFO species, including alfonsino, are not long lived and slow growing but are vulnerable to fishing because they form dense aggregations easily targeted by fishing vessels (SEAFRC, 2010a). Implementation of the process to identify candidate Vulnerable Marine Ecosystem sites has resulted in the closure of several SEAFO Convention Area sites to fishing (Table A1.12-7). Small (2005) determined that the SEAFO Convention Area does overlap with albatross distributions. The reviewed assessments did not specify whether or not more rigorous risk assessments are warranted.

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch

Score: 4 of 18 possible points, 22%

Table A1.12-6 provides details on the assessment outcome for criterion 3.

Table A1.12-6. Assessment of SEAFO conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
One or more bycatch problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in place to mitigate $\geq 50\%$ but $< 75\%$ of the number of identified problems.	3
At least one but $< 50\%$ of binding measures to mitigate bycatch include measurable performance standards.	1
There is a provision allowing Member States to opt out of binding measures.	0

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch problem for each fishery managed by the RFMO.

Live coral and sponge bycatch can be problematic in SEAFO-managed demersal trawl, longline and trap fisheries (SEAFO, 2009b, 2010e).

While not identified as constituting a bycatch problem, most species on the SEAFO list, which include target and incidental retained species, were identified to be able to maintain low fishing mortality rates, while some species, including alfonsino, are also vulnerable to overexploitation due to forming aggregations (SEAFRC, 2010a).

- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

Demersal longline fisheries, including those targeting Patagonian toothfish, and demersal trawl fisheries are documented to have problematic seabird bycatch (Gilman et al., 2005; Baker et al., 2007; Zollett, 2009; Orea et al., 2011). Sea turtle and marine mammal bycatch is problematic in some demersal trawl fisheries (Zollett, 2009; FAO, 2009d, 2010a). Bycatch of small/unmarketable sizes of target red crabs has been documented in demersal red crab trap fisheries from other regions (Tallack, 2007), and bycatch of whales is problematic in trap fisheries in some regions (Zollett, 2009).

Bycatch of coral and sponge species is problematic in demersal longline and trawl fisheries, primarily at seamounts (SEAFO, 2009b). For example, SEAFO (2010d) reported the composition of bycatch observed from a single Spanish longline Patagonian toothfish fishing trip conducted in 2010 in an area of the SEAFO Convention Area, identifying 17 taxa of benthic organisms taken as bycatch. The two predominant taxa were branching corals (Order Scleractinia) and sponges (phylum Porifera) with highest coral bycatch occurring on a seamount (SEAFO, 2010d).

- Using Table A1.12-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

This information has been recorded in Table A1.12-7.

- From the responses to the first two bullets, list each individual documented bycatch problem.

Bycatch problems identified through ecological risk assessments and other studies are:

- Demersal longline: Live coral, sponge, seabird
- Demersal trawl: Live coral, sponge, seabird, sea turtle, marine mammal
- Crab pot: Live coral, sponge, small/unmarketable sizes of target red crabs, whales

A measure on sea turtle bycatch does not require employment of bycatch mitigation measures (SEAFO, 2009c).

- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are

binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

8 of 12. Of the 12 bycatch problems identified in the previous bullet, SEAFO binding measures are in place to address the following 8:

- Demersal longline: Live coral, sponge, seabird
- Demersal trawl: Live coral, sponge, seabird
- Crab pot: Live coral, sponge

- What proportion of binding bycatch measures contain quantitative, measurable performance standards?

One of the 6 binding measures, on sharks, stipulates a quantitative performance standard, by requiring a 5% limit of ratio of weight of retained shark fins to carcasses.

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

None. It is not clear if the shark measure standard of the 5% limit of ratio of weight of retained shark fins to carcasses is being implemented in SEAFO-managed fisheries due to insufficient monitoring. It is not understood if the standard is contributing to the measure's explicit objective of reducing shark fishing mortality (Gilman, 2011).

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

None. The efficacy of the shark measure in terms of meeting the stipulated standard, or in meeting the explicit objective of reducing shark fishing mortality, has not been determined.

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

No information was identified indicating that one or more of the SEAFO binding measures has not been effective. However, information on bycatch levels and rates of vulnerable species groups in SEAFO-managed fisheries was not found.

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

Yes, Article 23 of the Convention text provides a mechanism for Parties to opt out of binding measures, where the Party must notify the Commission of its reasons and proposals for alternative measures which it will implement (SEAFO, 2003 [Article 23]).

No SEAFO party has opted out of a binding conservation and management measure (SEAFO, 2010a).

Table A1.12-7. Active SEAFO legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
<p>All longline vessels fishing south of 30 degrees South latitude must carry and use bird scaring tori lines; carry a backup tori line; all longline vessels must set at night; dumping offal is prohibited during setting; dumping offal is either to not occur during hauling or otherwise is to be discarded from the opposite side of the vessel from where hauling is occurring; vessels that either cannot retain offal onboard or discard offal from the opposite side of the vessel from where hauling occurs are to be prohibited from fishing in the SEAFO Convention Area; hooks must be removed from offal and fish heads prior to discarding; and birds</p>	<p>No performance standards are stated.</p>	<p>List of vessels authorized to fish in the SEAFO Convention Area; Longline vessel geospatial position; Tori line and line weighting design meeting technical specifications is deployed during setting; Back-up tori lines onboard; Longline vessel offal discard practices during setting and hauling; Hooks removed from discards on longline vessels; Trawl nets cleaned between sets.</p>	<p>c, d, e</p>

<p>that are captured alive must be released alive and whenever possible hooks are removed without jeopardising the life of the bird (SEAFO, 2009d). Guidance included in the measure for the requisite design of tori lines includes specifications on line weighting (SEAFO, 2009d)</p> <p>On trawl vessels, streamer or tori lines are to be deployed that comply with technical specifications in the measure; backup tori lines are to be carried; dumping offal is prohibited during setting and is discouraged during hauling; nets shall be cleaned prior to shooting to remove items that might attract seabirds; vessels shall adopt shooting and hauling procedures that minimise the time that the net is lying on the surface with the meshes slack; net maintenance shall, to the extent possible, not be carried out with the net in the water; and Contracting Party shall encourage their vessels to develop gear configurations that minimize the chance of birds</p>			
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encountering the part of the net to which they are most vulnerable, for instance, by increasing the net sink rate (SEAFO, 2009d).			
Sea turtles			
Member States are required to collect and report all available information on sea turtle bycatch on a per-set basis, report sea turtle interactions collected by observers (e.g., species of sea turtle, fate/disposition and condition upon release, relevant biological information and gear design), and are encouraged to implement best practices for mitigating sea turtle mortality per FAO guidance (SEAFO, 2009c).	No performance standards are stated.	List of vessels authorized to fish in the SEAFO Convention Area; Sea turtle bycatch events for each set; Condition of turtles upon release; Gear design.	d, e
Marine mammals			
No binding measures. SEAFO (2009d) includes in its guidelines for the design and deployment of tori lines by demersal longline vessels, the following recommendation, relevant to mitigating cetacean interactions: "SEAFO recommends that longline fisheries consider	NA – no binding measure	NA – no binding measure	NA – no binding measure

<p>[employing] the Chilean system (equivalent to CCAMLR Trotline system), which is designed to eliminate cetacean predation on demersal longlines, but simultaneously eliminates virtually all seabird bycatch. In this system, 4-10 kg weights are deployed per hookline.”</p>			
<p>Shark and relatives</p>			
<p>SEAFO-managed vessels are required to: (i) keep all parts of retained sharks, excluding head, guts and skins, to the point of first landing; (ii) have onboard fins that total < 5% of the weight of sharks onboard, up to the first point of landing, or otherwise ensure compliance with the 5% rule through certification, observer monitoring or other method (SEAFO, 2006c). Furthermore, in fisheries that are not directed at sharks, Contracting Parties shall encourage the release of live sharks, especially juveniles, to the extent possible, that are caught incidentally and are not</p>	<p>5% limit of ratio of weight of retained shark fins to carcasses.</p>	<p>List of vessels authorized to fish in the SEAFO Convention Area; Weight of landed shark fins and weight of remainder of shark carcasses.</p>	<p>a, e</p>

used for food and/or subsistence (SEAFO, 2006c).			
Juvenile and small/undersized target species			
None	NA	NA	NA
Unmarketable sizes and species of non-target species of fish			
None	NA	NA	NA
Other or multiple bycatch species group(s)			
To protect vulnerable marine ecosystems (VMEs), eleven areas around seamounts are closed to all SEAFO-managed fishing activities (SEAFO, 2010e).	No performance standards are stated.	List of vessels authorized to fish in the SEAFO Convention Area; Location of fishing effort.	c, e
To implement the precautionary approach to avoid risks of significant adverse impacts on VMEs, Parties are required to submit a proposal to the SEAFO Scientific Committee for all bottom fishing activities in new bottom fishing areas or with bottom gear not previously used in the area concerned. The Scientific Committee is to employ a prescribed assessment protocol to avoid fishing in areas identified to be VMEs, and the Commission then reviews the Scientific	No performance standards are stated. Candidate Vulnerable Marine Ecosystems are identified when the specified threshold is exceeded. No standardized definition is provided for determinations of the identification of Vulnerable Marine Ecosystems where bottom fishing is to be prohibited.	List of vessels authorized to fish in the SEAFO Convention Area; Location of fishing effort; Catch composition.	c, d, e

<p>Committee recommendation to determine if the exploratory fishing should be authorized (SEAFO, 2009b).</p> <p>Furthermore, bottomfishing in the Convention Area is to cease in an area when evidence of a Vulnerable Marine Ecosystem is encountered (SEAFO, 2009b). A site is determined to be a candidate Vulnerable Marine Ecosystem when more than 60 kg of live coral and/or 800 kg of live sponge is caught per set, in which case the vessel must move a minimum of 2 nautical miles from the location where the threshold was met, and when fishing in a new area, an interim 2 mile radius closure is implemented (SEAFO, 2009b). The Scientific Committee shall evaluate and, on a case-by-case basis provide advice to the Commission on whether the site is a VME. SEAFO (2007b) adopted a process for the resumption of fishing in areas subject to closure.</p>			
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Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 3 of 14 possible points, 21%

Table A1.12-8 provides details on the assessment outcome for criterion 3.

Table A1.12-8. Assessment of SEAFO conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
For managed fisheries for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are in place for $\geq 75\%$ of these fisheries.	3

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

Longline fisheries for Patagonian toothfish and trap fisheries for deep-water red crab have been identified as SEAFO gear types that pose a problem from abandoned or lost derelict gear (SEAFO, 2009e, 2011c). Gillnets, which also pose a ghost fishing problem (SEAFO, 2009e), have been banned in the SEAFO Convention Area since 2009. Studies have not been conducted that estimate ghost fishing mortality rates or levels in SEAFO-managed fisheries.

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

Lost and abandoned trawl gear was described by the SEAFO Scientific Committee to pose a relatively low degree of risk of ghost fishing (SEAFO, 2009e). This is because trawl gear typically employs larger diameter synthetic multifilament twine, which is visible and can be sensed and avoided by fish (SEAFO, 2009e). Carr and Harris (1994) further explain that derelict trawl gear, which likely is suspended from the seafloor by floats, provides a substrate for the attachment of benthic invertebrates, such as hydroids and sea anemone, further reducing the capacity of derelict trawl nets to cause fishing mortality. However, there is evidence of marine mammal entanglement in trawl net fragments, and coastal habitat degradation from derelict trawl nets (Jones, 1995; Donohue et al., 2001; Matsuoka et al., 2005).

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any

quantitative performance standards included in each measure (Table A1.12-9);

This information has been recorded in Table A1.12-9.

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

3 of 4. A binding measure applicable to fixed gear covers SEAFO trap and demersal longline fisheries, but not demersal trawl fisheries. Gillnet fisheries have been banned.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, the measures do not include quantitative performance standards.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, the measures do not include quantitative performance standards.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, Article 23 of the Convention text provides a mechanism for Parties to opt out of binding measures (SEAFO, 2003 [Article 23]).

Table A1.12-9. Active SEAFO legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measureable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
To mitigate ghost fishing, SEAFO closed its	No performance standards are stated.	List of vessels authorized to fish in the SEAFO	a, e

Convention Area to all gillnet fishing (SEAFO, 2010b), based on the rationale that gillnet fisheries contribute to abandoned, lost or otherwise discarded fishing gear (SEAFO, 2010a).		Convention Area; Gear type.	
SEAFO-managed vessels with fixed gear are required to possess onboard equipment to retrieve lost gear, to attempt to retrieve lost fixed gear as soon as possible, and to provide specified information to authorities within 24 hours if the vessel cannot retrieve lost gear, after which the flag State authorities are to notify SEAFO so that the information can be posted on the SEAFO website (SEAFO, 2010c).	No performance standards are stated.	List of vessels authorized to fish in the SEAFO Convention Area; Equipment to retrieve lost gear is onboard; Practices undertaken to retrieve lost gear; Gear markings to trace lost/abandoned gear to the vessel.	b, e, f (gear marking)

Criterion 4C Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea
Score: 0 of 14 possible points, 0%

Table A1.12-10 provides details on the assessment outcome for criterion 3.

Table A1.12-10. Assessment of SEAFO conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed	0

fisheries, and no relevant binding measures are in place.	
Members can opt out of binding measures.	0

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these discharges?

No relevant assessments were identified.

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from the these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

No information was identified on risks from pollution from discards from managed fisheries.

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table A1.12-11).

There are no relevant binding measures.

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

No relevant information was identified for managed fisheries documenting problematic pollution, or are identified as being likely to cause problematic pollution, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous

assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

Yes, Article 23 of the Convention text provides a mechanism for Parties to opt out of binding measures (SEAFO, 2003 [Article 23]).

Table A1.12-11. Active SEAFO legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	na	na	na

Criterion 5. Surveillance and Enforcement

Score: 6 of 20 possible points, 30%

Table A1.12-12 provides details on the assessment outcome for criterion 3.

Table A1.12-12. Assessment of SEAFO measures and resources for surveillance and enforcement.

Factor	Points for positive response
≥50% but <75% of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	3
The RFMO has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections,

VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

SEAFO adopted in 2007 an IUU list, comprised of the combined IUU lists of three other Atlantic RFMOs (CCAMLR, NAFO, NEAFC) (SEAFO, 2006b, 2008). SEAFO also maintains an Authorized Vessel List, with 37 vessels listed as of 16 June 2011 (SEAFO, 2011d), and a SEAFO Authorized Port List, currently with 7 ports listed as of 16 June 2011 (SEAFO, 2007a, 2011e). The 2010 performance assessment identified a need to establish rules to ensure that the list of authorized vessels, “better reflects the actual capacity deployed in the Convention Area,”; there were 35 vessels on the list in 2009, but only four active vessels (SEAFO, 2010a).

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.12-7, A1.12-9, and A1.12-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

Information on minimum surveillance methods has been recorded in Tables A1.12-7, A1.12-9, and A1.12-11. In summary, minimum surveillance methods to assess compliance with binding conservation and management measures are:

- Dockside inspection is needed to enforce a ban on gillnets and to ensure compliance with rules on landing shark fins
- At-sea inspections are needed to confirm that required equipment to retrieve lost gear is onboard, and that practices are undertaken to retrieve lost gear
- VMS is needed to determine compliance by longline vessels with requirement employment of tori lines when S. of 30 degrees S. latitude, and compliance with closed areas
- Onboard observer coverage is needed to determine compliance by longline vessels with prescribed offal discard practices, longline removal of hooks from discards, trawl vessels nets cleaned between sets, and collect data on sea turtle bycatch events and disposition on release, and trawl vessel catch composition (weight of live coral and sponges per set) to determine if sites qualify as candidate Vulnerable Marine Ecosystems
- A vessel list is needed to determine if vessels fishing in the SEAFO Convention Area are subject to SEAFO binding measures.
- Gear marking is needed to trace derelict gear to the vessel.

4 of 6 are met. Dockside and at-sea inspection are not met.

Conservation Measure 07/06 created a VMS program, authorized vessel list, obligations for scientific observation, and requirements for marking gear (SEAFO, 2006a). Flag and port State measures are also in place (SEAFO, 2007a). Furthermore, to contribute to controlling catches and deterring IUU fishing, SEAFO (2009a) banned at-sea transshipment and restricted transshipment in port by Parties’

vessels fishing for species covered by the SEAFO Convention. 100% onboard observer coverage is required, although no information was identified to determine compliance.

The Compliance Committee identified a lack of Party compliance with the port State inspection scheme, as no inspection reports have been submitted to the Committee with information on vessels landing catch from the SEAFO Convention Area (SEAFO, 2010a). While called for in Article 16 of the Convention text, SEAFO has yet to adopt binding measures creating an at-sea inspection program, including procedures for at-sea boarding and inspection of vessels, or allowing for the placement of observers from one Party on vessels of other Parties (SEAFO, 2010a).

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose sanctions against Members and/or non-Members in response to detected violations?

No. Although called for in the Convention text, SEAFO has not adopted binding measures that establish reporting obligations for infringements or procedures for follow-up on identified infringements (SEAFO, 2010a).

Under Article 13(4) of the Convention text, Parties must transmit to the Commission an annual statement of compliance measures it has implemented, including the imposition of sanctions for violations. Furthermore, Article 14(3)(a) requires flag States to take measures to ensure that they investigate immediately and report fully on actions taken in response to an alleged violation by a vessel flying its flag (SEAFO, 2010a). Article 16 calls for procedures to implement these measures. However, these procedures have yet to be adopted to implement these enforcement, sanctions, and reporting requirements (SEAFO, 2010a).

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

Yes, Article 9 of the Convention text called for the establishment of a SEAFO Compliance Committee, responsible, “to provide the commission with information, advice and recommendations on the implementation of, and compliance with, conservation and management measures (SEAFO, 2003 [Article 9(2)]). SEAFO established a Compliance Committee in 2007.

- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

Due to a lack of adoption of procedures to implement reporting requirements (SEAFO, 2010a), information on the imposition of sanctions for detected infringements was not available.

A1.13. Western and Central Pacific Fisheries Commission (WCPFC)

SUMMARY	
Criteria Suite Scores	
Overall	42 (± 7 SD of the mean)% ¹
Criterion 1: Data Collection	62% ²
Criterion 1A. Regional Observer Programme Bycatch Data Collection Protocols	96%
Criterion 1B. Regional Observer Coverage Rates	36%
Criterion 1C. Regional Observer Programme Dataset Quality	55%
Criterion 2. Open Access to Regional Observer Programme Datasets	47%
Criterion 3. Ecological Risk Assessment	25%
Criterion 4. Conservation and Management Measures	30% ²
Criterion 4A. Conservation and Management Measures to Mitigate Bycatch	39%
Criterion 4B. Conservation and Management Measures to Govern Lost and Abandoned Gear	29%
Criterion 4C. Conservation and Management Measures to Govern Problematic Localized Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea	21%
Criterion 5. Surveillance and Enforcement	45%
¹ Mean of five criteria scores	
² Mean of sub-criteria scores	

HISTORY

The Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean, which entered into force on 19 June 2004, established the Western and Central Pacific Fisheries Commission (WCPFC) (Lugten, 2010; WCPFC, 2010b). The Convention was concluded after seven negotiation sessions over six years, which began in 1994 (WCPFC, 2010b). A series of Preparatory Conferences occurred during the period between the conclusion of the Convention in 2000 and its entry into force (WCPFC, 2010b, 2011b).

MEMBERSHIP

The following States, political and economic union of States, and fishing entity are WCPFC members: Australia, China, Canada, Cook Islands, European Union, Federated States of Micronesia, Fiji, France, Japan, Kiribati, Korea, Republic of Marshall Islands, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Philippines, Samoa, Solomon Islands, Chinese Taipei, Tonga, Tuvalu, United States of America, and Vanuatu (WCPFC, 2011b). The following are WCPFC Participating Territories: American Samoa, Commonwealth of the Northern Mariana Islands, French Polynesia, Guam, New Caledonia, Tokelau, and Wallis and Futuna. The following States are WCPFC Cooperating Non-members: Belize, Ecuador, El Salvador, Indonesia, Mexico, Senegal, Vietnam, Panama, and Thailand (WCPFC, 2011b). Commission Members, Cooperating non-Members and participating Territories are collectively referred to in WCPFC materials as CCMs.

MANAGED SPECIES AND FISHERIES

The convention applies to all species of highly migratory fish stocks (defined as all fish stocks of the species listed in Annex I of the 1982 Law of the Sea Convention occurring in the convention area and such other species of fish as the WCPFC may determine) within the Convention Area, except sauries (United Nations, 1982; Lugten, 2010). These are:

- Albacore tuna: *Thunnus alalunga*.
- Bluefin tuna: *Thunnus thynnus*.
- Bigeye tuna: *Thunnus obesus*.
- Skipjack tuna: *Katsuwonus pelamis*.
- Yellowfin tuna: *Thunnus albacares*.
- Blackfin tuna: *Thunnus atlanticus*.
- Little tuna: *Euthynnus alletteratus*; *Euthynnus affinis*.
- Southern bluefin tuna: *Thunnus maccoyii*.
- Frigate mackerel: *Auxis thazard*; *Auxis rochei*.
- Pomfrets: Family *Bramidae*.
- Marlins: *Tetrapturus angustirostris*; *Tetrapturus belone*; *Tetrapturus pfluegeri*; *Tetrapturus albidus*; *Tetrapturus audax*; *Tetrapturus georgei*; *Makaira mazara*; *Makaira indica*; *Makaira nigricans*.
- Sail-fishes: *Istiophorus platypterus*; *Istiophorus albicans*.
- Swordfish: *Xiphias gladius*.
- Dolphin: *Coryphaena hippurus*; *Coryphaena equiselis*.
- Oceanic sharks: *Hexanchus griseus*; *Cetorhinus maximus*; Family *Alopiidae*; *Rhincodon typus*; Family *Carcharhinidae*; Family *Sphyrnidae*; Family *Isurida*.
- Cetaceans: Family *Physeteridae*; Family *Balaenopteridae*; Family *Balaenidae*; Family *Eschrichtiidae*; Family *Monodontidae*; Family *Ziphiidae*; Family *Delphinidae*.

Main fisheries managed by WCPFC, listed in order of weight of tunas captured, are: (i) purse seine, (ii) pelagic longline, (iii) pole and line, (iv) troll, and (v) other small-scale tuna fishing methods, including artisanal methods (e.g., handline, small traps, set nets, coastal gillnets, ring nets, small seiners) (Miyake et al., 2010; WCPFC, 2010b, 2011b).

AREA OF APPLICATION

The WCPFC Convention Area, shown in Fig. A1.13-1, is defined in the Convention Article 3 (WCPFC, 2000). The Convention Area comprises all waters of the Pacific Ocean bounded to the south and to the east by a line drawn from the south coast of Australia due south along the 141°E meridian to its intersection with the 55°S parallel; thence due east along the 55°S parallel to its intersection with the 150°E meridian; thence due south along the 150°E meridian to its intersection with the 60°S parallel; thence due east along the 60°S parallel to its intersection with the 130°W meridian; thence due north along the 130°W meridian to its intersection with the 4°S parallel; thence due west along the 4°S parallel to its intersection with the 150°W meridian; thence due north along the 150°W meridian (WCPFC, 2000). A portion of the WCPFC Convention Area overlaps with that of IATTC (bounded by 150 degrees longitude W, 130 degrees longitude W, 4 degrees latitude S, and 50 degrees latitude S); vessels of IATTC members that are not also WCPFC members are not subject to WCPFC measures when fishing in this overlap zone, and vice versa (IATTC and WCPFC, 2011).

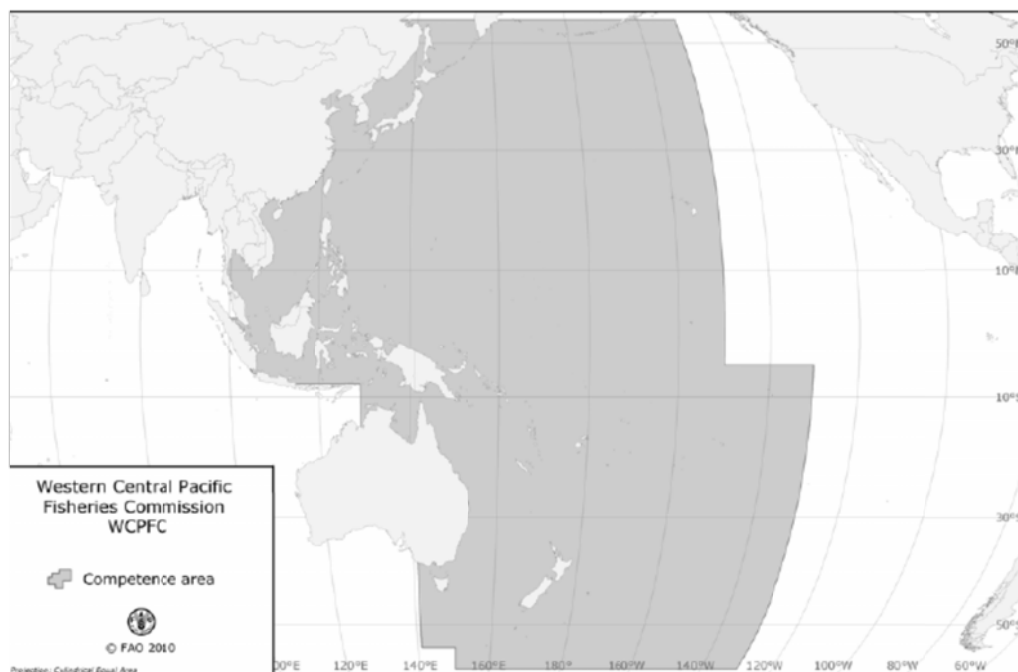


Fig. A1.13-1. WCPFC convention area (Lugten, 2010; authorized for reproduction by FAO).

INFORMATION TO ASSESS PERFORMANCE AGAINST THE CRITERIA SUITE FOR GOVERNANCE OF BYCATCH AND DISCARDS

Criterion 1A. Bycatch Data Collection Protocols for Regionally Observed Fisheries

Score: 24 of 25 possible points, 96%.

A maximum of 25 points are attainable for assessment of WCPFC against sub-criterion 1A as this includes longline and other hook-and-line fisheries in the regional observer programme.

Table A1.13-1 provides details on the assessment outcome for criterion 1A.

Table A1.13-1. Assessment of WCPFC regional observer programme data collection protocols for bycatch, including discards, and performance of conservation and management measures.

Factor	Points for positive response
Non-target fish and non-fish species are included in the RFMO's mandate.	1
Data for $\geq 75\%$ of documented vulnerable bycatch species are intended to be collected in fisheries that have regional observer coverage.	3
Information on the number and/or weight of at least 1 of documented vulnerable bycatch species is intended to be routinely collected for the regional observer programme.	1
$\geq 75\%$ of the items of information needed to assess performance standards of relevant binding conservation and management measures are intended to be collected by regional observers.	3
Information on fishing effort is intended to be routinely collected for fisheries with regional observer coverage.	1

Date and location of fishing operations are intended to be routinely captured for the regional observer programme.	1
Information on whether catch is retained or discarded is intended to be routinely captured by regional observers for $\geq 75\%$ of documented vulnerable bycatch species.	3
Data records are intended to be to the species-level for $\geq 75\%$ of documented vulnerable bycatch species in fisheries with regional observer coverage.	3
Information on length or other proxy for age class is intended to be collected for $\geq 50\%$ of identified vulnerable bycatch species.	3
Information on the disposition of discards (e.g., alive vs. dead, and possibly degree of injury) is intended to be collected for $\geq 75\%$ of identified vulnerable bycatch species.	3
For hook-and-line fisheries included in the regional observer programme, information on gear attached to individuals of vulnerable species that are discarded alive is intended to be collected for 57% ($>50\%$ but $<75\%$) of identified vulnerable bycatch species.	2

Information used for assessment:

- Is minimizing impacts by the RFMO's managed fisheries on associated and dependent species of non-target fish and non-fish species included in the RFMO's mandate?

Yes, under the Convention, Commission members are obligated to (i) "assess the impacts of fishing, other human activities and environmental factors on target stocks, non-target species, and species belonging to the same ecosystem or dependent upon or associated with the target stocks," (ii) "adopt measures to minimize waste, discards, catch by lost or abandoned gear, pollution originating from fishing vessels, catch of non-target species, both fish and non-fish species ...and impacts on associated or dependent species," and (iii) "protect biodiversity in the marine environment" (WCPFC, 2000 [Article 5 (d-f)]).

- In fisheries required to have regional observer coverage, for what proportion do the RFMO's data collection protocols call for catch data (i.e., data on both retained and discarded non-target species) to be routinely collected for known shark, sea turtle, seabird, marine mammal, or other documented vulnerable bycatch species?

Data are to be collected by regional observers for all retained and discarded target and bycatch species in WCPO pelagic longline and purse seine fisheries (SPC/FFA, 2009; WCPFC, No Date).

Of the WCPFC-managed fisheries, regional observer coverage is required in purse seine and longline fisheries; troll and pole-and-line fisheries are exempt from participation in the regional observer programme (WCPFC, 2007c). There is currently some level of regional observer coverage in pelagic longline and purse seine fisheries, and no regional coverage of other gear types (SPC, 2009; WCPFC, 2011c).

The *WCPFC ROP Minimum Standard Data Fields & Instructions* identifies minimum data standard fields that regional observers are to capture (WCPFC, No Date). This form calls for regional observers to record the FAO species code for all captured fish, sea turtles, seabirds and marine mammals (WCPFC, No Date).

Furthermore, WCPFC Form Gen-2, which is a part of the longline, purse seine, pole and line, and troll observer workbooks, includes data fields for the following species of special interest (SPC/FFA, 2009):

- Loggerhead turtle
 - Green Turtle
 - Eastern Pacific Green Turtle
 - Leatherback Turtle
 - Hawksbill Turtle
 - Flatback Turtle
 - Olive Ridley Turtle
 - All turtles
 - Common Dolphin
 - Risso's Dolphin
 - Bottlenose Dolphin
 - Spinner Dolphin
 - Striped Dolphins
 - Rough toothed dolphins
 - Spotted Dolphins
 - All dolphins
 - False Killer Whale
 - Short-Finned Pilot Whale
 - Pygmy Killer Whale
 - Melon Headed Whale
 - Sei Whale
 - Humpbacked whale
 - Brydes Whale
 - Toothed Whales
 - Baleen Whales
 - All marine mammals
 - Whale Shark
 - All birds.
- Does the RFMO's data collection protocols by regional observers call for information on the number and/or weight of documented vulnerable bycatch species to be routinely collected?

Observers are tasked with recording the number of caught organisms and lengths for individual organisms in both longline and purse seine fisheries using recommended measurements (WCPFC, No Date). And, WCPFC observers Work Book form Gen-2 includes data fields for length, to be recorded for each specimen. Catch is to be sampled randomly to avoid bias by sex, species, size, condition, etc. (SPC/FFA, 2009). Observer forms do not include capturing weight of the catch in purse seine and longline fisheries (WCPFC, No Date), however, weights can be estimated based on length data for most marine species.

- Identify minimum data requirements to assess the performance of legally binding conservation and management measures (described in Criterion 4, recorded in Tables A1.13-7, A1.13-9, and A1.13-11)

The information has been added to Tables A1.13-7, 9, and 11. Data requirements for the assessment of these binding measures are:

- For all WCPFC-managed fisheries, location of fishing effort;
- For longline vessels, presence onboard and design of bird mitigation equipment;
- For longline and purse seine vessels, presence onboard of sea turtle handling and release equipment;
- Longline fishing gear terminal tackle design, including hook and bait type;
- Longline vessel fishing methods in areas where bird mitigation measures are required (e.g., deck position of mainline and branchline deployment, time of day of setting, deployment of terminal tackle through underwater setting device);
- For all WCPFC-managed fisheries not targeting sharks, shark handling and release methods and disposition of discarded sharks (to monitor compliance with the requirement for releasing sharks alive that are caught incidentally and are not used for food or other purposes);
- For all WCPFC-managed fisheries, methods employed for handling and releasing caught turtles;
- For all WCPFC-managed fisheries, weight of landed shark fins and weight of remainder of shark carcasses;
- For purse seine vessels, weight of bigeye and yellowfin tuna landings and discards by purse seine vessel Flag State, set type, set date, and set location;
- Purse seine set type and date for sets made in PNA Members' EEZs and on the high seas in the area bounded by 20°N and 20°S;
- Purse seine days fished in EEZ's of PNA members;
- Real-time locations of all anchored and drifting FADs;
- Record of tuna discards by species by purse seine vessels operating within the area bounded by 20°N and 20°S (to monitor compliance with bigeye, yellowfin and skipjack tuna full retention requirement);
- Weight of bigeye and yellowfin tuna landings and discards by purse seine vessels operating north of 20°N and south of 20°S;
- Weight of bigeye and yellowfin tuna landings and discards by non-artisanal troll, pole-and-line, and other non-artisanal fisheries;
- Location of data buoys;
- Catch levels of North Pacific striped marlin north of the equator;
- Catch levels of swordfish south of 20°S;
- Design of drift gillnet gear in use and/or stowed onboard;
- List of vessels authorized to fish in the Convention Area.

Information on the location of vessels during fishing operations is needed for all WCPFC-managed fisheries in order to document the location in the Convention Area of (i) swordfish catch as being south or north of 20°S., north Pacific striped marlin catch as being north or south of the equator, (iii) fishing with large scale drift gillnets as being on the high seas or in EEZs, (iv) sets of all gear types in relation to the location of data buoys, (v) purse seine sets in relation to nearest FAD (during temporal FAD closures) and in relation to closed high seas pockets, and (v) location of longline sets to determine if the location is within the areas where seabird bycatch mitigation methods are required (Table A1.13-7).

- Identify gaps in information intended to be collected by regional observers that is required to assess the performance of bycatch conservation and management measures. What

percent of required minimum information is not intended to be routinely collected by the regional observer programme according to the RFMO's data collection protocols?

Provided that observers collect all data per the *WCPFC ROP Minimum Standard Data Fields & Instructions* and Form Gen 2 (WCPFC, No Date; SPC/FFA, 2009), of the 20 information items listed in the previous bullet, the following 5 are not routinely captured by regional onboard observers in fisheries where regional onboard observer coverage exists:

- For longline and purse seine vessels, presence onboard of sea turtle handling and release equipment;
- Longline vessel fishing methods in areas where bird mitigation measures are required (e.g., deck position of mainline and branchline deployment, deployment of terminal tackle through underwater setting device, offal discharge/retention practices);
- Methods employed for releasing caught turtles. SPC/FFA (2009) includes a field "describe onboard handling", but does not call for recording information on discard/release methods;
- Real-time locations of all anchored and drifting FADs;
- Design of drift gillnet gear in use and/or stowed onboard.

Weights of discards by species would be estimated from observer-collected length measurements. It is assumed that the locations of data buoys are monitored by organizations that manage them, and that domestic fishery management authorities and WCPFC could therefore determine the distance of set locations from data buoys.

While outside the scope of this portion of the performance assessment, gaps in monitoring occurs for all data collection methods required to be applied to all WCPFC-managed fisheries. This is because regional observer coverage occurs only on longline and purse seine vessels, as there is no regional observer coverage in other WCPFC-managed fisheries, including troll, pole-and-line, and 'other' fisheries (bullet three under criterion 1B) (SPC, 2009).

- Does the information intended to be collected by onboard observers per the RFMO's data collection protocols meet bycatch data collection requirements that are explicitly stated in binding conservation and management measures (described in Criterion 4)?

Yes, all explicitly required regional observer data collection methods called for in CMMs are captured in WCPFC observer data collection forms. For example, during the purse seine FAD time/area closure, CCM 2008-01 requires observers from the Regional Observer Program to monitor vessel deployment or servicing of FADs or associated electronic devices, and fishing on schools in association with FADs (WCPFC, 2008a). Observer data collection protocols call for recording information on purse seine set type (SPC/FFA, 2009; WCPFC, No Date, 2009i), and FAD activity, including FAD servicing (WCPFC, 2009i).

- Does the RFMO's protocol for observer data collection call for the routine collection of information on fishing effort?

Yes, observer data collection protocols call for capturing fishing effort (WCPFC, No Date).

- For how many of documented vulnerable bycatch species (compiled under Criteria 3 and 4) is information on whether the catch was retained vs. discarded intended to be routinely

by observers of the regional observer programme?

Observers are to record whether each individual caught organism is retained vs. discarded (WCPFC, No Date).

- Does the RFMO's data collection protocols for the regional observer programme call for information on the date and location of fishing operations to be routinely captured?

Yes, observers are to record the date and time of the start and end of sets, and latitude and longitude of each fishing activity (setting, hauling) (WCPFC, No Date).

- For what proportion of bycatch species of vulnerable species groups (identified under Criteria 3 and 4) are regional observers intended to have record be at the species level?

All organisms are to be recorded to the species level (WCPFC, No Date). However, where the observer may not be able to identify down to species level, Form Gen 2 allows for listing 'species of special interest' by species groups, e.g., all toothed whales, birds (SPC/FFA, 2009).

- For what proportion of identified vulnerable species groups is information on length intended to be collected under the regional observer programme? If other information is intended to be routinely collected by regional observers that provides a proxy for age class, identify the measurement method.

Observers are to record lengths for all species of catch (WCPFC, No Date). Form Gen 2 also contains a field for length measurement for each observed organism for species of special interest (SPC/FFA, 2009).

- For what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on the disposition of individuals that are discarded (alive vs. dead) intended to be routinely collected under the regional observer programme?

Observers are to record the condition of discards, as well as the condition when caught, in longline fisheries (WCPFC, No Date). In purse seine fisheries, regional observers are tasked to record the condition of 'species of special interest' upon landing on deck and condition of discards, but not for other species (WCPFC, No Date). Similarly, Form Gen 2 has a data field for describing the condition (alive, dead, unlikely to survive, etc.) of all discarded catch of species of special interest (SPC/FFA, 2009).

- For hook-and-line gear (longline, troll, pole-and-line, handline, etc.), for what proportion of vulnerable species groups (identified under Criteria 3 and 4) is information on fishing gear remaining attached to individual organisms that are discarded alive intended to be routinely collected under the regional observer programme (e.g., hooked and location of hooking, entangled, leader attached, weights attached, length of fishing line attached)?

4 of 7.

Form Gen 2 has a data field for codes to describe the condition (hooked, tangled, etc.) of species of special interest (turtles, seabirds, marine mammals, whale sharks) when landed on deck and when discarded (SPC/FFA, 2009). The *WCPFC ROP*

Minimum Standard Data Fields & Instructions does not call for the capture of information on gear remaining attached to discarded organisms (WCPFC, No Date).

As summarized in bullet 4 under criterion 4A, the following are identified or potential bycatch problems in WCPO longline and purse seine fisheries:

- Purse seine: Sharks, juvenile tunas, other unmarketable species and sizes of fish, sea turtles, cetaceans;
- Pelagic longline: Elasmobranchs, seabirds, sea turtles, cetaceans, juvenile swordfish, other species of non-targeted fish.

Of these, information on terminal tackle attached to discarded organisms is to be collected for sharks, turtles, cetaceans, and seabirds, but not for tunas, swordfish and other fish species.

Criterion 1B. Regional Observer Coverage Rates

Score: 4 of 11 possible points, 36%.

Table A1.13-2A provides details on the assessment outcome for criterion 1B.

Table A1.13-2A. Assessment of WCPFC onboard observer coverage rates to monitor discards and retained and transshipped bycatch.

Factor	Points for positive response
At least one but <25% of managed fisheries (fisheries covered by the RFMO) have $\geq 5\%$ regional onboard observer coverage. Only purse seine fisheries have $\geq 5\%$ regional onboard observer coverage.	1
The RFMO's scientific body has recommended target onboard observer coverage rates for each managed fishery, and the regional onboard observer coverage rates meet scientific advice for $\geq 50\%$ but <75% of managed fisheries. Required 100% onboard observer coverage rates for purse seine vessels operating between 20oN and 20oS since 1 Jan. 2010 is close to compliance. WCPFC has not been able to assess compliance with the requirement for 100% observer coverage of longline transshipments at sea, which commenced in 2011, due to a lack of capacity to track the presence of carrier vessel occurrence in the Convention Area, which intend to transship at sea.	3
There is no required or routine international exchange of observers in the regional onboard observer programme.	0

Information used for assessment:

- What recommendations on observer coverage rates have been made by the RFMO's scientific body or the Commission for fisheries under the RFMO's mandate?

Pursuant to CMM 2007-01, by 30 June 2012, CCMs are to provide $\geq 5\%$ coverage of the effort in each fishery under the jurisdiction of WCPFC (WCPFC, 2007c). The CMM stated that the Northern Committee shall make recommendations to the Commission on the implementation of the Regional Observer Program by fishing vessels fishing for fresh fish north of 20° north, and that the recommended date for implementation of regional observer coverage of vessels fishing for fresh fish in this

area would be no later than 31 December 2014 (i.e., these vessels might not be required to have regional onboard observer coverage until 2015) (WCPFC, 2007c). Furthermore, small vessels, the minimum size of which shall be determined, and troll and pole-and-line skipjack or albacore vessels are exempt from participating in the Regional Observer Programme (WCPFC, 2007c).

Pursuant to CMM 2008-01, as of the FAD seasonal closure in 2009, and from 1 January 2010 onwards, there is to be 100% onboard observer coverage by observers from the Commission's Regional Observer Program of purse seine vessels operating in the area bounded by 20°N and 20°S, excluding vessels that operate only in the EEZ of only one coastal State (and not on the high seas or in the EEZ of a second coastal State) (WCPFC, 2008a).

CMM 2009-06 requires 100% Regional Observer Programme coverage of transshipment activities (WCPFC, 2009g).

- Does a regional observer programme exist?

Yes, the Convention establishes general provisions for a regional observer programme (WCPFC, 2000 [Article 28]); CMM 2006-07 formalized the process to establish the Commission Regional Observer Program (WCPFC, 2006a); and CMM 2007-01 established the programme (WCPFC, 2007c).

- What are regional onboard observer coverage rates in each fishery managed by the RFMO?

The Secretariat of the Pacific Community provided summary statistics for 2009 observer coverage rates in WCPO pelagic fisheries as follows: 5.4% in regional purse seine, 0.3% in regional pelagic longline, and 0% in regional troll, pole-and-line, gillnet, drift gillnet, and 'other' fisheries (SPC, 2009).

Table A1.13-2B summarizes 2010 Regional Observer Programme onboard observer coverage rates of CCM's pelagic longline and purse seine fisheries operating in the WCPFC Convention Area, based on CCM self-reporting in submitted Part 1 reports to the Commission. No information was provided in the Part 1 reports on onboard observer coverage rates of other WCPFC-managed fisheries employing other gear types (WCPFC, 2011c). A rough estimate of average regional observer coverage of WCPFC-managed fisheries (100% purse seine, 1% longline, 0% each for troll, pole-and-line, gillnet, and 'other') is 17%.

Table A1.13-2B. Regional Observer Program onboard observer coverage rates of WCPFC-managed longline and purse seine fisheries, 2010 (as reported in CCM's Part 1 Reports; WCPFC 2011c).

Members, Participating Territories and Cooperating Non- Members	2010 Observer Coverage Rate	
	Pelagic longline	Purse seine
Australia	3.6	2.3
Belize	0 NA	
Canada	NA	NA

China	Not reported		Not reported
Chinese Taipei	Not reported (25 trips observed)		Not reported (6 trips observed)
Cook Islands		10	NA
Ecuador	No Report		No Report
El Salvador	NA		100
EU	Not reported		89
Fiji	No Report		No Report
France	No Report		No Report
French Polynesia		6.5	NA
FSM		0.2	100
Indonesia		0	0
Japan	Not reported		Not reported
Kiribati	Not reported		Not reported
Korea		0	0
Mexico	No Report		No Report
Nauru	No Report		No Report
New Caledonia		9	NA
New Zealand		19	9
Niue	No Report		No Report
Palau	No Report		No Report
Philippines	Not reported		Not reported
PNG	Not reported		20 (foreign access fleet)
RMI		0	100
Samoa	No Report		No Report
Senegal	No Report		No Report
Solomon Islands		1.47	99.53
Tokelau	No Report		No Report
Tonga	No Report		No Report
Tuvalu	Not reported		Not reported
USA	27.4% (HI), 25% (Am Samoa)		100%
Vanuatu	100 (locally based foreign vessels)		100 (locally based foreign vessels)
Vietnam	Not reported		Not reported
Wallis and Futuna	No Report		No Report

- If there have been recommendations for onboard observer coverage rates by the RFMO's scientific body, then for how many of the fisheries managed by the RFMO do current observer coverage rates meet the scientific body's recommendations? Recommended observer coverage rates made by an RFMO scientific body might include a schedule for increasing coverage, such that current coverage rates might not meet the final recommended level, but might meet the rate specified in the recommended schedule for gradual increase. [Recommended coverage rates may reflect rates needed to meet objectives of analyses, taking into account required levels

of accuracy and precision, the rate of bycatch interactions, amount of fishing effort, and distribution of discarded catch (Hall, 1999; McCracken, 2005; Gilman, 2011)].

The recommendations for observer coverage rates of non-purse seine fisheries are not yet in effect. The requirement for 100% onboard observer coverage by observers from the Commission’s Regional Observer Program of purse seine vessels operating in the area bounded by 20°N and 20°S is currently in effect as of the FAD seasonal closure in 2009, and from 1 January 2010 onwards, as is the requirement for 100% monitoring of longline transshipments at sea, which commenced in 2011 (WCPFC, 2008a).

Available information prevents determining if regional observer coverage rates of purse seine vessels operating in the Convention Area between by 20°N and 20°S reached 100% as of 1 January 2010, because data as reported did not enable a determination of whether vessels lacking a regional observer were either not in 20°N - 20°S portion of the Convention Area, or were fishing entirely in their own EEZ where a regional observer is not required, however, available information indicates that observer coverage was close to 100% in this area (WCPFC, 2011d). WCPFC’s Technical and Compliance Committee reported that, “It is not known if all carrier vessels transshipping at sea are carrying an observer, as it is impossible for the Commission Secretariat to know how many carriers maybe (sic) in the area, and how many of these intend to transship at sea,” (WCPFC, 2011d).

- For each fishery under the RFMO’s mandate, are international onboard observers assigned through a regional programme, or are they assigned by national fisheries management authorities?

CCMs are required to source observers for their vessels as determined by the Commission (WCPFC, 2007c). Observers may be sourced from national programmes and sub-regional programmes that are approved as observer providers to the Regional Observer Programme, and vessels may carry observers of their own nationality if the observers have been approved by the WCPFC Secretariat (WCPFC, 2007c).

Criterion 1C. Dataset Quality

Score: 6 of 11 possible points, 55%.

Table A1.13-3 provides details on the assessment outcome for criterion 1C.

Table A1.13-3. Assessment of WCPFC observer program data quality.

Factor	Points for positive response
A regional observer programme database with records of bycatch exists.	1
Either (i) the regional observer programme database is comprised of records pooled from observed national fisheries; or (ii) individual national observer programme datasets reported to the RFMO are in a standardized format that permits pooling.	1
The regional observer programme dataset is <5 years long.	1
It is assumed that ≥90% of Members reported regional observer data in 2010. All CCMs with regional observer coverage of purse seine trips in	3

<p>2010 reported data to the WCPFC data service provider, although data from 33% of observed trips had yet to be reported. Regional observer coverage of longline trips was <1% in 2010, and CCMs reported “very little” trip data in that year; however, it is not known how many CCMs, if any, with regional observer coverage of longline trips, did not report the data.</p>	
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Information used for assessment:

- Does a regional observer programme database exist? If yes, does the database include information on the capture of bycatch?

Yes. The Secretariat of the Pacific Community (SPC) Oceanic Fisheries Program provides database management services under contract to WCPFC, and is the custodian of regional observer program datasets submitted by WCPFC CCMs (Secretariat of the Pacific Community, 2011). Because the Regional Observer Program data collection protocols include the collection of information on bycatch, including discarded bycatch, from purse seine, longline and pole-and-line fisheries (WCPFC, No Date; SPC/FFA, 2009), it is assumed that the regional observer programme database includes fields for these records.

- If there is a regional observer programme, is there a dataset owned or managed by the RFMO Secretariat comprised of records pooled from observed national fisheries (e.g., the RFMO manages an observer programme, placing international observers on Parties' vessels, from which data are reported directly to the RFMO, or Parties submit national observer programme datasets to the RFMO, where they are pooled into a single regional database)? If individual national observer programme datasets are not pooled into a single regional dataset, then are national datasets submitted to the RFMO in standardized formats prescribed by the RFMO that enable pooling (e.g., are units of effort and taxonomic levels and names of catch consistent between the datasets)?

SPC pools/integrates the individual datasets submitted as part of the Regional Observer Program (Secretariat of the Pacific Community, 2011).

- What is the length in years of the regional observer programme dataset?

4 years. The WCPFC Regional Observer Program was initiated in 2007 (WCPFC, 2007c).

- Have observer data been collected evenly across seasons for observed fisheries? Are there gaps in seasonal observer coverage of managed fisheries?

Purse seine regional observer coverage is required to be 100% between 20°N and 20°S, and thus achieves even seasonal distribution in this portion of the Convention Area. Observer coverage rates on purse seine vessels operating outside of this area, and on longline vessels, are low and likely do not obtain even temporal distribution.

Historically, observer coverage held by SPC has not been distributed evenly spatially, temporally (by year or season) or by fleet (Gilman, 2006); given that Regional Observer Program coverage of WCPFC longline fisheries remains <1%, it is assumed that the historical uneven spatial and temporal coverage continues.

- Have observer data been collected evenly across fishing grounds for each observed fishery? Are there gaps in spatial observer coverage of managed fisheries?

Purse seine vessels operating between 20°N and 20°S are required to have 100% onboard observer coverage; purse seine coverage outside of this area has a target coverage rate of 5%. Required minimum observer coverage rates under the Regional Observer Program for longline vessels fishing for fresh fish north of 20° north have yet to be established.

Furthermore, the WCPFC Regional Observer Programme is intended to provide coverage of vessels fishing in the Convention Area that either fish (i) on the high seas, (ii) on the high seas plus in the EEZ of one or more coastal State, or (iii) in the EEZs of two or more coastal States, but not coverage of vessels operating only in the EEZ of one coastal State (WCPFC, 2007c). Thus, in concept, vessels/fisheries under WCPFC's mandate that operate in the Convention Area but only in the EEZ of one coastal State may not have regional observer coverage.

- Which countries with fisheries under the RFMO's mandate are not Members or Cooperating Non-Members?

Democratic People's Republic of Korea (DPRK) has applied to become a Cooperating Non-Member but the Commission has not approve the application (WCPFC, 2011a).

- For each fishery that is a part of the regional observer programme, are certain vessel classes exempt from carrying onboard observers, or are Members not required to provide data on certain vessel classes to the RFMO?

Small vessels, the minimum size of which has yet to be determined, are exempt from participating in the Regional Observer Program (WCPFC, 2007c).

- Which Member States do not routinely report required observer data on bycatch to the RFMO (FAO, 1995 [Articles 8.4.3, 12.4]; Small, 2005)? More specifically, either in each of the last three years, or for the full duration of the regional observer programme, whichever period is shorter, how many Members have not submitted regional observer data to the RFMO?

Regional observer providers report observer data directly to the Secretariat of the Pacific Community (SPC), the data service provider for WCPFC, and SPC has reported that there is a backlog in some regional observer programme observer data being submitted to SPC for data entry (WCPFC, 2011f). There were 23 programmes authorized by WCPFC to be WCPFC Regional Observer Programme Observer Providers as of 16 October 2011, which are national fishery management authorities and the Pacific Islands Forum Fisheries Agency (WCPFC, 2011f). For purse seine trips observed by a regional observer in 2010, SPC has yet to receive 33% (581 of a total of 1751 observed trips) of data from observed trips (WCPFC, 2011f). Of the eight national observer programmes that provided the regional observer coverage of the purse seine trips, all had reported a portion of trip data to SPC (WCPFC, 2011f). Similar information was not reported for longline observed trips, however, the 5% regional observer coverage of longline effort takes effect on 30 June 2012, and WCPFC reported that in 2010 the observer coverage rate was <1%, and there was "very little" longline data reported to SPC (WCPFC, 2011f). Pursuant to CMM 2007-

01, by 30 June 2012, CCMs are to also provide $\geq 5\%$ coverage of the effort in all other WCPFC-managed fisheries (WCPFC, 2007c), however, WCPFC (2011f) did not identify CCM's reporting regional observer data from non-purse seine nor non-longline fisheries in 2010, likely due to low or no regional observer coverage of these fisheries.

Given that standardized forms have been developed to provide minimum data collection protocols by regional observers, it is assumed that all CCMs participating in the WCPFC Regional Observer Program report data records on bycatch. However, datasets containing neither primary nor amalgamated observer records are publically available. WCPFC fishery-dependent datasets that are publically available do not identify the method for the collection of the available amalgamated records (i.e., from onboard observers, dockside monitoring, logbooks, research surveys, VMS, etc., or pooled from combined monitoring methods).

Criterion 2. Open access to bycatch data

Score: 7 of 15 possible points, 47%.

Table A1.13-4 provides details on the assessment outcome for criterion 2.

Table A1.13-4. Assessment of WCPFC provision of open access to regional bycatch and discards datasets.

Factor	Points for positive response
There is a regional observer programme dataset containing records of bycatch, and datasets of amalgamated and not primary data records are open access and records are amalgamated by ≤ 5 degree cells.	2
Primary or amalgamated observer data for $\geq 75\%$ of fisheries included in the regional observer programme are open access.	5

Information used for assessment:

- Does a regional observer programme dataset containing records on bycatch exist?

Yes, SPC pools and manages the WCPFC regional observer programme dataset. The regional observer program dataset includes records of catch and retention/discarding of bycatch.

- What confidentiality rules have been adopted on access to data on bycatch and discards that the RFMO owns or holds as a custodian?

The WCPFC Regional Observer Programme is mandated to ensure the confidentiality of non-aggregated data and other information deemed by the Commission to be of a confidential nature, and the release of data from the programme is to be conducted in accordance with the Commission's *Rules and Procedures for Access to, and Dissemination of, Data Compiled by the Commission* (WCPFC, 2007c,d). According to these Rules of Procedures, operational-level catch effort data, which are data records collected both via logbooks and observers, are categorized as high risk (WCPFC, 2007d).

- Are primary or amalgamated data available as an open public resource?

Only amalgamated data are publically available (WCPFC, 2011e). The publically available dataset pools data records from logbook and observer monitoring, and it is not possible to determine the source of an individual record.

It may be possible for researcher to obtain observer data by submitting a WCPFC Data Request Form and Confidentiality Agreement. If WCPFC provided the confidential dataset, the data would be aggregated by at least 5° x 5° cells for data collected from longline fisheries and 1° x 1° cells for data collected from purse seine fisheries, and the dataset would be processed to remove records as necessary in order to comply with a "minimum three vessel" rule, such that data will be released only for those strata covered by at least three vessels.

- If only a dataset of amalgamated records from the onboard observer programme is made publically available, is the dataset of amalgamated records at a resolution of ≤5 degree cells, >5 degree cells, or is information on resolution of records in the publically available dataset not specified?

Data are amalgamated by 5° x 5° cells (WCPFC, 2011e).

- If only amalgamated records from a regional onboard observer programme are made available to the public, has the amalgamation of records prevented any research applications that would have been feasible with the primary data? E.g., is the resolution of amalgamated data insufficient to identify spatial trends in bycatch, or has information on any factors known to significantly affect bycatch rates been eliminated from the publically available dataset (e.g., standard unit of fishing effort, fishing gear and methods, timing of fishing operations, taxonomic level) (Chaloupka and Balazs, 2005; Sullivan et al., 2006; Gilman et al., 2008b)?

The public domain dataset is not adequate for fundamental research applications. This is due to the limited fields available in the dataset (year, month, coordinates of the southwest corner of the 5° cell, effort [e.g., hooks set in that cell in that month], and catch only for principal market species and 'other'), low resolution of amalgamation, and pooling of records from both logbook and observer monitoring with no separation of these different sources within the database (WCPFC, 2011e).

- Of the fisheries that are included in the regional observer programme, for how many are primary or amalgamated datasets open access?

Regional Observer Program coverage occurs in purse seine and longline fisheries. Amalgamated data are available for both of these fisheries.

Criterion 3: Ecological risk assessment

Score: 2 of 8 possible points, 25%.

Table A1.13-5 provides details on the assessment outcome for criterion 3.

Table A1.13-5. Assessment of WCPFC ecological risk assessment.

Factor	Points for
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	positive response
Level 2 and/or 3 assessment has been conducted for either the effects of fishing on bycatch species or the effects of bycatch on the integrity of the ecosystem, but not both, for at least 1 fishery.	2

Information used for assessment:

- Identify each ecological risk assessment study that has been conducted by the RFMO. Identify the level of assessment conducted, per Hobday et al. (2007, 2011), Kirby (2006), and Sainsbury and Sumaila (2001).

Level 2 assessments have been conducted for WCPFC-managed longline and purse seine tuna fisheries for 236 species and 79 species groups of target and bycatch species (Kirby, 2006). These represent all species and species groups that had been observed caught in WCPO tuna longline and purse seine fisheries as documented in records of the Secretariat of the Pacific Community database, which pools several WCPO observer programmes (Kirby, 2006). The species groups were used by observers when identification to the species level was not possible (Kirby, 2006).

The 2006 level 2 Productivity-Susceptibility Analyses were updated in 2007 for deep- and shallow-set pelagic longline fisheries (Kirby and Hobday, 2007). The assessment of relative risk was conducted for (i) all 233 species observed caught, (ii) a subset of all 190 fish species observed caught, and (iii) a subset of all 99 species of special interest of birds, mammals, reptiles and sharks. The methods employed included a component that assessed the vertical overlap of assessed species and fishing gear terminal tackle, but did not account for geo-spatial (horizontal) overlap in species' distributions and fishing grounds.

A level 2 assessment was conducted for the effects of WCPFC-managed longline tuna fisheries on seabirds (Kirby et al., 2009). The assessment identified where the distributions of seabird species determined to be at risk of capture in pelagic longline fisheries overlapped, both spatially and temporally, with pelagic longline fishing effort in the WCPFC Convention Area, and employed selected life history parameters for each included seabird species as indicators of productivity and susceptibility, identifying areas where the highest risk of population-level effects from bycatch in longline fisheries was predicted to occur (Kirby et al., 2009).

Small (2005) conducted a partial Level 2 risk assessment, by assessing the overlap of 14 RFMO areas with albatross distributions

- For each fishery managed by the RFMO, identify whether an ecological risk assessment has been conducted that assesses the effects of the fishery on bycatch species and/or the effects of bycatch removals on ecosystem integrity.

Ecological risk assessments have been conducted for WCPFC-managed longline and purse seine fisheries (summarized in the previous bullet). Thus, risk assessments have been conducted for 2 of 5 managed fisheries (no assessments for pole and line, troll, and other small-scale gears).

- Describe the results of each ecological risk assessment. Describe the findings in terms of what ecological risks each assessed fishery poses, identify whether more rigorous ecological risk assessment was recommended. If a more rigorous

assessment was recommended, has it been conducted, in progress, or planned to be conducted?

Kirby (2006) found several shark species to be the highest risk group in both longline and purse seine fisheries, with silky shark being of highest risk in both fisheries, as well as short-finned mako, porbeagle, and oceanic whitetip sharks due to being frequently captured and having low fecundity relative to, for example, blue sharks and hammerhead sharks. Most caught sharks are retained: 31% and 39% of caught sharks were discarded alive in longline and purse seine fisheries, respectively (Kirby, 2006). Of teleosts, Kirby (2006) found target tunas and billfish, plus wahoo and mahi mahi, to have highest risk scores, due to high susceptibility as they are targeted, and not due to low productivity. No non-target teleost species were identified as high-risk (Kirby, 2006). Several additional shark species were found to be of high risk, when assessing only condition at capture, age classes subject to fishing mortality, and fate of captures (collectively referred to as susceptibility) and life history characteristics (productivity), but based on information on fishing mortality, these species experience nominal fishing mortality in these fisheries and hence are of low risk of experiencing population-level effects from these fisheries.

Kirby and Hobday (2007) found species of albatrosses and petrels to be of high or medium relative risk in pelagic longline deep- and shallow-set fisheries (relative to all species caught, and relative to other special interest species). Turtles were relatively high risk relative to all species caught, and medium risk relative to other special interest species, except for leatherback turtles, which ranked low and medium risk relative to all species, and relative to other special interest species, respectively, due to leatherbacks having a lower age at maturity, occurring deeper in the water column, and a large proportion of caught leatherbacks being retrieved alive and discarded compared to other marine turtles (Kirby and Hobday, 2007). Rays were high risk relative to other fish species, and several shark species were high risk relative to all caught species, due in part to only 30% of sharks being discarded alive without being finned (Kirby and Hobday, 2007). Most sharks did not rank as high risk relative to other fish because predominantly juvenile sharks are caught. Principal market species had a medium relative risk due to relatively high susceptibility. Blue marlin, frigate mackerel, longtail (tonggol) tuna, Spanish mackerel, and sailfish were of high risk relative to all caught species (Kirby and Hobday, 2007).

Areas with the highest probability of species-level population effects from bycatch in WCPFC-managed pelagic longline fisheries generally occurred along a broad swatch from New Zealand northeast to the Hawaii archipelago (Kirby et al., 2009). The ten most at risk seabird species were six tropical gadfly petrels (genuses *Pterodroma* and *Pseudobulweria*), one tropical shearwater, and three mainly temperate albatross species. The next 15 ranked at-risk seabird species were primarily IUCN-listed threatened species of petrels and albatrosses (Kirby et al., 2009). Interactions between the relatively small-sized tropical petrels and shearwater species and longline fisheries is not well understood; i.e., it is not currently known if these species are captured in longline fisheries.

Small (2005) found that WCPFC was the second ranked RFMO in terms of overlap with albatross distribution.

Criterion 4A. Conservation and Management Measures to Mitigate Problematic Bycatch
Score: 7 of 18 possible points, 39%

Table A1.13-6 provides details on the assessment outcome for criterion 3.

Table A1.13-6. Assessment of WCPFC conservation and management measures to mitigate bycatch, and efficacy.

Factor	Points for positive response
One or more bycatch problem has been identified to occur in one or more fisheries managed by the RFMO, and binding measures are in place to mitigate at least one identified problem but <50% of the number of identified problems.	1
≥50% but <75% of binding measures to mitigate bycatch include measurable performance standards.	2
Of binding bycatch measures that contain quantitative performance standards, at least one measure but <50% of the measures have been assessed for efficacy.	1
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Based on the review of ecological risk assessments conducted under Criterion 3, list each bycatch and discard problem for each fishery managed by the RFMO.

Ecological risk assessments of WCPFC-managed longline and purse seine fisheries have identified the following bycatch problems:

- Pelagic longline: silky, short-finned mako, porbeagle, oceanic whitetip and other shark species, species of seabirds (albatrosses, petrels and shearwaters), sea turtle species, and several non-target teleosts (blue marlin, frigate mackerel, longtail tuna, Spanish mackerel, and sailfish) (Small, 2005; Kirby, 2006; Kirby and Hobday, 2007; Kirby et al., 2009)
- Purse seine: silky, short-finned mako, porbeagle, oceanic whitetip and other shark species (Kirby, 2006)
- List bycatch problems that have been documented to occur in fisheries managed by the RFMO from studies other than ecological risk assessments. If there is limited information on the effects of the managed fisheries on species subject to bycatch and the ecological effects from bycatch removals, then list the occurrence of problematic bycatch that occurs in the same gear types as documented in other regions, which is likely to also occur in the fisheries managed by this RFMO?

WCPFC-managed fisheries for tunas and tuna-like species may have the following bycatch problems:

- Purse seine: Sharks (primarily silky and oceanic white tip), juvenile bigeye and yellowfin tunas, other unmarketable species and sizes of fish, sea turtles, cetaceans (Clarke, 2011a,b; Clarke et al., 2011; Gilman, 2011; Lawson, 2011);
- Pelagic longline: Elasmobranchs, seabirds, sea turtles, cetaceans, juvenile swordfish, other species of non-targeted fish (Petersen et al., 2007; Bugoni et al., 2008; Williams et al., 2009; FAO, 2010a; Clarke, 2011a,b; Clarke et al., 2011; Gilman, 2011; Lawson, 2011).

- Pole-and-line: Seabirds (Bugoni et al., 2008).
- Trolling: Seabirds (Bugoni et al., 2008).
- Gillnet: Sea turtles, elasmobranchs, marine mammals, coastal seabirds, waterbirds (Melvin et al., 2001; Read et al., 2006; Gilman et al., 2009; Kiszka et al., 2009; Zydalis et al., 2009; FAO, 2010a).
- Traps: Elasmobranchs, other mostly marketable finfish species (mostly Scianidae and Sparidae) (Neves dos Santos et al., 2002; Storia et al., 2011).
- Driftnet fisheries: Elasmobranchs, cetaceans and other marine mammals, seabirds, sea turtles, sharks, unmarketable species and sizes of finfish (Northridge, 1991; Goni, 1998; Silvani et al., 1999; Uhlmann et al., 2005).
- Pelagic handline fisheries: Seabirds (Bugoni et al., 2008).

Williams et al. (2009) summarizes sea turtle interaction rates, and condition of the turtles upon gear retrieval, from observer programme data of WCPFC-managed pelagic longline and purse seine tuna fisheries. Turtle interaction rates were higher in tropical vs. temperate areas. Leatherback/loggerhead turtle encounters being more prevalent in sub-tropical to temperate waters, while species encountered in tropical/sub-tropical waters include Olive Ridley, green, loggerhead, hawksbill, flatback and leatherback turtles (Williams et al., 2009). Sea turtle interaction rates were higher in shallow/night-set longline fisheries relative to deep/daytime-set fisheries. Sea turtle interaction rates based on turtles captured per set were substantially lower in purse seine fisheries relative to longline fisheries. Nominal sea turtle catch rates were highest in animal-associated purse seine sets (1.6 turtles/100 sets), followed by sets on anchored FADs (0.78 turtles/100 sets), then sets on drifting logs (0.78 turtles/100 sets), followed by unassociated sets (0.61 turtles/100 sets), and were lowest for sets made on drifting FADs (0.28 turtles/100 sets) (Williams et al., 2009). Sea turtle interactions in pole-and-line, troll and other tuna fisheries was considered to be non-existent or otherwise information was not available (Williams et al., 2009).

Several recent assessments have been conducted of shark catches in WCPFC-managed longline and purse seine fisheries, focusing on up to 13 key shark species as designated by the Scientific Committee of WCPFC (CMM 2010-07): blue (*Prionace glauca*); shortfin (*Isurus oxyrinchus*) and longfin (*I. paucus*) makos; oceanic whitetip (*Carcharhinus longimanus*); silky (*C. falciformis*); bigeye (*Alopias superciliosus*), common (*A. vulpinus*) and pelagic (*A. pelagicus*) threshers; porbeagle (*Lamna nasus*); scalloped (*Sphyrna lewini*), smooth, (*S. zygaena*), and great (*S. mokarran*); hammerheads; and winghead (*Eusphyra blochii*) (Clarke, 2011a,b; Clarke et al., 2011; Lawson, 2011). The designation of these key shark species was based on several factors, including: (i) high risk from fishing activities based on the WCPFC's Ecological Risk Assessment project; (ii) ease of identification; and (iii) frequency of reporting in annual catch data provided by Commission members and cooperating non-members (Clarke and Harley, 2010).

Networks of thousands of artificial drifting and anchored FADs used in WCPFC-managed tuna fisheries aggregate pelagic species from surrounding waters, and possibly act as 'ecological traps' of these species by altering their natural spatial and temporal distributions, habitat associations, migration patterns and residence times (Marsac et al., 2000; Bromhead et al., 2003; Hallier and Gaertner, 2008; Dagorn et al., 2010; Gilman, 2011).

- Using Table A1.13-7, summarize active legally binding conservation and management measures that mitigate bycatch, and identify any quantitative and measurable performance standards included in each measure (e.g., target reference points for bycatch species or species groups, such as Maximum Sustainable Yield or the more precautionary Maximum Economic Yield; limit reference points for the impacts of fishing on bycatch fish species; limits on catch rates or levels for protected or threatened bycatch species; minimum sink rate for hook-and-line terminal tackle; minimum depth for gear when soaking [United Nations, 1995; Garcia, 2000; Mace, 2001; Lodge et al., 2007; Cullis-Suzuki and Pauly, 2010; Gilman, 2011]).

This information has been recorded in Table A1.13-7.

CMM 2010-05 requires CCMs to annually report bycatch levels of South Pacific albacore, and CMM 2005-03 requires CCMs to annually report total catch levels of North Pacific albacore from the Convention Area north of the equator, but the measures do not require the employment of albacore bycatch mitigation measures (WCPFC, 2005a, 2010e).

- From the responses to the first two bullets, list each individual documented bycatch problem.

A summary of the bycatch problems in WCPFC-managed fisheries as identified in the first two bullets follows:

- Purse seine: Sharks, juvenile tunas, other unmarketable species and sizes of fish, sea turtles, cetaceans;
 - Pelagic longline: Elasmobranchs, seabirds, sea turtles, cetaceans, juvenile swordfish, other species of non-targeted fish.
 - Pole-and-line: Seabirds.
 - Trolling: Seabirds.
 - Other small-scale tuna fishing methods, including artisanal methods (gillnet, traps, small-scale driftnets, handline): Sea turtles, elasmobranchs, marine mammals, seabirds, waterbirds, bony fish.
- For what proportion of potentially existing or documented bycatch problems (considering both the adverse effects on species subject to bycatch and effects of bycatch removals on ecosystem integrity) in fisheries managed by the RFMO are binding conservation and management measures in effect (i.e., are measures based on the best scientific evidence available) (FAO, 1995 [Article 12.13]; Caddy, 1996)?

There are WCPFC binding CMMs in effect to address 9 of the 19 bycatch problems identified in the previous bullet. The bycatch problems that are not addressed by a CMM are: cetaceans and other unmarketable species and sizes of fish in purse seine fisheries; cetaceans and juvenile swordfish in longline fisheries; seabirds in pole-and-line fisheries; seabirds in troll fisheries; and marine mammals, seabirds, waterbirds, bony fish in other small-scale tuna fisheries. Measures related to managing bycatch of North Pacific striped marlin and swordfish from the south Pacific (WCPFC, 2009h, 2010f) were considered to address pelagic longline bycatch of 'other' non-target fish species.

- What proportion of binding bycatch mitigation measures contain quantitative, measurable performance standards?

50% (4 of 8) (Table A1.13-7).

- For what proportion of conservation and management measures that include measurable performance standards has efficacy been assessed?

Efficacy has been assessed against performance standards for one of four measures containing quantitative performance standards.

CMM 2008-01 is intended to improve the sustainability of exploitation of yellowfin and bigeye WCPO stocks, includes a temporal closure on purse seine sets on FADs, and has been assessed for compliance. Higher bycatch rates of juvenile bigeye and yellowfin occurs in purse seine sets on floating objects relative to sets on unassociated sets (Gilman, 2011). The efficacy of 2009-01 in terms of reducing juvenile bigeye and yellowfin tuna bycatch fishing mortality in purse seine fisheries is as yet undetermined, however, the number of purse seine sets on FADs in 2009 was the second highest level on record despite the temporal closure (Secretariat of the Pacific Community, 2010), and hence based on this, efficacy of the measure to address this bycatch problem is likely low.

The WCPFC binding measures on sharks contains a quantitative performance standard of a 5% limit of ratio of weight of retained shark fins to carcasses (WCPFC, 2010a). Insufficient monitoring, in particular in pelagic longline fisheries, hampers efforts to assess compliance and hence achievement of the shark measure's stipulated standard. Furthermore, the form of the fins (frozen vs. dried) and form of the carcass (whole weight, dressed or partially dressed) is not specified in the measure, which precludes defining a clear method to assess compliance (Fowler and Seret, 2010). Furthermore, the 5% limit of ratio of weight of retained shark fins to carcasses, even if it did lend itself to being monitored for compliance, may not achieve the measure's explicit objective of achieving sustainable shark fishing mortality if there is market demand for shark meat, as has been documented to be increasing in some regions (Gilman et al., 2008a; Gilman, 2011).

No assessments of combined WCPFC-managed fisheries presented information on temporal trends in total shark fishing mortality by weight or number, which would provide a direct measure for assessing efficacy of the shark measure in meeting the implicit objective of reducing shark fishing mortality. This could be estimated via fleet-wide estimates of the total number of sharks retained (whole or just fins), dead discards, plus unobserved mortalities.

Clarke (2011a) investigated the efficacy of the WCPFC shark measure (CMM 2010-07, WCPFC, 2010a) in terms of reducing fishing mortality of eight key shark species, and concluded that the effectiveness is unclear. Since the first WCPFC shark finning measure came into effect in February 2007, based on observer data of WCPFC-managed longline fisheries included in the Secretariat of the Pacific Community pooled dataset, the proportion of caught sharks that were released remained roughly the same in 2007 and 2008 relative to 2006, and the proportion of caught sharks that were finned and carcass discarded also experienced only a small change, increasing slightly (42% in 2006, 53% and 58% in 2007 and 2008, respectively) (Clarke, 2011a), suggesting that, for longline fisheries, the efficacy of the measure in meeting the objective of achieving full utilization is not being met. Analysis of purse seine observer data, however, revealed declining proportion of caught sharks that were finned and increasing proportion being discarded (Clarke, 2011a), indicating that the measure has been effective in both increasing full utilization and reducing shark fishing mortality in purse seine fisheries. The

assessment also reviewed available information on the status of these species' stocks in the WCPO, concluding that concern is warranted for blue sharks as the stock may have become overfished since the most recent assessment by Kleiber et al. (2009), and concluded that the WCPO oceanic white tip population is in a depleted state. Information on stock status of the other key shark species were determined to either be inconclusive due to data-deficiencies, or there was no strong evidence of overexploitation from interpretation of temporal trends in relative abundance (standardized catch rates) and length distributions (Clarke, 2011a).

The Secretariat of the Pacific Community (SPC), the data provided to WCPFC, conducted a one-day workshop on "Monitoring the effectiveness of WCPFC Conservation and Management Measures for bycatch" (Kirby, 2009). The workshop identified any stated explicit standard for efficacy as well as implicit standards for WCPFC measures on sharks, seabirds and sea turtles. Implicit standards were identified in part via information from individuals involved with drafting the measure. The workshop participants then identified scientific monitoring and analysis required to assess the efficacy of measures against these performance standards. In the case of the WCPFC shark measure, the workshop participants concluded that, "The shark CMM would be more transparent, less prone to creative compliance, more open to substantive compliance, and more amenable to further scientific monitoring and analysis, if the desired outcome was explicitly expressed in terms of a decrease in fishing mortality by comparison to a reference year/period," (Kirby, 2009). This was based on the determination that the implicit objective of the shark measure is to reduce shark fishing mortality. Adherence to the 5% fin to carcass ratio may be a less effective standard to achieve reduced shark fishing mortality than a standard that stipulates scientifically-based, species-specific limit reference points (Gilman, 2011).

Measures limiting total annual catch levels of South Pacific swordfish (WCPFC, 2009h) and North Pacific striped marlin (WCPFC, 2010f) have been assessed annually in that CCMs have reported retained catch levels of these species from designated areas through Part 1 and 2 reports to the Commission. However, due to low onboard observer coverage rates in longline fisheries, records of total catch levels (both retained and discarded catch) of these species are unavailable in order to assess the efficacy of the measures against their performance standards.

- For each binding bycatch measure that contains performance standards, which have been determined to be effective in meeting the stipulated performance standards?

None of the four measures containing performance standards has been determined to definitively be achieving their performance standards.

Insufficient monitoring, in particular in pelagic longline fisheries, hampers efforts to assess compliance and hence achievement of the swordfish, striped marlin and shark measures' standards. Furthermore, the 5% limit of ratio of weight of retained shark fins to carcasses, while lending itself to being monitored for compliance, may not achieve the measure's explicit objective of achieving sustainable shark fishing mortality in IATTC-managed fisheries (Gilman, 2011). The restrictions on shark finning practices has limited potential to control shark fishing mortality levels if WCPFC-managed fisheries have markets for shark meat, this in addition to problems in compliance due to limited resources for surveillance and enforcement (Gilman et al., 2008a; Gilman, 2011).

Available information on the status of some WCPO shark stocks suggests that the WCPFC shark measure has not resulted in reduced shark fishing mortality. The north Pacific blue shark (*Prionace glauca*) stock's biomass is close to its MSY-based

reference point and the exploitation fishing mortality rate is approaching the MSY-based reference point, based on data through 2002 (Kleiber et al., 2009), while more recent observations of declining trends in standardized catch rates and increased targeting of blue sharks by some commercial longline fisheries suggest further declines in abundance have occurred since 2002 (Gilman et al., 2008a; Clarke, 2011). Stock assessments of other Pacific pelagic sharks caught in longline and purse seine tuna fisheries have yet to be conducted but are planned (Clarke and Harley, 2010; Clarke et al., 2010). Oceanic white tip standardized catch rates from Pacific longline and purse seine fisheries have demonstrated declining temporal trends (Minami et al., 2007; Clarke, 2011; Clarke et al., 2011a,b; Walsh and Clarke, 2011).

- Of the binding bycatch measures that have been determined to be lacking in effectiveness either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment (e.g., Gilman et al., 2007a, 2008b), for how many have steps been taken or are in progress to improve efficacy?

One of four. A new CMM is planned to be adopted in 2011 to replace CMM 2008-01. Consideration to replace the seasonal FAD closure with a full purse seine closure may result in increased compliance and hence efficacy of the measure in meeting performance standards, if adopted and effectively implemented.

- Does the RFMO allow Member States to opt out of binding conservation and management measures (e.g., reservations or other forms of opt-out)? If yes, is information available documenting whether or not members are employing the opt out provision so as to not employ measures relevant to this criterion, or otherwise is information on employment of the opt out provision not available?

No, WCPFC members cannot opt out of binding measures (WCPFC, 2000 [Article 20]).

Table A1.13-7. Active WCPFC legally binding conservation and management measures related to the mitigation of problematic bycatch, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary: (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Seabirds			
<p>Longline vessels, when in areas south of 30° S. latitude and north of 23° N. latitude, must employ at least two seabird bycatch mitigation measures from a list of eight alternatives, one of which must be either: (i) side setting in combination with a bird curtain and weighted branch lines (counts as 2 measures; can only be selected for vessels fishing north of 23 degrees N. latitude), (ii) night setting, (iii) tori line (paired tori lines count as 2 measures), or (iv) weighted branch lines. The second method can be a second measure from this first list, or otherwise one of the following must be selected: (v) blue-dyed bait, (vi) mainline shooter, (vii)</p>	<p>No performance standards are stipulated to assess the measure's effectiveness.</p>	<p>Longline fishing gear terminal tackle design; Longline vessel presence onboard and design of bird mitigation equipment (e.g., tori pole and line, bird curtain, underwater setting chute, blue dye); Longline vessel fishing practices (e.g., timing of setting, location on deck where mainline is set, offal discharge practices, baited hooks set through underwater setting chute); Location of longline fishing vessels when operating; List of longline vessels authorized to fish in the Convention Area.</p>	<p>a, b, c, e</p>

<p>underwater setting chute, or (viii) management of offal discharge (WCPFC, 2007a). Vessels ≤ 24m in overall length fishing north of 23° N. latitude are exempt (WCPFC, 2007a).</p>			
<p>Sea turtles</p>			
<p>CCMs shall require vessels to:</p> <p>(i) Applicable to all WCPFC-managed fisheries, bring aboard, if practicable, any captured hard-shell sea turtle that is comatose or inactive as soon as possible and foster its recovery according to WCPFC handling and mitigation guidelines, prior to returning the turtle to the water.</p> <p>(ii) Purse seine vessels shall ensure, to the extent practicable, that they avoid encircling sea turtles, and if a sea turtle is encircled or entangled in a FAD or other gear, take practicable measures to safely release the turtle;</p> <p>(iii) If a sea turtle is entangled in a purse seine, stop net roll as soon as the turtle comes</p>	<p>No performance standards are stipulated to assess the measure's effectiveness.</p>	<p>For longline and purse seine vessels, sea turtle handling and release equipment onboard; For all fisheries, fishing practices for handling and releasing turtles observed captured; Hook and bait type used on shallow-set longline vessels; List of longline and purse seine vessels authorized to fish in the Convention Area.</p>	<p>a, b, e</p>

<p>out of the water; disentangle the turtle without injuring it before resuming the net roll, and to the extent practicable, assist the recovery of the turtle before returning it to the water;</p> <p>(iv) Purse seine vessels shall carry and employ dip nets, when appropriate, to handle turtles;</p> <p>(v) Longline vessels shall carry and use dip nets, line cutters and de-hookers to handle and promptly release sea turtles caught or entangled, in accordance with WCPFC guidelines;</p> <p>(vi) As of 1 January 2010, longline swordfish vessels employing shallow sets (CCMs are to establish and enforce their own definitions of shallow-set gear), shall use only large circle hooks (CCMs are to establish their own definition of 'large circle hook') with an offset of \leq 10 degree, whole finfish for bait, and any other method determined to effectively mitigate turtle bycatch rates. Fisheries</p>			
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determined to have 'minimal' observed sea turtle interactions (to be defined by the WCPFC Scientific Committee) over a three-year period and a level of observer coverage of $\geq 10\%$ during each of those three years are exempt from these requirements (WCPFC, 2008b).			
Marine mammals			
None	NA	NA	NA
Shark and relatives			
CCM's vessels are required to: (i) keep all parts of retained sharks, excluding head, guts and skins, to the point of first landing or transshipment; (ii) have onboard fins that total $\leq 5\%$ of the weight of sharks onboard, up to the first point of landing, or otherwise ensure compliance with the 5% rule through certification, observer monitoring, require that vessels land sharks with fins attached to the carcass, or other method (WCPFC, 2010a). Vessels targeting tunas and tuna-like species	5% limit of ratio of weight of retained shark fins to carcasses.	Weight of landed shark fins and weight of remainder of shark carcasses; Shark discard practices; List of longline and purse seine vessels authorized to fish in the Convention Area	a, b, e

<p>not directed at sharks shall release sharks alive that are caught incidentally and are not used for food or other purposes (WCPFC, 2010a).</p>			
<p>Juvenile and small/undersized target species</p>			
<p>A binding measure on yellowfin and bigeye tunas requires:</p> <p>(i) 30% reduction in bigeye tuna fishing mortality by purse seine vessels (juvenile bigeye is typically bycatch in purse seine tuna fisheries) over a three year period commencing when the measure came into effect in 2009, in the portion of the Convention Area bounded by 20°N and 20°S;</p> <p>(ii) Except for small developing State members and participating territories, purse seine effort in terms of days fished on the high seas are not to exceed the 2004 levels or the average of 2001-2004;</p> <p>(iii) In 2009-2011, for Forum Fisheries Agency members belonging to the Parties to the Nauru</p>	<p>Stated as objectives, the measure includes three quantitatively assessable standards related to bycatch in purse seine fisheries, which occurs primarily on sets on floating objects:</p> <p>(i) Maintain bigeye and yellowfin tuna stocks at levels capable of producing maximum sustainable yield;</p> <p>(ii) Between 2009-2012 achieve a minimum 30% reduction in bigeye tuna fishing mortality from the annual average during the period 2001-2004 or 2004;</p> <p>(iii) No increase in yellowfin tuna fishing mortality from the average during the period 2001-2004 or 2004 (WCPFC, 2008a).</p>	<p>Weight of bigeye and yellowfin tuna landings and discards recorded by purse seine vessel Flag State, set type, set date, and set location;</p> <p>Purse seine set type from 1 August – 30 September 2009, and from 1 July – 30 September 2010-2011, in PNA Members' EEZs and on the high seas in the area bounded by 20°N and 20°S;</p> <p>Purse seine days fished in EEZ's of PNA members in 2009-2011;</p> <p>Starting 1 January 2010, location of purse seine sets in relation to the closed high seas pockets;</p> <p>Location of purse seine sets and distance from nearest FAD;</p> <p>Starting 1 January 2010, record of tuna discards by species by purse seine vessels operating within the area bounded by 20°N</p>	<p>c, d, e, f (real-time locations of all anchored and drifting FADs)</p> <p>Note that under (d), 100% onboard observer coverage would be required in all purse seine, longline, troll, pole-and-line, and other non-artisanal fisheries that take $\geq 2,000$ mt of bigeye and/or yellowfin tuna in order to observe the weight of retained and discarded bigeye and yellowfin tunas to determine compliance with the requirement for bigeye and yellowfin fishing mortality levels to not exceed the average level for the period 2001-2004 or 2004 (WCPFC, 2008a [paragraph 39]).</p>

<p>Agreement (PNA), purse seine days fished within EEZs of PNA members are to be no greater than 2004 levels;</p> <p>(iv) In 2009, temporal closure on purse seine sets on FADs and other floating objects (per more detailed definitions in WCPFC, 2009a) from 1 August – 30 September in PNA Members' EEZs and on the high seas in the area bounded by 20°N and 20°S, plus during this period all purse seine vessels must carry an onboard observer from the Regional Observer Program. In 2010-2011, the FAD/floating object sets closure is from 1 July – 30 September;</p> <p>(v) In 2009, members can implement a purse seine catch limit with 100% onboard observer coverage as an alternative to the FAD temporal closure. The catch limit must result in a reduction in purse seine bigeye catch weight in the area bounded by 20°N and 20°S by a minimum of</p>		<p>and 20°S;</p> <p>Weight of bigeye and yellowfin tuna landings and discards by purse seine vessels operating north of 20°N and south of 20°S;</p> <p>Weight of bigeye and yellowfin tuna landings and discards by non-artisanal troll, pole-and-line, and other non-artisanal fisheries;</p> <p>List of vessels authorized to fish in the Convention Area.</p>	
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<p>10% relative to the average catch weight from 2001-2004;</p> <p>(vi) Two high seas pockets (areas wholly enclosed by EEZs) are closed to purse seine fishing starting 1 January 2010;</p> <p>(vii) By 1 July 2009, submit to the Commission FAD Management Plans that at a minimum meet the Suggested Guidelines for Preparation for FAD Management Plans;</p> <p>(viii) Full retention of bigeye, yellowfin and skipjack tunas by all purse vessels operating within the area bounded by 20°N and 20°S from 1 January 2010 (juvenile bigeye and yellowfin tuna are typically bycatch in purse seine tuna fisheries);</p> <p>(ix) As of 1 January 2010, 100% onboard observer coverage by observers from the Commission's Regional Observer Program of purse seine vessels operating in the area bounded by 20°N and 20°S, excluding vessels that operate only in the EEZ of only one</p>			
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<p>coastal State (and not on the high seas or in the EEZ of a second coastal State);</p> <p>(x) Beginning in 2009, CCMs shall take necessary measures to ensure that the total capacity of their respective other commercial tuna fisheries for bigeye and yellowfin tuna, including purse seining that occurs north of 20°N or south of 20°S, but excluding artisanal fisheries and those fisheries taking less than 2,000 tonnes of bigeye and yellowfin, shall not exceed the average level for the period 2001-2004 or 2004. (WCPFC, 2008a).</p> <p>Also, as part of these measures, there are requirements related to controlling longline catches of bigeye and yellowfin tunas (WCPFC, 2008a, 2009a), but these requirements are not related to bycatch and discards and hence are not summarized here.</p>			
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<p>Fishing within 1 nm of a data buoy is prohibited in the Convention Area (WCPFC, 2009f). The CMM stipulates that the measure may contribute to meeting the Commission objective of reducing fishing mortality of juvenile bigeye and yellowfin tunas (WCPFC, 2009f).</p>	<p>No performance standards are stipulated to assess the measure's effectiveness.</p>	<p>Location of fishing effort; Location of data buoys; List of vessels authorized to fish in the Convention Area.</p>	<p>c, e</p>
<p>A measure requires phased reduction of catch levels of North Pacific striped marlin (WCPFC, 2010f), a non-target species in tuna and swordfish-targeting fisheries.</p>	<p>Annual catch limits of north Pacific striped marlin from north of the equator in the Convention Area are established for each CCM for 2011-2013 based on percent reductions from the highest catch between 2000-2003.</p>	<p>Location of fishing effort; Catch levels of North Pacific striped marlin north of the equator; List of vessels authorized to fish in the Convention Area.</p>	<p>c, d, e</p>
<p>A measure establishes individual CCM total allowable catch limits (TACs) for swordfish from within the Convention Area south of 20°S (WCPFC, 2009h); swordfish may be a non-target incidental catch in some fisheries, e.g., longline tuna fisheries. Exceeding the TAC in a given year results in a concomitant reduction in the TAC for the subsequent year (WCPFC, 2009h).</p>	<p>Limit annual catch of swordfish from the Convention Area south of 20°S to the amount caught during any one year during the period 2000-2006.</p>	<p>Location of fishing effort; Catch levels of swordfish south of 20°S; List of vessels authorized to fish in the Convention Area.</p>	<p>c, d, e</p>

Unmarketable sizes and species of non-target species of fish			
None	NA	NA	NA
Other or multiple bycatch species group(s)			
Use of large scale drift gillnets (>2.5 km in length) on the high seas in the WCPFC Convention Area is prohibited (WCPFC, 2008c).	No performance standards are stipulated to assess the measure's effectiveness.	Design of drift gillnet gear in use and/or stowed onboard; Location of fishing effort; List of vessels authorized to fish in the Convention Area.	b, c, e

Criterion 4B. Conservation and Management Measures to Mitigate Bycatch in Derelict Fishing Gear

Score: 4 of 14 possible points, 29%

Table A1.13-8 provides details on the assessment outcome for criterion 3.

Table A1.13-8. Assessment of WCPFC conservation and management measures to mitigate bycatch in lost, abandoned, and discarded gear.

Factor	Points for positive response
For fisheries managed by the RFMO for which there is either evidence that ghost fishing is problematic or otherwise there is no knowledge of the degree of ecological risk from ghost fishing, binding measures to mitigate ghost fishing are in place for at least one but <50% of these fisheries.	1
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Have studies been conducted that determined whether or not problematic ghost fishing occurs in fisheries managed by the RFMO? In which fisheries managed by the RFMO has problematic ghost fishing been determined to occur, not occur, or otherwise there is no knowledge of the degree of ecological risk from ghost fishing?

Ghost fishing via entanglement in the appendages of abandoned, lost and discarded FADs used by purse seine and other gear types has been identified as problematic in some regions of the WCPFC Convention Area (e.g., Chanrachkij et al., 2008; Gilman, 2011). However, the rate of FAD abandonment, loss and discarding in the western and central Pacific and other regions is poorly understood (FAO, 2009e). Pelagic longline operators are hypothesized to routinely deliberately discard tangled and damaged line at sea during setting operations (FAO, 2009e). Otherwise, information on the ecological risk from ghost fishing by WCPFC-managed fisheries is not well understood.

- For fisheries managed by the RFMO that have not undergone assessment for problematic ghost fishing, is there information available that problematic ghost fishing in these gear types is documented to occur in other regions, and might also occur in the fisheries managed by this RFMO? Conversely, is there information that supports that ghost fishing is very unlikely to be a problem based on information on these gear types from other regions?

Of WCPFC-managed fisheries, ghost fishing may be problematic from pelagic longline gear, coastal handline gear, purse seine FADs, traps and various net gear, but not likely from purse seine netting, troll, or offshore pole-and-line gears (FAO, 2009e; Gilman, 2011). However, there is insufficient information to determine with any certainty the levels and degree of ecological risk from ghost fishing that occurs in WCPFC-managed fisheries.

In general, fisheries that employ passive fishing gear (e.g., pelagic and demersal longlines, gillnets, trammel nets, traps) are likely to cause ghost fishing, while fisheries that employ active gear (e.g., purse seine, trawl) are less likely to result in ghost fishing

as the catching process of active gears ceases when the gear is no longer attached to the vessel (NEAFC, 2008a; NAFO, 2008; SEAFO, 2009e; FAO, 2005a, 2009e, 2010d). However, there are many exceptions to this general rule. For instance, ghost fishing has been observed in seine nets and there is evidence of marine mammal entanglement in trawl net fragments, and coastal habitat degradation from derelict trawl nets (Jones, 1995; Donohue et al., 2001; Matsuoka et al., 2005).

- Summarize active legally binding conservation and management measures related to lost and abandoned derelict fishing gear and ghost fishing, and identify any quantitative performance standards included in each measure (Table A1.13-9);

A binding measure banning high seas large-scale drift gillnetting is in effect, which contributes to reducing ghost fishing by this gear type (Table A1.13-9). Measures on gear marking have been considered but a binding measure has not been adopted.

- For what proportion of fisheries where ghost fishing is documented to be problematic or otherwise are data deficient and ghost fishing is likely to be a problem based on information on these gear types from other regions, have binding measures been adopted to mitigate ghost fishing?

1 of 6. Assuming that ghost fishing has a high probability of being problematic in pelagic longline gear, coastal handline gear, purse seine FADs, traps, coastal net gear, and high seas net gear, then the one WCPFC binding measure indirectly related to ghost fishing by high seas large-scale drift gillnets addresses one of these six.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

The binding measure banning high seas large-scale drift gillnets does not contain quantitative performance standards.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, the one binding measure has not undergone an assessment of performance, and the measure lacks quantitative performance standards.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

No, WCPFC members cannot opt out of binding measures (WCPFC, 2000 [Article 20]).

Table A1.13-9. Active WCPFC legally binding conservation and management measures related to mitigating bycatch in lost, abandoned and discarded derelict fishing gear, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify requirements for surveillance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
Use of large scale drift gillnets (>2.5 km in length) on the high seas in the WCPFC Convention Area is prohibited (WCPFC, 2008c). One stated rationale for banning large scale drift gillnets is to avoid ghost fishing (WCPFC, 2008c).	No performance standards are stipulated to assess the measure's effectiveness.	Design of drift gillnet gear in use and/or stowed onboard; Spatial location of fishing vessels when operating; List of vessels authorized to fish in the Convention Area.	b, c, e

Criterion 4C. Conservation and Management Measures to Mitigate Problematic Pollution from the Discharge of Catch, Offal and Spent Bait During Fishing Operations at Sea

Score: 3 of 14 possible points, 21%

Table A1.13-10 provides details on the assessment outcome for criterion 3.

Table A1.13-10. Assessment of WCPFC conservation and management measures to mitigate problematic pollution from the discharge of catch, offal and spent bait during fishing operations at sea.

Factor	Points for positive response
There is limited understanding of the ecological risks from pollution effects from the discharges of catch, offal and spent bait at sea from all managed fisheries, and no relevant binding measures are in place.	0
There is no provision that allows RFMO Members to opt out of binding measures.	3

Information used for assessment:

- Have studies been conducted that determined whether or not problematic pollution results from discharges of discarded catch, offal from processed catch, and spent bait from fisheries managed by the RFMO? Which fisheries managed by the RFMO have been determined to cause or not cause problematic pollution due to these

discharges?

No relevant assessments were identified.

- For fisheries managed by the RFMO that have not undergone assessment for adverse pollution from the discharges of discarded catch, offal from processed catch and spent bait, is there information available that documents whether or not the fisheries either: (i) occur in areas where adverse pollution effects from these discharges are likely to result; (ii) the fisheries are understood to have potentially problematic levels of these discharges; and/or (iii) only nominal discharge levels occur, but they are spatially concentrated?

No information was identified via materials available on the RFMO's website on risks from pollution from discards from managed fisheries.

Purse seine fisheries on FADs can have relatively large levels of discharges at sea. Discharges from pelagic fisheries in deep sea areas may result in problematic alterations to benthic communities, and locking biomass up in bottom currents for centuries before recycling to the euphotic zone of the pelagic ecosystem (Hall et al., 2000). Small-scale gillnet and other coastal fisheries may also result in ecological problems from discharges. In general, large inputs of organic matter from discards at sea can increase natural nutrient levels in nutrient-poor benthic ecosystems, and in fisheries where discards are spatially concentrated, and especially in areas of low current flow, may cause localized hypoxia or anoxia of the seabed, which, if prolonged, causes avoidance and mortalities, alters benthic community composition, and alters ecosystem processes and structure (FAO, 1995 [Article 7.2.2g]; Goñi, 1998; Hall et al., 2000; Stevens et al., 2000; Gray et al., 2002; FAO, 2003a,b; Franco et al., 2008; Levin et al., 2009; Haselmair et al., 2010).

- Summarize active legally binding conservation and management measures related to pollution from the discharge of discarded catch, offal from processed catch, and spent bait, and identify any quantitative performance standards included in each measure (Table A1.13-11).

There are no relevant binding measures.

- For what proportion of fisheries where pollution from discharges is documented to be problematic or otherwise are data deficient and pollution is likely to be a problem (fisheries occur in areas where adverse pollution effects from the discharge of discarded catch, offal from processed catch, and spent bait are likely to result, and the fisheries are understood to discharge more than nominal levels) have binding measures been adopted to mitigate pollution effects from discharges?

No relevant information was identified for managed fisheries documenting problematic pollution, or are identified as being likely to cause problematic pollution, and there are no relevant binding measures.

- Of binding measures that contain quantitative performance standards, what proportion has been assessed for efficacy?

Not applicable, there are no relevant binding measures.

- For what proportion of the binding measures that have been determined to be lacking in effectiveness (either through assessment against measurable performance standards stated in the measure or otherwise through other scientifically rigorous assessment) have steps been taken or are in progress to improve efficacy?

Not applicable, there are no relevant binding measures.

- Does the RFMO allow Member States to opt out of binding conservation and management measures?

No, WCPFC members cannot opt out of binding measures (WCPFC, 2000 [Article 20]).

Table A1.13-11. Active WCPFC legally binding conservation and management measures related to discharge of discarded catch, offal from processed catch, and spent bait, whether the measure is legally binding, identify any performance standards and assess if these are quantitative and measurable or not, describe data requirements for performance assessment, and identify minimum surveillance resources to determine compliance.

Measure	Stipulated Performance Standards, Measurable or Subjective	Data Collection Needed to Assess Performance	Minimum surveillance resources necessary (a) dockside inspection, (b) at-sea inspection, (c) VMS, (d) onboard observers, (e) vessel list, (f) other (specify)
None	NA	NA	NA

Criterion 5. Surveillance and Enforcement

Score: 9 of 20 possible points, 45%

Table A1.13-12 provides details on the assessment outcome for criterion 5.

Table A1.13-12. Assessment of WCPFC measures and resources for surveillance and enforcement.

Factor	Points for positive response
≥50% but <75% of requirements of binding measures on bycatch that facilitate surveillance can be assessed for compliance via surveillance methods that the RFMO requires member States to employ.	3
WCPFC requires CCMs to report to the RFMO on their enforcement procedures and conclusions.	3
WCPFC does not require CCMs to take specified enforcement procedures	0

when an infraction of a binding conservation and management measure occurs.	
WCPFC does not require CCMs to impose specified sanctions when an infraction of a binding conservation and management measure occurs.	0
The RFMO has a formal procedure to review and assess the effectiveness of surveillance and enforcement activities and adapt surveillance and enforcement methods if warranted.	3
Summary information on detected infringements of binding measures on bycatch and discards and resulting sanctions/prosecution of detected infringements by CCMs was not available via materials on the WCPFC website.	0

Information used for assessment:

- Does the RFMO require member States to employ specified surveillance activities? For example, surveillance for compliance with bycatch conservation and management measures might be conducted via aircraft and patrol vessels, dockside inspections, VMS, vessel registers (e.g., positive and negative lists to deter IUU fishing), and observer programmes of some RFMOs (Lodge et al., 2007; Gilman et al., 2008b). Onboard observer coverage is identified as a requisite method for surveillance only when compliance with a measure can be assessed only through analyses of observer programme data.

In 2007, WCPFC3 adopted a Conservation and Management Measure for the Commission VMS, revised and replaced by CMM 2007-02 at WCPFC4 (WCPFC, 2007b), as required under the Convention (WCPFC, 2000 [Article 24(8-9)]). Standard Operating Procedures (SOPs) for the Commission's VMS were adopted in 2009 (WCPFC, 2009c). As of April 2009, vessels operating in the Convention Area were required to install an Automatic Location Communicator (a type of vessel monitoring system), which transmits a signal to a land-based receiving station where fisheries managers can view and track the location of fishing vessels (WCPFC, 2010b). VMS enables assessment of compliance with time/area restrictions on fishing effort. Based on the most recent available Secretariat quarterly report (second quarter of 2010), there are approximately 2,800 vessels registered on the VMS with monthly monitoring at about 1,800 vessels on the high seas (WCPFC, 2010c). Under CMM 2007-02, all vessels operating in the Convention Area are to maintain VMS transmission when they move into a section of the Convention Area (bounded by 20°N and 175°E) where a VMS implementation date has yet to be established, from elsewhere in the Convention Area. With respect to the area north of 20°N and west of 175°E, the system will be activated at a date to be determined by the Commission.

CMM 2010-02 created stringent surveillance mechanisms for vessels operating in a high seas pocket (bounded by the EEZs of the Cook Islands, French Polynesia and Kiribati) in order to provide real-time tracking of vessels authorized to fish in the area (WCPFC, 2010g).

Under the Convention and CMM 2009-01, WCPFC Members are obligated to maintain and report a record of fishing vessels authorized to fish in the Convention Area in international waters, and the Commission Secretariat is mandated to maintain a centralized/pooled list of authorized vessels (WCPFC, 2000 [Article 24(4-7)], 2009d, 2010b). CMM 2004-03 provides specifications for vessel marking, where WCPFC Identification Numbers assigned to each CCM's authorized vessels are maintained as a part of the Commission's record of authorized vessels (WCPFC, 2004a). CMM

2009-08 identifies a mechanism for notifying the Commission of vessel charter arrangements (WCPFC, 2009e). In addition, the Commission maintains an IUU List, and members are prohibited from engaging in fishing activities or other related transactions with vessels that are on this negative list (WCPFC, 2010b,d).

The WCPFC Regional Observer Program provides data that could be used to assess compliance with and the efficacy of binding conservation and management measures (WCPFC, 2010b).

The Convention calls for boarding and inspection procedures of fishing vessels on the high seas by patrol vessels registered with the Commission by CCMs, and CMM 2006-08 adopted the boarding and inspection procedures on the high seas of the Convention Area, with a purpose of ensuring compliance with CMMs (WCPFC, 2000 [Article 25], 2006b, 2010b). This binding measure allows fishing vessels to be boarded and inspected by the patrol vessels of other WCPFC members (WCPFC, 2006b, 2010b).

- What minimum methods permit effective surveillance of the requirements stipulated in binding conservation and management measures on bycatch (record this information in Tables A1.13-7, A1.13-9, and A1.13-11)? For example, measures to support surveillance of lost and discarded fishing gear includes requirements for marking fishing gear, employing internationally agreed systems, so that the owner of derelict gear can be identified (Caddy, 1996). For the surveillance methods required to determine compliance with these requirements, which of these methods does the RFMO require vs. not require member States to employ?

Surveillance methods necessary to implement binding CMMs, as identified in Tables A1.13-7 and A1.13-9 are:

- Dockside inspection,
- At-sea inspection,
- VMS,
- Onboard observers (100% onboard observer coverage would be required in all purse seine, longline, troll, pole-and-line, and other non-artisanal fisheries that take $\geq 2,000$ mt of bigeye and/or yellowfin tuna in order to observe the weight of retained and discarded bigeye and yellowfin tunas)
- List of authorized vessels, and
- Real-time locations of all anchored and drifting FADs

Of these requisite surveillance methods, WCPFC requires 4 of 6: VMS, authorized vessel list, and dockside and at-sea inspections. WCPFC does not require onboard observer coverage rates needed to monitoring compliance with CMM 2008-01 for annual catch limits or real-time monitoring of the locations of FADs.

- Are there RFMO requirements for member States to (i) take specified enforcement/prosecution procedures, (ii) impose specified penalties/sanctions against vessels that have been found to have committed a violation of a conservation and management measures, and (iii) report to the RFMO on these enforcement procedures and conclusions? Enforcement actions are likely to vary depending on the seriousness of the violation, and might include fines, seizure of illegal gear and catch, sequestration of the vessel, suspension or withdrawal of authorization to fish, and reduction or withdrawal of fishing quota. And (iv) can the RFMO impose

sanctions against Members and/or non-Members in response to detected violations?

Parties are required to annually report to the Commission on boarding and inspections and possible violations detected, and actions taken in response to observations of alleged violations by their vessels, including any proceedings instituted and sanctions applied (WCPFC, 2006b). The Commission is required to be notified of enforcement actions taken against vessels found to have taken an action determined to be a serious violation (WCPFC, 2006b). Under the Convention, WCPFC Members are required to annually report to the Commission information on the imposition of sanctions for any violations (WCPFC, 2000 [Article 25(8)]). WCPFC does not prescribe specific enforcement procedures or sanctions to be imposed by CCMs in response to identified violations of WCPFC binding measures.

- Does the RFMO have procedures to review the effectiveness of surveillance and enforcement activities, and recommend actions related to compliance with binding measures on a regular basis? Has the RFMO established a compliance committee with a mandate that includes evaluating compliance performance, and assessing efficacy of measures on surveillance and enforcement?

WCPFC has a Technical and Compliance Committee, established by the Convention (WCPFC, 2000 [Article 11(1)]) and defined functions include assessing efficacy of MCS and enforcement (WCPFC, 2000 [Article 14]). The Conservation and Management Measure for Compliance and Monitoring Scheme established a process to assess CCM's compliance with binding measures and calls for the Commission to adopt a range of responses to non-compliance (WCPFC, 2010h).

- Is there evidence that detected infringements of the RFMO's legally binding bycatch and discards measures regularly result in sanctions? How many violations of bycatch and discards measures are documented by the RFMO, and of these, how many resulted in the assessment of sanctions as required in RFMO measures?

The two most recent annual reports produced by the WCPFC Technical and Compliance Committee did not review CCM identified violations of binding CMMs, CCM enforcement actions, or sanctions and penalties imposed (WCPFC, 2010i, 2011d). WCPFC Part 2 reports, which are not publicly available, include sections for CCMs to report a summary of annual surveillance activities, investigations and prosecutions. A publicly available summary of CCM surveillance and prosecution actions in 2010 Part 2 reports via WCPFC materials was not identified.

Appendix 2

Contact Information for Marine RFMO Secretariats

Table 16. Contact information for the 13 RFMOs included in this performance assessment.

Marine RFMO Contact Information	Acronym
Mr. Drew Wright, Executive Secretary Commission on the Conservation of Antarctic Marine Living Resources P O Box 213 North Hobart Tasmania 7002 AUSTRALIA E-mail: ccamlr@ccamlr.org ; andrew_wright@ccamlr.org	CCAMLR
Mr. Robert Kennedy, Executive Secretary Commission for the Conservation of Southern Bluefin Tuna PO Box 37 Deakin West ACT 2600 AUSTRALIA E-mail: sec@ccsbt.org ; rkennedy@ccsbt.org	CCSBT
Mr. Abdellah Srour, Executive Secretary General Fisheries Commission for the Mediterranean Secretariat FAO Viale delle Terme di Caracalla Rome 00153 ITALY E-mail: abdellah.srour@fao.org	GFCM
Dr. Guillermo A. Compean, Director Inter-American Tropical Tuna Commission 8604 La Jolla Shores Drive La Jolla, California, 92037-1508 USA E-mail: gcompean@iattc.org	IATTC
Mr. Driss Meski International Convention for the Conservation of Atlantic Tunas Calle Corazón de María, 8, Sixth Floor 28002 Madrid SPAIN E-mail: driss.meski@iccat.int	ICCAT
Dr. Alejandro Anganuzzi, Executive Secretary Indian Ocean Tuna Commission PO Box 1011, Victoria SEYCHELLES E-mail: alejandro.anganuzzi@iotc.org	IOTC
Dr. Vladimir Shibanov, Executive Secretary Northwest Atlantic Fisheries Organization P.O. Box 638 Dartmouth - Nova Scotia B2Y 3Y9 CANADA E-mail: info@nafo.int ; vshibanov@nafo.int	NAFO
Dr. Malcolm Windsor, Secretary North Atlantic Salmon Conservation Organization 11, Rutland Square Edinburgh EH 1 2AS UNITED KINGDOM E-mail: hq@nasco.int	NASCO
Dr. Kjartan Hoydal, Secretary North East Atlantic Fisheries Commission 22, Berners Street London W1T 3DY UNITED KINGDOM E-mail: kjartan@neafc.org	NEAFC

<p>Mr. Vladimir Fedorenko, Executive Secretary North Pacific Anadromous Fish Commission 889 West Pender Street, Suite 502 Vancouver, British Columbia, V6C 3B2 CANADA E-mail: secretariat@npafc.org; vladf@npafc.org</p>	NPAFC
<p>Mr. Mona Hafez, Secretary Regional Commission for Fisheries Food and Agriculture Organization of the United Nations Regional Office for the Near East (RNE) P.O. Box 2223, Cairo EGYPT E-mail: RNE-KIMS@fao.org; FAO-RNE@fao.org; mona.hafez@fao.org</p>	RECOFI
<p>Dr. Ben van Zyl, Executive Secretary Southeast Atlantic Fisheries Organization 133 Nangolo Mbumba Drive, Savvas Building P.O. Box 4296, Walvis Bay NAMIBIA E-mail: info@seafo.org; bvanzyl@seafo.org</p>	SEAFO
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