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A Review of Regional Fisheries Management Organization Efforts in Addressing Cetacean Bycatch:

Report to the International Whaling Commission

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Executive Summary

Bycatch remains the single largest threat to cetaceans globally, with an estimate of at least 300,000 cetaceans killed each year. Regional fisheries management organizations (RFMOs) govern specific fisheries within specific ocean areas throughout the world's oceans, and may, as appropriate, be suited to monitor, manage and reduce bycatch. International legal instruments, such as the United Nations Law of the Sea Convention and UN Fish Stocks Agreement, call for RFMOs to address ecosystem-wide approaches in fisheries management. There has been criticism of RFMO performance in managing both their own target stocks and bycatch.

This report serves as a high-level overview intended to summarize initiatives within RFMOs related to cetacean bycatch reduction. It is a report commissioned by the International Whaling Commission (IWC) Secretariat to provide an overview of RFMO efforts and policies related to cetacean bycatch, in order to help inform the IWC and its Bycatch Mitigation Initiative which RFMOs could be prioritized for collaboration on bycatch reduction. This report focuses on the following RFMO components: legally-binding conservation and management measures, observer programs, data analyses, and other voluntary progress (e.g., workshops and special collaborative projects). This information is analyzed in a semi-quantitative "bycatch mitigation effort" score, coupled with a "potential for bycatch risk," to calculate an overall "average bycatch performance" score for each RFMO. It is important to note that this analysis was a simple, (nearly) binary review, is limited in scope as it only reviewed efforts in paper rather than in practice, does not survey coastal/artisanal fisheries, and has other limitations. Some 16 RFMOs were surveyed, regardless of cetacean bycatch levels, in order to better understand the overall policy landscape of RFMOs and cetacean bycatch. This index is a first in offering an index that assesses RFMO performance in monitoring and mitigating cetacean bycatch. There is room for improvement and the author welcomes further suggestions as to how to build on this initial attempt.

The Inter-American Tropical Tuna Commission (IATTC), the Commission for the Conservation of Antarctic Living Marine Resources (CCAMLR), and the Western and Central Pacific Fishery Commission (WCPFC) received the highest scores in relation to bycatch mitigation effort, whilst the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (CCSBP), North Pacific Fisheries Commission (NPFC), and North Atlantic Salmon Commission (NASCO) scored the lowest. In relation to the average bycatch performance score for tuna-RFMOs, the WCPFC, Commission for the Conservation of Southern Bluefin Tuna (CCSBT), IATTC, and Indian Ocean Tuna Commission (IOTC)/ International Commission for the Conservation of Atlantic Tunas (ICCAT) scored highest to lowest respectively.

Based on these results and contextual considerations, recommendations to the IWC are: 1) Prioritize engagement with ICCAT, IOTC, the South Pacific Regional Fisheries Management Organization (SPRFMO), and the Southern Indian Ocean Fisheries Agreement (SIOFA); 2) Host a workshop on analysis of cetacean bycatch; 3) Collaborate with RFMOs and the FAO to advocate for cetacean bycatch requirements in RFMOs and share the recent FAO guidelines as widely as possible, including building capacity to implement them; 4) Collaborate with the FAO and WCPFC/South Pacific Community (SPC) to increase attention and utility of Bycatch Management Information System (BMIS)/bycatch data exchange protocol (BDEP); and 5) Expand on the research presented in this report.

Introduction

Bycatch,[1] the incidental capture of non-target species in fisheries (Alverson et al., 1994; Reeves et al., 2013), is widely recognized as the largest threat to cetaceans globally (Lewison et al., 2004 and 2014; Read et al., 2006; Reeves et al., 2013; Brownell et al. 2019). For many species, bycatch is the primary driver in their decline (Read et al., 2006; Lewison et al., 2014; Brownell et al., 2019). Nearly all gear types pose risks to cetaceans to some degree, including trawls, gillnets, longlines, purse seines, traps, and other gear, though gillnets are considered the most risky gear in relation to cetacean bycatch (e.g., Read et al., 2006; Reeves et al., 2013, Brownell et al. 2019; Anderson et al., 2020). Sustained incidental capture, coupled with certain cetacean life history traits (e.g., long lifespans, slow growth, and low fecundity), increase the potential for bycatch to significantly impact cetacean populations (Lewison et al., 2014).

This report offers a high-level overview of regional fisheries management organizations (RFMO) efforts towards addressing cetacean bycatch. It was commissioned by the IWC Secretariat and written for the IWC community in order to provide background information on the current landscape of RFMO policy efforts, as documented by the RFMOs and then make recommendations to the IWC on RFMOs and related bodies/activity most suitable for engagement.

The IWC endorsed its Bycatch Mitigation Initiative (BMI) in 2016. The BMI aims to raise awareness of cetacean bycatch, and the multi-disciplinary solutions available to understand and reduce its impact and assist in capacity building efforts at national and international levels to address this issue. It has a particular emphasis on gillnet fisheries, including in coastal and small-scale fisheries, but also aims to understand and address bycatch on the high seas. Engaging with RFMOs is a key pillar in the BMI Strategic Plan (2018-2028), however there has been a gap in understanding which RFMOs should be prioritized for engagement. Thus, conducting this research weaves nicely with the BMI's priorities.

Cetacean bycatch has gained increased global attention in the policy and management context in recent decades. Key international instruments governing fisheries – including the United Nations Law of the Sea Convention (signed 1982), the United Nations Fish Stocks Agreement (adopted 1995) and the non-binding FAO Code of Conduct for Responsible Fisheries (adopted 1995) – require Parties to address conservation of living marine resources in the high seas and take an ecosystem-based approach to fisheries management (Bache, 2002; Amandè et al., 2012). Outside of direct fisheries work, a growing number of international fora are addressing

[1] In this report, "bycatch" is used broadly, inclusive of captured, non-target species in fisheries by active or passive (i.e., abandoned, lost, and discarded fishing gear) regardless of whether they are released alive, dead, or retained as catch. However, it is worth noting that different definitions and interpretations exist of the term "bycatch." For example, Hall et al. (2017) define bycatch as "Captured organisms […] discarded dead or so severely injured that it is clear that they will die post-release." Gilman, Passfield, and Nakamura (2013) note that bycatch can be comprised of: "(i) the retained catch of non-targeted but commercially valuable species, referred to as 'incidental catch' or 'byproduct', which may be landed/transshipped or otherwise consumed by crew, used for bait, or rejected at port; (ii) discards mortality, whether the reason for discarding is economic or regulatory, or results from vessel and gear characteristics; plus (iii) cryptic, generally 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."

cetacean bycatch. These are briefly described below to provide additional context on cetacean initiatives, but are not explored in detail given that the report focuses on RFMOs:

Fora with global focus

- The Food and Agriculture Organisation of the United Nations (FAO) recently published draft voluntary technical guidelines for best practices in reducing marine mammal bycatch, which are expected to be finalized as voluntary bycatch reduction guidance in the future (FAO, 2020);
- The Convention on the Conservation of Migratory Species of Wild Animals (CMS), a non-binding treaty of the UN, has a Resolution on bycatch (most recent is 12.22 adopted in 2017). Resolution 12.22 calls for increased efforts to address this issue, including for marine mammals, and requests that Parties that are members to both CMS and RFMOs work on this issue at RFMOs (Convention on Migratory Species, 2017);
- The IUCN Species Survival Commission (SSC) Cetacean Specialist Group (CSG), established in the 1960s, includes 125 members worldwide that provide scientific expertise on research and management concerning cetaceans;

Fora with regional focus

- The Agreement on the International Dolphin Conservation Program (AIDCP), closely tied to IATTC, is a binding, multilateral agreement that provides the framework for the progressive reduction and elimination of dolphin mortality associated with purse seine fisheries in the Eastern Pacific Ocean (EPO) (entered into force in 1999);
- The Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic area (ACCOBAMS)), an intergovernmental agreement that seeks to reduce threats to cetaceans and their habitats in the region (entered into force in 2001);
- The Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBAMS), an international agreement under the UNEP Convention on Migratory Species that works towards conservation of small cetaceans (entered into force in 1994);
    - The Joint Bycatch Working Group of ACCOBAMS/ASCOBAMS (formed in 2019);
- The International Council for the Exploration of the Sea (ICES), an intergovernmental marine science organization that aims to advance scientific understanding of marine ecosystems pertaining to the North Atlantic, and its Working Group on Bycatch of Protected Species, which collates and assesses information on bycatch (formed in 2007);
- The North Atlantic Marine Mammal Commission (NAMMCO), a 1992 international body focused on marine mammals in that region;
- The Permanent Commission for the South Pacific, which coordinates maritime management between its Member States, has a 1992 Plan of Action for the Conservation of Marine Mammals in the South-eastern Pacific that coordinates with other bodies (e.g., UNEP) on bycatch and marine mammal conservation;
- The UN Regional Seas Programme in the Wider Caribbean (UNEP-CEP), which oversees the Protocol Concerning Specially Protected Areas and Wildlife (SPAW), adopted a Marine Mammal Action Plan (MMAP) to help participating governments improve their marine mammal management.

Regional Fisheries Management Organizations (RFMOs)

RFMOs manage specific fisheries within certain ocean areas (Figure 1, 2). The primary competence and responsibility of RFMOs is to manage fisheries in Convention Areas, typically achieved through legally-binding conservation and management measures (CMMs). There is ongoing discussion regarding what constitutes an RFMO.The FAO recognizes 61 Regional Fisheries Bodies (RFBs), which have varying mandates and functions (e.g. advisory, coordination, management). According to the FAO, those RFBs which have a management mandate are considered RFMOs. It is important to note that although commonly referred to as an RFMO, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is a conservation organization with a remit beyond fisheries management, although it does share attributes with RFMOs. The term "RFMO" is therefore used broadly and inclusively in this report to include the five RFMOs that manage tuna and tuna-like fisheries, as well as those that manage non-tuna fisheries, such as deep-sea fisheries and more coastal fisheries. The RFMOs selected for this review include all tuna RFMOs, and any RFMOs with multiple parties and fisheries jurisdiction that may overlap with cetacean habitat. The note below provides more information on why these specific 16 RFMOs were selected for this report[2].

At present, RFMOs play an arguably limited role in addressing cetacean bycatch in their fisheries, despite mandates in some of their Conventions to address bycatch or ecosystem-based management (e.g., Small, 2005; Read et al., 2006; Gilman et al., 2013).This report reviews the efforts of these 16 RFMOs to address cetacean bycatch in their fisheries, including binding CMMs and voluntary efforts (Table 1).[3] This report also considers other recent RFMO reviews and "report cards" in order to qualitatively determine where RFMOs have been successful in addressing cetacean bycatch, and couples this review with a simple quantitative evaluation of each RFMO. Some of the 16 RFMOs selected have a low likelihood of interactions with cetaceans in their fisheries. Still, in order to gain a better landscape of policies towards cetacean bycatch in RFMOs, RFMOs were reviewed regardless of any estimated bycatch levels. There are also widespread data gaps on cetacean bycatch globally (e.g. Anderson et al., 2020; Lewison et al., 2014), making it challenging to select only those RFMOs with known bycatch. Therefore, RFMOs were given equal, due review, regardless of any data gaps.

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[2] Various sources cite different numbers of RFMOs and RFBs. The FAO includes 61 RFMOs and RFBs on its website - http://www.fao.org/fishery/rfb/search/en , including taxa-specific bodies such as the IWC and NAMMCO and ACAP. The Pew Charitable Trusts notes online that 17 RFMOs exist (without mentioning the exact RFMOs), while the EU Commission lists 17 RFMOs to which they are a party. This report included RFMOs or RFMO-like bodies commonly reviewed in scientific literature as managing fisheries (e.g., all tuna RFMOs, CCAMLR, and others), and did not include any RFMOs that are still in development (e.g., The Western Central Fishery Commission (WECAFC)), those only with two members (e.g., Pacific Salmon Commission, International Pacific Halibut Commission, Joint Norwegian-Russian Fisheries Commission), those with a taxa-focus outside fisheries (e.g., NAMMCO or the Agreement on the Conservation of Albatrosses and Petrels), those with a significant focus on inland water bodies (e.g., the Regional Commission of Fisheries of Gulf of Guinea (COREP)), or those where the Secretariat is held at the FAO level with very little bycatch work being undertaken (e.g., SWIOFA, RECOFI).

[3] Different RFMOs have different levels of bycatch in their fisheries, dependent on the spatio-temporal extent of fisheries, fishing effort, gear type, and marine mammal distribution and abundance. This report reviews all 16 RFMOs' paper-based efforts to reduce bycatch, regardless of baseline bycatch rates.

Figure 1. Map of Global Regional Fishery Bodies, including RFMOs (Source: The Pew Environment Group)

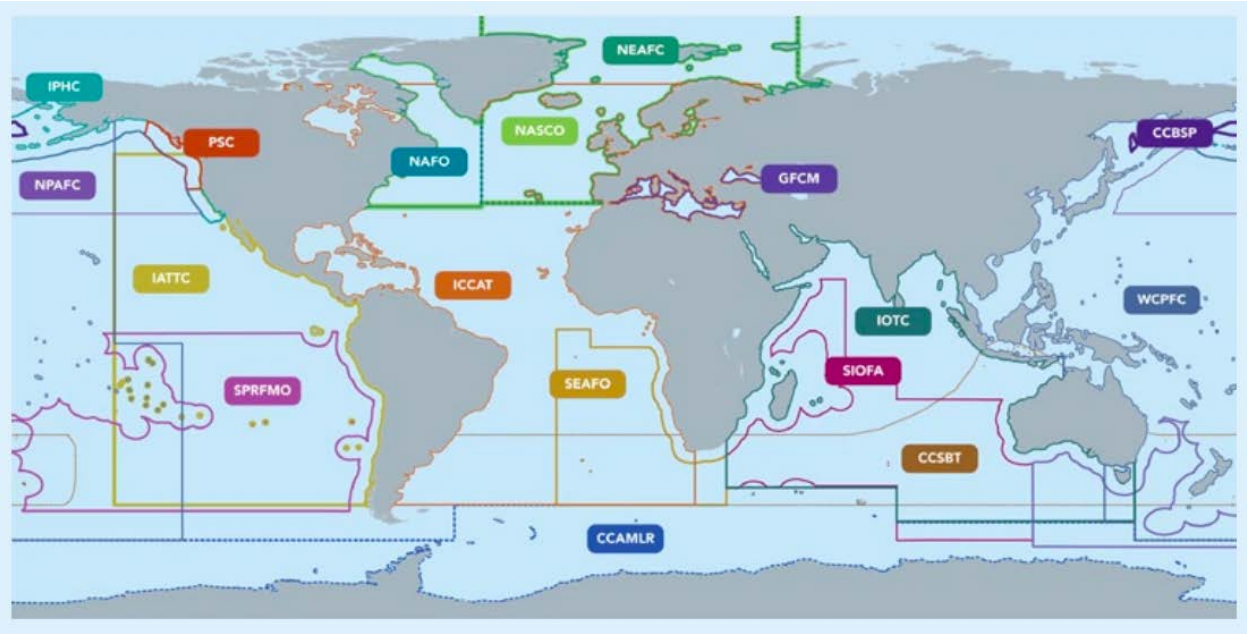


Figure 2. Map of Tuna RFMOs (Source: Pew)

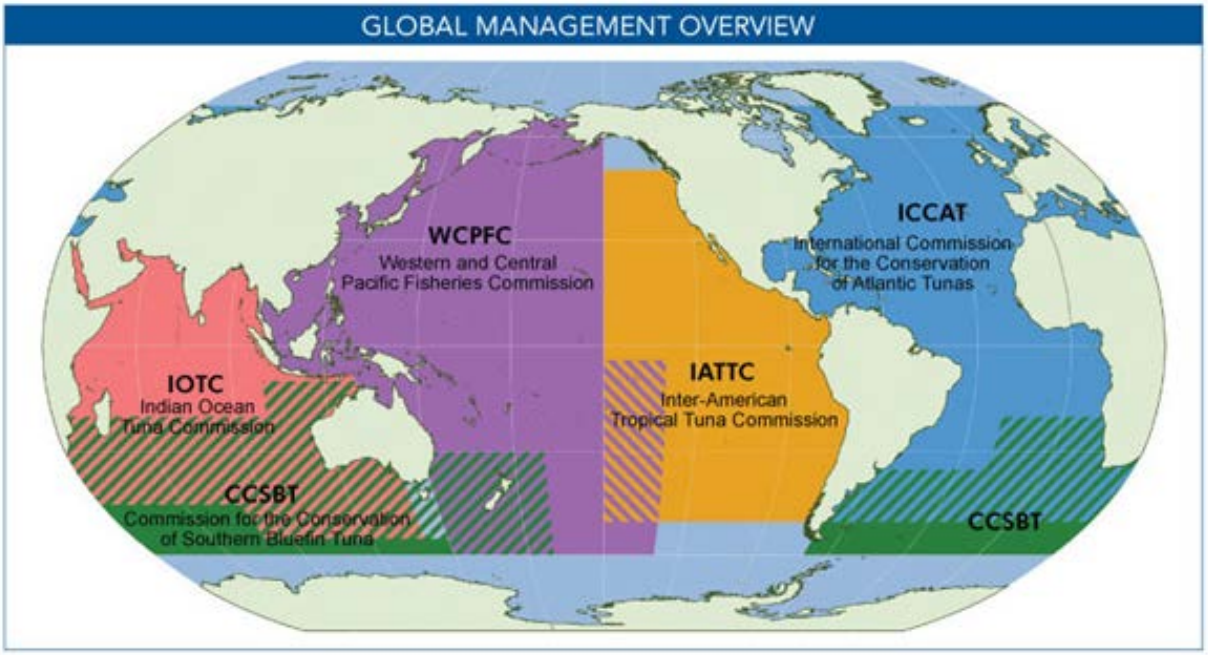


Table 1. List of fisheries-focused RFMOs reviewed in this report

RFMO	Primary Managed Fisheries	Primary Capture Gear Types[4]	Members[5]	Year Established /Signed
Tuna RFMOs				
Commission for the Conservation of Southern Bluefin Tuna (CCSBT)	Southern bluefin tuna	Longline and purse seine	8	1994
Inter-American Tropical Tuna Commission (IATTC)	Tropical tuna (yellowfin, bigeye, skipjack), northern pacific albacore, northern Pacific bluefin, swordfish, tuna-like species	Purse seine, pole and line, hook and line, gillnet, longline, harpoon, troll, trawl	26	1949[6]
International Commission for the Conservation of Atlantic Tunas (ICCAT)	Tropical tuna (yellowfin, bigeye, skipjack), albacore, bluefin tuna, billfish (swordfish and marlins), sharks (e.g., blue, shortfin mako, porbeagle, and others), other fish species	Purse seine, longline, bait boat, gillnet, pole and line, trap, trawl, rod and reel, and harpoon	59	1966
Indian Ocean Tuna Commission (IOTC)	Temperate and tropical tuna (albacore, yellowfin, bigeye, and skipjack), billfish (swordfish, black marlin, blue marlin, striped marlin, Indo-Pacific sailfish), neritic tuna and mackerels (bullet tuna, frigate tuna, kawakawa, longtail tuna, Indo-Pacific king mackerel, narrow-barred Spanish mackerel)	Gillnet, purse seine, longline, handline, pole-and-line, trolling, trawl	33	1993

[4] Note this report solely focuses on capture fisheries and does not address aquaculture managed by RFMOs..

[5] "Members" in this context refer to the collective group of Members and non-Members that are part of an RFMO in some capacity, including: Members/Cooperating Parties, Cooperating Non-Members/Cooperating non-Contracting Parties, Fishing Entities, Participating Territories, and Acceding States. Certain RFMOs use different terminology to describe Members, Contracting Parties, Cooperating Non-Member, etc., but for the purposes of this report, the term "Members" is used. This does not include countries that are Signatories but have not ratified Conventions. Thus, the number of Members listed here may appear slightly higher than officially listed on RFMO webpages, given that some RFMOs refer to "Members" as entities that are official parties to the respective RFMO convention.

[6] The Antigua Convention, which was negotiated to strengthen and replace the 1949 Convention establishing the IATTC, entered into force in 2010. To-date, 15 States and one Regional Economic Integration Organization, the EU, are Parties to the Convention, through ratification or accession. One fishing entity, Chinese Taipei, has submitted a written communication of commitment in accordance to the procedure established in the Convention.

Western and Central Pacific Fisheries Commission (WCPFC)	Pacific bluefin tuna, tropical tuna (bigeye, skipjack, yellowfin), albacore, billfish (marlin and swordfish), oceanic sharks	purse seine, longline, pole and line, troll, and other small-scale fishing methods (e.g., handline, small traps)	40	2004
Non-tuna RFMOs				
Commission for the Conservation of Antarctic Marine Living Resources)[7]	Patagonian toothfish, Antarctic toothfish, mackerel icefish, Antarctic krill	Bottom-set longlines, trawl (bottom and midwater trawls), pots	36	1982
Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (CCBSP)	Alaska pollock	Pelagic trawl, pair trawl, bottom trawl	6	1995
General Fisheries Commission for the Mediterranean (GFCM)	European anchovy, European pilchard, European hake, European eel, Blackspot seabream, giant red shrimp, blue and red shrimp, deep water rose shrip, Black Sea turbot, and other species.	Purse seine, dredger, beam trawl, pelagic trawl, longline, gillnets, trammel nets	28	1952[8]
North Atlantic Fisheries Organization (NAFO)	Primarily groundfish, shrimp, pelagic redfish (i.e., all marine fisheries resources except tuna, marlins, salmon and sedentary species)	Bottom trawl, purse seine, tuck ring seine, weir, trap, gillnet, longline, handline	12	1978
North Atlantic Salmon Conservation Organization (NASCO)	Atlantic salmon	Surface gillnet	6	1984[9]
North-East Atlantic Fisheries Commission (NEAFC)	Redfish, Norwegian spring spawning herring, blue whiting, mackerel, rockall	Trawl (pelagic and demersal), purse seine, deep-sea gear: longline, gillnet, and tangle nets	11	1980

[7] CCAMLR is a conservation organization with a remit beyond fisheries management, though it does share attributes with RFMOs. While it is included in this report, it is important to acknowledge it is technically not an RFMO.

[8] The agreement for establishment of GFCM was approved in 1949 and came into force in 1952. Previously 'General Fisheries Council for the Mediterranean', it became a Commission in 1997.

[9] The NASCO Convention was signed in 1983 and established in 1984.

	haddock, and multiple deep-sea fish species			
North Pacific Anadromous Fish Commission (NPAFC)	Chum salmon, coho salmon, pink salmon, sockeye salmon, chinook salmon, cherry salmon, steelhead trout	seine, gillnet, setnet, net traps, and troll gears are used, but directed fishing for anadromous fish is prohibited within the Convention Area or Fishing gear are used in member countries' EEZs only	5	1992
North Pacific Fisheries Commission (NPFC)	North Pacific armourhead, splendid alfonsino, oreo, mirror dory, sablefish, Pacific saury, Chub mackerel, spotted mackerel, Japanese sardine, and squid species	Bottom trawl, bottom gillnet, bottom longline, longline trap gear, stick-held dip nets/life nets	9	2015[10]
South East Atlantic Fisheries Organization (SEAFO)	Crustaceans (Deep-sea red crab), non-tuna fish (e.g., Patagonian toothfish, orange rough, alfonsino, armourhead species)	Trawl (bottom, midwater), longline, trotline, pots, midwater nets	7	2001
Southern Indian Ocean Fisheries Agreement (SIOFA)	Armourhead, Patagonian toothfish, oreo, orange roughy, dogfish, alfonsino	Bottom trawl, longline, pot, gillnet	11	2006
South Pacific Regional Fisheries Management Organization (SPRFMO)	Jack mackerel, jumbo flying squid, chub mackerel, orange roughy, and other benthic and demersal fish species	Purse seine, pelagic trawl, jigging, bottom trawl, bottom longline	19	2009

Cetacean Bycatch and Bycatch Hotspots

It is well known that interaction with gillnets, longlines, purse seines, and trawls cause cetacean bycatch (Reeves et al., 2013; Lewison et al., 2014). Gillnets are the gear type with the highest rate of interaction with cetaceans, based on extensive field research (Read et al., 2006; Brownell et al., 2019; Reeves et al., 2013; Kiszka et al., 2009). Trap fisheries are known to pose a particular risk for baleen whales (mysticetes) (e.g., Read et al., 2006; Pace et al., 2014), whereas longlines pose higher risk to odontocetes rather than mysticetes, since odontocetes may

[10] The NPFC Convention was signed in 2012 but did not enter into force until 2015.

opportunistically depredate longlines, which can then lead to a bycatch event (Clark et al., 2014; Werner et al., 2015).

Substantial data gaps remain concerning global marine mammal bycatch, making an assessment of global bycatch rates challenging (Amandè et al., 2012), as well as within RFMO jurisdictions. The best available science finds that roughly 300,000 cetaceans on average were caught per year in gillnets from 1990-1994 and at 3,500 on average per year in trawls from 1990-1994 (Read et al., 2006). This number – though nearly two decades old, and likely negatively biased according to the authors, and lacking any data on cetacean bycatch on the high seas – still represents the best available information on annual global bycatch levels (International Whaling Commission, 2018).

Based on a spatial analysis, Lewison et al. (2014) found that cetacean bycatch intensity was highest in the Eastern Pacific Ocean (EPO) and the Mediterranean (though this may be due to higher reporting levels in this region). Lewison et al. (2014) found that gillnet fishing, and therefore cetacean bycatch, was found around the world, whereas longline and trawl bycatch was highest in the EPO. The largest data gaps for bycatch data occur in the Indian Ocean, eastern Atlantic, southeast Asia, and central and western Pacific (Lewison et al., 2014). A recent paper estimated bycatch of small cetaceans in gillnets to reach roughly 4.1 million in the Indian Ocean from 1951-2018, including in some fisheries managed by IOTC, a figure which the authors state is likely an underestimate due to underreporting or poor data quality (Anderson et al., 2020). Further, in some regions, artisanal and small-scale fisheries are the greatest contributors to bycatch, especially with gear types responsible for most mortality (i.e., gillnets), and often operating outside the remit of RFMOs (Moore et al., 2010). It needs to be noted that understanding bycatch rates outside the context of RFMOs is even more challenging (e.g., Anderson et al., 2020, Coulter et al., 2020).

Global Bycatch Initiatives and Tools

Multiple policy initiatives exist to address cetacean bycatch at a global scale, within and outside RFMOs. Broadly, these include tuna RFMO collaboration through the Kobe process and the Common Oceans ABNJ Project[11]. There are several initiatives underway to facilitate increased collaboration, such as the Bycatch Management Information System (BMIS) web portal and the Bycatch Data Exchange Protocol (BDEP) through RFMOs. Each of these is summarized below.

Food and Agriculture Organisation of the United Nations Initiatives

FAO Draft Technical Guidelines: After over two years of meetings and effort, the FAO shared draft technical voluntary guidelines on reducing marine mammal bycatch with FAO Committee on Fisheries (COFI) Members (FAO, 2020). Similar FAO technical guidelines and initiatives already exist for seabirds (i.e., "Best practices to reduce incidental catch of seabirds in capture fisheries" (2009)), sharks (i.e., "International Plan of Action for the Conservation and Management of Sharks" (1999), and sea turtles (i.e., "Guidelines to reduce sea turtle mortality in fishing operations" (2009)) under the general framework of the FAO Code of Conduct for Responsible Fisheries. However, finalized technical guidelines do not yet exist for marine

[11] Common Oceans, Areas Beyond National Jurisdiction (ABNJ) Tuna Project, http://www.fao.org/in-action/commonoceans/projects/tuna-biodiversity/en/

mammals. These marine mammal guidelines provide information on effective bycatch mitigation measures and tools to support countries in addressing marine mammal bycatch. The finalized guidelines will be presented to the next FAO Committee on Fisheries (COFI) meeting.

RFMO-Related Initiatives

Kobe Bycatch Process: The Kobe Process has been a keystone in overall performance of tuna RFMOs, including bycatch management and raising awareness of bycatch in tuna RFMOs; as such, this section provides a brief overview of past Kobe meetings to provide background in RFMO-wide bycatch meetings. Tuna-RFMOs (tRFMOs) held their first joint meeting in Kobe, Japan in 2007, known as Kobe I. At Kobe I, tRFMOs decided on 14 commitments to collectively address bycatch in future years, including collection of protected species bycatch data and more generally addressing this issue across RFMOs. At Kobe II in San Sebastian (2009), tRFMOs created the Joint Tuna RFMO Bycatch Technical Working Group. A special Kobe Workshop on RFMO Management in Tuna Fisheries was held in 2010 in Brisbane, where RFMOs agreed to the Terms of Reference for the Bycatch Working Group (further agreed to and endorsed at Kobe III meeting in 2011 in San Diego) (no author, 2010 and 2015).

At Kobe II, participants discussed a variety of topics related to data gaps (e.g., quality data are needed to assess and characterize bycatch rates), noted that the scope and variations of data collected and provided in RFMO Conventions lead to data gaps across RFMOs, and noted that even agreeing to a definition of bycatch is challenging (Aranda, 2010). Attendees at the 2010 meeting agreed that the Joint Tuna RFMO Bycatch Technical Working Group would lead cooperation and coordination across tRFMOs to harmonize and streamline approaches to mitigating bycatch. Participants also made recommendations under several themes to bring forward to respective RFMOs: 1) Improve bycatch assessment, 2) Improve ways to mitigate/reduce bycatch, 3) Improve cooperation and coordination, and 4) Strengthen capacity building for developing countries. Meeting participants agreed that a strong RFMO bycatch framework should be: binding, clear and direct, measurable, and science- and ecosystem- based (Aranda, 2010). There have since been spin-off meetings under the Kobe umbrella, including:

- The Joint Technical Bycatch Working Group, as sponsored by the International Seafood Sustainability Foundation (ISSF), has since led two related workshops: “harmonization of bycatch data collected by tuna RFMOs,” focused on purse seine (2011) and longline fisheries (2015) (no author, 2015). At the longline-focused meeting (the “Keelung meeting”), the Bycatch Working Group agreed that a data exchange program would be used as the basis for summarizing data in each of the five tRFMOs in order to *i*) understand and harmonize tuna RFMO bycatch data; *ii*) review and improve bycatch data collection and reporting programs; and *iii*) plan for intra- and inter-RFMO analysis of bycatch rates and mitigation effectiveness.
- In December 2019, the Kobe Bycatch Working Group held a joint tRFMO meeting in Porto, Portugal focused on shark and ray bycatch. Recommendations from the meeting included re-energizing the Kobe bycatch working group and the establishment of a technical working group to focus on key bycatch research questions (Joint t-RFMOs Bycatch Working Group, 2019). Meeting participants agreed that they should meet again under the Kobe umbrella, reinvigorate the Kobe process, and pursue eighteen agreed-to

recommendations related to bycatch management, scientific and technical matters, and data collection (Joint t-RFMOs Bycatch Working Group, 2019).

Joint tRFMO Meeting on the Implementation of the Ecosystems Approach to Fisheries Management: In 2016, scientists from the tRFMOs and national experts convened for a meeting on establishing a dialogue in tRFMOs on an ecosystem approach and ecosystem-based fisheries management (EAF and EBFM). The three goals of the meeting were to, "(1) establish a sustained dialogue across t-RFMOs on the issues of EAF and its implementation, (2) understand common challenges in its implementation and (3) identify case specific solutions" (FAO, 2016). Key discussion points included determining a common definition of these terms, reviewing progress in the tRFMOs, data implementation requirements, and more. Participants detailed future work on bringing EAF and EBFM to Commission dialogues, continuing with specialized science-management meetings at RFMOs, and holding a possible future meeting hosted through the Common Ocean ABNJ Tuna Project (FAO, 2016). Additionally, the 2021 meeting of the informal consultation of States Parties to the UN Fish Stocks Agreement, an annual meeting that discuss issues related to the Fish Stocks Agreement, will focus on "Implementation of an ecosystem approach to fisheries management."

Non-RFMO Related Initiatives

Other international efforts: Several other international bodies are addressing bycatch issues. The International Whaling Commission's Bycatch Mitigation Initiative (BMI, described above); the Convention on Migratory Species (CMS) recently consolidated its previous bycatch measures into a single bycatch measure, Resolution 12.22 (CMS, 2018). It encourages Parties to reduce bycatch risk in their fisheries, calls for required mitigation, and asks for enhanced RFMO efforts to reduce bycatch. Additionally, NAMMCO, ICES, and ACCOBAMS/ASCOBANS have several resolutions and/or working groups focused on bycatch. For example, ACCOBAMS Resolution 2.12 provides guidelines for Parties on best use of acoustic deterrent devices in fisheries and Resolution 4.9 encourages Parties to improve mitigation, monitoring, and enforcement in fisheries; ASCOBANS Resolution 8.5 identifies legislation to address bycatch mitigation. Additionally, ASCOBANS/ACCOBAMS recently established a Joint Bycatch Working Group to address bycatch, and finalized their terms of reference in 2019. The CPPS Plan of Action for the Conservation of Marine Mammals in the South-eastern Pacific identifies regional priorities, promote marine mammal conservation, and identifies pilot projects for bycatch reduction projects (1992). The South Pacific Environment Program (SPREP) are also currently leading a multi-country project funded by the European Union (PEUMP Bycatch and Integrated Ecosystem Management Project).

National efforts with global scope: The U.S. is implementing the Marine Mammal Protection Act Import Provisions Rule. Under this Rule, fish-harvesting nations exporting seafood products to the U.S. have until March 2021 to apply for comparability findings, indicating that they have a regulatory program to mitigate marine mammal bycatch that is comparable in effectiveness to U.S. marine mammal bycatch reduction standards. Without a comparability finding for any given fishery, the U.S. will block seafood exports from the fisheries of these countries. The Rule has the potential to advance marine mammal conservation, and at minimum, push forward the bycatch dialogue (Williams et al., 2016).

Tools

BMIS: BMIS is an online database of consolidated bycatch information for RFMO stakeholders and the public. Originally a WCPFC project launched online in 2010 with information concentrated on the Western and Central Pacific Ocean, WCPFC relaunched BMIS in May 2017. It is funded by the Common Oceans ABNJ Tuna Project and closely maintained by WCPFC/the Pacific Community (SPC) (and formerly funded by ISSF) (Fitzsimmons et al., 2017 and 2018). BMIS serves as a one-stop web portal for a variety of resources on bycatch in tuna fisheries, including studies, access to some bycatch data (such as searching by species, gear type, and fishery), and provides links to all t-RFMOs and their CMMs.

WCPFC also had a bycatch workshop in May 2018, largely focused on education and awareness surrounding BMIS (Clarke and Smith, 2018; Fitzsimmons et al., 2018). Further work on BMIS is funded through August 2019 for the SPC and Common Oceans ABNJ Project (Fitzsimmons et al., 2018). The 2019 Porto Joint t-RFMOs Bycatch Working Group meeting also discussed the importance of harmonization and data sharing across BDEP and BMIS (Joint t-RFMO Bycatch Working Group, 2019).

BDEP: The 2015 longline Keelung Meeting decided to name the global bycatch information depository it established the 'global bycatch data exchange protocol' (BDEP) (Clarke et al., 2015). Data requested for submission to BDEP included fishing effort by gear type and area, total observed effort, observed captures of various bycatch species, observed mortality, and other fields (Clarke et al., 2015). Members anticipated challenges in obtaining data (particularly for RFMOs without regional observer programs), data harmonization, and data confidentiality issues, but BDEP was still proposed as a starting point for collecting RFMO bycatch data. Some parts of BDEP have been integrated into the BMIS projects (Fitzsimmons et al., 2018), but currently, it appears BDEP data is largely held within the tRFMOs that are working on providing information in a BDEP format (currently only IOTC, CCSBT, WCPFC are using a BDEP format) (Clarke and Smith, 2018; Fitzsimmons et al., 2018).

Bycatch.org: Additionally, the Consortium for Wildlife Bycatch Reduction is a group of collaborators that aims to bridge bycatch solutions through scientists and the fishing industry. It focuses on understanding bycatch interactions, developing gear modification, and facilitating exchange on information on bycatch techniques.

RFMO Performance in Scientific Literature

A number of studies have examined the efficacy of tuna RFMOs (tRFMOs) in fulfilling their mandates to manage target fish stocks or other ecologically-related components related to their jurisdiction, including bycatch governance (Small, 2005; Lodge et al., 2007; Cullis-Suzuik and Pauly, 2010; Gilman 2011; de Bruyn et al., 2013; Gilman et al., 2013; Clark et al., 2015; Juan-Jordá et al., 2017; Ewell et al., 2020)[12]. Four studies are summarized below:

[12] The author would like to acknowledge that RFMO activities may have changed since publication of these papers, so they are not intended to capture all CMMs and other initiatives within RFMOs at the time of writing. Please refer to individual RFMOs and Appendix II for more up-to-date information. For example, the CCSBT now has a number of binding measures that did not exist at the time of these studies; and the GFCM does include Non-target

1. **Small (2005) <u>Regional Fisheries Management Organisations: Their duties and performance in reducing bycatch of albatrosses and other species</u>**

The author reviewed RFMOs whose Convention Areas had the greatest overlap with albatross distribution: CCAMLR, CCSBT, WCPFC, IOTC, IATTC, and ICCAT.[13] The author reviewed performance for five major categories: 1) Participation and transparency; 2) Target fish data and assessment; 3) Target fish management and stock status; 4) Combatting IUU fishing, and 5) Bycatch. The author posed a total of 114 questions under these major categories, and assigned a score (0-1 scale) for each question. The questions the author posed specific to marine mammal bycatch in RFMOs is depicted below (Figure 2). For marine mammal bycatch, CCAMLR and IATTC had the highest performance in fulfilling Convention duties to address bycatch. CCAMLR in particular scored the highest, as it prioritizes bycatch collection in its regional observer program and its ecosystem monitoring scheme, as well as passed a measure to entanglement in marine mammals. Generally, much of the information presented in this study has remained constant over the past decade, apart from IOTC and WCPFC having now established a bycatch measure (see Appendix II).

Figure 3: Example of questions posed of each RFMO for marine mammal bycatch (Small, 2005)[14]

Marine mammals

Bycatch data collection

97	Has the RFMO requested that States collect data on bycatch?	0.5	-	0.5	0.5	1	0.75
98	Do the States provide bycatch data?	0.5	-	0	0	1	0.75
99	Has the RFMO conducted research on bycatch population impacts?	0	-	0	0	1	1
100	Has the RFMO conducted research on the impact of gear?	0	-	0	0	1	1
101	Has the RFMO established measures to monitor compliance?	0	-	0	0	1	1
102	Has the RFMO established measures to monitor success?	0	-	0	0	1	1
Total % score		**17**	**-**	**8**	**8**	**100**	**92**

Bycatch mitigation measures

103	Has the RFMO made recommendations on gear to reduce bycatch?	0	-	0	0	1	1
104	Has the RFMO established bycatch limits?	0	-	0	0	0	1
105	Has the RFMO established incentives for vessels to reduce bycatch?	0	-	0	0	1	1
Total % score		**0**	**-**	**0**	**0**	**67**	**100**

2. **Cullis-Suzuki and Pauly (2010) <u>Failing the high seas: a global evaluation of regional fisheries management organizations</u>**

This study reviewed performance of 18 RFMOs both "on paper" and "in practice" (based on standards by Alder et al. and Lodge et al. 2007). Broadly, the authors ranked RFMO performance

species in its Agreement, as it covers all living marine resources. Nevertheless, these referenced studies provide a foundation for which to review RFMO activities.

[13] WCPFC was established in 2004, and this study published in 2005, so this paper lacks accurate and current information on WCPFC in particular. For IATTC, the Antigua Convention was not yet in force. For other RFMOs, other CMMs have passed and changes have been made. Still, the reference is included here given the criteria to evaluate RFMOs and its focus on bycatch.

[14] The RFMOs listed in this figure are: CCSBT, WCPFC, IOTC, ICCAT, CCAMLR, and IOTC, respectively. Data is lacking for WCPFC in this category as it was established just prior to this study.

on a 1-10 point schedule for 26 criteria (e.g., performance review and assessment), asking 10 questions per criteria (see study for details; the methodology and data analysis are more complex than explained here). To measure "in practice" performance, the authors reviewed mortality and biomass for a total of 48 target stocks across the RFMOs. For overall theoretical performance, WCPFC scored highest (with the Pacific Salmon Commission, not examined in this report to the IWC, at the lowest); CCAMLR scored highest for conservation and management measures and actual performance, while CCSBT scored the lowest in practice and second-worst in paper performance. The authors concluded that the "on paper" or "intent" fared better than RFMO "action."

3. **Gilman, Passfield, and Nakamura (2013) Performance of regional fisheries management organizations: ecosystem-based governance of bycatch and discards**[15]

In this study, the authors assessed bycatch governance performance, including discards, for 13 RFMOs.[16] They based on five major criteria: 1) Regional observer programs; 2) Open access to regional observer program data sets; 3) Ecological risk assessment; 4) Conservation and management measures that direct bycatch; and 5) Surveillance and enforcement. Scores were assigned for each subcriteria on a 0-100% scale, and then each RFMO received a score based on its average score for Criteria 1-5 (each criteria was equally weighted). The authors also calculated standard deviation to determine degree of dispersion within and between RFMOs.

[15] Note: This study was based on a report by Gilman, Passfield, and Nakamura (2012) available on the IUCN website. This report did a thorough job of reviewing RFMOs, and the review is still largely applicable. It is recommended that Gilman, Passfield, and Nakamura (2012) be the go-to for an extremely detailed look into each RFMO and their rankings. The report is retrievable here:
https://portals.iucn.org/library/sites/library/files/documents/2012-034.pdf

[16] RFMOs assessed in Gilman, Passfield, and Nakamura 2013 included CCAMLR, CCBST, GFCM, IATTC, ICCAT, IOTC, NAFO, NASCO, NEAFC, NPAFC, RECOFI, SEAFO, and WCPFC. In this report, I did not analyze RECOFI.

Figure 4: RFMO scores in bycatch governance performance (Gilman et al., 2013)[17]

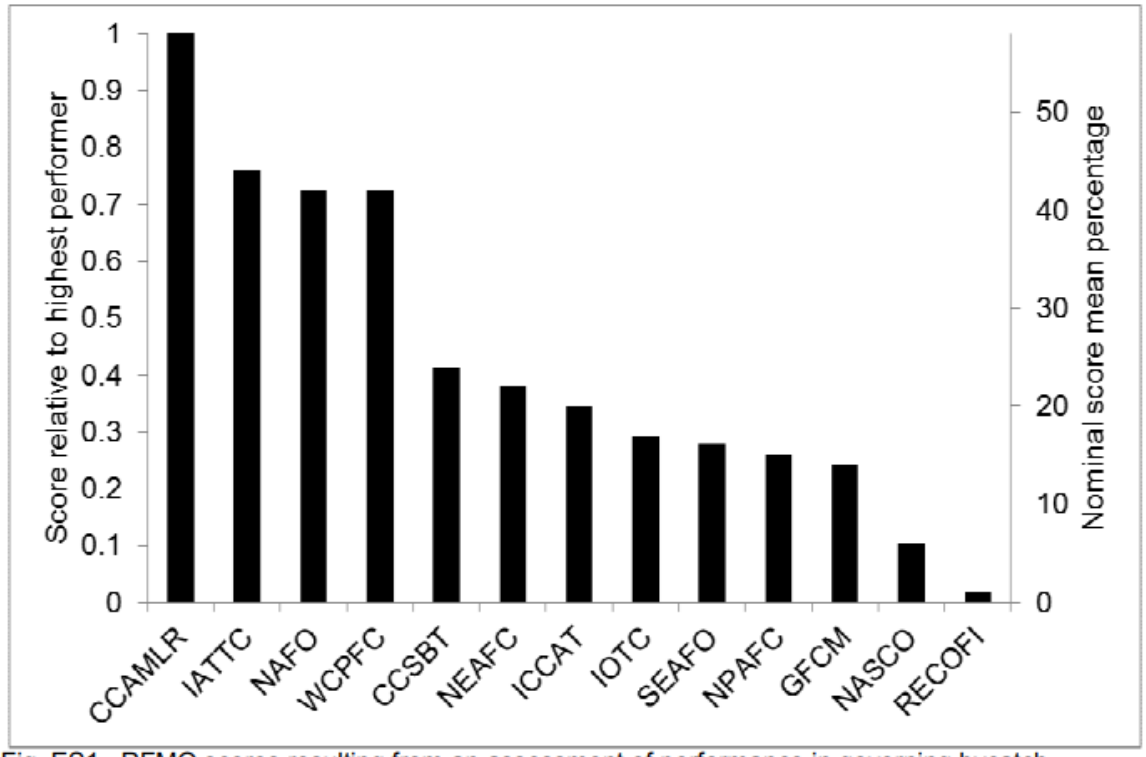


Fig. ES1. RFMO scores resulting from an assessment of performance in governing bycatch, including discards. Primary x-axis scale is the score relative to the highest performer. Secondary x-axis scale is the nominal mean percentage score of five criteria.

The authors found that CCAMLR, IATTC, NAFO, WCPFC, and CCBST scored highest in overall performance, respectively (see Figure 3). The number of voting Members did not affect performance in this study, but noted RFMO age, history, market drivers, and other factors did have an impact (e.g., factors not considered in this report to the IWC). Further, the authors noted that RFMOs without references to non-target catch management in their Convention (i.e., CCSBT, GFCM, ICCAT, IOTC, and NASCO) had poorer performance[18].

Across RFMOs, the authors found that there is an average regional observer coverage rate of under 20 percent and only nine of the 13 RFMOs had data from a regional observer program with sufficient time-series data for analysis. At the time of publication of Gilman et al. 2013, WCPFC was the only RFMO providing open access to data at a spatial resolution less than 5-degree cells.

4. **Juan-Jordá et al. (2017) <u>Report card on ecosystem-based fisheries management in tuna regional fisheries management organizations</u>**

This study sought to assess the current state of ecosystem-based fishery management in tuna RFMOs. The authors reviewed EBFM-like criteria across the five RFMOs, and compared RFMO

[17] Primary y-axis scale is the score relative to the highest performer. Secondary y-axis scale is the nominal mean percentage score of five criteria.

[18] As noted in Footnote 12 some of the RFMO activities and Convention texts have changed since the publication of this research. Please refer to individual RFMOs and Appendix II for more up-to-date information.

action towards a "best case" model for EBFM. The model addressed four ecosystem components: target species, bycatch species, ecosystem properties, and habitat based on Lodge et al. (2007). For each component, the authors posed a series of questions. For bycatch, these included:

- "Have conceptual and operational objectives been formally stated relevant to bycatch species? Relevant to indicators:"
- "Element 10: Have bycatch species been assessed, and have indicators of stock status been developed (associated to pre-established objectives) and are being monitored? Relevant to reference points:"
- "Element 11: Have reference points, including target and limit reference points, been defined, developed and linked to pre-established objectives and indicators relevant to bycatch species? Relevant to management responses and measures:"
- "Element 12: Have management responses and measures been put in place and linked to pre-established management objectives, indicators, and reference points relevant to bycatch species?"

This study then ranked the ecosystem components for *both* the Commission and Scientific Committee. For bycatch indicators and reference point criteria for marine mammals, IATTC scored highest as the only RFMO to not receive a slight or no progress. For measures on marine mammals, ICCAT and CCSBT had no or slight progress at the Commission or Committee level; all other RFMOs had some type of level of work on marine mammals. The authors noted the value of a setting up long-term bycatch database, including more than just housing aggregate data, in order to assess marine mammal impacts. WCPFC, IATTC, and CCSBT hold a regional database and thus allow for the harmonization of standardized data across RFMOs.

There have been additional external reviews of RFMO performance in recent years (e.g., Haas et al., 2020; McCluney et al., 2019; Ewell et al., 2020), but none have specifically examined RFMOs for their work on cetacean bycatch.[19] Therefore, this analysis seeks to examine recent cetacean-focused bycatch efforts of RFMOs.

Methods

The methodology outlined is a preliminary attempt at generating an index to evaluate RFMO performance in relation to cetacean bycatch management.[20] Both tuna and non-tuna RFMOs were assessed for their efforts in addressing cetacean bycatch. An overall "bycatch mitigation effort score" was calculated for all 16 RFMOs, based on six broad factors distributed over 12 questions. For tRFMOs, where more information generally exists on the number of vessels and other factors, an additional "average bycatch performance score" was calculated, which combined the 1) bycatch mitigation effort score and a 2) "potential for bycatch risk score" to assess overall bycatch performance.

Caveats: It should be noted that this is a very high-level and quantitatively simple analysis. Given that this is intended to be an informative report that broadly surveys cetacean-focused bycatch efforts within RFMOs, the author did not find that an intensive statistical analysis was

[19] There are none aware to the author's knowledge as of March 2020.

[20] The author acknowledges that further development of the methodology is needed due to the shortcomings identified throughout this report. Despite the challenges involved, working towards the development of an index is important in order to be able to document and encourage progress on cetacean bycatch reduction efforts.

warranted at this point. The report also includes a rather simple review of CMMs and other factors by way of a binary scoring system, as it did not have a continuous scoring scale given the level of detail within a factor. For example, a CMM requiring observer coverage was assigned a 1, and the level of required observer coverage did not influence the score. In other words, an RFMO either has an observer requirement, or it does not. Readers seeking a more complex quantitative review are encouraged to review the aforementioned studies. Further, a major limitation of this analysis is that it only reviews what RFMOs are doing on paper, and disregards compliance. The author intends to conduct a more thorough analysis of CMMs and their compliance in future published research.

Bycatch Mitigation Effort Score (all RFMOs): First, in order to assess the "bycatch mitigation effort score," six broad categories were considered in this analysis: 1) **Binding CMMs:** Reviewing all CMMs, noting any that directly focused on a) marine mammals/cetaceans, b) an observer program, or c) any other related, binding measures – including data reporting or quantitative bycatch metrics; 2) **Convention emphasis on bycatch:** Reviewing the Convention and Rules of Procedure to determine if there was mention of non-target species, an ecosystem-based approach, or bycatch management. Keyword search terms conducted for each RFMO included: "cetacean," "marine mammal," "bycatch," "non-target," "discard," and "ecosystem;" 3) **Committees examining bycatch:** Determined whether committees, subcommittees, working groups, or staff existed at each RFMO or their Secretariat that focused on bycatch; 4) **Voluntary initiatives:** Reviewed each RFMOs activities for any voluntary, formal or informal, projects, reports, identification cards, or other initiatives to address cetacean bycatch; 5) **Data transparency and analysis:** Determined if RFMOs had analyzed any available bycatch data and if it was publicly available, such as through their website and review of recent Scientific Committee and subcommittee reports; and 6) **Performance Reviews:** Where applicable, reviewed the most recent Performance Review to determine if recommendations were made to improve bycatch reduction or related ecosystem-based approaches to management.

These six broad categories were further divided into 12 questions/subcategories as noted below. Each criterion was assigned a binary score (i.e., 0 or 1) depending on whether the criteria were present (1) or absent (0) (e.g., the existence of a subcommittee on bycatch received a score of 1; no subcommittee or equivalent received a 0). Scores were tallied into a bycatch mitigation effort score, with a higher cumulative score indicating better bycatch mitigation effort. The 12 assessed criteria were:

1. *Binding CMMs:* Is there an observer program that requires collection of cetacean bycatch data?[21]
2. *Binding CMMs:* Is there a cetacean/purse seine CMM?
3. *Binding CMMs:* Is there a cetacean/longline CMM?
4. *Binding CMMs:* Is there a cetacean/gillnet CMM?
5. *Binding CMMs:* Are there other CMMs or binding measures specifically focused on cetaceans?

[21] A score of 1 was assigned even if observer coverage requirements existed for just one fishery, regardless of the required percentage. A score of 0 was assigned if the only scientific body of the Commission was a Scientific Committee or equivalent without an ecosystem or bycatch-focused working group.

6. *Convention Agreement:* Does the Convention include reference to management of bycatch (or other key bycatch-related terms mentioned above), or EBFM?
7. *Data Transparency and Analysis:* Do quantitative metrics exist for testing the efficacy of bycatch reduction measures (CMM or other)?
8. *Data Transparency and Analysis:* Is bycatch data (logbook or observer data) being analyzed, either by a third party, a sub-committee, or the Secretariat?
9. *Voluntary Initiatives:* Are there voluntary initiatives or projects undertaken to reduce cetacean bycatch?
10. *Voluntary Initiatives:* Have bycatch-reduction technologies or mitigation efforts been introduced in any managed fisheries?
11. *Subcommittees:* Is there a subcommittee, working group, and/or staff member within the Secretariat or RFMO managing and/or investigating bycatch, outside of the duties of the Scientific Committee?
12. *Performance Reviews:* Does the most recent Performance Review, where applicable, make recommendations to better manage bycatch, non-target catch, or address EBFM?

Potential for Bycatch Risk Score (only tRFMOs): Potential for bycatch risk was calculated by the following equation, and assigned to values listed below:

(cumulative gear type + cumulative binding cetacean CMM + observer program) x
(total number of vessels[22]/1000)

As with the bycatch mitigation effort score, a binary score of 0 or 1 was assigned to the three factors in the above risk equation, except for gear type. To account for the additional bycatch risk associated with gillnets, the binary score was expanded to a 0.5 scale to account for degree of risk across gear types. An absence of longline, trawl, gillnet and purse seines was assigned a 0, the use of gear other than gillnets received a score of 0.5, and gillnets received a score of 1. In this case, unlike the mitigation effort score, a 1 noted the negative/higher risk variable (e.g., a 1 for no binding CMM on cetaceans) and a 0 noted a positive variable (e.g., a 0 for a purse seine CMM). The four most dangerous gear types for cetacean bycatch were included here (Read et al., 2006; Lewison et al., 2014), and tallied individually. The values for each variable were:

Gear type:
- Gillnet: 1
- Longline, trawl, purse seine fishery: 0.5 (cumulative per use of gear type)
- No longline, trawl, gillnet, or purse seine in fisheries: 0

Binding Marine Mammal/Cetacean CMM:
- Absence of binding CMM: 1

[22] Note: Again, this is an over-simplification factors to consider when addressing bycatch, and ideally other factors would be in this equation to capture bycatch, including: mesh size (where applicable), better effort data (e.g., number of fishing trips or net soak time/number of hooks), gear stratification, and spatial extent. Given unknowns with fisheries/lack of publicly available data, those variables were not considered here. The author recognizes this considerably oversimplifies fishing effort.

- Presence of binding CMM: 0

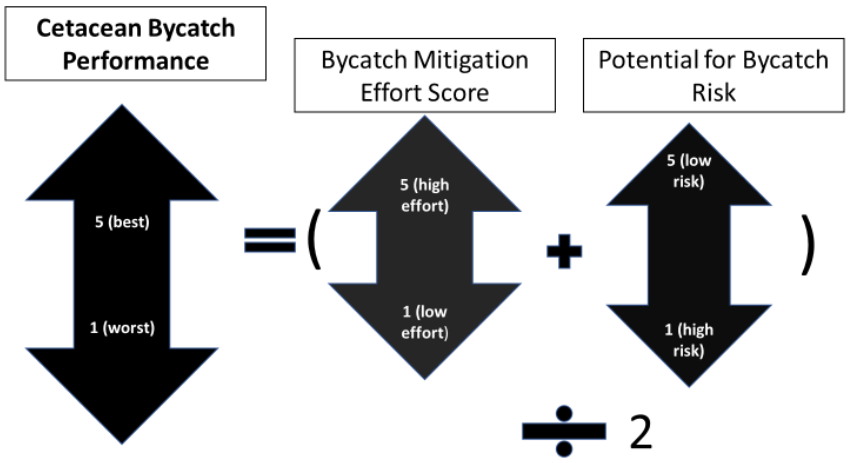
Observer Program:

- Absence of observer program: 1
- Presence of observer program: 0

The values for each gear type, presence/absence of a CMM, and presence/absence of an observer program were added and then multiplied by the total number of vessels for each RFMO, as publicly available on the Consolidated List of Authorized Vessels (CLAV) (http://clav.iotc.org/browser/search/).[23] While it is acknowledged that the number of vessels is not the best measure of fishing effort, that the number of authorized vessels does not necessarily translate to the number of vessels fishing, and that the CLAV includes many data gaps, it is publicly available and provides a consistent metric across tRFMOs. This total was divided by 1000 to scale the total potential for bycatch risk into a more digestible number. Therefore, unlike the bycatch mitigation effort where a higher score is "better," a higher score for risk was considered worse.

Average Bycatch Performance Score (only tRFMOs): Bycatch mitigation effort and potential for bycatch risk (for the tRFMOs) were then ranked on a 5-point scale: the lowest-risk RFMO received the highest score (5) and the highest risk received the lowest score (1). The highest-effort RFMO also received the highest score (5) and lowest effort RFMO received the lowest score (1). The two scores were averaged for each RFMO to assign it an average performance in addressing bycatch. A higher score indicated a higher overall bycatch performance (Figure 5).

Figure 5: Visualization of calculation for Average Cetacean Bycatch Performance Score



The methodology described above was only performed for the tRFMOs, which generally have more public-facing information available about gear type and number of vessels. Non-tuna RFMOs underwent both a qualitative review (e.g., Appendix II) and a bycatch mitigation effort

[23] CLAV data and all measures on CMMs and other efforts were last accessed December 20, 2019.

scoring based on the same criteria as described above. However, potential for bycatch risk and average performance scores were not calculated due to data restrictions or lack of reporting, making it difficult to retrieve information on the total number of vessels and other factors that could be considered as fishing effort.

This methodology built on some of the RFMO evaluative studies referenced above (section "RFMO Performance in Scientific Literature"). Each of the aforementioned studies used related but varied criteria to assess bycatch performance, as done here. The quantitative assessment here was far less complex than in Cullis-Suzuki and Pauly (2010) and Gilman, Passfield, and Nakamura (2013), as it did not contain a statistical analysis. Those two studies also went into far more detail in both their qualitative and quantitative studies; the analysis here was much simpler based on a generally binary score of presence or absence. There are also aspects of each study that make them unique; e.g., Juan-Jordá et al. (2017) assessed performance by both the Scientific Committee and the Commission, and Cullis-Suzuki and Pauly (2010) compared performance on paper and in practice. The evaluation in this study differs by considering slightly different performance sub criteria (chosen subjectively), and that it included a potential for bycatch risk assessment, which had not yet been seen in literature in regards to cetacean bycatch in RFMOs.

Results

Tuna RFMOs

Bycatch Mitigation Effort Score: IATTC, followed by WCPFC, IOTC, ICCAT, and CCSBT had the highest bycatch mitigation effort score, respectively (Table 2; see Appendix II for descriptions of bycatch efforts for each RFMO considered here). IATTC scored the highest due to its extensive observer program (100 percent coverage on purse seines), presence of a cetacean-focused CMM, the availability of transparent data that are analyzed, and quantifiable performance metrics within binding measures (i.e., AIDCP) to track efficacy of the program. IATTC's success is largely attributable to its AIDCP program, the only cetacean-focused, legally binding *program* of all of the RFMOs in relation to reducing cetacean captures in fishing gear, and IATTC's progress before signing AIDCP to reduce mortality, establish observer coverage, and monitor and review infractions. It should be noted that the AIDCP program exists as a policy response to several decades of intentional setting of purse seines on dolphins, and therefore IATTC/AIDCP's actions are not specifically relevant to reducing incidental cetacean bycatch. WCPFC had the next highest score, with an observer program in place, a cetacean-focused CMM, references to bycatch terminology in its Convention, and several voluntary initiatives focused on bycatch (e.g., it has taken the lead on BMIS as discussed above). IOTC has an observer program, a cetacean CMM (Resolution 13/04), and a Working Program on Ecosystems and Bycatch, but cetacean bycatch data held in the IOTC database is scarce[24], and up until recently cetacean bycatch has not been regularly discussed. The IOTC is one of two RFMOs that do not reference bycatch-related terms in their Convention (ICCAT is the other). ICCAT recently amended its Convention text to consider non-target species as of its November 2019 annual meeting. ICCAT is analyzing observer data and

[24] This is based on discussion during the joint IOTC-IWC Meeting on potential collaboration to address Indian Ocean bycatch, including data gaps and challenges in relation to understanding the scale of bycatch. See: https://www.iotc.org/documents/draft-report-meeting-collaborative-activities-cetacean-bycatch-iotc-iwc

is undertaking – at least in principle – initiatives to address bycatch and ecosystem-based management; its Subcommittee on Ecosystems is also developing an Ecosystem report card that, once finalized should have indicators for marine mammal bycatch. While CCSBT has adopted many of the other CMMs existing in tRFMOs with relevance to cetaceans there were gaps in taking voluntary initiatives or data analysis.

Table 2: Bycatch Mitigation Effort Score Performance for Each tRFMO

Criteria	CCSBT	IATTC	ICCAT	IOTC	WCPFC
1	1	1	1	1	1
2	1[25]	1[26]	0	1	1
3	0	0[27]	0	0	0
4	0	0	0	1	1
5	0	1	0	0	0
6	1	1	1	0	1
7	0	1	0	0	0
8	0	1	1	0	1
9	0	1	1	1	1
10	0	1	0	1	0
11	1	1	1	1	1[28]
12	1	1	1	1	1
Total	5	10	6	7	8

Criteria questions:

1. Is there an observer program that requires collection of cetacean bycatch data?[29]
2. Is there a cetacean/purse seine CMM?
3. Is there a cetacean/longline CMM?
4. Is there a cetacean/gillnet CMM?
5. Are there other CMMs or binding measures focused on cetaceans?
6. Does the Convention include reference to management of bycatch or non-target catch?
7. Do metrics exist for testing the efficacy of bycatch reduction measures (CMM or other)?
8. Is bycatch data (logbook or observer data) being analyzed, either by the RFMO or Secretariat?
9. Are there voluntary initiatives or projects undertaken to reduce cetacean bycatch?
10. Have bycatch-reduction technologies or mitigation efforts been introduced in any managed fisheries?
11. Is there a subcommittee, working group, and/or staff member within the Secretariat or RFMO investigating bycatch?
12. Does the most recent Performance Review, where applicable, make recommendations to better manage bycatch, non-target catch, or address EBFM?

[25] Note: This is via adoption of IOTC Resolution 13-04 "On the Conservation of Cetaceans"

[26] This is reflected as the binding Agreement on the International Dolphin Conservation Program, rather than a CMM.

[27] Note: IATTC's Resolution C-11-08, "Scientific Observers for Longline Vessels," is captured under criteria 1 and not duplicated here.

[28] Note that WCPFC treats its former Bycatch Working Group now as a "theme" under the Scientific Committee, titled the "Ecosystem and Bycatch Mitigation Theme" (WCPFC, 2017). This is still included here as a sub-body addressing bycatch under question 11 in the sub-criteria.

[29] A score of 1 was assigned even if observer coverage requirements existed for just one fishery.

Potential for Bycatch Risk Score: The analysis revealed that the tRFMOs can essentially be divided into two categories for risk potential: low risk (CCSBT and WCPFC) and high risk (IATTC, ICCAT, and IOTC). CCSBT and WCPFC had the lowest "risk" of the tRFMOs, respectively, likely due to the fact that they are the only RFMOs where there is little or no use of gillnets, and they have the lowest number of registered vessels (CCSBT also likely scored the lowest given its target catch is limited to a single species) (Table 3, Figure 4). IATTC and IOTC, respectively, had highest risk, likely due to the fact that both RFMOs use gillnets as a gear type (which had the highest weight – though it should be noted IATTC has less gillnet fishing than IOTC) and they had the highest number of registered vessels. ICCAT had the third highest risk, due to the fact that it is the only RFMO without a cetacean-focused CMM combined with it having the third-highest number of registered vessels.

Table 3: Potential for Cetacean Bycatch Risk Score in tRFMOs

Risk Factor	CCSBT	IATTC	ICCAT	IOTC	WCPFC
Gear Type (Longline (0.5), trawl (0.5), gillnet (1), purse seine (0.5) fishery)	1	2.5[30]	2	2.5	1.5
Presence (0)/absence (1) of binding cetacean CMM	0	0	1	0	0
Presence (0)/absence (1) of observer program CMM	0	0	0	0	0
Aggregate risk	1	2.5	3	2.5	1.56
Number of vessels	590	5604	3905	5447	3909
Total bycatch risk	0.59	14.01	11.72	13.62	5.86

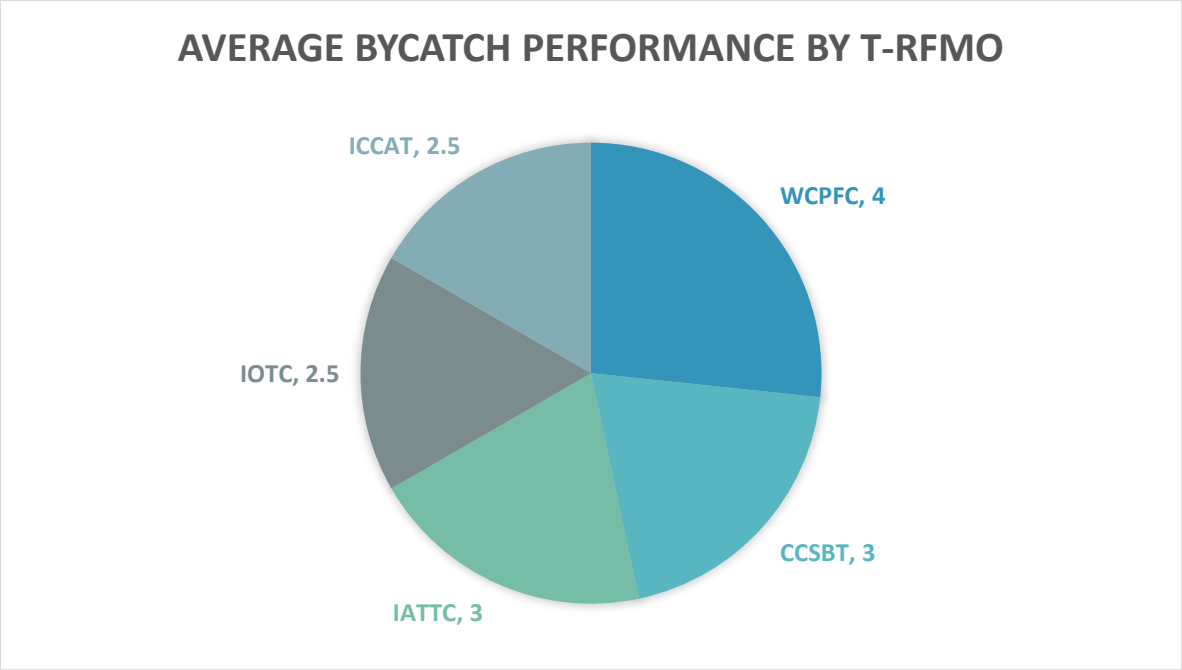
Average Bycatch Performance Score: Based on an averaged bycatch mitigation effort score and potential for bycatch risk score, WCPFC performed the highest for its total cetacean bycatch performance score on a 1-5 point scale. CCSBT/IATTC, and IOTC/ICCAT, respectively, followed in the rankings (Table 4, Figure 6). Quantitatively, CCSBT came in second for its overall performance, which is likely due to the lower number of vessels. In practice, given the AIDCP and other efforts within IATTC, IATTC is arguably undertaking more work to address direct mortality of dolphins from interactions with fishing gear, although again this is on intentional setting on dolphins in purse seines. It also adopted in 2003 a new Convention – the "Antigua Convention" – which replaced the original one and entered into force in 2010, among others to reflect the most recent rules, principles and standards contained in UNCLOS, UNFSA, the CCRF and other relevant international instruments." WCPFC has a binding cetacean-focused CMM, its Convention considers ecosystem variables, and it arguably has undertaken the most voluntary initiatives to address bycatch (e.g., BDEP and BMIS). ICCAT is the only RFMO without a cetacean-focused measure and is one of two tRFMOs without references to ecologically-related terms in its Convention – the two variables that likely contributed to its lower score.

[30] Note that IOTC has more gillnet fishing than IATTC, and this broad scoring system therefore does not capture this difference.

Table 4: Ranking of Calculations for Average Cetacean Bycatch Performance Score in tRFMOs[31]

Risk (lowest risk to highest risk)	Effort (best to worst)	Average Performance (best to worst)
CCSBT - 5	IATTC – 5	WCPFC – 4
WCPFC - 4	WCPFC – 4	CCSBT – 3
ICCAT- 3	IOTC – 3	IATTC – 3
IOTC - 2	ICCAT – 2	IOTC – 2.5
IATTC - 1	CCSBT – 1	ICCAT – 2.5

Figure 6: Average Bycatch Performance in tRFMOs



Non-Tuna RFMOs

Bycatch Mitigation Effort Score: CCAMLR had the highest bycatch mitigation effort score, followed by GFCM. CCBSP scored the poorest (Table 5; see Appendix II for full descriptions of RFMO performance). In general, CCAMLR has taken a precautionary and ecosystem-driven approach to bycatch management compared to other RFMOs, as reflected in its score. GFCM has undertaken several initiatives towards reducing cetacean bycatch in recent years, including the adoption of a marine-mammal focused CMM, participation in a Mediterranean-wide effort to

[31] Again, performance in the tRFMOs was based on: 1) bycatch risk, where a higher score = lower risk; 2) bycatch effort, where a higher score = most effort); 3) average performance, where a higher score = better performance on paper.

reduce bycatch (FAO, 2019), and voluntary bycatch work with ACCOBAMS and other partners. SIOFA, NAFO, SPRFMO, and NEAFC scored similarly on all criteria; in general, their Conventions have an objective towards addressing a precautionary approach and they meet minimum criteria with baseline observer coverage and some data analysis, but are not proactive on matters specific to cetaceans. The other RFMOs are not undertaking work specific to cetaceans, and their scores generally stem from references in their Convention to bycatch-related matters or the presence of subcommittees referencing the issue. NASCO, NPFC, and CCBSP had relatively low scores as they do not have any subsidiary bodies addressing bycatch, nor are bycatch-related matters mentioned in their Convention (and CCBSP has little to next to no fishing right now).

Table 5: Cetacean Bycatch Mitigation Score in Non-Tuna RFMOs

Criteria	*CCAMLR*	*CCBSP*	*GFCM*	*NAFO*	*NASCO*	*NEAFC*	*NPAFC*	*NPFC*	*SEAFO*	*SIOFA*	*SPRFMO*
1	1	1	1	1	0	0	1	1	1	1	1
2	0	0	0	n/a	0	0	0	0	n/a	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	1	0	1	0	0	1	0	0	1	1	1
5	1	0	1	0	0	0	0	0	0	1	0
6	1	0	1	1	0	1	1	1	1	1	1
7	1	0	0	0	0	0	0	0	0	0	1
8	1	0	1	1	0	0	0	0	0	0	1
9	1	0	1	0	0	1	0	0	0	0	0
10	1	0	0	0	0	0	0	0	0	0	1
11	1	0	1	1	0	0	1	0	1	1	1
12	1	0	0	1	0	1	1	0	0	1	1
Total	10	1	7	5	0	4	4	2	4	6	8

Criteria questions:

1. Is there an observer program that requires collection of cetacean bycatch data?[32]
2. Is there a cetacean/purse seine CMM?
3. Is there a cetacean/longline CMM?
4. Is there a cetacean/gillnet CMM?
5. Are there other CMMs or binding measures focused on cetaceans?
6. Does the Convention include reference to management of bycatch or non-target catch?
7. Do metrics exist for testing the efficacy of bycatch reduction measures (CMM or other)?
8. Is bycatch data (logbook or observer data) being analyzed, either by the RFMO or Secretariat?
9. Are there voluntary initiatives or projects undertaken to reduce cetacean bycatch?
10. Have bycatch-reduction technologies or mitigation efforts been introduced in any managed fisheries?
11. Is there a subcommittee, working group, and/or staff member within the Secretariat or RFMO investigating bycatch?
12. Does the most recent Performance Review, where applicable, make recommendations to better manage bycatch, non-target catch, or address EBFM?

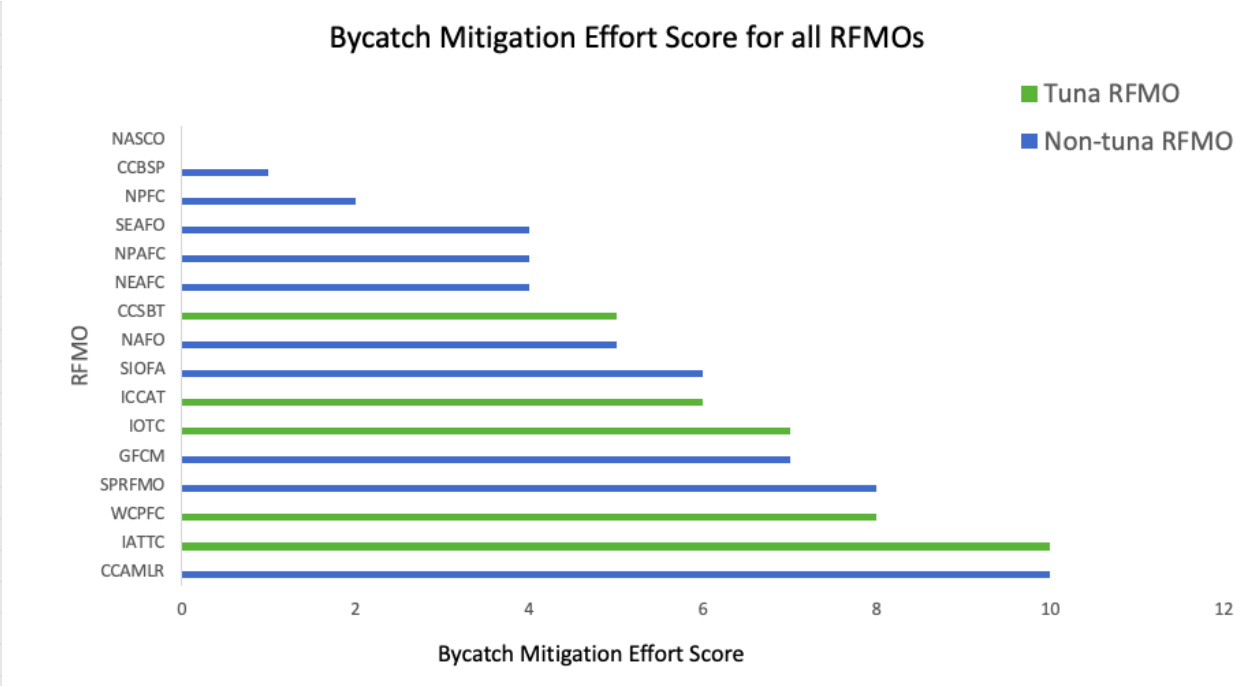
Discussion

RFMOs form the backbone of international fisheries management and provide regional governance frameworks for the high seas. They are often critiqued for not doing enough (e.g., Cullis-Suzuki and Pauly, 2010; Gilman et al., 2013) to address both the target stocks they manage

[32] A score of 1 was assigned even if observer coverage requirements existed for just one fishery.

and non-target bycatch, but it is important to acknowledge where progress has been made. This discussion begins with a more detailed review of RFMOs and their bycatch performance score, and then identifies areas for improvement and collaboration between RFMOs and the IWC. It is important to highlight, again, that the results of this analysis are highly relative and conducted at a very high-level. Additionally, the results only address what efforts the RFMOs are taking on paper, and do not address actual compliance and implementation by Member States.

Figure 7: Bycatch Mitigation Effort Scores of the 16 RFMOs[33]

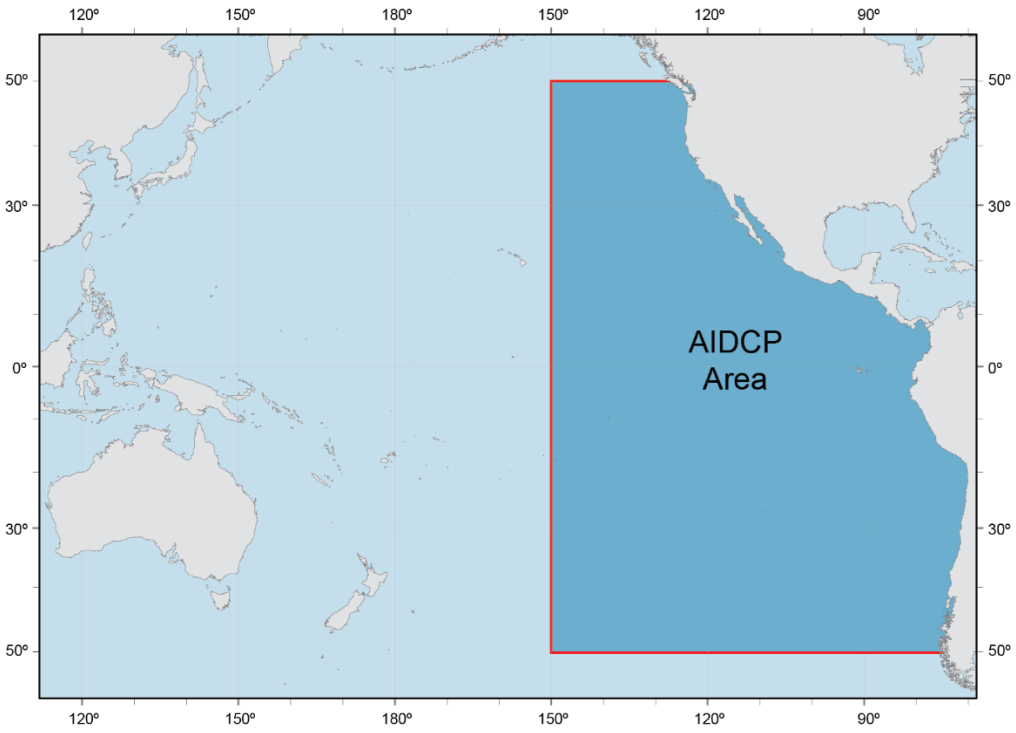


Tuna RFMOs: Here, **IATTC and WCPFC** scored within the top RFMOs overall (IATTC bycatch mitigation effort score = 10, average performance score = 3, risk potential = 14.01; WCPFC bycatch mitigation effort score = 8, average performance score = 4, risk potential = 5.86) (Figure 7). IATTC and WCPFC have the most policies and tools in place to address bycatch, as shown here and in other studies (Table 4; Figure 6) (Gilman et al., 2012; Juan-Jordá et al., 2017). Both of these RFMOs reference non-target or other ecological components in their Convention; both have binding measures to reduce cetacean bycatch in purse seine or other fisheries; and both are analyzing some portion of bycatch data (e.g., IATTC: through AIDCP and the IATTC Secretariat, as well as the Bycatch and FAD Working Groups as well as the Ecosystem and Bycatch considerations reports. It should be noted that IATTC data analysis is done in-house. WCPFC: through the Pacific Islands Forum Fisheries Agency (FFA) and SPC for WCPFC) (see Appendix II).

[33] Note: The Bycatch Mitigation Effort score, rather than performance score, was depicted here, as this is the metric calculated across all 16 RFMOs.

Interesting, IATTC scored highly in performance and policy effort – but also had the highest potential for bycatch risk (14.01). It is important to note again that what makes IATTC both perform so highly and yet have the highest risk is AIDCP, a legally-binding program that manages dolphin mortality limits in the purse seine fishery in the EPO. The IATTC staff acts as the AIDCP Secretariat. This program requires 100 percent observer coverage on tuna purse seine vessels over 363 t, sets quantitative limits (in the form of "Dolphin Mortality Limits"), lays out a methodology for assessing mortality and performance in reducing this, monitors mortality and compliance through observer data through its International Review Panel, and incorporates a management scheme within a binding agreement (though while bycatch has decreased in the fishery, dolphin recovery is in question. Wade et al., 2007 finds dolphins have not recovered, while Gerrodette et al. 2008 notes several stocks may be recovering, but the authors recognize this interpretation should include caveats and that the coefficients of variation and confidence intervals in this estimate are higher). Further, another strong feature of AIDCP is the International Review Panel within the AIDCP, which provides a unique oversight function where possible infractions are reviewed not only by the Parties, but also representatives from the industry and the NGO community.

Figure 8. Map of AIDCP Convention Area



However, as previously noted the AIDCP program addresses dolphin mortality in a fishery that intentionally sets on dolphins, so it is should possibly be considered a bit differently than a conventional bycatch reduction program. Still, this is the only RFMO to have a program of such magnitude, inclusive of a performance standard, though no other RFMO/fishery has had intentional setting bycatch to the magnitude as this fishery (Gilman, 2011). As aforementioned, Lewison et al. (2014) identified bycatch rates for cetaceans as being the highest in the EPO

(although this could be attributable to consistent reporting and full observer coverage out of AIDCP), and the analysis here also points to a high risk in the IATTC Convention Area, making it both promising and appropriate that IATTC and WCPFC offer stronger governance schemes in an area of high bycatch as noted in literature. It should be recalled also that IATTC has an active Permanent Working Group on Bycatch, which addresses all issues of bycatch, including cetaceans, which do not fall under the specific scope and mandate of the AIDCP."

Ultimately, WCPFC scored highest of all the tRFMOs in the average performance; its lower risk score levelled with its mitigation effort score to surpass IATTC[34]. Out of all of the tRFMOs, WCPFC is arguably doing the most to undertake voluntary initiatives to address bycatch across multiple fisheries and taxa. For example, it took the early lead on launching and contributing to BMIS, has advocated for RFMOs to submit data to BDEP, has held bycatch workshops, published some bycatch data online, and issued at least two reports (i.e., WCPFC, 2017b, 2019) analyzing purse seine and longline bycatch in the Convention Area largely since WCPFC's establishment to the present.

IOTC is currently behind some other RFMOs in addressing cetacean bycatch, as demonstrated here and in other studies (mitigation effort score = 7, average performance = 2.5, risk potential=13.62). A serious concern with IOTC is its prevalent use of gillnets compared to any other RFMO (e.g., Shahid et al., 2015; Anderson et al., 2020), which is believed to be the most high-risk gear for cetaceans (e.g., Reeves et al., 2013; Brownell et al., 2019). IOTC does not reference non-target species in its Convention, and is not receiving enough cetacean bycatch data from Members to analyze it in detail (Gilman et al., 2012; IOTC, 2018). Additionally, its observer CMM only applies to vessels over 24 meters in length that are fishing outside of their EEZs, while most of the fishing effort is concentrated in national waters of state members. Other semi-industrial gillnet vessels, estimated to comprise a significant portion of fishing activity in the IOTC Convention Area, are likely operating without observers and not reporting catch, and neither is the artisanal fleet. IOTC is, however, starting to make progress on bycatch. In 2013, it passed a binding measure prohibiting setting purse seines on cetaceans in the high seas and reporting interactions in other gear (Resolution 13/04), and in December 2019 passed a new CMM (Resolution 19/01) that calls for several important changes to IOTC gillnet fisheries. These include transitioning gillnet vessels to other gear types, transitioning to sub-surface setting of gillnets (particularly important for cetaceans, Anderson et al., 2020), and increasing observer coverage to 10 percent. IOTC is also one of three RFMOs that is starting to compile some of its BDEP data. Finally, IOTC also does have a sub-body committed solely to bycatch, the Working Party on Ecosystems and Bycatch.

CCSBT (bycatch mitigation effort = 5, average performance = 3, risk potential = 0.59) scored the lowest for its effort, though had the second-highest performance. This is likely because of its lower risk score (the lowest of the tRFMOs). CCSBT is unique in that it does not have a formalized Convention Area and overlaps with IOTC, WCPFC, and ICCAT. CCSBT has adopted Ecologically Related Species-CMMs from other RFMOs, specifically IOTC's Resolution 13-04 "On the Conservation of Cetaceans" and ICCAT's Recommendation 11-10, "Information Collection and Harmonization of Data on By-catch and Discards in ICCAT Fisheries". However, it

[34] Note that the score may have shifted should a more detailed scoring system be used, reflecting that IATTC has lower gillnet effort than IOTC.

does not appear to have adopted WCPFC's purse seine CMM, though the only purse seine fishing within CCSBT is Australia's purse seine fishery, which is highly targeted due to the use of spotter plans to pursue individual, juvenile tunas, and this specific fishery has no record of cetacean interactions. It also does not have any cetacean-focused CMMs on its own, other than a measure recommending a 10 percent observer coverage level. CCSBT does have an Ecologically Related Species Working Group, and some Members are submitting some BDEP data. However, more needs to be understood about CCSBT, bycatch reduction done within its own Commission, and fisheries overlap with other tRFMOs.

Finally, **ICCAT** tied second-lowest for its overall bycatch performance (with IOTC) and had the second-highest risk (bycatch mitigation effort = 6, risk = 11.72, average performance = 2.5). ICCAT, charged with monitoring fish stocks throughout the Atlantic Ocean, has no cetacean-focused CMM, including in its purse seine fisheries, though it does have an observer and data collection CMM. The Subcommittee on Ecosystems tracks and analyzes bycatch, but little data is being reported or analyzed. In particular, the 2018 Standing Committee on Research and Statistics (SCRS) report notes that ICCAT is lacking data to inform what constitutes a cetacean interaction, that observer data is currently not used to constitute bycatch estimates, and that observer data is confidential (ICCAT, 2018).

Promising efforts for ICCAT include the recent appointment of a bycatch coordinator on staff; the ICCAT Subcommittee of Ecosystems is also developing and Ecosystem report card that, once finalized, should have indicators for marine mammals; and ICCAT has taken two recent initiatives to address cetacean bycatch. In 2010, ICCAT commissioned a bycatch-focused report and database with the aim to aggregate and analyze available bycatch data, compile information on mitigation, and increase information sharing. Through this initiative, ICCAT compiled nearly 400 new studies, but was unable to analyze much data due to confidentiality requirements and a lack of data availability (Cotter, 2010). In 2016, ICCAT worked with the Common Oceans ABNJ tuna project, to convene all five tRFMOs for a meeting on implementing an ecosystem approach to management (Common Oceans, 2016), and they also led efforts to convene the December 2019 Joint Meeting of the Bycatch Working Groups. ICCAT is also in the process of developing an Ecological Based Fisheries Management Framework, which will establish indicators for an ecosystem report card at ICCAT to help establish ecosystem/bycatch priorities at ICCAT and in collaboration with other tRFMOs (ICCAT, 2018).

Non-Tuna RFMOs and RFMO-like bodies: Based on the quantitative assessment, **CCAMLR** outperformed the other non-tuna RFMOs for cetacean bycatch mitigation efforts (bycatch mitigation score = 10). CCAMLR is exceptional in its focus on a precautionary, science-based approach to management out of all RFMOs. It has a variety of CMMs directly and indirectly related to cetaceans, some of which set limits on bycatch. They also identify sentinel species representative of ecosystem change (one of which is a marine mammal, though not a cetacean, the Antarctic fur seal (*Arctocephalus gazelle*)), which is not otherwise recognized in RFMOs. Its data retrieval and presentation of information is also clear and comprehensive when compared to other RFMO websites. While that may seem like a small detail, and one that was not reflected in any quantitative rankings, user performance online may have the ability to greatly enhance understanding with management measures. Every study reviewed here also lauds CCAMLR as the exemplary RFMO-like body for ecosystem-based management (Small, 2005, Cullis-Suzuki and Pauly 2010, etc.).

A decade ago, **GFCM** had not undertaken significant efforts to address cetacean bycatch (Gilman et al., 2013), but have taken steps to address this in recent years. For example, they adopted a marine mammal CMM in 2012 that sets conservation objectives, calls for data recording, and it is the only observed CMM in RFMOs that references a necessary review on gear type as possible mitigation for cetacean bycatch. They are also working with ACCOBAMS and other organizations on a large-scale study to better understand and mitigate bycatch in the Mediterranean, in the context of which they developed a standard methodology for bycatch data collection (FAO, 2019c), and are quite transparent in online data reporting (http://www.fao.org/gfcm/data/en/).

SPRFMO also scored quite highly (8). SPRFMO has made much progress, and quickly, since coming into force earlier this decade. SPRFMO's convention has an emphasis on an ecosystem-based and precautionary approach to management; a CMM banning the use of gillnets; and has several CMMs with reference to marine mammal bycatch mitigation.

Several non t-RFMOs tied with five points or higher (**NAFO, SIOFA**). **NAFO** should receive recognition for emphasis on an ecosystem-based and precautionary approach to fisheries management. **NAFO** also has a requirement for 100 percent observer coverage, and at least some communication with NAMMCO and ICES on seal conservation (i.e., the ICES/NAFO/NAMMCO Working Group on Harp and Hooded Seals). Certain factors that led to these RFMOs receiving some points are that all mention bycatch or related terms in their Conventions; **SIOFA** does have a gillnet CMM (2016/05), as SIOFA Contracting Parties use gillnets.

SEAFO, CCSBP, NPFC, NPAFC, NEAFC, and NASCO (which all scored at 4 or less) are not directly addressing cetacean bycatch at all; some have minimum bycatch reporting requirements or minimum observer requirements (see Appendix II), but are not engaged directly with addressing fishery interactions with cetacean bycatch. This could partially be due to how young some of them are (e.g., NPFC), coupled with relatively low levels of fishing (e.g., SEAFO[35] and NASCO). In particular, NPAFC's Convention prohibits directed fishing for anadromous fish and retention of bycatch in the Convention Area, so bycatch management requirements appear applicable for NPAFC. Others, like NASCO, have extremely limited fishing[36], combined with a low likelihood of marine mammal interactions, and thus there is little need for a cetacean bycatch measure.

General Review

It is clear that none of the RFMOs are comprehensively addressing cetacean bycatch. Even the RFMOs that are making progress, such as IATTC and WCPFC, have focused on purse seines, and leave other fisheries with much less monitoring and control measures for cetacean bycatch.

[35] SEAFO has zero to three vessels fishing in year, so exploitation levels are low and any bycatch is reported. There are two main fisheries – the longline fishery for Patagonian toothfish and the deep-sea red crab fishery using pods (personal communication with SEAFO, 2020).

[36] NASCO prohibits fishing for salmon beyond areas of fisheries jurisdiction and, in most areas of the North Atlantic, beyond twelve nautical miles of the baselines. The exceptions are in the West Greenland Commission area, where fisheries may take place up to 40 nautical miles from the baselines, and in the North-East Atlantic Commission area, within the area of fisheries jurisdiction of the Faroe Islands. Within these two areas regulatory measures are negotiated to limit the fishery. However, there has been no fishery for salmon at the Faroes since 2000, and the current total allowable catch for all components of the Atlantic salmon fishery at West Greenland is 30 metric tonnes in 2020.

Even the AIDCP program and the decades of effort that went into the culminating Agreement, lauded as a success in reducing dolphin mortality from purse seine encirclement (although not recovering dolphin stocks), has not conducted a comprehensive cetacean abundance estimate, since NMFS' last abundance estimate over 13 years ago (Lennert-Cody et al., 2019), although it has recently undertaken and carried out a pilot project aimed at a future and more technologically and scientifically efficient such survey. Nonetheless, efforts to improve bycatch in recent years, such as the launch of the Kobe meetings, including the 2010 Bycatch Working Group meetings, marked the first time RFMOs dedicated considerable time to the issue and ensured that the issue of bycatch gained attention. The BDEP and BMIS databases offer promising steps forward and have potential to be the center of t-RFMO bycatch work, though more attention and greater participation from RFMOs is needed to be able to analyze bycatch estimates and address the issue for the potential of BDEP and BMIS to be realized as effective tolls.

It is noteworthy that cetaceans are receiving the least attention of non-target bycatch taxa within RFMOs when compared to seabirds, sea turtles, and sharks (Lewison et al., 2011)[37]. This is surprising, particularly given the estimated extent of cetacean bycatch levels in some fisheries (e.g., Read et al., 2006; Anderson et al., 2020). For example, a recent ICCAT Working Group on Ecosystems meeting focused on seabirds and turtles; the IOTC Program of Work mentions seabird and turtle work, but not marine mammals or cetaceans (https://www.iotc.org/science/wp/working-party-ecosystems-and-bycatch-wpeb, although a new Programme of Work was discussed during the 16th Session in September 2020); ICCAT has a CMM related to sea turtles but not marine mammals/cetaceans; the ABNJ Common Oceans Phase 1 project was focused on seabirds, sharks, and turtles, and the only cetacean bycatch efforts under this project were through WWF Pakistan. Further, the 2019 Kobe-related bycatch meeting in Portugal was shark focused. The lack of action coupled with widespread data gaps, only underscores the need for comprehensive cetacean bycatch analyses related to cetaceans, in both RFMO managed fisheries and coastal/small-scale fisheries.

Therefore, there is much room for improvement to address cetacean bycatch in RFMOs. In order to effectively tackle cetacean bycatch, the RFMOs must first understand baseline information of cetacean distribution, abundance, and bycatch levels; this is vital to properly understanding bycatch risk, potential population-level impacts, and working towards effective management and policy response. Several studies note that this is vital to establishing appropriate management and policy response and generating political will (Pulling and Knight, 2009; Lewison et al., 2013; Moore et al., 2013; McDonald et al., 2015). Moore et al. (2013) notes that data gaps are often drivers for inaction, so closing that gap could lead to more will to address the issue. Additionally, at present, it is also not clear who holds bycatch data, and to what degree of detail, between the RFMOs, FAO, ICES, IGOs, and NGOs. Global discussion and collaboration on this would be quite useful.

Lewison et al. (2011) recommends a four-tier approach to addressing bycatch: community involvement, governance, data collection, and quantitative analysis. Other studies note that in addition to long-term, high quality data sets (Read, Drinker, and Northridge 2006), observer data (McDonald et al., 2016) is vital and an ideal marine mammal CMM would include bycatch limit

[37] For IATTC and the AIDCP program, dolphins are the focus.

reference points (Moore et al., 2013). Further, several studies note that management approaches could include time-area closure or gear modifications (e.g., weak hooks) (Gilman, 2011; Read, 2006), a risk-based impact assessment, bycatch limits, and shifts in practices and equipment (Lodge et al., 2007). All of these components would comprise strong reference points for RFMOs looking to strengthen or establish a new marine mammal CMM.

Limitations of This Report

While this report provides a high-level review and simple quantitative ranking of RFMOs, it is important to consider limitations of the analysis and scope of the report. First, the methodology is simple in taking a near-binary approach to RFMO performance, which does not acknowledge subjective nuances to each variable. For example, while some RFMOs may have a working group or other sub-body addressing bycatch, not all working groups perform equally. Additionally, while certain RFMOs received a point for having a marine mammal CMM, this point was just for one fishery — and thus they were awarded a point with application only to one fishery, while there are other fisheries in the Convention generating cetacean bycatch.

Furthermore, this study did not differentiate between regional versus national observer programs; rates of observer coverage between fisheries (which could lead to biases in effort data); log book versus observer reporting; consider electronic monitoring; data quality standards and enforcement across RFMOs; or differentiate between work at the commission v. scientific committee level measures, which can lend a quite different view into each RFMO (Juan-Jordá et al., 2016). Due to time constraints, this report did not look into any measures related to Fish Aggregating Devices, ghost gear, aquaculture, or Members' national bycatch standards. Additionally, an evolution analysis accounting for how RFMOs may have improved over time and comparing performance across time periods could be useful in assessing performance. Finally, the report does not specifically focus on bycatch from small-scale/artisanal fisheries, whose inclusion within RFMO management may vary by RFMO, but can generate bycatch in their fisheries (Lewison et al., 2011).

It is also important to recognize that fishing effort was only identified for the tRFMOs, and even so, the metric used (i.e., number of registered vessels) vastly oversimplifies fishing effort in tRFMOs. Data was retrieved from the CLAV, the most readily-available, public-facing data repository, which provides registered vessel types by RFMO. The CLAV has been criticized by some as being too broad of a metric, that it does not necessarily include artisanal fisheries, and has other flaws (Elliott, personal communication, 2020), A better depiction of fishing effort would have been provided if fishing days/hours, number of sets/hooks, soak times, cumulative net-length, gear stratification, or other spatio-temporal variables were consistently publicly accessible across all RFMOs to provide a more accurate depiction of fishing effort in the context of calculating bycatch rates.

The greatest need for all RFMOs is first understand the extent of cetacean bycatch. Quantitative assessments of bycatch were not conducted here; it would be a significant undertaking to calculate these rates, and the analysis would be conducted in a data-poor scenario. However, such analyses would vastly inform the highest risk areas, and thus where policy response is most needed in RFMOs.

Additionally, RFMOs are inherently complex and political institutions, and attempting a quantitative comparative analysis ignores some of the political and social intricacies that shape

performance. Social and political variables — Secretariat capacity and political will of Member States — were not examined in detail. Studies considering these factors, as well as considering performance specific to RFMOs with amended Conventions with respect to EBFM would be possibly informative.

Finally, and importantly, the quantitative analysis also only considers what RFMOs are doing on paper, and does not examine compliance with CMMs or domestic action from RFMO Member States.

Considerations for Future Work

This report provides a high-level overview of major initiatives undertaken at RFMOs to address cetacean bycatch. While it is useful in providing general indicators of which RFMOs are most active on the issue, this work can be expanded to provide a more-detailed and thorough analysis of work at the RFMO level. There are three key areas on how this work could be expanded:

1) Expand the scope to include a review of all RFMOs and RFBs to gain a comprehensive global survey of cetacean-related initiatives at RFMOs and RFBs. This report did not examine efforts of all RFMOs/RFBs, and it also considered the RFMOs most highly reviewed in literature. In order to obtain a full picture of the scope of global, policy cetacean bycatch efforts at the RFMO level, it would be helpful to expand this scope to all RFBs. For example, this would include the Regional Commission for Fisheries (RECOFI), the Fishery Committee for the Eastern Central Atlantic (CECAF), the Southwest Indian Ocean Fisheries Commission (SWIOFC), the Western Central Atlantic Fishery Commission (WECAFC), the Regional Commission of Fisheries of Gulf of Guinea (COREP), and even the work of some scientific bodies, such as ICES and PICES.
2) Obtain better fisheries effort data and observer coverage data. Obtaining better spatio-temporal data on the extent of fisheries within each RFMO Convention Area would provide for a much better assessment as to cetacean bycatch risk. Delineating this data by gear type would also be quite helpful to determine how much particularly pervasive gear — such as gillnets and trawls – are being used. One resource that could be considered to supplement data gaps is the FAO's recent Global Atlas of AIS-based Fishing Activity, which presents fishing activity by gear type and the number of vessels using AIS data (FAO, 2019d).
3) Conduct analyses/modeling of cetacean bycatch across RFMOs, where possible, to understand the extent of cetacean bycatch, assess population-level impacts, and better determine bycatch risk within RFMOs. Data availability/access will make this challenging, but these efforts are also needed in order to prioritize which RFMOs have the greatest need in addressing bycatch.
4) Undertake a statistical analysis that creates hierarchical and/or generalized mixed linear models that considers other variables, such as Compliance rates observer coverage levels within CMMs. Once better bycatch data and fisheries effort data are acquired, it would be useful to create a more nuanced scoring system, with gear type being ranked beyond a binary system and conducting actual risk analyses. Doing so will allow managers to assess which factors may be most useful in addressing RFMO performance.

Conclusion

This report demonstrates that RFMOs vary in their performance in addressing cetacean bycatch. IATTC, CCAMLR, and WCPFC are currently the most proactive in addressing cetacean bycatch or direct mortality through cetacean-focused binding measures, observer coverage, and data analysis. Other RFMOs (e.g., CCSBT and NPFC) are not as active. Recent efforts amongst RFMOs (e.g., Kobe process, 2016 EBFM meeting) seeks to better address cetacean bycatch, and it is important that RFMOs continue to build on this momentum. Efforts do not necessarily need to be via binding measures; instead, ensuring some level of data reporting — including enforcing current data reporting requirements across multiple RFMOs — and gaining a sense of the spatio-temporal extent of bycatch would be a significant step forward in applying appropriate management and policy responses and voluntary projects. Cetaceans appear to be underrepresented as compared to other taxa in RFMO efforts, and the IWC could play an important role in bringing awareness and expertise to cetaceans at RFMO meetings.

Recommendations

The following are suggested recommendations to the IWC to engage with RFMOs to reduce cetacean bycatch, as appropriate:

1. **Prioritize collaboration with ICCAT, IOTC, SPRFMO, and SIOFA.** Although there is room for improvement in all RFMOs, the scores reported here and consideration of other contextual factors lend to these four RFMOs being ripe for engagement. Advocating for more observer coverage, data reporting, and data analysis are areas recommended to the IWC to engage with on all four of these RFMOs, as well as some RFMO-specific recommendations:
    - **IOTC:** Given the extent of gillnet bycatch in the region, it is suggested that IOTC be a priority RFMO for IWC engagement and it is recommended that further collaboration is developed. As gillnets are known to cause the highest amount of cetacean bycatch and there is a known, high level of tuna driftnet use by artisanal and semi-industrial vessels within the Convention Area —most of which lacks observer coverage data — there are likely tremendous, undocumented impacts to cetaceans in the Convention Area (Anderson et al., 2020). This ties in with the findings and recommendations of the IWC's 2019 workshop on cetacean bycatch in the Indian Ocean. Beyond the direct scope of IOTC fisheries, many of the world's most endangered cetaceans are endemic to IOTC Member States coastal fisheries (Brownell et al., 2019).

      Thus, a regional focus by the BMI on addressing gillnet bycatch has the potential to build impactful work relating to fisheries within the convention area and in the coastal areas of Member States. There is an urgent need for widespread, observer monitoring programmes for bycatch data collection in both small-scale and medium-scale semi-industrial gillnet fleets, including through the use of crew-based observer schemes and low-cost electronic monitoring. Classifying and quantifying the gillnet fleets (artisanal, small-scale, semi-industrial) across the region would also be an important first step. A regional bycatch risk assessment

for IOTC fisheries based on updated information of fishing activity and cetacean presence would undoubtedly be useful, and the IWC could potentially assist with such as task if it were undertaken. Mitigation and management measures, including time/area management, gear modifications and conversions and experimental gears need to be tested and effective solutions implemented throughout the convention area and the BMI could assist with technical input, outreach, incentivization and capacity building. The IWC could also engage with any future efforts by the IOTC Secretariat and Member States on a quantitative, precautionary driven CMM, or in any possible alterations to the existing Resolution 13/04 - again by providing technical assistance. These efforts would be aligned with the IWC's current focus on addressing gillnets in its Bycatch Mitigation Initiative and provide for a strong Indian Ocean-regional effort.

- **ICCAT:** ICCAT has one of the largest Convention Areas and is the sole body governing highly migratory species throughout the Atlantic Ocean – including the Mediterranean. Despite this, it is the only tRFMO without a focused measure on cetaceans; bycatch is underreported and currently undefined. Gaining a better sense of the extent of bycatch levels by gear type and distribution in the Atlantic would be instrumental to identifying a targeted CMM. The IWC could also consider engaging with Member States to build awareness for cetaceans in the Convention Area and thus help build consensus towards a cetacean CMM. There is already existing momentum at ICCAT towards cetacean bycatch, with ICCAT having a bycatch coordinator and conducting a bycatch study in 2010. Given the IWC's proximity to the Secretariat in Madrid, this may also help facilitate collaboration. NAMMCO, ACCOBAMS/ASCOBAMS, and ICES and researchers and experts in European institutions, national research bodies and NGOs could also be useful partners and collaborators, given their regional proximity and expertise in relation to cetaceans, cetacean bycatch data and bycatch estimation.
- **SPRFMO:** SPRFMO, which scored in the median range of non-tRFMOs, is included here due to its conservation potential. SPRFMO is a newer RFMO, still shaping and creating new CMMs. Further, the SPRFMO Convention Area covers one-fourth of the world's oceans. Encouraging SPRFMO to follow the approach in developing a quantitative-driven and robust CMM like its neighbor, CCAMLR (with which it already has an arrangement for collaboration), particularly while SPRFMO is still young, carries great potential for addressing cetacean bycatch.
- **SIOFA:** This RFMO is listed for many of the same reasons as IOTC: there are tremendous data gaps in an area with high numbers of artisanal fishermen, and it is likely that the extent of bycatch is not well-documented. Its spatio-temporal overlap with gillnets in the Indian Ocean could therefore make sense for the IWC to become engaged at the same time as engaging with IOTC.
- **Why not other RFMOs?** Of course, there is room for collaboration or assistance within every RFMO. It would still be beneficial for the IWC to use its Bycatch Mitigation Initiative to attend RFMO Scientific and/or Commission meetings, raise awareness with Members about the extent of bycatch (where applicable), and strengthen existing ties with RFMOs. The four presented here offer a spatial and

contextual menu of suggested priority RFMOs for engagement based on gaps, spatial extent, and gear type.

2. **Hold a BMI workshop on cetacean bycatch analyses:** As noted above, in order to effectively tackle cetacean bycatch, improving knowledge of cetacean bycatch levels and population-level impacts within RFMOs is vital. RFMOs must first understand baseline information of cetacean distribution, abundance, and bycatch levels in their fisheries; this is vital to properly understanding bycatch risk and working towards effective management and policy response. The BMI could be the center-point for bringing together individual or groups of RFMOs, Member States, the FAO, and experts for a workshop(s) to discuss funding for the analyses, modeling for data-poor scenarios, success stories in modeling bycatch for other taxa, lay the groundwork for analyses to be conducted, and discuss mitigation where needed. Specifically, information is needed about: bycatch rates (across space and time, fleets, gear, and other variables) and the spatio-temporal distribution of marine mammals and their abundance within Convention Areas. In this vein, a recommendation for standardized descriptions of gear, as discussed in previous meetings of tRFMOs, could be very helpful. Workshop Members could secondarily discuss a suite of management measures to be considered at tRFMOs to address cetacean bycatch.

   The IWC (and other collaborators) could assist by providing/analyzing existing data on cetacean distribution and abundance from tracking and at sea surveys to identify areas within convention areas with high cetacean presence, such as those linked to Important Marine Mammal Areas. This would require scientists and others to be willing to share their data within the prioritized RFMO convention regions, and that a standardized analysis be developed which could then be incorporated into the RFMO processes.

   3. Collaborate with: *a.* The FAO and RFMOs to build awareness and capacity to implement FAO Technical Guidelines on marine mammal bycatch, and *b*. with the Western and Central Pacific Fisheries Commission (WCPFC) and the South Pacific Community (SPC) to contribute technical information for BMIS and BDEP, and *c.* raise awareness within IWC Community of these tools.

   In relation to building capacity, the BMI could work with the FAO, relevant RFMO and Member States (and other organisations) to assist implementation of the FAO Technical Guidelines, with training programmes offered and technical input provided on mitigation measure effectiveness. The BMI could also assist national governments and RFMOs to better understand bycatch risk (e.g. training workshops on rapid risk assessment approaches, monitoring programmes and analysis).

   In relation to sharing existing information on mitigation measures and bycatch monitoring, the BMIS and BDEP, both launched within the past ten years, offer excellent platforms for RFMOs to harmonize cetacean bycatch data and collate them in one location. At present, however, participation in BMIS appears skewed towards WCPFC

information. Similarly, WCPFC, IOTC, and CCSBT are currently the only tRFMOs submitting information in a BDEP format. More data from a wider range of tRFMOs are needed to accurately assess cetacean bycatch hotspots in order to address best management approaches. It is suggested that the IWC engage with Secretariats or Scientific Committee Chairs encouraging them to participate in BMIS, BDEP, and/or asking what other approaches to cetacean bycatch management measures may be most suitable.

4. Collaborate with RFMOs (in addition to the four listed above) and the FAO to advocate for the following baseline requirements in RFMOs: Cetacean bycatch data reporting, observer coverage, and greater data synthesis at the Secretariat level. Within their documentation most RFMOs recognize the importance of EBFM and most call for certain levels of observer coverage and data reporting in some fisheries. Therefore, the foundation to address cetacean bycatch exists, but measures are not applied to the same standard across fisheries, or across RFMOs and enforcement seems to lag behind the intent of some of these measures. The IWC could consider contacting and collaborating with RFMO Secretariats who have seen cetacean bycatch success (e.g., CCAMLR, WCPFC) and/or work through the FAO to establish a five-year goal to see adequate levels of reporting and data analysis.

   a. In this vein, it may be of interest to the IWC to consider reviewing and sharing with relevant stakeholders a 2011 report that drafted a baseline cetacean-focused example CMM (Humane Society International et al. 2011). Presenting this model CMM to RFMOs, particularly in workshop or Scientific Committee meetings, could be useful in building progress. While dated, this could be a starting point in discussions on model CMMs.

5. **Expand on research presented in this report:** As mentioned in the Discussion section under "Considerations for Expanding on this Work," there are several major areas where this report could be improved and expanded with more resources: expand the scope include review of all RFMOs and RFBs; obtain adequate fisheries effort data; obtain cetacean bycatch rates for the range of fisheries; and undertake a more robust statistical analysis to understand the gear types and RFMOs most in need of collaboration. Leading an effort to continue to develop this research – particularly in synthesizing information from all FAO-recognized RFMOs and RFBs – would be useful in creating the first global synthesis of RFMO progress on cetacean bycatch.

Appendix I: References

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Appendix II: Description of Each RFMOs Bycatch Performance

Tuna RFMOs

Commission for the Conservation of Southern Bluefin Tuna (CCSBT)

Table 1. CCSBT at a Glance

Factor	Level
Observer coverage	10%
Data transparency	Some
Data analysis	No
Non-target in mandate	Yes
CMM on bycatch	Yes, by linking to other RFMOs
Gear types	Longline, purse seine

Established in 1994, CCBST solely manages southern bluefin tuna. It does not have an official convention area, but rather spans southern bluefin tuna's range, roughly from 30 degrees to 50 degrees south (FAO, 2019). Therefore, fishing for southern bluefin tuna occurs within the Convention Areas of IOTC, WCPFC, and ICCAT. Accordingly, CCSBT has adopted some of their CMMs. CCSBT Convention text does not reference the search terms listed in the methods section, though it does contain reference to "ecologically related species" (ERS). [38]

Binding Measures

CCSBT has one bycatch-focused measure, which essentially adopts measures in other RFMOs focused on ERS: "Resolution to Align CCSBT's Ecologically Related Species Measures with Those of Other Tuna RFMOs." Accordingly, CCSBT adopts the following measures to apply to CNPs: IOTC Resolution 13-04 "On the Conservation of Cetaceans" and ICCAT's Recommendation 11-10, "Information Collection and Harmonization of Data on By-catch and Discards in ICCAT Fisheries." CCBST's "Resolution on CCBST Scientific Observer Program Standards" sets a target for 10 percent observer coverage level, and requires observers to record mitigation measures, interactions with ERS, and cetacean state at the time of capture. Finally, non-binding "Recommendation to Mitigate the Impact on Ecologically Related Species of Fishing for Southern Bluefin Tuna" recommendations that Members collect and report on ERS, and requires Extended Commission and bodies to analyze this information.

Performance Review

The most recent independent Performance Review (2016) includes multiple references to the need to address bycatch. The Panel notes, "A really critical area (and new recommendation) relates to the need to develop a more comprehensive, specified and transparent bycatch policy and management strategy." It also noted that CCSBT, in coordination with other RFMOs, needs

[38] These references include directing Parties to provide information on ERS in their fisheries (Article 5); directing Parties to collaborate on data exchange in ERS (Article 5); directing the Commission to collect information on ERS (Article 8); and that the Scientific Committee will report to the Commission on the status of ERS (Article 9).

to make progress on Kobe mandates and objectives. Overall, the CCSBT Performance Review included an entire section on bycatch and addressed it in more detail than in other tRFMOs.

Committees, Other Initiatives, and Data Analysis
The Scientific Committee is CCBST's advisory body to the Commission, and it assesses stock status and trends, coordinates research, and leads other scientific initiatives. Within the Scientific Committee, the Ecologically Related Species Working Group (ERS WG) is charged with providing advice and information to the SC on ERS, monitoring trends and research, providing advice on mitigation, and other factors.

In 2018, CCBST conducted a review of implementation (not compliance) of the ERS-focused measure, which indicated most CNPs are implementing it for cetaceans. The ERS WG provides some summary analysis of this information, but data is not publicly viewable. There are currently no known other initiatives, special projects, or identification guides within CCBST that focus on cetaceans.

As noted in the 2014 Performance Review, data reporting is done at the national level. Aggregated data and compliance information is made public.

Review
CCSBT appears to be the quietest tRFMO on cetaceans. Its ERS-focused measure is unique in applying consistency of requirements in other RFMOs, but it has several drawbacks. It does not appear to adopt WCPFC's cetacean focused measure on purse seines, rather only requires CPCs to follow IOTC's purse seine measure. Further, most of the measures in other tRFMOs focus on other taxa, and thus marine mammals are still afforded less protection in CCSBT. While some of the recent ERS WG and SC reports mention cetaceans, they note that reporting and information on cetacean bycatch remains low.

Inter-American Tropical Tuna Commission (IATTC)
Table 2. IATTC at a Glance

Factor	**Level**
Observer coverage	100% on large purse seine vessels, 5% on longline
Data transparency	100% purse seine, some longline
Data analysis	100% purse seine, some longline
Non-target in mandate	Yes
CMM on bycatch	General bycatch resolution; purse seine agreement
Gear types	Purse seine, pole and line, hook and line, gillnet (minimal), longline, harpoon, troll, trawl

Established in 1949, IATTC manages tuna and tuna-like species in the Eastern Pacific Ocean. The Antigua Convention, adopted in 2003 to strengthen and replace the 1949 IATTC Convention,

includes several references to monitoring and management for non-target species or those that share the same ecosystem as IATTC-caught species.[39]

Binding Measures
IATTC has three binding CMMs with relevance to cetaceans. Resolution C-04-05, "Consolidated Resolution on Bycatch," requires data collection, the release of non-target species incidentally caught in purse seines (note: does not specifically reference cetaceans or marine mammals), and urges CPCs to report bycatch information to the Secretariat. Resolution C-11-08, "Scientific Observers for Longline Vessels," requires five percent observer coverage on vessels over 20 meters, and notes that observers are to record interactions with non-target species (note: does not specifically reference cetaceans or marine mammals).

Distinct from a Conservation and Management Measure, IATTC's Agreement on the International Dolphin Conservation Program (AIDCP) is a multilateral, legally-binding agreement established in 1999. Broadly, it seeks to reduce dolphin mortality to zero in purse seine operations in the EPO while allowing for the continuation of sustainable yellowfin tuna harvest. Pillars of AIDCP include setting dolphin mortality limits (DMLs) in the tuna purse seine fishery to no more than 5,000 dolphins annually based on an equitable system of allocating DMLs to vessels that meet a number of requirements. It also requires that vessels with a carrying capacity greater than 363 metric tons carry an observer during each fishing trip, thus calling for 100 percent observer coverage on large purse seine vessels. AIDCP also has its own resolutions, including Resolution A-03-02, "Resolution on At-Sea Reporting." This requires purse seine vessels with an on-board observer to transmit a weekly report to the Secretariat, noting any dolphin mortality by stock.

Performance Review
IATTC's 2016 Performance Review summarizes several instances where IATTC addresses bycatch, such as through AIDCP and in various CMMs. The Performance Review includes an entire section on bycatch, including a recommendation to improve data collection for longline fleets, but the recommendation addresses all other marine vertebrate taxa except marine mammals. It also included a Recommendation to improve compliance with certain CMMs, including those on data collection and bycatch efforts.

Committees, Other Initiatives, and Data Analysis

[39] References include: "Where the status of target stocks or non-target or associated or dependent species is of concern, the members of the Commission shall subject such stocks and species to enhanced monitoring in order to review their status and the efficacy of conservation and management measures. They shall revise those measures regularly in the light of new scientific information available." (Article IV 3); "adopt, as necessary, conservation and management measures and recommendations 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, with a view to maintaining or restoring populations of such species above levels at which their reproduction may become seriously threatened;" (Article VII f); and "adopt appropriate measures 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;" (Article VII g).

IATTC's Working Group on Bycatch is charged with discussing new research, assessments, and other information related to bycatch in IATTC fisheries. This body reports to the Scientific Advisory Committee, which advises the Commission on all scientific related matters. The Compliance Committee contains in its annual report aggregated bycatch data, and conducts important work on data review and enforcement. AIDCP has several committees and bodies that ensure compliance and management within AIDCP. AIDCP's Scientific Advisory Board seeks to advise the Commission on matters such as modifications to purse-seine technology, alternative means of capturing yellowfin tuna, and reviewing IATTC proposals on this matter. AIDCP's National Scientific Advisory Committee receives and reviews relevant data on assessments on dolphin mortality and makes recommendations to CPCs on research needs. Additionally, AIDCP's International Review Panel compiles the annual list of vessels that qualify for DMLs, analyzes reports and infractions submitted to the IRPs, and makes recommendations for compliance with AIDCP.

The only known other initiative or project focused on cetaceans in IATTC is current review and considerations for a new survey to determine abundance estimates for dolphin stocks overlapping with purse seine operations under AIDCP. Because a survey has not been undertaken in nearly 13 years to calculate abundance, researchers are in the process of developing and planning options for the survey (Oedekoven et al., 2018), which led to the implementation of a pilot project which was carried out in 2020.

IATTC publishes summary statistics each year, including on dolphin bycatch under AIDCP, and the Compliance Committee also reports on some data, but identifiable to individual vessels information remains confidential.

Review

IATTC is unique amongst RFMOs, as it is the only one with a legally-binding multilateral agreement focused on cetaceans. Further, unique to IATTC are purse seine observers that collection information on the identification of species. This agreement has been instrumental at substantially reducing dolphin mortality in purse seines in the EPO. While AIDCP is quite comprehensive with quantitative metrics, it large pertains to setting on specific dolphin species (common, spotted, and spinner dolphins), though other mortalities for other delphinids are reported in footnotes. The Working Group on Bycatch is actively working on bycatch reduction and management, though its efforts appear to again be more focused on other taxa.

International Commission for the Conservation of Atlantic Tunas (ICCAT)

Table 3. ICCAT at a Glance

Factor	Level
Observer coverage	A minimum of 5% observer coverage of fishing effort in each of the pelagic longline, purse seine, baitboat, traps, gillnet and trawl fisheries (Rec 16-14); higher levels required in the eastern Atlantic and Mediterranean Bluefin tuna fishery (Rec 19-04) and tropical tunas fishery (Rec. 19-02).
Data transparency	None being reported
Data analysis	None analyzed
Non-target in mandate	No
CMM on bycatch	Bycatch reporting
Gear types	Purse seine; longline; bait boat, pole and line, trap, trawl, rod and reel, gillnet, and harpoon

ICCAT, established in 1969, manages tuna and tuna-like fishes found in the entire Atlantic Ocean. The ICCAT Convention does not include reference to the bycatch-related search terms.

Binding Measures

Two binding measures with relevance to cetaceans exist within ICCAT. CMM 2011-10, "Recommendation by ICCAT on Information Collection and Harmonization of Data on Bycatch and Discards in ICCAT Fisheries" requires that Contracting Parties, Cooperating non-Contracting Parties, Entities and Fishing Entities (CPCs) collect bycatch and discard data "in their existing domestic scientific observer programs and logbook programs and requires CPCs to report annually on steps taken to mitigate bycatch." CMM 2016-14, "Recommendation by ICCAT to establish minimum standards for fishing vessel scientific observer programs," require a minimum of five percent observer coverage, and are expected to report on bycatch, including cetaceans, fishing operation information and bycatch mitigation measures. Observer coverage is required at 20 percent for eastern bluefin tuna trawlers, longline, and baitboat operations and at 100 percent for towing, trap, and purse seine fishing for eastern bluefin (Recommendation 19-04). Tropical tuna fisheries have some additional observer coverage requirements (via national programs) is at 5% ((Recommendation 19-02)).

Performance Review

ICCAT has undergone several independent performance reviews, with the most recent being in 2016. The 2016 review noted that ICCAT can make improvements for data collection surrounding bycatch. The Performance Review also included sections specifically on sea birds and turtles, but did not include a specific section on cetaceans or marine mammals. Overall, however, the independent Performance Review found that, "ICCAT scores reasonably well compared with other RFMOs on associated species including sharks, marine mammals, seabirds and turtles. The Panel recommends that the precautionary approach be consistently applied for associated species considering that the assessments for these species are highly uncertain and that their status is often poorly known."

Committees, Other Initiatives, and Data Analysis

ICCAT's Standing Committee on Research and Statistics (SCRS) is the body within ICCAT that provides scientific advice to the Commission. The SCRS's Subcommittee on Ecosystems tracks and analyzes bycatch, and reports to the SCRS on this. Notably, the 2018 SCRS reports note that ICCAT is lacking data to inform what constitutes a marine mammal/cetacean interaction, and also notes that observer data is currently not used to constitute bycatch estimates, is confidential, and recommends the Secretariat look into this. ICCAT has a bycatch coordinator on staff.

In 2010, ICCAT commissioned a bycatch-focused report and database with the aim to aggregate and analyze available bycatch data, compile information on mitigation, and increase information sharing. Through this initiative, ICCAT compiled nearly 400 new studies, but was unable to analyze much data due to confidentiality requirements and a lack of data availability (Cotter 2010). Not all CPCs are submitting observer and bycatch information, and much of what is available is not publicly accessible. The report recommends ICCAT work with CPCs to increase the available data (Cotter 2010).

In 2016, ICCAT worked with the Common Oceans ABNJ tuna project to convene all five tRFMOs for a meeting on implementing an ecosystem approach to management (Common Oceans 2016). ICCAT is also in the process of developing an Ecological Based Fisheries Management Framework, which will establish indicators for an ecosystem report card at ICCAT to help establish ecosystem/bycatch priorities at ICCAT and in collaboration with other tRFMOs (ICCAT 2018).

Review

Out of the tRFMOs, ICCAT has the lowest rating for its emphasis on addressing cetacean bycatch. It does not have a cetacean-focused measure, bycatch data appears hard to inquire publicly (if at all), and there are no other known initiatives on informally addressing bycatch. ICCAT does seem to be recognizing the need to address this and has recently been leading on a possible RFMO report card, but this initiative is still in early stages.

Indian Ocean Tuna Commission (IOTC)

Table 4. IOTC at a Glance

Factor	**Level**
Observer coverage	5% all fisheries; recent Resolution 19/01 calls for 10% on gillnets
Data transparency	None being reported
Data analysis	None analyzed
Non-target in mandate	No
CMM on bycatch	Purse seines; bycatch reporting
Gear types	Gillnet, purse seine, longline, handline, pole-and-line, trolling, trawl

Established in 1993, IOTC has competence on tuna and tuna-like species in the Indian Ocean, with the Convention Area covering the Indian Ocean from 20 degrees east to 150 degrees east. The IOTC Convention does not reference any of the marine mammal-related search terms.

Binding Measures

IOTC has several binding CMMs related to cetaceans. First, IOTC has a cetacean-focused measure: Resolution 2013-04, "On the Conservation of Cetaceans." This requires that vessels operating beyond their EEZs do not intentionally set a purse seine around a cetacean; sets reporting standards in the chance a cetacean is encircled or if vessels of other gear types interact with an animal; and requires CPCs to report information and data collected through logbooks to be reported annually. Resolution 2017-10, "On the Prohibition to Use Large-Scale Driftnets in the IOTC Area," prohibits large-scale driftnets in the entire IOTC area of competence40 and also requires monitoring, control, and surveillance for large-scale driftnet fishing. Resolution 15-02 requires annual reporting of cetacean interaction data alongside total catch data. Finally, Resolution 11-4, "On a Regional Observer Scheme," requires five percent observer coverage on all vessels over 24 meters in length, and for all vessels less than or equal to 24 meters if fishing on the high seas. This observer CMM specifically mentions bycatch, stating: "Observe and estimate catches as far as possible with a view to identifying catch composition and monitoring discards, by-catches and size frequency." Most recently, IOTC passed Resolution 19/01, which encourages Parties to "phasing out or convert gillnet fishing vessels to other gears, considering the huge ecological impact of these gears," to increase observer coverage, and transition to sub-surface setting of gillnets, the latter of which has been shown to reduce cetacean bycatch (Anderson et al., 2020).

Performance Review

The most recent IOTC Performance Review, conducted in 2015, included one recommendation on non-target species. This recommended that IOTC improve data collection, particularly for species caught as bycatch.

Committees, Other Initiatives, and Data Analysis

IOTC has a Working Party on Ecosystems and Bycatch (WPEB), housed under the Scientific Committee. It meets annually, and provides scientific advice to the Scientific Committee on bycatch and non-target species. Annual WPEB annual reports tend to mention cetacean bycatch in some form. For example, its 2018 report requested that CPCs provide information on cetacean interactions with gillnets, specifically sharing information on discards, mortality, and release. It also notes marine mammal bycatch is being underreported by observers. IOTC also has an in-house fisheries officer, whose duties include addressing bycatch.

IOTC has been working with WWF and academic partners for regional assessments on cetacean bycatch (e.g., cetacean mortality in gillnets in the Arabian Sea), including in gillnets, longlines, and purse seines in certain regions. Many of these reports can be accessed via searching for

[40] Resolution 2017-10 applies to all Members except for Pakistan.

"marine mammal" or "cetacean" at this link: https://www.iotc.org/search/content/cetacean. The IOTC does link to marine mammal identification cards on its website.

IOTC is currently not analyzing bycatch data, as the Secretariat has not received observer reports from CPCs reflecting bycatch data (Gilman Passfield and Nakamura 2012). Queries looking for publicly-available data on bycaught species are not broken into taxa or species: https://iotc.org/oqs#fieldset-generate-report.

Review
On paper, IOTC appears strong in addressing bycatch given that they have a cetacean-focused CMM, require a regional observer program on all fisheries, and require bycatch reporting. They also have a number of side projects and other work undertaken to analyze marine mammal bycatch in some of its fisheries or spatial jurisdiction. While a ROP has been established, data is not being reported and therefore not analyzed, which tremendously undercuts IOTC's potential in focusing on bycatch data. This is particularly significant given that roughly 40 percent of its fisheries are gillnet fisheries. Like other RFMOs, IOTC also seems to have more of a focus on other bycatch taxa (e.g., the current Program of Work for WPEB and the Scientific Committee webpage mentions all taxa but marine mammals).

Western and Central Pacific Fisheries Commission (WCPFC)

Table 5. WCPFC at a Glance

Factor	Level
Observer coverage	100% purse seines; 5% all other fisheries
Data transparency	Aggregate data publicly available
Data analysis	SPC analyzing purse seine and longline
Non-target in mandate	Yes
CMM on bycatch	Purse seines
Gear types	Purse seine, longline, pole and line, troll, and other small-scale fishing methods (e.g., handline, small traps)

WCPFC, established by the Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean in 2004, is the body that manages fisheries tuna and tuna-like species in the western and northern Pacific. The Convention area spans from the east Asian seaboard, extending to and overlapping the IATTC Convention Area, and extends north to the Bering Sea and to 60 degrees south – an area spanning nearly 20 percent of the world's surface. The Convention contains several references to non-target species, including to "assess the impacts of fishing, other human activities and environmental factors on target stocks, nontarget species, and species belonging to the same ecosystem or dependent upon or associated with the target stocks," and "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" (Article 5).

Binding Measures

WCPFC has two binding measures related to marine mammals. CMM 2011-03, "Conservation and Management Measure for Protection of Cetaceans from Purse Seine Fishing Operations," forbids purse seiners from intentionally setting on cetaceans on the high seas and EEZs in the Convention Area. Should a cetacean be unintentionally encircled, the master of the vessel is to ensure the safe release of the cetacean(s), report the interaction to the flag state, and also note the encounter in an Annual Report. CMM 2018-05, "Conservation and Management Measure for the Regional Observer Program," requires 100 percent observer coverage on all purse seine vessels, and five percent observer coverage on all other fisheries managed by WCPFC. Observers are to collect and report catch data and "other scientific data." The Regional Observer Program has data fields that establish which information needs to be provided on cetacean interactions, which is then used by the WCPFC Scientific Services Provider, the Oceanic Fisheries Programme of the Pacific Community (SPC), to prepare papers related to bycatch.

Performance Review

WCPFC underwent an independent Performance Review in 2012; the Review Panel included several possible recommendations related to bycatch. First, it noted that WCPFC has not yet undertaken a full ecosystem approach into management, including in applying "bycatch trigger levels" to reduce bycatch. It also recommended that the terms of reference for the Ecosystem and Bycatch Specialist Working Group be evaluated and aligned with FAO guidelines. It did, however, note that WCPFC is making progress on bycatch, especially through the Secretariat of the Pacific Community.

Non-binding measures, committees, or other initiatives

WCPFC's Scientific Committee analyzes, reviews, and reports to the Commission primarily on tuna and tuna-like assessments, and also reports to the Commission on cetacean bycatch in some instances. For example, the Technical and Compliance Committee, in its reports to the Commission on the Regional Observer Program, are reporting on cetacean bycatch in purse seine and longline fishing vessels (e.g., "cut or escaped before landing," "interacted or landed (discarded alive)," "interacted or landed dead," and "unknown condition when discarded" (e.g., WCPFC TCC 2016, 2017, 2018). Further, there are several reports produced by WCPFC/SPC that analyze available data. For example, the Secretariat of the Pacific Community (SPC) – a program of which serves as the Commission's Science Services Provider and Data Manager – produced two recent reports analyzing bycatch, including cetaceans, in WCPFC purse seine and longline fisheries from 2003-2017 (Peatman et al. 2017. 2018).[41] Further, the SPC also produced a Bycatch Data Exchange Protocol (Williams et al. 2016, 2017), which analyzed publicly-available observer data.

[41] Note: It is unclear what the nexus for these reports were, and whether SPC or other bodies will undertake another structured analysis.

In 2010, WCPFC began working towards the Bycatch Mitigation Information System (BMIS), an online resource for reviewing and tracking bycatch in RFMOs with the objective to support adoption and implementation of bycatch measures across tuna RFMOs.42 BMIS is an online resource for global bycatch information, including links to publicly-available data by RFMO, mitigation measures, and global bycatch reduction initiatives. SPC hosted a BMIS workshop May 28-30, 2018, attended by 27 participants representing 11 WCPFC CCMs and seven inter-governmental organizations, who discussed the resource, its shortcomings, and applications in detail.

Review

Out of the tuna RFMOs, WCPFC – the youngest tRFMO – has been a leader in addressing bycatch. The fact that they have two binding CMMs, one of which directly addresses all cetacean bycatch, is a rarity. Further, with the assistance of the SPC, WCPFC has analyzed some of its bycatch data in detail. As with other RFMOs, the bycatch attention and mitigation and attention appears to be more robust for sharks, sea turtles, and sea birds (e.g., safe handling and release guidelines exist for those taxa), though the SPC and Scientific Committee has called for the commission to provide greater attention to this issue.

Non-tuna RFMOs and RFMO-like bodies

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

Table 6. CCAMLR at a Glance

Factor	Level
Observer coverage	100%
Data transparency	Some
Data analysis	Some for bycatch
Non-target in mandate	Yes
CMM on bycatch	Yes
Gear types	Bottom-set longlines, trawl (bottom and midwater trawls), pots

CCAMLR was established in 1982 with the objective to manage fisheries and its resources in the Antarctic. The Convention includes waters surrounding the Antarctic Continent for a total of about 10 percent of the world's ocean and a surface area of 35,716,100 km2. The CCAMLR Convention takes a strong stance on protecting the broader ecosystem through its fishery resources, including that harvesting should be done in a manner that, "[…] prevention of changes or minimization of the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades[…]" (Article II), that the Commission shall facilitate research of the Antarctic marine ecosystem (Article IX), and several other references.

[42] Support for BMIS came from the Common Oceans Areas Beyond National Jurisdiction (ABNJ) Tuna Project, a Global Environment Facility (GEF) funded, FAO-implemented program of work intended to reinforce sustainable tuna fisheries, as well as the SPC. Though launched via WCPFC, it aims to cover and include all tRFMOs.

Binding Measures

CCAMLR has one binding measure directly related to marine mammals, Measure 25-03, "Minimization for the incidental Mortality of Seabirds and marine mammals in the course of trawl fishing in the Convention Area." This prohibits the use of net monitor cables, prohibits discharge of offal and discards during shooting and hauling of trawl gear, slack time on the water should be minimized, and other gear configuration requirements specific to birds. It does not establish any data reporting requirements. CCAMLR also has several binding measures related to bycatch and general environmental protections. Measure 33-02, "Limitation of by-catch in Statistical Division 58.5.2 in the 2018/19 season" prohibits bycatch limits no greater than 50 tons in Statistical Division 58.2.2. Conservation Measure 33-03, "Limitation of bycatch in new and exploratory fisheries in the 2018/19 season," also sets limits on levels for bycatch species in certain fisheries, and outlines various stop-gap measures (e.g., move-away rules) if certain incremental levels of bycatch are reached. Measure 51-06, "General measure for scientific observation in fisheries for *Euphausia superba*," requires that vessels have at least one observer where possible, and requires that by the 2020/21 fishing season, vessels will be expected to have 100% observer coverage. Several other CMMs establish frameworks for establishing Marine Protected Areas and protocols surrounding existing MPAs. Conservation Measure 26-01, "General environmental protection during fishing," establishes moratoriums on disposing of plastic and other discharges.

Performance Review

The most recent (2017) Performance Review included a recommendation for the Scientific Committee to deliver an assessment on the status of Antarctic marine living resources, including bycatch. This recommendation also encouraged CCAMLR to work with other relevant bodies on bycatch in the region.

Non-binding measures, committees, or other initiatives

The Scientific Committee primarily leads scientific analysis and advice for CCAMLR. CCAMLR also has an Ecosystem Monitoring Program (CEMP), established to carry out the ecosystem approach established in Article II of the CAMLR Convention. One-way CEMP carries out is objective is through "indicator species" that show measurable change to fluctuations in the environment – one of which is the Antarctic fur seal. CEMP has established a set of CCAMLR Ecosystem Monitoring Program Standard Methods to establish how data should be collected ad reported to the Secretariat. In addition to the CEMP program, there are several working groups that carry out bycatch-related work, including the Working Group on Ecosystem Monitoring and Management (WG-EMM) and the Working Group on Incidental Mortality Associated with Fishing (WG-IMAF). WG-EMM requires assessment for predators (i.e., marine mammals) associated with krill; recent meetings of the WG-EMM involved several reviews of papers related to marine mammals in the region. The WG-IMAF appears primarily focused on seabirds, but in the past has involved several presentations on marine mammals.

CCAMLR does publish some of its data (i.e., fishery summaries and a vulnerable marine ecosystem registry – and some catch and effort data) on its website. They also provide a specific form to observers on recording marine mammal entanglement in marine debris.

Review
CCAMLR has taken a proactive approach to ecosystem-based fisheries management, with a significant focus on ecosystem integrity and health. Its CMMs (e.g., on dumping, MPAs, etc.) go beyond the scope of any other RFMO. Further, its reporting guidelines and observer requirements are robust and transparent. Given this, coupled with the fact that they do have a marine mammal-focused CMM, they are a leader amongst RFMOs for addressing cetacean bycatch.

Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (CCBSP)

Table 7. CCBSP at a Glance

Factor	**Level**
Observer coverage	N/A
Data transparency	N/A
Data analysis	N/A
Non-target in mandate	Indirectly
CMM on bycatch	No
Gear types	Pelagic trawl, pair trawl, bottom trawl

Established in 1995, CCBSP manages pollock fisheries in the Bering Sea beyond 200 nautical miles from the territorial sea of coastal states. Its Convention text does not directly mention bycatch, but notes that Members should consider the relationship between related living marine species within the same ecosystem as pollock.

Binding Measures
CCBSP's observer coverage measure does include reference to marine mammals. It requires that observers record the number of incidental takes of marine mammals, including species and other biological information (including "condition" and other variables if found dead). However, there is currently no fishing activity under this Convention, so CMMs and other information are more of a framework at this point in time.

Performance Review
It is unknown whether CCBSP has conducted a Performance Review.

Committees, Other Initiatives, and Data Analysis
CCBSP has a Scientific and Technical Committee. At its most recent meeting, there was discussion of pollock bycatch but no known other bycatch. Some countries are reporting landings data (e.g., the United States), but it does not appear to include bycatch data.

Review

CCBSP's work is opaque, with an outdated website and it being very hard to find information on the organization. Measures and the Convention appear to be outdated, and bycatch does not seem to be a significant focus of the Commission at this point in time.

General Fisheries Commission for the Mediterranean (GFCM)

Table 8. GFCM at a Glance

Factor	Level
Observer coverage	Varies by fishery
Data transparency	Some
Data analysis	Some
Non-target in mandate	Yes
CMM on bycatch	Yes
Gear types	Purse seine, dredger, beam trawl, pelagic trawl, longline, gillnets, trammel nets

GFCM was established in 1949 and is charged with the conservation and sustainable use of living marine resources in the Mediterranean and the Black Sea. The GFCM Agreement was modernized in 2014 and provides several references to the ecosystem-related terms in the search criteria (FAO, 2019b).

The Agreement states that, "the Commission shall give particular attention to measures to prevent overfishing and minimize discards" (Article 5) and calls for the Commission to "minimize impacts for fishing activities on living marine resources and their ecosystems" (Article 8).

Binding Measures

GFCM does have a cetacean-focused CMM. "Recommendation GFCM/36/2012/2 on mitigation of incidental catches in the GFCM area" requires a variety of protections for marine mammals, including: 1) studying and monitoring cetaceans; 2) sets maximum monofilament net sizes; 3) requires releases of cetaceans as much as possible; 3) requires collection and reported on cetacean bycatch; and 4) calls on the Scientific Advisory Committee to report on certain mitigation and monitoring measures. "Recommendation GFCM/37/2013/2 on the establishment of a set of minimum standards for bottom-set gillnet fisheries for turbot and conservation of cetaceans in the Black Sea" reiterates fisheries management measures to be adopted for the mitigation of cetacean bycatch, including in relation to monofilament or twines and the collection of information.

"Recommendation GFCM/42/2018/5 on a multiannual management plan for bottom trawl fisheries exploiting demersal stocks in the Strait of Sicily (geographical subareas 12 to 16)" also requires an observer program be created in these fisheries.

Performance Review

GFCM launched an updated Performance Review in 2019, with the most recent completed Performance Review occurring in 2011. Preliminary results have been reviewed by the 43rd session of the GFCM in November 2019, but final results from 2019 are not yet available. The 2011 Performance Review does not appear to give regard to bycatch, with the focus on the review being on the GFCM agreement, enforcement, cooperation, and other factors.

Non-binding measures, committees, or other initiatives

GFCM adopted "Resolution GFCM/43/2019/2 on enhancing the conservation of cetaceans in the GFCM area of application" to urge improved data reporting and application of existing measures to eliminate cetacean bycatch. In this context, the Scientific Advisory Committee on Fisheries is required to identify gaps and provide elements for further measures, to be adopted as appropriate by the Commission.

GFCM's Mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries (Mid-term strategy) requires the implementation of a bycatch monitoring program, including through establishing an observer program, which has been implemented in select Mediterranean countries.

There is also a Working Group on Fishing Technology, which oversees work on selectivity and bycatch.

GFCM has established a Data Collection Reference Framework (DCRF) in order to optimize data collection and compilation in the Mediterranean and the Black Sea, to support the formulation of scientific advice for fisheries management. It includes an entire task dedicated to data on incidental catches of vulnerable species, including cetaceans.

Further, GFCM is working with ACCOBAMS – in the context of their Memorandum of Understanding – on a number of initiatives to monitor and mitigate bycatch impacts, which included the development of multi-lingual good practice guides for the safe handling of vulnerable species, including cetaceans, incidentally caught during fishing operations. Together with other organizations, they are implementing a recent large-scale project ('The Med Bycatch Project') on bycatch and mitigation in the Mediterranean as well as some targeted actions in the Black Sea.

Review

Within the past decade, GFCM has rapidly increased its focus on bycatch, reporting, and collaborations related to bycatch. They adopted a comprehensive cetacean CMM in 2012, and the Commission and subsidiary bodies are encouraging enhanced observer coverage requirements and data reporting. GFCM is also working with ACCOBAMS to address bycatch in the region. Public users need access to analyze bycatch data, though some capture data can be analyzed through the FAO (http://www.fao.org/figis/servlet/TabSelector#lastnodeclicked).

North Atlantic Fisheries Commission (NAFO)

Table 9. NAFO at a Glance

Factor	Level
Observer coverage	100%
Data transparency	Some
Data analysis	Some for bycatch (non-marine mammal species)
Non-target in mandate	Yes
CMM on bycatch	Yes (not focused on marine mammals)
Gear types	Bottom trawl, purse seine, tuck ring seine, weir, trap, gillnet, longline, handline, etc.

NAFO was founded in 1979 and manages fishery resources in the Northwest Atlantic apart from tuna, crustaceans, and sedentary species. NAFO's Convention Area spans 6,551,289 km^2, but its regulatory area only applies to straddling and Exclusive Economic Zones, a total size of 2,707,895 km^2. The Convention does contain multiple references to the bycatch-related search terms identified in the methodology, including requiring Members to, "[…] minimize discards [in particular endangered species.]," and states that, "the objective of this Convention 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," (Introduction), and "take due account of the impact of fishing activities on other species and marine ecosystems and in doing so, adopt measures to minimize harmful impact on living resources and marine ecosystems;" (Article III).

Binding Measures

NAFO, which refers to its binding measures as Conservation and Enforcement Measures (CEM), has CEMs that indirectly refer to cetaceans. Article 25 on Vessel Requirements and Chartering requires flag states to maintain a separate record of catch and bycatch data, and report that annually to the Executive Secretary. Similarly, it establishes duties for the Executive Secretary to ensure catch and bycatch is attributed to the proper Contracting Party. Article 30 on an Observer Program requires that each Party carry an observer at all times when fishing in the Convention Area.[43] Similarly, this measure requires that the Secretariat make copies of observer trip data and relays information available to NAFO bodies. Finally, Chapter II, "Protection of Vulnerable Marine Ecosystems (VMEs) in the Regulatory Area from Bottom Fishing Activities" calls for recording of any bycatch species, though it is unlikely marine mammals would be encountered in such a deep-sea fishery.

Performance Review

The most recent NAFO Performance Review occurred in 2018. The Panel commended NAFO for its recent Action Plan for the Management and Minimization of Bycatch and Discards, as well as

[43] Article 30 establishes circumstances for when 100% observer coverage may not be necessary, but observer coverage is never allowed to drop below 25% on any NAFO fisheries.

for recent adoption of a shark bycatch measure. The Panel provided a recommendation to NAFO to continue building its Ecosystem and Precautionary Approach.

Non-binding measures, committees, or other initiatives
NAFO has both a Scientific Council and a Working Group on Bycatches, Discards, and Selectivity. The Scientific Council reports on bycatch totals in specific fisheries in various meeting reports (e.g., NAFO, 2018b), though cetacean bycatch is not noted in these reports. The Working Group appears more focused on fish bycatch, though there appears to be underreporting and under analyzation of discard data (NAFO, 2018a). NAFO's website does link several times to NAMMCO, which has an overlapping Convention Area, and the search portion of the website does link to some papers reporting on marine mammal biology or presence in the NAFO Convention Area. Further, a representative from NAFO sat on the NAMMCO 2017 Performance Review Panel (NAMMCO, 2019).

Review
NAFO is unlikely to have much overlap with cetaceans given the focusing on deep-sea fisheries, though there is potential given some of the gear type used (e.g., longline, gillnets, etc.). NAFO does not refer to or reflect on cetaceans in its work. From a broader ecosystem perspective, NAFO is quite advanced in requiring 100% observer coverage on its fisheries, and clearly articulating requirements for both flag states and the Secretariat in its management. NAFO is also quite transparent and organized in the presentation of CEMs and other information, and in these senses serves as a model for other RFMOs.

North Atlantic Salmon Conservation Organization (NASCO)
Table 10. NASCO at a Glance

Factor	**Level**
Observer coverage	None
Data transparency	None
Data analysis	Some
Non-target in mandate	No
CMM on bycatch	No
Gear types	Surface gillnet

NASCO, established in 1983, seeks to conserve and restore Atlantic salmon stocks. NASCO prohibits fishing for salmon in large areas of the North Atlantic beyond 12 nautical miles from coastlines of Member States, creating a large protected zone for salmon recovery. It is thus inherently precautionary in its approach to management, but it does not mention any of the target bycatch-related search terms in its Convention.

Binding Measures

NASCO does not have any CMMs directly related to cetaceans, though there are a few measures with indirect relevance. CNL(98-46), "Agreement on Adoption of a Precautionary approach," calls for Members to adopt and apply a precautionary approach to management, and CNL(99)48, "Action Plan for Application of the Precautionary Approach," calls for salmon bycatch to be considered in implementation of the Precautionary Approach and asks Members and other bodies on information related to salmon bycatch.

Performance Review
NASCO's most recent completed Performance Review in 2012 discussed bycatch efforts within NASCO and included recommendations to address bycatch, though bycatch in the Performance Review is focused on salmon. The Performance Review noted that NASCO's actions towards bycatch are generally consistent with UNFSA, and encouraged NASCO to Review the International Guidelines on By-catch Management and Reduction of Discards with a view to developing a strategy to promote the application of by-catch measures in NASCO. It did include a recommend NASCO is expected to undertake another Performance Review in 2021.

Non-binding measures, committees, or other initiatives
The International Council for the Exploration of the Sea (ICES) provides much of the information on stock status to NASCO, and they are currently not requiring observer coverage. NASCO has several other regional Commissions that can provide advice to the Commission but are not active on bycatch.

Review
The NASCO Convention Area has a very small fishery, with effort only allowed to occur within 12 nautical miles of parties, with the exception of the West Greenland Commission area, where fisheries may take place up to 40 nautical miles from the baselines; and in the North-East Atlantic Commission area, within the area of fisheries jurisdiction of the Faroe Islands. Within these two areas regulatory measures are negotiated to limit the fishery. However, there has been no fishery for salmon at the Faroes since 2000, and the current total allowable catch for all components of the Atlantic salmon fishery at West Greenland is 30 metric tonnes in 2020. Fishing, using surface gillnets is focused exclusively on salmon. While cetacean bycatch has not been a priority, the limited fishing that does occur likely does overlap with some coastal cetacean species, such as harbour porpoise. While NASCO does give a heavy emphasis to the precautionary approach, it does not address bycatch in CMMs or other measures. ICES is analyzing some fisheries data, but none is related to marine mammals (NASCO, 2018).

North-East Atlantic Fisheries Commission (NEAFC)
Table 11. NEAFC at a Glance

Factor	**Level**
Observer coverage	On deep-sea fisheries
Data transparency	Some
Data analysis	Some
Non-target in mandate	Indirectly

CMM on bycatch	No
Gear types	Trawl (pelagic and demersal), purse seine, deep-sea gear: longline, gillnet, and tangle nets

Established in 1980, NEAFC has competence over fisheries in parts of the Atlantic and Arctic Oceans and their dependent seas north of 36° and between 42° west longitude and 51° east longitude, excluding the Baltic Sea and the Mediterranean Sea. The NEAFC Convention does not include direct references to bycatch, but calls for accounting for the impact of fisheries on living marine resources and marine ecosystems

Binding Measures
NEAFC does not have any measures directly related to cetaceans, though they do have several measures that indirectly pertain to bycatch. For example, Recommendation 06 2019 on "Roundnose, roughead, Roughsnout and Other Grenadiers" calls for reporting any bycatch to ICES. Recommendation 03 2006 bans gillnets in waters over 200 m deep. Exploratory deep-sea fisheries require observers (Recommendation 19:2014), but otherwise NEAFC does not have a regional observer coverage requirement.

Performance Review
NEAFC underwent its second Performance Review in 2014. The Panel noted that NEAFC is addressing bycatch through various CMMs, and through advice provided by ICES. The Panel recommended that NEAFC work to ensure that Contracting Parties provide accurate reporting on bycatch, that all measures related to bycatch are adhered to, and that observer coverage that reports bycatch be enhanced.

Committees, Other Initiatives, and Data Analysis
NEAFC has a Permanent Committee on Management and Science (PECMAS), which works closely with ICES to review impacts to living marine resources; scientific review and analysis is undertaken at ICES for NEAFC. NEAFC does appear to report annual catch statistics online, though statistics do not appear to include information on bycatch. NEAFC does work closely with ICES on reporting and analysis of catch data. Further, ICES has also worked with NEAFC on observer coverage, such as developing the 2010, "NEAFC Guidelines for Observers onboard fishing vessels authorized to fish in new bottom fishing areas."

Review
NEAFC currently has little focus on bycatch, especially cetaceans, and observer coverage seems to be limited to its deep-sea fisheries. Positive progress for NEAFC includes protecting vulnerable marine ecosystems from fisheries since the early 2000s, as well as its close coordination with ICES, which offers a strong outlet for scientific advice. NEAFC covers a wide area in the north-east Atlantic and includes many fisheries, and thus there could be a higher probability for interactions with marine mammals than are assumed here, but general perceptions towards NEAFC fisheries are that there is little bycatch.

North Pacific Fisheries Commission (NPFC)

Table 12. NPFC at a Glance

Factor	Level
Observer coverage	100% bottom fishing
Data transparency	None
Data analysis	None for bycatch
Non-target in mandate	Yes
CMM on bycatch	No
Gear types	Bottom trawl, bottom gillnet, bottom longline, longline trap gear, stick-held dip nets/life nets

NPFC, established by the Convention on the Conservation and Management of the High Seas Fisheries Resources in the North Pacific Ocean in 2015, manages a variety non-tuna fish, mollusc, crustaceans, and other species caught in the Convention Area. The Convention area spans the Northern Pacific, just south of the Hawaiian Islands and up to the EEZ of the U.S., Canada, Russia, and other countries in the northern Pacific. The Convention does contain multiple references to protecting the marine ecosystems of target catch (Article 2), following a precautionary and ecosystem approach to management (Article 3), and collecting and sharing data, including on non-target species (Article 3).

Binding Measures

NPFC does not have a measure that directly addresses bycatch, but has several that indirectly do: 1) CMM 2019-05 "Conservation and Management Measure for Bottom Fisheries and Protection of Vulnerable Marine Ecosystems in the North-western Pacific Ocean" and 2) CMM 2019-06 "Conservation and Management for Bottom Fisheries and Protection of Vulnerable Marine Ecosystems in the North-eastern Pacific Ocean" calls for any fishing in new deep-sea areas shall employ "precautionary effort limits" if information on target and bycatch species are not available. This measure also requires that catch data on bycatch of marine mammals be collected by observers on board.

Performance Review

NPFC is currently in the process of considering its first Performance Review, and there is no information to present on the matter at this time.

Non-binding measures, committees, or other initiatives

The NPFC has a Scientific Committee, but it does not appear to be analyzing bycatch data at this time. Recent meeting reports call for the need to review bycatch data (North Pacific Fisheries Commission, 2018).

Review

NPFC, one of the youngest RFMOs, does not have many fisheries that overlap with cetaceans. There are, however, some pelagic fisheries (e.g., chub mackerel, sardine, etc.) and there appear to be no observer CMM or other bycatch requirements for this fishery. At present, any bycatch

requirements are for bottom fisheries surrounding VMEs, which marine mammals are extremely unlikely to encounter; however, there is generally very little bycatch focus.

North Pacific Anadromous Fisheries Commission (NPAFC)

Table 13. NPAFC at a Glance

Factor	Level
Observer coverage	n/a
Data transparency	Some
Data analysis	Some – mostly by Member States
Non-target in mandate	Yes
CMM on bycatch	No
Gear types	Seine, gillnet, setnet, net traps, and troll (however, directed fishing for anadromous fish is prohibited within the Convention Area or Fishing gear are used in member countries' EEZs only)

NPAFC, established by the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean in 1992, manages chum salmon, coho salmon, pink salmon, sockeye salmon, chinook salmon, cherry salmon, and steelhead trout. The Convention area spans international waters of the North Pacific Ocean and its adjacent seas north of 33° north beyond the 200-mile zone (exclusive economic zones) of the coastal States. The Convention does reference conservation of ecosystem and other ecologically-related species, including the "desire to promote the acquisition, analysis, and dissemination of scientific information pertaining to […] ecologically related species in the North Pacific Ocean;" cooperating on scientific research for ecologically related species (Article VII); and considering measures for the conservation of ecologically related species (Article IX).

Performance Review

The most recent NPAFC Performance Review, conducted in 2011, discussed bycatch, noting that several articles of the Convention give indirect reference to reducing the taking of anadromous fish and increasing observer coverage, as well as the Terms of Reference for the Committee on Scientific Research and Statistics including mention of reviewing the impacts of bycatch. The Panel recommended that NPAFC work to define, "ecologically related species," and work with other bodies on the best way to define this.

Binding Measures

NPAFC does not have any binding measures related to bycatch, data collection, or a regional observer program. Instead, the Convention contains two binding provisions, and, instead of an observer program, the Commission performs annual patrolling of the Convention Area to detect and apprehend IUU fishing vessels. NPAFC prohibits retention of incidentally taken anadromous fish (NPAFC 2019).

Non-binding measures, committees, or other initiatives
The NPAFC has a Committee on Scientific Research and Statistics, but does not appear to address bycatch. Meeting documents and other detailed NPAFC information is available to the public after Annual Meetings, and included in the publicly-available Annual Report.

Review
NPAFC does not have any binding or non-binding measures or initiatives that pertain to marine mammal or bycatch more generally. This is likely due to the conservative nature of the Convention (e.g., no intentional fishing on anadromous fish) and the unlikely chance that cetaceans or even large whales would be affiliated with the primary target salmon catch.

South East Atlantic Fisheries Organization
Table 14. SEAFO at a Glance

Factor	**Level**
Observer coverage	Yes
Data transparency	Yes
Data analysis	No
Non-target in mandate	Yes
CMM on bycatch	Other taxa
Gear types	Trawl (bottom, midwater), longline, trotline, pots, midwater nets

Established in 2001, SEAFO manages non-tuna resources in the south-eastern Atlantic, including sedentary/discrete and straddling species. The SEAFO Convention Area covers about one-fourth of the world's oceans. The SEAFO Convention, the first to be adopted after the UN Fish Stocks Agreement was negotiated, relies heavily on the ecosystem and precautionary approaches in the Fish Stocks Agreement. The Convention gives reference to an ecosystem approach (Article 3) and precautionary approach (Article 7) to management, as well as recording and reporting of non-target species (Article 14).

Performance Review
SEAFO undertook an Independent Performance Review in 2016. The Review does include several mentions of bycatch, though they are focused on bycatch of target species (e.g., orange roughy). The Review did include one recommendation related to bycatch, which states, "Commission should identify criteria for maximum acceptable ecosystem impacts of fisheries in relation to inter alia habitat impacts and incidental bycatch." It is unclear, however, whether this refers to bycatch or target species or other animals.

Binding Measures

SEAFO has few measures related to marine mammals. They do require Flag States to carry observers on all vessels operating in the Convention Area, and there is also a non-binding measure (Recommendation 2/2009) to ban gillnets in the Convention Area.

Committees, Other Information, and Data Analysis
The Scientific Committee is SEAFO's primary scientific body providing advice and analysis to the Commission, including on anything related to bycatch. There is no current working group on bycatch. The Scientific Committee is not publicly analyzing or reporting on bycatch for marine mammals.

Review
SEAFO is undertaking minimal progress to address cetacean bycatch in its fisheries, but they also only have very little fishing activity (Gilman Passfield and Nakamura 2012). With zero to three vessels fishing in a year, the exploitation levels are minimal and bycatch figures are reported. Current fishing activity is primarily the Patagonian toothfish longline fishery and Deep-sea Red crab fishery using pods. SEAFO does require scientific observer coverage on its fisheries, and observers are required to report bycatch of sponges and corals. Bycatch figures are reported in stock status reports, which are available on the SEAFO website. SEAFO does mention bycatch fisheries in its mandate, and they do have CMMs for all other bycatch taxa (sea turtles, seabirds, and sharks).

Southern Indian Ocean Fisheries Agreement (SIOFA)
Table 15. SIOFA at a Glance

Factor	**Level**
Observer coverage	Yes
Data transparency	Some
Data analysis	Some
Non-target in mandate	Some
CMM on bycatch	Other taxa (e.g. seabirds: 2019/13; sharks: 2019/12)
Gear types	Bottom trawl, longline, pot, gillnet

SIOFA, adopted in 2006 and entered into force in 2012, aims to sustainably manage non-tuna species in its Convention Area. The Agreement calls for applying the precautionary approach in accordance with the 1995 Fish Stocks Agreement and that "Biodiversity in the marine environment shall be protected" (Article 4).

Binding Measures

Several CMMs indirectly refer to cetaceans. CMM 2018/02, "Conservation and Management Measure for the Collection, Reporting, Verification and Exchange of Data relating to fishing activities in the Agreement Area (Data Standards)," requires national scientific observer programs on all of its vessels. This CMM requires marine mammal interactions to be recorded as applicable, and includes a number of criteria that must be included. CMM 2016/03, "Conservation and Management Measure for Data Confidentiality and Procedures for access and use of data (Data Confidentiality)" outlines which data is to be made publicly available. CMM 2019/02, "Conservation and Management Measure for the Collection, Reporting, Verification and Exchange of Data relating to fishing activities in the Agreement Area (Data Standards)," requires that Parties collect basic information on all incidental marine mammal bycatch occurrences.

Performance Review
SIOFA, assumedly given how new it is, has not yet conducted its first Performance Review.

Non-binding measures, committees, or other initiatives
The Scientific Committee is SIOFA's lead committee conducting scientific assessment. SC meeting reports mention reports from Members that they have not observed marine mammal bycatch, but there does not appear to be analysis of marine mammal bycatch currently being undertaken.

Review
SIOFA is a small and young organization. While it recognizes a precautionary approach to management and requires observer coverage on its fisheries, it is not currently active on addressing marine mammal bycatch. While some Members are reporting no observed marine mammal interactions in their national reports, cetacean bycatch remains a possibility with bottom trawl, longlines, and gillnets being used in the Convention Area.

South Pacific Regional Fisheries Management Organization (SPRFMO)
Table 16. SPRFMO at a Glance

Factor	**Level**
Observer coverage	Varies, but required on all fisheries
Data transparency	Yes
Data analysis	Some
Non-target in mandate	Yes
CMM on bycatch	Indirectly
Gear types	Purse seine, pelagic trawl, jigging, bottom trawl, bottom longline

Established in 2010 and entered into force in 2012, SPRFMO manages non-tuna resources in the South Pacific. The SPRFMO Convention Area covers about one-fourth of the world's oceans. The SPRFMO Convention does take an ecosystem approach to management with consideration of non-target resources, such as stating, "fishing shall […] taking into account the impacts on non-

target and associated or dependent species and the general obligation to protect and preserve the marine environment;' and "maintain or restore populations of non-target and associated or dependent species to above levels at which their reproduction may become seriously threatened;" to protect habitat of fishery and non-target resources (Article 20), and other factors.

Binding Measures

SPRFMO has several binding measures related to marine mammals and bycatch. CMM 02-2020, "Conservation and Management Measure on Standards for the Collection, Reporting, Verification and Exchange of Data," requires that fishing vessels and observers record and describe bycatch – with a specific observer reference to any marine mammals that may have been caught, including their "fate" and types of interactions – as well as record any bycatch mitigation measures employed. CMM 08-2019, "Conservation and Management Measure for Gillnets in the SPRFMO Convention Area," prohibits Members from using large-scale pelagic driftnets and all deep-water gillnets in the Convention Area. CMM 03-2020, "Conservation and Management Measure for the Management of Bottom Fishing in the SPRFMO Convention Area," requires the Scientific Committee to provide advice biennially to the Commission on Interactions between bottom fishing and marine mammals. CMM 16-2019, "Conservation and Management Measure Establishing the SPRFMO Observer Program," requires observers on any fisheries where observer coverage is not already required (Observer coverage varies from 5 full time at sea observers or 5% of fishing days for squid, 10% for jack mackerel trawl, purse seine, and bottom longline to 100% for bottom trawl and all exploratory fisheries). All 3
current exploratory fisheries (CMM14a-2019, 14b-2020 and 14d-2020) also require discards and gear modifications be employed to reduce bycatch, as well as standards for recording marine mammal observed interactions. CMM 17-2019, "Conservation and Management Measure on Fishing Gear and Marine Plastic Pollution in the SPRFMO Convention Area" calls for minimizing abandoned, lost, and discarded fishing gear, and marine plastic pollution.

Performance Review

SPRFMO conducted its first Performance Review in 2018. The Review included multiple references to bycatch. The Panel commended SPRFMO for its work on seabirds, and encouraged them to expand seabird bycatch minimization to all fisheries in the Convention Area. The Panel also noted there is limited information on the status of non-target and bycatch species via SPRFMO fisheries, and urges Parties to increase data collection as a first step to understanding these impacts.

Committees, Other Information, and Data Analysis

The Scientific Committee is SPRFMOs primary scientific body providing advice and analysis to the Commission, including on anything related to bycatch. There is no current working group on bycatch. The SC does not appear to be analyzing any data related to bycatch, but some aggregated data is available online, as well information on vessels (https://www.sprfmo.int/data/catch-information/). An overview of bycatch records, presented at the 2019 Scientific Committee meeting, can be found here: http://www.sprfmo.int/assets/2019-SC7/Meeting-Docs/SC7-Doc13-Current-SPRFMO-by-catch-records-summary.pdf.

Review

SPRFMO gives healthy and ample consideration to ecosystem-components to fisheries management, both in its Convention and CMMs. Though it does not have a marine mammal-specific CMM, marine mammal data collection and mitigation is referenced in multiple measures. SPRFMO is one of the newest RFMOs, and has laid a strong groundwork to incorporate increased marine mammal monitoring in the future.

Appendix III: Terms of Reference

International Whaling Commission Bycatch Analysis: Terms of Reference
Brianna Elliott
16 February 2019

Project Objective:
Conduct a global review of marine mammal bycatch mitigation and other efforts in RFMOs and other international bodies in order to contribute to the International Whaling Commission's current knowledge on the global status of bycatch reduction.

Project Deliverables:

(1) White paper report summarizing RFMO bycatch initiatives and current global framework for addressing bycatch;
(2) (1a) Matrix/ranking system of RFMOs by levels of bycatch, gear type, and initiatives to address bycatch;
(3) Provide recommendations to the IWC based on this analysis, possibly including: pathways to collaborate with RFMOs on bycatch initiatives; recommendations on which RFMOs are suited for collaboration; and other recommendations as they arrive.

Key Methods:

(1) Identify existing studies and conduct literature review on RFMOs and their efforts to address marine mammal bycatch;
(2) Compile, review, and classify (e.g., binding or just recommendations) all CMMs, recommendations, and other existing initiatives within RFMOs to address bycatch (e.g., whether voluntary or mandatory data requirements; self-reported v. logbook data available);
(3) Compile and evaluate data within RFMOs on marine mammal bycatch;
    a. Research what happened with the Kobe Bycatch Working Group
    b. ~~Compile estimation of overall bycatch based on analyses of self-reported effort times observed bycatch~~ Note: It was decided during conversations at IWC that this would be eliminated from the project scope due to limitations on bycatch availability and the scope of this project.
(4) Develop risk assessment based on gear type and marine mammal bycatch;
(5) Conduct informational phone interviews with bycatch experts associated with RFMOs (e.g., bycatch coordinator at IATTC);
(6) Develop RFMO bycatch performance matrix based on type of fishing gear, levels of reported bycatch, bycatch mitigation, and other components as available.

Project Timeline (minimum 80 hours):

- Weeks 1-2 (15-20 hours): Conduct literature review; review RFMO CMMs; schedule phone interviews
- Week 3 (10 hours): Conduct phone interviews; assess bycatch data in RFMOs
- Week 4 (10 hours): Draft report
- Week ~5 (40 hours): Review, present, and finalize report at IWC (mid-late March)

Definitions:
RFMO: In this context, RFMOs are inclusive of both tuna and non-tuna RFMOs. Suggested RFMOs: IATTC, WCPFC, ICCAT, IOTC, CCAMLR, CCBST, NPFC, NPAFC, SPRFMO, NAFO, SEAFO. Note: added SIOFA, NASCO, NEAFO, CCBSP, and GFCM during project implementation.
Other initiatives: Defined here as, *e.g.,* special projects, funding, collaborations with universities, and other efforts to address bycatch within RFMOs or other international bodies.
International fora: In this context, inclusive of the FAO, UN, IUCN, ACCOBAMS, and other international bodies as determined.

Methods of Communication:

(1) Brianna to track all hours and information covered in tracking form (example below)
(2) Brianna to provide weekly update of key findings and progress
(3) At least two collaborative calls with IWC staff to discuss direction, progress, and next steps

Example of tracking template

Date	Hours worked	Completed work
e.g., 2/10	Half hour	Developed terms of reference
e.g., 2/14	Four hours	Began literature review. Reviewed Lewison et al. 2018; etc.