Agreement on the Conservation of Albatrosses and Petrels

Ninth Meeting of the Seabird Bycatch Working Group

Florianópolis, Brazil, 6 - 8 May 2019

Data collection guidelines for observer programmes to improve knowledge of fishery impacts on ACAP-listed species

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SUMMARY

The incidental catch of seabirds associated with fishing operations, especially in longline and trawl fisheries, is considered one of the greatest threats to ACAP-listed species. The management of seabird-fisheries interactions, particularly the reduction of incidental mortality of seabirds in longline and trawl fisheries, is a critical component of ACAP. The ACAP Action Plan calls on the Advisory Committee to review and update on a regular basis data on the mortality of albatrosses and petrels in commercial and other relevant fisheries. Such an assessment relies on the effective collection, analyses and reporting of seabird bycatch and associated data by Parties, as well as by Regional Fishery Management Organisations (RFMOs) and other non-Party sources. It is well recognised that the implementation of observer programmes that include the collection and management of seabird bycatch and associated data, are the most effective means of monitoring fisheries performance with respect to seabird bycatch and use of mitigation measures. This document updates a previous paper (SBWG4 Doc 26) to provide draft ACAP Conservation Guidelines on data collection for observer programmes to improve knowledge of fishery impacts on ACAP-listed species. It is proposed these guidelines, once adopted, be promoted to Parties, RFMOs and others alongside other ACAP advice.

RECOMMENDATIONS

We recommend that the Working Group:

1. consider these draft guidelines, and contribute to the further development of the advice
2. request the Advisory Committee support the adoption of these Conservation Guidelines as part of ACAP's formal advice, and promote the dissemination of this advice.

Pautas de recopilación de datos para programas de observadores destinadas a mejorar los conocimientos acerca de los efectos de las pesquerías en las especies amparadas por el ACAP

RESUMEN

La captura incidental de aves marinas asociada con las operaciones pesqueras, especialmente con las pesquerías de palangre y de arrastres, es considerada una de las mayores amenazas para las especies amparadas por el ACAP. La ordenación de las interacciones entre aves marinas y pesquerías, en particular la reducción de la mortalidad incidental de las aves marinas en las pesquerías de palangre y de arrastre, es un componente crucial del ACAP. El Plan de Acción del ACAP requiere que el Comité Asesor revise y actualice periódicamente los datos sobre la mortalidad de albatros y petreles en pesquerías comerciales y demás pesquerías pertinentes. Dicha evaluación depende de la recopilación, los análisis y la presentación de informes sobre captura secundaria de aves marinas y otros datos asociados a cargo de las Partes, de Organizaciones Regionales de Ordenación Pesquera (OROP) y de otras fuentes que no son Parte. Es bien sabido que la implementación de programas de observadores que incluyen la recopilación y gestión de datos sobre captura secundaria de aves marinas y otros datos asociados constituyen los medios más efectivos para supervisar el desempeño de las pesquerías respecto de la captura secundaria de aves marinas y la aplicación de medidas de mitigación. Este documento actualiza un documento anterior (GdTCS4 Doc 26) a los efectos de ofrecer Pautas preliminares de conservación sobre la recopilación de datos para programas de observadores destinadas a mejorar los conocimientos acerca de los efectos de las pesquerías en las especies amparadas por el ACAP. Se propone que estas pautas, una vez adoptadas, sean fomentadas entre las Partes, las OROP y terceros, junto con otras recomendaciones del ACAP.

RECOMENDACIONES

Se recomienda al Grupo de Trabajo realizar las siguientes acciones:

1. considerar estas pautas preliminares y colaborar para seguir desarrollando las recomendaciones;
2. Solicitar al Comité Asesor apoyar la adopción de estas Pautas de conservación como parte de las recomendaciones formales del ACAP y fomentar la difusión de estas recomendaciones.

Lignes directrices pour les collectes de données pour les programmes d'observateurs en vue d'améliorer les connaissances des impacts des pêcheries sur les espèces inscrites à l'ACAP

RÉSUMÉ

La capture accessoire d'oiseaux de mer dans le cadre des opérations de pêche, en particulier dans les pêcheries à la palangre et au chalut, est considérée comme l'une des principales menaces pour les espèces inscrites à l'ACAP. La gestion des interactions entre les oiseaux de mer et les pêcheries, surtout la réduction du taux de mortalité accidentelle des oiseaux de mer dans les pêcheries à la palangre et au chalut, est un pan essentiel des activités de l'ACAP. Le Plan d'action de l'ACAP prévoit que le Comité consultatif passe en revue et actualise régulièrement les données relatives au niveau de mortalité des albatros et des pétrels enregistrés dans les activités de pêche commerciale et autre pêche concernée. Cette évaluation repose sur une collecte, des analyses et une communication efficaces des données relatives à la capture accessoire d'oiseaux de mer et de données connexes par les Parties, ainsi que par les organisations régionales de gestion des pêches (ORGP) et d'autres sources qui ne sont pas parties à l'Accord. Il n'est plus à démontrer que la mise en œuvre de programmes d'observateurs qui comprennent des activités de collecte et de gestion des données relatives aux captures accessoires d'oiseaux de mer et de données connexes est l'un des moyens les plus efficaces de surveiller les résultats des pêcheries en matière de capture accessoire des oiseaux de mer et d'utilisation des mesures d'atténuation. Le présent document actualise un document précédent (GTCA4 Doc 26) et vise à fournir un projet de Lignes directrices de conservation de l'ACAP sur la collecte de données pour les programmes d'observateurs afin d'améliorer les connaissances sur les impacts des pêcheries sur les espèces inscrites à l'ACAP. Il est proposé que ces lignes directrices, une fois adoptées, soient défendues auprès des Parties, des ORGP et d'autres acteurs, et s'accompagnent de conseils de l'ACAP.

RECOMMANDATIONS

Nous recommandons que le Groupe de travail :

1. examine ce projet de lignes directrices, et participe à l'élaboration des avis ultérieurs ;
2. demande au Comité consultatif de soutenir l'adoption de ces lignes directrices de conservation sous la forme d'un avis officiel de l'ACAP, et plaide en faveur de la diffusion de cet avis.

1. **INTRODUCTION**

The incidental catch of seabirds associated with fishing operations, especially in longline and trawl fisheries, is considered one of the greatest threats to ACAP-listed seabirds. Consequently, the management of seabird-fisheries interactions, and particularly the reduction of incidental mortality, or bycatch, of seabirds in longline and trawl fisheries, is a critical objective of ACAP. Indeed, the ACAP Action Plan calls on the Advisory Committee to review and update on a regular basis data on the mortality of albatrosses and petrels in commercial and other relevant fisheries (ACAP Action Plan 5.1 (f)). Such an assessment relies on the effective collection, analyses and reporting of seabird bycatch and associated data by Parties, as well as by Regional Fishery Management Organisations (RFMOs) and other non-Party sources.

It is well recognised that the implementation of fishery observer programmes that include the collection and management of seabird bycatch and associated data, are the most effective means of monitoring fisheries performance with respect to seabird bycatch and use of bycatch mitigation measures (FAO 2009). Attempts to assess the impacts of fisheries activities on seabirds have generally been constrained by the lack, or limited nature, of bycatch data and the inconsistent manner in which these data have been collected, reported and analysed. Consequently, several assumptions are required to fill observations in space and time, which inevitably leads to high but un-quantified uncertainty in bycatch estimates.

The development and implementation of effective observer programmes is an important but challenging task. A number of initiatives have been implemented, some of which are ongoing, to address data collection and other requirements of fisheries observer programmes. Following a Fisheries Observer workshop held in November 2004, a document providing detailed best practice guidelines for observer programmes in longline fisheries on data collection requirements to assess and reduce bycatch of protected species (including seabirds, marine mammals, and sea turtles) was published (Dietrich et al. 2007). BirdLife International has developed and presented to a number of RFMOs recommendations relating to the establishment of regional observer programmes, and minimum data standards for collecting and reporting seabird bycatch (e.g. Black et al. 2007; Anderson et al. 2009; BirdLife International 2010; Anderson et al. 2010). The establishment and implementation of effective observer programmes has also been a key component of the ACAP-RFMO engagement strategy (e.g. Wolfaardt et al. 2017, Wolfaardt et al. 2016). The Common Oceans Tuna Project Seabird Bycatch Assessment has also considered the issue of minimum data requirements for assessing seabird bycatch in longline fisheries.

This paper draws on the documents referred to above, and the experience gained from these and other initiatives. The purpose of the paper is to outline draft guidelines for the establishment and implementation of effective data collection and reporting protocols for fishery observer programmes. The focus of the document is on seabird bycatch, but the principles are broadly relevant to other taxa caught as bycatch. It is not intended to be a detailed manual of observer programme protocols but rather seeks to outline the main elements and principles that should inform the design and implementation of observer programme data collection practices. *It is intended that this draft guideline document be discussed at SBWG9, and on the basis of these discussions and inputs, developed into an ACAP conservation guideline document.*

2. THE MAIN OBJECTIVES OF A BYCATCH DATA COLLECTION PROGRAMME

The main objectives of routinely collecting seabird bycatch data are:

- To characterise and quantify seabird bycatch within a fishery.
- To understand the nature of seabird bycatch, and the importance of the various factors that contribute to the observed level of bycatch. This is important for identifying specific mitigation solutions for the particular fishery.
- To assess and monitor the effectiveness of seabird bycatch mitigation measures in reducing seabird mortality.

To fulfil these objectives a number of issues need to be addressed. These include:

- The establishment and implementation of effective observer programmes.
- Sufficient observer coverage of the fishing effort to quantify accurately seabird bycatch, and to scale up reliably observed bycatch to the whole fishery.
- Standardised collection of reliable seabird bycatch and associated data by well-trained observers.
- Clear and standardised requirements for reporting bycatch, and co-ordinated and preferably centralised management of bycatch data so that these can be used for regional and global assessments.

3. OBSERVER PROGRAMMES

It is well recognised that monitoring of target and non-target fisheries catch via formal observer programmes is a vital component of responsible fisheries management (e.g. FAO, 2009, Lutchman 2014). Fishery Observer Programmes are designed and implemented to fulfil a number of different objectives, ranging from catch (and bycatch) characterisation and estimation to assessing compliance with mandatory fishery management regulations. In respect of bycatch monitoring, the observer programme implemented by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is generally recognised as being the most progressive of the RFMO programmes (Small 2005) and has contributed to the reduction of seabird bycatch in CCAMLR fisheries (Croxall, 2008). Key elements of the CCAMLR observer programme that have made it successful include: independence of observers, the centralised management of the programme, the provision of clear objectives, protocols and data recording forms, the high level of observer coverage (100% coverage in the longline fishery), and regular review of the data and objectives that facilitates an adaptive approach to seabird bycatch management (Sabourenkov & Appleyard 2005).

Observer programmes have been established in most fisheries managed by Parties and RFMOs that overlap with ACAP-listed species, including the Indian Ocean Tuna Commission (IOTC), ICCAT and the Inter-American Tropical Tuna Commission (IATTC), all of which have adopted a requirement of 5% coverage of fishing effort. The IOTC, ICCAT, IATTC and Western and Central Pacific Fisheries Commission (WCPFC) longline observer programmes differ from CCAMLR in that they are based on national observer programmes, with a coordinating role for the Secretariats, though the exact nature of this coordinating role differs. The use of a centralised approach is preferred as it facilitates uniform standards of data collection and reporting, observer training and observer coverage. If the alternative approach (implementation of national schemes) is adopted, it is critical that the specific requirements and protocols relating to the observer programme are clearly stated and communicated to all Parties, and properly co-ordinated by the RFMO.

Although this paper deals specifically with seabird bycatch, it is important to recognise that observer programmes will have a number of other objectives, including the collection of bycatch data for other taxa, such as sea turtles and marine mammals, as well as collection of data on target species. Data collection protocols should cover all relevant species and objectives. An observer will often therefore have to undertake a range of responsibilities, and it is critical that the observer programme is managed to ensure the necessary observation and data collection requirements are reliably and consistently fulfilled. For seabirds, this would best be achieved by using dedicated seabird observers, or at least to ensure dedicated time periods (at the optimal times) within the observer schedule for dedicated seabird-fisheries interaction and bycatch observations.

Harmonisation of observer programmes between the different fisheries management agencies is necessary to facilitate a consistent approach in data collection and reporting across all of these jurisdictions, and thus allow a larger scale assessment of bycatch than is possible when considering each management authority individually.

3.1. Key recommendations

- All Parties and regional fisheries management bodies with fisheries that overlap with seabirds susceptible to bycatch should establish and implement Fishery Observer Programmes that explicitly include seabird bycatch monitoring objectives and standards.
- For regional bodies, such as RFMOs, centralised management of observer programmes is preferable to a nationally implemented and managed system.
- Ensure a co-ordinated approach across regional bodies to enable larger scale assessments of bycatch. This includes making use of data collection and reporting protocols that have already been set up in other bodies, and potentially making use of joint databases.

4. OBSERVER COVERAGE

To conduct a reliable assessment of seabird bycatch in a fishery, the level of observer coverage (percentage of fishing effort observed) needs to be tailored to the specific objectives of the monitoring programme. A higher level of coverage will be needed to quantify seabird bycatch and assess the efficacy of different mitigation measures than if the objective is simply to detect whether bycatch is occurring.

The exact level of observer coverage required depends on several factors such as the frequency of bycatch events, the variability of bycatch rates, and the desired coefficient of variation of bycatch estimates. This makes it difficult to recommend a single optimum level of observer coverage that will cover all fisheries and taxa. Seabird bycatch tends to be highly variable, often clumped in distribution, and may be relatively rare, making it difficult to obtain accurate estimates of mortality with low levels of observer coverage. It should be noted that although bycatch events may be relatively infrequent, for rare species, these events cumulatively constitute critical threats in population terms.

CCAMLR requires 100% observer coverage of their longline fishery (i.e. an observer on each trip). Although it would be ideal to have complete observer coverage of all fishing trips in

RFMOs whose fishing effort overlaps with susceptible seabirds, given the cost and other practical considerations, this is an unrealistic expectation. Lawson (2006) has shown that in general the co-efficient of variation of bycatch estimates decreases rapidly as the coverage rate increases to 20% and then decreases slowly to 0 when reaching 100% coverage. Therefore, in order to extrapolate observed bycatch rates to the whole fishery, the level of observer coverage should ideally be 20% of the fishing effort. Measures adopted in some of the key RFMOs, including WCPFC, ICCAT, IATTC and IOTC, have established minimum observer coverage rates of 5%. At this level of observer coverage, bycatch estimates will remain highly imprecise for low occurrence species and would be inadequate to document the frequency of particular species' interactions with fishing gear (Gilman et al. 2012). But it is better than no coverage at all and may be sufficient to identify the existence of some level of bycatch. Analysis of the bycatch data collected with this level of coverage will almost certainly reveal a lack of precision in bycatch estimates, and it is important that efforts continue to encourage the level of observer coverage, and the accuracy and precision of estimates, to be increased. Another option is to adopt a targeted approach and identify high risk areas which require greater levels of observer coverage. It is important to ensure that within these high-risk areas, observer coverage is spatially and temporally representative of fishing effort.

It is important that observer coverage targets are clearly defined and differentiate between within fleet and within-trip coverage. The true coverage is a function of the proportion of fishing effort (number of hooks set/hauled or number of trawl tows or hours) observed on each vessel within each trip. Coverage of 20% of the fleet, will equate to less than 20% of the actual fishing effort, because not all of the hooks set/hauled or trawl tows/hours will be observed on each trip observed.

Another important issue to consider when designing a fishery observer programme sampling strategy is representativeness. It is inappropriate to assume that bycatch and associated data collected for a small sample of the overall fishing effort is necessarily representative of the whole fleet. With this in mind, every effort should be made to ensure that observer programmes sample a representative portion of the fishing effort of each fleet, spatially, temporally and across the full range of vessels and gear types.

4.1 Key Recommendations

- The level of observer coverage should be sufficient to allow accurate and precise estimates of bycatch to be derived for the whole fishery. It is important that ACAP Parties lead by example in terms of committing to minimum levels of observer coverage.
- The level of observer coverage should be based on the actual fishing effort (total number of hooks set/hauled, number of trawl tows or hours), and not on the number of trips.
- The observer coverage should be representative across fishing operations, spatially and temporally, and sufficient to derive robust estimates of bycatch. *Question for the SBWG: Do we want to recommend targeted observation effort in areas/seasons that are considered to be high risk for seabirds, and for which few data are available. This would be counter to the concept of representative sampling but may be something to recommend when faced with prioritising the allocation of limited (5% coverage) observer time.*

- Observer programmes should establish a process by which the effectiveness of the programme, and especially the level of coverage, is regularly reviewed. This should be a robust process with pre-agreed management decision rules on which to decide how the observer coverage should be amended.
- Representativeness should be based on appropriate stratification. Temporal stratification should be based on year quarters. Spatial stratification should comprise unit areas that are similar in respect of the distribution of seabirds and fishing effort, at a resolution comparable or finer than 5x5 degree grid squares, or simply based on 5x5 degree grid squares. Representativeness can be evaluated very simply by calculating (and reporting) the proportion of the total fishing effort observed for each strata, and how these compare with the target level of observer coverage required.

5. DATA COLLECTION PROTOCOLS

In order to rigorously assess and monitor seabird bycatch, it is necessary for observers to collect a range of data in a systematic and standardised manner. It is crucial that the data collection requirements are made explicit in the relevant protocols and manuals, and that these protocols are standardised. Ideally, data collection protocols should be broadly consistent across all ACAP member countries and fisheries bodies to allow a wider-scale, and indeed global, assessment of fishery impacts on seabirds. The first step would be to identify a minimum set of data fields which need to be cross-comparable. Although, countries and RFMOs that have already established data collection and management (including database) protocols will often be reluctant to change these, the development of any new programmes should be informed by initiatives in adjacent fisheries. Standardisation of seabird bycatch data collection protocols across regional bodies will also have practical benefits in that observers working across RFMOs will be implementing the same protocols.

Observers will normally have a number of tasks and duties, including the collection of seabird bycatch and associated data, so it is important to define very clearly what data need to be collected, and the sampling strategy to collect the data. Both of these depend on the specific seabird bycatch monitoring objectives of the observer programme. Assessing and monitoring seabird bycatch will require a minimum set of data to be collected. If the objective is to assess the relative influence of a number of factors, and the efficacy of mitigation measures, on seabird bycatch rates, additional variables will be required.

Dietrich et al. (2007) and Black et al. (2007) provide a detailed description and summary of the data that should be collected as part of a seabird bycatch monitoring programme. It is useful to distinguish between critical (minimum) data that are required for recording seabird bycatch, and additional data that would be desirable to collect to gain a better understanding of the factors contributing towards seabird bycatch and its reduction. Such an approach incorporates some flexibility, and takes account of the reality of observer programmes, where observers will have a multitude of tasks.

Table 1a provides details of data collection fields for longline fishing provided in Dietrich et al (2007) and subsequently adapted by BirdLife International (Anderson et al. 2009, 2010, BirdLife International 2010). The fields in Table 1a that were suggested in SBWG4 Doc 26_Rev1 as being critical for recording seabird bycatch are highlighted in **bold**. *Subsequently, as part of the Common Oceans Tuna Project pre-assessment workshops, there was some discussion regarding the critical versus desirable data for observer programmes to collect.*

The recommendations from the workshop were largely consistent with those identified in the ACAP paper (and Table 1a). There were a couple of data fields added that were considered useful as proxy information (such as vessel length/size), which could be used to estimate bycatch for unobserved fleets/strata. The list of priority data fields recommended by the Common Oceans Tuna Project seabird bycatch pre-assessment workshop is provided in Table 1b. Table 1a has been modified slightly to incorporate information relevant to trawl fisheries.

The following data from Table 1a are considered to be critical:

- **Vessel characteristics**, including name, registration and nationality.
- **Fishing trip and event characteristics,** including target fish species, trip number, event number, fishing method and gear used
- **Total fishing effort**, recorded as the number of hooks set, or tows or trawl hours in the case of trawling.
- **Total fishing effort observed**, recorded as the number of hooks observed during the haul, or the total number of trawl tows or hours observed. This is crucial for calculating seabird bycatch rates for the entire fleet.
- **Spatial and temporal information about the fishing operation**. This is essentially the time and vessel position at the start and end of setting and hauling and is necessary to assess the spatial and temporal extent of bycatch. The collection of this information is standard for all observer programmes and should be easily obtained from the vessel's logbook. A key issue is the scale at which this information is reported. Currently this is mostly at 5x5 degrees, which is a rather low resolution, but may be considered adequate for RFMOs.
- **Mass of added weight**. Line weighting is considered a critical bycatch mitigation measure for longline fisheries.
- **Branchline length,** in metres.
- **Distance between weight and hook,** in metres. This is an important component of the line weighting regime and should be recorded.
- **Mitigation measures used.** Description of mitigation measures in place, and preferably information about how effectively they were used. These include the use of tori lines (single or paired, overall length, height of deployment, number and length of streamers), line weighting (mass of weights and distance between weights and hooks – see above), night setting, use of hook pods.
- **Information about offal management.** This is particularly important for trawl fisheries, as it is the presence and dynamics of offal discharges from trawl vessels that explains the abundance of seabirds attending vessels and the risk of bycatch events. For longline vessels, information regarding timing of discards in relation to setting and hauling, and position of discharge relative to the hauling bay, is considered useful, by not critical to collect.
- **Seabird data and samples.**
    - All seabirds caught should be identified to species level as far as possible to derive an estimate of the seabird catch per unit effort for each species. The Seabird Bycatch Identification Guide produced by ACAP in collaboration with the Japan Fisheries Research Agency provides a useful tool to help identify bycaught seabirds. However, it may not always be possible to identify a

bycaught bird to species level. In these cases, the identification of a bycaught bird at a coarser level (e.g. large/great albatross), or even unidentified birds, still contribute to the estimate of the total number of birds caught. A recommended standard set of nested groupings for unidentified (ACAP) species level is provided in Annex 1, the use of which would allow estimates to be summed at different taxonomic levels.

- The fate (dead/alive/injured) and number of birds (for each species) in each of these categories should be recorded, and it should be indicated whether the bird was released alive or discarded. Detailed injury characteristics (see below) and which part of the fishing event (set or haul) the birds were recovered from, should also be noted.
- The condition of all birds brought onboard alive should be described. Birds that have sustained serious injuries – fractured wing bone, leg bone or beak, an open wound, several primary feather shafts broken etc – are likely to have a low chance of survival after it is released, and so should later be added to the number of dead birds.
- Ideally, all seabird carcasses should be retained onboard (and kept frozen) for subsequent identification and examination by appropriate experts. This would allow a more accurate determination of species, sex and age class, and may also be used to determine the provenance of the caught birds. If storage space is limited, retention of the head and one of the legs would still be useful; photographs of the bird, especially the head and underwing can generally be used to help identify species. It is important that all samples and photographs are properly labelled with date, time taken on board, species, vessel name, observer's name and a label number which corresponds to the unique number for the haul observed.
- For all birds caught, details of any rings or tags should be recorded.

The following data are considered ideal to record and would contribute to a better understanding of the nature of bycatch and especially the factors that influence bycatch rates:

- **Regular seabird abundance estimates**. Estimates of seabird abundance during setting will allow observed seabird bycatch rates to be related to the number of birds attending the vessel. This is particularly useful as seabird abundance has been related to observed bycatch rates (e.g Gilman et al. 2003; Reid & Sullivan 2004). These estimates can therefore be used to account for spatial and temporal variation in the numbers of seabirds attending vessels, and thus allow a more accurate comparison of bycatch rates between vessels, seasons and areas. Standardised protocols have been developed for a number of fisheries (e.g. Ramm et al 2015) and are included in Annex 2 of this document.
- **Interactions of seabirds with fishing operations**. Detailed observations of seabird interactions with fishing gear can contribute usefully to an understanding of the circumstances that lead to bycatch and can be used to identify and assess optimal mitigation measures. For example, some studies of mitigation measures in pelagic longline fisheries have recorded how far astern of the vessel seabirds dive for bait, and whether they were successful or not. This has highlighted that seabirds can still access

baited hooks behind the protection of tori lines if the weighing regime is insufficient. It has also highlighted the importance of secondary hooking (where deeper diving seabirds bring baited hooks to the surface where they are accessible to albatrosses) in areas dominated by White-chinned Petrels and other deeper diving seabirds (e.g. Jiménez et al. 2011).

- **Environmental data**. Environmental factors that may influence seabird mortality rates include the sea state, wind speed and direction relative to the vessel's course, cloud cover, visibility and moon phase (for night fishing operations). Routine collection of these data (during line setting) will contribute towards a greater understand of the importance of these factors in determining bycatch.

The successful implementation of the data collection protocols requires that these protocols, including sampling regimes, are clearly described, that data recording forms are tailored to capture all the necessary data, and that observers are well trained to undertake the work. Seabird identification is particularly complex, especially for observers with little previous experience or interest in seabird work and is thus a crucial component of a training programme.

Many observer programmes have developed manuals, which contain detailed descriptions of the sampling protocols, species identification guides, and annotated data collection forms with instructions how to complete these (e.g. the CCAMLR Scientific Observers Manual).

5.1 Undetected Mortality

Seabird mortality estimates are generally based on the number of dead birds brought aboard vessels on hooks (in longline fisheries), and on trawl gear (in trawl fisheries) or on direct observations of mortality events. However, in many cases an unknown proportion of birds that are caught on longlines during line setting may drop off hooks prior to hauling, and so will not be retrieved and recorded. This undetected mortality is sometimes referred to as "cryptic mortality", and the proportion in some longline fisheries has been estimated at 50% (Brothers et al. 2010). Similarly, an unknown proportion of birds that collide with trawl warps or other fishing gear and either drown or are fatally injured, may not be retrieved and included in mortality estimates. This undetected mortality has the potential to significantly underestimate actual mortality. Ideally, the undetected mortality should be accounted for in bycatch estimates, but this is not necessarily a simple task. Some studies have been undertaken to derive correction factors, by for example quantifying the relationship between heavy contacts of seabirds with trawl gear and observed mortality. However, such a relationship is influenced by a number of variables, making it difficult to apply broadly. We recognise that methods to estimate undetected mortality are likely to vary, and rather than stipulating a single preferred method, providing metadata on the methods may be a more appropriate solution. The use of standardised metadata will allow quick assessment of the comparability of different estimates.

5.2 Key Recommendations

- Observer programmes should define the minimum data collection requirements to assess and monitor seabird bycatch and specify these in as much detail as possible. This should include the data to be collected and the sampling regime. Data collection forms should be tailored to solicit very clearly the required data. See Tables 1a and 1b for recommended minimum data fields.
- The data collection protocols, sampling regime, and other materials such as identification guides and data forms, should be incorporated into observer manuals, or be made easily available.
- Recognise that mortality estimates based on retrieved seabird carcasses are likely to underestimate actual mortality. Consequently, observer programmes should record explicitly whether they are accounting for cryptic mortality or not.
- Encourage investigations that attempt to quantify the incidence and extent of undetected mortality. In longline fisheries, this would generally require focussed observations of seabird hookings during line setting and comparing these with the number of birds subsequently hauled aboard. For trawl fisheries, the fatal outcomes of seabird collisions with trawl gear (observed through dedicated observation of seabird interactions with trawl gear) can be compared to the number of carcasses subsequently retrieved. Other experimental approaches may also be applied to estimate the levels of undetected mortality associated with each fishery/method.
- Building capacity to establish and maintain observer programmes is of critical importance. This should include regular training and the provision of resources (such as identification guides and clearly articulated protocols) to support the work of the observers.

Table 1a: Recommended data to be collected in longline fisheries operations (adapted from Dietrich et al. 2007, FAO 2009 and Anderson et al. 2010). These data should be recorded for each set and haul observed. Data considered critical for assessing seabird bycatch are highlighted in bold. The table has been further updated to make it relevant to trawl fisheries.

Category	Variables
Temporal	**Date gear deployed**
	Start time of gear deployment
	End time of gear deployment
	Date gear retrieved
	Start time of gear retrieval
	End time of gear retrieval
Spatial	**Latitude at beginning of gear deployment**
	Longitude at beginning of gear deployment
	Latitude at beginning of gear retrieval
	Longitude at beginning of gear retrieval
	Latitude at end of gear retrieval
	Longitude at end of gear retrieval
Physical and Environmental	Sea state (Beaufort Scale)
	Moon phase
	Wind strength and direction
	Depth fished (average/target depth)
	Cloud cover (important for night setting)
Fishing operation	**Unique vessel identifier**
	Unique observer identifier
	Vessel length
	Setting speed (knots)
	Total number of hooks deployed/Total number of trawl hours or tows
	Total number of hooks observed/Total number of trawl hours or tows observed (crucial for calculating seabird bycatch levels)[1]
	Target species[2]
	Bait species
	Composition of bait used (%)
	Bait status (live/fresh/frozen/thawed/whole/cut)
	Mass of added weight (describe size and position of weight, e.g. 60g 1m from the hook)

Category	Variables
Fishing gear	Groundline/mainline length[3]
	Branchline/ganglion length
	Distance between weight and hook on ganglion (when used)
	Distance between branchlines
	Line setter used (Y/N)
	Line setter speed (knots)
	Hook size
	Hook type
Catch	Total catch, actual or estimated (number and/or weight)
	Catch by species (number and/or weight)
Mitigation Measure	**Tori line used (yes/no)**
	Side of tori line deployment (port or starboard or both)
	Number of tori lines used
	Length of tori line (m)
	Aerial coverage achieved (m)
	Attachment height (m above water line)
	Number of streamers
	Distance between streamers
	Dumping of bait/offal (yes/no). For trawl fisheries, indicate if/how offal is managed (e.g. full retention of waste during fishing activities, Mealing or Batching). For longline fisheries also describe if dumping of offal took place during setting and hauling and whether offal was dumped on the opposite side of the hauling bay.
	Deck lighting astern of the vessel (yes/no)
	Bait caster used (yes/no)
	Other mitigation measures used (provide details)
Bycatch information	**Species identification**
	Number of each species captured
	Type of interaction (hooking/entanglement/contact with warp)
	Disposition (dead/alive/injured)
	Description of condition/viability of animal upon release (if released alive)
Other	Seabird abundance counts

1 – Important to record the numbers of hooks observed specifically for seabirds. If the observer is in the factory or collecting information elsewhere they may miss seabirds being hauled aboard. Therefore it is important to be able to relate the number of birds caught to the number of hooks observed.

2 – Target species may be derived in some programmes from the catch composition

3 – Groundline/mainline length is rarely an exact measurement, due to the length of the line. Instead it is either derived (by multiplying distance between floats by number of floats), estimated by the observer, or reported by the vessel.

Table 1b: Draft list of priority data fields to be collected by set for seabird bycatch per unit effort standardisation and estimation, as recommended by the Common Oceans Tuna Project seabird bycatch pre-assessment workshops. These data fields are specifically for pelagic longline fisheries

Category	Variables
Dependent variable	Number of seabirds caught (by spp.)
	Condition (Dead/Alive/Injured)
	End time of gear deployment
Spatial	Latitude at beginning of set
	Longitude at beginning of set
Physical	Moon phase (this can also be calculated by date)
Fishing operation	Vessel identification
	Observer identification
	Vessel characteristics e.g. length, tonnage, & target species, for extrapolation to unobserved fleets
	Number of hooks between floats
	Number of hooks deployed
	Number of hooks observed during the haul
	Catch composition or target species
Relevant Conservation and Management Measures	Bird Scaring Lines (Yes/No)
	Number of Bird Scaring Lines
	Text field for description of Bird Scaring Line
	Mass of added weight (grams) and distance from the hook (metres)

6. STANDARDISED REPORTING OF OBSERVER DATA

Standardised collection of bycatch data is considered essential for a reliable assessment of seabird bycatch. The standardised reporting of these data and associated information by Parties to the respective management authorities, e.g. RFMO Secretariats, and the management of these data, are equally important. However, the data reporting requirements for regional management bodies are often quite vague, and as a result data and information that are provided to these bodies vary in their quality, quantity and format, severely hampering efforts to assess and monitor seabird bycatch. Moreover, rules on confidentiality may preclude robust analyses even if the data are centrally managed and theoretically available.

It is important that there is an explicit link between the data that are required to be recorded (see section 5), and the data that should be reported to the RFMO or management body. Often, fisheries management bodies simply require that summary information from the domestic observer programmes of Parties are reported to the authority or one of its organs, rather than the primary data sheets, or digital versions thereof. This highlights one of the shortcomings, already mentioned, of an observer programme that is not centrally managed, and leaves a lot open to interpretation by Parties as to what they are expected to report.

A rigorous regional assessment of bycatch by an RFMO or multiple RFMOs will require that most, if not all, of the crucial data to be collected (identified in section 5 and table 1), are submitted to the RFMO. Further it is necessary for the actual data to be reported so that they can be incorporated into a central database, rather than reporting the information in the annual reports of Parties. The use of standardised electronic forms for the reporting of bycatch data is being investigated by some RFMOs, which may be a useful mechanism to solicit the required information.

As indicated in section 5, it is crucial that the proper use of bycatch mitigation measures is recorded. It is also important that this information is reported to the co-ordinating management body, so that, in the assessment of seabird bycatch, it is possible to understand the factors contributing to varying levels of mortality. There is concern amongst some Parties that reporting on the use of mitigation measures constitutes a compliance function. It is therefore important that guidelines and recommendations relating to the collection and reporting of mitigation measures is framed to highlight the necessity of such data for monitoring the performance of bycatch reduction objectives.

It is also considered useful to exchange seabird bycatch data between regional fisheries management bodies at the finest resolution feasible in order to facilitate collaborative and wider-scale assessments of bycatch. Consistency in data collection and reporting standards would facilitate the transfer of these data between fisheries management organisations.

The reported data and information should be used by fisheries management organisations to conduct regular reviews of seabird bycatch and the effectiveness of mitigation measures to reduce levels of bycatch. In this respect, these management organisations should establish a framework to monitor and review performance, which includes clear reporting formats, protocols and timelines.

6.1 Key Recommendations

- Explicit protocols for the reporting of seabird bycatch and associated data should be developed and implemented. These should be linked directly to the data collection requirements, and ultimately to the objective of monitoring levels of seabird (and other) bycatch in the respective fisheries.
- Actual data should be reported, rather than qualitatively reporting on bycatch in national reports.
- Bycatch data should be managed in a co-ordinated manner, ideal through centralised management of a purpose-built database.
- Exchange of seabird bycatch data between RFMOs and other fisheries management organisations should be encouraged.

7. THE ROLE OF ELECTRONIC MONITORING

The use of electronic monitoring (EM) technology, such as video recording equipment, has been used in a range of fisheries to monitor target and non-target catch, and could provide a cost-effective means of increasing 'observer' coverage and monitoring and improving compliance with mitigation requirements, thus contributing towards the assessment of bycatch levels. Some pilot studies have been conducted to assess the utility of electronic monitoring in relation to seabird bycatch. These studies, most of which are still underway, have focussed on both monitoring compliance regarding the use of mandatory seabird bycatch mitigation measures, and also to identify seabird species incidentally caught in fishing operations. Increased efforts are also being directed towards the development of electronic reporting systems for observer programmes.

7.1 Key recommendations

- Consider the use of remote monitoring technology to increase levels of observer coverage.
- The design of EM systems, and procedures governing the deployment of these systems, should ensure imagery is collected and stored in a manner that avoids external tampering and provides safe storage for subsequent review, and that analysis of the imagery is undertaken by independent reviewers
- EM systems should collect fine scale data about the day, time, and location of deployment and retrieval of fishing gear
- EM systems should provide imagery of a clear view of the fishing gear as it is set and retrieved and all setting and hauling events should be recorded by the system.
- Imagery gathered by EM systems should be independently reviewed so that the programme and all aspects being monitored can be considered transparent and robust.
- EM systems should provide imagery that results in a clear and unobstructed view of any mitigation measures required by regulatory bodies and footage should be independently reviewed to verify that the mitigation is being deployed in accordance with specifications
- Seabirds brought onboard the vessel should be handled in accordance with ACAP's advice for removing hooks from seabirds.

- Protocols for the identification of seabirds to species level should be developed and applied, where practicable. Such protocols may include, but should not be limited to, retaining the carcass or a sample of the feather or muscle for post-trip analysis. The protocol should incorporate those detailed in ACAP's Seabird Bycatch Identification Guide, where relevant.
- Development of EM systems should ideally include a pre-implementation phase in which stakeholders work together to address challenges for implementation, as well as a process for providing feedback on implementation.

8. CONCLUSION

It is recognised that observer programmes require considerable technical and financial resources to be successful, and that the collection of seabird bycatch and associated data adds to the workload of observers. However, bycatch of seabirds and other non-target species is recognised as a critical concern for fisheries management organisations. The standardised collection and reporting of relevant data by well-trained observers are considered to be the most reliable means of monitoring fisheries performance with respect to seabird bycatch and the effective use of mitigation measures. Rigorous assessment and monitoring of seabird bycatch will require a sufficient level of observer coverage, the development and implementation of standardised data collection and reporting protocols and regular review.

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ANNEX 1: PROPOSED CATEGORISATION FOR BIRDS UNIDENTIFIED TO SPECIES LEVEL

Seabird sp	Large albatross species	*Diomedea sp*	Northern Royal Albatross - *Diomedea sanfordi*
			Southern Royal Albatross - *Diomedea epomophora*
			Wandering Albatross - *Diomedea exulans*
			Antipodean Albatross - *Diomedea antipodensis*
			Amsterdam Albatross - *Diomedea amsterdamensis*
			Tristan Albatross - *Diomedea dabbenena*
	Smaller albatross species	*Phoebetria sp*	Sooty Albatross - *Phoebetria fusca*
			Light-mantled Albatross - *Phoebetria palpebrata*
		Phoebastria sp	Waved Albatross - *Phoebastria irrorata*
			Black-footed Albatross - *Phoebastria nigripes*
			Laysan Albatross - *Phoebastria immutabilis*
			Short-tailed Albatross - *Phoebastria albatrus*
		Thalassarche sp	Atlantic Yellow-nosed Albatross - *Thalassarche chlororhynchos*
			Indian Yellow-nosed Albatross - *Thalassarche carteri*
			Grey-headed Albatross - *Thalassarche chrysostoma*
			Black-browed Albatross - *Thalassarche melanophris*
			Campbell Albatross - *Thalassarche impavida*
			Buller's Albatross - *Thalassarche bulleri*
			Shy Albatross - *Thalassarche cauta*
			White-capped Albatross - *Thalassarche steadi*
			Chatham Albatross - *Thalassarche eremita*
			Salvin's Albatross - *Thalassarche salvini*
	Petrel species	*Macronectes sp*	Southern Giant Petrel - *Macronectes giganteus*
			Northern Giant Petrel - *Macronectes halli*
		Procellaria sp	White-chinned Petrel - *Procellaria aequinoctialis*
			Spectacled Petrel - *Procellaria conspicillata*
			Black Petrel - *Procellaria parkinsoni*
			Westland Petrel - *Procellaria westlandica*
			Grey Petrel - *Procellaria cinerea*
		Shearwater *sp*	Pink-footed Shearwater - *Ardenna creatopus*
			Balearic Shearwater - *Puffinus mauretanicus*

Coarsest level of taxonomic classification

Lowest (specific) level of taxonomic classification

ANNEX 2: PROTOCOLS FOR SEABIRD ABUNDANCE COUNTS BY FISHERIES OBSERVERS

(from Ramm et al. 2015)

Purpose

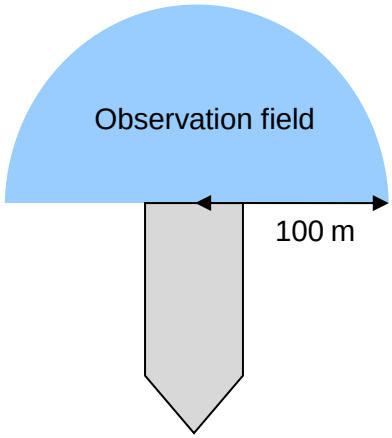
A basic understanding of the variety and abundance of seabird species present around a vessel during fishing activity can inform estimates of the bycatch risk posed by that fishing vessel. This protocol for seabird abundance counts at-sea has been developed following an international review of existing protocols and will enable the collection of directly comparable data across fisheries. A model data collection form is also provided.

Count Frequency

A minimum of one count per day should be undertaken during fishing activity. Where time allows it is recommended that further counts are undertaken during as many fishing events as possible.

Observer Location

A standard observation location should be selected at the beginning of the trip. Where possible this should be at a high point with an unobstructed view of the area 100 m astern of the vessel.



Count Method

The counts are intended to record ‘snapshots’ of bird abundance around the vessel at a given point, including both birds in flight and on the water. Therefore, it is important that adequate time is taken to assess all birds within the observation field. Depending on sea states this may also mean ensuring seabirds are not obscured by swell.

Note: One form should be completed per count

Observation Steps

1. Fill out Section 1- Summary Data. Provide either a valid 'linking ID' (this will vary by jurisdiction) or the vessel effort details. Ensure that positional data is recorded as Latitude / Longitude to at least 0.1 degree resolution in decimal format. All times should be recorded in UTC.

2. A 'snapshot' count should be undertaken of all seabirds in the observation field and recorded in Section 2 – Seabird Abundance Data.

    i. Each seabird should be identified to the finest possible taxonomic level and the corresponding FAO species code used. Each taxon should have a separate line.

    ii. If a bird or group of birds cannot be identified to species level, the most appropriate generic code should be used.

    iii. If there is no corresponding FAP code for the species or species group, record this in the Comments field.

    iv. If it is possible to differentiate juveniles from adults, age group should be identified on the form using the following coding:

Age group	Code
Total	T
Adult	A
Juvenile	J

    v. The Comments field in Section 2 should be used for anything of note about the birds observed. This may include any markings, banding of birds, tracking equipment or presence of fishing gear.

3. Fill out Section 3 - Observation Period.

    i. Record the vessel activity at the time of observation, as categorised below:

Vessel activity
Trawl - set
Trawl - tow
Trawl - haul
Longline/setnet - set
Longline/setnet - soak
Longline/setnet - haul
Purse seine - set
Purse seine - pursing
Purse seine - brailing

ii. For each count 'eye height' should be recorded. This is defined as the vertical distance between the observer's eye and the surface of the water (m).

iii. Presence of other vessels should be marked 'Yes' if any vessels are visible by the naked eye.

iv. Wind force should be recorded using the Beaufort scale.

v. The observers position on the vessel should be noted by the following categories:

Position	Code
Port	P
Starboard	S
Stern	R
Other	O

vi. Use of visual aids should be recorded:

Visual aids	Code
Binoculars	B
Other	O
None	N

vii. Any biological discharge from the vessel should be recorded by the observers as Yes **(Y)**, No **(N)** or unobserved **(U)**

viii. The observer should indicate **(Y/N)** whether weather conditions allow them to see up to 100m.

NOTE: every field should be filled with a value

4. Section 4 - Comments should be used to record any unusual events or conditions during the count. These may include gear failures that occurred during the count, noteworthy weather events, or reasons why a count was interrupted.

Seabird Abundance Count Form

1. General information

Linking ID		Observer name(s)		Vessel	
Date		Organization		Position	
Time		Jurisdiction		Event number	

2. Seabird abundance data

FAO species code	Number	Age group	Comments

3. Observer period data

Vessel activity		Eye height (m)		Other vessels		Wind force	
Observer position		Visual aid		Discharge		Visibility ? 100 m	

4. Comments (e.g. decreased viewing angle, changes to observation transect width, noise disturbances)

Seabird abundance form - codes

Vessel activity
Trawl - set
Trawl - tow
Trawl - haul
Longline/setnet - set
Longline/setnet - soak
Longline/setnet - haul
Purse seine - set
Purse seine - pursing
Purse seine - brailing

Observer position	
P	= Port
S	= Starboard
R	= Stern
O	= Other

Visual aid	
B	= Binoculars
O	= Other
N	= None

Age group of birds	
T	= Total birds
A	= Adult birds
J	= Juvenile birds

Other	
Y	= Yes
N	= No
U	= Unknown

Beaufort Scale of Wind Force

Beaufort Number	Description	Mean wind speed (knots)	Probable wave height* (m)
0	Calm	< 1	
1	Light air	1 - 3	0.1 (0.1)
2	Light breeze	4 - 6	0.2 (0.3)
3	Gentle breeze	7 - 10	0.6 (1.0)
4	Moderate breeze	11 - 16	1.0 (1.5)
5	Fresh breeze	17 - 21	2.0 (2.5)
6	Strong breeze	22 - 27	3.0 (4.0)
7	Near gale	28 - 33	4.0 (5.5)
8	Gale	34 - 40	5.5 (7.5)
9	Strong gale	41 - 47	7.0 (10.5)
10	Storm	48 - 55	9.0 (12.5)
11	Violent storm	56 - 63	11.5 (16.0)
12	Hurricane	> 64	14 (-)

*This table is intended as a rough guide for the open sea. Figures in parentheses indicate the probable maximum wave heights. In coastal areas, greater heights will be experienced.