



ABSTRACT

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 (FAO 2009). The purpose of this paper is to assist the ERSWG to identify the minimum data collection requirements necessary to improve the CCSBT's understanding of SBT fishery impacts on seabirds and to assess the efficacy of the mitigation measures currently being used. Minimum data collection requirements should include:

- **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 in the case of trawling.
- **Total fishing effort observed**, recorded as the number of hooks observed during the haul. This is crucial for calculating seabird bycatch rates.
- **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.
- **Mass of added weight**. Line weighting is considered a critical mitigation measure for longline fisheries, and it is hoped that most RFMOs will be requiring the mandatory use of line weighting in the near future.
- **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 about mitigation measures in place, and preferably information about how effectively they were used.
- **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.
- 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.
- The condition of all birds brought onboard alive should be described. Birds that have sustained serious injuries should be recorded as dead birds.
- Ideally, all seabird carcasses should be retained onboard (and kept frozen) for subsequent identification and examination by appropriate experts.
- 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.
- **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.
- **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).
- **Information about offal management** (timing in relation to setting and hauling, and position of discharge relative to the hauling bay).

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 overall fishing effort (total number of hooks set/hailed), and not on the number of trips.
- Minimum data collection requirements specified in this document should be adopted to assess and monitor seabird bycatch. Data collection forms should be tailored to solicit the required data.
- Actual data should be reported, rather than qualitatively reporting on bycatch in national reports.
- 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.

- 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.
- All RFMOs should establish and implement Regional Observer Programmes that explicitly include seabird bycatch monitoring objectives and standards.
- Centralised management of observer programmes is preferable to a nationally implemented system.
- A co-ordinated approach across RFMOs should be adopted 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 RFMOs, and potentially making use of a joint database, in the case of the tuna RFMOs.
- The data collection protocols, sampling regime, and other materials such as identification guides and data forms, should be incorporated into observer manuals.
- Centralised management of a database for bycatch data.
- Exchange of seabird bycatch data between RFMOs and other fisheries management organisations should be encouraged.
- Consider the use of remote monitoring technology to increase observer coverage.

Minimum Data Requirements for Seabird Bycatch

**Anton Wolfaardt, Deputy Convenor,
ACAP Seabird Bycatch Working Group**

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 the survival of many albatross and petrel species.

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 (FAO 2009). Recent attempts to assess the impacts of fisheries activities on seabirds in some RFMOs, such as the International Commission for the Conservation of Atlantic Tunas, ICCAT (see Tuck *et al.* 2011), have been constrained by the lack of bycatch data in some areas and the inconsistent manner in which these data have been collected, analysed and reported. Consequently, several assumptions are required to fill observations in space and time, which inevitably leads to high but un-quantified uncertainty in bycatch estimates (International Commission for the Conservation of Atlantic Tunas 2009).

The development and implementation of effective observer programmes for RFMOs is an important but challenging task. A number of initiatives have been implemented recently, some of which are ongoing, to address data collection and other requirements of 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).

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 provide advice to RFMOs on data collection requirements to improve their knowledge of and management of fishery impacts on seabirds. It is geared primarily for longline fisheries, but can be adapted for other fisheries.

2. Objectives of collecting seabird bycatch and associated data

The main objectives of collecting seabird bycatch data are:

- a) To characterise and quantify seabird bycatch within a fishery.

- b) 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.
- c) To assess and monitor the effectiveness of seabird bycatch mitigation measures in reducing 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 (by RFMO Secretariats or even jointly by all tuna RFMOs – see below).

Each of these issues will be dealt with separately below.

3. Observer programmes

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 the observer programme has contributed to the reduction of seabird bycatch in CCAMLR fisheries. 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 other RFMOs, most recently in the Indian Ocean Tuna Commission (IOTC), ICCAT and the Inter-American Tropical Tuna Commission (IATTC), all of which have adopted an initial aim 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, and in most cases is still to be finalised. 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, and data collection protocols should cover all relevant species and objectives. An observer will often therefore have a range of responsibilities to implement, 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 bycatch observations.

Harmonisation of observer programmes between the different RFMOs is necessary to facilitate a consistent approach in data collection and reporting across all RFMOs, and thus allow a larger scale assessment of bycatch than is possible when considering RFMOs individually. This is explicitly recognised in the joint tuna RFMO mechanisms that are currently being developed through the Joint Tuna RFMO Technical Bycatch Working Group.

Key recommendations

- All RFMOs should establish and implement Regional Observer Programmes that explicitly include seabird bycatch monitoring objectives and standards.
- Centralised management of observer programmes is preferable to a nationally implemented system.
- Ensure a co-ordinated approach across RFMOs 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 RFMOs, and potentially making use of a joint database, in the case of the tuna RFMOs.

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 other RFMOs, 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. Recent measures adopted in WCPFC, ICCAT, IATTC and IOTC have established minimum observer coverage rates of 5%. At this level of observer coverage, bycatch estimates will likely remain highly imprecise for low occurrence species, but it is

better than no coverage at all. Further, it has been argued that 5% observer coverage is sufficient to identify simply where and when bycatch is occurring. 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/hailed) observed on each vessel within each trip. Coverage of 20% of the fleet, will equate to less than 20% of the overall fishing effort, because not all of the hooks will be observed on each trip observed.

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 overall fishing effort (total number of hooks set/hailed), and not on the number of trips.
- 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.

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 RFMOs, and their member countries, 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 fields which need to be cross-comparable. Although, countries and RFMOs that have already established data collection and management (including database) protocols may 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 RFMOs will also have practical benefits in that observers working across RFMOs will be implementing the same protocols. The joint tuna RFMO Technical Bycatch Working Group mentioned earlier has established harmonisation of data collection protocols as a key element in its work plan. The Working Group has established a process by which, by the end of 2011, the critically important data fields that need to be standardised across tRFMOs will be identified.

Observers will normally have a range 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. 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, but 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 or 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, including factory sampling.

Table 1 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 1 that are suggested as being critical for recording seabird bycatch are highlighted in **bold**.

It is suggested that the following data from Table 1 are 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 in the case of trawling.
- **Total fishing effort observed**, recorded as the number of hooks observed during the haul. This is crucial for calculating seabird bycatch rates.
- **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 these are 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 mitigation measure for longline fisheries, and it is hoped that most RFMOs will be requiring the mandatory use of line weighting in the near future.
- **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 about 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).
- **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.
- 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 (contact details for band returns can be obtained from ACAP www.acap.aq).

The following additional 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.
- **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 understanding of the importance of these factors in determining bycatch.
- **Information about offal management** (timing in relation to setting and hauling, and position of discharge relative to the hauling bay).

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 (see http://www.ccamlr.org/pu/e/e_pubs/om/toc.htm for the CCAMLR Scientific Observers Manual).

Key Recommendations

- RFMOs/Fisheries Managers should agree on 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 the required data.
- The data collection protocols, sampling regime, and other materials such as identification guides and data forms, should be incorporated into observer manuals.
- Building capacity to establish and maintain observer programmes is of critical importance.

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 RFMO Secretariats, and the management of these data, are equally important. However, the data reporting requirements for RFMOs may be quite vague, and as a result data and information that are provided to RFMOs vary in their quality, quantity and format, severely hampering efforts to assess seabird and other 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. Often, RFMOs simply require that summary information from the domestic observer programmes of Parties are reported to the RFMO 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 (e.g. ICCAT), and may be a useful mechanism to solicit the required information.

As indicated in section 5, it is crucial that the use of bycatch mitigation measures is recorded. It is also important that this information is reported to the RFMO Secretariat, 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. Consistency in data collection and reporting standards would facilitate the transfer of these data between fisheries management organisations. The joint tuna RFMO Technical Bycatch Working Group has established within its work plan a role for facilitating the sharing of seabird bycatch data.

The reported data and information should be used by RFMOs to conduct regular reviews of seabird bycatch and mitigation. In this respect, RFMOs should establish a framework to monitor and review performance, which includes clear reporting formats, protocols and timelines.

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.
- Actual data should be reported, rather than qualitatively reporting on bycatch in national reports.
- Centralised management of a database for bycatch data.
- Exchange of seabird bycatch data between RFMOs and other fisheries management organisations should be encouraged.

7. Other issues

The use of electronic monitoring technology, such as electronic/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, and contributing towards the assessment of bycatch. Such cameras should be directed to view line setting, the hauling bay and (discard) processing in the factory. These recordings could be reviewed after each fishing trip, and methods developed for sub-sampling. Development of this technology should be encouraged within each RFMO.

Key recommendations

- Consider the use of remote monitoring technology to increase observer coverage.

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 a critical concern for RFMOs. The standardised collection and reporting of relevant data by well-trained observers is recognised as the most reliable means of monitoring fisheries performance with respect to seabird bycatch and 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. This paper draws on work that has been undertaken previously (e.g. Black et al. 2007; Anderson et al. 2009; BirdLife International 2010; Anderson et al. 2010). It serves to guide discussions at ERSWG to help inform the provision of advice to the Commission. The provision of detailed protocols, data standards, and reporting formats is beyond the scope of this paper, but can be provided by ACAP to assist in the work of the CCSBT.

9. Acknowledgements

This paper has benefitted greatly from the inputs of Cleo Small and Ross Wanless of BirdLife International.

10. References

- Anderson, O.R., Booker, H., Frere, E., & Small. 2009. Data collection protocols for reporting seabird bycatch in IATTC industrial longline fisheries. Paper presented at the Seabird Technical Meeting of the IATTC Stock Assessment Working Group, 11 May 2009, Del Mar, California. BirdLife International, Sandy, Bedfordshire, UK.
- Anderson, O.R., Small, C., Wanless, R., & Yates, O. 2010. Minimum data collection protocols for reporting seabird bycatch within the IOTC Regional Observer Programme. Paper presented at the 14th session of the Indian Ocean Tropical Tuna Commission, 1-5 March 2010, Busan, Republic of Korea. BirdLife International, Sandy, Bedfordshire, UK.
- BirdLife International. 2010. Establishing an ICCAT Regional Observer Programme: minimum data standards for reporting seabird bycatch. Paper presented at the 2010 inter-sessional meeting of the Sub-committee on Ecosystems (SC-ECO), International Commission for the Conservation of Atlantic Tunas (ICCAT), 31 May-4 June 2010, Madrid, Spain. BirdLife International, Sandy, Bedfordshire.
- Black, A.D., Small, C., & Sullivan, B. 2007. Recording seabird bycatch in longline observer programs. Western and Central Pacific Fisheries Commission. WCPFC-SC3-EB SWG/WP-6, WCPFC-SC3-EB SWG/WP-6.
- Dietrich, K.S., Cornish, V.R., Rivera, K.S., & Conant, T.A. 2007. Best Practices for the Collection of Longline Data to Facilitate Research and Analysis to Reduce Bycatch of Protected Species: Report of a workshop held at the International Fisheries Observer Conference, Sydney, Australia, Nov. 8, 2004.
- FAO. 2009. FAO Technical guidelines for responsible fisheries. Fishing Operations. 2. Best practices to reduce incidental catch of seabirds in capture fisheries. FAO, Rome. FAO Technical Guidelines for Responsible Fisheries. No. 1, Suppl 2.
- Gilman, E., Boggs, C. & Brothers, N. 2003: Performance assessment of an underwater setting chute to mitigate seabird bycatch in the Hawaii pelagic longline tuna fishery. *Ocean & Coastal Management***46**: 985-1010.
- International Commission for the Conservation of Atlantic Tunas. 2009. Report of the 2009 inter-sessional meeting of the Sub-committee on Ecosystems. ICCAT, Madrid, Spain. http://www.iccat.int/Documents/Meetings/Docs/2009_SC-ECO_Rep_ENG.pdf.
- Jiménez, S., Abreu, M., Brazeiro, A., & Domingo, A. 2011. Bycatch susceptibility in pelagic longline fisheries: are albatrosses affected by the diving behaviour of medium-sized petrels. Paper presented at the 2011 inter-sessional meeting of the Sub-committee on Ecosystems (SC-ECO), International Commission for the Conservation of Atlantic Tunas (ICCAT), Miami, 9-13 May 2011. SCRS/2011/061.
- Lawson, T. 2006. Scientific aspects of observer programmes for tuna fisheries in the Western and Central Pacific Ocean. *WCPFC-SC2-2006/ST WP-1*.
- Reid, T.A. & Sullivan, B.J. 2004: Longliners, black-browed albatross mortality and bait scavenging in Falkland Island waters: what is the relationship? *Polar Biology***27**: 131-139.
- Sabourenkov, E.N. & Appleyard, E.J. 2005: Scientific observations in CCAMLR fisheries - past, present and future. *CCAMLR Science***12**: 81-98.

Small, C. 2005: Regional Fisheries Management Organisations: their duties and performance in reducing bycatch of albatrosses and other species. BirdLife International, UK.

Tuck, G. N., Phillips, R. A., Small, C., Thomson, R. B., Klaer, N. L., Taylor, F., Wanless, R. M., and Arrizabalaga, H. 2011. An assessment of seabird–fishery interactions in the Atlantic Ocean. SBWG Doc 34. Agreement on the Conservation of Albatrosses and Petrels, Seabird Bycatch Working Group, Guayaquil, 22-24 August 2011.

Table 1: Recommended data to be collected in longline fisheries operations (adapted from Dietrich et al. 2007, FAO 2009 and Anderson et al. 2010). These data will 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 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 (crucial for calculating seabird bycatch levels)¹ Target species ² Bait species Composition of bait used (%) Bait status (live/fresh/frozen/thawed/whole/cut)

Category	Variables
	Mass of added weight (describe size and position of weight, e.g. 60g 2m from the hook)
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; 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	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.