Agreement on the Conservation of Albatrosses and Petrels

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

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EXECUTIVE 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, relies on the effective collection, analyses and reporting of seabird bycatch and associated data. It is well recognised that the implementation of observer programmes that include the collection and management of seabird bycatch and associated data, are a highly effective means of monitoring fisheries performance with respect to seabird bycatch and use of mitigation measures.

These guidelines draw on a number of reviews, workshops and other initiatives, and aim to inform the establishment and implementation of effective and standardised data collection and reporting protocols for fishery observer programmes. 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. These guidelines cover the establishment and implementation of effective observer programmes, observer coverage levels, the standardised collection of reliable seabird bycatch data, as well as requirements for standardised reporting.

Data variables are recommended across a number of categories, including temporal, spatial, physical and environmental, fishing operations, fishing gear, catch, mitigation measures and bycatch information. Those data variables considered critical for assessing seabird bycatch are highlighted and should be implemented as a priority. Appendices on the categorisation of birds unidentified to species level, protocols for seabird abundance counts and protocols for seabird warp strike observations are also included. This guidance is focussed on longline and trawl fisheries, and over time ACAP intends to develop more detailed guidance for other fishing methods that pose bycatch risk to ACAP-listed species. ACAP has also developed complementary guidelines for fisheries electronic monitoring (EM).

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1. BACKGROUND

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. The review, and update on a regular basis, of data on the mortality of albatrosses and petrels in commercial and other relevant fisheries relies on the effective collection, analyses and reporting of seabird bycatch and associated data by ACAP 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 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). A January 2015 meeting of experts on tuna longline observer datasets held in Keelung, Taiwan, identified a need for a systematic review of existing information collected by the t-RFMO longline observer programmes in order to identify priority data gaps that hamper our understanding of longline bycatch (ISSF, 2015). A number of these recommendations were later implemented by the Western and Central Pacific Fisheries Commission (WCPFC) (Gilman & Clarke 2015). The Common Oceans Tuna Project Seabird Bycatch Assessment has also considered the issue of minimum data requirements for assessing seabird bycatch in longline fisheries (Birdlife South Africa 2019). The establishment and implementation of effective observer programmes has also been a key component of the ACAP-RFMO engagement strategy (e.g. Bogle et al. 2021).

These guidelines draw on the documents referred to above, and the experience gained from these and other initiatives, and aim to. inform 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. The guidance around objective setting for bycatch data collection, the design and implementation of observer programmes, have generic applicability to any time of fishing method. The more detailed data

collection protocols (section 5) are however focussed on longline and trawl fisheries. ACAP intends to review and update these guidelines over time, which will include developing more detailed guidance for other fishing methods that pose bycatch risk to ACAP-listed species. ACAP has also developed complementary guidelines for fisheries electronic monitoring (EM) systems.

2. 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% vessel coverage in the longline fishery; although it is the percentage of fishing effort observed that is most pertinent to seabird bycatch data), 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 ACAP 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 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 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. It has shown that in general the co-efficient of variation of bycatch estimates decreases rapidly as the coverage rate increases to 20-30% and then decreases slowly to 0 when reaching 100% coverage (Cryer et al. 2018; Debski et al. 2016; Lawson 2006). Therefore, in order to extrapolate observed bycatch rates to the whole fishery, the level of observer coverage should ideally be 20-30% 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 20-30% of the fleet, will equate to less than that level of 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.
- 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.
- 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 fisheries management 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. Priority data fields to be collected by set for seabird bycatch per unit effort standardisation and estimation, were also recommended by the Common Oceans Tuna Project seabird bycatch assessment workshops, and these have been included in Table 1a. 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, with those being critical for understanding seabird bycatch highlighted in **bold**. **Table 1b** correspondingly provides data collection fields for trawl fisheries. It is intended that over time these guidelines will be improved and updated, and this will include consideration of data collection for other fishing methods (e.g. purse seine), as our understanding of critical data collection fields grows for other fishing methods.

The following data from **Tables 1a and 1b** 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/trawl hours (ideally both) 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/trawl hours (ideally both) 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.

- **Key trawl gear characteristics** including the use and characteristics of **net monitoring cables**.
- **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. Standardised protocols have been developed for observing warp strikes by seabirds (e.g. Ramm et al 2015), which help improve our understanding of the true extent of seabird mortality, and are included in Annex 3 of this document.

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.
- 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 using protocols described in Annex 3) 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. These data should be recorded for each set and haul observed. Data considered critical for assessing seabird bycatch are highlighted in bold.

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 (this can also be calculated by date)
	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 hooks observed[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
	Hook size
	Hook type
	Number of hooks between floats
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)
	Average horizontal distance between bait entry point and tori line (m)
	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). 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)
	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: Recommended data to be collected in **trawl** fisheries operations. These data should be recorded for each tow observed. Data considered critical for assessing seabird bycatch are highlighted in bold.

Category	Variables
Temporal	**Date gear deployed**
	Start time of trawl shoot
	Start and end times of trawl turns
	Start time of haul
	End time of haul
Spatial	**Latitude at trawl shoot**
	Longitude at trawl shoot
	Latitude at end of haul
	Longitude at end of haul
	Latitude at trawl turns
	Longitude at trawl turns
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
	Tow speed (knots)
	Total number of trawl hours/tows (ideally both)
	Total number of trawl hours/tows (ideally both) observed (crucial for calculating seabird bycatch levels)
	Main discard species
	Target species[1]
Fishing gear	**Net monitoring cable** (yes/no). If used, where does the cable enter the water in relation to warps.
	Headline height
	Door type and area
	Headline length/Wingspread
	Lengthener mesh
	Number of codends
	Sweep length
	Codend mesh

Category	Variables
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) Are all warps and net monitoring cables covered?
	Attachment height (m above water line)
	Number of streamers
	Distance between streamers
	Dumping of bait/offal (yes/no). Indicate if/how offal is managed (e.g. full retention of waste during fishing activities, Mealing or Batching).
	Deck lighting astern of the vessel (yes/no)
	Other mitigation measures used (provide details)
Bycatch information	**Species identification**
	Number of each species captured
	Type of interaction (entanglement/contact with warp)
	Disposition (dead/alive/injured)
	Description of condition/viability of animal upon release (if released alive)
Other	Seabird abundance counts
	Warp strike observations

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

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 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 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 members. 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. Concerns have been raised 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. Complementary guidelines have been developed by ACAP for electronic monitoring systems.

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

Coarsest level of taxonomic classification → Lowest (specific) level of taxonomic classification

Seabird sp	Larger albatross species	*Diomedea sp*	**Northern Royal Albatross - *Diomedea sanfordi***	**DIQ**
			Southern Royal Albatross - *Diomedea epomophora*	**DIP**
			Wandering Albatross - *Diomedea exulans*	**DIX**
			Antipodean Albatross - *Diomedea antipodensis*	**DQS**
			Amsterdam Albatross - *Diomedea amsterdamensis*	**DAM**
			Tristan Albatross - *Diomedea dabbenena*	**DBN**
	Smaller albatross species	*Phoebetria sp*	**Sooty Albatross - *Phoebetria fusca***	**PHU**
			Light-mantled Albatross - *Phoebetria palpebrata*	**PHE**
		Phoebastria sp	**Waved Albatross - *Phoebastria irrorata***	**DPK**
			Black-footed Albatross - *Phoebastria nigripes*	**DKN**
			Laysan Albatross - *Phoebastria immutabilis*	**DIZ**
			Short-tailed Albatross - *Phoebastria albatrus*	**DAQ**
		Thalassarche sp	**Atlantic Yellow-nosed Albatross - *Thalassarche chlororhynchos***	**DCR**
			Indian Yellow-nosed Albatross - *Thalassarche carteri*	**TQH**
			Grey-headed Albatross - *Thalassarche chrysostoma*	**DIC**
			Black-browed Albatross - *Thalassarche melanophris*	**DIM**
			Campbell Albatross - *Thalassarche impavida*	**TQW**
			Buller's Albatross - *Thalassarche bulleri*	**DIB**
			Shy Albatross - *Thalassarche cauta*	**DCU**
			White-capped Albatross - *Thalassarche steadi*	**TWD**
			Chatham Albatross - *Thalassarche eremita*	**DER**
			Salvin's Albatross - *Thalassarche salvini*	**DKS**
	Larger petrel species PRX	*Macronectes sp MBX*	**Southern Giant Petrel - *Macronectes giganteus***	**MAI**
			Northern Giant Petrel - *Macronectes halli*	**MAH**
		Procellaria sp PTZ	**White-chinned Petrel - *Procellaria aequinoctialis***	**PRO**
			Spectacled Petrel - *Procellaria conspicillata*	**PCN**
			Black Petrel - *Procellaria parkinsoni*	**PRK**
			Westland Petrel - *Procellaria westlandica*	**PCW**
			Grey Petrel - *Procellaria cinerea*	**PCI**
		Shearwater *sp*	**Pink-footed Shearwater - *Ardenna creatopus***	**PUC**
			Balearic Shearwater - *Puffinus mauretanicus*	**UIM**
			Other *Ardenna* spp*	
			Other *Puffinus* spp*	
			Calonectris spp*	
		Cape petrel	Cape petrel – *Daption capense**	DAC
		Aphrodroma sp	Kerguelen petrel - *Aphrodroma brevirostris**	
		Bulweria sp	*Bulweria* spp*	
		Fulmarus sp	*Fulmarus* spp*	
		Pagodroma sp	*Pagodroma spp**	
		Pseudobulweria sp	*Pseudobulweria* spp*	
		Pterodroma sp	*Pterodroma* spp*	
		Thalassoica sp	*Thalassoica antarctica**	TAA

	Prion species	*Pachyptila sp* *PWX*	*Pachyptila* spp*	
	Storm petrel species	*Fregetta sp* *FGZ*	*Fregetta* spp*	
		Garrodia sp	Grey-backed storm petrel - *Garrodia nereis**	
		Nesofregetta sp	Polynesian storm petrel - *Nesofregetta fuliginosa**	
		Oceanites sp	*Oceanites* spp*	
		Oceanodroma sp	*Oceanodroma* spp*	
	Diving petrel species	*Diving petrel sp*	*Pelecanoides* spp*	

*Not ACAP-listed

ACAP species in bold.

FAO codes provided for taxa where appropriate codes exist.

ANNEX 2. PROTOCOLS FOR SEABIRD ABUNDANCE COUNTS BY FISHERIES OBSERVERS

Purpose

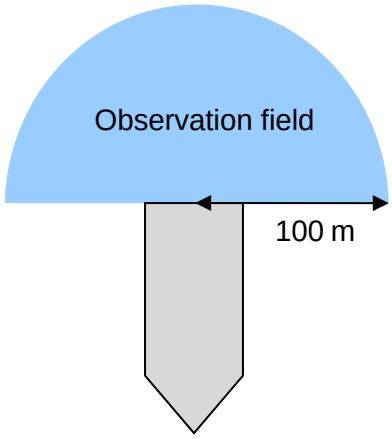
A basic understanding of the variety and abundance of seabird species present around a vessel during fishing activity can inform estimates of the bycatch risk posed by that fishing vessel. This protocol for seabird abundance counts at-sea has been developed following an international review of existing 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 immediately astern of the vessel 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 (100m astern of the vessel) 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 and operational conditions allowed them a clear and unobstructed view 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.

ANNEX 3: PROTOCOLS FOR SEABIRD WARP STRIKE OBSERVATIONS

Purpose

When seabirds, particularly albatross and larger petrels, are in close attendance to trawl vessels, there is risk of mortality or injury through warp strikes. Detecting such normally unobserved mortality requires specialised data collection. To investigate this risk further, dedicated observations can be made through implementation of these protocols, which follow Ramm et al (2015).

Choosing which warp to observe

Normally only one warp will be observed during a recording period. Observers should position themselves at a safe point, ideally at the stern of the vessel, where:

- the warp can be clearly seen for its entire length from the point it is outboard of the vessel to the point it ends, or enters the water; and
- any biological discharge occurring can be observed.

The warp with the highest interaction rate should be selected to sample over the entire tow. This would generally be the warp on the same side of the vessel from which most of the offal/discards are discharged, even if there is no discharge at the time of the sampling observations or if discharge is noted from both sides of the vessel. Availability of a safe observation position must be an overriding factor in determining the side of the vessel observed. If both warps are observed, this should be clearly recorded.

Observation Steps

1) Confirm with the skipper that it is safe, in his/her opinion, to carry out the observations.
2) Fill out Section 1 of the form. Record the start time, date and time zone of the tow using 24 hour format.
3) The observation sequence is as follows:
    a) Sample period 1 begins 15 minutes after the start of the tow
    b) The next sample period begins 20 minutes after the end of the previous sample, or immediately following a change in environmental or operational conditions
    c) Repeat step b) following each successive sample period until end of tow
4) For each sample:
    a) Two minutes before the sample period is set to begin, record a bird abundance estimate on the observation form
    b) Record start time of observation using 24 hour format
    c) Observe the chosen warp (or both warps) for 15 minutes and count bird strikes (defined below) for each category of bird and strike.
    d) Record end time of observation using 24 hour format

5) Record bird strikes, noting seabird categorisation below, on the observation work sheet.

6) Complete Section 3 of the form for that sample period (see “instructions for completing sampling form”).

7) Observe the haul and record net interactions according to the haul observation protocol described below.

8) Photograph and record details of all birds captured by the fishing gear and mitigation device.

9) Record any pertinent comments in Section 4 of the form.

Sampling periods

Observers should undertake 15-minute sampling periods during each tow where trawling occurs in daylight. As many sampling periods as possible should be carried out per tow. The 20 minute break between sampling periods ensures that one observation is not affected by the period before it.

Sampling periods of 15 minutes each will be used to characterise strikes on the warp. These are to be carried out during the fishing phase of the tow (i.e. when the net is in the water and cables are no longer being paid out). It is very important to record the correct start and stop time of the observation and the tow.

If conditions change significantly during an observation period; e.g., the wind conditions change considerably, or if the offal discharge rate changes significantly, terminate your observation at that point and note on the form the environmental conditions that prevailed during the observation period. Record the reason for early termination of the sample period under section 4 of the form. Begin a new sampling period later in the tow if possible, or on the next tow.

Start a new form for observations on a new tow.

Instructions for completing the warp-strike form

The text in bullet points and italics refers to elements to record on the form.

Section 1. Fishing event descriptors

- *At the beginning of the sampling set of observations, record details of the trip, tow and observer. Note that a new form must be started for each new tow observed.*
- *Record the date, start time and time zone for the tow. Record times in 24 hour format.*
- *Side observed (P/S/B) – Record which warp is observed during the tow. P = Port, S = Starboard, B = Both. Note that the same side should be observed for the whole tow.*
- *Observer initials – Initials of the observer making the observations on this form.*

Section 2. Fifteen-minute warp/mitigation device strike observations and bird abundance

- *Record the time at the start and end of each 15-minute sampling period in 24 h clock times, e.g., 09:30 - 09:45 or 15:00 - 15:15.*

Seabird abundance:

The objective of the abundance estimate is to provide order-of-magnitude level of information about the numbers and species group of birds behind the vessel during the sampling period. This is done by counting the number of birds in the sample area just before the 15 minute observation of warp strikes. Estimate the total number of birds of each species group on the water **and** in the air and record this information separately. Separate the bird groupings in this estimation.

The area in which bird abundance is to be assessed is a 25m radius around the stern of the vessel (Figure 1).

- *Fill in the form by writing the number of birds for each sample period under the bird categories (defined below).*

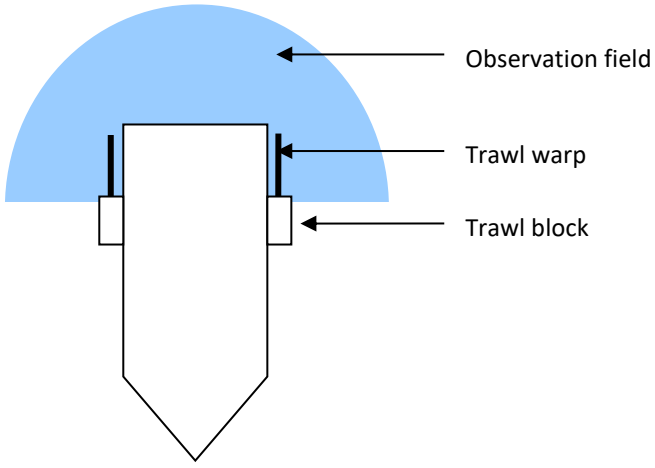


Figure 1. Diagram of a vessel with the warp entry point shown. The 25m radius in which seabird abundance is estimated is highlighted (not to scale).

Number of heavy contacts

- *Record the total number of heavy contacts and the type of contact for each bird category during the 15 minute observation period (see below for definitions of Heavy Contacts, and birds).*

Defining heavy contacts between birds and the trawl warp or mitigation device:

A heavy contact is one in which a bird:

1 has its path of movement deviated when it comes into contact with the trawl warp; *and*

2 the part of the body contacted is above the 'wrist' joint of the bird (i.e. on the upper part of the wing and or on the head or body).

This can occur on the water or in the air. Birds on the water may be dragged under the water by a heavy contact. Heavy contacts occur either when the bird, through active movement, comes into contact with the warp/mitigation device, or when the warp/mitigation device moves to contact the bird (e.g. whilst the bird is sitting on the water).

Light Contacts are NOT included in this category are when birds may have contacted the warps or mitigation device but are not moved out of their flight path or position on the water. Light contacts are recorded separately.

Bird size categories:

Birds of different species will be seen in contact with trawl warps. Differences in size and behaviour between species result in variation in vulnerability to striking the warp or mitigation device. Seabirds have been grouped into 5 categories based on behaviour and size in order to maximise the information coming out of each observation period. These categories were based on bird assemblages around New Zealand domestic trawlers and may need to be adapted to include other groups of species in other fisheries.

L Alb Large albatross: royal and wandering albatross; *Diomedea spp*.

S Alb Small albatross and giant petrels: other albatross; *Thalassarche spp.* and *Phoebetria spp.* plus *Macronectes spp*.

P Shearwaters and other petrels apart from giant petrels and cape pigeons: other Procellariidae.

CP Cape petrels: *Daption capense*.

O Other species.

Section 3: Environmental factors and offal/fish discharges

- *Swell height (m) - Estimate the average height of the swell during the sampling period in metres.*

- *Swell direction (1-12 h) – Record the direction from which the swell is coming relative to the direction of travel of the vessel. Use a 12 point "clock" scale. The bow of the vessel is defined as the 12h point, therefore a swell coming directly from the stern direction is recorded as 6. Port side is 9, starboard is 3.*

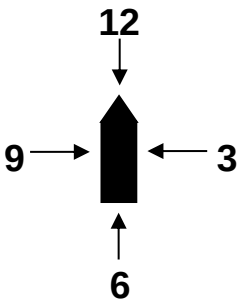


Figure 2. The 12 hour clock scale to be used for swell and wind direction.

- *Wind speed (Beaufort) – Record the wind speed using the Beaufort Scale (below). The information is a rough guide for the open sea. Figures in brackets indicate the probable maximum wave heights. In coastal areas, greater heights will be experienced.*

Beaufort Scale	Description	Mean wind speed (knots)	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 and over	14 (-)

- *Wind direction (1-12 h) - Record the direction from which the wind is coming relative to the direction of travel of the vessel. Use a 12 point "clock" scale. See figure 2.*
- *Discharge side - Record whether offal discharge was on the Port (P), Starboard (S), both or Neither (N) sides of the vessel during the observation period.*
- *Discharge rate - Record the rate of offal or discard discharge during each 15-minute sampling period, using four categories (0 = none, 1 = negligible, 2 = intermittent, 3 = continuous). Only one rate should be recorded. If the rate changes significantly, i.e. to the extent that a different discharge rate category would be appropriate, terminate the sample and start a new one later. Note: discharge from all around the vessel should be considered when recording. Diagrams of discharge points should be included in the trip report.*

- *Discharge Type (S/O/D) Multiple types are allowed and should be recorded. Record the type of discharges (S = Sump water, O = offal, meaning heads and guts of processed product, D = whole fish or squid discards). Other material (such as rubbish) on which birds might feed is not included in this category and should not be recorded. If the vessel is discharging any non-fish waste i.e. rubbish, this should be recorded in the comments section of the form.*
- *Mitigation used – record the use of seabird mitigation device deployed in association with the warp being observed (BSL = bird scaring line, BB = bird baffler, T = Storage tanks. O = other – describe in Section 4 Comments).*

Section 4. Comments

Record comments in this section, e.g. if you are required to stop your observations for some reason (wind changes, the vessel does a turn, or an incident happens that means the observation period is cut short). Anecdotal information that might help researchers analyse the data you recorded is also helpful as are general comments on the performance of mitigation devices.

Mitigation Assessment Warp-Strike Form

1. Fishing event descriptions

Linking ID		Date		Tow start time		Warp angle θ	
Observer trip		Observer tow		Observer initials		Dist. to entry (m)	

See reverse for directions

2. Fifteen-minute warp/mitigation device strike observations and bird abundance

Fishing stage	1. At depth / hauling		2. At depth / hauling		3. At depth / hauling		4. At depth / hauling	
15-min observation	Time start	Time end	Time start	Time end	Time start	Time end	Time start	Time end

Taxa grouping	LAlb	SAlb	P	CP	O	LAlb	SAlb	P	CP	O	LAlb	SAlb	P	CP	O	LAlb	SAlb	P	CP	O
Bird abundance																				
No. light contacts																				
No. heavy contacts:																				
Air																				
Water (deflected)																				
Water (dragged under)																				

3. Environmental factors and mitigation devices

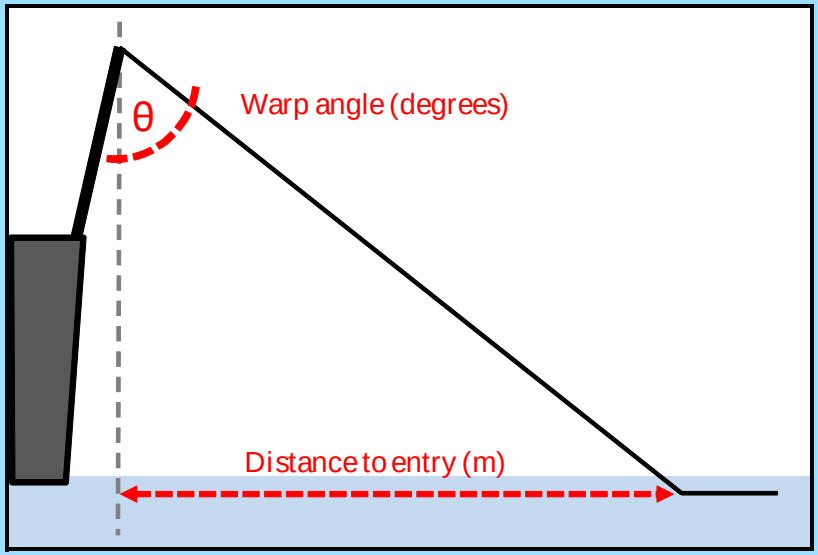
Swell height (m)				
Swell direction (1–12 h)				
Wind speed (Beaufort)				
Wind direction (1–12 h)				
Discharge location	P / S / R / N	P / S / R / N	P / S / R / N	P / S / R / N
Discharge rate	0 / 1 / 2 / 3	0 / 1 / 2 / 3	0 / 1 / 2 / 3	0 / 1 / 2 / 3
Discharge type	S / O / D	S / O / D	S / O / D	S / O / D
Mitigation used	BSL / BB / O	BSL / BB / O	BSL / BB / O	BSL / BB / O

4. Comments: include any usual factors that may have influenced the number of warp strikes, e.g. gear failure or changes in environmental or fishing factors

Reference Tables and Diagrams

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.



Mitigation codes:

BSL	=bird scaring line
BB	=bird baffler
O	=other

Discharge codes:

Discharge side: (one or more)	
P	=Port
S	=Starboard
R	=Stern
N	=Neither / none

Discharge rate: (record one)	
0	=none
1	=negligible
2	=intermittent
3	=continuous

Discharge type: (one or more)	
S	=sump water (deck wash)
O	=offal, i.e. heads and guts
D	=discards of whole fish