Commission for the Conservation of
Southern Bluefin Tuna

みなみまぐろ保存委員会

Report of the
Effectiveness of Seabird Mitigation Measures
Technical Group

4-6 November 2014
Tokyo, Japan

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Agenda Item 1. Opening of meeting

1.1. Welcome

1. The Chair of the Effectiveness of Seabird Mitigation Measures Technical Group (SMMTG), Dr Cleo Small, welcomed participants and opened the meeting.
2. The head of delegation of Japan, Dr Kotaro Yokawa, made an opening statement and welcomed all participants on behalf of Japanese government.
3. Each participant introduced themselves. The list of participants is at **Attachment 1.**

1.2. Meeting Arrangements

4. The Chair and the Secretariat announced the administrative arrangements for the meeting.
5. The meeting agreed to the proposal that Mr Sandy Morison act as co-chair.

Agenda Item 2. Purpose of meeting

2.1. Terms of Reference

6. The Chair introduced the Terms of Reference of SMMTG (CCSBT-SMM/1411/Info01).

2.2. Adoption of Agenda

7. The agenda was adopted and is shown at **Attachment 2.** The meeting agreed to the Chair's proposal to consider agenda item 4 after agenda items 5 – 7 had been dealt with.
8. The list of documents for the meeting is shown at **Attachment 3.**

2.3. Meeting outputs and rapporteurs

9. Dr Kelly, Mr Vallieres, Dr Wolfaardt, Dr Wanless, Dr Clarke assisted as rapporteurs for the substantive agenda items.
10. It was agreed that the outcomes of discussion of substantive agenda items (agenda items 4-9) would be included within a revised scoping paper that would be attached to the meeting report rather than within the body of the meeting report itself.

Agenda Item 3. Scoping paper

11. The SMMTG agreed that the revised scoping document, which forms the main output of the meeting, would be of interest and value to other tuna RFMOs. Consequently, the SMMTG recommended that the revised scoping report be circulated to the other tuna RFMOs, following guidance from the CCSBT Secretariat on the appropriate process to follow.

Agenda Items 4-9

12. Discussion of these agenda items are reflected in the revised draft scoping paper that will be included at **Attachment 4** once the scoping paper is finalised intersessionally after the close of the meeting.
13. The meeting agreed that the final version of the scoping paper would be submitted at least 4 weeks prior to the March 2015 meeting of the Ecologically Related Species Working Group.

Agenda Item 10. Conclusions and recommendations

10.1. Recommendations from this meeting

Recommended actions for the Secretariat

14. The group requested that the CCSBT Secretariat submit current CCSBT documents on national reporting requirements and observer information standards to the January 2015 Kobe TWG-Bycatch meeting.

Methods available to review the content and coverage of tuna RFMO seabird conservation and management measures (Section 4 of Attachment 4)

15. It was suggested that ERSWG considers developing a work plan which has an increased use of collaborative analyses. These might include joint stock assessment style workshops in which participants bring data and undertake collaborative analyses, bilateral collaboration intersessionally or designating key scientists to undertake analyses of joint datasets. A draft workplan to begin this work with respect to cooperation across tRFMOs will be provided in an Appendix of the finalised scoping paper that will be submitted to ERSWG 11.

Methods available to review the data collected and reported by tuna RFMO longline fleets (Section 5 of Attachment 4)

16. The workshop agreed that measures of both % longline observer coverage and spatial-temporal representativeness were important metrics of longline observer program data. Spatial and temporal representativeness are needed for developing reliable estimates of seabird capture rates and in particular for understanding and reducing uncertainty in estimates.
17. The group recommended that % coverage be calculated as number of hooks observed per stratum divided by total fishing effort per stratum, and that

representativeness should be evaluated using the calculated proportion of strata which have met the target level of observer coverage.

18. When discussing options for reviewing quality of observer data, it was agreed that the ERSWG currently undertakes such a review. An additional metric of data quality was therefore not considered necessary, but the group noted several activities could help improve the quality of observer data, including:

    - The ACAP-Japan seabird species identification guide, which is planned to be translated into French, Spanish, Korean and Taiwanese and other key languages;
    - Collecting bycatch photos for confirmation of species ID;
    - Debriefing observers after the trip;
    - More detailed guidance on priorities for seabird related tasks, including how to allocate observer time appropriately, recognising multiple demands made on observer time; and
    - Development of mechanisms to facilitate the collection and analysis of DNA from bycaught birds.

19. The group recognised that it would be useful to have a central system by which seabird bycatch photos collected by observers could be validated. Alternatives could include accessing online volunteer networks (such as www.ispotnature.org) or seabird specialists.

Methods to monitor the degree of implementation of mitigation measures by SBT longline fleets/vessels (Section 6 of Attachment 4)

20. The group suggested that CCSBT and other t-RFMOs share documents, formats and procedures for observer data collection through a dedicated web portal or through the WCPFC-hosted BMIS.

21. The group suggested that the ERSWG, with support of the Compliance Committee, prepare guidance on seabird relevant data that are being, or could be, collected from compliance-led processes (e.g. port inspections), for the purpose of better assessing total seabird mortality in relation to the application of seabird CMMs. The group suggested that CCSBT members be encouraged to assist in the development of electronic monitoring technologies through participating in trials and reporting back on their experiences.

Methods to measure and monitor the level and impact of seabird bycatch by SBT longline fisheries (Section 7 of Attachment 4)

22. There should be a tiered approach to measuring and monitoring seabird bycatch and the efficacy of mitigation measures, as per the following:

    - The first tier would entail monitoring based on the agreed annual reporting template. This would include estimates of seabird bycatch per unit fishing effort and total number of seabirds caught.
    - The annual monitoring should be complemented by periodic (once every three to five years) multi-tuna RFMO assessments, using fine-scale information, preferably at a set level, taking into account data confidentiality. This could take the form of a data assessment workshop, at which countries and relevant

experts collaboratively undertake the data analyses, or alternatively could involve members conducting their own analyses according to agreed protocols and contributing the results of these analyses to the assessment process.

23. As far as possible assessment methods and efforts should be harmonised across tuna RFMOs so that the cumulative impacts of fishing activities on seabirds can be determined.

Development and testing of methods (Section 8 of Attachment 4)

24. Recognising that the planned revisions to the CCSBT seabird risk assessment will identify absolute levels of spatial and temporal risk of seabird bycatch within the CCSBT area, a definition of 'high risk' may need to be developed and agreed. In applying a uniform risk assessment method across tuna RFMOs, it may be useful to seek agreement on the definition of 'high risk' areas.

25. It would be useful to ask tuna RFMO Secretariats to clarify the availability and resolution of fishing effort data, and to be explicit about the assumptions used in raising that data. The group highlighted the need to understand the degree of overlap in reporting seabird bycatch and associated data to multiple tuna RFMOs.

26. The group agreed that intersessional development of the scoping paper would include more detail on potential methods for calculating bycatch rates and extrapolating to total number of birds killed. New Zealand offered to lead this work.

Ways of extending monitoring across other tuna RFMOs and bodies with responsibility for seabird bycatch mitigation in longline fisheries (Section 9 of Attachment 4)

27. It would be useful to develop estimates of background bycatch rates (pre bycatch mitigation) using retrospective analyses, in order to compare these to current seabird bycatch rates and assess effectiveness of tuna RFMO seabird CMMs. It was noted that these may only be possible for certain regions, and that phased implementation meant there would seldom be a knife-edge transition pre and post implementation. Such an analysis would need to:

    - Identify suitable datasets which have a long enough time series and sufficient levels of observer coverage;
    - Identify what the seabird CMMs required and when they were implemented; and
    - Take care not to confound comparisons with changes in fishing gear configurations, areas fished or seasons fished.

28. It was agreed that it would be useful to submit to the November 2014 ICCAT Commission meeting a proposal for tuna RFMO collaboration on seabird bycatch analyses.

10.2. Outputs to submit to ERSWG 11

29. Reporting of some additional information for each of the agreed strata in Table 1 of the Template for the Annual Report to the Ecologically Related Species

Working Group (ERSWG) would assist in interpreting any trends in the unstandardised catch rate data it contains. In particular, reporting the proportion of effort that was associated with the use of mitigation measures would be useful in measuring the effectiveness of seabird CMMs.

30. The group recommends that the ERSWG review the data included in the annual report template to support improved evaluation of seabird CMMs.

Agenda Item 11. Other business

31. There was no other business raised.

Agenda Item 12. Conclusion

12.1. Adoption of meeting report

32. The report was adopted.

33. The Chair expressed gratitude to Japan for initiating and hosting this meeting, and welcomed the input of experts external to ERSWG. The group commented that it hoped that it would be possible to continue such collaborations in the future. The Chair then thanked the CCSBT Secretariat for its support, and the Japan Fisheries Agency for the reception it hosted. The Chair thanked Sandy Morison for his support as Co-Chair, and thanked all participants for their contributions, and for travelling so far to be at the meeting

12.2. Close of meeting

34. The meeting closed at 12.21pm on 6 November 2014.

List of Attachments

Attachment

1. List of Participants
2. Agenda
3. List of Documents
4. Revised draft Scoping Paper on approaches for measuring and monitoring the effectiveness of seabird conservation measures in SBT longline fisheries

Attachment 1

List of Participants
The Effectiveness of Seabird Mitigation Measures Technical Group

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Attachment 2

Effectiveness of Seabird Mitigation Measures Technical Group
4 – 6 November 2014
Tokyo, Japan
Agenda

1. Opening of meeting
   1.1. Welcome
   1.2. Meeting Arrangements

2. Purpose of meeting
   2.1.Terms of Reference
   2.2. Adoption of Agenda
   2.3. Meeting outputs and rapporteurs

3. Scoping paper

4. Identify and evaluate methods available to review the content and coverage of tuna RFMO seabird conservation and management measures
   4.1. Identify and evaluate methods to assess whether the current tuna RFMO seabird conservation and management measures reflect best practice (bycatch mitigation requirements and their technical specifications)
   4.2. Methods to measure and assess the appropriate application (spatially, temporal, vessel type) of tuna RFMO seabird conservation and management measures

5. Identify and evaluate methods available to review the data collected and reported by tuna RFMO longline fleets
   5.1. Identify and evaluate methods to review extent of bycatch data collection systems and processes and assess their utility with respect to measuring and monitoring the effectiveness of seabird conservation and management measures
   5.2. Identify and evaluate methods to review extent of bycatch data reporting
   5.3. Identify and evaluate methods to review availability and accuracy of fishing effort data

6. Identify and evaluate methods to measure and monitor the degree of implementation of seabird conservation and management measures by SBT longline vessels/fleets

7. Identify and evaluate methods to measure and monitor the level and impact of seabird bycatch by SBT longline fisheries
   7.1. Seabird bycatch levels and rates
   7.2. Total seabird bycatch per year and region
   7.3. Risk assessment

8. Development and testing of methods
    8.1. Identify and plan ways of conducting retrospective analyses of existing data on seabird bycatch mitigation to test developed methods of monitoring effectiveness

9. Ways of extending monitoring across other tuna RFMOs and bodies with responsibility for seabird bycatch mitigation in longline fisheries

10. Conclusions and recommendations
    10.1. Recommendations from this meeting
    10.2. Outputs to submit to ERSWG 11

11. Other business

12. Conclusion
    12.1. Adoption of meeting report
    12.2. Close of meeting

Attachment 3

List of Documents
The Effectiveness of Seabird Mitigation Measures Technical Group

(CCSBT-SMM/1411/)

1. Provisional Agenda
2. List of Participants
3. List of Documents
4. (Chair) Scoping Paper: Approaches for Measuring and Monitoring the Effectiveness of Seabird Conservation Measures in SBT Longline Fisheries

(CCSBT-SMM/1411/Info)

1. (Secretariat) Effectiveness of Seabird Mitigation Measures Technical Group Terms of Reference
2. (Japan) Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2012 and 2013 (Osamu Sakai, Tomoyuki Itoh, Hiroshi Minami, Osamu Abe) (SMMTG Agenda Item 5.1)
3. (Japan) Estimation of incidental catch of seabirds in the Japanese southern bluefin tuna longline fishery in 2010-2012 (Hiroshi Minami, Yukiko Inoue) (SMMTG Agenda Item 7.2)
4. (Japan) Factors affecting bycatch of black-browed albatross and wandering albatross, Estimation of bycatch rate from effect of the seabird distribution and effectiveness of bycatch mitigation measure (Yukiko Inoue, Makoto Okazaki, Maria P. Dias, Cleo Small, Hiroshi Minami) (SMMTG Agenda Item 7.3)

(CCSBT-SMM/1411/Rep)

1. Report of the Twenty-first Annual Meeting of the Commission (October 2014)
2. Report of the Nineteenth Meeting of the Scientific Committee (September 2014)
3. Report of the Twentieth Annual Meeting of the Commission (October 2013)
4. Report of the Eighth Meeting of the Compliance Committee (October 2013)
5. Report of the Tenth Meeting of the Ecologically Related Species Working Group (August 2013)
6. Report of the Ninth Meeting of the Ecologically Related Species Working Group (March 2012)

CCSBT Effectiveness of Seabird Mitigation Measures Technical Group

Scoping Paper: Approaches for Measuring and Monitoring the Effectiveness of Seabird Conservation Measures in SBT Longline Fisheries

UPDATED AFTER SMMTG MEETING 4-6 November 2014

Table of contents

1. Summary

This paper scopes potential methods for monitoring the effectiveness of tuna Regional Fisheries Management Organisations (RFMO) seabird Conservation and Management Measures (CMMs). An initial draft was prepared for the meeting of the CCSBT Effectiveness of Seabird Mitigation Measures Technical Group (SMMTG), Tokyo, Japan, 4-6 November 2014, and this revised version incorporates discussion and recommendations from that meeting.

The paper considers the following four elements of assessment:

- Reviewing the content (i.e. the actual requirements and specifications) of tuna RFMO seabird CMMs
- Reviewing the availability of relevant data reported by tuna RFMO longline fleets
- Reviewing the degree of implementation by vessels/fleets
- Monitoring the level and impacts of bycatch

Grey boxes contain the questions that formed the focus of discussion at the SMMTG meeting. The meeting agreed on a number of recommendations, which are listed in the grey boxes and the conclusion.

2. Background

The five tuna RFMOs have established conservation and management measures (hereafter referred to as 'tuna RFMO seabird CMMs')[1] which require or recommend their pelagic longline vessels to use a combination of seabird bycatch mitigation measures, although exact requirements vary, in most, but not all, areas overlapping with albatross and petrel distributions (CCSBT 2011a, IATTC 2011, ICCAT 2011, IOTC 2012, WCPFC 2012). All of the tuna RFMO seabird CMMs have provisions for reviewing their effectiveness (**Table 1**), but methods or criteria for such reviews have not yet been established. Such monitoring is important for ensuring that management interventions are having the desired effect, and to inform future management measure design and improve implementation. This monitoring will be important for CCSBT, given its reliance on the seabird CMMs adopted by other RFMOs, and the need to ensure these CMMs adequately protect the seabirds that may be vulnerable to fishing for Southern Bluefin Tuna (SBT).

This paper scopes potential methods for measuring and monitoring the effectiveness of tuna RFMO seabird CMMs, incorporating discussion and recommendations from the meeting of the CCSBT Effectiveness of Seabird Mitigation Measures Technical Group (SMMTG), 4-6 November 2014. The paper takes into account the feasibility, practicality, timeliness and effectiveness of each option, and the relevant data and mechanisms that currently exist. Implicitly, this also requires an understanding of financial and human resource constraints. This scoping paper expands upon a paper on the same topic submitted to the CCSBT Ecologically Related Species Working Group (ERSWG) meeting in 2013 (CCSBT-ERS/1308/17).

At several points throughout the paper, options are presented by which harmonization between the tuna RFMOs might be enhanced. This reflects agreement achieved by tuna RFMOs as part of the 'Kobe' process that a core objective is to harmonize approaches and actions of the five tuna RFMOs, including in relation to bycatch (Anon 2009, Anon 2011a, Anon 2010), which also led to the establishment of a Joint Tuna RFMO Technical Working Group on Bycatch (Anon 2011b). The CCSBT Strategic plan also anticipates working with other tuna RFMOs to identify and manage risks to Ecologically Related Species, including in relation to data provision and data reporting requirements, as well as on seabird CMMs (Appendix 1).

Concerning seabird bycatch, there are at least two incentives to increase harmonization between the tuna RFMOs. Firstly, many albatross and petrel species move between the areas of more than one tuna RFMO. Therefore, having a harmonized tuna RFMO system for monitoring

[1] ICCAT Rec 11-09, IOTC Res12-06, WCPFC CMM 12-07, IATTC Rec 11-08, and CCSBT 2011 will be referred to in this paper as 'tuna RFMO seabird CMMs', in order to distinguish these prescriptions and recommendations from the specific bycatch mitigation measures that they require vessels to use, e.g. bird scaring (tori) lines, night setting and line weights.

overall seabird bycatch and CMM effectiveness is necessary in order for cumulative impacts on each species to be assessed. Secondly, harmonization should bring increased efficiencies and savings in time and resources. For those vessels and fisheries that operate across more than one RFMO area, efficiencies will be realised through those RFMOs having bycatch mitigation specifications and data collection and reporting processes that are consistent, or at least not incompatible. At a tuna RFMO level, increased harmonization has the potential to reduce duplication of discussion and analysis, saving time and resources. In addition, establishing a coordinated approach to seabird bycatch across the tuna RFMOs, should facilitate a greater degree of input from seabird specialists (including scientists, developers of seabird bycatch mitigation technologies and those with operational experience of using bycatch mitigation gear), who are often unable to attend a large number of meetings.

3. Scope

The purpose of the SMMTG meeting in November 2014 was to consider methodologies for assessing the effectiveness of tuna RFMO seabird CMMs in relation to SBT fisheries. As CCSBT currently has a non-binding recommendation that CCSBT fleets comply with the seabird CMMs of the Indian Ocean Tuna Commission (IOTC), Western and Central Pacific Fisheries Commission (WCPFC), and International Commission for the Conservation of Atlantic Tunas (ICCAT) (CCSBT 2011a), an assessment by CCSBT will require consideration of these seabird CMMs (ICCAT 2011, IOTC 2012,WCPFC 2012, if not that of IATTC also (IATTC 2011)). Because of this, Section 4 of this paper, on methods to review seabird CMM content, considers methods that could be applicable to review of the content of all tuna RFMO seabird CMMs. For discussion of methods to review data availability, degree of implementation of mitigation measures by vessels, and impact on seabirds (Sections 5-7), the primary objective of the SMMTG discussion was to identify methods most suitable for CCSBT in the short, medium and long term. However, given the declared tuna RFMO objective of increasing harmonization, information on the other tuna RFMOs was also included in Sections 5, 6 and 7, to allow SMMTG to assess whether methods recommended for CCSBT might also be compatible with what might be undertaken in the other tuna RFMOs.

The paper focuses on options for methods for scientific and data-driven reviews of tuna RFMO seabird CMMs. Therefore, it predominantly relates to discussions that might be held within tuna RFMO scientific meetings, such as the CCSBT ERSWG. The exception to this may be in relation to compliance aspects, which may be the responsibility of compliance committees.

Following the structure of CCSBT-ERS/1308/17, the paper considers the following four elements of assessment:

- Reviewing the content (i.e. the actual requirements and specifications) of tuna RFMO seabird CMMs
- Reviewing the availability of relevant data reported by tuna RFMO longline fleets
- Reviewing the degree of implementation by vessels/fleets
- Monitoring the level and impact of bycatch

Within each, information is provided on current methods used within tuna RFMOs. Further options are then presented, along with potential strengths and weaknesses. The paper ends with sections on ways that such methods might be further developed and tested, and ways in which harmonization of assessment processes might be promoted across tuna RFMOs.

This paper endeavours to present possible options, and portray potential strengths and weaknesses of each, and efforts have been made to reflect views on which consensus has been reached previously at ERSWG.

4. Methods available to review the content and coverage of tuna RFMO seabird conservation and management measures

This element is most closely linked to the process of review that has been underway for several years in the ecosystem and bycatch working groups of most tuna RFMOs, and has led to the establishment of the existing tuna RFMO seabird CMMs.

4.1 Methods to assess whether the existing tuna RFMO seabird CMMs reflect best practice (bycatch mitigation requirements and their technical specifications)

This section refers to the technical specification of bycatch mitigation measures within seabird CMMs, for example ICCAT Recommendation 11-09's requirement for ICCAT longline vessels to use 2 out of 3 measures when fishing south of 25°S, from a choice of bird scaring (tori) line, night setting and line weighting, together with the technical specifications for each of these mitigation options.

Currently, discussion in tuna RFMO scientific meetings on the content and technical specifications of the tuna RFMO seabird CMMs usually involves scientific papers being submitted to ecosystem and bycatch working groups when papers become available, and consideration of 'best practice' advice from the Agreement on the Conservation of Albatrosses and Petrels on seabird bycatch mitigation for pelagic longline fishing (ACAP 2014), although occasionally a tuna RFMO will hold a dedicated seabird bycatch meeting at which many papers will be submitted.

Identification of 'best practice' in this context represents the bycatch mitigation measure options, combinations, and technical specifications that have been tested and proven effective through research published in peer-reviewed literature, or presented and reviewed at scientific meetings such as tuna RFMO ecosystem and bycatch meetings and ACAP. ACAP has defined criteria to define 'best practice' (**Table 2)**.

A strength of the current approach within tuna RFMOs is that each tuna RFMO ecosystem and bycatch working group has the ability to focus on information and data gaps that are particularly relevant to its own region. Weaknesses are that participation by seabird bycatch experts (including scientists and those with operational knowledge of seabird bycatch mitigation gear) at each ecosystem and bycatch working group meeting can be limited due to time and travel constraints, and that information or expertise from other regions, which would be informative, may be lacking. Also, in the absence of a formalised periodic review of seabird bycatch mitigation research, papers may be submitted one at a time over a period of years, which can limit comparative assessment.

Reflection on the experience of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is also useful to consider in relation to the potential methods for reviewing content of seabird CMMs. While not a tuna RFMO, CCAMLR provides an example of a process in which monitoring the effectiveness of seabird bycatch regulations formed a core part of CCAMLR's working group on Incidental Mortality Associated with Fisheries (WG-IMAF), which met each year from the early 1990s to 2009, and then in 2011 . The CCAMLR processes led to near zero seabird bycatch within all but the French CCAMLR areas. WG-IMAF process was so successful that the Scientific Committee decided that while there remained a need to retain the issue of incidental mortality on its agenda, WG-IMAF should only meet in future to address specific issues identified by the Scientific Committee, rather than have a fixed meeting schedule (CCAMLR 2011). The WG-IMAF process was data-driven in that it was based on experts reviewing the most recently available data on seabird bycatch by species and mitigation compliance by management area at the vessel level. WG-IMAF also reviewed technical papers submitted by member states and experts. These reviews and analysis of data from the fishery were used to fine tune best practice mitigation, measures of compliance and data collection protocols for fisheries observers relative to seabird bycatch mitigation on an annual basis. The ACAP Seabird Bycatch Working Group was modelled on the WG_IMAF and initially included WG-IMAF members.

Since 2007 the Seabird Bycatch Working Group of ACAP has taken on the role of routinely reviewing published and unpublished research and information on seabird bycatch mitigation measures for pelagic longline, demersal longline, trawl and gillnet fisheries, using ACAP's

criteria for identification of best practice (SBWG 2014). ACAP's Seabird Bycatch Working Group comprises experts in the field of seabird bycatch and mitigation from countries that are Parties to ACAP, and from other research and non-government organisations. At each of its meetings, which are generally held at 18 month intervals, the ACAP Seabird Bycatch Working Group conducts formal reviews of bycatch mitigation technologies for each fishery type to update the ACAP best practice advice (ACAP 2013a), and Seabird Bycatch Mitigation Fact Sheets, the latter of which are jointly produced by BirdLife International and ACAP (BirdLife & ACAP 2014). The reviews also identify knowledge gaps and establish research priorities for each fishing gear. The ACAP best practice advice is presented to the working groups of tuna RFMOs as a resource to help inform discussion. Such a process provides collated and digested advice at no cost to the tuna RFMOs. The ACAP Seabird Bycatch Working Group endeavours to consider all published or otherwise-available materials on seabird bycatch, including from countries not party to ACAP. Not all CCSBT members are represented at ACAP meetings, therefore not all CCSBT parties are present for ACAP's best practice discussion. ERSWG has recommended that the CCSBT Extended Commission consider the ACAP best practice reviews when deciding future bycatch mitigation measures (CCSBT 2012, CCSBT 2013).

If CCSBT and other tuna RFMOs are seeking to reduce duplication of discussion, enhance participation by seabird experts, and increase harmonization, four options that could be considered are as follows:

4.1.1 Periodic review

Improvements to the current system might be achieved by each tuna RFMO establishing periodic reviews of their seabird bycatch mitigation measures, as is already the case in ICCAT and IOTC, which are due to review their seabird measures in 2015 and 2016, respectively. Setting a date for periodic review could have the advantages of:

(i) Facilitating a more comprehensive and structured review and encouraging a larger number of seabird bycatch papers to be submitted for consideration, in addition to inputs from ACAP
(ii) Encouraging additional seabird bycatch experts to attend a specific meeting
(iii) Ensuring that regular review occurs and is ongoing, recognising the meeting agendas can get very full
(iv) Largely using processes and systems already in place

Weaknesses might be perceived to include:

(i) Some continued lack of efficiency, since similar discussions would be repeated across the five tuna RFMO ecosystem and bycatch working groups

(ii) Information or expertise from other regions, that may be informative, may be missed
(iii) Potential for each tuna RFMO to progress differently, missing an opportunity for harmonization across the tuna RFMOs
(iv) Potential to delay updates in seabird CMM content if updates need to wait for periodic review

4.1.2 Joint Tuna RFMO Technical Working Group on Bycatch

A second option could be to seek to use the Joint Tuna RFMO Technical Working Group on Bycatch as a forum in which to discuss best practice for seabird bycatch mitigation within tuna RFMOs. The Terms of Reference of this group, as agreed at the 2010 Kobe II Workshop on Bycatch, includes:

> "5. *Review existing bycatch mitigation measures including those adopted by each Tuna RFMO and consider new mitigation research findings to assess the potential utility of such measures in areas covered by other Tuna RFMOs taking into consideration differences among such areas*" (see Appendix 3 of Anon 2010)

Therefore, the review of seabird bycatch mitigation best practice is consistent with its objective. Each tuna RFMO ecosystem and bycatch working group could then assess the current requirements of its tuna RFMO in relation to the advice of the Joint Tuna Bycatch Technical Working Group. The strengths of this approach are that it:

(i) Facilitates concentrated and co-ordinated discussion of seabird bycatch mitigation trials and developments.
(ii) Should reduce duplication of discussion across the tuna RFMOs.
(iii) Should enable participation of a larger number of seabird bycatch mitigation experts at a focused meeting.
(iv) Is a structure/process already agreed by tuna RFMOs

The weaknesses might be perceived to be:

(i) The Joint Tuna Bycatch Technical Working Group has not been very active since it was established in 2011 (as noted in paragraph 20 and recommendation of ERSWG 2012). Workshops on identifying minimum standards for purse-seine and longline observer programs have been or are being held in its name (Nicol & Clarke 2014), with participation of a subset of the expert group
(ii) As there is no dedicated funding for this group, resources would be required to convene a meeting (the new project 'FAO-GEF Project Sustainable Management of

Tuna Fisheries and Biodiversity Conservation in the ABNJ, GCP/GLO/365/GFF' might be a part-source of funding during the period 2014-2019).

(iii) The membership of the existing joint tuna bycatch expert group (as defined at its first meeting during the 2011 Kobe III tuna RFMO meeting) would likely need to be expanded for this purpose.

(iv) Since the expert group does not have a well-established mode of working, it could take time to develop agreement on terms of reference for such a workshop, together with who would lead on planning and logistics.

(v) Duplication between the discussion of this group and that already being held within the ACAP Seabird Bycatch Working Group.

4.1.3 Hold regular joint tuna RFMO workshop to review best practice

Alternatively, reviewing best practice for seabird bycatch mitigation could be pursued through the hosting of a joint tuna RFMO workshop perhaps by CCSBT ERSWG. Such an approach could have the advantages noted in 4.1.2 above, with potential for support from the host tuna RFMO (e.g. CCSBT Secretariat and ERSWG participants) in relation to preparation and logistics. As in 4.1.2, weaknesses might be perceived to be:

(i) Additional and ongoing funds would be required to bring this group together (as above, the new project 'FAO-GEF Project Sustainable Management of Tuna Fisheries and Biodiversity Conservation in the ABNJ, GCP/GLO/365/GFF' may be a source of funds during the period 2014-2019).

(ii) Hosting a one-off workshop would not, alone, fulfil the need for regular review and update of best practice advice; an ongoing process would be needed.

(iii) Duplication between the discussion of this group and that already being held within the ACAP Seabird Bycatch Working Group.

4.1.4 Increased input to ACAP best practice discussion

As noted above, ERSWG considers ACAP best practice advice in relation to seabird bycatch mitigation recommendations (paragraph 64 CCSBT 2012, paragraph 54 CCSBT 2013). Increased participation by CCSBT member scientists, either formally or informally, in the discussion held within the ACAP Seabird Bycatch Working Group could have the advantages of:

(i) Taking advantage of the existing ACAP process of structured, regular and ongoing review.

(ii) Ensuring data from SBT fleets are represented in discussion of ACAP best practice.

(iii) Increasing efficiency of discussion within the tuna RFMO ecosystem and bycatch working groups, as discussion will have previously taken place at ACAP.

(iv) Being a relatively low cost option, because the ACAP meeting is routinely scheduled.

The weaknesses of this approach would include:

(i) Not all CCSBT members are ACAP parties, and although ACAP's SBWG includes experts who are not formally part of an ACAP party delegation, and that CCSBT members may seek observer status at meetings of ACAP's Seabird Bycatch Working Group, there may be practical or other limitations to participation.

4.2 Methods to measure and assess the appropriate application (spatial, temporal and vessel type) of the tuna RFMO seabird conservation and management measures

4.2.1 Spatial and temporal application

To date, the following data have been used to determine the spatial and temporal application of tuna RFMO seabird CMMs:

- The spatial and temporal distribution of seabird bycatch as determined by observer data
- The distribution of vulnerable seabird species, as determined by seabird distribution data, including seabird tracking data and at-sea survey data
- Ecological Risk Assessment (ERA), which usually uses seabird distribution data, fishing effort data and some measure of vulnerability (typically drawn from bycatch data) to produce a spatial and temporal assessment of risk (e.g. Waugh et al. 2012a, Richard and Abraham 2013, Tuck et al. 2013).

Analyses of these data have included spatial and temporal stratification of seabird-longline fishing effort overlap or risk, for example by 5x5 degrees and year quarter (Waugh et al. 2012a) or 5x5 degree and month (Taylor et al. 2009[2]). Currently, however, all existing tuna RFMO seabird CMMs apply throughout the year and across broad latitudinal bands (with the exception of IATTC, in which an area up the west coast of South America is also included).

The current broad spatial and temporal application of seabird CMMs reflects at least two factors, the first of which is data availability. Although there has been an acceleration in the availability of seabird tracking data in the past two decades, and data are brought together through collaborations between scientists such as through the Global Procellariiform Tracking Database (www.seabirdtracking.org), data gaps remain, especially in understanding the distribution of non-breeding and juveniles birds, whose distribution is typically more widespread than breeding birds due to being free from the constraints of incubating eggs or

[2] In the experience of ICCAT, initial work was undertaken by month, but the limits to data availability led subsequent analyses of tracking data to be undertaken by year quarter (ACAP 2010).

feeding chicks. Seabird distribution may also vary over time, and in response to environmental conditions, and tracking data are unlikely to capture this full variation. In addition, while seabird bycatch data collected through pelagic longline observer programs have gradually increased over the past decade, overall coverage remains low and is often patchy. It is likely that data uncertainties alone will mean that broad spatial and temporal application remains the most appropriate approach, at least in the short term.

A second factor behind the current broad spatial and temporal application of tuna RFMO seabird CMMs is that quantitative thresholds for defining spatial/temporal boundaries of seabird CMMs have not been extensively discussed within tuna RFMOs (for example, what cut-off of risk would be used to determine that a seabird CMM would apply south of 25°S rather than 20°S). In the short-term, the data gaps described above mean that a quantitative approach to demarcation of boundaries is unlikely to be practical. However, in the long term, it might become feasible in some circumstances if data gaps are filled, which would then raise the question of what criteria to use.

In terms of options for review methodology, in the short term it is likely that data gaps mean that region or 5x5 degrees and year quarter may be the appropriate level of resolution. While the definition of spatial and temporal application remains relatively qualitative and expert-led, a flexible approach to making use of seabird distribution data, seabird bycatch data and ERA analyses may be the most appropriate approach (and relative reliance on the three data types might vary depending on availability of data). Details on options for methods for calculating each of these are discussed in Section 7.

4.2.2 Vessel type application

The application of seabird CMMs to different vessel types has typically involved tuna RFMO agreement to exempt smaller vessel sizes from seabird CMMs (e.g. WCPFC 2012 for vessels <24m length in the North Pacific; IATTC 2011 for vessels <20m length), or to allow more time for smaller vessels to implement seabird CMMs (e.g. IATTC 2011 giving greater time for vessels 20-24m). Such matters have been chiefly discussed at tuna RFMO commission meetings, largely in terms of the practical difficulties perceived in ensuring implementation by small vessels. However, the WCPFC Scientific Committee has been tasked with reviewing the existing WCPFC exemption. In addition, the IOTC and WCPFC (for the areas south of 30°S) seabird CMMs have different bird scaring line specification for vessels <35m and vessels >35m, reflecting ACAP best practice advice. Within scientific meetings, methods available for a review of vessel-type application could include comparison of estimates of seabird bycatch rates and total seabird bycatch for different vessel classes, where sufficient data exist. Compliance committees (or similar bodies of the tuna RFMOs) may consider technical or practical aspects to

implementation across different vessel types, and such discussion is likely to be qualitative as well as quantitative.

Size of vessels is less likely to be a factor for CCSBT given that most vessels are above the size limits mentioned for longline fleets, and/or operate in southern waters where all vessel sizes are covered by the seabird CMM. However, the SMMTG agreed it would be useful to request some simple analysis of SBT vessel sizes from the CCSBT Secretariat.

The SMMTG meeting was invited to consider:

4a Whether it considered that the current arrangements within the CCSBT ERSWG would be strengthened by establishing a periodic review (4.1.1); joint tuna RFMO workshops (4.1.2 or 4.1.3) and/or increased input to ACAP Seabird Bycatch Workshop discussion (4.1.4)?

4b In the long term, is the current semi-quantitative approach to defining the spatial and temporal boundaries of the tuna RFMO seabird CMMs sufficient? If not, what would be the steps required to develop methodology?

4c Is there a need within SBT fisheries to assess seabird bycatch stratified by vessel size?

SMMTG discussion

4a The SMMTG noted that seabird bycatch reviews could be onerous for some scientists of member states working in isolation, and that collaborative work would help with this.

The SMMTG recognised the ACAP process for providing advice on bycatch mitigation 'best practice' and the value in this advice being disseminated to RFMOs. SMMTG felt it is up to RFMOs to judge ACAP advice against their needs and specifications.

The SMMTG recognised that research into new mitigation methods is generally ad hoc, and based on the research interest of individuals. Therefore, if a tuna RFMO is interested in advancing new bycatch mitigation methods, then such research needs more collaboration and funding.

It is generally felt that it would be more efficient to spread the effort of review by undertaking collaborative work among RFMOs. However, it was also noted that necessary updates to seabird CMMs should not be delayed by periodic review.

It would be useful if updates on best practice mitigation advice and estimates of abundance and distribution of seabird species was supplied at the same time that reviews are being completed.

4b The SMMTG recognised that, in the short term, the current semi-quantitative expert-led approach to defining spatial and temporal boundaries of seabird CMMs is the most appropriate, and that the resulting simple boundaries also have ease of implementation. In the long term, however, there is much scope for improvement in the process of delineating spatial and temporal boundaries. It was recognised that this could include identification of high-risk areas, where, for example, the simultaneous use of three

bycatch mitigation measures (e.g. tori lines, night setting, line weighting) might be required, and identification of areas that are of lower bycatch risk than previously thought. Methods would need to be developed, and criteria defined for thresholds of risk.

This led to a broader SMMTG discussion on sharing of data and collaborative analyses. SMMTG participants recognised that bringing together member states into a workshop environment represents the best scenario to maximise the amount of data available, and facilitates sharing of ideas about analytical methods and interpretations. However, SMMTG also recognised the importance of developing skills and capacity within member states, and for national scientists to be able to analyse their own data. SMMTG discussed the potential for capacity development through data analysis workshops and through exchange programs, and agreed adequate time and funding needs to be allocated to allow capability to develop and flow through research teams of member states, particularly to younger scientists.

4c SMMTG felt that, in general, vessel size is already considered by CCSBT. It was noted that it would be important to ensure representative observer coverage across vessel sizes, noting that it can be harder to obtain observer coverage on smaller vessels.

SMMTG recognised that, in many cases, analyses have found 'Individual Vessel ID' to be a key factor explaining variation in seabird bycatch rates and, once particular vessels are identified, one of the most effective ways to reduce bycatch can be to engage directly with these high-bycatch vessels.

It was noted that fleet characteristics, such as degree of vessel aggregation in an area, could affect bycatch rates. There was a request for guidance to be provided on collecting seabird abundance data, while recognising that bycatch data were the priority. At-sea seabird survey data can also be used to calibrate the representativeness of seabird tracking data. There is also the potential to use other research programs, such as Japanese cetacean sighting surveys in the North Pacific, to provide seabird count data to augment current models of seabird distribution and abundance.

SMMTG Recommendation

It was suggested that ERSWG considers developing a work plan which has an increased use of collaborative analyses. These might include joint stock assessment style workshops in which participants bring together data and undertake collaborative analyses, bilateral collaboration inter-sessionally or designating key scientists to undertake analyses of joint datasets. A draft work plan to begin this work with respect to cooperation across tuna RFMOs is provided in Appendix 2.

5. Methods available to review the data collected and reported by tuna RFMO longline fleets

An understanding of the availability and resolution of bycatch data is necessary for interpreting the results of a review of tuna RFMO seabird CMMs. For example, low or patchy levels of bycatch observer coverage are likely to result in uncertainty around estimates of seabird bycatch rates or total numbers of birds killed. In the absence of comprehensive data, a precautionary approach is required.

All five tuna RFMOs now require (or encourage) at least 5% observer coverage in their longline fisheries. **Table 3** summarises the tuna RFMO longline observer programs in terms of their data collection and reporting requirements. The CCSBT template for annual reporting to ERSWG is also provided in **Appendix 3**. Options for methods presented in this section primarily consider the longline observer data reporting requirements in tuna RFMOs because these data provide much of the basis on which reviews can be conducted.

The types of data that one may want to review the availability of include (i) the quantity of available longline observer bycatch data, including spatial and temporal representativeness, (ii) the degree to which the data collected and reported meet tuna RFMO (or CCSBT) data reporting requirements, and (iii) the availability and resolution of fishing effort data, on the basis that fishing effort data would be used, among other things, to scale up bycatch rates to estimates of total seabird bycatch, and in risk assessment procedures. These are addressed in sections 5.1 to 5.3 below.

5.1 Extent of data collection in tuna RFMOs: quantity of longline observer data

Options include reviewing overall percent coverage of longline fishery observer programs (total and/or by fleet), and spatial/temporal representativeness of percent coverage either overall or by fleet. These options are discussed in more detail below.

5.1.1 Review overall percent longline observer coverage

This method would require RFMOs to review their longline fishery observer coverage against their targets or requirements (5% for most or 10% for CCSBT) and track these coverage levels over time. The strengths of this approach would be:

(i) Data should exist in all tuna RFMOs based on current data requirements.
(ii) Overall percent observer coverage would provide a simple measure of the quantity of data being collected. Ideally, for seabirds this would be percent observer coverage within the area that the seabird CMM applies, which would require tuna RFMOs to ask

for countries to report percent observer coverage by area (this is already the case for CCSBT and WCPFC).

(iii) It would be possible to assess whether a given tuna RFMO had met its own target for longline observer data collection, and by fleet.

Issues that would need consideration are that additional work would be needed to obtain and collate data on percent longline observer coverage within the seabird CMM area specifically, in order to link to the bycatch risk posed to seabirds. In addition, tuna RFMOs currently define percent observer coverage in a variety of ways (e.g. observed days, trips or sets; Table 3). Observer coverage based on the numbers of hooks set and the number of hooks observed during that haul of that set will provide the most accurate metric of percent observer coverage. Fishing days or number of sets are of limited value is assessing percent observer coverage.

5.1.2 Representativeness of longline observer data

This method would assess longline observer program coverage by spatial and temporal stratification to assess its representativeness of overall longline fishing effort. It would require countries to submit data on observer coverage and total effort in standardised spatial-temporal strata, or to submit raw longline observer data. Alternatively, countries could choose to assess the representativeness themselves based on agreed protocols.

A metric of representativeness would need to be agreed upon, and a decision made on whether this is a measure of representativeness of the entire longline observer program, or specifically a measure of representativeness in the seabird CMM area. In terms of the scale at which to assess representativeness, issues of data availability (discussed in Section 4.2.1), and potentially data confidentiality, mean that this might be appropriate to be in year quarters and region or 5x5 degrees in the short to medium term. For CCSBT, the data needed to calculate this metric have been specifically asked for in Table 1 of the ERSWG annual reporting requirements (Appendix 3), and so should be feasible.

An advantage of such an assessment of representativeness is that it would identify major spatial and temporal gaps in the observer coverage (potentially specifically in relation to the area to which the seabird CMM applies), and could be an indicator that can be monitored over time. The disadvantage of this is that it would likely entail additional work by tuna RFMO Secretariats, particularly for the tuna RFMOs which don't have requirements for reporting observer coverage and fishing effort by region. Alternatively, it would be an additional requirement for countries in their national reporting. CCSBT, WCPFC and IOTC have requirements for reporting longline observer data that are spatially and temporally stratified, but ICCAT and IATTC do not yet have these requirements.

5.1.3. Who would undertake the reviews

In terms of who might be best placed to undertake the assessment options in this section, assessment could be done within each tuna RFMO, by CCSBT ERSWG, or by the Joint Tuna RFMO Technical Working Group on Bycatch. Alternatively, an external review could be undertaken. The benefit of each tuna RFMO carrying out this review process might be that it gives the tuna RFMO greatest autonomy over the process. Mandating CCSBT (or the Joint Tuna RFMO Bycatch Technical Working Group) to undertake the review would yield some efficiencies, but this would require funds, and agreement from the other tuna RFMOs. An external review would have the strength of independence from RFMOs. However, this would also require funds.

5.2 Extent to which data reported meet reporting requirements: quality of bycatch data

This section refers to a review of the longline observer data fields reported to tuna RFMOs, measured against reporting requirements. There is not yet an agreed set of minimum data collection standards for all tuna RFMO longline observer programs. However, a workshop is scheduled in January 2015 to develop such standards, with funding support from the International Sustainable Seafood Foundation (Nicol & Clarke 2014). If the outcomes of this workshop are endorsed by the tuna RFMOs, then it would be feasible to assess each tuna RFMO in terms of the extent to which its fleets are collecting (or reporting) the data fields relevant to seabird bycatch. Alternative methods include the degree to which fleets are reporting data in accordance with the CCSBT ERSWG annual report template, or for the relevant tuna RFMO. These three options are discussed below.

5.2.1 Assessment of the proportion of parties that meet seabird bycatch relevant parts of tuna RFMO longline observer data reporting requirements

CCSBT, WCPFC and IOTC have their own data reporting standards (**Table 3**). For these three RFMOs, if the seabird-bycatch-relevant aspects are identified, then the Secretariat and others (via national meeting reports) should have data to assess the proportion of countries (or the proportion of longline fishing effort that these countries represent) that meet the data reporting requirements.

The advantage of such an approach would be the utilisation of data that are publically available (though would require collation). However, while IATTC has recently established longline data collection standards it does not yet have reporting standards, nor does ICCAT, although these are in development (ICCAT 2014a). In addition, the measure of each tuna RFMO against its own reporting requirements will miss measuring against a harmonized and common benchmark.

5.2.2 Assess the proportion of fleets that meet the seabird bycatch relevant parts of CCSBT national reporting requirements

The CCSBT ERSWG could assess CCSBT ERSWG national reports to determine to what extent CCSBT ERSWG reporting requirements are being met.

In terms of method, this could be a simple calculation of the proportion of fleets meeting the ERSWG annual reporting requirements (Appendix 3), or the percentage of longline effort that those fleets represent. Within Appendix 3, of particular relevance might be the degree of reporting on 'Summary of CPUE and total numbers of seabird incidentally caught by area and fleet and list of numbers of each seabird species observed caught'. Two factors to consider might be (i) whether a yes/no measure would be sufficient (yes the reporting requirements were met, no they weren't), or if something more graduated would be needed, (ii) how strata with zero observer coverage would be treated in this assessment.

5.2.3 Assess the proportion of fleets that meet the seabird bycatch relevant parts of harmonized minimum data standards

Assuming that the January longline observer data workshop (Nicol & Clarke 2014) produces a harmonized tuna RFMO longline observer data collection standard, assessment could be made of the proportion of fleets (or the percent effort that the fleets represent) that report in accordance with this standard. This has the advantage of allowing comparisons of data availability across tuna RFMOs, though would clearly require time and resources to set up and implement. In addition, the January workshop is focused on minimum data collection standards not on data reporting (although data reporting standards may also be covered – to be confirmed).

5.3 Methods to review availability and accuracy of fishing effort data

It is likely that fishing effort data would be used, for example, to extrapolate the total number of birds killed per year across a tuna RFMO area, in risk assessment, or to assess whether seabird bycatch observer data are representative of fishing effort as a whole.

5.3.1 Availability of catch and effort data

A metric of availability of catch and effort data would make use of information that is already produced by tuna RFMO Secretariats to document availability of effort data. An example is Figure 3 in WCPFC's recent paper ST-WP-01, which shows percent coverage rates for available aggregate and operational catch and effort data by fleet for the longline fishery covering recent years (WCPFC 2013), which could be combined into an overall measure of availability of effort data. The ICCAT Secretariat also produces information on submission of catch and effort data

(Figure 1, ICCAT 2013), as does IOTC in its annual report on data collection and statistics, in which it divides longline catch and effort data into percent 'fair quality' and percent 'uncertain' (IOTC 2013). It would be useful to confirm whether CCSBT, ICCAT, IOTC, WCPFC and IATTC are calculating 'availability of effort data' in the same way.

5.3.2 Gap-filling in effort data

This could be a measure of whether the tuna RFMO has methods in place to fill effort data gaps. In both the ICCAT and IOTC seabird assessments, the respective Secretariats undertook work to improve and fill gaps in the fishing effort datasets in order to facilitate the seabird assessment by using catch data and partial catch-effort data to estimate total effort data at a 5x5 degree and month resolution (see ICCAT 2014b for a description of methods used to produce the ICCAT Effort Distribution ('EFFDIS') database in 2007).

This would largely be a yes/no answer, unless a metric could be devised to assess the estimated accuracy of the effort extrapolations.

The SMMTG meeting was invited to consider:

5a Which of the two measures of quantity of observer data in Section 5.1 it considers necessary (5.1.1 percent longline observer coverage, 5.1.2 assessment of spatial and temporal representativeness).

5b For other tuna RFMOs (not CCSBT), would it be useful to apply the 5.1 methods specifically to the area to which their seabird CMM applies? (i.e. rather than the whole of the tuna RFMO area)

5c If 5.1.2 (spatial and temporal representativeness) is considered important, how would it be calculated?

5d Which of the options in Section 5.2 (reviewing quality of observer data) is desirable in the long term (5.2.1 review against requirements of each tuna RFMO, 5.2.2 review against ERSWG reporting requirements, 5.2.3 review against a harmonized data reporting standard)?

5e Who would be most appropriate to undertake the data availability assessments in 5.1 and 5.2 (each tuna RFMO ecosystem and bycatch working group; the joint tuna RFMO bycatch working group, CCSBT ERSWG; an external reviewer?)

5f Is the ICCAT EFFDIS approach something useful for CCSBT, or are CCSBT catch-effort data already complete? Are there additional aspects of tuna RFMO longline fishing effort data that need to be reviewed?

SMMTG discussion

5a The workshop agreed that measures of both percent longline observer coverage and spatial-temporal representativeness were important metrics of longline observer program data. It was also noted that low observer coverage levels were unlikely to achieve temporal data needs and we should be mindful of the operational difficulties in achieving coverage. Spatial coverage is equally problematic based on the difficulties in planning the deployment of resources in a variable fishery. A suggestion was made that it was possible to evaluate the relationship between percent coverage and reliability of results within EEZ where coverage is higher.

5b SMMTG noted that for a seabird bycatch review it would be important to know the level of observer coverage within the area in which a seabird CMM applies.

5c The group recommended that percent coverage be calculated as number of hooks observed per stratum divided by total fishing effort (number of hooks) per stratum, and that representativeness should be evaluated using the calculated proportion of strata which have met the target level of observer coverage.

5d When discussing options for reviewing quality of observer data, it was agreed that the ERSWG currently undertakes such a review against CCSBT reporting requirements. *Also see recommendations below*.

5e In relation to CCSBT, the SMMTG noted that CCSBT has established a process of reviewing national data reporting against CCSBT requirements. However, the SMMTG also noted the work that could be done to increase harmonisation in observer data collection across the tuna RFMOs, noting the longline observer data workshop that is planned for January 2015.

5f Regarding the question of whether there is a need for cross RFMO analysis of effort data it was agreed that individual characteristics of RFMOs would require differing methods and that it was up to individual organisations to raise effort data and maintain representativeness. It was noted, however, that it was also important to clarify any assumptions underpinning the scaling up/raising of effort data to account for these in any analyses.

SMMTG Recommendations

The workshop agreed that measures of both percent longline observer coverage and spatial-temporal representativeness were important metrics of longline observer program data. Spatial and temporal representativeness measures are needed for developing reliable estimates of seabird capture rates and, in particular, for understanding and reducing uncertainty in estimates.

The group recommended that percent coverage be calculated as number of hooks observed per stratum divided by total fishing effort (total number of hooks set) per stratum, and that representativeness should be evaluated using the calculated proportion of strata which have met the target level of observer coverage.

When discussing options for reviewing quality of observer data, it was agreed that the ERSWG currently undertakes such a review. An additional metric of data quality was therefore not considered necessary, but the group noted several activities could help improve the quality of observer data, including:

- **The ACAP-Japan seabird species identification guide, which is planned to be translated into French, Spanish, Korean and Taiwanese and other key languages;**
- **Collecting bycatch photos for confirmation of species ID;**
- **Debriefing observers after the trip;**
- **More detailed guidance on priorities for seabird related tasks, including how to allocate observer time appropriately, recognising multiple demands made on observer time; and**
- **Development of mechanisms to facilitate the collection and analysis of DNA from bycaught birds.**

The group recognised that it would be useful to have a central system by which seabird bycatch photos collected by observers could be validated. Alternatives could include accessing online volunteer networks (such as www.ispotnature.org) or seabird specialists.

(A recommendation on tuna RFMO effort data (5f) is made under Section 8.)

6. Methods to monitor the degree of implementation of mitigation measures by SBT longline fleets/vessels

Implementation of seabird CMMs at the fleet level and set level is central to the effectiveness of seabird CMMs. An understanding of the degree of implementation is therefore also central to measuring the effectiveness of the seabird CMM and estimation of the overall impact of fishing activities on seabirds.

The tuna RFMOs have established some requirements for reporting fleet-wide implementation of seabird CMMs, as follows:

- **CCSBT:** the CCSBT ERSWG annual reporting template includes data on the level of compliance with mitigation measures (Appendix 3).
- **WCPFC:** the WCPFC seabird CMM (WCPFC 2012) provides a template for annual reporting of seabird bycatch that includes mitigation measures used (although use of mitigation measures is listed in the title, but absent from the columns of Table x).
- **IOTC:** countries are required to give a summary of 'current seabird mitigation measures used by the national longline fleet', although this is not required to be quantitative.
- **ICCAT:** ICCAT Rec 11-09 requires countries to report on 'how they are implementing the measures'.
- **IATTC:** IATTC C 11-08 requires CPCs annually to 'inform the IATTC…of the mitigation measures that their flag vessels plan to employ in the implementation of this resolution'.

However, methods to monitor compliance with bycatch mitigation measure requirements have not yet been substantially discussed within tuna RFMOs' compliance committees and quantitative methods for monitoring compliance have yet to be developed, although some members may already have these in place for their fleets.

Paper CCSBT-ERS/1308/17 proposed four elements which might be feasible to measure within CCSBT based on CCSBT's reporting requirements (Appendix 3), and by other tuna RFMOs depending on their requirements for annual reporting. These are discussed below.

6.1 Self-reporting via logbooks

Self-reporting via logbooks could be used to assess the proportion of sets in which the required bycatch mitigation measures were used when fishing in the specified areas. Countries would then report this proportion to the ecosystem and bycatch working group of the relevant tuna RFMO.

A strength of this approach is that self-reporting via logbooks would reinforce fisher responsibility for incidental catches as well as target catches, and be a means (among others) to raise and maintain awareness among captains and crew of seabird bycatch mitigation requirements. Logbook data can also be used to validate information from other sources. However, self-reporting on compliance with a required mitigation measure will suffer from the likelihood that captains and crew may document compliance rather than non-compliance, such that in the short term at least it is unlikely to be an effective measure on its own (see 6.2.3 below).

6.2 Independent data collection on bycatch mitigation use

An alternative approach would be to monitor the proportion of sets in which the required bycatch mitigation measures were used when fishing in the specified areas, verified by an independent source. Three options for independent sources are as follows:

6.2.1 Data recorded by observers

WCPFC, ICCAT, IOTC and IATTC have all established requirements for longline observer programs to collect and/or report information on seabird bycatch mitigation measures used (Table 3). For WCPFC this is a Yes/No question on whether each mitigation measure was used during the trip. For IOTC, use of mitigation measures is also reported for the trip as a whole, although data are also required on the percent sets in which bird scaring lines were used when fishing south of 25°S. The ICCAT observer measure (Rec 10-10) states that observers should be required to record the use of bycatch mitigation measures, but further detail on collection or reporting requirements have not yet been established. However, the IATTC longline observer forms require data to be collected on mitigation measures used for each seabird capture (IATTC 2014).

Information from observers has the advantage that data on mitigation deployment are collected directly from vessels by an independent data source, although longline observer coverage in most RFMOs is less than or equal to 5%and there is also the possibility that vessels with observers onboard behave differently to the rest of the fleet.

6.2.2 Fishery inspection

Fishery inspection, including port inspection and inspection at-sea, is used by a number of countries, and CCAMLR, to monitor the presence of seabird bycatch mitigation gear onboard vessels. In CCAMLR, for example, Conservation Measure 10-03 requires Contracting Parties to inspect all fishing vessels carrying toothfish species that enter their ports and at least half of all fishing vessels carrying other Antarctic species harvested in the Convention Area (CCAMLR 2013). Contracting Parties must supply CCAMLR with reports from all inspections, submitted using a template that requires information on compliance with CCAMLR conservation measures, including those related to seabird bycatch (e.g. description of line weights and whether the tori line meets the required specifications).

Fishery inspection requires fewer resources than on-vessel observers, and could be used to monitor the presence of bird scaring lines and poles, as well as line weights. This approach has the disadvantage that the presence of mitigation measure devices on the vessel does not mean that they were actually used on all required sets. However, the 2013 ACAP Seabird Bycatch Working Group concluded that "relatively simple methods to check compliance include port inspections of branch lines to determine compliance with branch line weighting requirements,

determination of the presence of davits (tori poles) to support bird scaring lines, inspections of bird scaring lines for conformance with design requirements". For branch line weighting specifically, ACAP concluded that, for coastal vessels, port inspection would be an acceptable form of implementation monitoring. In distant water fisheries, given that it is technically possible to re-configure gear at sea, ACAP has advised that implementation monitoring would need to include methods such as video surveillance and at-sea compliance checks) (ACAP 2013b).

CCSBT's 'Resolution on action plans to ensure compliance' required Members and Cooperating non-Members to report, by April 2010, on their 'action plan to systematically verify catch data of SBT and ERS reported by fishermen' (CCSBT 2009). CCSBT has not yet adopted specific measures requiring port inspection of fishing and support vessels, or minimum standards, but CCSBT plans to develop a port state measures agreement in 2014 (CCSBT 2013).

The current challenges for using port and at-sea inspection data for monitoring implementation may include the fact that:

- The reporting of seabird-bycatch-related port inspection data has not yet been substantially discussed within RFMOs
- The extent of port inspection and at-sea inspection coverage is currently unknown (at least to this author) in relation to longline fleets operating in the tuna RFMO seabird CMM areas

6.2.3 Electronic monitoring

Data reported to the flag state from vessel VMS or video monitoring could be used to establish whether mitigation measures were used.

VMS could be used to establish if a vessel is night setting (and could be used as a means to cross-check log book entries). An advantage of this approach is that VMS is present on most vessels, though a disadvantage is that VMS data is currently unlikely to be examined for night setting, requiring resources to analyse the data. In addition, work is underway to develop algorithms which could be used to automate analysis of VMS data to, for example, find times and locations of starts of sets (e.g. Vermaud 2010; Langley 2011). Another way to reduce the resource requirement could be to examine a subsample of the VMS data from the vessels fishing within the seabird CMM areas. Another factor to consider is that VMS data are currently not centralised in tuna RFMOs, with the exception of WCPFC, such that analysis would need to be undertaken by each flag state.

Electronic video monitoring is not yet widely implemented across tuna longline fleets, but has been trialled in several (e.g. Australia, New Zealand, USA). A question that is still being resolved is the accuracy that could be expected in relation to quantifying seabird bycatch, especially to species level. However, cameras would be able to document if bird scaring lines, night setting and line weights were being used, if cameras are set up with this purpose in mind, and if the cameras were set to monitor the set as well as the haul (e.g. Piasente et al. 2012).

6.3 Industry outreach

A less direct indicator of degree of uptake by vessels might be the proportion of vessels (or captains/crew) which have received education and outreach on bycatch mitigation within the last 1 or 2 years. Data on education and outreach will be reported through the CCSBT ERSWG annual reports (Appendix 3), and it might be possible for the CCSBT reporting requirements to be amended slightly such that this becomes a quantified data field (for example percent captains receiving seabird bycatch outreach within the last X year(s)). Additional data could be made available as part of the ISSF Positive Vessel Register, which records whether captains and crew have undertaken a bycatch education module (although the ISSF vessels will be vessels targeting tuna for canneries (e.g. albacore) and will not represent vessels targeting SBT). A downside of this metric is that is only a proxy for the implementation of mitigation measures, rather than a direct observation, such that it might be considered an 'indicator' to be used alongside, not replacing, other monitoring tools. To be confirmed as a useful metric, it would be useful to have supporting information on the uptake of mitigation measures by vessels after outreach and education events, and whether the likelihood of uptake increases with the number of outreach events.

6.4 Observer training

The extent to which the observers are receiving training on recording bycatch (the key training elements in training for seabird bycatch monitoring could be defined) could also be a useful indirect measure of outreach to vessels and thereby implementation. Data on observer training will be reported through the CCSBT national reports to ERSWG (Appendix 3) although, as above, the reporting requirements may need to be amended slightly in order to create a quantified data field (for example percent observers receiving seabird bycatch mitigation training module within the last X year(s)).

Strengths and weaknesses of this approach are similar to 6.3: it is cheaper than other options and is an important element of bycatch mitigation implementation, but is a proxy, rather than a direct observation, of mitigation measure implementation.

The SMMTG meeting was invited to consider:

6a The scope for increasing usefulness of logbooks, both in terms of gathering data on use of mitigation measures, and as a means for reinforcing fisher responsibility for incidental catch.

6b Whether the longline observer data field of 'use of mitigation measures' is best measured per trip, per set, or per bird caught.

6c Whether there is further useful work to be done in harmonizing across the tuna RFMOs how longline observers collect and report data on use of mitigation measures.

6d The relative importance of port inspection in assessing implementation and what steps could be taken to strengthen port data collection and reporting.

6e Recommendations it may have on electronic monitoring.

6f Whether it would be useful to attempt to quantify the education and observer training elements of the ERSWG annual report template.

SMMTG discussion:

Participants considered that logbooks, observers, port inspection, electronic monitoring and outreach can all be viable means of obtaining useful data.

6a While logbook formats need to be kept simple to avoid creating a reporting burden, they can be a valuable mechanism for communicating with and enhancing awareness among fishers. Participants noted a variety of experiences with comparing logbook and observer data ranging from matching to conflicting accounts of bycatch rates.

6b When requesting observers to record information on the type of mitigation measures employed it was agreed that it is important to document situations that result in seabird mortality. Participants differed on whether applied mitigation measures would vary within a set, and whether it was practical for observers to document such variation in a commercial fishing operation. It was agreed that a priority was to document use of mitigation by set, and to then focus on recording any problems with implementation of the mitigation measures at a set-by-set level, assuming forms are set up for them to do so. Participants recognized that the effects of factors such as vessel identity, location, season and targeting strategy are potential important factors for the effectiveness of mitigation and called for more collaborative research.

6c In order to support efforts to harmonize data collected by observers across tuna RFMOs, it was agreed that the CCSBT Secretariat should submit documents on national reporting requirements and observer information standards to the January 2015 Kobe TWG-Bycatch meeting on longline observer data. It was suggested that other relevant tuna RFMOs documents, formats and procedures for observer data collection should be shared through a dedicated web portal or through the WCPFC-hosted Bycatch Mitigation Information System (BMIS) in order to support the harmonization efforts.

6d It was agreed that some useful information on use of seabird bycatch mitigation measures can be gained from port inspections, but participants suggested that situations will vary between fleets and countries. The number of port inspections varies by country and fleet. Some participants cautioned against mixing scientific and compliance objectives, and noted the potential for conflicts during port inspections to damage cooperation between fishers and scientists. Care is needed that port inspections don't undermine benefits from positive engagements with industry. Nevertheless, inspections at return and/or departure may be useful. For example, port inspectors can check whether tori poles, tori lines and line weighting gear appear to have been used at sea; night setting could be assessed through inspection of logbooks. Some participants considered that port inspections represent an opportunity to identify and help resolve practical issues that contribute to ineffective deployment of mitigation measures. It was suggested that, using the existing CCSBT Annual Report template as a basis, the ERSWG and the Compliance Committee could work together to prepare guidance on what seabird-relevant data should be collected and to define how these data could be used to complement observer or logbook data in assessing whether mitigation measures are effectively applied.

6e Participants considered that electronic monitoring including video, sensors, other auto-recorded data such as VMS, and electronic reporting, can provide useful information on the implementation and effectiveness of seabird mitigation measures. This may be important both for fleets which do not have observer program, and as a complement to observer coverage where it exists. Although it is only just starting to be used, a number of trials are underway and ACAP will be working toward the development of best practice guidelines for electronic monitoring in relation to seabird bycatch. Participants expressed concern about the limited number of vendors available to provide the technology and considered that this might hinder its use in some cases. Electronic monitoring was considered to be well-suited to video checking of tori line and line weighting use, but less reliable for recording the total number of seabirds caught or identifying species. VMS polling rates may need to be shortened if night setting is to be monitored through electronic methods. The importance of fishers' cooperation in achieving effective e-

monitoring was emphasized given the potential to subvert the systems. It was suggested that CCSBT members can assist in the development of technologies and advice on experiences in their fleets.

6f There was general agreement that fisher outreach and training are essential elements of successful mitigation programs. However, it was considered that the terms of reference of this group requires it to focus on data quality issues that could be improved through outreach and training. While it was considered that data quality does improve with outreach and training, it is very difficult to quantify this.

SMMTG Recommendations

The group suggested that CCSBT and other t-RFMOs share documents, formats and procedures for observer data collection through a dedicated web portal or through the WCPFC-hosted BMIS.

The group suggested that the ERSWG, with support of the Compliance Committee, prepare guidance on seabird relevant data that are being, or could be, collected from compliance-led processes (e.g. port inspections), for the purpose of better assessing total seabird mortality in relation to the application of seabird CMMs. The group suggested that CCSBT members be encouraged to assist in the development of electronic monitoring technologies through participating in trials and reporting back on their experiences.

7. Methods to measure and monitor the level and impact of seabird bycatch by SBT longline fisheries

There are a range of methods that might be used to measure and monitor levels of tuna RFMO seabird bycatch, or seabird bycatch impacts, ranging from simple to more complex. A decision on the most appropriate method will be guided by factors such as data availability, available capacity and resources to undertake the review, and review objectives. The impact of data availability on analytical methods was discussed at the ACAP Seabird Bycatch Working Group in April 2012, and a summary is provided in **Table 4**.

An issue across all of this Section, and the paper generally, is whether monitoring can be done to the seabird species level. In order to have a meaningful measure of impact on seabirds, the preference would clearly be assessment by species (or ideally population), recognising that this

presents a challenge to data collection, requiring precise species identification and recording. However, use of photography to confirm the ID of birds that have been caught is already relatively widespread, and there may be scope for increasing collaborations between seabird specialists and national longline observer program coordinators to assist with photo confirmation. In addition, collection of feather samples for DNA confirmation is being explored (Edwards et al, 2001; Walsh & Edwards 2005; ACAP and NRIFSF 2012).

In terms of current tuna RFMO data reporting requirements (Table 3), CCSBT ERSWG's annual report template requests bycatch rate and total number of birds killed by area and fleet, and number of each seabird species observed caught (although not stratified by area or season) (Appendix 3). The WCPFC seabird CMM 2012-07 requests aggregated seabird bycatch rate and number, and total number of each species, specified by 3 areas (south of 30s, north of 23N, and in between) (WCPFC 2012). The IOTC observer trip report template, which must be submitted to the IOTC Secretariat, requires the number of birds caught to be recorded by species and 1x1 degree square (this is not directly linked to observed or total effort, i.e. BPUE per 1x1degree is not asked for, but observed and total effort is reported for the whole trip). The IOTC seabird CMM also encourages the use of photographs to confirm identification (IOTC 2012). The IATTC seabird CMM (IATTC 2011), asks generally that countries provide annual information on seabird interactions with no additional specific reporting requirements, however the IATTC longline observer data collection forms also require bycaught birds to be listed individually, recording species and mitigation measures used at each capture event (IATTC 2014). ICCAT has not established its longline observer data collection and reporting requirements yet, but Rec 10-10 requires 'data collection that includes quantifying total target catch and by-catch (including...seabirds)' and disposition status' (ICCAT 2010).

Based on the level of data that are likely to be available to tuna RFMOs in the near future, feasible approaches to monitor the effect of tuna RFMO seabird conservation measures on seabird bycatch rates/total number of birds killed/impacts are discussed in sections 7.1 to 7.5 below.

One other issue to consider is that in the past there has some been some ambiguity of whether seabird bycatch is reported twice across CCSBT and other tuna RFMOs such as ICCAT, IOTC and WCPFC (is this resolved?).

7.1 Track reported seabird bycatch levels and rates

Tuna RFMOs could monitor reported seabird bycatch rates (birds caught/1000 hooks), both aggregated and by species, tracked over time, stratified by area as appropriate. This would be monitored with expectations that rates would decrease as mitigation measures are

implemented, and with the potential to make comparisons between different fleets, fishing areas and periods (e.g. by month or year quarter).

This approach has the benefit of using data that are currently required by tuna RFMOs (with the exception of ICCAT).

However, this approach would need to be able to account of non-reporting fleets, non-observed strata, the fact that bycatch rates can be affected by seabird population trend, and bias that may occur from data reported from low or non-representative observer coverage. It would need to consider how to include measures of bias, and how best to describe uncertainty.

Given that seabird bycatch rates (aggregated and by species) vary spatially and temporally, some form of standardisation will be needed to take into account variations in fishing effort distribution, and it would be helpful to have agreed methodological approaches to doing so (ICCAT 2014, ACAP 2014).

If best-practice methodology for calculating and reporting bycatch rates is agreed, then countries could undertake the bycatch rate analyses themselves, as long as the methods used were clearly documented. This may be a useful step to take in the short term, recognising that while all the tuna RFMOs (except ICCAT and IATTC) have requirements for member states to submit stratified longline observer data, few data have been submitted to date. This approach also reinforces country responsibility for reporting. If considered acceptable, then this could also save time and resources for the tuna RFMO Secretariats or ecosystem and bycatch working group.

In addition to data gap challenges, another important limitation to the usefulness of seabird bycatch rates as a monitoring tool is that, even if bycatch rates decline, impact on seabirds could increase if fishing effort increases. In some cases, decreases/increases in bycatch rates could also reflect declining/increasing populations. As such, bycatch rates can be a useful indicator, but will need to be used in combination with others of the options below.

7.2 Estimate total number of birds killed per year and region

Tuna RFMOs could monitor estimates of total number of birds killed per year, both aggregated and by species, tracked over time, and stratified by area as appropriate. CCSBT and WCPFC already request parties to estimate total number of seabirds killed per year by area. If bycatch rates are reported in a spatially and temporally stratified format, and total fishing effort data are available, then simple extrapolation to total birds should be possible.

As in section 7.1, it would be helpful to have agreed methodological approaches for undertaking this extrapolation, and this was an issue raised recently at the September 2014 meetings of the ICCAT Sub-Committee on Ecosystems and ACAP Seabird Bycatch Working Group (ICCAT 2014, ACAP 2014). Both the ICCAT and ACAP meetings agreed to undertake intersessional work in 2014-15 to identify best practice methodologies for both data-rich and data-poor scenarios, drawing on publications to date. As above, important elements of this will be how data gaps are accommodated (e.g. non-reporting fleets and strata with zero observations), and how best to describe uncertainty.

The usefulness of this indicator will be that it can account for changes in both bycatch rate and fishing effort, with the expectation that the number of birds killed per year will decrease over time as mitigation measures are implemented (assuming that fishing effort does not increase). The challenges for this indicator will be the need for accurate fishing effort data, the need for methods that account for data gaps, and the need for spatially and temporally stratified and species-level bycatch data.

7.3 Ecological risk assessment

Ecological risk assessments for seabirds (ERAs) estimate bycatch risk using data on seabird distribution and fishing effort combined with a measure of a species' vulnerability to bycatch. Several ERAs have been undertaken for seabird bycatch impacts within pelagic longline fisheries (e.g. Tuck et al. 2013, Waugh et al. 2012a, Richard and Abraham 2013), with the methodology most developed in New Zealand. In the case of the WCPFC and New Zealand ERAs, vulnerability was derived from a detailed observer data set in which bycatch rates by species were compared to estimated species distribution. An estimate of the number of birds caught can then be created by weighting seabird distribution by population size, and this can be compared to estimates of Potential Biological Removal, if demographic parameters are available.

If risk assessment were to be used as a tool for monitoring the effectiveness of the tuna RFMO seabird CMMs, risk would be monitored over time. As part of this, vulnerability will be affected by the degree of implementation of seabird bycatch mitigation measures. Therefore to track the effectiveness of tuna RFMO seabird measures, the vulnerability measure (or at least degree of bycatch mitigation measure implementation) would need to be tracked for each fleet.

The data requirements for a risk assessment approach are more intensive (e.g. estimates of population size, spatial data on the overlap of seabirds and fisheries, and set-by-set observer data on seabird capture rates including the particular mitigation measures and operational practices in place for the set) than the approaches outlined in 7.1 and 7.2. The existing CCSBT

ecological risk assessment for albatrosses and petrels shows that the approach can be used in the CCSBT fisheries, but also highlights the uncertainty generated by highly aggregated fishery information and limited observer coverage.

7.4 Population modelling

In addition to the overall principle of tuna RFMOs minimizing catch of non-target species (as established in, for example, the UN Fish Stocks Agreement, United Nations 1995), an additional measure of success or effectiveness of tuna RFMO seabird CMMs would be to demonstrate reduced impact on seabird populations. For those species for which sufficient demographic and population data are available, population models can be constructed which estimate the impact of tuna pelagic longline fisheries at a colony or species level (e.g. Tuck et al. 2011).

However, success is conditional on the availability of a time series of adequate data on the seabird populations. In addition, population models to date have focused on a colony rather than an entire species, but bycatch cannot yet be attributed to colony in most cases. An additional fundamental challenge for population modelling is that change will only occur over generations and is dependent on changes outside the management control of tuna RFMOs (including other fisheries, but also non-fishery factors such as environmental variables).

Despite these challenges and limitations, population modelling may contribute important additional insights into understanding impacts of bycatch, including identification of (i) life-history or breeding stages most vulnerable to fishing impacts (by fleet/area/time) (ii) whether current levels of predicted bycatch are sustainable (iii) the potential impact of changes in tuna RFMO seabird CMMs (iv) identifying other measures that may be effective (e.g. spatial management). In addition, some seabird species may be more amenable to population modelling, for example by being more spatially restricted, which would allow more confident assignment of provenance of each bycaught bird.

7.5 Population status

Use of seabird population status (e.g. species' population trend) as an indicator of effectiveness of tuna RFMO seabird measures is also complicated because of factors such as (i) assumption that tuna fleets have an impact that is large relative to other fleets, i.e. sufficiently large to detect an impact (ii) the impact of other fleets and non-fishing factors on the population (iii) time lag between management measure effectiveness and demographic response (iv) the difficulty in assigning management effectiveness in one area to specific colonies. However, improved population trend and status is clearly an ultimate objective of seabird bycatch mitigation efforts.

The SMMTG meeting was invited to consider:

7a Whether it agrees that two useful indicators of impact are seabird bycatch rates (7.1) and total number of birds killed (7.2)

7b Whether it agrees it would be useful to identify 'best practice' methodology for calculating 7.1 and 7.2, and how to develop this (recognising intentions expressed by ICCAT and ACAP to consider this in 2014-2015)

7c Additional indicators of impact for monitoring overall impact of the tuna RFMO seabird CMMs, e.g. risk assessment (7.3), population modelling (7.4), and population status (7.5)

SMMTG Discussion

7a The SMMTG agreed that it is useful and important to measure, report and track both seabird bycatch rates (per unit effort) and total number of birds killed, and that this is currently what is required by CCSBT.

The CCSBT Reporting Form (Table 1 in Appendix 3) provides a useful basis for soliciting the required information from member states. However, it was noted that the form currently does not include a temporal component, or information on seabird bycatch mitigation measures used. It was also noted that analysis at a scale of 5 x 5 degree grid-square, rather than Table 1's CCSBT Statistical Areas, would result in enhanced ability to define high risk areas; enhanced compatibility of data with data from other tuna RFMOs; and increased precision of bycatch estimates and a consequent improvement in the level and quality of advice that can be provided from the assessment process. It was noted that catch and effort data are already provided to CCSBT at a 5x5 degree scale. Removal of some existing but redundant columns would allow more space of such additional data columns if necessary. It was also noted that there could be benefits from the provision of more detailed data, for example in the capacity for early detection of any data collection issues that may otherwise not be recognised until more detailed (but less frequent) analyses are conducted.

Overall, the SMMTG recommended a tiered approach to assessing and monitoring these indicators. This would entail basic annual monitoring of seabird bycatch on an annual basis, using information reported in Table 1 of Appendix 3. This could be implemented immediately (i.e. in the short term), and should be complemented by a more detailed analysis of finer-scale (set-by-set) data at less frequent intervals. The more detailed, finer-scale, analysis could take the form of a data assessment workshop, at which countries and

relevant experts collaboratively undertake the data analyses, or alternatively could involve members conducting their own analyses according to agreed protocols and contributing the results of these analyses to the assessment process.

It was proposed that the first detailed assessment should take place in approximately three years. A detailed work plan should be prepared in advance of such an assessment.

Recording and assessing the extent to which seabird bycatch mitigation measures were used, the specifications of these, and their efficacy in reducing seabird bycatch, would be easier on a set-by-set basis. However, it was also proposed that it would be useful to include some measure of this in Table 1 of Appendix 3. In particular, reporting the proportion of effort that was associated with the use of mitigation measures would be useful in measuring the effectiveness of seabird CMMs.

7b The SMMTG agreed that it would be useful to identify best practice methods to estimate bycatch rates, and best practice methods to extrapolate from the observed fishing effort to the entire fleet. This should be progressed through collaboration with other organisations involved in similar initiatives presently underway or planned (this includes ACAP and ICCAT Sub-Committee on Ecosystems), and ideally lead to a harmonised approach across tuna RFMOs. Model-based approaches are useful in dealing with unobserved fishing effort, raising estimates, and quantifying uncertainty or error, but have their limitations. Given the demanding data requirements, the SMMTG agreed that the use of models would be more appropriate for the periodic (once every three to five year) reviews of seabird bycatch mitigation, rather than in the annual monitoring process. It was suggested that a useful first step in identifying best practice approaches could be to use test data sets (ideally including both data poor and data rich examples) to investigate the use of different extrapolation approaches to inform the development of methodology for a full assessment.

7c The ERSWG has already agreed that ERA provides a useful tool for determining the risk of SBT fishing activities to seabirds. Such an approach requires high quality observer data and estimates of seabird vulnerability. The SMMTG agreed that ERA, and methods that relate bycatch rates to seabird population demographic parameters is the gold standard. Although it is unlikely and impractical to pursue these in the short-term, they should be considered longer-term options.

Japan confirmed that it currently double-reports seabird bycatch data to overlapping RFMOs. This is likely also to be the case for some other countries, and highlights the need to understand the degree of overlap in reporting seabird bycatch and associated data to

multiple RFMOs. It also highlights that simple addition of bycatch estimates from overlapping RFMOs would be inappropriate, unless all incidents of double reporting are first resolved. At a minimum, countries need to be very clear when they are reporting to each RFMO whether they have submitted the same or a subset of that data to other RFMOs. Correct estimates of cumulative impact will then require that all such double-reporting is excluded from any analyses.

SMMTG Recommendations

There should be a tiered approach to measuring and monitoring seabird bycatch and the efficacy of mitigation measures, as per the following:

The first tier would entail monitoring based on the agreed annual reporting template. This would include estimates of seabird bycatch per unit fishing effort and total number of seabirds caught.

The annual monitoring should be complemented by periodic (once every three to five years) multi-tuna RFMO assessments, using fine-scale information, preferably at a set level, taking into account data confidentiality. This could take the form of a data assessment workshop, at which countries and relevant experts collaboratively undertake the data analyses, or alternatively could involve members conducting their own analyses according to agreed protocols and contributing the results of these analyses to the assessment process.

As far as possible assessment methods and efforts should be harmonized across tuna RFMOs so that the cumulative impacts of fishing activities on seabirds can be determined. This will require careful scrutiny of the data to ensure that there is no double-counting of mortalities from countries reporting the same data to multiple RFMOs.

Reporting of some additional information for each of the agreed strata in Table 1 of the Template for the Annual Report to the ERSWG would assist in interpreting any trends in the unstandardised catch rate data it contains. In particular, reporting the proportion of effort that was associated with the use of mitigation measures would be useful in measuring the effectiveness of seabird CMMs.

The group recommended that the ERSWG review the data included in the annual report template to support improved evaluation of seabird CMMs.

8. Development and testing of analytical methods

Monitoring and measuring the effectiveness of tuna RFMO seabird CMMs is likely to require the development of new approaches and the refinement of existing bycatch measures and indicators For some measures/indicators it is as simple as having data collected for 1-2 years and conducting the analyses. For other approaches, development and testing of analytical frameworks is required.

8.1. Development of analytical methods and indicators

The preceding sections have included proposals for further development of methods and indicators, including:

- Method for quantified demarcation of spatial and temporal boundaries of seabird CMM (4.2.1 and 4b)
- How to extract data on percent observer coverage specific to seabird CMM areas (5.1.1)
- Measure of representativeness of longline observer data (5.1.3 and 5c)
- Method to monitor data reporting (yes/no or more graduated) (5.2)
- Check if all tuna RFMOs use the same method to calculate percent submission of catch-effort data (5.3.1)
- [5.3.2 also notes the need for further development of methods to fill effort data gaps]
- How to increase utility of logbook data on mitigation use (6.1 and 6a)
- What is the most appropriate way to measure 'use of mitigation measures' (by trip, by set, by bird) (6.2.1 and 6b)
- What port and at-sea inspection data collecting protocols are needed, and what is the current coverage (6.2.2)
- How much work would it take to extract night-setting data from VMS data (6.2.3)
- [6.2.3 also notes the work underway to explore use of electronic monitoring for seabird bycatch]
- How to turn information on industry outreach and observer training into a proxy indicator for implementation, and how useful would this be (6.3/6.4 and 6f)
- Identifying best practice methods for standardising seabird bycatch rates and extrapolating to total number of birds killed (7.1/7.2 and 7b)

In terms of options for method development, the issues above will also be relevant for the other tuna RFMOs, not just CCSBT, and dialogue with the other tuna RFMOs is likely to be beneficial. Development of methodology may be best done through a combination of discussions at tuna RFMO ecosystem and bycatch meetings along with a member state or intersessional group offering to progress work between meetings. The CCSBT ERA for seabirds provides one example on how methods have been developed to date. The CCSBT specific methodology has

been adopted from other similar risk assessments (e.g. Waugh et al. 2012a, Richard and Abraham 2013). In 2012, New Zealand presented a proposal for development of this method for CCSBT (Waugh et al. 2012b), and this was further developed for ERSWG10 (New Zealand 2013). To shift the tool forward and see it used in monitoring the effectiveness of CCSBT measures (and other tuna RFMO seabird CMMs) over time will require further development as discussed at ERSWG10. New Zealand continues to develop the method generally, including plans to expand the New Zealand risk assessment to include fishing impacts on New Zealand birds outside New Zealand waters, and the CCSBT implementation specifically. Future development will include a global ecological risk assessment (Neville Smith, pers. comm.). In all of this development, one of the key underlying constraints is availability of and access to robust data.

8.2. Identify and plan ways of conducting retrospective analyses of existing data on seabird bycatch mitigation to test developed methods of monitoring effectiveness

The Terms of Reference of the SMMTG clearly state that monitoring methods must take into account feasibility, practicality, timeliness and effectiveness. As such, any methods developed would benefit from testing against existing data.

SMMTG discussion

It was proposed that an R script could be developed to automate calculation of % observer coverage by stratum (including 5x5 degree grid squares and temporal strata e.g. quarter year), using observer data and fishing effort data. This script could be made freely available to tuna RFMO Secretariats and parties for their review and use as appropriate.

SMMTG Recommendations

Recognising that the planned revisions to the CCSBT seabird ERA will identify absolute levels of spatial and temporal risk of seabird bycatch within the CCSBT area, a definition of 'high risk' may need to be developed and agreed. In applying a uniform risk assessment method across tuna RFMOs, it may be useful to seek agreement on the definition of 'high risk' areas

It would be useful to ask tuna RFMO Secretariats to clarify the availability and resolution of fishing effort data, and to be explicit about the assumptions used in raising that data. The group highlighted the need to understand the degree of overlap in reporting seabird bycatch and associated data to multiple tuna RFMOs

9. Ways of extending monitoring across other tuna RFMOs and bodies with responsibility for seabird bycatch mitigation in longline fisheries

Throughout this paper, ideas have been proposed which would enhance consistency and harmonization across the tuna RFMOs in terms of monitoring regional and global impact of tuna fleets on seabird populations. These include enhancing consistency in bycatch data collection and data reporting standards, and development of analytical methods that are consistent across the tuna RFMOs, for example in relation to methods to standardise bycatch rates and methods to extrapolate to total number of birds killed. The paper has also included proposals for joint tuna RFMO working, including ideas for joint workshops or further activation of the Joint Tuna RFMO Bycatch Expert Group.

The January 2015 workshop to identify minimum standards for tuna RFMO longline observer programs may also be an initial opportunity to extend the outputs of the November 2014 CCSBT SMMTG meeting.

SMMTG Recommendations

It would be useful to develop estimates of historical bycatch rates (prior to implementation of bycatch mitigation) using retrospective analyses, in order to compare these to current seabird bycatch rates and assess effectiveness of tuna RFMO seabird CMMs. It was noted that these may only be possible for certain regions, and that phased implementation meant there would seldom be a knife-edge transition pre and post implementation. Such an analysis would need to:

- **Identify suitable datasets which have a long enough time series and sufficient levels of observer coverage**
- **Identify what the seabird CMMs required and when they were implemented**
- **Take care not to confound comparisons with changes in fishing gear configurations, areas fished or seasons fished.**

It was agreed that it would be useful to submit to the November 2014 ICCAT Commission meeting a proposal for tuna RFMO collaboration on seabird bycatch analyses.

10. Conclusions and recommendations

The SMMTG agreed that the revised scoping document, which forms the main output of the meeting, would be of interest and value to other tuna RFMOs. Consequently, the SMMTG

recommended that the revised scoping report be circulated to the other tuna RFMOs, following guidance from the CCSBT Secretariat on the appropriate process to follow.

The group requested that the CCSBT Secretariat submit current CCSBT documents on national reporting requirements and observer information standards to the January 2015 Kobe TWG-Bycatch meeting.

Recommendations from Sections 4-9, listed in the grey boxes, are summarised in the SMMTG meeting report, and will be passed to ERSWG 11 for discussion.

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Appendix 1. Extract from CCSBT Strategic Plan

(Taken from CCSBT 2011b)

Goal	*Strategies*
4. Ecologically related species *4.1 Risks to ecologically related species caused by fishing for SBT are identified and appropriately managed. Priority: High/Medium*	*(i) Implement the Recommendation to Mitigate the Impact on ERS of fishing for SBT, including collection and reporting of data on ERS (para 3), implementation of mitigation measures (para 2) and assessment of the risks caused by fishing for SBT (para 7) in each fishery* • *All Members implement the Recommendation to Mitigate the Impact on ERS of Fishing for SBT* • *Review the implementation of the Recommendation on ERS* • *Agree on data provision requirements for ERS that ensure full reporting of bycatch and mitigation measures used in each fishery; this could occur through other RFMOs (e.g. WCPFC, IOTC) if they have appropriate protocols in place for ERS data reporting.* • *Assess how well the mitigation measures adopted by other area-based RFMOs mitigate the risks caused by fishing* • *Where necessary, identify and adopt additional mitigation measures to manage risk taking into account the coordination and harmonization with other RFMOs* *(ii) Coordination and harmonization with area-based RFMOs, including on data reporting (see above)*

Appendix 2. Ideas for tuna RFMO collaboration on seabird bycatch analyses (especially in view of the upcoming ICCAT and IOTC seabird assessments, due to start 2015)

1. Concept of preparation and capacity building among national scientists

In light of the planned ICCAT and IOTC seabird CMM reviews (due to start 2015), and the proposal in (2) below, we discussed the concept of a program of work to support national scientists to prepare their seabird bycatch data, develop their analytical skills, and undertake analyses. This would develop a cohort of member state national scientists skilled in seabird bycatch analyses, and development of a consistent approach to the analytical process and where appropriate analysis across member states.

We proposed a stepped approach, which could include:

i. **Meta-data:** gathering meta-data to assess seabird bycatch data availability (this will help determine what analytical methods are appropriate).

ii. **Identify the national scientist within each member state** that will have responsibility for the seabird bycatch analysis for tuna RFMOs on an ongoing basis (focus is longline fishing nations operating in seabird CMM areas).

iii. **Face-to-face workshop:** bring together these national scientists and other experts to undertake training on simple approaches to standardising seabird bycatch rates and extrapolating to estimate total number of birds killed. This workshop could include training and practice on:
   - Data preparation/grooming datasets
   - Diagnostic tools to examine data
   - Principles of stratification
   - Simple approaches to bycatch estimation
   - Simple approaches to bycatch rate standardisation and advanced non-model approaches to bycatch estimation (total number of birds killed)

   It would be useful to link this workshop to other planned meetings e.g. WCPFC Scientific Committee or IOTC WPEB or ICCAT Ecosystem Sub-Committee (in all three cases, national scientists may be attending, and not all of the agenda will be relevant to seabirds, therefore may be possible to identify time for workshop in margins)

iv. Supplementary online communication

A face to face workshop could be followed up (and/or preceded) by online work and training, including via webinars

v. **Workshop on modelling approaches to extrapolation**: next stage would be a workshop to train/develop skills on more advanced approaches, in particular model-based approaches, to seabird bycatch analyses

We felt this work was core to ACAP objectives and also objectives under the seabird elements of the GEF Common Oceans tuna project.

2. **Proposal for single cross-tuna RFMO review of seabird CMMs**
   We agreed that it would be effective to ask tuna RFMOs to consider a single seabird CMM review, rather than separate reviews. However, we do note that this will be challenging to achieve and a clear lead organisation needs to be identified.

3. **Seabird identification**
   Work underway and in discussion includes:
   - Ongoing development of ACAP/Japan identification guide (translation into French, Spanish, Taiwanese, Korean)
   - Collaboration to check species ID from bycatch photos and support seabird identification training for national scientists
   - Investigate the potential for dispersed sequencing (to avoid issues around biosecurity and international transfer of samples) and centralised identification of sequenced data (to improve quality of species and population ID)

4. **Seabird distribution data**
   It was agreed it would be useful to make a request to seabird tracking data owners to undertake an updated analysis of albatross and petrel distribution in order to input into the ICCAT and IOTC seabird assessments (need by May 2015) and the CCSBT risk assessment (need as soon as possible). This request would be via the Global Procellariiform Tracking Database.

Appendix 3. Template for the Annual Report to CCSBT Ecologically Related Species Working Group (Annex 4, ERSWG 9 meeting report 2012)

1. Introduction
   - General comments on fishing methods by which southern bluefin tuna is caught in party fisheries (by fleet, area, and time).
   - General comments on type and magnitude of ERS caught by fishery/method.
2. Review of SBT Fisheries
   - Fleet size and distribution (brief summary of trends)
   - Distribution of Catch and Effort (Summary of catch and effort by area and fleet)
3. Fisheries Monitoring for Each Fleet
   - Summary of recent observer coverage of SBT fisheries fleets and summary of data collection activities of observers.
   - Summary of data collection activities from non observed activities.
4. Seabird[3]
   - Summary of cpue and total numbers of seabird incidentally caught by area and fleet and list of numbers of each seabird species observed caught[4].
   - Summary of seabird capture from non observed sources[2].
5. Other Non-target Fish[1]
   - Summary of cpue and total numbers of shark and the predominant non-target fish species by area and fleet[2].
6. Marine Mammal and Marine Reptile[1]
   - Summary of total numbers of marine mammal and marine reptile incidentally caught[2].
7. Mitigation Measures to Minimise Seabird and Other Species Bycatch

Current Measures

- Mandatory Measures for Each Fleet
  - Description of each measure
  - Compliance Monitoring System (i.e. how is compliance measured)
  - Level of Compliance for each measure
- Voluntary Measures for Each Fleet
  - Description of each measure
  - Proportion of fleet using each measure and how this proportion was determined

Measures under Development/Testing

- Description of each measure being developed and tested
- Lead agency undertaking research
- Description of any collaboration
- Results to date
- Planned development/testing for next year
- Expected completion date and report to ERSWG

8. Public Relations and Education Activities

Public Relations Activities

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[3] This information should also be provided by species (including the scientific name) wherever possible.
[4] ERSWG 9 recommended that Members and Cooperating Non-Members should include the information shown in Table 1 of this reporting template in future national reports to the ERSWG.

- media releases
- information booklets, posters, other written material
- video
- public presentations
    - trade shows
    - forums, conference
    - school/university group

Education

- crew training, especially ship masters
- trainee fishers
- engineers
- managers
- observers

Information Exchange

- research
- educational materials
- other regional fisheries organisations
- international organisations
- non-member states and entities
- review of new ideas obtained from crew debriefings or ship fishing reports

9. Information on other ERS (non-bycatch) such as prey and predator species
10. Others
Information obtained concerning ERS related fishing activities of non-party fleets.

Annex 1 – Summary of papers submitted to ERSWG
Members should provide a summary of papers submitted to the ERSWG meeting in their national report
CCSBT 9 specified that Members should provide a summary of papers submitted to the ERSWG meeting in their national report (see paragraph 89 of the CCSBT 9 report).

Table 1: Reporting form for estimation of total mortality of ERS in CCSBT fisheries

Country _____ Year (calendar year) _____

Species (or group) _____

Fishery		Observed							Estimate
Stratum (*CCSBT Statistical Areas or finer scale*)	Total Effort[3]	Total Observed Effort[3]	Observer Coverage[4]	Captures (*number*)	Capture Rate[5]	Mortalities (*number*)	Mortality Rate[5]	Live releases (*number*)	Estimated total mortalities (*number*)
TOTAL									

3 For longline provide number of hooks, for purse seine provide number of sets.
4 For longline provide as a percentage of the number of hooks, for purse seine provide as a percentage of the number of shots.
5 For longline provide as captures per thousand hooks, for purse seine provide as captures per set.

Table 1. Currently active tuna RFMO seabird conservation and management measures and plans to review the effectiveness of these measures

Tuna RFMO seabird measure	Seabird bycatch mitigation requirements	Intent to review
ICCAT Recommendation 11-09 (ICCAT 2011)	Use at least two of the following mitigation measures: night setting with minimum deck lighting, bird-scaring lines, or line weighting in the area south of 25°S with minimum technical standards. Use bird-scaring lines in the area between 20°S to 25°S (swordfish vessels can instead set lines at night and use line weights of >=60g within 3 m of the hook). Vessels in the Mediterranean are encouraged to use mitigation measures on a voluntary basis.	Paragraph 7. CPCs shall collect and provide to the Secretariat information on how they are implementing these measures and on the status of their National Plans of Action for Reducing Incidental Catches of Seabirds in Longline Fisheries Paragraph 8. In 2015, the SCRS shall conduct another fishery impact assessment to evaluate the efficacy of these mitigation measures. Based on this fishery impact assessment, the SCRS shall make appropriate recommendations, if necessary, to the Commission on any modifications.
IOTC Resolution 12-06 (IOTC 2012)	Use at least two of the following measures: night setting with minimum deck lighting, bird-scaring lines (tori lines) or line weighting in the area south of 25°S with the minimum technical standards	Paragraph 6. The Scientific Committee, based notably on the work of the WPEB and information from CPCs, will analyse the impact of this Resolution on seabird bycatch no later than for the 2016 meeting of the Commission. It shall advise the Commission on any modifications that are required, based on experience to date of the operation of the Resolution and/or further international studies, research or advice on best practice on the issue, in order to make the Resolution more effective
WCPFC CMM 2012-07 (WCPFC 2012)	Use two of weighted branch lines, night setting or tori lines, in the area south of 30°S; use at least two of bird streamer line, line weights, night setting, side setting with a bird curtain, blue-dyed bait, line shooter, offal management, including at least one of the first four of these, in the area north of 23°N. CCMs are required to report annually on mitigation used, bycatch rates and total number of birds killed; vessels encouraged to undertake	Paragraph 6. The SC and TCC will annually review any new information on new or existing mitigation measures or on seabird interactions from observer or other monitoring programmes. Where necessary, an updated suite of mitigation measures, specifications for mitigation measures, or recommendations for areas of application will then be provided to the Commission. Paragraph 8: The intersessional working group for the regional observer programme will take into account the need to obtain

	research and ensure safe handling and release;	detailed information on seabird interactions to allow analysis of the effects of fisheries on seabirds and evaluation of the effectiveness of bycatch mitigation measures.
IATTC Resolution C-11-02 (IATTC 2011)	Use at least two of the following mitigation measures: bird scaring line, line weights, night setting, side setting with a bird curtain, blue-dyed bait, line shooter, offal management, underwater setting chute, including at least one the first four of these, in the area north of 23°N and south of 30°S, plus the area bounded by the coastline at 2°N, west to 2°N-95°W, south to 15°S-95°W, east to 15°S-85°W, and south to 30°S, with minimum technical standards.	Paragraph 11: The effectiveness of this resolution to reduce seabird bycatch in the EPO, including the mitigation measures in Table 1, the area of application, and the minimum technical specifications adopted pursuant to this resolution, shall be subject to review and possible modification, taking into account the scientific advice from the Working Group on Bycatch, the SAC, and the IATTC scientific staff.
CCSBT ERS Recommendation 2011 (CCSBT 2011a)	Comply with all IOTC, WCPFC and ICCAT measures; report data on interactions to the Commission which is authorized to exchange it with other tuna RFMOs	Paragraph 6: The Extended Commission will review the operation of this Recommendation with a view to enhancing the protection of ecologically related species from the impacts of fishing for southern bluefin tuna.

Table 2. ACAP criteria for assessing and recommending best practice advice on seabird bycatch mitigation measures (ACAP 2014)

Criteria	Notes
i. Individual fishing technologies and techniques should be selected from those shown by experimental research to statistically significantly reduce the rate of seabird incidental mortality to the lowest achievable levels.	Experience has shown that experimental research comparing the performance of candidate mitigation technologies to a control of no deterrent, where possible, or to status quo in the fishery, yields definitive results. Analysis of fishery observer data after it has been collected regarding the relative performance of mitigation approaches are plagued with a myriad of confounding factors. Where a significant relationship is demonstrated between seabird behaviour and seabird mortality in a particular system or seabird assemblage, significant reductions in seabird behaviours, such as the rate of seabirds attacking baited hooks, can serve as a proxy for reduced seabird mortality. Ideally, when simultaneous use of fishing technologies and practices is recommended as best practice, research should demonstrate significantly improved performance of the combined measures.
ii. Fishing technologies and techniques, or a combination thereof, shall have clear and proven specifications and minimum performance standards for their deployment and use.	Examples would include: specific bird scaring line designs (lengths, streamer length and materials; etc.), number (one vs. two) and deployment specifications (such as aerial extent and timing of deployment), night fishing defined by the time between nautical dusk and nautical dawn, and line weighting configurations specifying mass and placement of weights or weighted sections.
iii. Fishing technologies and techniques shall be demonstrated to be practical, cost effective and widely available.	Commercial fishing operators are likely to select for seabird bycatch reduction measures and devices that meet these criteria including practical aspects concerning safe fishing practices at sea.
iv. Fishing technologies and techniques should, to the extent practicable, maintain catch rates of target species.	This approach should increase the likelihood of acceptance and compliance by fishers.
v. Fishing technologies and techniques should, to the extent practicable, not increase the bycatch of other taxa.	For example, measures that increase the likelihood of catching other protected species such as sea turtles, sharks and marine mammals, should not be considered best practice (or only so in exceptional circumstances).
vi. Minimum performance standards and methods of ensuring compliance should be provided for fishing technologies and techniques, and should be clearly specified in fishery regulations.	Relatively simple methods to check compliance include port inspections of branch lines to determine compliance with branch line weighting, determination of the presence of davits (tori poles) to support bird scaring lines, inspections of bird scaring lines for conformance with design requirements. Compliance monitoring and reporting should be a high priority for enforcement authorities.

Table 3. Characteristics of the tuna RFMO longline observer program data collection and reporting requirements (drawing from Anderson & Small 2012, Turner & Papworth 2013, and updated with recent developments)

	ICCAT	IATTC	IOTC	WCPFC	CCSBT
Longline observer coverage required (and unit of measurement)	Min. 5% observer coverage required (excl. vessels <15m, which must use alternative methods, subject to SCRS approval **(Rec. 10-10, Rec 11-10).** Rec 10-10 to be reviewed in 2012 and every 3 years (including coverage and data standards). % coverage measured by fishing days, number of sets or trips **(Rec 10-10)**	Min. 5% observer coverage required (excl. vessels <20m) from Jan 2013. Coverage to be reviewed in 2014. Does not indicate if/how data collected from vessels <20m **(Res. C-11-08)** Recommend 5% coverage be defined by no. of days fishing (excl. transit), as no. of hooks deemed impossible **(SAC 2012)**	Min. 5% coverage for vessels ≥24m and <24m that fish outside their EEZs **(Res. 09-04).** Artisanal vessels to be monitored by field samplers in port **(Res. 10-04)** Coverage subject to review in 2012 and subsequent years **(Res. 11-04)** % coverage measured by number of sets observed (though observer trip report also reports % hooks observed) For artisanal vessels, 5% of total no. of vessel trips or total no. of vessels active **(Res 10-04)**	Min. 5% coverage (excl. small vessels, troll, pole and line for skipjack/albacore). Exclusions to be reviewed in subsequent years by IWG-ROP **(CMM 07-01)**. Initial data to be used to assess necessary coverage for more sporadic bycatch incidents (e.g. seabirds) **(WCPFC 2007a)** % coverage measured by number of fishing trips	Recommended 10% coverage of catch and effort as target level **(CCSBT 2001b)** Reporting of coverage initially in terms of % catch and number of employment days (Attachment 2 in CCSBT 2001b). ERSWG annual report template requires reporting in observed hooks versus total hooks.
Requirement to collect spatially and temporally representative data	Requires representative spatio-temporal coverage, but no specifications on how to measure this **(Rec. 10-10)**	Requires representative spatio-temporal coverage, but no specifications on how to measure this **(Res. C-11-08)**	Mentions representative sampling of gear types, but not spatio-temporal representativeness explicitly **(Res. 09-04, 10-04, 11-04). S**tratified observer data (5x5° grid/month) should be submitted to the Secretariat **(IOTC 2012a).**	Recommends observer effort be representative of species of interest, fishing areas, types and seasons **(WCPFC 2007a)**	Has representative sampling strategy for allocating observers to vessels. Recommends CPCs report on mechanism for observer assignment **(CCSBT 2001b)**
Data collection standards (including data of particular interest to seabird bycatch)	No data collection templates but **Rec. 10-10** requires data to be collected on fishing operation (including date, time, lat/long, effort observed), total catch and bycatch (including birds), fate, and use of mitigation measures.	Longline observer program data standards agreed August 2014. Bird form (F6) includes data on set number (can be linked back to fishing data), date, lat/long, species, fate and use of mitigation measures.	Has established data standards and data collection templates (including % effort observed, date, lat/long, gear and mitigation set-up, and catch/bycatch data). **(ROP Tech. WG 2010).**	Has established required data fields **(WCPFC 2008a). In 2012,** WCPFC agreed to the addition of new data fields including those relevant to seabird bycatch, and will be added to data collection forms from January 2015 (WCPFC 2012). SPC assesses quality of data collected to audit and monitor **(WCPFC7-2010/26)**	Scientific Observer Standards asks for bird bycatch data to be collected by weight (kg) **(CCSBT 2001b). CCSBT 2011a** recommends data collected in accordance with IOTC, ICCAT and WCPFC requirements**.** ERSWG annual report template has detailed data fields including CCSBT area, effort observed, bycatch rates, species data, mitigation measures used (Appendix 3).
Data reporting requirements (frequency)	Requires annual report to SCRS. Report every 3 yrs on coverage, and review min. standards **(Rec. 10-10)**	Director to draw up reporting requirements (not yet done?). **(Res. C-11-08)**	Observers to submit trip report to CPC within 30 days of trip. CPCs required to report in 90 days (later extended to 150 days) **(Res. 09-04, Res 11-04).**	No detail on submission deadline after initial date of 31 Dec 2008 **(CMM 07-01).** All observers to forward data to Secretariat /CPC as soon as possible after each trip **(WCPFC 2007a)**	In 2012, the ERSWG agreed an updated annual reporting template (Appendix 3)
Data reporting requirements (including data of particular interest to seabird bycatch)	Annual report to SCRS on catch rates, coverage and how calculated, consistent with domestic confidentiality requirements **(Rec.10-10)**. Requires reporting of bycatch data in format specified by SCRS **(Rec. 11-10)**, but reporting formats not yet agreed (no spatial or temporal aggregation agreed). Draft tables considered at Sept 2014 Sub-Committee on Ecosystems.	Requires CPCs to report to SAC in format to be established by SAC **(Res. C-11-08).** (not yet done?)	Observer trip report includes mitigation measures used (and % sets south of 25S with tori lines), also birds caught per 1x1 degree, but not observed effort per 1x1 degree (and. no link to set ID), meaning bycatch rates can't be deduced directly from reports. However, Res 12-02 established longline observer data at 5x5 to be in the public domain. National reports require summary of mitigation measures used in the fishery but not a quantified measure of implementation.	Requires CPCs to submit data (as collected) to Commission **(CMM 07-01).** Supports training of qualified de-briefers for full report after each trip **(WCPFC7-2010/26).** Information on seabird interactions to be reported in annual national reports, including % hooks observed and bycatch rates by areas of seabird CMM and outside seabird CMM (to species level), and mitigation used (although missing from table?), to allow WCPFC estimate of total mortality **(CMM 12-07).**	Annual report to ERSWG on observer coverage, seabird bycatch rates by CCSBT area or finer resolution, and estimate of total birds caught. List and number of birds caught by species. Also level of compliance across fleet and how measured.

Table 4. Types of approaches possible in assessing the impact of fisheries on seabird bycatch depending on the spatial/temporal resolution of the data available (Annex 8, ACAP 2013b).

Type 1: Fleet footprint data only	• Summaries of change in the fishing footprint over time. • Low quality risk assessment (possible only if seabird distribution information is available)
Type 2: Fleet wide effort data only	• Annual summary of fishery effort. • Only provides a good indicator of trends in fishing effort if the fishery is stable by season and area through time (not normally the case). Determining the impact on seabirds requires data on seabird bycatch (and distribution of that bycatch)
Type 3: Spatial and temporal effort data (e.g. 5x5 degrees, quarterly)	• Annual spatial and temporal summaries of fishery effort data. • Improved description of fishery effort that accounts for major spatial and/or temporal shifts common in fisheries. • Impact on seabirds requires data on seabird bycatch (and distribution of that bycatch).
Type 4: Spatial and temporal effort data + spatial foraging distributions of interacting birds by species	• An overlap index could be calculated and tracked over time. • While not providing a direct measure of bycatch, an overlap index can give a relative indication of potential interaction. For example, if a fishery relocated to another area beyond the normal range of previously impacted seabirds, the level of bycatch as well as the overlap index would be expected to decline.
Type 5: Bycatch rate data for fleet only	• Annual trends in bycatch rate for fleets could be tracked. • Integration of fleets not examined.
Type 6: Bycatch rate analysis + spatial and temporal effort data available	• Matching corresponding (in space and time) bycatch rates with effort, allowing an estimate of total bycatch (total and by area, time and fleet). • This is what is recommended for ACAP
Type 7: Bycatch rate analysis with seabird species composition + spatial and temporal effort data available	• As above but by species/population
Type 8: Bycatch rate analysis by seabird species + spatial and temporal effort data available + demography parameters	• A population level impact assessment could be conducted; this would enable the estimated bycatch totals (e.g. from 7 above) to be related to the consequent population impact. This can be important as tracking bycatch totals alone may not be giving an indication of population impact.