Commission for the Conservation of Southern Bluefin Tuna

みなみまぐろ保存委員会

Report of The Fifteenth Meeting of the Ecologically Related Species Working Group

4 – 7 June 2024

Tokyo, Japan

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Agenda Item 1. Opening

1. The independent Chair of the Ecologically Related Species Working Group (ERSWG), Dr Martin Cryer, welcomed participants and opened the meeting. The Chair advised that discussion for some agenda items had commenced in advance of the meeting by correspondence and thanked participants for their cooperation with this arrangement.
2. Each delegation introduced its participants. The list of participants is shown at **Attachment 1**.
3. The Chair noted that the European Union (EU) and Indonesia did not attend this meeting.
4. The Executive Secretary announced the administrative arrangements for the meeting.

1.1 Adoption of agenda

5. The agenda was adopted through the discussion commenced by correspondence in advance of the ERSWG meeting. The agreed agenda is provided at **Attachment 2**.

1.2 Adoption of Documents List

6. The adopted list of documents for the meeting is shown at **Attachment 3**. The Chair noted that some documents were submitted after the due date for the meeting. The ERSWG agreed to accept these late documents.
7. The Chair thanked participants for developing and submitting documents to the meeting. In particular, the Chair expressed appreciation to ACAP[1] and BirdLife International (BLI) for providing documents requested by the Secretariat.

1.3. Appointment of Rapporteurs

8. New Zealand, Australia and BLI volunteered to rapporteur agenda items 5, 7.2 and 10 with the Secretariat to rapporteur the remainder of the agenda.

Agenda Item 2. Annual Reports

2.1. Members

[1] Agreement on the Conservation of Albatrosses and Petrels

9. Discussion for this agenda item commenced by correspondence in advance of the ERSWG meeting.

10. The European Union did not submit its annual report to the ERSWG.

11. A summary of comments and key responses to questions is provided below.

Australia

- For the question on acceptable bycatch target, Australia clarified that the 0.05/1000 hooks is the current requirement of the Australian Threat Abatement Plan 2018, and it would be keen to discuss seabird bycatch targets/objectives as part of a wider ERSWG discussion;
- Australia considered that the current focus at CCSBT should be strengthening compliance with existing mitigation measures rather than changes to the current requirements. Australia also noted that the effectiveness of mitigation measures, and combinations of mitigation measures, should be considered in terms of effectiveness against any agreed bycatch targets;
- For the compliance monitoring system, Australia advised that its level of compliance with measures to minimise bycatch is high, based on e-monitoring (EM), observer and compliance reports. E-monitoring technologies are a cost-effective tool without the limitations associated with at-sea observers. Where EM audit detects an incident of possible non-compliance relevant to ERS species including mitigation requirements, an information report is reviewed by the Australian Fisheries Management Authority (AFMA) investigators and actioned accordingly; and
- Australia advised that it would share the result of the project investigating new tori line designs once it is completed.

Indonesia

- For the question on observed sea turtles bycatch, Indonesia noted that, considering 18 sea turtles were incidentally caught with 10 were released dead and 8 were released alive, crew handling capabilities for ERS need to be improved. Indonesia advised that one possible approach is to train the crews/captain not to force to remove the hook from the sea turtle’s throat, but to cut the line with a cutter as close as possible to the hook and immediately release the sea turtle into the sea;
- There were questions on data from non-observed fishing (i.e. fisher logbooks) and Indonesia’s compliance monitoring systems, but Indonesia did not provide answers to these questions.

Japan

- Japan explained that ERS data could not be collected in 2021 and 2022 due to the impact of COVID-19, and advised that it will be able to report ERS data, as it did previously, to the next ERSWG meeting;
- For “switching night setting to weighted branch line,” Japan considered that branch lines set during the night (until before 1 hour of sunrise) effectively mitigate seabird by-catch and that the operation of switching to a weighted line by 1 hour before dawn should be regarded as an effective by-catch mitigation measure;
- For the question of whether Japan’s logbook reporting includes interactions with seabirds, Japan advised that, as the logbooks from the vessels are not

intended for collecting detailed information related to mitigation measures, it considers that information from the logbooks is not suited for appropriate verification of conducting mitigation measures. Therefore, Japan basically considered that bycatch information, including seabirds, should be collected by scientific observers, not by fishing vessels, to ensure higher accuracy, including species identification;

- For the observer training program, Japan advised that it conducts training for observers on how to identify species at sea. In addition, if it is difficult to identify the species on board, observers take photographs for species identification by trainers or experts after fishing trips; and
- Japan clarified that it requires each fishing vessel to report its plan for the use of mitigation measures prior to fishing trips, including the 2021 and 2022 fishing seasons.
- For the possible use of logbook data, Japan considered that it is not appropriate to utilise logbook data for the collection of seabird bycatch information, considering there are problems with its accuracy (including species identification). In addition, the data quality on the use of bycatch mitigation measures in logbook data is not the same level as observer data, hence, it is not appropriate to fill the absence of observer data with logbook data.

Korea

- Regarding the use of mitigation measures, Korea explained that Korean SBT longline fleets use BSL + LW combination due to safety reasons, such as bad weather conditions at sea.
- Korea also clarified that the information on seabird bycatch and mitigation use for 2020 and 2021 in the Korean report were provided based on logbook information as observers were unable to conduct surveys in those years due to the impact of COVID -19.
- For the question on verification of species ID, Korea explained that an ID guide is provided to the observers during training prior to deployment, and photographs are often sent to a seabird expert to seek for opinions for species difficult to identify.
- Korea also explained that additional information on the design and specifications of seabird mitigation devices was not available at present.

New Zealand

- New Zealand clarified that all relevant New Zealand data on seabird bycatch is included in the current iteration of the Spatially Explicit Fisheries Risk Assessment (SEFRA), and New Zealand is continuously working towards improving the quality of this data, and it considers that the recent rollout of onboard cameras will contribute towards significantly improving the quality of its bycatch data. New Zealand also clarified that it would continue to support the outcomes of the Multi-year Seabird Strategy;
- For the increase in seabird bycatch, New Zealand advised that its surface longline effort has diversified with a larger portion of SBT now being caught off the east coast of the South Island. This area has more overlap with albatross species, which has potentially driven the increase in both observed and commercially reported captures; and

- For the question on actions to be taken against non-compliance to domestic legislation on seabird mitigation measures, New Zealand advised that its Fisheries Compliance operates under a VADE model which is an acronym for ‘voluntary, assisted, directed, enforced’. In a case where an observer has identified non-compliance with mitigation measures, it is recorded in a trip report or a compliance report for follow up by Fisheries Officers. Officers work with a fisher to rectify the identified issue which can take the form of advising/directing remediation, or warning/prosecuting. New Zealand is currently updating domestic legislation to create an infringement regime that will provide Officers with an additional enforcement tool for lower-level offences without the need for prosecution.

South Africa

- South Africa clarified that the non-SBT fishery is subject to the same management and mitigation measures as the SBT fishery. South Africa has one pelagic longline fishery that is not further defined or differentiated by targeting or species caught. The distinction between a “targeted” and non-SBT sector in its annual report conforms with the ERSWG’s requirement that a SBT fishery is defined by “shots/sets where SBT was either targeted or caught”. On average (2012-2023), the seabird mortality CPUE (number of seabird mortalities/1000 hooks) of the SBT-target-fishery was 0.15 in comparison to the non-SBT which was 1.00;
- South Africa advised that observer reports showed that close to 95% of sets were conducted at night. Whilst night setting is mandatory and operators may choose to use line weighting or bird scaring line, observer reports showed that 77% of sets have used all three mitigation measures. There is a slight preference towards line weighting accompanying night setting (9% of sets) compared to the BSL (6% of sets). 4% of sets used line weighting only, which may be sets conducted in areas of lower risk of seabird interactions (e.g. <30°S);
- For the question on safety concerns for the use of line weighting, South Africa advised that the permit conditions for the pelagic longline fleet require line weighting to be either of these three configurations: 40 g or greater attached within 0.5 m of the hook, or 60 g or greater attached within 1 m of the hook, or 80 g or greater attached within 2 m of the hook. However, reports from observers indicated that vessels had more often been implementing the “>98 g weight attached within 4 m of the hook” that appears in International Commission for the Conservation of Atlantic Tunas (ICCAT)’s Rec.11-09 and Indian Ocean Tuna Commission (IOTC)’s Res.23-07. Risks of flybacks and crew safety may be the reason for this deviation from the permit conditions which requires engagement with the fishing industry;
- For the verification of seabird species identification, South Africa advised that observers receive training on seabird identification and on the protocols to follow should an ID be cryptic. It also noted that permit conditions for the current season have made it clearer that deceased seabirds should be frozen and handed to Birdlife South Africa for collection after returning to port; and
- For the monitoring of vessel specific limits for seabird bycatch, South Africa clarified that it relies on observer reporting to monitor compliance with permit

conditions on night setting, line weighting, bird-scaring lines, deck lighting, bait thawing and seabird handling.

Taiwan

- Taiwan clarified that all of Taiwan's submitted data are observer data. The differences in mitigation measure uses reflects the fact that observers observed on different vessels among years;
- Regarding the variation in the use of line weighting, the limited coverage of observers and the difficulty in determining whether fishing vessels fully comply with the regulations on weighted branch line during fishing could both affect the reported implementation percentage of line weighting;
- For the question of the increase of observed seabird bycatch, Taiwan highlighted that the total number of observed hooks in 2022 was higher than in 2021, and therefore, the BPUE was 0.009 birds/1000 hooks in 2021 and 0.003 birds/1000 hooks in 2022;
- Taiwan advised that, to those fishing vessels that only used one mitigation measure, Taiwan will issue an administrative instruction to the captain and also the operator. For now, there is no record of recommitment; and
- For the point of not providing any information on captures from sources other than observers, Taiwan advised that the observers' data are considered the most precise and correct information for Taiwan's data related to bycatch information.

2.2. Secretariat report on the ERSWG Data Exchange

12. Discussion for this agenda item commenced by correspondence in advance of the ERSWG meeting.

13. The Secretariat submitted paper CCSBT-ERS/2406/04 (Rev.1), which presented summaries of data provided for the ERSWG Data Exchange (EDE) including the 2023 EDE with data provided for 2022. As tasked at ERSWG 10, the summaries are aggregated over Members and include observed and actual effort, observer coverage rate, observed mortalities and estimated total mortalities. Aggregation was also to be by year, CCSBT statistical area and species/species groups. Data from 2019 have been provided by 5x5 degree square, so the summaries now include 5x5 maps using data from 2019 onwards. Data were provided by all Members apart from the EU, who has no ERS data to report. In recent years observer coverage has been low or was 0% for some Members, which has greatly affected the number of ERS observations and needs to be taken into consideration when looking at the paper.

14. Concerns were raised that the current timeframe of the EDE (due on 31 July each year) and the fact that ERSWG meetings are held every other year makes it difficult for the ERSWG to discuss bycatch-related issues based on the latest information in a timely manner.

15. The meeting discussed the possibility of changing the timeframe of EDE. One Member stated that it would be possible to bring forward the deadline for EDE submission, while another stated that even the current submission deadline is challenging because it takes around six months to clean and compile observer data

and that it is not realistic to make the deadline earlier. The meeting did not reach a consensus on changing the timeframe of EDE.

16. The meeting also discussed the possibility of reviewing summaries from EDE every year by holding the full ERSWG every year or having a standing agenda item at the ERSWG Technical meeting to check Members' performance on ERS bycatch. The Secretariat pointed out that Members' performance on ERS is discussed every year through the Secretariat report to the Compliance Committee and the Extended Commission and that the latter does have a standing agenda item on ERS that ensures that yearly engagement on this topic is possible.

Agenda Item 3. Reports of meetings and/or outcomes of other organisations relevant to the ERS Working Group

17. Discussion for this agenda item commenced by correspondence in advance of the ERSWG meeting.

18. The Chair advised that all organisations with long term observer status for CCSBT ERSWG meetings have been invited to attend and to present a report to the meeting, and they may also present relevant meeting reports from organisations not present at the ERSWG meeting.

19. BLI submitted paper CCSBT-ERS/2406/Info 09, which provided a brief update on activities of BLI related to seabird bycatch, including RFMOs, industry, scientific, and the supply chain. This covered global activities, not specifically related to the CCSBT.

20. BLI International submitted paper CCSBT-ERS/2406/Info 10, which provides a very brief update on developments and /or proposed changes to seabird related measures in RFMOs that are relevant to the CCSBT.

21. The Secretariat reminded Members that the list of relevant ERS measures from other RFMOs is updated annually in Annex I of the Resolution before the annual Extended Commission (EC) meeting, according to any decisions taken on ERS at the annual meetings of the ICCAT, IOTC, and Western and Central Pacific Fisheries Commission (WCPFC).

22. BLI submitted paper CCSBT-ERS/2406/Info 11, which summarised the results of five years of port-based outreach based in Suva, Fiji to improve the implementation of seabird and other protected species bycatch mitigation. The paper summarised the data on vessel access and knowledge of protected species requirements, tori-line construction project, and planned future activities. Humane Society International (HSI) and BLI raised concerns with regard to compliance with seabird CMMs. BLI clarified that the port-based outreach program is an effort to improve implementation of the required measures and raise awareness, not enforcement of compliance. It is the role of Members to ensure that their fleets are following the regulations that they have agreed to. However, there seems to be a lack of communication and enforcement on bycatch issues from the regulators to the fleets, so BLI saw a need to work directly with captains and crews to address those gaps.

Agenda Item 4. Review of progress with the work program from ERSWG 14

23. Discussion for this agenda item commenced by correspondence in advance of the ERSWG meeting.

24. The Secretariat submitted paper CCSBT-ERS/2406/05 on Progress on Action Items from the ERSWG 14 Workplan. This paper provided a brief update on the progress that has been made with the workplan from ERSWG 14. Progress on some workplan activities (e.g. the CCSBT Multi-year Seabird Strategy) are not presented in the paper and will instead be discussed in the agenda items indicated in the paper.

25. HSI noted that with Member's ERS Reporting there is still incomplete presentation of species names in accordance with requirements, and 3-alpha name codes are occasionally being mixed in presentation taxonomically and not necessarily in alphabetical order, which makes data interpretation more difficult.

26. ACAP reported that the translation of the ACAP Seabird Identification Guide into Indonesian has been completed. ACAP also introduced its various resources available for CCSBT Members, including Data collection guidelines for observer programmes, Guidelines on electronic monitoring systems, ACAP-BLI Bycatch Mitigation Factsheets, and new Guidelines for working with albatrosses and petrels during H5N1 avian influenza outbreak. Many of these have been translated into CCSBT Member languages, with links available in paper CCSBT-ERS/2406/20.

Agenda Item 5. Information and advice on ERS

5.1 Seabirds

5.1.1 Information on stock status

27. ACAP presented the related part of paper CCSBT/ERS/2406/20 on conservation status of albatrosses and petrels and advice on reducing their bycatch in CCSBT longline fisheries. The incidental mortality of seabirds in longline and trawl fisheries continues to be a serious global concern, especially for threatened albatrosses and petrels. The need for international cooperation in addressing this concern was a major reason for establishing ACAP. There are currently 31 species listed in Annex 1 of the Agreement. Of the 22 species of albatrosses, 18 breed or forage in the CCSBT Area, as do seven of the nine listed petrel species. ACAP has also identified nine high priority populations which have declined at more than 3% per year over a 20 year period for which a major underlying cause was incidental mortality in fisheries. Seven of these nine populations occur where SBT is fished. ACAP's paper provides a summary of the status and current trends of all 25 relevant species, as well as an update on the latest ACAP seabird bycatch mitigation best practice advice for pelagic longline fisheries and other relevant ACAP resources.

28. ACAP and BLI submitted a joint paper CCSBT-ERS/2406/Info 08 updating ACAP Species Assessment distribution maps. The ACAP Species Assessments aim to summarise the most recent scientific information regarding albatross and petrel species listed under the Agreement. These assessments provide data on each

species' population status and trends, their distribution, the threats they face both at breeding sites and at sea, as well as the conservation measures that are in place to protect them. As part of an ongoing process to update the assessments with the latest information, ACAP and BLI have been undertaking a process to update the distribution maps contained within the assessments. The update has involved compiling tracking data to produce new adult breeding and non-breeding distribution (densities) maps for albatrosses and petrels listed under the Agreement. In cases, where available, maps for juvenile and immature birds were also created. Noting Objective 3C of the CCSBT Multi-Year Seabird Strategy (to regularly monitor and identify changes in the spatial overlap of fishing effort for SBT and the distribution of seabird species, particularly threatened albatross and petrel species, and inform the relevant fisheries across tuna RFMOs) and the development of the SEFRA on seabird spatial data, these latest distribution maps were provided for consideration by ERSWG 15. Only maps for those 22 ACAP species which overlap with SBT fisheries are included in the paper. These maps will be incorporated into updated ACAP Species Assessments due to be published in late 2024.

29. Members thanked ACAP and recommended that there should be collaboration between ACAP and CCSBT on standardised distribution data for seabirds.

30. The meeting noted that there is an appreciable set of non-bycatch risks to seabirds from human activities, including terrestrial risks. ACAP advised that a database of non-bycatch threats at breeding sites is maintained. Following considerable conservation actions such as pest eradications there are only five remaining breeding sites across all the ACAP species occurring in the CCSBT area which still have threats of current high magnitude, however this does not include new arising potential threats from highly pathogenic avian influenza subtype H5N1 Clade 2.3.4.4b (HPAI).

31. It was suggested that the risk to seabirds from other sources than fishing should be considered with the other information about the scale of risks to seabirds.

32. Members commented on the difficulties (and costs) associated with gathering additional information for certain seabird species to reduce uncertainty and that this should not delay taking immediate actions that would reduce risks.

33. The meeting discussed whether there was a need to update the longstanding advice from ERSWG in light of the most recent SEFRA results (refer Agenda item 5.1.3).

34. One Member considered it not appropriate to utilise the preliminary SEFRA results to revise the existing management advice based on its reservation on the model used in the current version of SEFRA.

35. Another Member also expressed concern about using high risk area analysis in the advice to the EC without having an agreed definition of high-risk areas.

36. One Member stated that the SEFRA analysis represents the best available information and that action should not be delayed on the basis of the need for perfect information noting the precautionary principle and guidance found under the UN Fish Stocks Agreement (UNFSA).

37. BLI and HSI both commented on the need for this Commission to take immediate action based on the SEFRA results noting the conservation crisis facing albatross and petrel species.

38. ERSWG agreed to the following updated advice on seabirds:

- The level of interaction between seabirds and SBT fisheries remains a significant concern.
- The ERSWG noted that the most recent version of the SEFRA indicates that Wandering and Royal Albatross species groups are at high risk. Species in these groups are of high conservation concern and ACAP indicated that some populations are in sharp decline.
- The SEFRA indicates areas with higher risk in some parts of the Tasman Sea (especially), Southern Atlantic, and Southern Indian Ocean. These areas account for a large proportion of the modelled risk to seabirds from SBT surface longline fisheries, but contain a very small proportion of SBT surface longline fishing effort.
- Based on the best scientific information available, the ERSWG recommends that CCSBT Members consider taking further actions that would ensure robust seabird mitigation measures and effective monitoring of implementation of the mitigation measures, whilst minimising impacts on SBT surface longline fisheries effort.

5.1.2 Estimates of ERS mortality and associated uncertainty

39. The Chair advised that this agenda item provides an opportunity to consider methods for estimating total seabird mortality and for reviewing any mortality estimates provided by Members.

40. New Zealand presented paper CCSBT-ERS/2406/21 on Antipodean albatross multi-threat risk assessment. The results of the Antipodean albatross multi-threat risk assessment align with the results obtained in the CCSBT collaborative risk assessment. These indicated that fisheries from CCSBT member nations are not contributing substantially to the bycatch of Antipodean albatross that is resulting in the substantial population decline of the species.

41. The meeting noted that this work was in relation to the Antipodean wandering albatross subspecies (*Diomedea antipodensis antipodensis*) and should not be interpreted as applying to the Gibson's wandering albatross subspecies (*Diomedea antipodensis gibsoni*).

42. New Zealand discussed CCSBT-ERS/2406/Info04 on the fine scale overlap of Gibson's Albatross and pelagic longline fishing effort. Gibson's albatross is a declining population and of high conservation concern. This paper provides insights of four years of satellite tracking of 82 Gibson albatrosses, and their spatiotemporal overlap with pelagic longline fishing effort. The areas of highest bird-vessel overlap occurred in CCSBT and WCPFC, primarily in the High Seas areas of the central Tasman Sea and North-East of New Zealand. The results of this analysis were consistent with the results of the SEFRA in both CCSBT-ERS/2406/13 and CCSBT-ERS/2406/22.

5.1.3 Ecological risk assessment

43. The ERSWG 14 Workplan specified that New Zealand would lead work, in collaboration with Members, to "conduct the SEFRA as an ERSWG collaborative assessment in the areas of data provision, model development and examination of model robustness", and that the ERSWG would review the outcome of this work including conclusions from the Technical ERSWG hybrid meeting of 27-29 February 2024.

Seabird bycatch risk assessment

44. On behalf of the SEFRA Technical Group, Dr Sachiko Tsuji presented paper CCSBT-ERS/2406/13, which provided the Report of the Technical Working Group on CCSBT collaborative risk assessment for seabird bycatch with surface longlines in the Southern Hemisphere.

45. New Zealand presented paper CCSBT-ERS/2406/22, which provided an alternative version of the report from the SEFRA Technical Group that captured the most recent revisions made by the researchers. New Zealand explained some of the challenges encountered, the coding errors and the impacts of fixing those errors, and proposed that this be adopted as the output from the technical group. New Zealand wanted to be confident that the results of the CCSBT collaborative risk assessment were reproducible by ensuring the 'methods' section of the report reflected as accurately as possible the work undertaken by the researchers. The methods section in the version of the report submitted by New Zealand was contributed by the researchers. In addition to this, tables and figures were updated to include the most recent results after the coding error was fixed.

46. Members discussed the need to ensure that the information put forward by the group was the most accurate available while also recognising that the technical group had not had sufficient time to review the latest changes.

47. The Chair reminded the meeting of the need for a consolidated report arising from this meeting to describe the SEFRA work, and suggested merging New Zealand and the Technical Working Group Chair's papers.

48. The Chair convened a small group to resolve the outstanding issues around the differences between CCSBT-ERS/2406/13 and CCSBT-ERS/2406/22.

49. The Technical Group agreed in consolidating two versions of the report from the Technical Group intersessional meetings as shown in Report of the Technical Working Group on CCSBT collaborative risk assessment for seabird bycatch with surface longlines in the Southern Hemisphere (**Attachment 4**).

50. The final SEFRA report concluded that this collaborative analysis was useful in developing mutual collaboration and understanding among colleagues with different expertise. A number of CCSBT members that did not contribute to the current analysis expressed their intention to contribute data to the next iteration. The current participants deepened their understanding of the nature of the SEFRA and the limitations of currently available information to support the model. All participants agreed that it would be beneficial to maintain the current momentum to ensure delivery of an updated SEFRA that included data from all CCSBT members. The Technical Group considered the general conclusions of the current SEFRA of wandering and royal albatrosses at a high level of risk posed by the CCSBT surface longline fisheries with relatively high confidence, despite

divergence in views regarding the model used in the current SEFRA. The risk to these species was concentrated in core areas within the Tasman Sea and south Atlantic Ocean.

51. New Zealand noted that they could support the management responses around improved spatial monitoring based on SEFRA outputs as outlined in paper CCSBT-ERS/2406/16. Additionally, New Zealand opposed some statements in this paper including that input data was not shared, and that routines for parameter estimation were hidden from Members of the technical working group. Clarification was provided by New Zealand that all code used to compile code packages was shared on the technical working group GitHub sharing platform, and also that all input files were shared with the results of each model run.

52. Japan confirmed that all code was shared on the code repository, but clarified that the problem was with interpretability on the overall SEFRA code due to the infrequency of code annotations without the input data portion of the code. In addition, Japan also pointed out frequent communication difficulties in a timely manner in clarifying the issues on code. Additionally, Japan also clarified that the management options outlined in paper 16 were hypothetical and since defined high risk areas were not agreed that it was inappropriate to discuss management options at this meeting.

53. The meeting discussed next steps for the SEFRA work and the need for additional resourcing either through the Commission or as part of the Marine Areas Beyond National Jurisdiction (ABNJ) Common Oceans Program.

54. The meeting agreed to recommend the EC to approve the future SEFRA workplan, including the request for funding from the Commission and ABNJ, which is shown in **Attachment 5**.

High-risk area

55. New Zealand presented paper CCSBT-ERS/2406/18 on high-risk areas. The objective of this paper was to put forward a dynamic proposal that can be applied in the current SEFRA as well as future assessments. New Zealand suggests only exploring those options in relation to the wandering and royal albatrosses given the outcomes from the current SEFRA.

56. ERSWG supported the suggestion made by New Zealand to explore further at this time options in relation to the wandering and royal albatrosses. It was also suggested to incorporate temporal aspects into the consideration.

57. It was noted that there was consistency in areas of highest risk identified by the SEFRA and those identified by other assessments. However, there were divergent views about the extent to which the model results were suitable for use in providing management advice.

58. New Zealand clarified that the purpose of their exploratory work in CCSBT-ERS/2406/18 is to define the methodology for identifying high risk areas, and to explore a number of options from this approach, with a view to defining a method that can be used consistently, so that high risk areas can be identified from each analysis.

59. Some Members considered that frequent changes to the defined high risk areas would be problematic for considering bycatch management.

60. The meeting agreed that the results from CCSBT-ERS/2406/18 were very interesting, had potential, and should be explored further.

5.1.4 Assessment and advice on mitigation measures

61. The Chair advised that this is a standing item on the ERSWG agenda for the ERSWG to review current measures and provide advice on any changes that might be needed.

62. Taiwan presented paper CCSBT-ERS/2406/19 on preliminary results of seabird mitigation measure's effectiveness for Taiwanese southern bluefin tuna fishing vessels. This study examined the effectiveness of seabird mitigation measures on Taiwanese southern bluefin tuna vessels using observer data from 2009 to 2021, which included 11,248 line sets in the Indian Ocean. During the period, a total of 364 seabird bycatch events were observed with an average BPUE of 0.015 birds per thousand hooks. Using zero-inflated generalised linear mixed models, this study identified the model considering latitude, proportion of setting at night, use of bird-scaring line, and use of weighted branch line, emerged as the best fit. While all those factors showed no significant effect on bycatch occurrence, they significantly predicted the number of seabirds caught. Higher latitudes, lower night setting proportions, non-use of bird-scaring lines, and the use of weighted branch lines were associated with increased seabird bycatch. However, the author reminded that careful interpretation with the results about weighted branch lines was required because data reporting and complicated specification issues might affect the results. These findings provide valuable insights for improving seabird bycatch mitigation strategies for the southern bluefin tuna fishery.

63. In response to questions, Taiwan advised that:

- Although Taiwan did not evaluate the impact of mitigation use on CPUE of SBT as part of this exercise, it would certainly help encourage fishers to support the use of mitigation if a positive relationship was found;
- The results may have been influenced by differing line weighting practices being applied by fleets operating in higher risk areas in the south; and
- Although existing requirements do include line weighting specifications, skippers often have differing preferences for the location of weights and their material which creates difficulties when monitoring.

64. It was suggested to re-run the analysis with seabird species group as a covariate to see if this had an impact on the result showing that the use of weighted branch lines increased bycatch.

65. ACAP presented the related part of paper CCSBT/ERS/2406/20 on the conservation status of albatrosses and petrels and advice on reducing their bycatch in CCSBT longline fisheries. ACAP introduced the criteria used by ACAP to determine whether a particular technique or technology can be considered best practice and noted that the best practice advice from the paper is unchanged from the previous advice provided two years earlier, which does reflect the maturity of the advice. The latest version of the advice, however, does provide more clarity on the limitations of single mitigation use. In particular, there is a period of time

when hooks are accessible to birds even when branch lines are weighted. Night setting used alone is less effective at reducing seabird bycatch for nocturnally active birds and during bright moon light conditions. Bird scaring lines used alone can rarely protect baited hooks beyond the aerial extent of the line. Simultaneous use of the three ACAP recommended seabird bycatch mitigation measures compensates for these limitations.

66. In response to questions, ACAP advised that:

- It was always interested in receiving feedback from fishers particularly if put in the context of the existing advice and the criteria used by ACAP to determine whether a particular fishing technology or measure can be considered best practice; and
- Also recognised that the current categorisation of those vessels that are smaller or greater than 35m may not fully capture the operational differences that exist within fleets.

5.1.5 Seabird species identification

67. The Secretariat provided a brief update on the potential use of the Bycatch Mitigation Information System (BMIS) platform to host a seabird photo database. Initial feedback from the Western and Central Pacific Fisheries Commission (who host BMIS) is that it is reasonably straightforward to accommodate the upload of a basic file but not those with functionality (such as .exe files). In order to give this further consideration, Members would need to determine what type of tool is needed and this would, in turn, determine data requirements. The Secretariat also advised that the development of a seabird photo database should be considered as a part of item 5D of the CCSBT's Multi-year Seabird Strategy.

68. The Chair sought clarification from Members as to what specific needs this tool was likely to address. It was suggested that one possible use would be in supporting the development of AI technology to assist electronic monitoring where machine learning would benefit from having access to a large database of images that go beyond what can be collected by a single Member. It was agreed that BMIS would not be pursued further as an option in this regard.

69. Japan presented paper CCSBT-ERS/2406/17 (Rev.1) on obstacles in collecting bycaught seabird specimens from observer program during the HPAI outbreak. Species identification of seabirds bycaught in SBT longline fisheries is a high-priority task for assessing the risk of bycatch in CCSBT-ERSWG. Collecting external morphometric measurements, photographs, and DNA specimens from bycaught seabirds is essential for precise species identification. However, the recent global spread of highly pathogenic avian influenza subtype H5N1 Clade 2.3.4.4b (HPAI) raises concerns about obstacles to these efforts. HPAI has been detected in seabird species, even in albatross species in southern hemisphere. This situation may make it more difficult to conduct onboard surveys of bycaught seabirds due to the potential for infection of crew members. While there is ample information on infection prevention measures for handling potentially HPAI-infected wild birds on land, there is little shared information on measures at sea. Therefore, to ensure stable collection of species identification data, it would be recommended that the CCSBT develop and share guidelines for the safe handling

of seabirds from an HPAI perspective with the collaboration of other organisation (e.g. ACAP and The World Organisation for Animal Health (WOAH)).

70. Members were advised that the work currently underway at ACAP would provide safety guidance on how best to handle seabirds in a way that minimises the risk to both the seabird and the fishing crew. Members appreciated the effort and were informed that the information would be publicly available once completed.

71. It was noted that an effective means of minimising the risk of virus exposure to fishing crews was to reduce the likelihood of seabird captures through the improved use of mitigation measures.

5.2 Sharks

72. The Chair noted that no papers had been submitted for this agenda item but opened the floor to Members for discussion.

5.2.1 Information on stock status

73. The Chair noted that no papers were submitted for this sub-agenda item.

5.2.2 Estimates of ERS mortality and associated uncertainty

74. The Chair noted that no papers were submitted for this sub-agenda item.

75. The meeting agreed that there were no specific or additional concerns about shark bycatch that warranted action by ERSWG 15. However, Members noted that significant gaps in observer coverage may be impacting ERSWG's ability to assess the impact of SBT Fisheries on sharks.

76. One member stated that the shark species related to SBT fisheries are pelagic sharks for which stock assessments, etc. are being conducted by other RFMOs, so if the ERSWG is to assess these shark species, it will need to consider collaboration with other RFMOs and careful consideration should be given to how coastal shark species are treated.

5.3 Other ERS

77. The Chair noted that no papers were submitted for this agenda item, but Members were invited to raise issues and encouraged to present information about the impacts of SBT fishing on other ERS species.

5.3.1 Australia's update on interactions between recreational SBT fishery and fur seals around Tasmania

78. The Chair recalled that the ERSWG 14 Workplan specified that Australia would provide an update on interactions between the recreational SBT fishery and fur seals around Tasmania and the work that Australia plans to conduct to better quantify the nature of these interactions, if necessary.

79. For interactions with fur seals, Australia advised that there are a low level of fur seal mortalities from commercial fisheries in Tasmania (trawl and gillnet fisheries) but no data on any interactions between fur seals and SBT recreational fisheries. Australia considered there is little to no impact of recreational fishing on fur seals around Tasmania, and it does not have any plan for further investigation on fur seal interactions. For the separate question around depredation of SBT by

fur seals, the national SBT recreational fisheries survey completed in 2020 showed that such depredation occurs around Tasmania, contributing around 30% of Tasmanian SBT mortalities, or around 16.8 tonnes. Australia has set aside 5% of its national SBT allocation for its recreational fisheries sector (equalling 365 tonnes in 2024) and this amount is greater than the most recent estimate of recreational catch (270 tonnes). Australia considered that this buffer is sufficient to account for the additional estimated mortality related to fur seal depredation.

Agenda Item 6. CCSBT Strategic Plan 2023 – 2028

80. The CCSBT30 adopted the revised CCSBT Strategic Plan 2023 – 2028 (CCSBT-ERS/2406/Info 01), that takes account of recommendations from the 2021 CCSBT Performance Review. The Chair advised that the discussions under this agenda item will inform the Secretariat's report back to the EC on progress against the actions of the Strategic Plan.
81. The Secretariat presented paper CCSBT-ERS/2406/06, which introduced the ERSWG-related elements of the CCSBT Strategic Plan and proposed a template to report the progress against the Strategic Plan from the CCSBT subsidiary bodies.
82. Members agreed to the reporting template proposed by the Secretariat and discussed how best to characterise the progress to date.
83. The meeting agreed to the Report Back to the EC on Progress Against the Strategic Plan (**Attachment 6**).

6.1 Review of Draft ERS and Bycatch Plan

84. The Secretariat presented paper CCSBT-ERS/2406/07 on Ecologically Related Species and Bycatch Action Plan. The Secretariat explained that this paper was aimed at meeting an action from the CCSBT Strategic Plan that was agreed at CCSBT 30. In developing the plan, the Secretariat considered existing monitoring and reporting requirements and was mindful of the need to minimise resourcing demands on both Members and the Secretariat. The meeting refined the objectives and added clarity surrounding the scope of the plan, noting specifically that this plan does not cover seabirds and should be seen as complementary to the already agreed Multi-Year Seabird Strategy. The group also emphasised the need to collaborate with other tuna RFMOs and other relevant organisations and institutions.
85. In line with one of the proposed actions of the plan, Members committed to developing a list of non-target shark species to be covered by this plan. Members will provide this information to the Secretariat in time for consideration at the 2025 meeting of the Ecologically Related Species Technical Working Group.
86. The meeting agreed to recommend that CCSBT 32 adopt the draft Ecologically Related Species and Bycatch Action Plan, which is shown in **Attachment 7**.

Agenda Item 7. Electronic Monitoring

7.1 High Level Guiding Principles on EM/S for the CCSBT

87. Discussion for this agenda item commenced by correspondence in advance of the ERSWG meeting.

88. The Chair advised that, in 2023, EC 30 adopted the "High Level Electronic Monitoring/Systems (EM/S) Guiding Principles for CCSBT" (EM Principles), which were provided to this meeting as CCSBT-ERS/2406/Info 02. The Secretariat also provided additional context surrounding the adoption of the Guiding Principles.

7.2 Review of ERS related data elements in the CCSBT's Scientific Observer Program Standard

89. The Chair advised that, based on the discussion of the EM workshop in 2023, Members were requested to provide their view about availability through EM and actual usage/necessity of data elements required through the CCSBT's Scientific Observer Program Standard (SOPS).

90. The Secretariat presented paper CCSBT-ERS/2406/08 (Rev.1) on Impacts of Electronic Monitoring on ERS data, which summarised the feedback received from Members when assessing the potential impact of EM/S on data currently required as part of SOPS. During the pre-meeting discussion, the meeting was asked to:

- Review the feedback from Member submissions;
- Consider whether there are ERS information gaps, not currently addressed by the existing SOPS, that could be addressed by EM; and
- Consider what changes may be required of the SOPS and, if any, propose these to the ESC.

91. During the pre-meeting discussion, it was suggested that:

- EM is incapable of collecting many of the 'observer' data fields which Members have indicated are necessary;
- With respect to ERS information gaps, consider:
    - The potential for 100% coverage (depending on review) vs observers which typically observe only part of the fishing operations;
    - Verifiable identification of species depending on footage quality;
    - The capability for multiple reviews of captures to increase certainty and verify data; and
    - The ability to target footage review to high risk areas/times/vessels as needed;
- The SOPS could be revised in the following ways:
    - Clarify the numbers and types of ERS species interacted with, including life status;
    - Include hook-shielding devices under 'seabird mitigation measure'; and
    - Include other ERS mitigations besides for seabirds i.e. circle hooks, wire vs nylon leaders.

92. It was pointed out that all the information currently required by the SOPS can be collected through the use of EM/S and the issue becomes one of cost effectiveness where information from other sources, such as logbooks, may be able to provide the information at a lower cost. In some cases, EM/S can exceed the performance of traditional human observers and there may be benefits in updating the SOPS to recognise those instances.

93. It was noted the importance to maintain the consistency between discussions in ERSWG with those discussions currently going on in other tRFMOs.

94. It was noted that consistency across logbook reporting among Members would be important if this information is to be used to supplement EM/S data.

95. Clarification was sought whether the current SOPS allow for the recording of numbers and types of ERS species interacted with, including life status.

96. The meeting agreed to recommend the addition of hook-shielding devices as one of the mitigation types captured as part of the EDE.

Agenda Item 8. Progress on the CCSBT Multi-year Seabird Strategy

97. The Chair advised that EC 29 adopted the CCSBT Multi-year Seabird Strategy (CCSBT-ERS/2406/Info 03), which was recommended by ERSWG 14 in 2021. In the ERSWG 14 Work Program, Members were asked intersessionally to provide the outcome and plans for each activity specified in the Seabird Strategy. The ERSWG was expected to review Members' feedback for each activity and make recommendations for appropriate actions for the Seabird Strategy.

98. The Secretariat presented paper CCSBT-ERS/2406/09, which described the progress on the CCSBT Multi-Year Seabird Strategy. In this paper, the Secretariat compiled feedback from Members, ACAP, and BLI on the current status/progress made and possible next steps, and also provided suggested actions for each action item. In conjunction with these suggested actions, the Secretariat also proposed some amendments to the timeframe for several action items.

99. The meeting recognised that Attachment A of CCSBT-ERS/2406/09 contained items from Actions to achieve the specific objectives of the Multi-Year Seabird Strategy (Action No., Action, Action by, and Timeframe) and items added by the Secretariat as reference information for consideration by the ERSWG (Current Status and Next Step). The meeting agreed to focus on reviewing the items from the original Multi-Year Strategy in ERSWG 15.

100. The meeting noted that the Current Status and Next Step presented in Attachment A of CCSBT-ERS/2406/09 are important information for reviewing the implementation of the seabird strategy and developing the ERSWG 15 work program.

101. The meeting agreed to revise the timeframes for each action item as appropriate, taking into account the progress made on each action and the expected significant workload in ERSWG 16. The meeting agreed to recommend the EC to adopt the revised actions to achieve the specific objectives of the Multi-Year Seabird Strategy, which is shown in **Attachment 8**.

Agenda Item 9. Education and public relations activities

102. Discussion for this agenda item commenced by correspondence in advance of the ERSWG meeting.

103. The Chair advised that the Food and Agriculture Organisation (FAO) funded Seabird Project to Enhance the Implementation of Seabird Measures has been initiated since February 2023. The Chair further advised that Members were expected to consider the work plan for each project element that is related to respective Members and for aligning the schedule between Members' project and the Seabird Project.

104. The meeting noted the importance of aligning the CCSBT's SEFRA Workplan, which was agreed under Agenda Item 5.1.3, and activities related to Element 4: Global Seabird Risk Assessment.

105. The CCSBT Seabird Project Manager presented paper CCSBT-ERS/2406/10, which provided the progress report of the CCSBT Seabird Project. Progress to date on the three active elements of the Seabird Project are covered in this report. Element 1 (Skipper Training) was at two cities in Japan. The International Sustainable Seafood Foundation (ISSF) will co-deliver workshops in Cape Town in mid-July, and in in Kaohsiung in October. Indonesia has not yet indicated when it wants training to occur. For Element 2 (inspector training), CCSBT has contracted the observer and fisheries services agency CapMarine to co-develop coursework. The Project Manager delivered the first E2 workshop in Tokyo in June. Training is also likely to happen in Kaohsiung in October. No other Members have indicated preferences for E2 training. The in-person Inception Workshop for Element 3 (Electronic Monitoring) was attended by representatives from six Members. A key outcome was the request from Members that have not got fully functional EM programs in place to Australia and New Zealand, which have, for bilateral assistance. The Project Manager is actively developing a program of bilateral engagement on EM between the governments of New Zealand and South Africa, and Indonesia recently requested the same. Other Members are encouraged to advise the Project Manager of any EM needs that the Seabird Project could assist in meeting.

106. Japan noted that the Inspector Training coursework was well balanced, practical, non-prescriptive, and encouraged other Members to have their inspectors undergo the training as well as active participation in the Skipper Training.

Agenda Item 10. Review of methodology used to calculate representativeness of scientific observer coverage

107. The Chair advised that, currently, representativeness of scientific observer coverage is calculated as the proportion of Statistical Areas fished that reached the target of 10 % observer coverage as per the recommendation by the Effectiveness of the Seabird Mitigation Measures Technical Group (SMMTG) in 2014. The Chair also advised that the Secretariat's paper CCSBT-ERS/2406/11 provided useful context and background to this issue and now based on the request from the Compliance Committee (CC), the ERSWG is asked to review the current

calculation methodology of the representativeness, and if necessary, to recommend a revised calculation methodology for the CC and the EC's consideration.

108. New Zealand provided a starting point for discussion with a new approach to calculating representativeness via a weighted average approach. A formula was distributed to Members for consideration,

109. Taiwan presented an alternative to the New Zealand proposal, noting a major difference that areas that are at the margin of reaching the 10 % observer coverage, will be considered as part of the calculation.

110. Japan indicated its preference for using a simple approach to tracking nominal observer coverage by CCSBT areas, noting that representativeness is not important in the SEFRA methodology.

111. Considering the current usage of the representativeness indicator, the meeting agreed to retain the simpler calculation of representativeness as it stands.

Agenda Item 11. Terms of Reference of the Technical ERSWG

112. The Secretariat presented paper CCSBT-ERS/2406/12, which proposed a draft Terms of Reference (ToR) for the Technical Ecologically Related Species Working Group (ERSTech). The Secretariat suggested that having a well-defined ToR would provide transparency and clarity in the administration of the group and its communications, including attendance by observers. The Secretariat also advised that these draft ToR were developed taking guidance from those that currently prevail in other CCSBT subsidiary bodies.

113. The meeting agreed to recommend that the EC adopt the ToR for ERSTech, with the addition of a reference to related CCSBT rules on confidentiality and publication of documents submitted to ERSTech. The agreed ToR are shown in **Attachment 9**.

Agenda Item 12. Future work program

114. The ERSWG developed the following workplan. Tasks of an ongoing or administrative nature are not shown unless they are new for 2025.

Activity	Approximate Period	Resource
Share the result of the project investigating new tori line designs once it is completed.	When the work completed	Australia
Indonesia to provide answers to questions to Indonesia's national report by other Members.	As soon as possible	Indonesia
Progress collaborative SEFRA work in accordance with **Attachment 5**	As specified in **Attachment 5**	Members, ACAP, BLI, Secretariat

Activity	Approximate Period	Resource
Safety guidance about HPAI H5N1 zoonotic affecting wild bird populations on how best to handle seabirds in a way that minimises the risk to both the seabird and the fishing crew would be publicly available once completed.	When the work completed	ACAP
Submit the Report from ERSWG on Progress Against Strategic Plan to EC.	EC 31	Secretariat
Develop a list of non-target shark species to be covered by the ERS and Bycatch Action Plan.	ERS Tech 2025	Members
Add hook-shielding devices as one of the mitigation types captures as part of the EDE.	EC 31	Secretariat
Progress Multi-Year Seabird Strategy Action items in accordance with **Attachment 8** including by convening an intersessional working group.	As specified in **Attachment 8**	Members, ACAP, BLI, Secretariat
Members utilise the FAO funded Seabird Project to Enhance the Implementation of Seabird Measures.	2024 - 2025	Members

Agenda Item 13. Other business

115. There was no other business.

Agenda Item 14. Referral of ERS matters for consideration by CCSBT subsidiary bodies

116. In accordance with the ERSWG's Terms of Reference, the full report of the ERSWG will be provided to the Extended Scientific Committee (ESC), which may provide comments on the report to the EC.

117. For the request from CC 18 to review the current calculation methodology of the representativeness, and if necessary, to recommend a revised calculation methodology, the ERSWG agreed, considering the current usage of the representativeness indicator, to retain the simpler calculation of representativeness as it stands.

118. ERSWG also request that CC 18 take note of the revised workplan for the Multi-Year Seabird Strategy and in particular the actions where CC is listed as one of the responsible parties.

Agenda Item 15. Recommendations and advice to the Extended Commission

119. The ERSWG recommends that the EC adopt/agree to the following:

1) The ERSWG has revised its advice on seabirds to the following:

- The level of interaction between seabirds and SBT fisheries remains a significant concern.
- The ERSWG noted that the most recent version of the Spatially Explicit Fisheries Risk Assessment, SEFRA, indicates that Wandering and Royal Albatross species groups are at high risk. Species in these groups are of high conservation concern and ACAP indicated that some populations are in sharp decline.
- The SEFRA indicates areas with higher risk in some parts of the Tasman Sea (especially), Southern Atlantic, and Southern Indian Ocean. These areas account for a large proportion of the modelled risk to seabirds from SBT surface longline fisheries, but contain a very small proportion of SBT surface longline fishing effort.
- Based on the best scientific information available, the ERSWG recommends that CCSBT Members consider taking further actions that would ensure robust seabird mitigation measures and effective monitoring of implementation of the mitigation measures, whilst minimising impacts on SBT surface longline fisheries effort

2) The SEFRA Workplan and its associated resource request;
3) The revised timeframe for the Multi-Year Seabird Strategy Action items;
4) Terms of Reference for the Technical Ecologically Related Species Working Group; and
5) Add hook-shielding devices as one of the specified measures in the ERS Data Exchange.

120. The ERSWG wishes to advise the EC of the following matters:

1) Note the outputs of the most recent SEFRA exercise;
2) There were no specific or additional concerns about shark bycatch that warranted action by ERSWG 15, noting that significant gaps in observer coverage may be impacting ERSWG's ability to assess the impact of SBT Fisheries on sharks;
3) ERSWG has provided the EC with a report back against the objectives and agreed actions contained in the CCSBT Strategic Plan; and
4) ERSWG recommends that the current methodology applied to calculate representativeness be retained without change.
5) ERSWG will be seeking approval from EC 32 on the adoption of an ERS Bycatch Action Plan.

Agenda Item 16. Conclusion

16.1 Recommendation on timing and topic of next technical/in-person ERSWG meetings

121. For the timing of the next ERSTech meeting, the meeting agreed that the meeting would take place around June of next year.

122. The format of the next ERSTech meeting will be in-person and be used to progress SEFRA work and the development of an agreed list of non-target shark species for the ERS Bycatch Action Plan.

16.2 Adoption of meeting report

123. The report was adopted.

16.3. Close of meeting

124. The meeting closed at 15:38 (JST), 7 June 2024.

List of Attachments

Attachment

1. List of Participants
2. Agenda
3. List of Documents
4. Report of the Technical Working Group on CCSBT collaborative risk assessment for seabird bycatch with surface longlines in the Southern Hemisphere
5. SEFRA Workplan, including resource requirements
6. Report from ERSWG on Progress Against Strategic Plan
7. Ecologically Related Species Bycatch Strategy
8. Revised Actions to achieve the specific objectives of the Multi-Year Seabird Strategy Action Plan
9. Terms of Reference for the Technical Ecologically Related Species Working Group

Attachment 1

List of Participants
The 15th Meeting of Ecologically Related Species Working Group

First name	Last name	Title	Position	Organisation	Postal address	Tel	Email
CHAIR							
Martin	CRYER	Dr			679 Wakapuaka Rd, Nelson 7071, New Zealand		cryerm56@gmail.com
MEMBERS							
AUSTRALIA							
George	DAY	Mr	Commissioner	Department of Agriculture, Fisheries and Forestry	GPO Box 858 Canberra ACT 2601 Australia	61 2 6271 6466	george.day@aff.gov.au
Jonathon	BARRINGTON	Mr	Assistant Director	Department of Climate Change, Energy, the Environment and Water	GPO Box 3090, Canberra ACT 2601 Australia	61 439 064 293	Jonathon.Barrington@aad.gov.au
Jeremy	SMITH	Mr	Manager	Australian Fisheries Management Authority	Box 7051, Canberra BC Canberra ACT 2610 Australia	61 2 6225 5407	jeremy.smith@afma.gov.au
David	ELLIS	Mr	CEO	Tuna Australia	n/a	61 427 837 966	ceo@tunaaustralia.org.au
FISHING ENTITY OF TAIWAN							
Ting-Chun	KUO	Dr.	Associate Professor	National Taiwan Ocean University	2 Pei-Ning Road, Keelung 20224, Taiwan	886 2 2462 2192 ext 5603	tckuo@mail.ntou.edu.tw
Simon	LEE	Mr	Secretary	Taiwan Tuna Association	3F No.2 Yu-Kang Central 1st Road Qianzhen Dist. Kaohsiung Taiwan	886 7 841 9606	simon@tuna.org.tw
JAPAN							
Daisuke	OCHI	Dr.	Group Head	Fisheries Resources Institute, Fisheries Research and Education Agency	2-12-4 Fukuura, Yokohama, Kanagawa 424-8633, JAPAN	81 45 788 7931	ochi_daisuke36@fra.go.jp

First name	Last name	Title	Position	Organisation	Postal address	Tel	Email
Hiroki	YOKOI	Dr.	Senior Scientist	Fisheries Resources Institute, Fisheries Research and Education Agency	2-12-4 Fukuura, Yokohama, Kanagawa 424-8633, JAPAN	81 45 788 7932	yokoi_hiroki85@fra.go.jp
Sachiko	TSUJI	Dr.	Advisor	Fisheries Resources Institute, Fisheries Research and Education Agency	2-12-4 Fukuura, Yokohama, Kanagawa 424-8633, JAPAN	81 45 788 7931	sachiko27tsuji@gmail.com
Tetsuya	KAWASHIMA	Mr.	Counsellor	Fisheries Agency Government of JAPAN	1-2-1 Kasumigaseki, Chiyoda-city, Tokyo	81 3 3591 1086	tetsuya_kawashima610@maff.go.jp
Taisuke	IWANO	Mr.	Assistant Director	Fisheries Agency Government of JAPAN	1-2-1 Kasumigaseki, Chiyoda-city, Tokyo	81 3 3591 1086	taisuke_iwano460@maff.go.jp
Mako	IIOKA	Ms.	Assistant Director	Fisheries Agency Government of JAPAN	1-2-1 Kasumigaseki, Chiyoda-city, Tokyo	81 3 3591 1086	mako_iioka540@maff.go.jp
Hiroto	NAKAMOTO	Mr.	Section Chief	Fisheries Agency Government of JAPAN	1-2-1 Kasumigaseki, Chiyoda-city, Tokyo	81 3 3591 1086	hiroto_nakamoto890@maff.go.jp
Hiroaki	ONDA	Mr.	Section Chief	Fisheries Agency Government of JAPAN	1-2-1 Kasumigaseki, Chiyoda-city, Tokyo	81 3 6744 2364	hiroaki_onda990@maff.go.jp
Yuji	UOZUMI	Dr.	Adviser	Japan Tuna Fisheries Co-operative Association	31-1, Eitai 2-Chome, Koto-ku, Tokyo	81 3 5646 2382	uozumi@japantuna.or.jp
Kiyoshi	KATSUYAMA	Mr.	Adviser	Japan Tuna Fisheries Co-operative Association	31-1, Eitai 2-Chome, Koto-ku, Tokyo	81 3 5646 2382	katsuyama@japantuna.or.jp
Hiroyuki	YOSHIDA	Mr.	Director	Japan Tuna Fisheries Co-operative Association	31-1, Eitai 2-Chome, Koto-ku, Tokyo	81 3 5646 2382	yoshida@japantuna.or.jp
Nozomu	MIURA	Mr.	Deputy Director	Japan Tuna Fisheries Co-operative Association	31-1, Eitai 2-Chome, Koto-ku, Tokyo	81 3 5646 2382	miura@japantuna.or.jp

First name	Last name	Title	Position	Organisation	Postal address	Tel	Email
Daisaku	NAGAI	Mr.	Manager	Japan Tuna Fisheries Co-operative Association	31-1, Eitai 2-Chome, Koto-ku, Tokyo	81 3 5646 2382	nagai@japantuna.or.jp
NEW ZEALAND							
Heather	BENKO	Ms	Senior Fisheries Analyst	Ministry for Primary Industries - Fisheries New Zealand	38-42 Bowen St Pipitea PO Box 2526 Wellington 6140	64 9 953 6245	heather.benko@mpi.govt.nz
William	GIBSON	Mr	Senior Fisheries Scientist	Ministry for Primary Industries - Fisheries New Zealand	38-42 Bowen St Pipitea PO Box 2526 Wellington 6140	64 4 819 4759	william.gibson@mpi.govt.nz
REPUBLIC OF KOREA							
Jaebong	LEE	Dr.	Director	National Institute of Fisheries Science (NIFS)	216 Gijanghaean-ro, Gijang-eup, Gijang-gun, Busan 46083, Republic of Korea	82 51 720 2310	leejb@korea.kr
Sanggyu	SHIN	Mr.	Advisor	National Institute of Fisheries Science (NIFS)	216 Gijanghaean-ro, Gijang-eup, Gijang-gun, Busan 46083, Republic of Korea	82 51 720 2327	gyuyades82@gmail.com
SOUTH AFRICA							
Charlene	DA SILVA	Dr	Production Scientist: Sharks	Department of Forestry, Fisheries and the Environment	Foretrust Building, Martin Hammerschlag Way, Foreshore, Cape Town, 8001	27 829 231 063	Cdasilva@dffe.gov.za
Wendy	WEST	Ms	Production Scientist	Department of Forestry, Fisheries and the Environment	Foretrust Building, Martin Hammerschlag Way, Foreshore, Cape Town, 8001	27 761 282 245	wmwest@dffe.gov.za
OBSERVERS							
AGREEMENT ON THE CONSERVATION OF ALBATROSSES AND PETRELS							
Igor	DEBSKI	Dr	Co-Convenor Seabird Bycatch Working Group	Agreement on the Conservation of Albatrosses and Petrels	119 Macquarie St, Hobart TAS 7000, Australia	64 2 7201 3607	idebski@doc.govt.nz

First name	Last name	Title	Position	Organisation	Postal address	Tel	Email
BIRDLIFE INTERNATIONAL							
Stephanie	BORRELLE	Dr	Pacific Marine Coordinator	BirdLife International	205 Glengarry Road, Auckland, New Zealand 0602	64 2 1136 2531	Stephanie.Borrelle@BirdLife.org
Yasuko	SUZUKI	Dr	Senior Marine Speciaist	BirdLife International	1-13-1 Nihonbashi Kakigaracho, Chuo City, Tokyo, 131-0014 Japan	81 3 6206 2941	yasuko.suzuki@birdlife.org
HUMANE SOCIETY INTERNATIONAL							
Nigel	BROTHERS		Consultant	Humane Society International Australia	27 Old Barrenjoey Rd, Avalon, NSW, 2107, Australia	61 429 674 142	brothersbone1@gmail.com
INTERPRETERS							
Kumi	KOIKE	Ms					
Yoko	YAMAKAGE	Ms					
Kaori	ASAKI	Ms					
CCSBT SECRETARIAT							
Dominic	VALLIERES	Mr	Executive Secretary				dvallieres@ccsbt.org
Akira	SOMA	Mr	Deputy Executive Secretary		PO Box 37, Deakin West ACT 2600 AUSTRALIA	61 2 6282 8396	asoma@ccsbt.org
Colin	MILLAR	Mr	Database Manager				CMillar@ccsbt.org
Ross	WANLESS	Dr	Seabird Project Manager				rwanless@ccsbt.org

Attachment 2

Agenda
Fifteenth meeting of the Ecologically Related Species Working Group
4 -7 June 2024
Tokyo, Japan

1. Opening
   - 1.1 Adoption of the Agenda
   - 1.2 Adoption of Document List
   - 1.3 Appointment of Rapporteurs
2. Annual reports
   - 2.1 Members
   - 2.2 Secretariat report on the ERSWG Data Exchange
3. Reports of meetings and/or outcomes of other organisations relevant to the ERS Working Group
4. Review of progress with the work program from ERSWG 14
5. Information and advice on ERS
   - 5.1 Seabirds
     - 5.1.1 Information on stock status
     - 5.1.2 Estimates of ERS mortality and associated uncertainty
     - 5.1.3 Ecological risk assessment
     - 5.1.4 Assessment and advice on mitigation measures
     - 5.1.5 Seabird species identification
   - 5.2 Sharks
     - 5.2.1 Information on stock status
     - 5.2.2 Estimates of ERS mortality and associated uncertainty
   - 5.3 Other ERS
     - 5.3.1 Australia’s update on interactions between recreational SBT fishery and fur seals around Tasmania
6. CCSBT Strategic Plan 2023 - 2028
   - 6.1 Review of Draft ERS and Bycatch Plan

7. Electronic Monitoring
    7.1 High Level Guiding Principles on EM/S for the CCSBT
    7.2 Review of ERS related data elements in the CCSBT's Scientific Observer Program Standard

8. Progress on the CCSBT Multi-year Seabird Strategy

9. Education and public relations activities

10. Review of methodology used to calculate representativeness of scientific observer coverage

11. Terms of Reference of the Technical ERSWG

12. Future work program

13. Other business

14. Referral of ERS matters for consideration by CCSBT subsidiary bodies

15. Recommendations and advice to the Extended Commission

16. Conclusion
    16.1. Recommendation on timing and topic of next technical/in-person ERSWG meetings
    16.2. Adoption of meeting report
    16.3. Close of meeting

Attachment 3

List of Documents
Fifteenth Meeting of the Ecologically Related Species Working Group

(CCSBT-ERS/2406/)

1. Provisional Agenda
2. List of Participants
3. List of Documents
4. (Secretariat) Summaries from the 2023 ERSWG Data Exchange (Rev.1) (ERSWG Agenda Item 2.2)
5. (Secretariat) Progress on Action Items from the ERSWG 14 Workplan (ERSWG Agenda Item 4)
6. (Secretariat) Report against Strategic Plan (ERSWG Agenda Item 6)
7. (Secretariat) Draft Ecologically Related Species and Bycatch Action Plan (ERSWG Agenda Item 6.1)
8. (Secretariat) Impacts of Electronic Monitoring on ERS data (Rev.1) (ERSWG Agenda Item 7.2)
9. (Secretariat) Progress on the CCSBT Multi-Year Seabird Strategy (ERSWG Agenda Item 8)
10. (Secretariat) Seabird Project Progress Report (ERSWG Agenda Item 9)
11. (Secretariat) Calculation Methodology for Representativeness of Observer Coverage (ERSWG Agenda Item 10)
12. (Secretariat) Draft Terms of Reference for the Technical Ecologically Related Species Working Group (ERSWG Agenda Item 11)
13. (SEFRA Technical Group) Report of the Technical Working Group on CCSBT collaborative risk assessment for seabird bycatch with surface longlines in the Southern Hemisphere (ERSWG Agenda Item 5.1.3)
14. ~~(Japan) Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2021 (ERSWG Agenda Item 2.1)~~
15. ~~(Japan) Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2022 (ERSWG Agenda Item 2.1)~~
16. (Japan) Consideration on pragmatic approach for improving the seabird bycatch management based on the findings from the CCSBT collaborative risk assessment results (ERSWG Agenda Item 5.1.3)
17. (Japan) Obstacles in collecting bycaught seabird specimens from observer program during the HPAI pandemic (Rev.1) (ERSWG Agenda Item 5.1.5)

18. (New Zealand) SEFRA high-risk areas discussion paper (Rev.1) (ERSWG Agenda Item 5.1.3)
19. (Taiwan) Preliminary results of seabird mitigation measures' effectiveness for Taiwanese southern bluefin tuna fishing vessels (ERSWG Agenda Item 5.1.4)
20. (ACAP) Conservation Status of Albatrosses and Petrels and Advice on Reducing their Bycatch in CCSBT Longline Fisheries (ERSWG Agenda Item 5.1.1 and 5.1.4)
21. (New Zealand) Antipodean albatross multi-threat risk assessment (ERSWG Agenda Item 5.1.2)
22. (New Zealand) New Zealand version of Report of the Technical Working Group on CCSBT collaborative risk assessment for seabird bycatch with surface longlines in the Southern Hemisphere (Rev.1) (ERSWG Agenda Item 5.1.3)
23. (New Zealand) Changes to the Technical Working Group Report in the NZ Version of the Report (ERSWG Agenda Item 5.1.3)

(CCSBT-ERS/2406/BGD)

1. (New Zealand) Assessing inter-annual variability in Antipodean albatross distribution (*Previously* **CCSBT-ERS/2203/12**) (ERSWG Agenda Item 5.1.2)
2. (New Zealand) Antipodean albatross multi-threat risk assessment (*Previously* **CCSBT-ERS/2203/14**) (ERSWG Agenda Item 5.1.2)
3. (BirdLife International) Global prevalence of setting longlines at dawn highlights bycatch risk for threatened albatross (*Previously* **CCSBT-CC/2310/Info02**) (ERSWG Agenda Item 5.1.4)

(CCSBT-ERS/2406/Annual Report- ）

Australia	Australian Country Report - Ecologically Related Species in the Australian Southern Bluefin Tuna Fishery 2020-21 and 2021-22 (Rev.1)
Fishing Entity of Taiwan	National Report of Taiwan: Ecologically Related Species in the Taiwanese Southern Bluefin Tuna Fishery 2021-2022 (Rev.1)
Indonesia	Indonesia Country Report - Ecologically Related Species in the Indonesian Southern Bluefin Tuna Fishery
Japan	National Report of Japan Overview of Researches on Ecologically Related Species in Japanese SBT Longline Fishery, 2021-2022

New Zealand	Report to the Ecologically Related Species Working Group – New Zealand
Republic of Korea	2024 Annual Report to the Ecologically Related Species Working Group (ERSWG)
South Africa	2024 Annual Report to the Ecologically Related Species Working Group (ERSWG)

(CCSBT- ERS/2406/Info)

1. (Secretariat) Strategic Plan for the Commission for the Conservation of Southern Bluefin Tuna 2023 – 2028 (ERSWG Agenda Item 6)
2. (Secretariat) High-Level Electronic Monitoring/Systems (EM/S) Guiding Principles for CCSBT (ERSWG Agenda Item 7.1)
3. (Secretariat) Multi-year Seabird Strategy (ERSWG Agenda Item 8)
4. (New Zealand) Fine scale overlap of Gibson's Albatross and pelagic longline fishing effort (ERSWG Agenda Item 5.1.2)
5. (New Zealand) Summary of the ongoing review of WCPFC CMM 2018-03 – Conservation and Management Measure to mitigate the impact of fishing for highly migratory fish stocks on seabirds (ERSWG Agenda Item 5.1.4)
6. (New Zealand) Mitigation of seabird bycatch in pelagic longline fisheries: Best practice measures, evidence and operational considerations (ERSWG Agenda Item 5.1.4)
7. (ACAP) Towards mitigation of seabird bycatch: Large-scale effectiveness of night setting and Tori lines across multiple pelagic longline fleets (ERSWG Agenda Item 5.1.4)
8. (ACAP and BirdLife International) ACAP Species Assessment distribution maps: 2024 update (ERSWG Agenda Item 5.1.1)
9. (BirdLife International) BirdLife International's activities related to Seabird measures in RFMOs (ERSWG Agenda Item 3)
10. (BirdLife International) Status of Seabird Conservation and Management Measures in CCSBT related tRFMOs (ERSWG Agenda Item 3)
11. (BirdLife International) Five years of Port Based outreach to improve implementation of seabird bycatch mitigation measures in Fiji (ERSWG Agenda Item 3)

(CCSBT-ERS/2406/Rep)

1. Report of the Thirtieth Annual Meeting of the Commission (October 2023)
2. Report of the Eighteenth Meeting of the Compliance Committee (October 2023)
3. Report of the Sixth Meeting of the Strategy and Fisheries Management Working

Group (July 2023)

4. Report of the Twenty-Ninth Annual Meeting of the Commission (October 2022)
5. Report of the Seventeenth Meeting of the Compliance Committee (October 2022)
6. Report of the Fourteenth Meeting of the Ecologically Related Species Working Group (March 2022)
7. Report of the Twenty-Eighth Annual Meeting of the Commission (October 2021)
8. Report of the Twenty-Seventh Annual Meeting of the Commission (October 2020)
9. Report of the Thirteenth Meeting of the Ecologically Related Species Working Group (May 2019)
10. Report of the Twelfth Meeting of the Ecologically Related Species Working Group (March 2017)

Attachment 4

Report of the Technical Working Group on

CCSBT collaborative risk assessment for seabird bycatch with surface longlines in the Southern Hemisphere

1. BACKGROUND and INTRODUCTION

The issue of substantial interactions between SBT fisheries and seabirds was well recognized even at the time of establishment of the CCSBT in 1994. An initial draft of recommendations on reducing the incidental bycatch of seabirds was developed in 2006 at the 6th meeting of the CCSBT Ecologically Related Species Working Group (ERSWG), which ignited the debate whether the CCSBT can make binding measures for ERS related issues. Subsequently, the 7th meeting of ERSWG could not reach agreement on draft recommendations. The debate around the CCSBT's legal capacity to establish mandatory measures on ERS related matters continued until 2018 when the CCSBT agreed on the Resolution to Align CCSBT's Ecologically Related Species measures with those of other tuna RFMOs at the 25th Annual Meeting, which was updated at the 28th Annual Meeting in 2021.

A Performance Review was conducted in 2008 that criticized the ERSWG and pointed to, at the very least, a need to assess the risks and impacts of SBT fisheries on ERS species and adopt an appropriate mitigation strategy to address those risks and impacts. In response, the 15th Annual Commission meeting in 2008 agreed to develop a non-binding recommendation for the CCSBT covering bycatch mitigation for seabirds, sea turtles and sharks. Additionally, it agreed to develop a Strategic Plan and established Strategy and Fisheries Management Working Group. The Plan was adopted at a Special Meeting held in 2011, which included three items and seven action items under the ERSWG.

In 2014, the Strategy and Fisheries Management Working Group was re-established to discuss revisions of the action plan. At the same time, following the ERSWG recommendation, a small technical group, Effectiveness of Seabird Mitigation Measures Technical Group (SMMTG), was established to provide advice to the ERSWG on feasible, practical, timely, and effective technical approaches for measuring and monitoring the effectiveness of seabird mitigation measures in SBT longline fisheries. Both groups tabled their reports in 2015. The ERSWG took the SMMTG recommendations to progress in two directions: 1) undertaking a global assessment of seabird bycatch collaboratively among all tuna RFMOs through the support of the ABNJ Tuna Project Seabirds component that was concluded in 2019 (Abraham et al 2019)), and 2) developing an ERSWG work plan. The latter led to the development of the CCSBT Multi-year Seabird Strategy, which was adopted at the 26th Annual Meeting of CCSBT.

A range of actions to be undertaken under each specific objective of the Multi-year Seabird Strategy was developed at the 14th meeting of ERSWG in 2021 and adopted by the 29th Annual meeting of CCSBT, which included an action to "update SEFRA seabird risk assessment" (1E) with New Zealand and Japan volunteering to take a leading role intersessionally. This would also allow work to "assess the cumulative impacts of fishing for SBT on seabirds, particularly threatened albatross and petrel species, across tuna RFMOs including developing methods for extrapolating seabird bycatch levels and seabird bycatch rates to identify total mortalities and total mortality rates" (3D) to be undertaken.

New Zealand and Japan held initial discussions in Wellington, New Zealand in June 2022 and agreed on a tentative work plan that included two technical workshops, one online and the other hybrid, and one face-to-face data preparatory meeting (Appendix 1). It was also agreed that the CCSBT collaborative assessment would begin after the completion of a seabird risk assessment of fisheries within New Zealand and would be developed based on the model developed for the New Zealand domestic risk assessment.

Following the decision at the 29th meeting of the Commission to hold one technical workshop before ERSWG-15, the original work plan was modified to hold one combined meeting to review the SEFRA procedure developed by New Zealand and to agree on basic data requirements in 2023, and one assessment meeting online, but with voluntary participation face-to-face without asking the Secretariat for assistance in conducting the meeting.

The first technical workshop (hybrid) was held in Wellington, New Zealand, from 21 to 22 June

2023 with the participation of Australia, Japan, New Zealand and Taiwan. Agreed outcomes from the meeting can be found in Appendix 2. The meeting agreed the first collaborative assessment would be based on the best available science and knowledge and provide a basis for future regular assessments with continuous improvements. The technical workshop agreed a range of basic assumptions, the time-period subject to the analysis, a range of species to be covered, and the temporal and spatial resolutions. The workshop established two expert teams: 1) for reviewing seabird biological parameters and distribution data, and 2) for incorporating modifications agreed at the workshop and evaluating them, together with the draft work schedule.

A review of biological parameters was shared among the group in January 2024. The New Zealand domestic seabird risk analysis was concluded in October 2023 and the program package including seabird observed catch and effort preparation package was provided in late 2023. Thereafter, the individual 'Contracting Party and Cooperating non-contracting parties' (CPCs) processed the observed seabird catch and effort data and ran the model for catchability estimation independently, using each CPCs domestic information.

The second technical workshop (hybrid) was held in Wellington, New Zealand, from 27 to 29 February 2024 with participation from Australia, Japan, New Zealand and Taiwan. The workshop reviewed the model outputs step-by-step and evaluated the reliability/ feasibility of estimated parameters. The workshop noted problems in estimating species-specific catch, mainly due to potential errors in observed seabird identification, and a mismatch in overlap caused by partial coverage of bird density distribution information with tracking data.

Consequently, the workshop agreed to further modify the model by incorporating new aggregation as a species complex for those species difficult to identify at species level. Observed capture and observed overlaps were summed across species within the species complex during the model fitting. Therefore, the model would ignore the species identification confusion within a species complex but would make a prediction of total mortality at species level relying on the overlap information (discussed further in section 4.2). The revised procedure was reviewed at an online discussion held on 4 April 2024 that confirmed general consistencies between the predicted and observed catches with the agreed aggregations.

The technical group examined the outputs of the modified model including the estimates of total bycatch mortalities and corresponding risks at an online discussion held on 23 April, 2024. The technical group noted that at least two of the biological parameters (the number of breeding pairs, and the probability of breeding for some species) show a large shift away from the priors when the model was run (discussed further in the Section 4.3). This would impact on the assessment of catchability estimates and evaluation of relative risks in particular for small albatrosses (mollymawks) and medium petrels, so the model output for those species groups should be interpreted carefully.

This document describes the process and results of the CCSBT collaborative seabird risk assessment for the surface longline fishery using the Spatially Explicit Fisheries Risk Assessment (SEFRA) framework. The document includes the methodology used, assumptions, input data and their preparation, initial review results and subsequent model modifications, and the final outputs. The document is focused on the description of facts and observations and does not include interpretations, particularly on potential implications for CCSBT seabird management.

While the outputs of the SEFRA update are expected to provide a basis for addressing other actions in the CCSBT Multi-year Seabird Strategy, including "to agree on a SBT seabird bycatch target for reducing the level of impact of SBT fishing operations on seabird populations" (1A), to "agree on the list of priority species and corresponding management targets, taking into account the status of seabird population, distributional overlaps with SBT fisheries, and significance of SBT fisheries in their mortality" (1D), and "establish a robust definition of high risk areas that takes into account the precautionary approach" (1F), such considerations are left to the individual CPCs and subsequent discussions at the ERS.

2. METHODS

General model structure and a range of assumptions were agreed to amongst the technical group. The researchers under contract to New Zealand undertook model development and prepared this section. There was some divergence in views amongst the technical group as to the appropriateness of the methodology adopted for parameter estimation.

2.1 General concept of SEFRA

A Spatially Explicit Fisheries Risk Assessment (SEFRA) framework used in this risk assessment was developed and has been utilised in New Zealand as standard procedure to estimate the risk to seabirds and other protected species caused by commercial fishing (Edwards et al. 2023a, Abraham et al. 2017a, b, Sharp 2019) and subsequently applied to the capture of Diomedea albatrosses in southern hemisphere longline fisheries (Ochi et al 2018, Abraham et al. 2019).

The approach is designed to accommodate multiple species and fisheries simultaneously, constructing risk profiles as a function of spatial and temporal overlap. Application has been primarily within the New Zealand Exclusive Economic Zone (EEZ; e.g., Richard & Abraham 2015, Richard et al. 2017, 2020), but, since seabirds migrate widely across the southern hemisphere, a comprehensive assessment of the fisheries risk needs to account for all the fishing effort that may be encountered as they move through international waters. This, as well as the need to inform management outside of the New Zealand EEZ, has motivated application of the method in this wider context.

The SEFRA approach is a quasi-spatial model where temporal and spatial overlap of the seabird distribution and fishing effort are used to predict a catch. Parameterisation of the capture rate per unit of overlap occurs via a fit to fisheries observer capture data, and total captures are calculated by multiplication of the total overlap (including the unobserved component) with this estimated rate (referred to as the *catchability*). Deaths are calculated from the predicted captures using a mortality multiplier that accounts for the probability of dead capture and cryptic mortality. Following estimation of the total deaths, the SEFRA approach attempts to quantify the risk using a limit reference point referred to as the Population Sustainability Threshold (PST; Sharp 2019). For the current project, instead of risk we report the relative mortality per species s as:

$$Relative\ Mortality_s = \frac{Total\ deaths_s}{Maximum\ population\ growth_s}$$

which is equal to the proportion of the theoretical maximum growth rate removed by fisheries bycatch per year. The relative mortality approach still provides the same relative ranking as that achieved using the PST reference point:

$$PST_s = \frac{1}{2} \cdot \varphi \cdot r_s \cdot N_s$$

However, this assessment only considers a subset of total fishing effort and therefore cannot estimate overall risk to the population from fishing. Since the PST reference point is designed to allow a measurement of risk, and includes management related tuning parameters, it was determined that use of this reference point may be misleading.

The maximum population growth is a function of both the population size and productivity:

$$Maximum\ population\ growth_s = r_s \cdot N_s$$

where r_s is the maximum intrinsic population growth rate (i.e., under optimal conditions and in the absence of density dependent constraints), and N_s is the total population size, which we assume in the current setting to be the total number of adults.

To estimate total deaths, first the capture rate per unit of overlap must be paramterised per fishery fleet and species group. To do this the catchability coefficient $\boldsymbol{q}$ is estimated using observed capture and effort data, and then is applied to the total effort to obtain the predicted total seabird catch.

Individual members of the CCSBT are each treated as one fishery fleet, except the joint-venture (JV) operation under New Zealand flag that was handled as a separate fleet based on its characteristics in Japanese operational style under strict management and surveillance under the joint venture arrangement. For those Members with no observed capture data available, the $\boldsymbol{q}$ was obtained from the fleet with the similar operational characteristics, such as operating area and operation procedures, and fishing efforts reported to the CCSBT. The approximation utilised in the current assessment is shown in Table 2.

The assessment was targeted to cover the 27 ACAP priority species. Those species were grouped into six species groups: wandering albatross, royal albatross, small albatross, sooty albatross, large petrel, and medium petrel, according to their feeding behaviour and aggression, and willingness to travel large distances to a fishing vessel. The catchability was shared across species within a species group, assuming that their vulnerability to fishing is a determined by these shared behavioural characteristics. The list of species assessed, along with their species group, is given in Table 1. The fishery coverage of the assessment was defined as surface longline fisheries operated by the CCSBT members in the southern hemisphere, regardless of target species, in the period from 2012 to 2019 inclusive. A first model run assumed constant catchability over the whole time period. For a second model run, the temporal range was divided into two periods, 2012-2016 and 2017-2019, with a separate catchability estimated for each. Because of changes to both the model structure (e.g. monthly biological distributions) and the input data (e.g. updated biological parameters) direct comparisons between these results and those from the previous southern hemisphere risk assessment (Abraham et al., 2019) should not be made. Additionally, changes between the early and late period could be used to quantify any changes in seabird bycatch that may have occurred since 2016, though it would not be possible to assess if these were being driven by changes in fishing practices or seabird abundance. The assessment is able to distinguish between live and dead captures, and estimates deaths assuming mortality of live captures post release. To ensure consistency with the previous assessment, which assumed that all captures led to death of the bird, we applied a 99% mortality rate to live captures (effectively treating all captures as dead). This gives a more precautionary estimate of bycatch impacts. Also, inadequacy of biological and distributional information of immature birds as well as ambiguity in capture data caused difficulty in distinguishing maturity stage and all captured birds were treated as adults.

2.2 Seabirds available to the CCSBT fishery

The seabird population is usually indicated as number of breeding pairs in colonies. Therefore, the information on the total breeding pairs, N_{bp} in the world was translated into the total adult population, N_{adult}, using the probability of breeding $P_{\_breeding}$.

$$N_{adult} = \frac{2 * N_{bp}}{P_{breeding}}$$

Then, the number of adults available to the CCSBT surface longline is determined by multiplying with the probability of being in the southern hemisphere (P_{SH}) first and adjusted with the probability of being breeding and nesting, since seabirds are likely not available for fishery whilst they are attending the nest. Outside the breeding season, the probability of nesting becomes zero (i.e. P_{nest} = 0), and all adults are considered to be available to surface longline fishing. This adjustment is made for each month:

$$N = N_{adult} * P_{SH} * \left[1 - P_{breeding} * P_{nest}\right]$$

The SEFRA requires the number of seabirds available in a certain time (month) and location (grid cell) and therefore need to allocate above mentioned N into each grid cell.

2.3 Estimation of the catchability

The first stage in the estimation of fleet specific catchability and bird specific vulnerability requires estimating overlap between observed fishing events and seabird distributions. This is done by overlaying the relative density of seabirds estimated from available seabird tracking data with observed fishing effort and seabird bycatch information.

The relative density of seabirds can be described using the term, $d_{s,m,x}$, which is derived from the number of individuals of species s in grid cell x in month m (see Section 0). It was treated as a fixed data input to the model. When y_{smx} is the estimated number of individuals in grid cell $\boldsymbol{x}$, and $\boldsymbol{A_x}$ as size of grid cell $\boldsymbol{x}$ in square kilometers, then $d_{s,m,x}$ in grid cell $\boldsymbol{x}$ is:

$$d_{s,m,x} = \frac{y_{s,m,x}}{A_x \cdot \sum_x y_{s,m,x}}$$

The value $y_{s,m,x} / \sum_x y_{s,m,x}$ is treated as the multinomial sampling probability of an individual from species s being in grid cell x during month m. The absolute density, in number of birds per grid cell, is therefore:

$$\mathbb{D}_{s,m,x} = d_{s,m,x} \cdot N_s$$

If fishing effort is allocated to grid cell $\boldsymbol{x}$, and assuming a random distribution of birds and fishing effort within that grid, then the overlap is a measure of the possibility for interaction per grid cell:

$$overlap_{f,s,m,x} = effort_{f,m,x} \cdot d_{s,m,x}$$

The SEFRA process then takes this overlap and sums it by grid cell and month such that the density overlap is:

$$desnity\ overlap_{s,f} = \sum_{x,m} (effort_{f,m,x} \cdot \mathbb{D}_{s,m,x})$$

The observable interactions are referred to as captures and are a function of the catchability ($q_{z,f}$), defined at the level of the fishery fleet f and species group z. Model predicted captures are therefore expected to be:

$$predicted\ captures_{z,f} = q_{z|s,f} \cdot \sum desntiy\ overlap_{s,f}$$

The model is fit to the observed captures with the likelihood is abbreviated as:

$$observed\ captures_{z,f} \sim Poisson(predicted\ captures_{z,f})$$

A problem with this likelihood is that captures may be recorded at a taxonomic level that is higher than the species. Likelihoods are required that fit the model to these low-resolution captures. This also means that the captures recorded for any given species will likely underestimate the total observed captures for that species, because some of those observed captures will have been recorded at, for example, the genus or family level.

To construct a likelihood that is able to accommodate low resolution captures we first defined the cumulative captures. For example the cumulative captures that include genus level identification would be:

$$\text{cumulative captures}_{f,z} = \sum C_{f,genus} + \sum C_{f,species\ complex} + \sum C_{f,s}$$

Using this definition we can then include probability terms that measure the probability that a capture is recorded at a series of lower taxonomic resolutions. In the current model, a capture for species s may be recorded at the species, species complex, genus, family level or phyla. Similarly, the inclusive predicted captures would be the summation of all model-predicted captures for members of that genus. In this case, we require a probability π_G, which refers to the probability of a capture being recorded at the genus level or higher. And we would therefore write, for genus-level captures:

$$\text{inclusive observed captures} \sim Poisson(\text{inclusive predicted captures} \cdot \pi_G)$$

Intuitively, the π_G term accounts for the fact that a proportion 1 - π_G of the captures of any given genus may have been recorded at a taxonomic resolution that is lower than the genus level. For the complete model, a set of ordered probability terms is required: $\pi_S < \pi_C < \pi_G < \pi_F$, referring to the probabilities of being recorded at the species level, at the species complex level or higher, the genus level or higher, or the family level or higher. These probabilities were assumed to be conditional on the fishery fleet and estimated as part of the model fit. As for the genus-level capture likelihood above, likelihood functions were constructed for the other taxonomic resolutions and the model was fitted to the revised likelihoods using the inclusive captures.

The catchability itself is a function of fishery group f and species group z covariates. The fishery group coefficient β_f is centred on the intercept term, with deviations around this intercept constrained to sum to zero. Species group coefficients $\beta_{z|f}$ were specific to the fishery group and were similarly constrained to sum to zero. This allowed the catchability per species group to deviate from the fishery group effect in a fishery group-specific manner.

$$log_{10}(q_{f,z}) = \beta_0 + \beta_f + \beta_{z|f}$$

2.4 Prediction of deaths

Captures are a subset of all the interactions between fishing effort and birds. These captures can lead to death but not all deaths will have resulted from observable captures because they can be cryptic (unobservable even were an observer present). To predict the number of deaths based on the number captures we use a mortality multiplier. This multiplier specifically relates the number of predicted observable captures to the number of deaths. It includes observable dead captures, the rate of cryptic capture per observable capture, and the probability that these cryptic captures lead to death (cryptic mortality). It also includes the death of live captures post-release. For this assessment it was assumed that almost all seabirds that were caught subsequently died (post release survival was set to 0.01). The multiplier was used to scale up the predicted captures to the predicted deaths. During the second technical workshop New Zealand suggested using the surface longline mortality multiplier from the Edwards et al (2023a) assessment.

$$total\ deaths_{s,f,m,x} = q_{z,f} \cdot overlap_{s,f,m,x} \cdot N_s \cdot K$$

For this assessment all captures are considered dead, so there is only consideration of the probability that a capture was observable.

2.5 Maximum population growth rate

The estimated total seabird mortality taken by the CCSBT longline fleets and measured as the number of deaths was then compared with the maximum population growth rate, for the optimal intrinsic population growth rate, r_s, is required. This will allow the deaths to be compared per species in a manner that accounts for their relative productivity levels. First this requires an accompanying distribution for $r_s = \ln(\lambda_s)$. This was achieved using allometric theory as follows. Mean generation time is first approximated as:

$$\bar{T} = A + \frac{S}{\lambda - \mathrm{S}}$$

Allometric theory defines the optimal generation time such that:

$$T_{[opt]} \cdot \ln(\lambda) = k$$

Where $k \approx 1$ is a constant. Therefore, under constant fecundity and assumed optimal conditions we can write:

$$\frac{k}{\ln(\lambda)} = A + \frac{S^{opt}}{\lambda - S^{opt}}$$

$$\lambda = \exp\left(k \cdot \left(\mathrm{A} + \frac{S^{opt}}{\lambda - S^{opt}}\right)^{-1}\right)$$

which must be solved numerically. This provides the so-called demographic-invariant solution for λ (Niel & Lebreton 2005) that has been used in the applications of the SEFRA methodology to date (e.g., Abraham et al. 2017) including this exercise.

A major assumption of this approach is that we have information on the optimum survivorship (S_s^{opt}) and the current age at first breeding (A_s^{curr}) as indicative of the current environmental conditions. These are estimated parameters within the model, each with strongly informed priors.

2.6 Parameter estimation

All estimation was performed within a Bayesian framework using rstan (Stan Development Team 2020). Two chains were run for 2000 iterations each, with the first half discarded. Posterior samples from estimated parameters were inspected visually to ensure convergence of the model. All biological parameters were treated as estimable: N_s^{BP}, P_s^B, S_s^{opt}, A_c^{curr} with strongly informed priors.

Predictor coefficients for the catchability coefficients (β_f and $\beta_{z|f}$) were given standard normal priors. The intercept term β_0 was given improper uninformative priors.

3. DATA

3.1 Seabird biological input parameters

The model required accurate and up-to-date estimates for the biological parameters with associated uncertainties for each species to be analyzed, including population size, breeding probability, proportion of adults on nest, age at first breeding (under current and optimal conditions) and adult survival (under current and optimal condition). Biological inputs to the risk assessment consist of demographic parameters, generally represented with statistical distributions (referred to as priors) and spatial distribution as point estimates without uncertainty. The demographic parameters with distributions can be updated during the model fit, which was of strong concern in the group. The biological information was collated, reviewed and evaluated by many experts, and was more reliable than the bycatch occurrence information fragmentarily collected through observer programs. Additionally, free modification of biological parameters could result in shifting of judgement basis for risk caused by bycatch. Due to the difficulty of completely decoupling updates of the biological parameters, the group accepted placing strong constraints into the modification of biological parameters as a compromise.

A literature review was conducted to update and improve upon demographic parameters summarized in a previous assessment (Edwards et al., 2023) while spatial distributions were based on Devine et al (In Press). Subsequently, the draft input parameters were hosted online by ACAP and a supplementary review was organized with 73 seabird experts invited to review these input parameters and provide input on estimates, uncertainty, and adequate prior distributions. These experts were selected based on their publication record and known involvement with particular species of interest. To facilitate the review, population size, breeding probability, and adult survival were disaggregated per colony (and subsequently reaggregated for use in the model). Further engagement with all experts resulted in a response rate of ~38% and a successful review of all parameters for all target species.

It was cautioned that the bird population dynamic data is incomplete. ACAP reports that gaps in population data remain for globally significant breeding populations at sites that are logistically difficult to access and for species that are particularly difficult to census (ACAP 2024). Nine albatross or petrel species on nine islands groups, estimated to hold >10% of the species' global population, have not had a population estimate in >10 years. Similarly, four species at seven island groups, which account for >5% of the species' total global breeding population, have not been censused since 2012. As an example, New Zealand is assumed to hold 33% of the world population of light-mantled sooty albatross (*Phoebetria palpebrata*), but as this species is notoriously difficult to survey, population estimates rely on incomplete data from the 1970s and 1990s, depending on the island group. Other population parameters, such as breeding probability, are even more limited for these poorly surveyed populations.

The technical group agreed to utilise the updated demographic parameters and their statistical distributions, but use the spatial distribution data synthesized by Devine et al. (in press) and subsequently used in Edwards et al (2023). However, the ongoing need for improved spatial data was flagged for future work.

Part of the review included an investigation into the time periods covered by the data underlying the parameters to assess whether temporal variation in demographic parameters could be included in the model. This investigation revealed that data on demographic parameters for many species are not recorded at temporal intervals on a scale fine enough to allow for the inclusion of temporally varying demographic parameters in the model.

3.2 Seabird distribution information

For the previous iteration of the Southern Hemisphere risk assessment, Devine et al. (2023) used spatiotemporal 3-dimension GAMs to create monthly maps for 28 seabird taxa in the southern hemisphere using tracking data. Distribution maps were only for adults and the adult only model was continued for this risk assessment, as Lonergan et al, (2017) states there is difficulty in distinguishing older immatures/pre-breeders (which may also have well-developed gonads) from adults, even with necropsy. This approach was also considered to be more conservative as all captures would be measured against the adult proportion of the population when evaluating the risk. Tracking data were the preferred data to produce species distributions maps, because of the fine spatiotemporal resolution of the data, and the reasonably good seasonal/spatial coverage of information for most species (i.e., throughout most phases of their respective breeding cycles). Tracking data for most species were requested from individual data owners via BirdLife International. Some tracking data were also retrieved from the Department of Conservation website[1] for Gibson's albatross (*Diomedea antipodensis gibsoni*), northern royal albatross (*Diomedea sanfordi*), Salvin's albatross (*Thalassarche salvini*), and from Dragonfly Data Science for Antipodean albatross (*Diomedea antipodensis antipodensis*).

The 3-dimensional spatiotemporal GAM approach worked well, even when data was relatively sparse. For species for which tracking data was limited (not all major colonies had data), distribution maps were augmented with mapping layers from Carneiro et al. (2020). Only four species had distributions that lacked substantial data from the main colonies.

Expected densities were predicted into a 1-degree cell resolution for each month. Often extremely small but positive values were predicted at the margins of the distribution. This caused, for example, densities predicted across continental boundaries where species were known not to occur, such as across the southern tip of South America. A manual soap film boundary was constructed, where values less than the 40th percentile ($<10^{-5}$) were set to 0. Data were then aggregated at a 5-degree cell resolution, and

[1] https://docnewzealand.shinyapps.io/albatrosstracker/

then the same rule applied, i.e. density values below the 40th percentile (<10^{-5}) were set to 0, to remove data where only a few 1-degree cells contributed to the 5-degree cell. This resolved the issues in predicting distribution at the margins such that predictions did not cross continents.

A review of biological inputs to the seabird risk assessment of Edwards et al. (2023) was undertaken as part of the collaborative update to the assessment. This review was coordinated by the Department of Conservation (New Zealand) and sought feedback from international experts on the species-specific distribution maps. Notable issues with the distributions and recommendations for future work can be found in Table A.6 of Edwards et al (2024).

3.3 Seabird bycatch and effort from surface longlines

The assessment utilised the observed monthly catch and effort data provided by the participating CPCs in the calendar years for 2012 to 2019. The spatial resolution used was decided by each CPC, though ultimately 5x5 degree cells were used. Individual CPCs compiled their own data using the package provided by the modeling team that allowed direct inputs into the model, as well as compilation into one combined file. The time periods selected (2012-2016 and 2017-2019) were chosen to allow a comparison between the previous assessment (2012 – 2016) and evaluation of change afterward (2017 – 2019). Onboard observer programs were drastically reduced and/or ceased for high-sea operating fleets due to movement constraints during the COVID-19 pandemic from 2020 to 2022, which meant that these data could not be incorporated into the analysis. Japan, New Zealand and Taiwan provided the observed catch and effort data. New Zealand joint venture information was added only for reference purposes with the previous assessment and did not include any information for the later period.

Australia encountered problems with domestic data confidentiality rules, as well as allocating species identification since the chosen time period corresponded to a shift towards using Electronic Monitoring. The provision of Australian longline fishery seabird bycatch and fishing effort data to the project was not possible due to timing. Under the Australian Government's information disclosure policy, agreements are established to protect confidential information. An agreement has been prepared for the project that will allow the inclusion of Australia's data in future, as this assessment is updated. For this round of assessment, Australia agreed to apply the catchability coefficient estimated for New Zealand as an initial approximation, based on the same coastal nature of its fishing operation.

South Africa indicated its intention to provide the observed catch and effort data at a late stage of the assessment process. Time constraints prevented this occurring and South Africa expressed its continued commitment to participate in the process in future. Additionally, South Africa expressed keen interest and enthusiasm to actively engage in future seabird risk assessment opportunities and projects. South Africa's pelagic longline fleet has on average 21 local flagged vessels active each year, and only one Joint Venture Japanese vessel with no Joint Venture operations having taken place in 2022 and 2023. Observer coverage in recent years across the fleet has typically been around 20% of hooks set for operations covering the entire coastline, i.e. CCSBT areas 9, 14 and 15. Scientific observers report on all seabird interactions during fishing operations to the species level where possible and provide a description of the fate of each seabird. South Africa's dedicated Offshore Resource Observer Programme (OROP) ran from 2002 to 2011. Since then, vessels have been deploying RFMO recognized and accredited observers at their cost. Therefore, historical observer data are available from 2002 to the current year. Additionally, vessels have been reporting on their interactions with seabirds in their skipper logbooks since 2015, indicating to species level when possible and the fate of seabird as dead or alive. South Africa will continue to collect these data and is willing to process these data into the required format for future risk assessment projects.

Neither Korea nor Indonesia participated in the process described in this report.

The seabird bycatch and effort data from Taiwanese longline vessels spanning 2012 to 2019 were sourced from two datasets: 1) observer records for seabird bycatch and observed effort, and, 2) logbooks and e-logbooks documenting fishing effort. All Taiwanese tuna longline vessels, regardless of size or target species, were considered the same fleet (TW). While the observer data aimed to identify seabird bycatch to the species level, Gibson's albatross was not differentiated from other species, likely resulting in being recorded as Antipodean albatross or similar species. Observers were restricted to a maximum of eight working hours during hauling, resulting in incomplete hook observations. Hence, the observed number of hooks were provided. Fishing effort data consisted of logbook-recorded number of hooks set from 2012-2016, while e-logbook data provided effort information for 2017-2019, as e-logbook implementation began in 2017. In Taiwan's data, the Gibson's and Antipodean albatross were reported as Antipodean, since there is no code assigned to Gibson's in Taiwanese observer reporting forms. Therefore, a 'Gibson's and Antipodean albatross' group was created for this analysis.

While it is ideal for all seabird catch to be identified to a species level, both Japanese and Taiwanese data contained a substantial amount of data with species aggregation as shown in Table 3. About 80% of seabird catch reported was within one species group, though reporting in family level crossed multiple species groups; Diomedeidae for four and Procellariidae for two. Over 96% of reported seabird catch was considered to belong either to Diomedeidae or Procellariidae which covers the 27 ACAP species in this assessment, even when assuming that all catch reported as generic "birds" falls outside these two categories.

Regarding total effort under CCSBT, the technical group agreed to utilise the effort information maintained by the CCSBT Secretariat unless the CPC provides updated information on longline effort in the southern hemisphere for all targets. Japan and Taiwan provided the corresponding data for their respective southern hemisphere longline effort. The RFMO data contained surface longline effort from Australia, Indonesia, Korea, New Zealand and South Africa. The total effort of Japan and Taiwan was updated to be included in the model.

4. RESULTS

4.1 Review of initial catchability coefficient estimates (q) and their reliabilities

Initial models were fitted to each CPC's observer dataset in isolation, as well as to a combined dataset including observer data from all participating CPCs. First, the behavior of direct model output, i.e. the catchability coefficients estimate, was examined against the source data used. The results obtained with the combined dataset were compared with those obtained when only one CPC's input data was used, to evaluate the impacts of partial spatial data coverage. The results indicated that the model could predict the catchability coefficients relatively well even with data of spatially limited coverage, e.g. NZ (Table 5 and Figure 1). The technical group considered it preferable to utilise the combined dataset expecting complementary effects of fulfilling missing components, and that this would also give an assurance for a model capacity to combine model outputs after running a model independently when and where data sharing would be restricted. It was agreed to utilise the combined data set for all the analyses afterwards.

Figure 2 shows species group-specific and fleet-specific catchability coefficients obtained with combined data. The Figure indicated unrealistically high catchability for the Japanese fleet on the large petrel group, and to a lesser extent on the sooty albatross group. Those two groups also indicated large uncertainty in estimates for New Zealand's domestic fleet. This was considered potentially to be driven by a mismatch between seabird capture data and distributional information obtained from tracking, namely that the tracking data used for southern giant petrel only accounted for less than 30% of the world population and northern giant petrel was missing tracking from the Pacific Ocean representing >20% of the world population. For the Japanese fleet the model estimated unrealistically high values for *q* to explain catch occurring in areas with low estimated population density and limited observations in the cells with density overlap. For the New Zealand fleet there were no observed captures of either species of giant petrel for the model period.

Figure 3 shows a comparison of species group-specific catchability standardised with fleet-specific catchability that should indicate a general pattern in vulnerability among species groups. However, the Figure did not show any consistent pattern other than a similarity between small albatross and medium petrel groups. The New Zealand joint venture fleet was in fact an operation by the Japanese vessels within New Zealand waters and operated in the same way as the Japanese fleet, and therefore both are expected to show a similar pattern in catchability coefficients among species groups. However, the pattern did not show any particular consistency, which raised a concern on plausibility of assumptions on the similarity of catchability according to the operational characteristics' similarity, the basis of utilizing *q* obtained from alternative fleet when no observed catch and effort data is available. This emphasized the importance of all CPCs participating in the collaborative analysis with their own data being incorporated.

4.2 General examination of initial model outputs – comparison between predicted and observed values for observed catch by species

The technical group examined the prediction of an observed capture against the observed seabird capture used as an input. The model predicted the observed seabird capture based on estimated catchability coefficient of certain fleet and species group-specific, together with species specific overlap density given as an input and observed effort information. Through species-specific density overlap, the species group level estimation would translate into a catch estimate at species level. Since the process relies heavily on the credibility of density overlap mainly derived from tracking data, the discussion here was conducted in conjunction with consideration on reliability of species identification and distribution data derived from tracking data.

The model prediction on observed seabird capture by species is shown in Table 6, against all data provided. According to the methodology description, the model fitted by species group, if so, the prediction at species group level should be also available. The results were examined together with general consideration of species identification difficulty and reliability of temporal-spatial seabird distribution maps (Table 7).

The empirical data used in the model reflects the best available evidence but are nevertheless incomplete. Species distributions were derived from tracking data requested from individual data owners via BirdLife International. Some tracking data was also retrieved from the Department of Conservation's website. Seabird tracking activities have only occurred at a subset of known seabird breeding sites, while tracking efforts globally are ever increasing (Bernard et al. 2021). Some tagging studies are focused on adult birds and as such there is limited data available for juveniles, immatures, and pre-breeders, which can comprise up to 55% of seabird populations (Carneiro et al. 2020). The assessment in this report compensates this by using a conservative approach of assuming that every bycaught bird is an adult. However, this does not negate the potential impacts of species where tracking of other life stages is not available, and for these species the current model may be omitting important areas for these other life stages.

The seabird distributions derived from tracking studies used in this report may under-represent the actual distributions of seabirds, at least for some species. For example, the distribution of Campbell black-browed albatross (*Thalassarche impavida*) is based on limited short-term tracking efforts (Sztukowski et al. 2017). The distribution of grey-headed albatross (*T. chrysostoma*) and light-mantled sooty albatross are biased towards the tracking efforts conducted in the Atlantic Ocean, while substantial populations persist in the Pacific Ocean, which remain poorly tracked to date (Cleeland et al. 2019, Goetz et al. 2022). Similarly, both

Giant Petrel species are under-represented due to the limitations of the available tracking data, particularly the lack of tracking of northern giant petrels (*Macronectis halli*) in the Pacific. Giant petrel data were largely under-represented and therefore removed from the final model.

Tracking coverage for the Antipodean albatross (which contains extensive tracking for all life and breading stages), Tristan albatross (*D. dabbenena*), Indian yellow-nosed albatross (*T carteri*), New Zealand white-capped albatross (*T. steadi*), Salvin's albatross, Chatham albatross (*T. eremita*), black petrel (*Procellaria parkensoni*), and white-chinned petrel (*P. aequinoctialis*) were considered adequate from the review of the data. For a number of species including Gibson's albatross, wandering albatross (*D. exulans*), southern royal albatross (*D. epomophora*), shy albatross (*T. cauta*), southern Buller's albatross (*T. bulleri bulleri*), light-mantled sooty albatross, grey petrel (*P. cinerea*) and Westland petrel (*P. westlandica*) additional tracking data have become available since the publication of Devine et al. (In Press). The review undertaken by the experts provided clear guidance on the priorities for future revisions of the distribution maps.

Bird specialists considered that there is a false sophistication in the identification of species bycaught in SBT fisheries. At-sea identification of dead seabirds is problematic. Species differentiation between juveniles of similar species (e.g. among giant albatross, mollymawk and petrel species) is difficult. Additionally, the condition of the retrieved birds can hinder their identification, for example, if a bird is damaged or waterlogged.

It was noted the extremely low occurrence of certain species from the areas of well-known overlap was likely caused by reporting practices of those species which are difficult to distinguish from each other. The technical group considered that a false sophistication in species identification could distort the whole picture and it would be preferrable to reflect the existing difficulty into the model. The group also considered that a large divergence between predicted and observed values and catchability coefficient estimations of giant petrels was mainly caused by lack of density overlap information in the time and area where the majority of captures occurred.

Ultimately, the technical group agreed to introduce a concept of species-complex for those species difficult to distinguish and to disregard the species identification label attached to the capture records. Accordingly, the group agreed to treat all members of the wandering albatross group as one species complex and that the species allocation of predicted catch would be made based on the density overlap per species since the reliability of distribution maps of this group is quite high. Similarly, two yellow-nosed albatrosses, shy albatross and New Zealand white-capped albatross, Southern and Northern Buller's albatrosses (*T. b. platei*), and three medium petrels (black, Westland and white-chinned) would be treated as a species-complex, respectively. The agreed species-complex covers a large portion of data reported under the aggregated species by Japan and Taiwan.

It was also agreed to drop the giant petrel group from this round of assessment, considering their relatively healthy stock conditions with less concerns together with a large gap in tracking data, and mismatches with bycatch occurrence time and areas.

While fitting the model to predicted observable captures it was noted that for several species, such as the wandering albatross, high numbers of captures were occurring in areas of low species density. For the New Zealand domestic risk assessment, where certainty around identification is high, predicted observable captures at the species level were calculated using the term π which portioned out the predicted captures based on the proportion of observed species identification. Due to uncertainty in species level identification for some observed captures this term was not used as a diagnostic for the model fit. This was however found to be useful for assessing limitations around species identification in observed captures.

4.3 Modifications introduced and corresponding results

The outputs of the modified model were presented at an online meeting held on 4 April 2024 for estimation of catchability coefficients and examination of predicted and observed capture data, and an online meeting on 18 April 2024 for estimation of total seabird bycatch mortality and its risk.

The model was run with two conditions: 1) with a constant catchability over the whole time period (i.e. 2012-2019), and 2) with two catchability estimates for an early (2012-2016) and late (2017-2019) period. The former corresponded roughly to the years that were utilised in the 2019 assessment. The results section is split into two parts. In the first part we provide model fit diagnostics and estimates of the catchabilities. In the second part we provide model outputs, including estimates of the total number of deaths and risk.

Convergence of the model with a single time period was good (Figure 4), and the model was able to reproduce the number of observed captures per code (Tables 10, 11 and Figure 5). Figure 10 showed fits to the observed data for both runs with the one time period and two time periods models. Both models were able to fit the data. No obvious issues in the model fit arose for the two-period model, despite the reduced size of data available for each period. This indicates the possibility to assess the temporary change in catchability when at least three years of data is available.

The group noted that the biological parameters, in terms of number of breeding pairs and the probability of breeding, showed large shifts through the model fitting process (Figures 8a and 8b). The number of breeding pairs of black-browed albatross (DIM) and white-chinned petrel (PRO) dropped substantially, while New Zealand white-capped albatross (TWD) and grey petrel (PCI) showed visible increases in posteriors. Alternatively, the probability of breeding of Campbell black-browned albatross (TQW), grey-headed albatross (DIC) and southern Buller's albatross (DSB) dropped to almost zero and that for Indian yellow-nosed albatross (TQH), New Zealand white-capped albatross (TWD), and light-mantled sooty albatross (PHE) was reduced by two-thirds to a half. The probability of breeding of grey petrel (PCI) and Westland petrel (PCW) also showed visible declines. The level of change indicates that the model is forcing the priors to update unrealistically to ensure that q is constant throughout the species group. It was noted that substantial updates frequently occurred in small albatrosses and medium petrels. The same diagnosis existed from the initial model, indicating that the issues identified here would apply to all analyses included in this document. Due to the structure of the model, the strong updates to biological prior distributions for the effected species had a limited effect on other species within the same catchability group, for which adequate fits to observations were achieved without implausible updates to the prior distributions.

Both parameters influence the estimates of number of vulnerable birds available for capture by the fishery and are therefore co-estimated with the catchability parameters. The posteriors typically matched the input prior values. When the prior is updated, it indicates that the number of vulnerable birds needs to be adjusted to fit the observed data. Species may share catchability, but the overlap per species is fixed on input. If the overlap is a poor predictor of the catchability, then the number of vulnerable individuals may need to be adjusted by updating the biological priors. The prior updates therefore provide an indication of where the overlap data are inconsistent with the captures.

The discussion indicated many drawbacks and limitation of spatiotemporal distribution solely derived from spatially or temporally biased tracking data. The model treated density overlap with the species distributions derived from tracking data as no associated error and forced all the other parameters to fit it, which caused this situation. It is also possible that bycatch of juveniles, immatures and pre-breeders, which make up a significant portion of the population, is requiring the model to increase the adult portion of the population to compensate. It should be noted that some previous assessments utilised seabird distribution based on combined information obtained from tracking data, general distribution range and hypothetical bird distribution around breeding areas which had a much broader range. An alternative way of improving model-fit other than updating biological parameters should be taken into consideration as an option for future improvement of the model.

The review of the species distributions has identified a clear need to update the distributions using both existing tracking data, and the collection of further tracking data from colonies that currently lack tracking, which would require substantial time and resourcing. Those biological parameters were used not only to predict the number of vulnerable birds to longline fishery bycatch, but also as a basis for assessing the risk of bycatch.

Specifically, prior information on the biological values was used to estimate population growth yet these may be conservative in scenarios where high proportions of juveniles, immatures and pre-breeders have different distributions as adults, as may be the case in the Tasman Sea. As the species distributions do not fully capture these life cycle stages and may be spatially or temporally biased for some selected species, caution should be used when interpreting results.

Posterior plots of the catchabilities per species group and fishery group are shown in Figure 9 and in Table 9. The width of the boxplots indicates both the quantity and consistency of the data (large amounts of data that are consistent with the model structure will usually generate less uncertainty in the posterior). The NZ (JV) fleet has the lowest catchabilities, and the JPN fleet has the highest. The NZL (DOM) and TWN fleets have intermediate catchabilities. The relative catchability per species group differs per fleet, but typically medium petrels and mollymawks have lower catchabilities, whereas the wandering albatross, royal albatross and sooty albatross have higher catchabilities.

Comparative catchabilities for each of the early and late time periods, per species group and fishery group, is shown in Figure 7.

The predicted total number of annual deaths with cryptic deaths per species is listed in Table 12, together with cryptic deaths, productivity index based on both priors and posteriors of biological parameters and corresponding relative mortality. The productivity index is calculated as the maximum intrinsic growth rate multiplied by the number of adults per species. The global spatial distributions of deaths per catchability estimate (i.e., per estimated fishery group and species group) are illustrated in Figure 9.

Relative mortalities per time period for the two-period model are illustrated in Figures 11 and 12, where the prior demographic information is used as basis of population growth. Total mortality prediction is in Table 13. Relative mortality rates were broadly consistent for the two periods, though with differences observed for some species, for example increases in relative mortalities for sooty albatrosses in the later period. The time period-specific relative mortality rates are influenced by a number of variables, including the relative levels of total effort by the different fleets, the spatial distribution of their effort relative to the distribution of the seabird populations, as well as the estimated catchabilities. Additionally, the biological inputs to the risk assessment model were time invariant. This complicates interpretation of model runs with time-period specific catchabilities, as catchabilities are confounded with the size of the population available for capture in fisheries.

Table 14 shows a comparison of the assessment of total mortality obtained from this analysis and that of 2019 (Abraham et al. 2019). It should be noted that there are a number of differences in the methodology applied in this analysis compared to that from 2019. While the 2024 analysis utilised updated biological inputs, the 2019 assessment fixed biological parameters. Additionally, the observed catch and effort used was different between the two analyses. While the 2019 analysis applied Japan's estimated catchabilities (which is the highest among Japan, Taiwan, and New Zealand) to all fleets that did not contribute observer data (i.e. Korea, Indonesia, and Taiwan), the catchability obtained from Japan was only applied to Korea in 2024. On the other hand, the 2019 assessment utilised the observed catch and effort data from Australia and South Africa which showed substantially lower estimated catchability than New Zealand. These two CPCs were approximated using the catchability estimated for the New Zealand domestic fleet in the 2024 assessment.

Despite technical differences in input data and model structures, the results of this collaborative assessment are broadly consistent, particularly in 1) high risk to species from the Wandering albatross species group, 2) importance of the Tasman area as an area with an elevated risk profile, and 3) the same four of the five species identified as most at risk. It should be noted that Abraham et al (2019) indicated general consistency with other previous assessments (e.g. Peatman et al. (2019), Richards et al (2024)). The group also noted that the more substantial differences in total mortality estimates were observed for those species with substantial updates in biological parameters observed.

4.4 Code errors detected after the conclusion of Group discussion

Code errors in compiling observed catch and effort data for medium petrel species group and Procellariidae were detected and updated outputs were shared. Comparison of catchability estimates in Table 8. A comparison between the model fit is provided in Figure 13 and a comparison between the estimated of total deaths are provided in Figure 14.

These outputs indicated; 1) compilation errors for "Medium petrel species group" and "Procellaridae" was fixed, 2) the model exclude giant petrels from Procellaridae catch and effort information, as well as those for the Birds, and 3) despite the correction was made only to petrels, it affected the catchability estimates of other species groups. The last point suggested the potential importance of amount of observed catch and effort data actually utilized in the model to catchability estimates, which then raised several questions, including 1) whether the initial model output included observed catch and effort data of aggregated species, and 2) impacts of removing giant petrels catch and effort data from the model. They were quite fundamental questions relating with general credibility of the model outputs, but it would be difficult to evaluate with the information shared during the process. The procedures used in handling species aggregates for catchability estimation was also questioned.

Because PRZ captures were being lost, this caused a drop in the catchability. With The updated model indicated the increase of the catchability, and then total mortality, for the medium petrel species group, corresponding to the inclusion of additional catch and effort data in species-complex and Procellariidae. The impacts on the other species catchability and total mortality estimates were relatively minor, though there is divergence in views on their implications.

Output based on updated runs were indicated in the caption, with a comparison to those prior to the code correction provided when needed. All figures included in the report were updated with the outputs of the final runs. Due to other problems including the issues of biological parameters updates as well as mismatch of bird distribution and observed catch occurrences, the group already decided not to consider on the medium and giant petrel species groups in this round of analysis. Noting that the impacts of updates on wandering and royal albatrosses was minor, the group agreed that this update would not cause substantial impacts on the general conclusions previously reached.

5. CONCLUSIONS, REMAINING ISSUES AND NEXT STEPS

This process was useful in developing mutual collaboration and understanding among colleagues with different expertise. An increased number of participants expressed their intention to contribute data to the next iteration. Many participants deepened their understanding of the nature of the SEFRA and its potential and limitations, as well as the limitation of currently available information to support the model. All participants agreed that it would be beneficial to maintain the current momentum at least to ensure delivery of the first collaborative risk assessment result.

While there are unresolved issues, there remain three things which require urgent attention: 1) archiving codes and input data in an accessible and workable way, 2) modification of the model to resolve the issues in relating to updating biological parameters and, and 3) preparing observed seabird catch and effort data for those CPCs that have not yet done so. To make this possible, it is important to formalize the process as a CCSBT activity with clear Terms of Reference and responsibilities, though recognizing that the current assessment process was supported with informal and voluntary contribution of all the participating CPCs and institutions.

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Table 1: Species and catchability groups used in the southern hemisphere risk assessment model. Note that the final model applied species-complex and excluded the Southern and Northern giant petrels catch data from the model (see Section 4.2 for details).

Species code	Common name	Scientific name	Species group	Species-complex
DIW	Gibson's albatross	*Diomedea antipodensis gibsoni*	Wandering albatross	Wandering albatross complex
DQS	Antipodean albatross	*Diomedea antipodensis antipodensis*	Wandering albatross	Wandering albatross complex
DIX	Wandering albatross	*Diomedea exulans*	Wandering albatross	Wandering albatross complex
DBN	Tristan albatross	*Diomedea dabbenena*	Wandering albatross	Wandering albatross complex
DAM	Amsterdam albatross	*Diomedea amsterdamensis*	Wandering albatross	Wandering albatross complex
DIP	Southern royal albatross	*Diomedea epomophora*	Royal albatross	Royal albatrosses
DIQ	Northern royal albatross	*Diomedea sanfordi*	Royal albatross	Royal albatrosses
DCR	Atlantic yellow-nosed albatross	*Thalassarche chlororhynchos*	Small albatross	Yellow-nosed albatrosses
TQH	Indian yellow-nosed albatross	*Thalassarche carteri*	Small albatross	Yellow-nosed albatrosses
DIM	Black-browed albatross	*Thalassarche melanophris*	Small albatross	Black-browed albatrosses
TQW	Campbell black-browed albatross	*Thalassarche impavida*	Small albatross	Black-browed albatrosses
DCU	Shy albatross	*Thalassarche cauta*	Small albatross	Shy-type albatross
TWD	New Zealand white-capped albatross	*Thalassarche cauta steadi*	Small albatross	Shy-type albatross
DKS	Salvin's albatross	*Thalassarche salvini*	Small albatross	
DER	Chatham Island albatross	*Thalassarche eremita*	Small albatross	
DIC	Grey-headed albatross	*Thalassarche chrysostoma*	Small albatross	
DIB	Southern Buller's albatross	*Thalassarche bulleri bulleri*	Small albatross	Buller's albatross
DNB	Northern Buller's albatross	*Thalassarche bulleri platei*	Small albatross	Buller's albatross
PHU	Sooty albatross	*Phoebetria fusca*	Sooty albatross	
PHE	Light-mantled sooty albatross	*Phoebetria palpebrata*	Sooty albatross	
MAI	Southern giant petrel	*Macronectes giganteus*	Giant petrels	
MAH	Northern giant petrel	*Macronectes halli*	Giant petrels	
PCI	Grey petrel	*Procellaria cinerea*	Medium petrel	
PRK	Black petrel	*Procellaria parkinsoni*	Medium petrel	Petrel complex
PCW	Westland petrel	*Procellaria westlandica*	Medium petrel	Petrel complex
PRO	White-chinned petrel	*Procellaria aequinoctialis*	Medium petrel	Petrel complex
PCN	Spectacled petrel	*Procellaria conspicillata*	Medium petrel	Petrel complex

Table 2: Fleet-specific catchability and proxy values

Fleet	Catchability utilised
Australia	New Zealand domestic
Indonesia	New Zealand domestic
Japan	Japan
Korea	Japan
New Zealand domestic	New Zealand domestic
New Zealand joint venture	New Zealand joint venture
South Africa	New Zealand domestic
Taiwan	Taiwan

Table 3. Observed seabird catch data of Japan and Taiwan with their reported identification.

Species code	Common name	Scientific name	Sp Grp	JPN all	JPN early	JPN late	TWN all	TWN early	TWN late
DIW	Gibson's albatross	*Diomedea antipodensis gibsoni*	1	32	24	8	na	na	na
DQS	Antipodean albatross	*Diomedea antipodensis antipodensis*	1	3	3		na	na	na
	Gibson's and Antipodean albatross						6	4	2
DIX	Wandering albatross	*Diomedea exulans*	1	162	91	71	48	26	22
DBN	Tristan albatross	*Diomedea dabbanena*	1	14	8	6	0	0	0
DAM	Amsterdam albatross	*Diomedea amsterdamensis*	1	0	0	0	0	0	0
	Wandering albatross complex		1	131	107	24			
		SPECIES GROUP 1 TOTAL		**342**	**233**	**109**	**54**	**30**	**24**
DIP	Southern royal albatross	*Diomedea epomophora*	2	12	11	1	1	0	1
DIQ	Northern royal albatross	*Diomedea sanfordi*	2	2	2		3	2	1
	Royal albatrosses		2	7	5	2			
		SPECIES GROUP 2 TOTAL		**21**	**18**	**3**	**4**	**2**	**2**
	Diomedea spp		1,2	26	25	1			
		***Diomedea* spp TOTAL**		**389**	**276**	**113**	**58**	**32**	**26**
CDR	Atlantic yellow-nosed albatross	*Thalassarche chlorothynchos*	3	8	7	1	85	72	13
TQH	Indian yellow-nosed albatross	*Thalassarche carteri*	3	138	108	30	63	42	21
	Yellow-nosed albatrosses		3	59	11	48			
DIM	Black-browed albatross	*Thalassarche melanophris*	3	301	180	121	101	92	9
TQW	Campbell black-browed albatross	*Thalassarche impavida*	3	170	111	59	12	9	3
	Black-browed albatrosses		3	312	160	152			
DCU	Shy albatross	*Thalassarche cauta*	3	0	0	0	4	4	0
	Shy-type albatross		3	796	429	367			
TWD	New Zealand's white-capped albatross	*Thalassarche cauta steadi*	3	0	0	0	34	22	12
DKS	Salvin's albatross	*Thalassarche salvini*	3	0	0	0	8	0	8

Table 3. [Continued]   Observed seabird catch data of Japan and Taiwan with their reported identification.

Species code	Common name	Scientific name	Sp Grp	JPN all	TWN early				Sp Grp
DER	Chatham Island albatross	*Thalassarche eremita*	3	3	1	2	0	0	0
DIC	Grey-headed albatross	*Thalassarche chrysostoma*	3	840	656	184	17	15	2
DSB	Southern Buller's albatross	*Thalassarche bulleri bulleri*	3	0	0	0	0	0	0
DNB	Northern Buller's albtatross	*Thalassarche buller platei*	3	9	8	1	0	0	0
	Buller's albatross		3	780	398	382	4	1	3
	Thalassarche spp.		3	267	257	10			
		SPECIES GROUP 3 TOTAL		**3683**	**2326**	**1357**	**328**	**257**	**71**
PHU	Sooty albatross	*Phoebetria fusca*	4	134	52	82	61	43	18
PHE	Light-mantled sooty albatross	*Phoebetria palpebrata*	4	95	56	39	6	4	2
	Phoebetria spp		4	4	3	1			
		SPECIES GROUP 4 TOTAL		**233**	**111**	**122**	**67**	**47**	**20**
	Diomedeidae		1,2,3,4	822	456	366	170	169	1
		***Diomedeidae* TOTAL**		**5101**	**3144**	**1957**	**623**	**505**	**118**
MAI	Southern giant petrel	*Macronectes giganteus*	5	94	60	34	7	4	3
MAH	Northern giant petrel	*Macronectes halii*	5	88	51	37	3	3	0
	Macronectes spp.		5				1	1	0
		SPECIES GROUP 5 TOTAL		**182**	**111**	**71**	**11**	**8**	**3**
PCI	Grey petrel	Procellaria cinerea	6	152	89	63	3	2	1
PRK	Black petrel	*Procellaria parkinsoni*	6	5	3	2	0	0	0
PCW	Westland petrel	*Procellaria westlandica*	6	4	4	0	1	1	0
PRO	White-chinned petrel	*Procellaria aequinoctialis*	6	407	186	221	190	132	58
PCN	Spectacled petrel	*Procellaria conspicillata*	6	44	24	20	53	53	0
	Precellaria spp		6				25	24	1
		SPECIES GROUP 6 TOTAL		**612**	**306**	**306**	**272**	**212**	**60**
	Procellariidae		5,6	165	110	55	14	2	12
		Procellariidae TOTAL		959	527	432	297	222	75
	Birds		?	223	209	14	8	8	0

Table 4: Total effort by fleet in 1000 hooks

Year	AUS	JPN	KOR	NZL	TWN	ZAF	IDN
2012	7 051.7	132 955.1	52 674.2	2 932.3	225 852.7	4 298.3	-
2013	6 897.8	116 537.5	61 177.6	2 235.7	250 937.6	4 838.2	-
2014	6 805.2	103 089.9	54 717.3	2 782.0	247 603.6	3 030.9	-
2015	8 359.8	92 143.4	53 627.5	2 845.2	217 063.7	3 053.1	-
2016	7 849.1	90 765.9	59 769.2	1 386.6	249 709.3	2 228.0	-
2017	8 927.6	90 093.6	43 957.8	1 277.2	309 153.1	2 662.5	-
2018	7 785.2	87 406.1	43 973.9	1 402.7	287 858.5	2 904.4	1 276.5
2019	8 215.0	69 702.5	51 692.8	1 053.8	319 264.7	2 539.4	1 702.4

Table 5: Catchability coefficients estimated from the combined dataset as well as those from individual CPCs seabird catch and effort data for the initial model run

Dataset	Species Group	JPN		TWN		NZL (DOM)		NZL (JV)	
Combined	Wandering albatross	8.45	(7.12-10)	0.62	(0.47-0.78)	5.04	(3.99-6.27)	0.04	(0.01-0.11)
Combined	Royal albatross	7.63	(4.21-12.09)	2.17	(0.92-4.29)	3.53	(2.1-5.59)	0.07	(0.01-0.22)
Combined	Mollymawk	4.26	(3.86-4.68)	0.74	(0.65-0.83)	2.42	(2.13-2.77)	0.21	(0.17-0.26)
Combined	Sooty albatross	21.9	(17.54-27.13)	4.6	(3.51-5.88)	5.94	(0.28-26.56)	0.35	(0.01-1.52)
Combined	Large petrel	52.48	(41.98-64.44)	0.8	(0.48-1.24)	5.73	(0.29-25.92)	0.34	(0.01-1.66)
Combined	Medium petrel	4	(3.38-4.68)	0.71	(0.58-0.84)	5.48	(4.48-6.58)	0.18	(0.07-0.34)
Combined	Fleet specific q	10.31	(9.24-11.38)	1.15	(0.96-1.36)	3.71	(1. 92-6.44)	0.11	(0.04-0.24)
JPN	Wandering albatross	8.1	(6.79-9.53)						
JPN	Royal albatross	7.59	(4.28-12.17)						
JPN	Mollymawk	3.12	(2.82-3.45)						
JPN	Sooty albatross	20.45	(16.62-25.58)						
JPN	Large petrel	51.54	(42.01-62.6)						
JPN	Medium petrel	2.95	(2.43-3.54)						
JPN	Fleet specific q	9.1	(8.13-10.08)						
TWN	Wandering albatross			2.13	(1.66-2.68)				
TWN	Royal albatross			2.53	(0.95-4.92)				
TWN	Mollymawk			1.77	(1.59-1.95)				
TWN	Sooty albatross			5.33	(4.18-6.69)				
TWN	Large petrel			0.82	(0.51-1.21)				
TWN	Medium petrel			0.54	(0.44-0.66)				
TWN	Fleet specific q			1.65	(1.39-1.94)				
NZL	Wandering albatross					4.96	(3.82-6.28)	0.03	(0-0.1)
NZL	Royal albatross					3.37	(1.91-5.38)	0.05	(0.01-0.17)
NZL	Mollymawk					3.29	(2.69-4.03)	0.31	(0.24-0.39)
NZL	Sooty albatross					6.04	(0.31-27.03)	0.25	(0.01-1.28)
NZL	Large petrel					6.55	(0.26-35.06)	0.22	(0.01-1.11)
NZL	Medium petrel					4.5	(3.58-5.55)	0.14	(0.05-0.28)
NZL	Fleet specific q					3.77	(1.87-6.9)	0.09	(0.03-0.21)

Table 6: Comparison of predicted vs observed values for seabird observed capture. Initial model with combined dataset for 2012-2019.

Code	Common name	Sp Grp	JPN Obs	JPN Pred	TWN Obs	TWN Pred	NZL Obs	NZL Pred	NZL (JV) Obs	NZL (JV) Pred
DIW	Gibson's albatross	1	32	45 (34.2-56.7)	0	2.1 (0-4.8)	11	9.1 (4-14.4)	0	0 (0-0.3)
DQS	Antipodean albatross	1	3	4.3 (1.7-7.3)	0	0.7 (0-2.8)	12	5.5 (1.9-9.9)	0	0 (0-0.2)
	Gibson's and Antipodean albatross		0		6		0		0	
DIX	Wandering albatross	1	162	111.4 (93.4-131.2)	48	41.4 (28.9-55.2)	3	6.8 (2.9-11.6)	0	0 (0-0.3)
DBN	Tristan albatross	1	14	17.3 (10-25.1)	0	1.5 (0-4.2)	0	0 (0-0)	0	0 (0-0)
DAM	Amsterdam albatross	1	0	0.1 (0-2.1)	0	0.1 (0-1.8)	0	0 (0-0)	0	0 (0-0)
	Wandering albatross complex	1	131		0		0		0	
0	**SPECIES GROUP 1 TOTAL**		**342**		**54**		**26**		**0**	
DIP	Southern royal albatross	2	12	12.2 (6.9-18.8)	1	2.8 (0-6.8)	10	5.4 (1.7-10.3)	0	0.1 (0-0.5)
DIQ	Northern royal albatross	2	2	0.7 (0-2.1)	3	0.7 (0-2.8)	1	3.1 (0.6-6.9)	0	0 (0-0.1)
	Royal albatrosses	2	7		0		0		0	
	SPECIES GROUP 2 TOTAL		**21**		**4**		**11**		**0**	
	Diomedea spp	1,2	26		0		2		0	
	***Diomedea* spp TOTAL**		**389**		**58**		**39**		**0**	
CDR	Atlantic yellow-nosed albatross	3	8	14.5 (9.1-20.1)	85	18.1 (10.1-26.6)	0	0 (0-0)	0	0 (0-0)
TQH	Indian yellow-nosed albatross	3	138	113.1 (96.2-131.3)	63	60.6 (46.1-76.4)	0	0 (0-0)	0	0 (0-0)
	Yellow-nosed albatrosses	3	59		0		0		0	
DIM	Black-browed albatross	3	301	425.6 (390-462.8)	101	37 (26.5-48.1)	3	11 (5.7-16.9)	0	0.8 (0.1-1.9)
TQW	Campbell black-browed albatross	3	170	65.7 (52.2-79.5)	12	0.7 (0-2.3)	11	32.9 (23-44.5)	1	3.8 (1.7-6.6)
	Black-browed albatrosses	3	312		0		0		0	
DCU	Shy albatross	3	0	47.6 (34.9-61.1)	4	0 (0-0.7)	0	0 (0-0)	0	0 (0-0)
	Shy-type albatross	3	796		0		0		0	
TWD	New Zealand's white-capped albatross	3	0	272.3 (244.4-302.7)	34	34.2 (23.7-45.7)	151	65.9 (50.5-83.6)	11	5 (2.5-8.7)
DKS	Salvin's albatross	3	0	8 (4.4-12.1)	8	1.6 (0-4.1_	1	12.1 (6.4-18.7)	0	0.3 (0-1.9)
DER	Chatham Island albatross	3	3	1.3 (0-3)	0	0.2 (0-0.8)	0	0.5 (0-1.9)	0	0 (0-0)
DIC	Grey-headed albatross	3	840	682.3 (623.7-737.5)	17	178.2 (152.9-207.6)	1	0.1 (0-0.7)	0	0 (0-0)

Table 6 [Continued]: Comparison of predicted vs observed values for seabird observed capture. Initial model with combined dataset for 2012-2019.

Code	Common name	Sp Grp	JPN Obs	JPN Pred	TWN Obs	TWN Pred	NZL Obs	NZL Pred	NZL (JV) Obs	NZL (JV) Pred
DSB	Southern Buller's albatross	3	0	226.7 (199.6-254.4)	0	18.9 (11.8-27.9)	0	64.7 (50.4-80.7)	0	4 (1.8-7.4)
DNB	Northern Buller's albtatross	3	9	17.3 (11-24.8)	0	1.3 (0-3.7)	0	8.9 (4.1-14.8)	0	0.4 (0-1.1)
	Buller's albatross	3	780		4		125		62	
	Thalassarche spp.	3	267		0		0		0	
	SPECIES GROUP 3 TOTAL		**3683**		**328**		**292**		**74**	
PHU	Sooty albatross	4	134	106 (88.5-125.3)	61	47.4 (33.4-62.3)	0	0 (0-0)	0	0 (0-0)
PHE	Light-mantled sooty albatross	4	95	53.3 (40.76-67)	6	14.2 (7.2-22)	0	0 (0-0)	0	0 (0-0)
	Phoebetria spp	4	4		0		0		0	
	SPECIES GROUP 4 TOTAL		**233**		**67**		**0**		**0**	
	Diomedeidae	1,2,3,4	822		170		0		0	
	***Diomedeidae* TOTAL**		**5127**		**623**		**331**		**74**	
MAI	Southern giant petrel	5	94	71.2 (57-85.8)	7	5.3 (1.4-10)	0	0 (0-0)	0	0 (0-0)
MAH	Northern giant petrel	5	88	40.7 (30.5-52.3)	3	4.3 (0.8-9.1)	0	0 (0-0)	0	0 (0-0)
	Macronectes spp.	5	0		1		0		0	
	SPECIES GROUP 5 TOTAL		**182**		**11**		**0**		**0**	
PCI	Grey petrel	6	152	67.5 (53.8-82.5)	3	16.5 (9.1-24)	4	16.5 (9.9-24.1)	0	0.1 (0-0.5)
PRK	Black petrel	6	5	3.9 (1.3-7.1)	0	1.1 (0-3)	32	3.6 (0.7-7.2)	0	0 (0-0.2)
PCW	Westland petrel	6	4	10.1 (5.2-16)	1	1.6 (0-4)	37	21.9 (13.4-31)	1	0.4 (0-1.1)
PRO	White-chinned petrel	6	407	280.9 (254-311.9)	190	172.6 (144.1-199.9)	12	22.2 (14.7-31.2)	1	0 (0-0)
PCN	Spectacled petrel	6	44	15.9 (10.4-22.5)	53	38 (26.5-52.3)	0	0 (0-0)	0	0 (0-0)
	Precellaria spp	6	0		25	0			0	
	SPECIES GROUP 6 TOTAL		**612**		**272**		**85**		**2**	
	Procellariidae	5,6	165		14		0		0	
	***Procellariidae* TOTAL**		**959**		**297**		**85**		**2**	
	Birds	?	223		8		0		0	

Table 7: Results of general consideration on reliability and decisions taken for further model modifications. Columns "ID" and "Maps" indicating general evaluation of reliability of species level identification and seabird spatiotemporal distribution maps derived from tracking data.

Code	Common name	Sp Grp	Obs	Predicted		ID	Maps	Decision taken
DIW	Gibson's albatross	1	43	56.2	(4.1-19.5)	L	H	
DQS	Antipodean albatross	1	15	10.5	(1.9-12.9)	L	H	
	Gibson's and Antipodean albatross		6					Removing species info in capture, reassign total prediction according to density overlap
DIX	Wandering albatross	1	213	159.6	(125.2-198.3)	L	H	
DBN	Tristan albatross	1	14	18.8	(10-29.3)	L	H	
DAM	Amsterdam albatross	1	0	0.2	(0-1.2)	L	H	
	Wandering albatross complex	1	131					
	SPECIES GROUP 1 TOTAL		**422**					
DIP	Southern royal albatross	2	23	20.5	(8.6-45.4)	M	M	No change
DIQ	Northern royal albatross	2	6	4.5	(0.6-11.9)	M	H	
	Royal albatrosses	2	7					
	SPECIES GROUP 2 TOTAL		**36**					
	Diomedea spp	1,2	28					
	Diomedea spp TOTAL		486					
CDR	Atlantic yellow-nosed albatross	3	93	32.6	(19.2-46.7)	M	H	Removing species info in capture, reassign total prediction according to density overlap
TQH	Indian yellow-nosed albatross	3	201	173.7	(142.3-207.7)	M	H	
	Yellow-nosed albatrosses	3	59					
DIM	Black-browed albatross	3	405	474.4	(422.3-529.7)	Var	M	No change
TQW	Campbell black-browed albatross	3	194	103.1	(76.9-132.9)	M	L	
	Black-browed albatrosses	3	312					
DCU	Shy albatross	3	4	47.6	(34.9-61.8)	L	L	Removing species info in capture, reassign total prediction according to density overlap
TWD	New Zealand's white-capped albatross	3	196	377.4	(321.1-440.7)	L	H	
	Shy-type albatross	3	796					
DKS	Salvin's albatross	3	9	22	(10.8-35.8)	M	H	No change

Table 7 [Continued]: Results of general consideration on reliability and decisions taken for further model modifications. Columns "ID" and "Maps" indicating general evaluation of reliability of species level identification and seabird spatiotemporal distribution maps derived from tracking data.

DER	Chatham Island albatross	3	3	2	(0-5.7)	H	H	
DIC	Grey-headed albatross	3	858	860.6	(776.6-945.8)	M	M	
DSB	Southern Buller's albatross	3	0	314.3	(183.6-370.4)	L	H	Removing species info in capture, reassign total prediction according to density overlap
DNB	Northern Buller's albtatross	3	9	27.9	(15.1-44.4)	L	H	
	Buller's albatross	3	909					
	Thalassarche spp.	3	267					
	SPECIES GROUP 3 TOTAL		**4315**					
PHU	Sooty albatross	4	195	153.4	(121.9-187.6)	M	M	No change
PHE	Light-mantled sooty albatross	4	101	67.5	(47.9-89)	M	M	
	Phoebetria spp	4	4					
	SPECIES GROUP 4 TOTAL		**300**					
	Diomedeidae	1,2,3,4	992					
	Diomedeidae TOTAL		6065					
MAI	Southern giant petrel	5	101	76.5	(59.1-95.8)	M	M	Removing from analysis
MAH	Northern giant petrel	5	91	45	(31.3-61.4)	M	M	
	Macronectes spp.	5	1					
	SPECIES GROUP 5 TOTAL		**193**					
PCI	Grey petrel	6	159	100.6	(72.8-131.1)	H	L	No change
PRK	Black petrel	6	37	8.6	(2-17.3)	L	M	Removing species info in capture, reassign total prediction according to density overlap
PCW	Westland petrel	6	43	34	(18.7-52.1)	L	M	
PRO	White-chinned petrel	6	610	475.7	(412.8-543)	L	M	
PCN	Spectacled petrel	6	97	53.9	(36.9-74.8)	L	M	No change
	Precellaria spp	6	25					
	SPECIES GROUP 6 TOTAL		**971**					
	Procellariidae	5,6	179					
	Procellariidae TOTAL		1343					
	Birds	?	231					

Table 8. Comparison of q estimates after correction of codes in compiling petrel species aggregations.

Data s species_group	JPN		TWN		NZL (DOM)		NZL (JV)	
Initial Model:								
Wandering albatross	8.45	(7.12-10)	0.62	(0.47-0.78)	5.04	(3.99-6.27)	0.04	(0.01-0.11)
Royal albatross	7.63	(4.21-12.09)	2.17	(0.92-4.29)	3.53	(2.1-5.59)	0.07	(0.01-0.22)
Mollymawk	4.26	(3.86-4.68)	0.74	(0.65-0.83)	2.42	(2.13-2.77)	0.21	(0.17-0.26)
Sooty albatross	21.9	(17.54-27.13)	4.6	(3.51-5.88)	5.94	(0.28-26.56)	0.35	(0.01-1.52)
Large petrel	52.48	(41.98-64.44)	0.8	(0.48-1.24)	5.73	(0.29-25.92)	0.34	(0.01-1.66)
Medium petrel	4	(3.38-4.68)	0.71	(0.58-0.84)	5.48	(4.48-6.58)	0.18	(0.07-0.34)
Fleet specific q	***10.31***	***(9.24-11.38)***	***1.15***	***(0.96-1.36)***	***3.71***	***(1.92-6.44)***	***0.11***	***(0.04-0.24)***
After modification (2012-2019):								
Wandering albatross	16.13	(13.51-18.78)	3.14	(2.43-3.93)	4.65	(3.14-6.33)	0.17	(0.02-0.58)
Royal albatross	6.39	(3.4-10.23)	2.63	(1.09-4.94)	4.58	(2.62-7.2)	0.21	(0.01-0.8)
Mollymawk	3.78	(3.42-4.2)	0.78	(0.68-0.9)	1.58	(1.35-1.83)	0.12	(0.1-0.15)
Sooty albatross	19.9	(16.03-25.06)	5.75	(4.45-7.43)	4.55	(0.25-21.5)	0.57	(0.02-3.64)
Large petrel	-	-	-	-	-	-	-	-
Medium petrel	1.97	(1.61-2.35)	0.38	(0.3-0.48)	1.66	(1.19-2.21	0.13	(0.03-0.32)
Fleet specific q	***6.54***	***(5.4-7.63)***	***1.59***	***(1.24-1.96)***	***2.67***	***(1.53-4.28)***	***0.17***	***(0.05-0.32)***
Update on 20240515 (2012-2019):								
Wandering albatross	15.27	(12.71-18.1)	2.63	(2.04-3.35)	4.22	(2.92-5.78)	0.16	(0.01-0.56)
Royal albatross	6.24	(3.6-10.19)	2.32	(0.97-4.41)	4.38	(2.39-7.05)	0.23	(0.02-0.97)
Mollymawk	3.63	(3.25-4.04)	0.68	(0.6-0.78)	1.47	(1.27-1.68)	0.13	(0.1-0.15)
Sooty albatross	18.83	(15.24-23.15)	5.05	(3.88-6.42)	5.94	(0.23-29.94)	0.52	(0.02-3.09)
Large petrel	-	-	-	-	-	-	-	-
Medium petrel	3.04	(2.5-3.64)	0.59	(0.48-0.71)	4.17	(3.3-5.11)	0.12	(0.05-0.23)
Fleet specific q	***7.17***	***(6.28-8.12)***	***1.63***	***(1.35-1.91)***	***3.22***	***(1.86-5.05)***	***0.15***	***(0.06-0.34)***

Table 9: Catchability coefficients estimates obtained with the initial model as well as the model after modification incorporated, as well as after code fixing on petrels.

Model	Species group	JPN	TWN	NZL (DOM)	NZL (JV)
Initial					
	Wandering albatross	8.45 (7.2-10)	0.62 (0.47-0.78)	5.04 (3.99-6.27)	0.04 (0.01-0.11)
	Royal albatross	7.63 (4.21-12.09)	2.17 (0.92-4.29)	3.53 (2.1-5.59)	0.07 (0.01-0.22)
	Mollymawk	4.26 (3.86-4.68)	0.74 (0.65-0.83)	2.42 (2.13-2.77)	0.21 (0.17-0.26)
	Sooty albatross	21.9 (17.54-27.13)	4.6 (3.51-5.88)	5.94 (0.28-26.56)	0.35 (0.01-1.52)
	Large petrel	52.48 (41.98-64.44)	0.8 (0.48-1.24)	5.73 (0.29-25.92)	0.34 (0.01-1.66)
	Medium petrel	4 (3.38-4.68)	0.71 (0.58-0.84)	5.48 (4.48-6.58)	0.18 (0.07-0.34)
	Fleet specific q	10.31 (9.24-11.38)	1.15 (0.96-1.36)	3.71 (1.92-6.44)	0.11 (0.04-0.24)
After modification (2012-2019)					
	Wandering albatross	15.27 (12.71-18.1)	2.63 (2.04-3.35)	4.22 (2.92-5.78)	0.16 (0.01-0.56)
	Royal albatross	6.24 (3.6-10.19)	2.32 (0.97-4.41)	4.38 (2.39-7.05)	0.23 (0.02-0.97)
	Mollymawk	3.63 (3.25-4.04)	0.68 (0.6-0.78)	1.47 (1.27-1.68)	0.13 (0.1-0.15)
	Sooty albatross	18.83 (15.24-23.15)	5.05 (3.88-6.42)	5.94 (0.23-29.94)	0.52 (0.02-3.09)
	Large petrel	-			
	Medium petrel	3.04 (2.5-3.64)	0.59 (0.48-0.71)	4.17 (3.3-5.11)	0.12 (0.05-0.23)
	Fleet specific q	7.17 (6.28-8.12)	1.63 (1.35-1.91)	3.22 (1.86-5.05)	0.15 (0.06-0.34)
After modification (2012-2016)					
	Wandering albatross	16.91 (13.92-20.31)	2.78 (2.01-3.68)	6.24 (4.1-8.78)	0.17 (0.02-0.57)
	Royal albatross	8.2 (4.59-13.33)	2.49 (0.78-5.54)	3.27 (1.48-6.05)	0.26 (0.02-1.06)
	Mollymawk	3.56 (3.17-3.99)	0.96 (0.83-1.09)	1.76 (1.5-2.06)	0.13 (0.11-0.15)
	Sooty albatross	12.01 (9.43-14.85)	6.53 (4.94-8.52)	5.8 (0.23-27.23)	0.57 (0.02-3.53)
	Large petrel	-			
	Medium petrel	2.2 (1.78-2.65)	0.67 (0.53-0.82)	3.43 (2.52-4.48)	0.12 (0.05-0.23)
	Fleet specific q	6.6 (5.76-7.48)	1.91 (1.54-2.34)	3.25 (1.8-5.35)	0.16 (0.05-0.33)
After modification (2017-2019)					
	Wandering albatross	12.55 (10.4-15.05)	2.25 (1.55-3.11)	2.4 (1.25-3.93)	
	Royal albatross	2.43 (0.71-5.29)	3.94 (0.94-8.95)	5.58 (2.97-9.13)	
	Mollymawk	3.9 (3.46-4.4)	0.31 (0.26-0.37)	1.31 (1.12-1.54)	
	Sooty albatross	34.75 (27.72-43.62)	2.91 (1.97-4.1)	6.01 (0.21-28.27)	
	Large petrel	-			
	Medium petrel	5.13 (4.15-6.18)	0.45 (0.35-0.56)	4.88 (3.64-6.3)	
	Fleet specific q	7.18 (5.71-8.67)	1.25 (0.93-1.56)	3.04 (1.68-5.04)	

Table 10a. Observed and predicted captures per capture code.

		JPN			TWN			NZL			NZ_JV		
		obs	est.		obs	est.		obs	est.		obs	est.	
DIP	Southern royal albatross	12	15.9	(8.4-24.2)	1	0.7	(0-2.4)	10	3.7	(1-2.7)	0	0	(0-0)
DIQ	Northern royal albatross	2	0.8	(0-2.6)	3	0.9	(0-3.7)	1	2	(0.4-4.5)	0	0	(0-0)
DIM	Black-browed albatross	301	575	(520.9-631.9)	101	35.2	(23.6-48.4)	3	3.7	(1.6-6.6)	0	0	(0-0)
TQW	Campbell black-browed albatross	170	118.4	(95.1-143.2)	9	1.3	(0-3.4)	11	14.5	(9.1-21.8)	1	2	(0.2-5.8)
DKS	Salvin's albatross	0	0	(0-0)	8	0.2	(0-1)	1	5	(2.2-8.7)	0	0	(0-0)
DER	Chatham Island albatross	3	1.7	(0-4.1)	0	0	(0-0)	0	0	(0-0)	0	0	(0-0)
DIC	Grey-headed albatross	840	753.7	(687.8-821)	17	118.8	(92-149.1)	1	0	(0-0.4)	0	0	(0-0)
PHU	Sooty albatross	134	142.7	(117.4-169)	61	47.7	(31-67.1)	0	0	(0-0)	0	0	(0-0)
PHE	Light-mantled sooty albatross	95	71.8	(52.5-91.2)	6	13.5	(6.1-23)	0	0	(0-0)	0	0	(0-0)
PCI	Grey petrel	152	61.4	(46.8-76.4)	3	9.4	(3.8-16.6)	4	3	(1-5.7)	0	0	(0-0)
PCN	Spectacled petrel	44	13.7	(7.6-20.4)	53	23.7	(15.1-34)	0	0	(0-0)	0	0	(0-0)
DRA	Royal albatross Species Group	21	19.5	(10.5-30.2)	4	5.3	(0-14.3)	11	15.5	(7.3-25.8)	0	0	(0-0)
DYN	Yellow-nosed albatross complex	205	229.6	(193.3-269)	148	90.9	(68-114)	0	0	(0-0)	0	0	(0-0)
DST	Shy-type albatross complex	796	811	(744-878.9)	38	64.6	(46.5-84.6)	151	98.2	(79.9-120.3)	11	22.9	(13.9-33.3)
DBB	Black-brown albatross complex	783	805.3	(742.3-875)	113	41.6	(27.7-58.3)	14	48.1	(35.2-63.3)	1	16	(9.1-24.7)
DIB	Buller's albatross complex	789	785.2	(715.2-855)	4	49.6	(34.7-65.1)	125	129.1	(106.5-152.4)	62	24.2	(14.6-34.8)
DWC	Wandering albatross complex	342	356.2	(315.5-400)	54	53.3	(32.3-77.7)	27	25	(13.3-384)	0	0	(0-0)
PRZ	Petrels complex	416	280	(244.7-313.8)	191	99.1	(74.3-126.2)	81	24.3	(15.1-34.6)	2	2.3	(0-6.7)
DIZ	*Diomedia* spp	389	382	(339.8-423.7)	58	59.5	(38-85)	40	40.7	(27.3-55.8)	0	0	(0-0)
THZ	*Thalassarche* spp	3683	3563.5	(3432.1-3821.6)	328	394.8	(336.1-454.9)	292	292.6	(259-322)	74	70.1	(52.6-89.5)
PHZ	Sooth albatross Species Group	233	251.8	(216.8-288)	67	74.8	(51-103.3)	0	0	(0-0)	0	0	(0-0)
PTZ	Medium petrel species group	196	371.1	(333.8-412)	81	138	(106.8-171.5)	4	32.6	(21.4-45.2)	0	0	(0-0)
ALZ	Diomedeidae	5127	5045.8	(4869.7-5307.9)	623	590.1	(514.9-675.7)	332	341.2	(302.4-384.1)	74	78	(58.5-98.3)
PRX	Procellariidae	361	446.5	(400.9-494)	95	154	(119.3-192.2)	4	33.7	(21.9-46.8)	0	0	(0-0)
BLZ	Birds	6127	6122.7	(5908-6429)	917	915.5	(811-1030)	417	416.8	(364-476)	76	87.4	(67-110)

Table 10b. Observed and predicted captures per capture code, after fixing the petrel code errors.

			JPN		TWN		NZL		NZL (JV)
Code	**Common name**	**Observed**	**Estimated**	**Observed**	**Estimated**	**Observed**	**Estimated**	**Observed**	**Estimated**
DIP	Southern royal albatross	12	15.7 (7.9-24.5)	1	2.7 (0-6.3)	10	3.1 (1.1-6.1)	0	0 (0-0)
DIQ	Northern royal albatross	2	0.8 (0-2.6)	3	0.7 (0-2.5)	1	1.8 (0.3-4)	0	0 (0-0)
DIM	Black-browed albatross	301	559.1 (504.9-612.5)	101	30.5 (21.7-40.5)	3	3 (1.2-5.3)	0	0 (0-0)
TQW	Campbell albatross	170	116.1 (92.7-140.8)	12	0.8 (0-2.6)	11	12.1 (7.1-18.8)	1	2 (0.2-5.9)
DKS	Salvin's albatross	0	0 (0-0)	8	1.7 (0-4.5)	1	4.2 (1.9-7.4)	0	0 (0-0)
DER	Chatham Islands albatross	3	1.7 (0-4.1)	0	0 (0-0)	0	0 (0-0)	0	0 (0-0)
DIC	Grey-headed albatross	840	723.3 (657.6-792.1)	17	118 (95.8-143.8)	1	0 (0-0.3)	0	0 (0-0)
PHU	Sooty albatross	134	135.6 (110.8-161.4)	61	44.7 (32.1-59.9)	0	0 (0-0)	0	0 (0-0)
PHE	Light-mantled sooty albatross	95	68.4 (50.9-87.4)	6	13.4 (7.6-20.7)	0	0 (0-0)	0	0 (0-0)
PCI	Grey petrel	152	110 (87-135.3)	3	16.9 (10.4-24.7)	4	7.9 (4.3-13)	0	0 (0-0)
PCN	Spectacled petrel	44	24.5 (15.1-34.5)	53	37.5 (25.6-51.2)	0	0 (0-0)	0	0 (0-0)
DRA	Royal albatrosses	21	19.4 (10.7-29.8)	4	4.4 (0.8-10.1)	11	15.6 (7.3-25.9)	0	0 (0-0)
DYN	Yellow-nosed albatrosses	205	218.2 (183.2-255)	148	87.8 (68.9-108.8)	0	0 (0-0)	0	0 (0-0)
DST	Shy-type albatrosses	796	777.1 (709.1-849.2)	38	60.2 (44.8-77.2)	151	95.4 (75.3-116.4)	11	23 (14.1-33.6)
DBB	Black-browed albatrosses	783	793.5 (722.4-858.9)	113	41.2 (29.5-52.9)	14	48.3 (34.9-62.8)	1	16.8 (9.3-25.6)
DIB	Buller's albatross	789	749.8 (685.6-817.1)	4	43.5 (31-56.3)	125	125.6 (101.4-151)	62	24.1 (14.7-34.8)
DWC	Wandering albatrosses	342	345.7 (303.1-384.5)	54	54 (37.7-71.5)	27	24.1 (13.4-37.2)	0	0 (0-0)
PRZ	Petrels	416	447.3 (400.4-493.9)	191	188.7 (160.4-219.9)	81	61.8 (44.9-78.8)	2	1.7 (0-4.8)
DIZ	*Diomedia* spp	389	388 (345.7-435.5)	58	59.2 (43.2-77.6)	40	40.5 (26.3-56.1)	0	0 (0-0)
THZ	*Thalassarche* spp	3683	3628 (3486.8-3784.7)	328	396.7 (353.3-439.6)	292	289.1 (253.5-326.3)	74	70.1 (52.9-88.3)
PHZ	Sooty albatrosses	233	256.4 (217-294.1)	67	78 (58.7-99.6)	0	0 (0-0)	0	0 (0-0)
PTZ	Medium petrels	612	644.2 (591.7-697)	272	264.6 (227.8-299.5)	85	88.5 (68.7-110.4)	2	2.2 (0-5.8)
ALZ	Diomedeidae	5127	5123.8 (4936.2-5301.2)	623	598.2 (540-658.3)	332	336.9 (299-376.7)	74	78 (57.9-100)
PRX	Procellariidae	777	774.1 (710-841.8)	286	296.3 (259.5-338)	85	90.7 (68.7-113.4)	2	2.4 (0-6.8)
BLZ	Birds	6127	6124.8 (5918-6343)	917	930.8 (851.9-1011)	417	441.7 (392-493)	76	87.5 (65-111)

Table 11. Comparison between observed vs predicted catch at species and species-complex, after fixing the petrels code errors.

Code	Common name	Sp Grp	Initial model			After modification		
			Obs	Predicted		Obs	Predicted	
DIW	Gibson's albatross	1	43	56.2	(4.1-19.5)			
DQS	Antipodean albatross	1	15	10.5	(1.9-12.9)			
	Gibson's and Antipodean albatross		6					
DIX	Wandering albatross	1	213	159.6	(125.2-198.3)			
DBN	Tristan albatross	1	14	18.8	(10-29.3)			
DAM	Amsterdam albatross	1	0	0.2	(0-1.2)			
	Wandering albatross complex	1	131					
	SPECIES GROUP 1 TOTAL		**422**			**423**	**423.8**	**(354.2-493.2)**
DIP	Southern royal albatross	2	23	20.5	(8.6-45.4)	23	21.5	(9-36.9)
DIQ	Northern royal albatross	2	6	4.5	(0.6-11.9)	6	3.3	(0.3-9.1)
	Royal albatrosses	2	7			7		
	SPECIES GROUP 2 TOTAL		**36**			**36**	**39.4**	**(18.8-65.8)**
	Diomedea spp	1,2	28					
	Diomedea spp TOTAL		486			487	487.7	(415.2-569.2)
CDR	Atlantic yellow-nosed albatross	3	93	32.6	(19.2-46.7)			
TQH	Indian yellow-nosed albatross	3	201	173.7	(142.3-207.7)			
	Yellow-nosed albatrosses	3	59					
	Yellow-nosed albatrosses TOTAL					353	306	(252.1-363.8)
DIM	Black-browed albatross	3	405	474.4	(422.3-529.7)	405	592.6	(527.8-658.3)
TQW	Campbell black-browed albatross	3	194	103.1	(76.9-132.9)	194	131	(100-168.1)
	Black-browed albatrosses	3	312					
DCU	Shy albatross	3	4	47.6	(34.9-61.8)			
TWD	New Zealand's white-capped albatross	3	196	377.4	(321.1-440.7)			
	Shy-type albatross	3	796					
	Shy-type albatross TOTAL					996	955.7	(843.3-1076.4)
DKS	Salvin's albatross	3	9	22	(10.8-35.8)	9	5.9	(1.9-11.9)

Table 11 [Continued]. Comparison between observed vs predicted catch at species and species-complex, after fixing the petrels code errors.

DER	Chatham Island albatross	3	3	2	(0-5.7)	3	1.7	(0-4.1)
DIC	Grey-headed albatross	3	858	860.6	(776.6-945.8)	858	841.3	(753.4-936.2)
DSB	Southern Buller's albatross	3	0	314.3	(183.6-370.4)			
DNB	Northern Buller's albtatross	3	9	27.9	(15.1-44.4)			
	Buller's albatross	3	909					
	Buller's albatross TOTAL					980	943	(832.7-1059.2)
	Thalassarche spp.	3	267					
	SPECIES GROUP 3 TOTAL		**4315**			**4377**	**4383.9**	**(4146.5-4638.9)**
PHU	Sooty albatross	4	195	153.4	(121.9-187.6)	300	334.4	(275.7-393.7)
PHE	Light-mantled sooty albatross	4	101	67.5	(47.9-89)	101	81.8	(58.5-108.1)
	Phoebetria spp	4	4					
	SPECIES GROUP 4 TOTAL		**300**			**300**	**334.4**	**(275.7-393.7)**
	Diomedeidae	1,2,3,4	992					
	Diomedeidae TOTAL		6065			6156	6136.9	(5833.1-6436.2)
MAI	Southern giant petrel	5	101	76.5	(59.1-95.8)			
MAH	Northern giant petrel	5	91	45	(31.3-61.4)			
	Macronectes spp.	5	1					
	SPECIES GROUP 5 TOTAL		**193**					
PCI	Grey petrel	6	159	100.6	(72.8-131.1)	159	134.8	(101.7-173)
PRK	Black petrel	6	37	8.6	(2-17.3)			
PCW	Westland petrel	6	43	34	(18.7-52.1)			
PRO	White-chinned petrel	6	610	475.7	(412.8-543)			
	Petrels TOTAL (PRK, PCW, PRO)					690	699.5	(605.7-797.4)
PCN	Spectacled petrel	6	97	53.9	(36.9-74.8)	97	62	(40.7-85.7)
	Procellaria spp	6	25					
	SPECIES GROUP 6 TOTAL		**971**			**971**	**999.5**	**(888.2-1112.7)**
	Procellariidae	5,6	179					
	Procellariidae TOTAL		1150			1150	1163.5	(1038.2-1300)
	Birds		7537			7537	7584.8	(7226.9-7958)

Table 12. Final model outputs of the predicted bycatch mortality and cryptic deaths, together with the productivities and relative mortalities corresponding to priors and posteriors of biological parameters. Relative mortalities are measured relative to a productivity index, which is the maximum intrinsic growth multiplied by the total number of adults. The figures corresponding to the final outputs after fixing code errors.

			Priors		Posterior	
Common name	**Total deaths**	**Cryptic deaths**	**Maximum population growth**	**Relative mortality**	**Maximum population growth**	**Relative mortality**
Gibson's albatross	606 (444-827)	159 (15-366)	940 (701-1 265)	0.65 (0.43-0.97)	943 (675-1 337)	0.64 (0.41-1.03)
Antipodean albatross	67 (48-96)	18 (3-39)	655 (499-861)	0.10 (0.07-0.15)	658 (465-906)	0.10 (0.07-0.17)
Wandering albatross	253 (179-354)	69 (13-144)	1 875 (1 403-2 594)	0.13 (0.09-0.19)	1 893 (1 336-2 665)	0.13 (0.08-0.22)
Tristan albatross	188 (113-312)	50 (5-126)	455 (274-771)	0.41 (0.28-0.62)	461 (264-792)	0.41 (0.20-0.85)
Amsterdam albatross	2 (2-4)	1 (0-2)	9 (7-13)	0.25 (0.17-0.38)	9 (6-14)	0.26 (0.15-0.47)
Southern royal albatross	74 (53-103)	16 (4-36)	1 146 (712-1 900)	0.06 (0.04-0.11)	1 165 (656-2 136)	0.06 (0.03-0.12)
Northern royal albatross	16 (9-26)	3 (1-8)	834 (567-1 367)	0.02 (0.01-0.03)	788 (508-1 348)	0.02 (0.01-0.04)
Atlantic yellow-nosed albatross	91 (63-133)	25 (4-56)	5 304 (3 965-7 124)	0.02 (0.01-0.02)	5 046 (3 580-7 070)	0.02 (0.01-0.03)
Indian yellow-nosed albatross*	943 (702-1 310)	264 (31-597)	13 901 (10 580-18 427)	0.07 (0.05-0.10)	6 469 (4 392-9 443)	0.15 (0.09-0.24)
Black-browed albatross*	1 268 (926-1 769)	354 (14-842)	56 203 (44 501-70 437)	0.02 (0.02-0.03)	84 043 (62 630-111 305)	0.02 (0.01-0.02)
Campbell black-browed albatross*	449 (332-626)	125 (15-283)	99 228 (71 446-138 500)	0.00 (0.00-0.01)	3 018 (2 166-4 397)	0.15 (0.09-0.24)
Shy albatross	128 (84-198)	35 (2-90)	2 377 (1 656-3 475)	0.05 (0.03-0.08)	2 267 (1 501-3 396)	0.06 (0.03-0.10)
New Zealand white-capped albatross*	2 158 (1 594-2 937)	601 (68-1 360)	28 743 (20 842-39 599)	0.07 (0.05-0.11)	11 429 (7 407-17 792)	0.19 (0.11-0.32)
Salvin's albatross	127 (84-194)	35 (4-84)	6 885 (4 841-9 760)	0.02 (0.01-0.03)	6 579 (4 502-9 731)	0.02 (0.01-0.03)
Chatham Island albatross	12 (8-18)	3 (-0-8)	703 (568-894)	0.02 (0.01-0.03)	693 (524-901)	0.02 (0.01-0.03)
Grey-headed albatross*	3 169 (2 409-4 250)	886 (129-1 934)	95 090 (76 764-118 084)	0.03 (0.02-0.05)	15 564 (9 205-32 810)	0.20 (0.09-0.39)
Southern Buller's albatross	2 110 (1 554-2 910)	587 (50-1 368)	23 601 (19 122-29 641)	0.09 (0.06-0.13)	1 625 (1 238-2 189)	1.29 (0.85-1.98)
Northern Buller's albatross	99 (70-142)	27 (3-64)	2 260 (1 814-2 902)	0.04 (0.03-0.06)	2 251 (1 704-2 954)	0.04 (0.03-0.07)
Sooty albatross	646 (475-857)	188 (34-391)	1 677 (1 193-2 315)	0.39 (0.25-0.58)	1 787 (1 250-2 534)	0.36 (0.22-0.59)
Light-mantled sooty albatross*	306 (220-426)	89 (16-189)	5 052 (3 505-7 424)	0.06 (0.04-0.09)	2 726 (1 800-4 646)	0.11 (0.06-0.19)

* species with updates to biological parameters

Table 12 [continued]. Final model outputs of the predicted bycatch mortality and cryptic deaths, together with the productivities and relative mortalities corresponding to priors and posteriors of biological parameters. Relative mortalities are measured relative to a productivity index, which is the maximum intrinsic growth multiplied by the total number of adults. The figures corresponding to the final outputs after fixing code errors.

			Priors		Posterior	
Common name	**Total deaths**	**Cryptic deaths**	**Maximum population growth**	**Relative mortality**	**Maximum population growth**	**Relative mortality**
Grey petrel	458 (337-636)	128 (17-287)	35 025 (26 669-46 892)	0.01 (0.01-0.02)	17 542 (11 839-26 187)	0.03 (0.02-0.04)
Black petrel	38 (26-54)	11 (2-23)	1 267 (1 069-1 520)	0.03 (0.02-0.04)	1 264 (1 039-1 541)	0.03 (0.02-0.04)
Westland petrel*	117 (74-181)	32 (5-72)	1 929 (1 305-2 896)	0.06 (0.04-0.09)	1 810 (1 235-2 753)	0.06 (0.03-0.11)
White-chinned petrel*	3 167 (2 469-4 076)	894 (213-1 772)	148 436 (109 106-200 975)	0.02 (0.01-0.03)	272 104 (190 406-377 588)	0.01 (0.01-0.02)
Spectacled petrel	374 (263-531)	103 (17-227)	26 760 (18 315-39 850)	0.01 (0.01-0.02)	8 111 (5 858-11 660)	0.05 (0.03-0.07)

* species with updates to biological parameters

Table 13: Comparison of predicted seabird bycatch mortality, including cryptic mortality, according to the catchabilities estimated with observed catch and effort data in different time period. The figures corresponding to the final outputs after fixing code errors.

Species	2012-2019	2012-2016 (early)	2017-2019 (late)
Gibson's albatross	606 (444-827)	700 (522-980)	484 (342-684)
Antipodean albatross	67 (48-96)	81 (58-119)	50 (35-74)
Wandering albatross	253 (179-354)	205 (146-298)	303 (217-429)
Tristan albatross	188 (113-312)	179 (103-293)	186 (104-343)
Amsterdam albatross	2 (2-4)	2 (1-3)	3 (2-4)
Southern royal albatross	74 (53-103)	83 (57-120)	55 (34-85)
Northern royal albatross	16 (9-26)	16 (9-29)	19 (10-35)
Atlantic yellow-nosed albatross	91 (63-133)	116 (79-169)	62 (43-88)
Indian yellow-nosed albatross *	943 (702-1 310)	1 090 (802-1 492)	694 (508-953)
Black-browed albatross *	1 268 (926-1 769)	1 201 (872-1 660)	1 494 (1 066-2 087)
Campbell black-browed albatross *	449 (332-626)	415 (311-566)	548 (387-759)
Shy albatross	128 (84-198)	126 (81-189)	148 (98-235)
New Zealand white-capped albatross *	2 158 (1 594-2 937)	2 169 (1 659-2 948)	2 232 (1 633-3 067)
Salvin's albatross	127 (84-194)	140 (95-211)	127 (85-193)
Chatham Island albatross	12 (8-18)	12 (8-18)	13 (9-20)
Grey-headed albatross *	3 169 (2 409-4 250)	2 930 (2 243-3 857)	3 577 (2 631-4 929)
Southern Buller's albatross *	2 110 (1 554-2 910)	2 115 (1 594-2 878)	2 241 (1 614-3 102)
Northern Buller's albatross	99 (70-142)	106 (73-154)	101 (70-150)
Sooty albatross	646 (475-857)	468 (353-637)	1 210 (857-1 733)
Light-mantled sooty albatross *	306 (220-426)	217 (156-305)	540 (371-785)
Grey petrel *	458 (337-636)	378 (283-503)	735 (543-1 058)
Black petrel	38 (26-54)	33 (23-46)	44 (31-65)
Westland petrel *	117 (74-181)	101 (68-157)	142 (91-231)
White-chinned petrel *	3 167 (2 469-4 076)	2 491 (2 002-3 174)	4 577 (3 568-6 216)
Spectacled petrel	374 (263-531)	351 (246-508)	396 (280-572)

* species with updates to biological parameters

Table 14. Comparison with 2019 result on predicted seabird bycatch mortality. Estimates using the data 2012-2016 without including cryptic mortality was used for this comparison. The figures corresponding to the final outputs after fixing code errors.

Code	Common name	2019 assessment		2024 assessment	
DIW	Gibson's albatross	550	(466-640)	447	(429-461)
DQS	Antipodean albatross	147	(117-177)	49	(45-57)
DIX	Wandering albatross	696	(591-803)	184	(166-210)
DBN	Tristan albatross	377	(316-441)	138	(108-186)
DAM	Amsterdam albatross	6	(2-11)	1	(2-2)
DIP	Southern royal albatross	126	(76-187)	58	(49-67)
DIQ	Northern royal albatross	96	(57-143)	13	(8-18)
CDR	Atlantic yellow-nosed albatross	1080	(892-1290)	66	(59-77)
TQH	Indian yellow-nosed albatross	1860	(1540-2210)	679	(671-713)
DIM	Black-browed albatross	8350	(7580-9160)	914	(912-927)
TQW	Campbell black-browed albatross	812	(722-907)	324	(317-343)
DCU	Shy albatross	232	(196-269)	93	(82-108)
TWD	New Zealand's white-capped albatross	2060	(1870-2260)	1557	(1526-1577)
DKS	Salvin's albatross	10	(0-39)	92	(80-110)
DER	Chatham Island albatross	22	(0-86)	9	(8-10)
DIC	Grey-headed albatross	8440	(7800-9090)	2283	(2280-2316)
DSB	Southern Buller's albatross	2260	(2040-2480)	1523	(1504-1542)
DNB	Northern Buller's albatross			72	(67-78)
PHU	Sooty albatross	1350	(1100-1620)	458	(441-466)
PHE	Light-mantled sooty albatross	875	(708-1050)	217	(204-237)
MAI	Southern giant petrel	1460	(1210-1710)		
MAH	Northern giant petrel	493	(402-589)		
PCI	Grey petrel	1000	(807-1230)	330	(320-349)
PRK	Black petrel	191	(72-390)	27	(24-31)
PCW	Westland petrel	90	(45-155)	85	(69-109)
PRO	White-chinned petrel	7550	(6550-8630)	2273	(2256-2304)
PCN	Spectacled petrel	948	(576-1410)	271	(246-304)

Table 15. Comparison of q estimates after correction of codes in compiling petrel species aggregations.

Data s species_group	JPN		TWN		NZL (DOM)		NZL (JV)	
Initial Model:								
Wandering albatross	8.45	(7.12-10)	0.62	(0.47-0.78)	5.04	(3.99-6.27)	0.04	(0.01-0.11)
Royal albatross	7.63	(4.21-12.09)	2.17	(0.92-4.29)	3.53	(2.1-5.59)	0.07	(0.01-0.22)
Mollymawk	4.26	(3.86-4.68)	0.74	(0.65-0.83)	2.42	(2.13-2.77)	0.21	(0.17-0.26)
Sooty albatross	21.9	(17.54-27.13)	4.6	(3.51-5.88)	5.94	(0.28-26.56)	0.35	(0.01-1.52)
Large petrel	52.48	(41.98-64.44)	0.8	(0.48-1.24)	5.73	(0.29-25.92)	0.34	(0.01-1.66)
Medium petrel	4	(3.38-4.68)	0.71	(0.58-0.84)	5.48	(4.48-6.58)	0.18	(0.07-0.34)
Fleet specific q	***10.31***	***(9.24-11.38)***	***1.15***	***(0.96-1.36)***	***3.71***	***(1.92-6.44)***	***0.11***	***(0.04-0.24)***
After modification (2012-2019):								
Wandering albatross	16.13	(13.51-18.78)	3.14	(2.43-3.93)	4.65	(3.14-6.33)	0.17	(0.02-0.58)
Royal albatross	6.39	(3.4-10.23)	2.63	(1.09-4.94)	4.58	(2.62-7.2)	0.21	(0.01-0.8)
Mollymawk	3.78	(3.42-4.2)	0.78	(0.68-0.9)	1.58	(1.35-1.83)	0.12	(0.1-0.15)
Sooty albatross	19.9	(16.03-25.06)	5.75	(4.45-7.43)	4.55	(0.25-21.5)	0.57	(0.02-3.64)
Large petrel	-	-	-	-	-	-	-	-
Medium petrel	1.97	(1.61-2.35)	0.38	(0.3-0.48)	1.66	(1.19-2.21	0.13	(0.03-0.32)
Fleet specific q	***6.54***	***(5.4-7.63)***	***1.59***	***(1.24-1.96)***	***2.67***	***(1.53-4.28)***	***0.17***	***(0.05-0.32)***
Update on 20240515 (2012-2019):								
Wandering albatross	15.27	(12.71-18.1)	2.63	(2.04-3.35)	4.22	(2.92-5.78)	0.16	(0.01-0.56)
Royal albatross	6.24	(3.6-10.19)	2.32	(0.97-4.41)	4.38	(2.39-7.05)	0.23	(0.02-0.97)
Mollymawk	3.63	(3.25-4.04)	0.68	(0.6-0.78)	1.47	(1.27-1.68)	0.13	(0.1-0.15)
Sooty albatross	18.83	(15.24-23.15)	5.05	(3.88-6.42)	5.94	(0.23-29.94)	0.52	(0.02-3.09)
Large petrel	-	-	-	-	-	-	-	-
Medium petrel	3.04	(2.5-3.64)	0.59	(0.48-0.71)	4.17	(3.3-5.11)	0.12	(0.05-0.23)
Fleet specific q	***7.17***	***(6.28-8.12)***	***1.63***	***(1.35-1.91)***	***3.22***	***(1.86-5.05)***	***0.15***	***(0.06-0.34)***

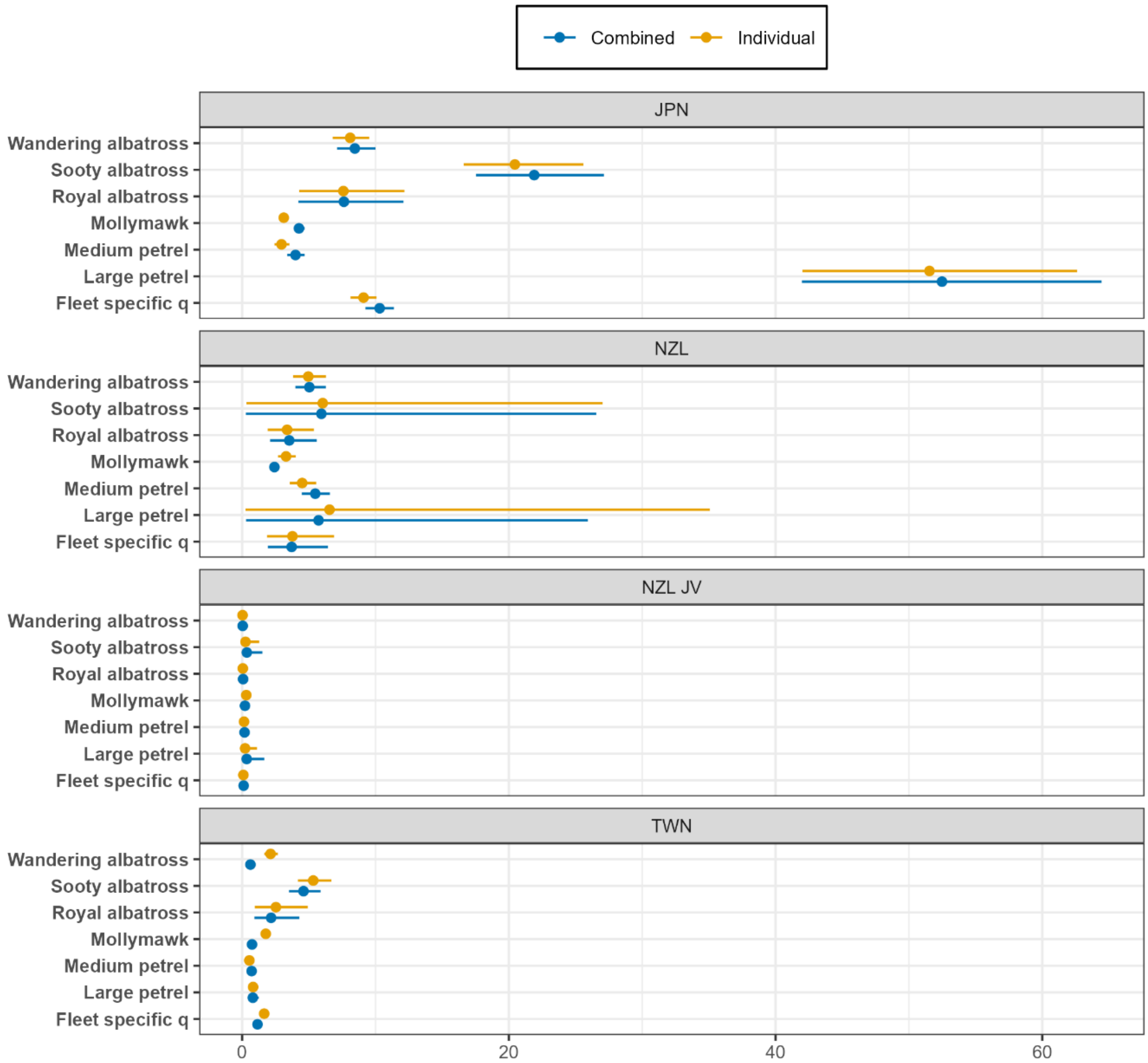

Figure 1. Comparison of catchability coefficient estimates according to data sources. Orange corresponds to the outputs using the combined data set and blue for individual CPC's data for the initial model run

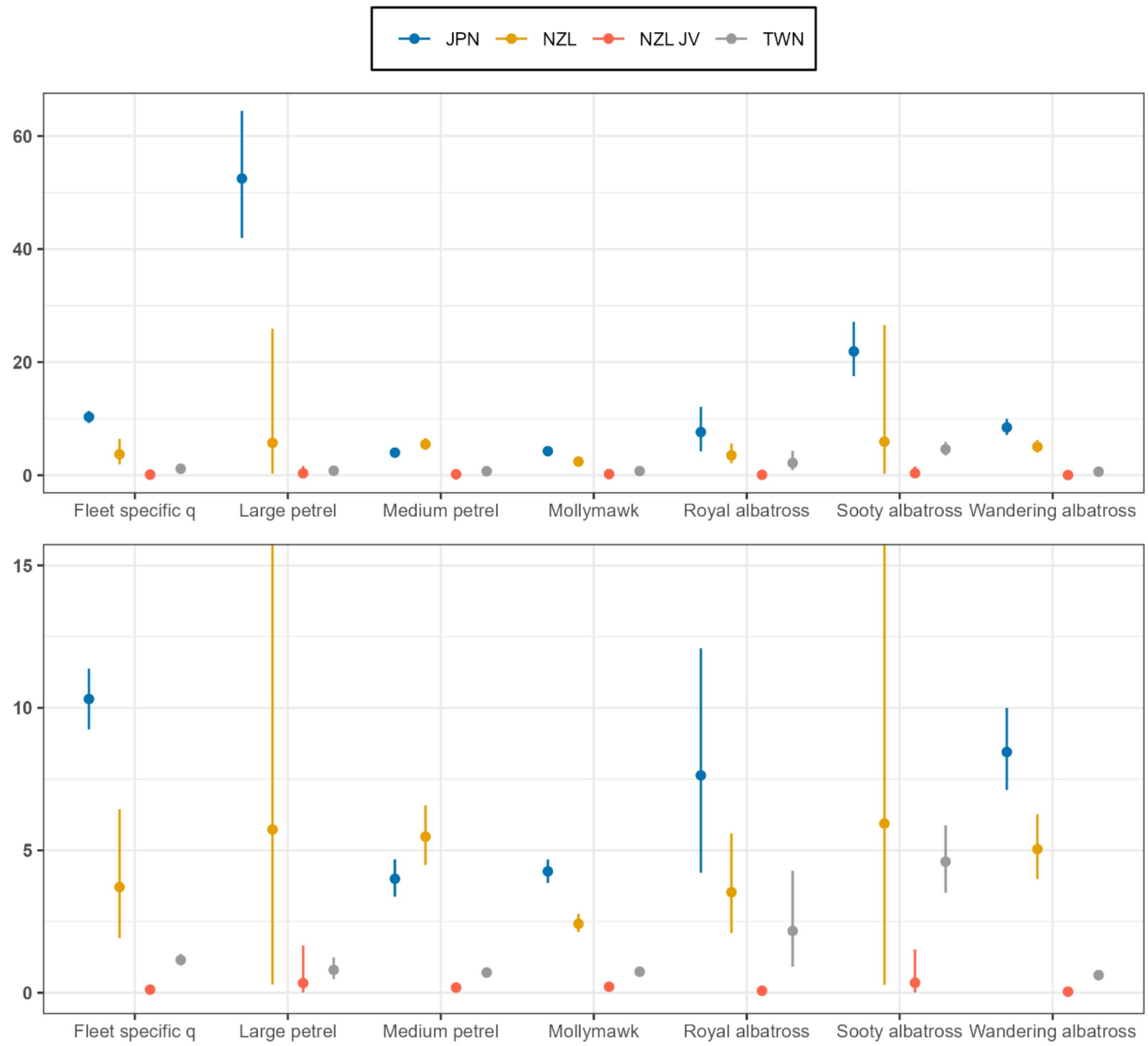

Figure 2. Catchability coefficient estimates obtained from the initial model. Lower figure with different Y-scale to focus differences among lower values.

Figure 3. Catchability coefficients relative to fleet-specific catchability for the initial model .

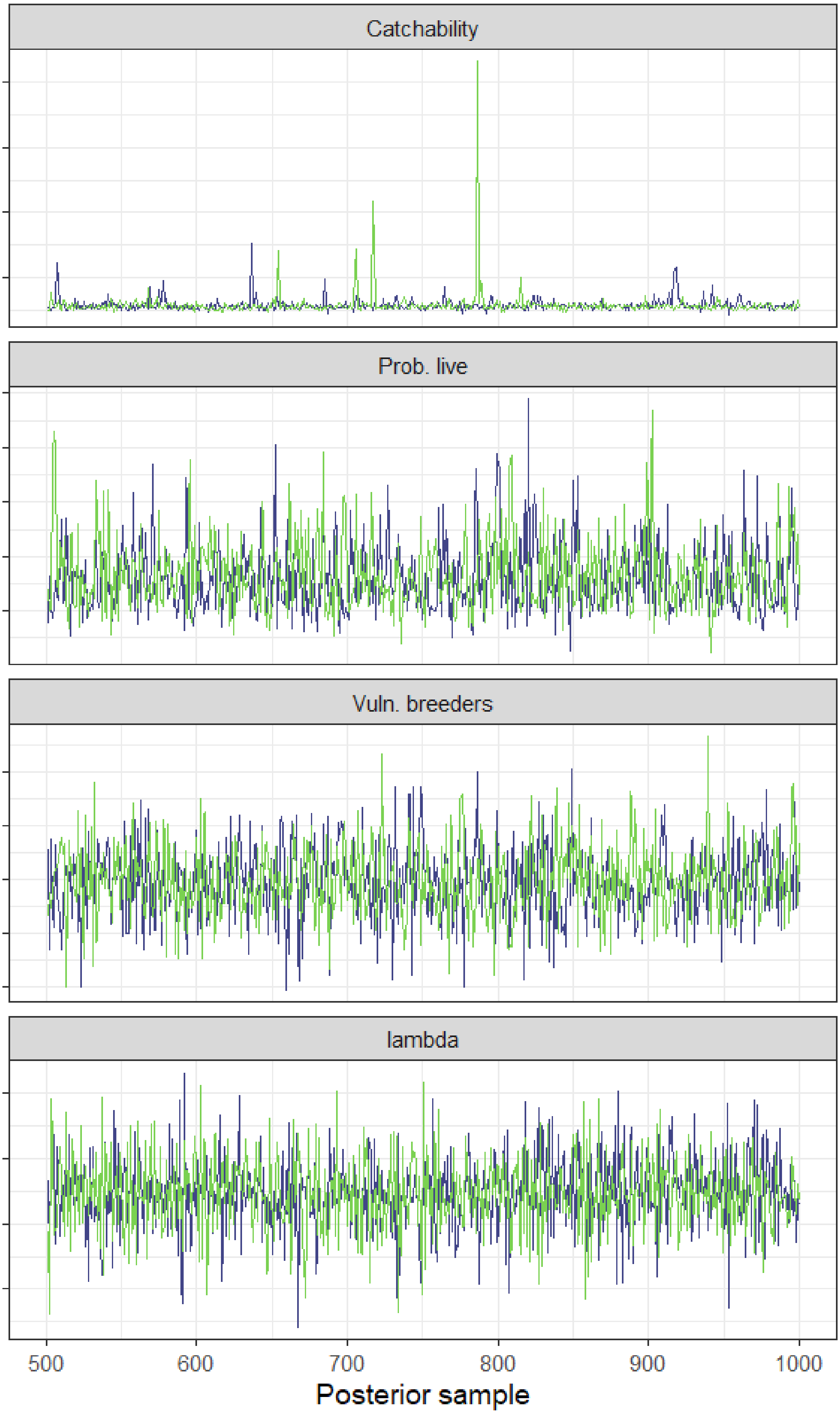

Figure 4. MCMC trace diagnostics for model fit. For each MCMC chain, the Euclidean norm is calculated for each parameter vector.

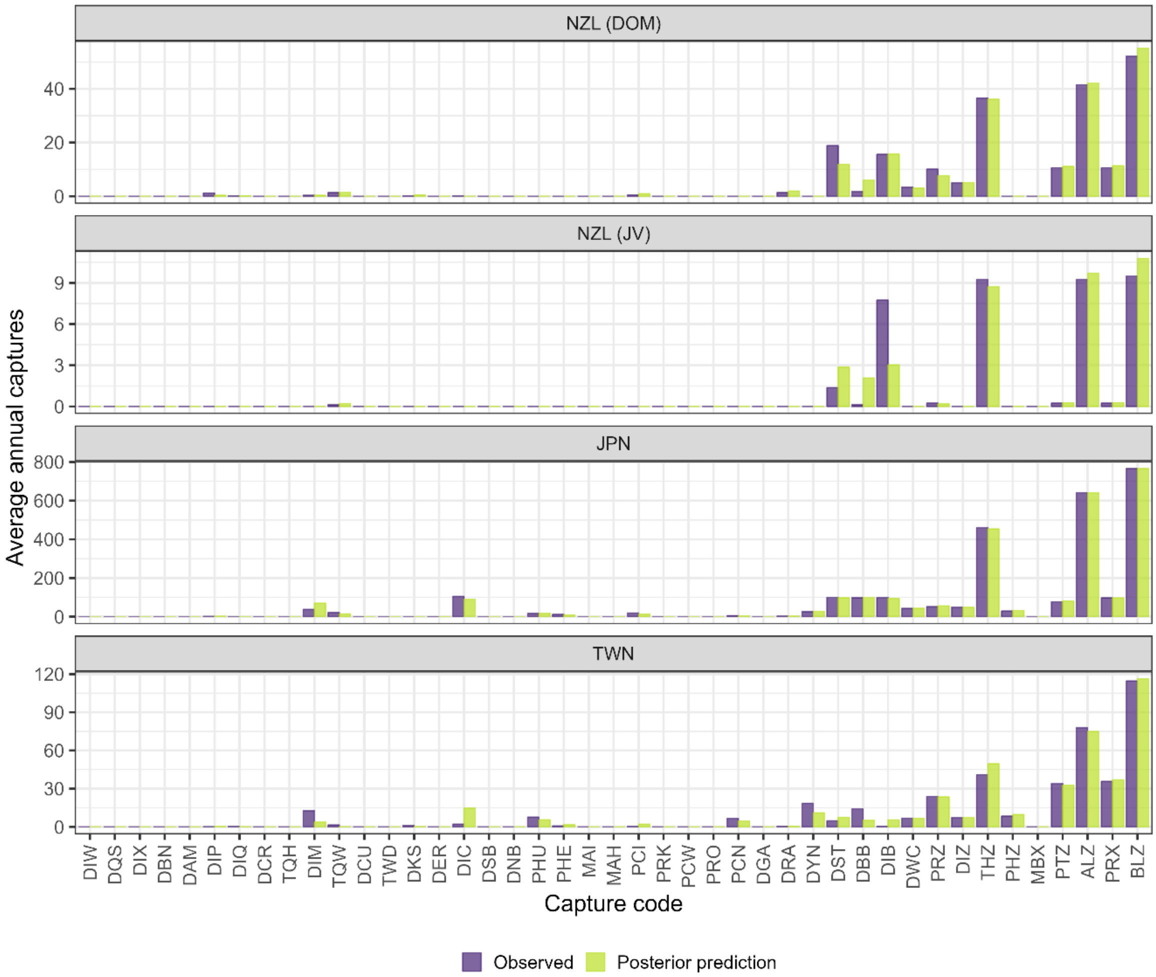

Figure 5. Model fit to the observed number of average annual captures per capture code. Empirical (observed) values are plotted next to the posterior predicted values.

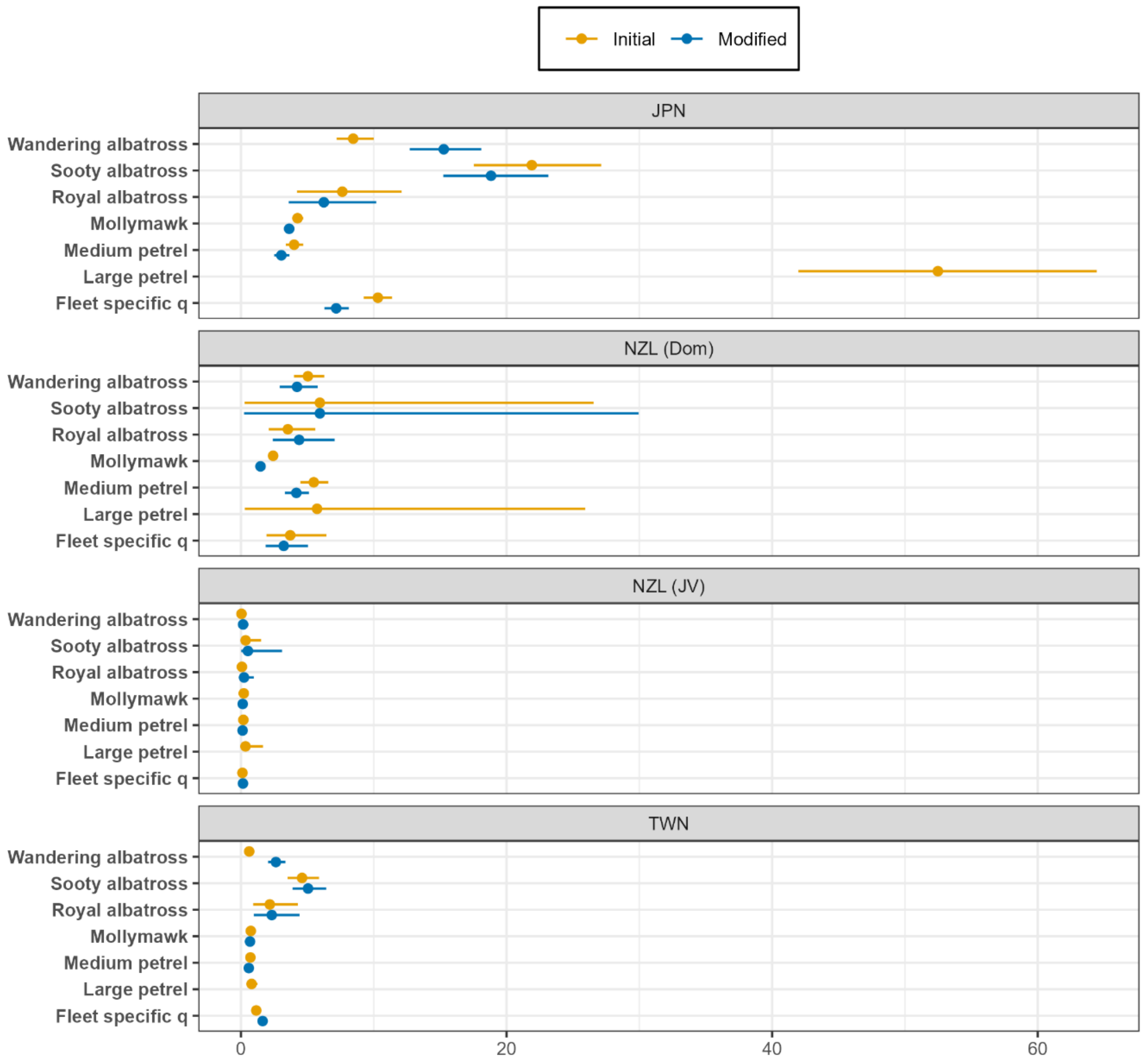

Figure 6. Comparison of catchability coefficient estimates between models before and after modification incorporated.

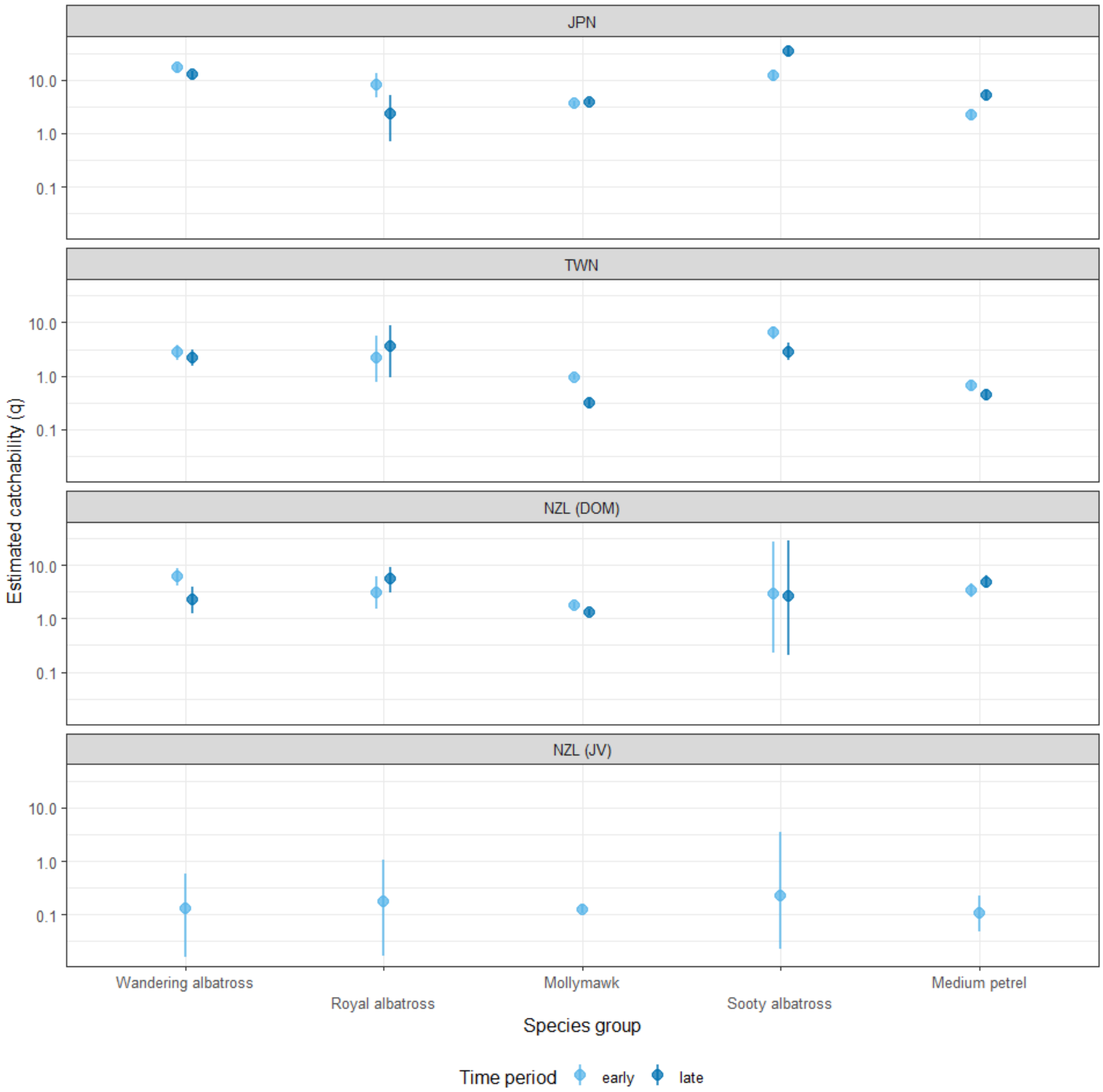

Figure 7. Change of catchability coefficients between two periods.

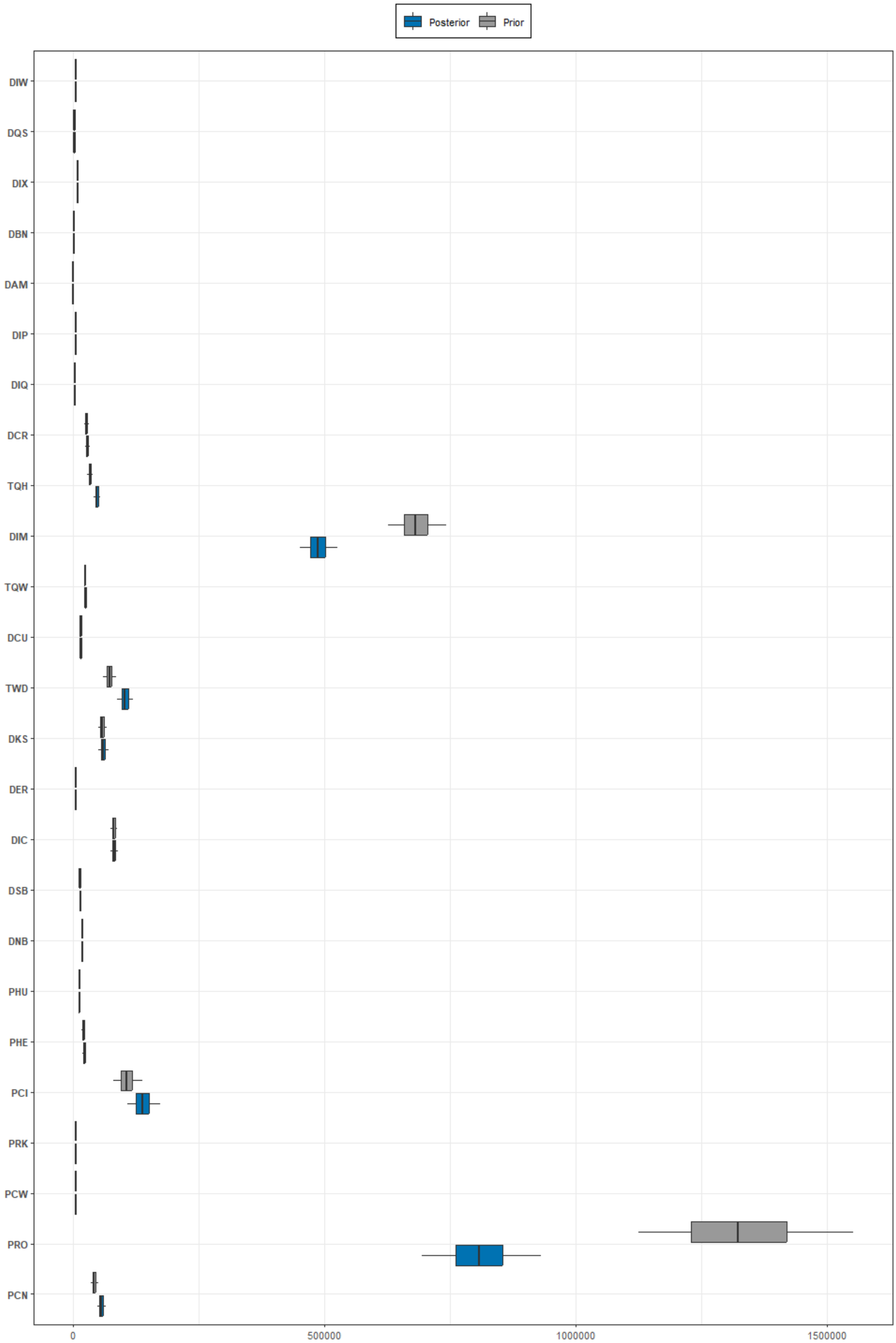

Figure 8a. Boxplots indicating the prior and posterior number of breeding pairs per species.

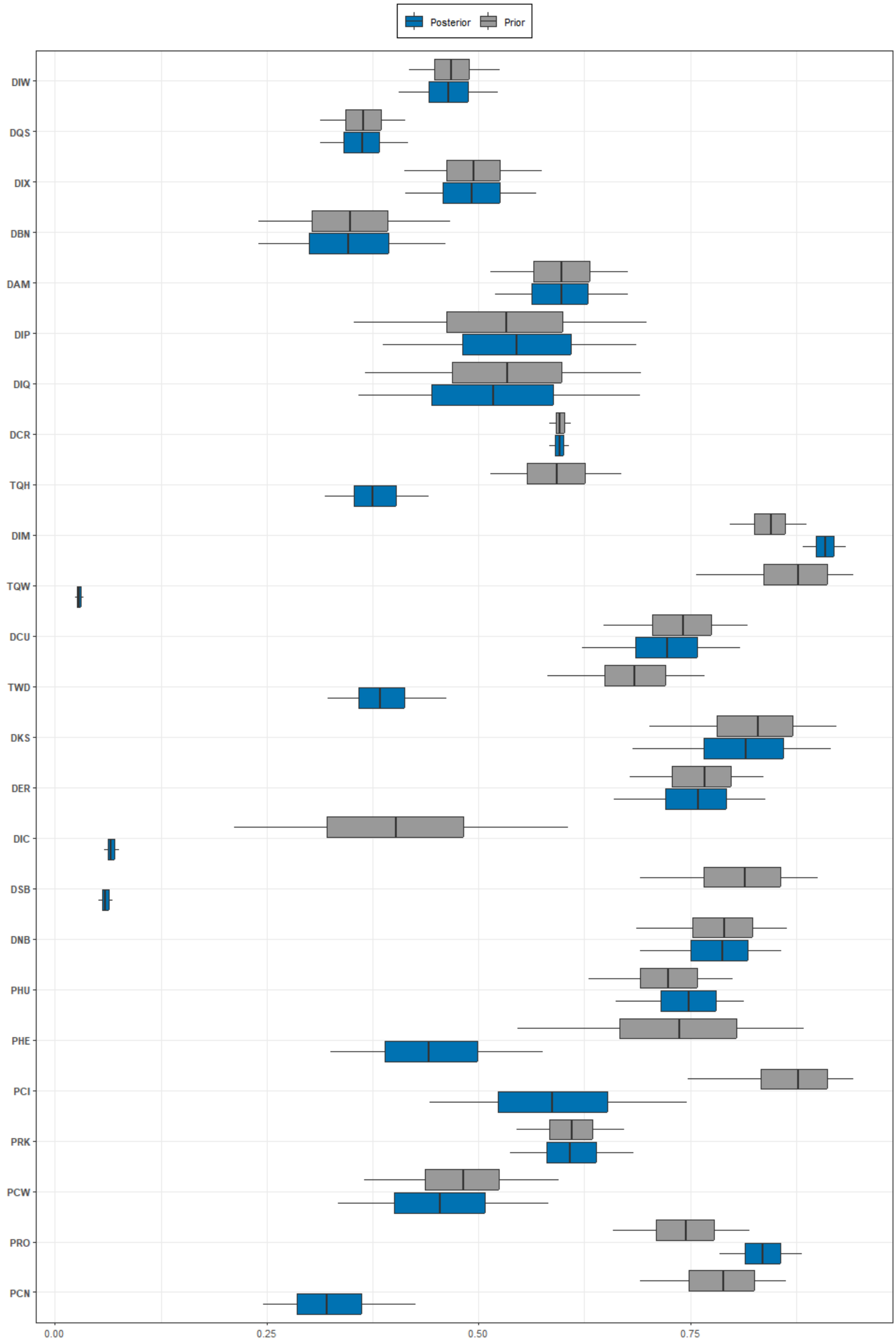

Figure 8b. Boxplots indicating the prior and posterior number of probability of breeding per species.

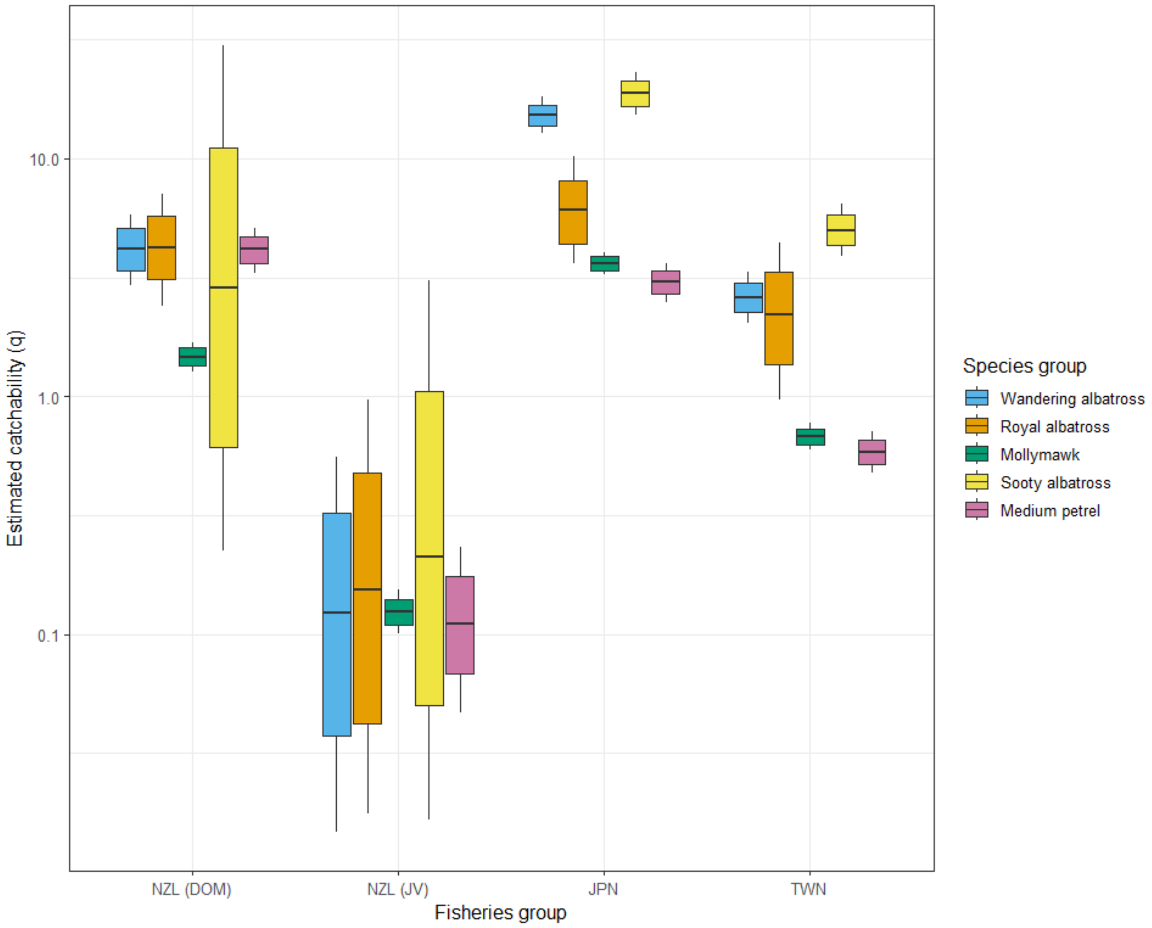

Figure 9. Boxplot showing posterior distribution of catchability values (on a log-10 scale) per species group and fishery group.

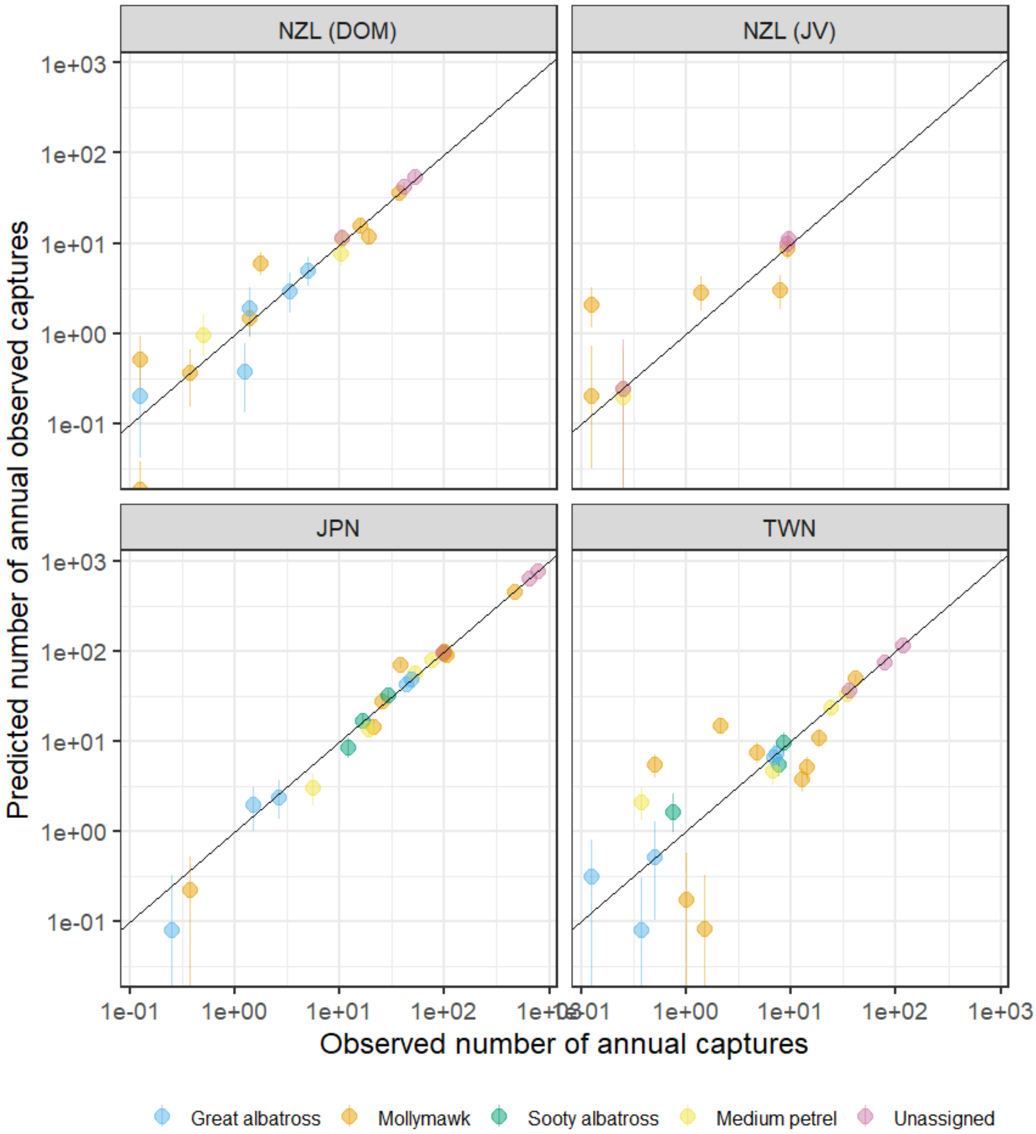

Figure 10a. Fit of the model to the average annual observed captures per capture code (on a log-10 scale) for the one time period model.

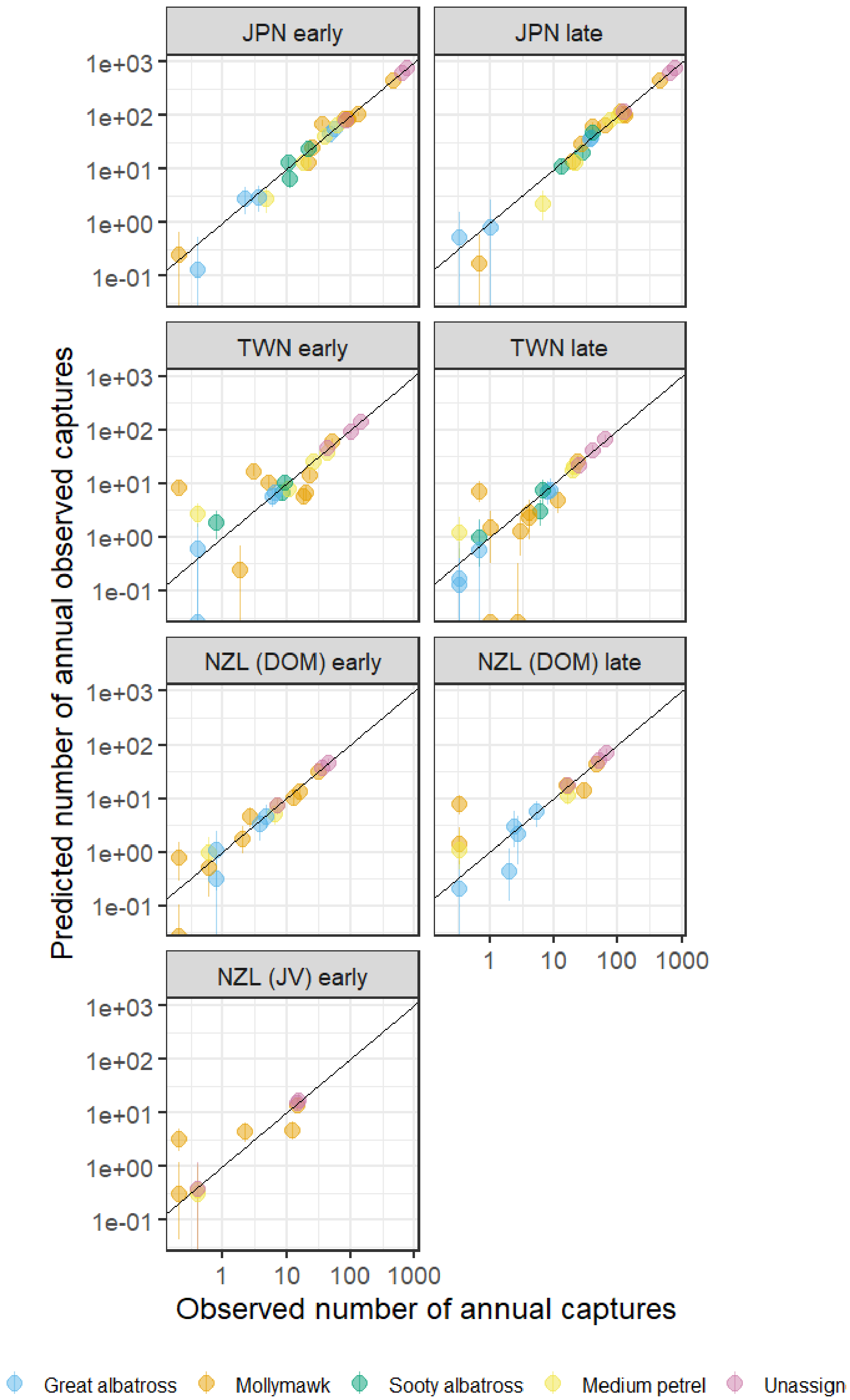

Figure 10b. Fit of the model to the average annual observed captures per capture code (on a log-10 scale) for the model.

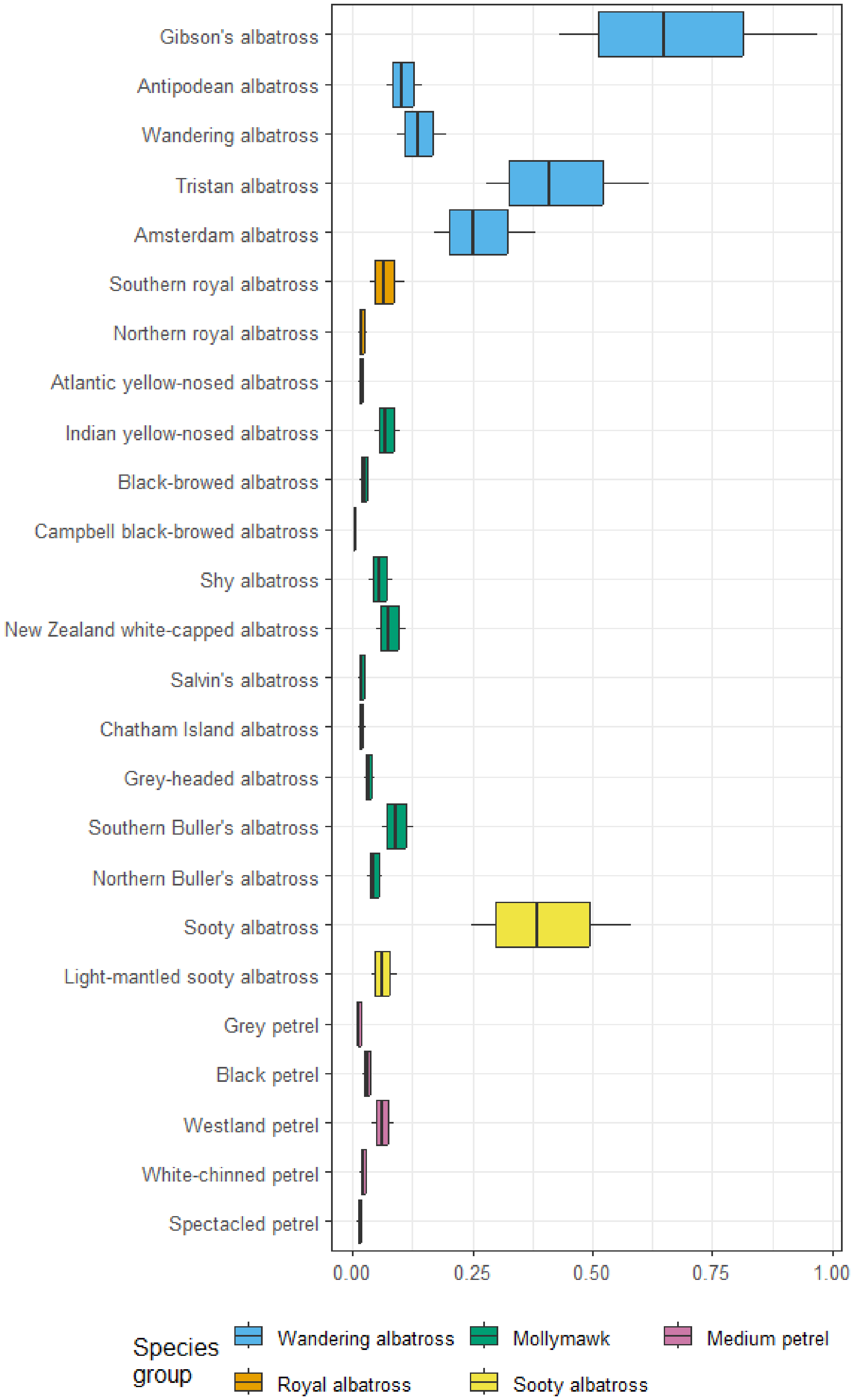

Figure 11. Relative mortalities per species with catchabilities shared across the full time period (2012 to 2019).

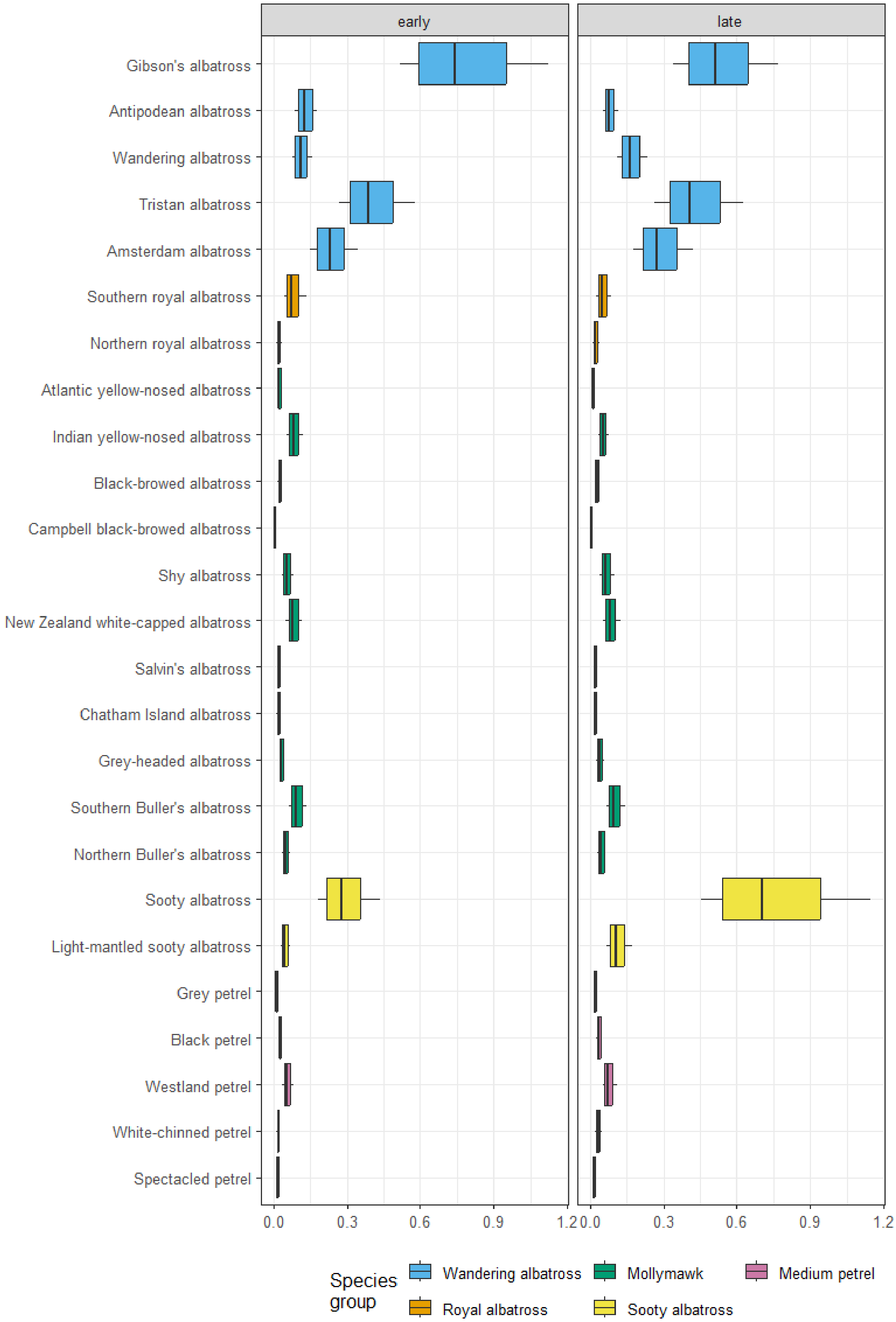

Figure 12. Relative mortalities per species with catchabilities specific to the early (2012-2016) and late (2017-2019) period.

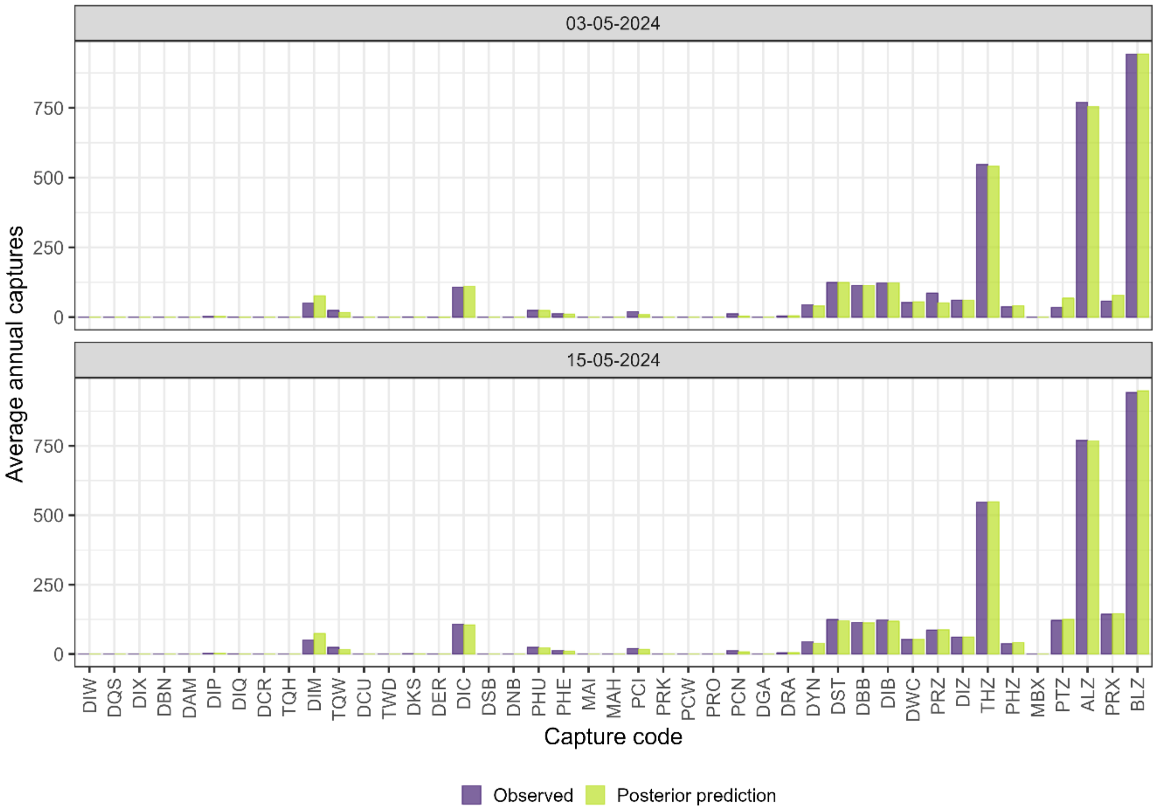

Figure 13. Model fit to the observed number of average annual captures per capture code for each model run. Empirical (observed) values are plotted next to the posterior predicted values.

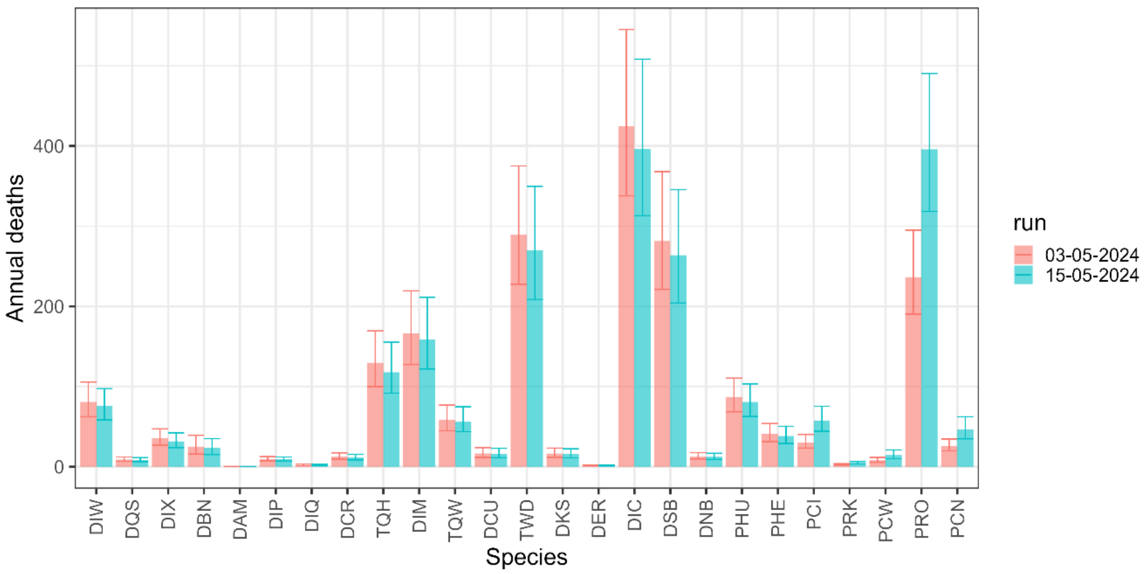

Figure 14. Estimated number of annual deaths per capture code for each model run.

Figure 13. Relative mortalities per species with catchabilities specific to the early (2012-2016) and late (2017-2019) period.

Appendix 1: Initial work plan developed by New Zealand and Japan in July 2022

Work plan for CCSBT-ERS – collaboration on Southern Hemisphere Risk Assessment

Japan and New Zealand would like to propose several Technical Workshops, and an intersessional work plan to establish a collaborative framework for a Southern Hemisphere Risk Assessment among the CCSBT Members. While collaboration within the CCSBT is the primary objective, it opens opportunity for wider acceptance by non-CCSBT Members whose surface longliners also overlap with seabirds in this study. This programme is therefore a first step towards a risk assessment of the entire southern hemisphere.
The work plan includes:

- Technical workshop I (virtual) in 1st Quarter 2023
- Data preparation meeting (face-to-face) in 3rd Quarter 2023
- Technical workshop II (face-to-face/virtual) in 1st Quarter 2024

All meetings will include options for virtual attendance if required.
Details of formats and objectives of the individual meetings are described below, together with inter-sessional preparatory work. Noting that the Data Preparatory Meeting and subsequent Technical Workshop II are contingent on New Zealand's internal research prioritisation process for 2023/24, and any potential funding contribution from other interested parties.

Technical Workshop I (Virtual)

Estimated dates: 1st quarter 2023 *Location: Online* *Duration: 1 – 2 days*

The aim of this workshop is for participating CCSBT-Member scientists to familiarise themselves with the SEFRA process, to understand and demonstrate the importance of collaborative participation, and summarise the data requirements needed to undertake this work. At least three presentations are planned:

i) The methodology and results from the current version of the Southern Hemisphere Risk Assessment conducted by New Zealand;
ii) The results from the quick analysis, comparing inclusion of Japanese data with initial model runs to evaluate increases in the precision of estimates;
iii) Summary of data requirements to conduct SEFRA; and
iv) Provisional work plan.

Coordinator: Sachik Tsuji

In preparation for this meeting, New Zealand and Japan will collaborate to establish the best way to share the inputs, codes and results sufficiently in advance to allow for the updated analyses with Japanese data.

The expected outputs include achieving general commitment by Members to participate in the collaborative risk assessment and receiving feedback and suggestions for further modification in methodology as well as potential constraints in input data provision.
It is expected that New Zealand will contract and fund the CCSBT-collaborative risk assessment.

After the completion of the first technical workshop, Japan and New Zealand will make efforts to encourage participation in the collaborative assessment with individual Members.
No support from ERS chair or Secretariat required.

Data Preparatory Meeting (In Person)

Estimated dates: 3rd quarter 2023 *Location: Wellington* *Duration: 5 days*

This workshop is to establish an integrated dataset for use in the CCSBT-collaborative risk assessment, including agreeing on fisheries and species grouping and the parameter inputs. Expected participants are scientists from member nations who agree to provide data into the collaborative assessment.

New Zealand and Japan would like to request the Secretariat to host this meeting. However, we recognize that this may not be possible in the first iteration of this process. Hosting by the CCSBT Secretariat is preferred due to the expectation that Members provide data towards establishing an integrated dataset under the CCSBT Secretariat to support a regular assessment.

Due to the highly technical nature of discussions, the meeting would ideally be face-to-face. Prior to the meeting, a GitHub repository for the code used in the analysis would be established and Members would have access.

At or promptly after the meeting, the integrated data set would be established, and the assessment would be conducted by an appropriate science provider funded by New Zealand. Items to be agreed upon at this workshop:

- i) Fleet definition;
- ii) Species grouping;
- iii) Spatial and temporal resolution;
- iv) Handling of data within the EEZ;
- v) Handling of unidentified seabird captures;
- vi) How information will be shared;
- vii) What can and cannot be modified;
- viii) Sensitivity runs including cryptic mortality

Coordinator: Sachiko Tsuji

Following this meeting the estimated input parameters would be shared among participating scientists. The New Zealand science provider would then develop a first draft of the assessment that would be reviewed before Technical Workshop II.

Ideally this meeting would take place in person, in Wellington New Zealand. This would ensure engagement with the contract researcher and IT infrastructure. There could be an option to attend virtually but strongly recommend an in-person presence.

Data manager: Support would be needed from the Secretariate for a data manger.

Output: Report drafted by the ERSWG Chair for members to report back to their respective governments summarizing the technical session.

Appendix 2: Note of agreement for the first Technical workshop, 21-22 June 2023

CCSBT ERSWG Collaboration on Southern Hemisphere Seabird Risk Assessment Workshop 1 -Technical workshop
21-22 June 2023
Online and in-person in Wellington New Zealand

Meeting attendees

Neil Hughes, Jonathan Barrington, Heather Patterson (Australia), Shachiko Tsuji, Ochi Daisuke, Nishimoto Makoto (Japan), William Gibson, Heather Benko, Johannes Fisher, Robert Gear (New Zealand), Ting Chun (Taiwan), Martin Cryer (ERSWG Chair), Ross Wanless (CCSBT Seabird Project Manager), Charles Edwards (researcher), Yonat Swimmer (WCPFC Co-Chair Ecosystem and Bycatch Theme), Akira Soma, Dominic Vallieres (CCSBT Secretariat)

Purpose of meeting

For participating CCSBT-Member scientists to familiarise themselves with the spatially explicit fisheries risk assessment (SEFRA) process, to understand and demonstrate the importance of collaborative participation, and summarise the data requirements needed to undertake this work.

Agreed data requirements/parameters

- Spatial and temporal resolution and coverage
    - Temporal resolution: monthly
    - Temporal coverage:
        - Comparing two time periods (2012-2015 and 2017-2019) to compare q(f,z)[2]
        - Longest time period possible, determined by CCSBT reporting to assess period with adequate observer data (e.g. 2002-2019)
    - Spatial resolution: 5x5 or 1x1 where feasible
    - Spatial coverage: all southern hemisphere
- 'Fishery' definition and coverage[3]
    - All SLL effort from CCSBT Member nations regardless of declared target
    - Separated by fleet, each fleet considered an independent 'fishery'
    - Flag nation to decide on further disaggregation needs
- Seabird components
    - Coverage: ACAP priority species plus additional frequently bycaught species which occur in the southern hemisphere (e.g., wedge-tailed, flesh-footed, and sooty shearwaters) if feasible
    - Species/species groups: to be reviewed by species experts intersessionally[4]

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[2] New Zealand has raised concerns around confounding between q(f,z) and N when fitting to C'. If two periods of stable seabird populations could be identified and population parameters entered into the model then q(f,z) may be able to be assessed. If N is fixed and q(f,z) allowed to vary then it will be impossible to assess whether a change in q(f,z) of the true value of N are effecting C'

[3] Noting that ideally these parameters would align with the goals of the Multi-Year Seabird Strategy for ease of implementation of the strategy.

[4] Utilizing the ACAP TOR to access/share seabird documents

- Growth stage segmentation: juveniles and adults
    - Bird distribution file: to be reviewed by species experts intersessionally
    - P(nest): to be reviewed by species experts intersessionally
    - Biological parameters: to be reviewed by species experts intersessionally
    - Sustainability criteria: intrinsic growth, static or dynamic (conversation to continue intersessionally)

- Post-release and cryptic mortality
    - Post release mortality: assuming no survival – all caught birds assumed dead
    - Cryptic mortality: make visible in output by splitting out cryptic mortality from post release survival[5]

- Operational procedure
    - Establish combined data, then run the model – CCSBT Secretariat to act as data custodian
    - Meeting 2 to be held in first quarter 2024 – hybrid approach online and in Wellington New Zealand for collaborative model runs and sensitivity analysis
    - Closed GitHub to be used as code sharing platform
    - Intersessional communications among participating experts to be conducted via email

- Incorporating precautionary principle
    - Elements of the precautionary principle incorporated throughout (e.g., zero survivability, cryptic mortality)
    - Exploring sensitivities (vulnerability, psi, omega, P-obs) – to be considered intersessionally but also discussed at next workshop

Draft Work Plan:

Task	Lead	Deadline
Preparation of package to process input observer and effort data for SEFRA	NZ, JP	ASAP but before Nov 2023
Review and selection of bird distribution and biological data and creation of density maps (if feasible)*	NZ (DOC), AU, Dr Ross Wanless	First draft by Oct, final draft by end of 2023
Preparation of observer and effort data	Members	By meeting 2
Modification of model	NZ, JP	ASAP but before Nov 2023
Evaluation of model operability via GitHub	Members	By meeting 2
Meeting 2 (hybrid) - collaborative model run, interpretation of results, compilation of input data, sensitivity runs	Members	First quarter 2024 (Jan, Feb**)
Report preparation	Members	For delivery at ERSWG15***
Meeting 3 (if needed)	Members	In conjunction with ERSWG15 ***

* Species list will be based on what is currently available and Member's capacity to fill gaps, and input from species experts
**Avoiding lunar new year second week of February
*** ERSWG 15 scheduled for 4-7 June 2024, location TBD

Attachment 5

SEFRA workplan, including resource requirements

(abbreviations: Sec=Secretariat Staff, Interp=Interpretation, Ch=Independent ERSWG Chair, C=Consultant, Cat=Catering only, FM=full meeting costs – venue & equipment hire etc., VEH=venue & equipment hire etc., FreeV=Venue & some equipment at no cost, inf=informal meeting)

	2024	2025
Archiving 2022-24 Assessment	NZ, Sec	-
Data prep AU, ZA, KR	AU, ZA, KR. Possible assistance from JP/NZ	AU, ZA, KR. Possible assistance from JP/NZ
ERSTech	-	5 days in-person (FreeV, no Interp, CH, 10C, 1Sec)
Model development		40 contractor days
Data compilation		Members
Initial model runs and review		Members 20 contractor days
Report outputs of 2022-24 assessment to ACAP and tRFMOs	Members	Members
Establish collaboration with ACAP for biological data/distribution	AU, JP, NZ, ZA, ACAP, BLI	20 contractor days

In addition to the table above, ERSWG supports the transition of SEFRA to the CCSBT Seabird Project funded as part of the ABNJ Common Oceans Project in 2025 to maximise the use of resources available as part of element 4 for this project.

Attachment 6

<table>
<tr><th colspan="3">Report from CCSBT Subsidiary Bodies on Progress Against Strategic Plan</th></tr>
<tr><td colspan="2">Subsidiary Body: ERSWG</td><td>Year: 2024</td></tr>
<tr><th colspan="3">Vision and Goals</th></tr>
<tr><td></td><td colspan="2">Comments from Subsidiary Body</td></tr>
<tr><td>Management of SBT
The Commission agrees the SBT tuna stock is to be managed at a biomass level that supports the maximum sustainable yield, and the risks related to fishing for SBT and impacts from fishing for SBT on ecologically related species are mitigated.
• This includes strategies concerning stock rebuilding, allocation and ecologically related species.
• This also includes consideration and review of all other risks including, but not limited to, marine pollution and human safety.</td><td colspan="2">• ERSWG is developing an ERS and Bycatch Action Plan for consideration and adoption by EC
• ERSWG has adopted and is in the process of actioning the Multi-year Seabird Strategy
• ERSWG is undertaking a SEFRA risk assessment for seabirds, which could eventually contribute to the ongoing FAO work under the previous Common Oceans project.</td></tr>
<tr><td>Operation/Administration of the Commission and Secretariat
It was agreed the Commission should operate effectively and efficiently, to responsibly manage fishing for SBT.
• This includes strategies for effective and efficient operation of Commission, its subsidiary bodies and Secretariat, including harmonisation with other RFMOs.</td><td colspan="2">• ERSWG 15 has developed and agreed on new Terms of Reference for the ERS Technical Group.
• ERSWG has agreed to meet on an annual basis by including a technical working group in the years where ERSWG does not meet to continuously advance the work outlined under such initiatives as the Seabird Strategy and the Bycatch Reduction Strategy.</td></tr>
</table>

<table>
<tr><td>Participation and implementation by Members, including Compliance

Members are actively participating in management of SBT through the Commission and implementing its decisions.

• This includes strategies concerning MCS, sanctions and assistance to developing countries.</td><td colspan="2">• The CCSBT Seabird Project is actively engaging with Members to improve on MCS measures, specifically emphasising engagement with developing countries.
• Members reported ERS data submission[1], mitigation measures and education. In addition, some members take part in Evaluation on mitigation measures, Assesment of SBT-fishery-bird interaction, outreach activities through the Seabird Project.</td></tr>
<tr><th colspan="3">Action Plan</th></tr>
<tr><th>Action</th><th>Progress since previous report</th><th>Planned work</th></tr>
<tr><td>Noting the Multi-year Seabird Strategy adopted at ERSWG 14, develop an Ecologically Related Species and Bycatch Action Plan based on the recommendations from the Performance Review.</td><td>• ERSWG has developed and agreed to an ERS and Bycatch Action Plan.</td><td>• ERSWG is committed to actioning the objectives of the ERS and Bycatch Action Plan per the timeline agreed to at the ERSWG15.</td></tr>
<tr><th colspan="3">Ongoing Work Plan</th></tr>
<tr><th>Action</th><th>Changes since previous report</th><th>Planned work</th></tr>
<tr><td>PR2021-24: CCSBT should continue to implement CMMs based on ESC and ERSWG advice for both target and non-target species.</td><td>• ERSWG15 updated its advice to EC on seabirds.</td><td></td></tr>
<tr><td>PR2021-25: CCSBT members should continue to strengthen the implementation of the IPOAs and FAO guidelines in fishing operations.</td><td>• Members noted that NPOAs have been adopted since the previous report, e.g. Australia's NPOA-Sharks, South Africa's NPOA-Sharks.</td><td>• Members continue to review NPOAs in line with IPOAs and FAO guidelines.</td></tr>
</table>

[1] The inablitiy of some Members to reach the target level of observer coverage is constraining availablity of useful ERS data for analysis.

PR2021-13: Achieve a better balance between the scientific efforts dedicated to SBT and ERS.	• ERSWG has undertaken a technical SEFRA risk assessment examining the risk to ACAP seabirds from CCSBT fisheries. ERSWG15 made recommendations to the EC on the future of the SEFRA initiative for consideration at EC31.	• The future of the SEFRA initiative will be dependant on the decision of the EC, however, could entail additional iterations using supplementary Member data, implementing additional mitigation/monitoring measures in high risk areas, and/or socialising the work with other RFMOs.

Attachment 7

Ecologically Related Species Bycatch Strategy

1. Introduction

CCSBT adopted the "Strategic Plan for the Commission for the Conservation of Southern Bluefin Tuna 2023 – 2028" (hereinafter "Strategic Plan"), which includes an implementation plan of recommendations from the 2021 CCSBT Performance Review.

The Strategic Plan specifies "*Addressing the impact of SBT fisheries on non-target species that belong to the same ecosystem, in particular seabirds*" as one of the key challenges of CCSBT, and also specifies "*strategies concerning stock rebuilding, allocation and ecologically related species*" as one of the items under "Management of SBT" that is a part of the Vision and Goals of the Strategic Plan.

The Strategic Plan, in its Action Plan, also specifies that "*Noting the Multi-year Seabird Strategy adopted at ERSWG 14, develop an **Ecologically Related Species and Bycatch Action Plan** based on the recommendations from the Performance Review.*"

2. Current Monitoring and Reporting of ERS (non-seabird)

The main ERS data that Members are required to provide to the CCSBT are the data specified in the annual ERSWG Data Exchange (EDE), which must be provided by 31 July each year. Compliance with EDE requirements is monitored and reported on annually as part of the Secretariat paper to the Compliance Committee on *Members' implementation of ERS measures and performance with respect to ERS*[1]. The Secretariat paper also includes a raised mortality estimate for each of the species groups defined in the EDE broken down by individual Member.

Members' annual reports to the Compliance Committee and the Extended Commission (Annual CC/EC Report) are also required to include information on:

Whether the IPOA-seabirds[2], IPOA-sharks[3] and the FAO Guidelines to reduce sea turtle mortality have been implemented;

- Whether all current binding and recommendatory measures of ICCAT, IOTC and WCPFC aimed at the protection of ERS from fishing are being complied with;
- Whether data is being collected and reported on ERS in accordance with the requirements of ICCAT, IOTC and WCPFC; and
- The methods used to monitor compliance with bycatch mitigation measures, including the level of coverage and the type of information collected.

The Secretariat also reports on whether Members have provided this information as part of its *Members' implementation of ERS measures and performance with respect to ERS* paper to the Compliance Committee.

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[1] The latest available report is CCSBT-CC/2310/05.
[2] International Plan of Action for Reducing Incidental Catches of Seabirds in Longline Fisheries.
[3] International Plan of Action for the Conservation and Management of Sharks.

3. Current Measures Relating to ERS (Non-Seabird)

Binding Measures

At its 25th Annual Meeting in October 2018, the CCSBT adopted the "Resolution to Align CCSBT Ecologically Related Species measures with those of other tuna RFMOs" (the "ERS Resolution"). In accordance paragraph 2 of the ERS Resolution, each Member and Cooperating Non-Member shall ensure that such vessels flying its flag and fishing for SBT in IOTC[4], WCPFC[5] and ICCAT[6]'s Area of Competence comply with all ERS Measures in force in that Area of Competence (whether or not the Member or Cooperating Non-Member is a Member of the tuna RFMO in which the ERS Measures were adopted).

To ensure SBT vessels comply with the latest ERS measures, paragraph 6 of the ERS Resolution tasks the Secretariat to annually update the list of ERS Measures contained in Annex I of the Resolution before the annual EC meeting according to any decisions taken on ERS at the annual meetings of the ICCAT, IOTC, and WCPFC.

Voluntary Measures

In accordance with CCSBT's Recommendation to Mitigate the Impact on Ecologically Related Species of Fishing for Southern Bluefin Tuna, Members will, to the extent possible, implement the International Plan of Action for Reducing Incidental Catches of Seabirds in Longline Fisheries (IPOA-Seabirds), the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks), and the FAO Guidelines to reduce sea turtle mortality in fishing operations (FAO-Sea turtles), if they have not already done so.

This recommendation also states that the EC and/or its subsidiary bodies as appropriate will undertake an assessment of the risks to ERS posed by fishing for SBT. The EC will consider how these risks are mitigated by the adoption of the "*Resolution to Align CCSBT Ecologically Related Species measures with those of other tuna RFMOs*", and will consider whether any additional measures to mitigate risk are required. The Seabird Strategy includes a component to assess the risk to seabirds, however, there is no planned review to look at non-seabird ERS risks.

4. Current Status of (Non-Seabird) ERS

ERS catch information collected as part of the EDE represents only a subset of the total captures of those species and therefore cannot be used in isolation to determine the overall status of the stock or species. CCSBT's ERS bycatch information can potentially highlight year to year trends from individual Member fleets but even this level of analysis is problematic given the recent gaps in observer data that arose during the pandemic.

CCSBT typically relies on the stock status assessments of third parties (e.g. other tuna RFMOs, ACAP, ABNJ, etc) for ERS. This approach is not unique to CCSBT. For example, the IOTC provides its Members with the IUCN threat status for marine turtles given that it has not undertaken its own assessment.

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[4] Indian Ocean Tuna Commission

[5] Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean

[6] International Convention for the Conservation of Atlantic Tunas

Scope:

The Bycatch Action Plan applies to sea turtles, marine mammals and non-target shark species. The non-target shark species to which the Bycatch Action Plan applies are listed in ....[to be developed]. The Bycatch Action Plan does not apply to other shark species. The Bycatch Action Plan does not apply to seabirds, which are covered under the complementary Multi-Year Seabird Strategy.

The Bycatch Action Plan will be implemented in collaboration with other tuna Regional Fisheries Management Organisations and other relevant organisations and institutions.

Overall objective

This Bycatch Action Plan's overall objective is to reduce or eliminate bycatch of ERS including sea turtles, marine mammals, and non-target sharks, such that SBT fisheries do not impose a significant adverse impact on these species.

Specific objectives

To achieve the overall objective, the following specific objectives have been developed:

> ***Objective 1*: Information objective**
>
> *CCSBT's assessment of the impacts of SBT fisheries on ERS is based on the best available information, includes assessment of uncertainty, and highlights information gaps.*
>
> ***Objective 2*: Governance objective**
>
> *CCSBT's governance arrangements ensure it effectively manages the impacts of SBT fisheries on ERS.*
>
> ***Objective 3*: Effectiveness objective**
>
> *To provide advice, developed in collaboration with industry and other relevant organisations and institutions, on bycatch mitigation technologies and techniques, which are practical, cost-effective and safe.*
>
> ***Objective 4:* Education & Outreach**
>
> *To enhance education and outreach programs highlighting the importance of mitigating ERS interactions while fishing, and advocating effective implementation of mitigation measures.*

Actions to achieve the specific objectives

The following actions will be undertaken against each of the specific objectives.

Actions to Achieve the Specific Objectives of the Plan

		Responsibility	Short Term 2024	2025	Medium Term 2026	2027	Long Term 2028++
(A) Information Objective							
1	***Data Collection and Information Sharing***						
i.	Confirm species/species groups relevant to Southern Bluefin Tuna (SBT) fisheries to be covered by this Bycatch Action Plan.	**ERSWG**	●	●			
ii.	Continue and improve ERSWG Data Exchange reporting.	**Members**	**Ongoing**				
iii.	Secretariat continues to submit its annual report on Members' implementation of ERS measures and performance with respect to ERS	**Secretariat**	**Ongoing**				
iv.	Secretariat to provide recent assessments of relevant bycatch species as information papers at future ERSWG meetings.	**Secretariat**			●		●
v.	Have a standing agenda item at ERSWG on Climate Change.	**ERSWG**			●		●
2	***Collaboration***						
i	Collaborate with other RFMOs on their activities related to the forecasting of the likely impacts of climate change on tuna ecosystems, SBT, ERS, and their productivity, distribution, and resilience. (PR2021-06)	**Secretariat**	**Ongoing**				
ii	Secretariat to share the Summary of Key Points from ERSWG meetings with other tRFMOs following on the agreed template (PR2021-06)	**Secretariat**	●		●		●

		Responsibility	Short Term 2024	Short Term 2025	Medium Term 2026	Medium Term 2027	Long Term 2028++
(B) Governance Objective							
3	***Commission Instruments***						
i	Periodic review of this Action Plan to ensure effectiveness. (PR2021-20)	**ERSWG**					●
ii	Assess whether Convention should be amended to clarify the role and mandate of CCSBT with regards to non-target species. (PR2021-03)	**EC**					●
(C) Effectiveness Objective							
4	***Review of Existing Measures***						
i	Advocate for strengthened CMMs on ERS at IOTC, ICCAT, and WCPFC. (PR2021-04)	**Members**	**Ongoing**				
ii.	ERSWG to consider whether the risks to ERS are sufficiently mitigated by the adoption of the "Resolution to Align CCSBT Ecologically Related Species measures with those of other tuna RFMOs", and provide advice to EC on whether any additional actions are required.	**ERSWG**	●		●		●
5	***Implementation***						
i	Explore the potential for an incentivised mechanism to combat an increase in bycatch and address the impact of fisheries on living marine resources and the ecosystem. (PR2021-27)	**ERSWG**					●

Attachment 8

Revised Actions to achieve the specific objectives

Objective 1: To reduce the level of impact of seabird bycatch by SBT fishing operations on seabird populations.			
No.	Action	Action by	Timeframe
1A	To agree on a SBT seabird bycatch target for reducing the level of impact of SBT fishing operations on seabird populations, including, but not limited to: a. Targets based on nominal reported seabird bycatch rates. b. Targets based on SEFRA outputs.	ERSWG	ERSWG 16
1B	That a minimum level of 10% observer coverage is achieved on a fleet-by-fleet basis for SBT fisheries or a comparable minimum level of review of video footage collected using electronic monitoring	CCSBT Members	Ongoing
1C	Evaluate the effectiveness of the seabird CMMs introduced around 2005 by tuna RFMOs, in the context of reducing the overall seabird mortalities, taking into consideration fleet differences and seabird distributions and identify the areas for improvement. The outcomes from the evaluation will be communicated across tuna RFMOs and used as a basis for future evaluations.	ERSWG	ERSWG 16, after that every 4 years
1D	Agree on the list of priority species and corresponding management targets, taking into account the status of seabird population, distributional overlaps with SBT fisheries, and significance of SBT fisheries in their mortality.	ERSWG, CCSBT	ERSWG 16
1E	Update SEFRA seabird risk assessment to evaluate the progress in seabird bycatch mitigation by SBT fisheries and their impacts on seabird populations from the previous assessment in 2019. The results to be communicated across tuna RFMOs.	ERSWG	Ongoing
1F	Establish a robust definition of *high risk* areas that takes into account the precautionary approach by: a. Establishing a definition of *high-risk* areas. b. Identifying areas that meet the definition. c. Characterising the nature of the risk in each area. d. Developing tailored measures aimed at reducing those risks.	ERSWG, CCSBT	ERSWG 16

Objective 2: To ensure the collection of timely, reliable, representative data to support accurate regular estimations of total seabird mortality in SBT fisheries and its impact on seabird populations.			
No.	Action	Action by	Timeframe
2A	Define improved protocols for reporting and analysing fishing effort data in the context of estimating seabird bycatch and its impacts on seabird populations, including concerning any implicit assumptions used when raising data.	ERSWG	ERSWG 17 (as required)
2B	Report and disseminate annually numbers of incidentally caught seabirds by species according to agreed reporting standards, total and observed effort, and mitigation use, according to agreed formats and strata.	CCSBT Members, Secretariat	Annually
2C	Explore options for the use of electronic monitoring systems by: a. Including seabirds (and other ERS) in discussions and the development of electronic monitoring systems. b. Considering electronic monitoring systems that contribute to, among other things, the effective monitoring of the implementation of seabird mitigation measures, and seabird interaction levels, throughout SBT fisheries.	ERSWG, CC, SC, ACAP, other tuna RFMOs	Ongoing
2D	Explore methodologies and techniques for estimating seabird mortalities in a timely and reliable manner, based on best available information and technologies, and not limited to observers and electronic monitoring.	CCSBT Members	Ongoing
2E	Agree on the CCSBT standard protocols for collecting feather samples and photographing dead bycaught seabirds, based on ACAP guidance.	ERSWG, Australia	ERSWG 16
2F	Review observer coverage of each stratum and fishing fleet to identify gaps and where additional coverage is needed concerning seabird bycatch.	CCSBT Members	At each ERSWG
2G	Update guidance for observers to include electronic monitoring seabird related task priorities including how to allocate time appropriately, recognising the multiple tasks undertaken, where applicable.	ERSWG, Australia, New Zealand, ACAP	ERSWG 16
2H	Review procedures and protocols to facilitate improved reporting of seabird interactions to species level by: a. Consistent reporting of seabird interactions across SBT fishing fleets. b. Removing any ambiguity about species groupings.	ERSWG, CC, BirdLife International (under CCSBT seabird Project)	2024 and 2025, report back at ERSWG 16, after that every 4 years
2I	Consider options for the use of fishing vessel logbook records of seabird interactions by examining the potential for logbook records to supplement other seabird interaction information sources, where appropriate.	ERSWG, CC, ACAP, other tuna RFMOs	ERSWG 16

Objective 3: To develop and refine, in collaboration with industry and ACAP, practical, cost-effective and safe seabird bycatch mitigation technologies and techniques.			
No.	Action	Action by	Timeframe
3A	Encourage CCSBT Members to undertake and support research and development to refine practical, cost-effective and safe seabird bycatch mitigation technologies and techniques.	CCSBT Members	Ongoing
3B	Advocate for strengthened seabird CMMs relevant to SBT fisheries within tuna RFMOs, where appropriate, taking account of, among other things, the best practice advice provided by ACAP.	CCSBT Members	Ongoing
3C	Regularly monitor and identify changes in the spatial overlap of fishing effort for SBT and the distribution of seabird species, particularly threatened albatross and petrel species, and inform the relevant fisheries across tuna RFMOs.	ERSWG	At each ERSWG
3D	Assess the cumulative impacts of fishing for SBT on seabirds, particularly threatened albatross and petrel species, across tuna RFMOs including developing methods for extrapolating seabird bycatch levels and seabird bycatch rates to identify total mortalities and total mortality rates.	ERSWG	At each ERSWG
3E	Consider the development of protocols on potential management responses to high seabird bycatch events.	ERSWG, BirdLife International, ACAP	ERSWG 16

Objective 4: To develop and refine compliance approaches to ensure fleet-wide compliance with seabird bycatch mitigation measures required while conducting fishing for SBT.			
No.	Action	Action by	Timeframe
4A	Collate information from compliance programs of CCSBT Members on implementation of seabird bycatch mitigation measures in SBT fisheries on a fleet-by-fleet basis.	CCSBT Members, Secretariat	Annually
4B	Review procedures and methods to improve compliance by SBT fishing operators with seabird CMMs and reporting requirements concerning seabird interactions by: a. Reviewing existing procedures and methods, including for in-port and transhipment at-sea inspections, and when other monitoring and surveillance technologies and techniques are used. b. Considering implementation, where appropriate, of additional monitoring and surveillance technologies and techniques. c. Considering options for management responses concerning non-compliance. d. Considering the development of options to enable, particularly for high seas SBT fishing fleets, the timely reporting of non-compliance events.	Members for a and b. CC for c and d based on specific requests by ERSWG 15	2024 and 2025 for a and b. CC 19 for c and d. Report back at ERSWG 16
4C	Review data collection forms and procedures across tuna RFMOs regarding compliance with seabird CMMs by longline fishing operators and develop harmonised format to communicate and advocate across tuna RFMOs.	CC	ERSWG 17 (if required), after that every 4 years

Objective 5: To enhance education and outreach programs highlighting the importance of mitigating seabird interactions while fishing, and advocating effective implementation of mitigation measures.			
No.	Action	Action by	Timeframe
5A	Share documents, formats and procedures for observer and electronic monitoring, seabird bycatch data collection through a centralised portal, e.g. the Bycatch Mitigation Information System hosted by the Western and Central Pacific Fisheries Commission.	Secretariat, BMIS	Ongoing
5B	Pursue collaboration across tuna RFMOs in capacity building in seabird bycatch monitoring and analyses.	CCSBT Members, Secretariat	Ongoing
5C	Explore options (if data are available) for the establishment of a reference DNA database for seabird species bycaught during fishing for SBT across tuna RFMOs.	CCSBT Members (Australia), ACAP, Seabird Experts	At Technical ERSWG in 2025 (if required)
5D	Support the establishment of a reference photographic database through a centralised portal, e.g. the Bycatch Mitigation Information System (BMIS) hosted by the Western and Central Pacific Fisheries Commission, for seabird species bycaught during fishing for SBT across tuna RFMOs. This may include involving volunteer networks and seabird specialists.	CCSBT Members, BMIS, Seabird Experts	ERSWG 17
5E	Translate ACAP's seabird species identification guide into key languages (e.g. French, Indonesian, Korean, Spanish, and Taiwanese) and disseminate together with the other languages (e.g. English Japanese).	Common Ocean Project II, ACAP	ERSWG 15

Attachment 9

TERMS OF REFERENCE FOR THE TECHNICAL ECOLOGICALLY RELATED SPECIES WORKING GROUP

(adopted at the Thirty-First Annual Meeting of the CCSBT – October 2024)

Terms of Reference
for the Technical Ecologically Related Species Working Group

Functions

The Technical Ecologically Related Species Working Group (ERSTech) will advise the ERSWG on issues of a technical nature.

Such matters may include, for example:

- A review of the effectiveness of existing bycatch mitigation measures;
- A review of ERSWG Data Exchange requirements;
- Exercises aimed at quantifying the risk to ERS from SBT fisheries and vice versa;
- Work aimed at improving ERS species identification;
- The development of seabird bycatch targets;
- Technical work to support the identification of high-risk areas;
- Applicability of electronic monitoring in the context of ERS data collection;
- The development of response protocols for high capture events;
- Assessment of new bycatch mitigation measures; and
- The development of ERS research proposals.

Operations

The ERSTech will meet (as required) in years where no physical Ecologically Related Species Working Group (ERSWG) meeting is taking place.

The ERSTech meeting is held by either hybrid or online meeting format, unless the Extended Commission (EC) agrees otherwise.

The ERSTech meeting shall be chaired by the Chair of the ERSWG, unless the ERSWG determines otherwise.

Membership

The Chair of the ERSWG will convene the meeting.

The ERSTech will be composed of Member and Cooperating Non-Member representatives, invited experts and observers as appropriate[1].

Communication

Communication between the Secretariat and ERSTech participants will take place through the use of participants list from the most recent ERSWG meeting. An area of the private section of the CCSBT website will be designated to each ERSTech and available to meeting participants.

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[1] States, entities and organisations that have been granted observer status to and attended the ERSWG meeting immediately prior to ERSTech will automatically be granted observer status to the ERSTech unless the Extended Commission decides otherwise.

Matters for Consideration

Initial consideration of ERSTech topics will take place during the physical ERSWG meeting. Members and Cooperating Non-Members may at any time submit to the Secretariat technical matters to be discussed at the ERSTech. The Secretariat, in consultation with the Chair of ERSWG, will develop and submit a Draft Provisional Agenda 100 days before the meeting in accordance with the CCSBT's Rules of Procedure. Members may add additional items to the agenda, in accordance with the CCSBT's Rules of Procedure, before the Provisional Agenda is circulated.

Reporting

The ERSTech will not produce a formal report although it may produce documents for consideration by the ERSWG and/or inclusion in the ERSWG Report as Attachment. The Chair of the ERSWG will provide an informal oral report of the ERSTech meeting to the ERSWG.

Documents submitted to the ERSTech will follow the CCSBT's Rules of Procedures, Rules and Procedures for the Protection, Access to, and Dissemination of Data Compiled by the CCSBT, and Terms of Reference of the Ecologically Related Species Working Group.