Agreement on the Conservation of Albatrosses and Petrels

Thirteenth Meeting of the Advisory Committee

Edinburgh, United Kingdom, 22 – 26 May 2023

Report of the Seabird Bycatch Working Group

Seabird Bycatch Working Group

Report of the Eleventh Meeting of the Seabird Bycatch Working Group, Edinburgh, United Kingdom, 15 - 17 May 2023

1. INTRODUCTION

This Report documents discussions and recommendations of the Eleventh Meeting of the Seabird Bycatch Working Group (SBWG11), held in Edinburgh, United Kingdom, 15 - 17 May 2023.

The SBWG Co-Convenor, Igor Debski (New Zealand), welcomed all SBWG members and observers (**ANNEX 1**) to the 11th meeting of the SBWG. He introduced SBWG's Co-Convenor Sebastián Jiménez (Uruguay) and Vice-convenors Juan Pablo Seco Pon (Argentina) and Dimas Gianuca (Brazil).

2. SBWG MEMBERSHIP

The Co-Convenor welcomed the following new members joining the group since SBWG10; Jose Carlos Báez (Spain), Caroline Fox (Canada), Verónica Iriarte (United Kingdom) and Helen Wade (BirdLife International). SBWG thanked Roberto Sarralde and Stephanie Prince for their input over previous years. The Co-Convenor noted that Parties can nominate Working Group members at any time. Current membership of SBWG is included in **ANNEX 1**.

3. ADOPTION OF THE AGENDA

The Convenor introduced the Agenda and related documents. The meeting adopted the Agenda (**SBWG11 Doc 01 Rev 1**).

4. ACAP SEABIRD BYCATCH MITIGATION BEST PRACTICE ADVICE - DEFINITION AND CRITERIA

The Co-Convenor noted that this agenda item serves as a reminder to continually review the definition and criteria for ACAP Best Practice Advice to ensure the advice remains fit-for-purpose. There were no papers to consider under this agenda item.

5. SEABIRD BYCATCH MITIGATION IN TRAWL FISHERIES

5.1. Review recent developments in mitigation research and update Best Practice Advice

SBWG11 Doc 06 provided an amended version, in tracked changes, of the advice for mitigating seabird bycatch in trawl fisheries endorsed by AC12. It aimed to improve clarity of the advice and consistency with advice documents for other fishing methods. The changes proposed inclusion of consistent language on the management of offal discharge and discards

(fish waste management), risk of net capture, as well as moving the advice on the Tamini Tabla to the section on Bird Scaring Line Minimum Standards and introducing a section "Other Considerations".

SBWG11 endorsed the suggested changes and identified some additional minor improvements to update references and further improve clarity. This included to clearly note the opportunity to use wireless transmission for net monitoring rather than a net monitoring cable, which has been shown to account for the majority of cable strikes in various trawl fisheries. SBWG11 was informed that the snatch block developed in Alaska was no longer commonly in use due to excessive cable wear. SBWG11 also recalled that CCAMLR IMAF-WG (Convention for the Conservation of Antarctic Marine Living Resources Incidental Mortality Associated with Fishing Working Group) has recently considered novel mitigation techniques developed for the net monitoring cable used on continuous krill trawl vessels and would welcome a paper from those active in this work for consideration at a future meeting.

SBWG11 Doc 11 described research to determine if lasers cause eye injury in birds. Results suggested that lasers of an energy output similar to the ones known to be used in fisheries can cause injures in two passerine species. The study concluded that if seabirds were to be exposed to lasers, it would be likely that similar results would be obtained to those with passerines in terms of eye injury.

SBWG11 expressed serious concerns about bird welfare issues associated with continued marketing and increasing use of laser technology to mitigate seabird bycatch, and considered that it is the responsibility of manufacturers of such technologies to demonstrate these devices do not cause damage to seabirds prior to marketing them. SBWG11 also recalled that results from research in Alaska found lasers were of limited efficacy as a seabird bycatch mitigation technique, especially during daytime. SBWG11 noted that various laser products were currently in use in several fisheries globally and recommended that the ACAP Best Practice Advice be updated to clearly indicate that the use of high energy lasers should be strongly discouraged.

SBWG11 Doc 17 Rev 1 described work undertaken in New Zealand to understand the mitigation of trawl net captures. This was a focal area for industry and government agencies and the Net Capture Programme worked collaboratively to ensure all possible mitigation tools and approaches were considered, and ideas for further work were prioritized based on feasibility (i.e., the mitigation had to be practical within regulatory bounds and safe to use). Potential options were categorised into one of three themes: attraction, deterrence or prevention. It was concluded that attempts to minimise overall attraction of the vessels or using visual or sound deterrents were not feasible for the New Zealand squid trawl fishery. The most plausible approach to reducing internal net capture (attributing to approximately 44% of captures) was prevention, by reducing the surface area encompassed by the headline to the end of the wings (referred to as the pooling area) in the last moments of hauling.

SBWG11 welcomed this research noting that net captures in trawl fisheries have been a priority research area for a number of years. It was noted that similar challenges are faced in other trawl fisheries across ACAP Parties, for example as described in **SBWG11 Inf 10**. SBWG11 recommended the addition of "minimising pooling area" as a mitigation option described in the review section of the Best Practice Advice, noting that this technique was not feasible for some vessels and fishing operations, and that currently there is not yet sufficient evidence on the effectiveness of this method to recognise it as best practice. SBWG11 encouraged further testing to quantify effectiveness.

SBWG11 welcomed **SBWG11 Inf 10,** which reported trials that showed the ineffectiveness of net binding as a mitigation measure in a demersal trawl fishery. The potential effect of mesh size on captures was also highlighted.

SBWG 11 Inf 07, **SBWG11 Inf 17** and **SBWG11 Inf 20** provided valuable information on the effectiveness of bird scaring lines and offal management in a range of trawl fisheries.

SBWG11 noted these studies provided further support to current Best Practice Advice.

SBWG 11 Inf 20 provided an update on the further development of the Tamini Tabla, which is now commercially available.

5.2. Update Mitigation Factsheets

SBWG11 noted that the planned update of the mitigation fact sheets for trawl fisheries should reflect the details of the latest Best Practice Advice arising from this meeting.

5.3. Priorities for mitigation research

SBWG reviewed and reiterated that the highest priorities for research on reducing seabird bycatch in trawl fisheries continue to be:

Cable mitigation: continued development of mitigation options to reduce seabird interactions with cables, in particular net monitoring cables and in fisheries using a range of different operational practices;

Cable interactions: determine relationships between seabird abundance, cable interactions and mortality (quantifying the level of undetected or cryptic mortality), including the potential to use electronic monitoring (EM) of cable strikes;

Net entanglement: further develop and test options to reduce seabird interactions with trawl gear to reduce the entanglement or capture of seabirds in nets during setting and hauling; and

Innovation: investigate innovative techniques.

SBWG11 reiterated the benefit of synthesising accumulated research so that the outcomes can be used to provide generalised advice, as well as developing fishery-specific guidance that is relevant to different species complexes in different regions.

New SBWG leads for bycatch mitigation in trawl fisheries were identified as Igor Debski, Verónica Iriarte and Leandro Tamini.

RECOMMENDATIONS TO THE ADVISORY COMMITTEE

SBWG recommends that the Advisory Committee:

1. Endorse the updated review and Best Practice Advice for reducing the impact of pelagic and demersal trawl fisheries on seabirds contained in **ANNEX 2.** These updates provide improved clarity and consistency in the document and reflect the latest research presented to SBWG11, but do not make any substantive change to Best Practice Advice.
2. Encourage implementation of the research priorities for bycatch mitigation in trawl fisheries identified in Section 5.3.

6. SEABIRD BYCATCH MITIGATION IN DEMERSAL LONGLINE FISHERIES

6.1 Review recent developments in mitigation research and update Best Practice Advice

SBWG11 Doc 11 was discussed under Agenda Item 5. Updated guidance about laser use was developed in the Best Practice Advice for trawl, demersal longline and pelagic longline fisheries.

SBWG11 Doc 21 reported on trials of simple haul mitigation devices (a 'baffler' and a 'dangler') on small demersal and pelagic longliners where bird attendance in the area around the longline was used as a proxy for bycatch risk. Model results showed that mitigation devices reduced the number of birds moving into the area immediately around the hauling station. Retrieving surface floats also reduced bird attendance beside the hauling station. This work showed that simple and cheap hauling mitigation devices can reduce risk to birds during longline hauling with minimal impact on fishing operations. Further work is currently underway to help fishing operators across the fleet to adopt these mitigation devices. Further at-sea testing to verify effectiveness across a greater range of vessel operations is also planned.

SBWG11 was advised that New Zealand has incorporated these devices into domestic mitigation standards for small vessels. These systems, although developed for small vessels, would be suitable with minor adjustments for use on vessels of any size. The approaches used could also be suitable in handline fisheries provided that hauling is confined to a fixed area on the vessel. More research on the amount of weight used would also be useful to examine the effect this would have haul interactions.

SBWG11 Inf 01 analysed the sinking speed of a floated-demersal longline used to target European Hake in many European offshore waters and found that the average sinking speed of the floated-demersal longline was substantially slower than the ACAP recommended best practice. Hooks from the floated-demersal longlines were therefore readily available to seabird attacks, and as a result present a clear bycatch risk. Similar issues have also been experienced in Australia, where the use of longer droppers to buoys has improved sink rates, as well as in New Zealand and South African fisheries. SBWG11 was advised that more work was necessary to address these challenges, including considering setting speed, gear configuration and target species. How gear is stored may also be relevant to effective deployment of weighted gear.

SBWG11 Inf 12 described work undertaken to further develop and trial two underwater setting devices ('underwater setter' and the 'line depressor') for use on small demersal longline vessels in New Zealand. Promising progress was reported, but further development is required for these devices to be suitable for wider commercial uptake.

SBWG11 Inf 13 reported on a project focused on the New Zealand shallow water demersal longline fleet where sink times to depth are known to vary with gear setup, position of weights on the line, and environmental conditions. Tests showed that a range of gear configurations achieved the required sink depth and this was communicated to fishers through an infographic. Work is currently underway to expand this approach to other target fisheries including floated demersal longline methods targeting bluenose and ling in deeper water. SBWG11 was advised that New Zealand hoped to bring a paper on best practices to the next meeting of the SBWG.

SBWG11 noted that the language used in ACAPs Best Practice Advice differs substantially when describing similar mitigation approaches for both demersal and pelagic longline gears.

There was agreement to work intersessionally to harmonise the text for best practice advice on both these gear types to ensure language is consistent throughout.

6.2 Update Mitigation Factsheets

SBWG11 noted that there was no requirement to update the mitigation fact sheets.

6.3 Priorities for mitigation research

SBWG confirmed the following mitigation research priorities for demersal longline fisheries:

Improved sink rates: further identify mitigation measures that improve the sink rate of baited hooks on floated longlines, including reducing the number of hooks positioned close to floats and the shape and design of weights to achieve higher sink rates. Synthesise experience and information from other demersal floated longline fisheries to inform the development of advice for this gear.

Haul mitigation devices: continue haul mitigation studies in small vessel demersal (and pelagic) fisheries, including at-sea testing to verify effectiveness across a range of vessel operations.

Ed Melvin and Juan Pablo Seco Pon remain the SBWG leads for bycatch mitigation advice in demersal longline fisheries.

RECOMMENDATIONS TO THE ADVISORY COMMITTEE

SBWG recommends that the Advisory Committee:

1. Endorse the updated review and Best Practice Advice for reducing the impact of demersal longline fisheries on seabirds contained in **ANNEX 3.** These updates reflect the latest research presented to SBWG11, but do not make any substantive change to Best Practice Advice.

2. Encourage implementation of the research priorities for bycatch mitigation in demersal longline fisheries identified in Section 6.3.

7. SEABIRD BYCATCH MITIGATION IN PELAGIC LONGLINE FISHERIES

7.1 Review recent developments in mitigation research and update Best Practice Advice

SBWG11 Doc 07 provided a range of proposed amendments to ACAP's pelagic longline mitigation advice document, following routine intersessional review. A number of further suggested amendments were identified.

SBWG11 updated the pelagic longline advice:

(i) noting research from one fishery that the use of weighted hooks negatively affected catch rates of target species

(ii) explaining why night setting, branch line weighting and bird scaring lines should be used in combination

(iii) strongly discouraging the use of the high energy lasers as seabird bycatch mitigation (based on **SBWG11 Doc 11**)

(iv) noting evidence suggesting that in some fisheries switching from daytime to deep night-time setting can maintain target catch rates, while significantly reducing seabird bycatch risk compared to deep, partial day-time setting (based on **SBWG11 Doc 10**)

(v) highlighting the importance of aerial extent when using bird scaring lines.

SBWG11 discussed the divergence between the ACAP Best Practice Advice recommending use of night setting, branch line weighting and bird scaring lines, and the approaches adopted by RFMOs where the use of only two out of three best practice measures is stipulated. SBWG11 recommended that intersessional work be undertaken to review the range of seabird bycatch mitigation measures used by RFMOs, and consider if two out of three best mitigation measures could be prioritised, and if so, in what circumstances. SBWG11 also discussed including information on the rationale and sink rate of existing ACAP branch line weighting recommendations.

SBWG11 Doc 10 examined, through an observational study, the effects of the time-of-day and relative depth of fishing on seabird and target species catch rates for a Pacific Ocean pelagic longline fishery that targets albacore tuna. Modelling results indicated that deep night-time setting had significantly lower albatross and seabird bycatch rates compared to both deep and shallow partial daytime sets, without impacting albacore catch rates. SBWG11 welcomed the research findings and noted that further research is merited to assess the effects of moving from daytime to deep night setting in different fisheries, and to develop a definition of deep setting.

SBWG11 Doc 11 was discussed under Agenda Item 5.

SBWG11 Doc 15 reported on the development of the weighted 50g Procella Hook for use in pelagic longline fisheries (see also SBWG10 Inf 09). Placing weights on the hook was reported as having the advantage of avoiding any lag in the sink profile of the branch line, compared with weights farther from the hook. SBWG11 discussed whether the weight of the hook could be used as a contribution to branch line weighting, without drawing a conclusion on this issue. SBWG11 agreed to move the guidance about hook mass and design to the 'Other Recommendations' category to allow for further research and innovation, and recommended against the use of lead when adding weight to the hook and to instead use non-toxic materials.

SBWG11 Doc 21 reported on haul mitigation research for small vessels and was discussed under Agenda Item 6. SBWG leads for bycatch mitigation will seek to harmonise Best Practice Advice on haul mitigation for small vessels in pelagic and demersal fisheries.

SBWG11 Doc 23 reported on modelling approaches to assess variables that may affect seabird bycatch in pelagic longline fisheries in New Zealand. The model indicated that seabird capture rates: (a) decreased with increased night hours, when the tori line was over the bait entry point, with increasing tori line attachment height (a proxy for aerial extent), and with increasing distance from shore, and (b) increased with higher numbers of vessel turns during setting, and fishing during higher sea surface temperatures.

SBWG11 Inf 04 reported on research into the effectiveness of alternative bird scaring line and tori pole designs for use in Japan's small-scale longline fisheries (vessels <24 m). WCPFC-mandated bird scaring line designs are not favoured by the fishing industry and the research compared streamer-less bird scaring lines, compared with light bird scaring lines. Aerial extent

was more easily attained using streamer-less bird scaring lines. SBWG11 noted with concern that one of the trials resulted in 99 albatross mortalities, suggesting a high bycatch rate, even with the tested bird scaring lines deployed. The streamer-less bird scaring lines would be difficult for birds to discern during the day and unlikely to be detected at night. While seabird assemblages in the north Pacific Ocean differ from those elsewhere, SBWG11 noted that seabirds were abundant in this region and well designed bird scaring lines are needed to effectively minimise bycatch.

SBWG11 Inf 06 provided advice to the tuna longline supply chain on the performance of seabird bycatch mitigation measures. SBWG11 noted that the information on the effectiveness of various mitigation options would also be relevant to the ACAP communication strategy and other outreach.

SBWG11 Inf 11 reported on research that indicated that using night setting, bird scaring lines and weighted branch lines significantly reduced seabird bycatch in a south-eastern Atlantic Ocean pelagic longline fishery targeting albacore. SBWG11 noted that the research demonstrated ACAP's best practice advice recommending the combined use of night setting, branch line weighting, and bird scaring lines is the most effective way to reduce seabird bycatch that would otherwise be very high.

7.2 Update Mitigation Factsheets

This issue was discussed under Agenda Item 16.2.

7.3 Priorities for mitigation research

SBWG confirmed the following mitigation research priorities for pelagic longline fisheries:

Weighted branch lines: carry out further collaborative field research on the relationship between the current ACAP Best Practice Advice concerning line-weighting regimes and resulting seabird mortalities and/or seabird attack rates, impacts on catch rates of target species, other bycatch species (e.g., sea turtles), and safety aspects associated with using line-weighting. Conduct further research to investigate the effect of the total length of branch lines on sink rates.

Improved branch line weighting for high seas fisheries: develop an experimental branch line with hook sink rates consistent with ACAP's Best Practice line weighting advice (e.g., 60 g located ≤ 1 m from hooks) in the upper levels of the water column (0–2 m depth). High sink rates in the shallow depth ranges are advantageous to seabird conservation and are particularly important in the absence of bird scaring lines or night setting. An average sink rate of ≥0.4 m/s to 2 m depth should be used to inform the development of the new weighting regime. A single weight, or an improved version of the existing double weight system, might be the operationally preferred weighting option. A multi-disciplinary approach, potentially involving key members of the fishing industry, marine engineers and others as deemed appropriate, is encouraged.

Hook-shielding devices: conduct further field research to evaluate the relative contributions of the sink rate and hook protection components of hook-shielding devices in reducing bycatch, including through entanglements. Research on hook-shielding devices should also investigate their long-term durability or failure rates, and the possibility of increasing the depth (or time) of protection provided. Further research on the effectiveness of the Hookpod-mini (48 g) is encouraged. Research on the performance of any hook-shielding device should collect data

on seabird attacks on baited hooks to assess the risk of entanglement or being swallowed together with the bait.

Bird scaring lines: developing bird scaring line configuration for smaller vessels and methods that minimize entanglements of the in-water portion of bird scaring lines with longline floats, while creating sufficient drag to maximize aerial extent, remains the highest priority for research on bird scaring lines. Research activities evaluating the effectiveness of one vs. two bird scaring lines, bird scaring line design features (streamer lengths, configurations, and materials), and methods for efficient retrieval and stowage of bird scaring lines remain research priorities.

Time-of-day: determine the relative effectiveness of bird scaring lines and branch line weighting at night by characterising seabird behaviour at night using thermal or night-vision technologies.

Underwater bait setting devices: evaluate performance with unweighted vs weighted branch lines.

Combinations of mitigation measures: evaluate the effectiveness of the simultaneous use of various combinations of two best practice mitigation methods (night-setting, branch line weighting and bird scaring lines) as called for by existing Regional Fisheries Management Organisation (RFMO) seabird conservation measures. Continue to evaluate the effectiveness of the simultaneous use of all three ACAP best practice mitigation measures, including comparative catch rates for both bycatch and target species.

Novel/emerging technologies: continue to develop novel and/or emerging technologies. Also consider innovation in independent monitoring of fishing activities.

Sensory ecology: encourage and initiate research to examine the sensory capabilities of seabirds (visual, acoustic, olfactory systems) to inform the development of sensory-based safe mitigation technologies and measures as an alternative to trial-and-error approaches. This research priority has application to the development of mitigation options across a broad range of fishing methods.

Live bird haul capture: investigate the nature and extent of live bird haul capture in pelagic longline fisheries.

Haul mitigation technologies: develop methods that minimise seabird hooking during hook retrieval. Encourage further research to mitigate bycatch on small vessels during hauling.

Time/area closures: update seabird tracking/fishing effort overlap maps to advance options for time/area management.

Bait-casting machines: conduct a survey to characterise the extent of use of bait-casting machines, and their operational attributes that may influence seabird bycatch risk.

Hook mass and design: investigate whether changes to hook mass and design may reduce the chance of seabird mortality in longline fisheries without adversely affecting target species catch rates.

Jonathon Barrington and Sebastián Jiménez remain the SBWG leads for bycatch mitigation advice in pelagic longline fisheries.

RECOMMENDATIONS TO THE ADVISORY COMMITTEE

SBWG recommends that the Advisory Committee:

1. Endorse the updated review and Best Practice Advice for reducing the impact of pelagic longline fisheries on seabirds contained in **ANNEX 4**. These updates provide improved clarity and consistency in the document and reflect the latest research presented to SBWG11, but do not make any substantive change to Best Practice Advice.

2. Encourage implementation of the research priorities for bycatch mitigation in pelagic longline fisheries identified in Section 7.3.

8. ARTISANAL AND SMALL-SCALE FISHERIES

8.1 Review recent developments in mitigation research and update toolbox advice

SBWG11 Doc 18 described the development of the double NISURI system. This is a fishing system that consists of setting baits at a speed of three hooks per second from a double PVC tube so that birds do not see the exit of the baited hook. The system also helps fisherman to reduce their time at sea. With the authors unavailable to answer queries on how the gear worked, it was not clear to what extent seabird bycatch is a problem in the fishery where the device was tested. SBWG11 noted that the external line weights used in this demersal longline fishery fall well short of that recommended in the Best Practice Advice for demersal longline fisheries. Insufficient evidence was available in the paper to demonstrate the effectiveness of the technique as a best practice seabird bycatch mitigation measure. However, the work was welcomed as a cheap and practical tool and a report back on any further testing was encouraged. Specifically, SBWG11 encouraged the authors to communicate the gear configuration of the fishery clearly in a way that would allow assessment of the wider applicability of the technique.

SBWG11 Doc 19 described a novel seabird bycatch mitigation device for the little-studied Ecuador hand line fishery. It consists of a camouflage tube of 8 inch (20 cm) diameter PVC tube one metre long, where the hooks are inserted at the beginning and the line is collected. The system prevents birds from seeing the baited hooks which are inside the tube when the line is cast. With the authors unavailable to answer queries on the design and operation of the device, it was unclear whether there were any effects on bait loss, what size of target fish catch could be accommodated and whether this method might be better classified as a drop line. There was insufficient evidence in the paper on the effectiveness to demonstrate this device as best practice. However, SBWG11 welcomed the development of this innovative device and encouraged further testing and a report back.

SBWG11 noted that the bird scaring line extension arms described in **SBWG11 Inf 18** represent an innovative development to enable safe deployment of bird scaring lines in small-scale fisheries. Such devices may also be applicable to larger industrial trawl vessels and SBWG11 encouraged the results of further development and tested to be reported back in future.

SBWG11 agreed that the seabird bycatch mitigation toolbox for artisanal and small-scale fisheries be updated to appropriately reflect the mitigation options described in the papers above.

SBWG11 noted the observational study reported in **SBWG11 Inf 21** on the role of offal discards in causing albatross congregations in offshore waters of southern Peru. Whilst the study was small and reported limited quantitative data, SBWG11 noted that if seabird attraction to fishing vessels was driven by the discharge of shark liver then practical offal management techniques could be developed. Further data collection was encouraged.

SBWG11 welcomed **SBWG11 Inf 22**, which analysed voluntarily self-reported set-by-set and cruise information by fishing skippers in a major port in southeast Brazil to assess seabird bycatch in southeast Brazilian small-scale fisheries. SBWG11 noted that these fisheries were a priority for at-sea conservation action, and occur in an area where high levels of beach cast seabirds have been documented. SBWG11 noted the substantial challenges involved in collecting data across such a large and complex artisanal fleet. The fishery employs a range of operational methods including a surface longline targeting dolphinfish, where the mainline is attached directly to surface floats, leading to live capture of seabirds. The fishery overlaps with ACAP-listed species breeding in other jurisdictions. SBWG11 was informed that the Brazil National Plan of Action recognises the bycatch risks posed by this fishery, and SBWG11 strongly encouraged Brazil to continue work to reduce seabird bycatch in these fisheries.

RECOMMENDATIONS TO THE ADVISORY COMMITTEE

SBWG recommends that the Advisory Committee:

1. Note the important findings on bycatch in Brazilian small-scale fisheries described in **SBWG11 Inf 22** and requests that Brazil continues this important monitoring initiative and works urgently towards reducing bycatch in these fisheries.

2. Encourage further intersessional work to populate the seabird bycatch mitigation toolbox for artisanal and small-scale fisheries to reflect the updates provided to SBWG11 and report back to future meetings.

9. SEABIRD BYCATCH MITIGATION IN PURSE SEINE FISHERIES

9.1 Review recent developments in mitigation research and update toolbox advice

SBWG11 Inf 16 presented updated actions in Chile on reducing seabird bycatch in purse seine fisheries and the implementation of mitigation measures. The authors were encouraged to use the toolbox for best practice advice mitigation measures in purse seine fisheries (currently available as ANNEX 3 of AC12 Doc 13 Rev 1).

10. SEABIRD BYCATCH MITIGATION IN OTHER FISHERIES

10.1 Consider recent developments in mitigation research and consider priorities for further research

SBWG Vice-co-convenor Juan Pablo Seco Pon presented the latest FAO International Standard Statistical Classification of Fishing Gear which can be used as a guide for the classification of gear categories in other fisheries. A previous version of this classification was presented in SBWG6 Doc 07. SBWG11 acknowledged that such categorization is adequate, but also noted that there are variations within fishing gear across fleets and regions that deserve attention.

11. ACAP PERFORMANCE INDICATORS: SEABIRD BYCATCH DATA WORKSHOP

11.1 Seabird Bycatch Data Workshop

SBWG11 Doc 05 reported on a workshop held on 14 May 2023, immediately prior to SBWG11. The workshop aimed to understand and find solutions to the challenges experienced in reporting ACAP seabird bycatch indicators.

The workshop identified a range of challenges faced by Parties in reporting data to inform the current Pressure indicators on seabird bycatch. Several potential actions were identified that ACAP could take to address some of these challenges, including:

(i) Develop guidelines on appropriate protocols for data grooming and analysis.

(ii) Establish an intersessional correspondence group to agree 4-5 relevant questions that could be used to elicit responses, in a consistent way, from Parties concerning their main data-related challenges and solutions. These answers could then be used to get an overview of the main issues that need to be addressed.

(iii) Each Party should hold a workshop between their fisheries data specialists, managers and ACAP data suppliers. Such workshops would raise the profile of ACAP nationally and could provide useful feedback to ACAP on the Party's approaches to data. Matters to be discussed at the workshops could include:

1. Developing guidance on methods, possibly a data collection and analysis toolbox.
2. How to address barriers to lack of capacity and guidance.
3. A focus on estimating confidence intervals as well as total bycatch and bycatch rates.
4. Developing a range of case studies to inform discussion on capacity limitations and to contribute to the development of possible solutions to Party-specific priorities.

The workshop also considered the scope and focus of the current State-Pressure-Response indicators for seabird bycatch and identified some areas for improvement which could allow for more immediate reporting while actions are taken to improve reporting on key Pressure indicators.

It was noted that many terms (e.g. 'availability') used in the Indicators needed better definition in order to ensure consistent and comparable data is collected.

SBWG11 Doc 16 analysed available information relevant to seabird bycatch contained in annual reports of CPCs (Contracting Parties and Cooperating Non-Contracting Parties) submitted to IATTC (Inter-American Tropical Tuna Commission). This analysis took considerable resources and could not readily be automated. However, analyses like this may allow to better understand the amount and quality of information reported by CPCs, to identify weak areas in the reporting, and ascertain how ACAP could assist to improve the data gathered by observers.

SBWG11 Doc 20 described an analytical approach to bycatch data in Chilean trawl fisheries that demonstrated a decrease in bycatch between 2015 and 2021. The analysis used simple ratio estimation, as suggested by SBWG7 Doc 05. It was noted that geographical variation and change in the location of the freezer-trawl fishery was likely an important driver of change in bycatch rate alongside the implementation of other technical mitigation.

SBWG11 Doc 25 was discussed under Agenda Item 15.

The authors were not available to present **SBWG11 Doc 27** but SBWG11 nevertheless welcomed the work as an interesting way to obtain bycatch information from fishers in a small boat fleet in the western Mediterranean. The sample sizes indicated that the authors had interviewed many fishers and the self-reporting logbooks appeared to have been successful in both gathering data and raising awareness about bycatch. The approach may be of value elsewhere, but it was noted that if the information gained by this method started being used in regulation or enforcement then there was a risk of reduced quality of data.

SBWG11 Inf 02 indicated that there was very little bycatch on Argentine scallop trawlers that did not discard much edible fishery waste.

SBWG11 Inf 22 was considered under Agenda Item 11.

RECOMMENDATIONS TO THE ADVISORY COMMITTEE

SBWG recommends that the Advisory Committee:

1. Endorse the establishment of an intersessional correspondence group to discuss key challenges in data collection and reporting.
2. Encourage Parties to hold a workshop between their fisheries data specialists, managers and those responsible for reporting to ACAP to improve data flow to ACAP.
3. Endorse ACAP support of these workshops, such as through provision of expert advice, where feasible, and encourage Parties to share their experiences with other Parties to maximise lessons learned.
4. Conduct an intersessional review to refine the State-Pressure-Response indicators so they can be better implemented by ACAP Parties and provide improved visibility on the use of Best Practice Advice.

12. MONITORING TECHNIQUES FOR SEABIRD BYCATCH AND MITIGATION USE

12.1 Review developments in monitoring methods or techniques in relation to seabird bycatch and the use of seabird bycatch mitigation

SBWG11 Doc 12 reported that a range of genetic markers were developed and evaluated, based on samples from feathers, to assist in the identification of albatross and petrel species bycaught in fisheries. Analyses found that the combination of two genetic markers could identify 97% (n=35) of 36 target seabird species to either species (n=32) or sister species (n=3), while for one petrel species there were no reference sequences. Genetic methods provide a streamlined framework for the molecular identification of seabird bycatch to corroborate and/or correct logbook entries, observer reports and audits of imagery captured by Electronic Monitoring (EM). SBWG11 noted the importance of genetic analysis for species-specific identification of seabirds bycaught in fisheries for improving bycatch monitoring and management, and acknowledged the value of the results presented in **SBWG11 Doc 12**. The authors noted the tests were specifically designed to be simple and cost-effective and advised that the sex of the bycaught birds could also be determined from feather samples, which is important in understanding of population-level impacts of seabird mortality in fisheries.

SBWG11 Doc 24 presented a bird scaring line compliance monitoring device developed with funding from an ACAP Small Grant. The device works by continuously measuring the tension exerted by a bird scaring line when its terminal end is dragged through the water. Such devices have the potential to improve the independent monitoring of the deployment and use of bird scaring lines, and to reduce workloads and potential work health and safety hazards facing fisheries observers at sea. Further research and development of bird scaring line compliance monitoring devices is merited. SBWG11 agreed that this reliable and affordable tool could be included in the arsenal of devices that can be integrated into EM to allow monitoring of the use of seabird bycatch mitigation measures. SBWG11 encouraged further research and development concerning such devices.

SBWG11 Doc 26 described the results of an EM program developed within the framework of certification of the Argentine hoki fishery in accordance with the MSC (Marine Stewardship Council) standard and the development of a joint action plan between the fishery client and Aves Argentinas. Cameras were installed and logbooks were requested on four freezer trawlers to record the use and configuration of bird scaring lines for warp cables across 21 fishing trips. Data collected indicated that bird scaring lines were deployed during 80.5% of the hauling time in the trips monitored. Technical limitations were identified that can affect the quality of the data collected. SBWG11 acknowledged the importance of **SBWG11 Doc 26** showing how cameras can be used to evaluate the effectiveness of bird scaring lines and monitor their use, and further noted the potential value of certification schemes to promote improvements in compliance with seabird bycatch mitigation measures.

SBWG11 acknowledged the value of using self-reporting logbooks to assess seabird bycatch, particularly in small-scale fisheries as described in **SBWG11 Doc 27** and **SBWG11 Inf 22**. This method allows a large volume of data to be obtained with daily (or individual fishing operation) resolution. SBWG11 noted that using logbooks could also be useful for building relationships with fishers, however, in fisheries where management measures are mandatory and/or fishers perceive reporting bycatch as something negative, the reliability of data from self-reporting logbooks is expected to be low.

SBWG11 Inf 24 analysed time of setting of individual pelagic longline sets in tuna RFMOs and flag-fleets using AIS (Automatic Identification System) data from Global Fishing Watch (GFW), and showed that overall night setting is extremely rare, much lower than recorded by on-board observer schemes, and in information reported by CPCs to RFMOs. SBWG11 acknowledged the importance of the results in **SBWG Inf 24** as a potential tool to assess compliance with CMMs (Conservation and Management Measures) on the high seas. SBWG11 discussed the value of the methodology and algorithms used in this work to allow remote verification of night setting, and noted this kind of analysis can also be conducted using VMS (Vessel Monitoring System) data.

The following information papers were also relevant to Agenda Item 12: **SBWG11 Inf 09, SBWG11 Inf 14** and **SBWG11 Inf 23**.

RECOMMENDATIONS TO THE ADVISORY COMMITTEE

SBWG recommends that the Advisory Committee:

1. Encourage further collaboration between Parties on using genetic techniques for the identification of bycaught seabird specimens.
2. Elevate ACAP's focus on the implementation and monitoring to the same priority level as Best Practice Advice development.
3. Encourage further work among Parties to adopt, or develop and implement, technologies and techniques to assess fisheries compliance with seabird bycatch mitigation measures.

13. FAO IPOA/NPOA-SEABIRDS

13.1 Review of status of implementation of NPOA-Seabirds

SBWG11 congratulated Argentina and Uruguay on progressing the development of a Regional Action Plan to reduce the interaction of seabirds with fisheries operating in the Treaty Area of Río de la Plata and its Maritime Front, which was adopted by the Treaty Commission in June 2022 (**SBWG11 Inf 03**). The objective of the plan is to provide a formal, conceptual and operational framework that contributes to improving the conservation status of seabirds occurring in the Argentine-Uruguayan Common Fishing Zone, and to mitigate the negative impacts of the interaction on these species with fisheries under an ecosystem approach. Although Argentina and Uruguay have already adopted their own National Action Plans - Seabirds, the Regional Plan is intended to be more than the sum of both national plans, favouring the collaboration between both countries, and seeking to expand the collaboration at a wider regional scale.

Many ACAP species utilise waters where fisheries that impact seabird bycatch are managed by more than one Party. Therefore, SBWG11 recognised the potential benefit of other Parties, who share responsibilities for such waters, also developing and implementing Regional Action Plans which would complement but not replace their own National Plans of Action.

SBWG11 Inf 15 reported that Chile's NPOA-Seabirds has now been updated to include mitigation measures for domestic trawl fisheries as well as longlines. The NPOA is currently under review and should be finalized this year. SBWG11 welcomed this report.

RECOMMENDATIONS TO THE ADVISORY COMMITTEE

SBWG recommends that the Advisory Committee:

1. Encourage collaboration among Parties to establish and implement regional plans of action to address seabird bycatch, where relevant.

14. COORDINATION OF ACTIVITIES RELATING TO RFMOS

14.1 Update on RFMO Engagement Strategy implementation

SBWG11 Doc 09 was accepted for consideration by the meeting despite its late publication. Following discussion of **SBWG11 Doc 09** it was agreed that there needed to be a clear, updatable, summary of developments and a clear engagement strategy for RFMOs. In order to create these, it was agreed that a small intersessional group should be established. It was noted that MoP7 had given great priority to successful engagement with the RFMOs.

SBWG11 noted the importance of ACAP continuing to engage in the RFMOs, in collaboration with Range State CPCs and BirdLife International, to make progress on improvements to seabird-related CMMs, monitoring measures, and compliance.

SBWG11 Doc 16 was introduced under Agenda Item 11. SBWG11 noted the relevance of the described approach and highlighted the value of a refined version being presented to IATTC.

SBWG11 Doc 25 was discussed under Agenda Item 15.

SBWG11 Inf 05 addressed a multi-year seabird strategy adopted by the CCSBT (Commission for the Conservation of Southern Bluefin Tuna) in 2019 and its action plan adopted in 2022. SBWG11 acknowledged the importance of this strategy and potential for the development of similar strategies in other RFMOs.

RECOMMENDATIONS TO THE ADVISORY COMMITTEE

SBWG recommends that the Advisory Committee:

1. Endorse the continued implementation of the current RFMO Engagement Strategy, as updated in **SBWG11 Doc 09**.
2. Endorse the establishment of an intersessional group to:
   (i) review the aims of the current RFMO engagement strategy with a view to updating them as necessary;
   (ii) review the theme-based format of the strategy and decide whether a different format might be preferable;
   (iii) develop an updated list of priority actions concerning advocacy, communications and education to be reviewed on a rolling basis; and
   (iv) report back to SBWG12 and AC14.

15. ENHANCING IMPLEMENTATION OF BEST PRACTICE SEABIRD BYCATCH MITIGATION MEASURES

SBWG11 Doc 25 identified key gaps in the implementation of ACAP Best Practice Advice in the commercial longline fisheries of ACAP Parties; explored potential limitations or impediments to adoption of Best Practice Advice; and identified ways to improve adoption and/or implementation of this advice. The source information comprised an examination of all Party Implementation Reports submitted to MoP6 (2018), a review of approved conservation measures on seabird bycatch mitigation of RFMOs and an online survey that asked 13 questions about the uptake and adoption of ACAP Best Practice Advice. The survey approached scientists, gear technologists, conservation agencies and fishery managers employed both in government and the private sector, and who were known to have experience with ACAP and the development and implementation of Best Practice Advice. The authors found that currently few ACAP Parties and tRFMOs implement the ACAP Best Practice Advice in full, despite there being little evidence that experts think the Best Practice Advice would be ineffective if fully implemented. They also reported that poor and ambiguous reporting in the Implementation Reports submitted by Parties makes it difficult to accurately assess the level of uptake of Best Practice Advice. They also noted that full implementation of ACAP Best Practice Advice by RFMOs was unlikely to be achieved while ACAP Parties do not fully implement these measures. Finally, the authors recommend that ACAP encourage Parties to incorporate the Best Practice Advice into elements of their domestic legislation and regulations for the management of fisheries.

SBWG11 welcomed this important contribution and acknowledged that barriers exist to compliance with ACAP reporting. A major barrier for several Parties was that not all relevant entities with data needed for ACAP reporting are motivated to share information. In some cases, managers may not agree that seabirds need protection in their fisheries. It was noted that legislation requiring Best Practice Advice implementation does not necessarily result in adoption and enforcement. It was also noted that the inclusion of industry representatives in the SBWG meetings is recommended as it could improve the ACAP process and Best Practice Advice implementation.

SBWG11 also agreed that revision of indicators would improve the quality and usefulness of information provided to ACAP, and agreed that indicators should be revised intersessionally to be more specific and focused on action statements.

SBWG11 Doc 13 presented the results of a review of best practices in developing management frameworks to address seabird bycatch. This included evaluating how bycatch issues are identified, how population and bycatch reduction objectives are set and how risk assessment processes are used to evaluate impact. The review drew on current practices in national and international management frameworks for managing fisheries impacts on seabirds, as well as marine mammals, sea turtles and elasmobranchs. Based on this review, a set of recommendations were made at two levels: for fisheries managers and policy makers working with individual fisheries, and for wider international or regional organisations working on seabird bycatch. SBWG11 welcomed this paper and agreed to encourage Parties to consider its recommendations. It was noted that ACAP intends to update fishery overlap information with seabird distributions and share this information widely. This will be improved further with the development of the ACAP communication strategy.

SBWG11 Doc 22 described an evidence-based information toolkit for the tuna vessel-to-market supply chain developed by the Southern Seabirds Trust and the New Zealand Department of Conservation. The toolkit will:

- summarise the risk zones for seabirds in the world's oceans;
- describe the technical and operational mitigation measures available to reduce seabird mortalities; describe the extent to which the measures are likely to reduce mortalities of seabirds when used singly and in combination;
- outline the auditing tools available to verify the measures are in use and meet the ACAP specifications;
- describe the suitability and reliability of these auditing tools in different situations; and
- provide guidance on audit results in terms of likely reductions in seabird mortality.

The toolkit will provide at-a-glance information for responsible companies seeking to ensure the sustainability of their produce.

SBWG11 welcomed this approach to implementation of Best Practice Advice by engaging directly with the vessel-to-market supply chain, especially since Marine Stewardship Council standards have been revised and strengthened relative to seabirds. Many ACAP resources are available to assist in this effort and SBWG11 welcomed sharing of all available ACAP products to support this effort. SBWG11 expressed a desire to collaborate with the project and encouraged future requests on how ACAP may assist.

SBWG 11 Inf 06 was an early product of the toolkit which reviewed available evidence on the performance of selected seabird bycatch mitigation measures, including five that have been identified as best practice measures for use in pelagic longline fisheries by ACAP. This report focused on presenting evidence and is not intended as a source of best practice mitigation advice. SBWG11 welcomed this well-crafted paper and agreed it is a useful summary of the strengths and limitations of ACAP Best Practice Advice, as well as the rationale for the simultaneous use of the three main best practice mitigation measures. SBWG looked forward to considering other products flowing from the toolkit.

SBWG11 Inf 08 presented the results of the review of the Marine Stewardship Council Fisheries Standard on the impacts on Endangered, Threatened and Protected (ETP) species. The main changes relevant to seabird bycatch include that the fishery seeking certification demonstrates that: it does not hinder recovery of ETP species to 'favourable conservation status', it applies best practice measures to minimise mortality where these exist and it demonstrates that measures have been effective at reducing mortalities of ETP species or the impact is zero or negligible. SBWG11 welcomed this paper and voiced support for Revision 3 of the Marine Stewardship Council standard recognizing that it strengthens the need for the protection for seabirds in the certification process. SBWG11 thanked those members who had contributed to the review process.

RECOMMENDATIONS TO THE ADVISORY COMMITTEE

SBWG recommends that the Advisory Committee:

1. Endorse and support the development of an evidence-based information toolkit by Southern Seabirds Trust for the tuna vessel-to-market supply chain.
2. Recognize that currently few ACAP Parties and tRFMOs implement the ACAP Best Practice Advice in full and that inadequate reporting in MoP Implementation Reports submitted by Parties makes it difficult to accurately assess the level of uptake of Best Practice Advice.
3. Consider the range of reporting by Parties and how that might be improved to yield more transparent and robust reporting of Best Practice Advice implementation and bycatch reporting.
4. Recognise that ACAP participation in the Marine Stewardship Council Fisheries Standard review process contributed to substantial improvements to a new version of the standard. The new standard includes requirements on information, management and outcomes of seabird bycatch.
5. Encourage continued ACAP engagement with fishery certification processes.

16. TOOLS AND GUIDELINES

16.1 Updates and new guidelines

SBWG11 Doc 14 noted that during bycatch events in purse seine fisheries, there has been a lack of protocols for efficient rescue and handling of non-target species such as seabirds. In most of these events, bird extraction and handling procedures are performed inadequately, with the potential for physical damage to the birds that are subsequently released. The document provided an update and recommendations on safe seabird handling techniques in purse seine fisheries and the use of appropriate tools for this purpose. SBWG11 thanked the authors for the paper and suggested that this advice could be presented as a purse seine-specific factsheet or integrated into a safe handling of seabirds entangled in nets factsheet.

16.2 Mitigation Factsheets

SBWG11 Doc 08 reported progress made in updating the Bycatch Mitigation Factsheets to reflect the new simplified design. Following SBWG10, the introductory factsheet and one on improving crew safety during branch line hauling have been finalised and translated into eight languages. The four bird scaring line sheets remain to be completed as a priority. Other ACAP Best Practice factsheets that are yet to be converted into the new simplified format are demersal longline line weighting (currently separate sheets for external weights, integrated weights and Chilean system), trawl warp strike and trawl net entanglement. SBWG11 considered that the trawl warp strike factsheet should be a priority, noting that it should also cover monitoring cables. Marcelo Garcia (Chile) agreed to lead on this factsheet.

Sebastián Jiménez will continue to lead on the four bird scaring lines factsheets and Verónica Iriarte will lead in drafting a factsheet on the safe handling of seabirds entangled in nets, including in purse seine nets.

Barry Baker (Australia) agreed to develop the demersal longline weighting factsheet if another lead was not found.

The Secretariat noted that the factsheets were produced in several languages and that translation and especially proofreading support from SBWG members and others with relevant expertise would be welcome. A number of SBWG members offered their services for this task. The Secretariat thanked the USA for sponsoring the most recent translations.

RECOMMENDATIONS TO THE ADVISORY COMMITTEE

SBWG recommends that the Advisory Committee:

1. Support the update of the remaining Mitigation Factsheets to the new simplified format in a phased approach in accordance with the prioritisation identified by SBWG11.
2. Welcome development of guidance on safe handling of seabirds in purse seine fisheries (reported in **SBWG11 Doc 14**) and encourage development of guidelines for other fishing gears.

17. ACAP FUNDED PROGRAMMES

17.1 Small Grants and Secondments

AC13 Inf 02 provided a summary of Secondments supported by the 2022 funding round. It also provided a summary of progress and outcomes of Small Grants supported in the 2020 and 2019 funding rounds, as well as 2019 Secondments, which were delayed due to international travel restrictions and were yet to commence at the time of reporting to AC12 in August 2021. SBWG11 noted both programmes enabled valuable and interesting work to progress ACAP's objectives and would like to see this continue.

17.2 Funding priorities for 2023 - 2025

SBWG encouraged future Small Grant and Secondment proposals that address items identified on the Work Programme or other research priorities identified in this report.

18. SBWG WORK PROGRAMME

18.1 Work Programme 2023 - 2025

Tasks relevant to the Seabird Bycatch Working Group in the 2023 - 2025 Advisory Committee Work Programme approved by MoP7 (**AC13 Doc 13**) were reviewed following discussions at SBWG11. An updated version of the Work Programme has been prepared for consideration by the Advisory Committee.

19. ANY OTHER BUSINESS

There were no items raised under this agenda item.

20. CLOSING REMARKS

The Co-Convenor Sebastián Jiménez thanked authors of the papers submitted for consideration, and Members and Observers for their valuable contributions to the meeting. The Co-Convenor also thanked the ACAP Secretariat and the technical support team for organising and running the meeting. He thanked the interpreters for their valuable efforts during the meeting and the United Kingdom hosts for providing an excellent venue and facilities for the meeting.

ANNEX 1. LIST OF SBWG11 MEETING PARTICIPANTS

SBWG Members	
Igor Debski	SBWG Co-convenor, Department of Conservation, New Zealand
Sebastián Jiménez	SBWG Co-convenor, Dirección Nacional de Recursos Acuáticos, Uruguay
Dimas Gianuca	SBWG Co-viceconvenor, BirdLife International
Juan Pablo Seco Pon	SBWG Co-viceconvenor, Instituto de Investigaciones Marinas y Costeras, CONICET-UNMDP, Argentina
Luis Adasme	Instituto de Fomento Pesquero, Chile
José Carlos Baez	Spanish Oceanographic Institute
Barry Baker	Institute for Marine and Antarctic Studies (IMAS), Australia
Jonathon Barrington	Department of Climate Change, Energy, the Environment and Water, Australian Antarctic Division, Australia
Andrés Domingo	Dirección Nacional de Recursos Acuáticos, Uruguay
Marco Favero	Instituto de Investigaciones Marinas y Costeras, CONICET, Argentina
Caroline Fox	Environment and Climate Change Canada
Eric Gilman	Fisheries Research Group,
Ed Melvin	University of Washington, USA
Gabriela Navarro	Subsecretaría de Pesca y Acuicultura, Argentina
Tatiana Neves	Projeto Albatroz, Brazil
Cristián Suazo	Albatross Task Force - Chile, BirdLife International
Mark Tasker	Joint Nature Conservation Committee, United Kingdom/ TWG Convenor
Megan Tierney	Joint Nature Conservation Committee, United Kingdom

Advisory Committee Members, Representatives and Advisors	
Orea Anderson	Advisor, United Kingdom
Elizabeth Biott	Alternate Representative, United Kingdom
Kristopher Blake	Alternate Representative, United Kingdom
Mike Double	AC Chair
Marcelo Garcia	Member, Chile
Sue Gregory	Advisor, United Kingdom
Verónica Iriarte	Advisor, United Kingdom
Andrei Langeloh Roos	Advisor, Brazil
Verónica López	Advisor, Chile
María Andrea Meza	Representative, Peru
Patricia Pereira Serafini	Advisor, Brazil/ PaCSWG Co-convenor
Richard Phillips	Advisor, United Kingdom/ PaCSWG Vice-convenor

Observers	
Nicola Beynon	Humane Society International
Bernadette Butfield	BirdLife International
Gabriel Canani	AATM-FURG/Projeto Albatroz, Brazil
Ana Carneiro	BirdLife International
Esteban Frere	BirdLife International
Stephanie Good	University of Exeter
Thomas Good	USA
Mi Ae Kim	USA
Daisuke Ochi	NRIFR, Japan
Yann Rouxel	BirdLife International
Jonathan Rutter	University of Oxford
Ben Steele-Mortimer	Seafood New Zealand Ltd
Leandro Tamini	BirdLife International
Desmond Tom	Namibia
SachikoTsuji	NRIFR, Japan
Susan Waugh	BirdLife International
Yu-Min Yeh	Chinese Taipei

ACAP Secretariat	
Christine Bogle	Executive Secretary
Wiesława Misiak	Science Officer
Bree Forrer	Communications Advisor

Interpreters
Cecilia Alal
Sandra Hale

Non-attending SBWG members	
Joanna Alfaro-Shigueto	ProDelphinus, Peru
Jorge Azócar	Instituto de Fomento Pesquero, Chile
Nigel Brothers	Humane Society International
Rory Crawford	BirdLife International
Johannes De Goede	Department of Environment, Forestry and Fisheries, South Africa
Elisa Goya	Instituto del Mar del Peru (IMARPE), Peru
Marco Herrera	Insituto Público de Investigaciones en Acuacultura y Pesca, Ecuador
Svein Løkkeborg	Institute of Marine Research, Norway
Amanda Kuepfer	Exeter University, United Kingdom

Non-attending SBWG members	
Jeffry Mangel	ProDelphinus, Peru
Alexandre Marques	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, Brazil
Graham Robertson	Unaffiliated
Barbara Wienecke	Department of the Environment and Energy, Australian Antarctic Division, Australia
Anton Wolfaardt	Unaffiliated

ANNEX 2. ACAP REVIEW OF SEABIRD BYCATCH MITIGATION MEASURES FOR PELAGIC AND DEMERSAL TRAWL FISHERIES

Agreement on the Conservation of Albatrosses and Petrels

ACAP Summary Advice for Reducing the Impact of Pelagic and Demersal Trawl Fisheries on Seabirds

Reviewed at the Thirteenth Meeting of the Advisory Committee
Edinburgh, United Kingdom, 22-26 May 2023

BEST PRACTICE MEASURES

Seabird mortality in trawl fisheries occurs when birds collide with cables as they feed on fish processing waste (offal and discards) or are entangled in trawl nets as they attempt to forage on captured fish or fish parts. Cable strikes, including collisions with net-monitoring cables[1], warp cables[2] and paravanes are associated with the fish waste discharged by vessels that catch and process fish on-board (catcher-processors). It is recognized that larger seabirds (albatrosses and giant petrels) with long wingspans are most vulnerable to cable strike mortalities; however, smaller seabirds can also suffer cable strike mortalities. Although in many fisheries vessels are required to discard prohibited fish species whole and unprocessed, vessels that catch fish for delivery for shoreside processing (catcher vessels) and do not produce offal, are in general not associated with cable strikes. However, seabird net mortalities can occur in catcher-processor and catcher vessels trawl operations.

Trawl fisheries are extremely diverse and encompass pelagic trawling for schooling off-bottom species and demersal trawling for fish species on the sea floor. In general, trawl fisheries range from high volume fisheries that land and process hundreds of tonnes of fish 24 hours a day continuously for weeks, to lower volume fisheries that fish for shorter time periods producing little to no waste. Because fish waste drives cable strikes, and can attract birds that may then interact with the net, management of offal discharge and discards[3] is considered the primary means to reduce cable strikes and net entanglements. However, fishery and vessel characteristics dictate the extent to which offal can be managed and the method that might be employed. Where the opportunity for fish waste management is limited or impractical, cable strikes can be prevented by protecting trawl cables with mitigation devices. Birds can also be attracted to the net during hauling by fish in the net, creating risk of net entanglement. Net entanglements can be prevented by reducing the time the net is exposed on the surface of the

[1] The netsonde monitor cable connects the echo-sounder or net-sounder on the headline of the trawl net to the vessel.

[2] The warp cables or trawl warps are the cables used to tow nets.

[3] Offal discharge refers to the disposal at sea of any fish waste resulting from processing, including heads, guts and frames. Fish discards refers to any unwanted whole fish (and or benthic material)

water. The following measures have been shown to be effective at reducing seabird bycatch in trawl fisheries and are recommended as best practice measures:

Measures to reduce general attractiveness to seabirds

Management of offal and discards

In all cases, the discharge of offal and discards is the most important factor attracting seabirds to the stern of trawl vessels, where they are at risk of cable and net interactions. Managing offal discharge and discards while fishing gear is deployed has been shown to reduce seabird attendance of vessels and consequent risk of interactions and bycatch. The following offal and discard management measures, in order of their effectiveness in reducing bird attendance, are recommended:

1. **Retention of waste** – No discharge during fishing trips (full retention) should occur. When this is impracticable, no discharge should occur during fishing activity (when cables or net are in the water);
2. **Mealing waste** – Where retention of waste is impracticable, converting offal into fish meal, and retaining all waste material with any discharge restricted to liquid discharge / sump water;
3. **Batching waste** – Where meal production and retention of offal and discards are impracticable, waste should be stored temporarily for two hours or longer before strategically discharging it in batches;
4. **Mincing of waste** – Where retention, mealing or batching is impracticable, reduce waste to smaller particles (currently only recommended as a mitigation for bycatch of large *Diomedea* spp.).

Measures to reduce cable strikes

Where the opportunity for fish waste management is limited or impractical, cable strikes can be prevented by protecting trawl cables with mitigation devices. The following measures are recommended:

Warp cables

1. Deploy Bird Scaring Lines while fishing to deter birds away from warp cables.

Net monitoring cables

Net monitoring cables should not be used (wireless systems can be used instead). Where this is impracticable:

1. Deploy bird scaring lines specifically positioned to deter birds away from net monitoring cables while fishing; and

2. Install a snatch block at the stern of a vessel to draw the net monitoring cable close to the water and thus reduce its aerial extent.

Measures to reduce net entanglement

Recognising that even with management of offal and discards there may be risk of net entanglement, the following further measures are recommended:

1. Clean nets after every haul to remove entangled fish (“stickers”) and benthic material to discourage bird attendance during gear shooting;

2. Minimise the time the net is on the water surface during hauling through proper maintenance of winches and good deck practices; and

3. For pelagic trawl gear, apply net binding to large meshes in the wings (120–800 mm), together with a minimum of 400 kg weight incorporated into the net belly prior to setting.

Further measures include avoiding peak areas and periods of seabird foraging activity. It is important to note that there is no single solution to reduce or avoid incidental mortality of seabirds in trawl fisheries, and that the most effective approach is to use the measures listed above in combination. Net entanglements during the haul remain the most difficult interactions to prevent. The ACAP review of seabird bycatch mitigation measures for pelagic and demersal trawl fisheries is presented in the following section.

Agreement on the Conservation of Albatrosses and Petrels

ACAP Review of Seabird Bycatch Mitigation Measures for Pelagic and Demersal Trawl Fisheries

Reviewed at the Thirteenth Meeting of the Advisory Committee
Edinburgh, United Kingdom, 22 – 26 May 2023

INTRODUCTION

A range of technical and operational mitigation methods have been designed or adapted for use in trawl fisheries. In all cases, the discharge of offal and discards is the most important factor attracting seabirds to the stern of trawl vessels, where they are at risk of cable and net interactions. Managing offal discharge and discards while fishing gear is deployed has been shown to reduce seabird attendance of vessels and consequent risk of interactions and bycatch. Even with management of offal and discards there may be risk of cable strikes and net entanglement. Other mitigation measures have been developed to address these risks. Apart from being technically effective at reducing seabird bycatch, mitigation methods should be easy and safe to implement, cost effective, enforceable and should not reduce catch rates of target species.

The feasibility, effectiveness and specifications of mitigation measures may vary by area, seabird assemblages, fishery, vessel size, and gear configuration. Some of the mitigation methods are well established and explicitly prescribed in trawl fisheries; however, additional measures are undergoing further testing and refinements.

The Seabird Bycatch Working Group (SBWG) of ACAP has comprehensively reviewed the scientific literature dealing with seabird bycatch mitigation in trawl fisheries. This document is a distillation of that review.

THE ACAP REVIEW PROCESS

At each of its meetings, the ACAP SBWG considers any new research or information pertaining to seabird bycatch mitigation in trawl fisheries. The following criteria are used by ACAP to guide the assessment process, and to determine whether a particular fishing technology or measure can be considered best practice to reduce the incidental mortality of albatrosses and petrels in fishing operations.

Best Practice Seabird Bycatch Mitigation Criteria and Definition

i. Individual fishing technologies and techniques should be selected from those shown by experimental research to significantly[4] reduce the rate of seabird incidental mortality[5] to the lowest achievable levels. Experimental research yields definitive results when performance of candidate mitigation technologies is compared to a control (no deterrent), or to status quo in the fishery. When testing relative performance of mitigation approaches, analysis of fishery observer data can be plagued with a myriad of confounding factors. Where a significant relationship is demonstrated between seabird behaviour and seabird mortality in a particular system or seabird assemblage, significant reductions in seabird behaviours, such as the rate of seabirds attacking baited hooks, can serve as a proxy for reduced seabird mortality. Ideally, where simultaneous use of fishing technologies and practices is recommended as best practice, research should demonstrate significantly improved performance of the combined measures.

ii. Fishing technologies and techniques, or a combination thereof, should have clear and proven specifications and minimum performance standards for their deployment and use. Examples would include: specific bird scaring line designs (lengths, streamer length and materials; etc.), number (one vs. two) and deployment specifications (such as aerial extent and timing of deployment); night fishing defined by the time between the end of nautical dusk and start of nautical dawn; and, line weighting configurations specifying mass and placement of weights or weighted sections.

iii. Fishing technologies and techniques should be demonstrated to be practical, cost effective and widely available. Commercial fishing operators are likely to select for seabird bycatch reduction measures and devices that meet these criteria including practical aspects concerning safe fishing practices at sea.

iv. Fishing technologies and techniques should, to the extent practicable, maintain catch rates of target species. This approach should increase the likelihood of acceptance and compliance by fishers.

v. Fishing technologies and techniques should, to the extent practicable, not increase the bycatch of other taxa. For example, measures that increase the likelihood of catching other protected species such as sea turtles, sharks and marine mammals, should not be considered best practice (or only so in exceptional circumstances).

vi. Minimum performance standards and methods of ensuring compliance should be provided for fishing technologies and techniques, and clearly specified in fishery regulations. Relatively simple methods to check compliance should include, but not be limited to, port inspections of branch lines to determine compliance with branch line weighting, determination of the presence of davits (tori poles) to support bird scaring lines, and inspections of bird scaring lines for conformance with design requirements. Compliance monitoring and reporting should be a high priority for enforcement authorities.

[4] Any use of the word 'significant' in this document is meant in the statistical context.

[5] This may be determined by either a direct reduction in seabird mortality or by reduction in seabird attack rates, as a proxy.

On the basis of these criteria, the scientific evidence for the effectiveness of mitigation measures or fishing technologies/techniques in reducing seabird bycatch is assessed, and explicit information is provided on whether the measure is recommended as being effective, and thus considered best practice, or not. The ACAP review also provides notes and caveats for each measure, together with information on performance standards and further research needs. Following each meeting of ACAP's SBWG and Advisory Committee, this review document and ACAP's best practice advice is updated (if required). A summary of ACAP's current best practice advice for trawl fisheries is provided in the preceding section of this document.

SEABIRD BYCATCH MITIGATION FACT SHEETS

A series of seabird bycatch mitigation fact sheets have been developed by ACAP and BirdLife International to provide practical information, including illustrations, on seabird bycatch mitigation measures (https://www.acap.aq/bycatch-mitigation/bycatch-mitigation-fact-sheets) The sheets, which include information on the effectiveness of the specific measure, their limitations and strengths and best practice recommendations for their effective adoption, are linked to the ACAP review process, and are updated following ACAP reviews. Links to the available fact sheets are provided in the relevant sections below.

1. MITIGATION MEASURES TO REDUCE GENERAL ATTRACTIVENESS TO SEABIRDS

Management of offal and discards[6]

In all cases, the discharge of offal and discards is the most important factor attracting seabirds to the stern of trawl vessels, where they are at risk of cable and net interactions (Wienecke & Robertson 2002; Sullivan *et al.* 2006a; Favero *et al*. 2011).

Managing offal discharge and discards while fishing gear is deployed has been shown to reduce seabird attendance of vessels and consequent risk of interactions and bycatch. The following offal and discard management measures, in order of their effectiveness in reducing bird attendance, are recommended:

1. **Retention of waste** – No discharge during fishing trips (full retention) should occur. When this is impracticable, no discharge should occur during fishing activity (when cables or net are in the water);
2. **Mealing waste** – Where retention of waste is impracticable, converting offal into fish meal, and retaining all waste material with any discharge restricted to liquid discharge / sump water;
3. **Batching waste** – Where meal production and retention of offal and discards are impracticable, waste should be stored temporarily for two hours or longer before strategically discharging it in batches;
4. **Mincing of waste** – Where retention, mealing or batching is impracticable, reduce waste

[6] Offal discharge refers to the disposal at sea of any fish waste resulting from processing, including heads, guts and frames. Fish discards refers to any unwanted whole fish (and or benthic material).

to smaller particles (currently only recommended as a mitigation for bycatch of large *Diomedea* spp.)

1.1 Retaining waste

ACAP advice

Proven and recommended as the most effect mitigation method for both pelagic and demersal trawl fisheries. No discharge during fishing trips (full retention) should occur. When this is impracticable, no discharge should occur during fishing activity (when cables or net are in the water).

Scientific evidence for effectiveness in trawl fisheries

Repeated studies have shown that in the absence of offal discharge / fish discards seabird interactions and mortality levels are negligible (Sullivan *et al*. 2006; Watkins *et al*. 2008; Melvin *et al*. 2010; Abraham & Thompson 2009). Storage of all fish discard and offal, either for processing or for controlled release when cables and net are not in the water, has resulted in significant reductions in the attendance of all groups of seabirds (Abraham *et al.* 2009).

Notes and Caveats

Retrofitting of fish waste storage tanks may not be a viable option for existing vessels due to associated space requirements (Munro 2005).

Minimum standards

Any discharge is restricted to times when cables and net are out of the water.

Need for combination

Should be used in combination with additional mitigation methods to mitigate interactions with cables (if birds are still attending the vessel) and net.

Implementation monitoring

On-board observers or electronic monitoring. Potential for at-sea surveillance (of discharge or bird attendance).

Research needs

None identified.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1627-fs-13-trawl-fisheries-warp-strike/file

1.2 Mealing waste

ACAP advice

Proven and recommended as a mitigation method for both pelagic and demersal trawl fisheries when retention of waste is impracticable.

Scientific evidence for effectiveness in trawl fisheries

Mealing resulted in significant reduction in the number of seabird species feeding behind vessels, relative to the discharge of unprocessed fish waste (Abraham *et al.* 2009; Wienecke & Robertson 2002; Favero *et al*. 2011) or minced waste (Melvin *et al.* 2010).

Notes and Caveats

Good evidence from a number of fisheries that fish meal processing and reducing discharge to sump water is highly effective in reducing seabird bycatch. Retrofitting of meal plants may not be a viable option for existing vessels due to associated space requirements (Munro 2005).

Minimum standards

Any discharge is restricted to liquid discharge / sump water.

Need for combination

Should be used in combination with additional mitigation methods to mitigate interactions with cables (if birds are still attending the vessel) and net.

Implementation monitoring

Port-based inspection of meal plants, on-board observers or electronic monitoring. Potential for at-sea surveillance (of discharge or bird attendance).

Research needs

Investigate through robust trialling the extent to which reduced seabird abundance affects seabird interaction rates.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1627-fs-13-trawl-fisheries-warp-strike/file

1.3 Batching waste

ACAP advice

Proven and recommended as a mitigation method for both pelagic and demersal trawl fisheries where meal production and retention of offal and discards are impracticable.

Scientific evidence for effectiveness in trawl fisheries

Batching (temporary storage and periodic, controlled and fast release of discards / discharge during trawling) has been trialled in New Zealand (Pierre *et al*. 2010; Pierre *et al*. 2012b), the Falkland Islands (Islas Malvinas)[7] (Kuepfer *et al*. 2022) and Uruguay (Jimenéz et al. 2022;). Results showed that batching can significantly reduce numbers of seabirds and associated

[7] A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Islas Malvinas), South Georgia and the South Sandwich Islands (Islas Georgias del Sur e Islas Sándwich del Sur) and the surrounding maritime areas.

bycatch risk, although adequate storage period and minimal duration of batching events are important.

Notes and Caveats

Effectiveness of batching relies on minimising the frequency of discharges and efficient (fast) dumping of batched material. Retrofitting of fish waste storage tanks may not be a viable option for existing vessels due to associated space requirements (Munro 2005).

Minimum standards

Recommended when full retention or mealing is not possible. Where feasible, batch waste for at least 2 hours, preferably 4 hours or longer.

Need for combination

Should be used in combination with additional mitigation methods to mitigate interactions with cables and net.

Implementation monitoring

Port-based inspection of fish waste storage and discharge system, on-board observers or electronic monitoring. Potential for at-sea surveillance (of discharge or bird attendance).

Research needs

Investigate through robust trialling the extent to which reduced seabird abundance affects seabird interaction rates.

Identify threshold where increased storage is compromised by increased batching (discharging) period required.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1627-fs-13-trawl-fisheries-warp-strike/file

1.4 Mincing of waste

ACAP advice

Insufficient evidence to recommend this as a primary mitigation measure to reduce general attractiveness to seabirds in pelagic and demersal trawl fisheries at this time, however it is recommended as a mitigation for bycatch of large *Diomedea* spp. where retention, mealing or batching is impracticable.

Scientific evidence for effectiveness in trawl fisheries

Mincing waste to maximum 25 mm significantly reduced the number of large albatrosses (*Diomedea* spp) attending vessels but had no effect on other groups of seabirds (Abraham *et al*. 2009; Abraham 2010). Pierre *et al.* (2012a) showed that whilst reduced particle size (10-40 mm and 30-60 mm) reduced seabird attendance compared with untreated waste, the effect was lowest for small albatross species, and not significant for the 10-40 mm treatment.

Notes and Caveats

Bottom trawled material, such as rocks, may impact the feasibility of mincing.

Minimum standards

None established. Insufficient evidence to recommend this as a primary measure at present.

Need for combination

Should be used in combination with additional mitigation methods to mitigate interactions with cables and net.

Implementation monitoring

Port-based inspection of mincing systems, on-board observers or electronic monitoring. Potential for at-sea surveillance (of discharge or bird attendance).

Research needs

At present only demonstrated to be effective against large *Diomedea* spp albatrosses. Efficacy with *Thalassarche* spp albatrosses needs to be proven before measure can be recommended (Abraham *et al*. 2009).

2. MITIGATION MEASURES TO REDUCE CABLE STRIKES

2.1 Bird Scaring Lines (BSL) to reduce interaction with warp and net monitoring cables

ACAP advice

Proven and recommended as a mitigation measure to deter birds away from warp cables, and net monitoring cables where their use cannot be avoided, for pelagic and demersal trawl fisheries.

Scientific evidence for effectiveness in trawl fisheries

Attachment of a Bird Scaring Line (BSL) to both the port and starboard sides of a vessel, above and outside of the warp blocks, greatly reduces the access of birds to the danger zone where warps enter the water (Watkins *et al.* 2006; Reid & Edwards 2005; Melvin *et al*. 2010). An off-setting towed device has been demonstrated to improve BSL performance (Tamini *et al.* 2015).

Notes and Caveats

Effectiveness is reduced in strong cross winds and rough seas, when BSLs are deflected away from warps (Sullivan & Reid 2003; Crofts 2006a, 2006b). This can be alleviated in part by towing a buoy or cone attached to the end of lines to create tension and keep lines straight (Sullivan *et al*. 2006a; Cleal *et al.* 2013). Hard wearing and non-tangling materials and design can improve performance (Cleal *et al.* 2013), including the use of semi rigid streamers, particularly those constructed from Kraton. BSLs cannot be deployed while the warp cable is being set, or remain in place during hauling, leaving periods when warps are not protected.

Bird mortality as a result of entanglement with the BSL is known to occur (Snell *et al.* 2011; Kuepfer 2016).

Minimum standards

BSL are recommended even when appropriate offal discharge and fish discard management practices are in place (Melvin *et al*. 2010). A BSL should be fitted to the outside of both the starboard and the port-side cable. The main line should extend beyond the warp-water interface and should maintain its tension under normal tow speed. Streamer lines should be attached at maximum 5 m intervals and should be long enough to extend beyond the point at which warp and net monitoring cables reach the water's surface. It is recommended that for every metre of block height, 5 m of backbone be deployed and 1.2 kg of terminal object drag weight be used. An off-setting towed device (Tamini Tabla) has been developed in Argentina (Tamini *et al.* 2023). This device is attached to the terminal end of the BSL and has a buoyant upper board with three 45° vertical keels, which are weighted for stability. Under forward motion of the vessel, the keels cause the device to move outward of the trawl cables and therefore maintain the BSL from entangling with trawl cables. BSLs should be deployed once the trawl doors are submerged and retrieved as net hauling commences. Where the use of a net monitoring cable cannot be avoided, Bird Scaring Lines should be specifically positioned above the net monitoring cable.

Need for combination

Should be used in combination with offal/discard management.

Implementation monitoring

On-board observers, electronic monitoring or at-sea surveillance.

Research needs

Further research is required on reducing the entanglement risk of birds in the BSL.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1627-fs-13-trawl-fisheries-warp-strike/file

2.2 Snatch block

ACAP advice

Recommended as a mitigation measure to reduce the aerial extent of net monitoring cables, when their use cannot be avoided, in pelagic and demersal trawl fisheries.

Scientific evidence for effectiveness in trawl fisheries

A snatch block, placed on the stern of a vessel to draw the third-wire close to the water to reduce its aerial extent, reduced seabird strikes, although performance varied by vessel (Melvin *et al*. 2010).

Notes and Caveats

Melvin *et al.* (2010) were confident that third-wires can be pulled closer to the water or submerged at the stern to make this measure highly effective, but noted that, as third-wires are fragile and expensive, any snatch block-like system should aim to minimise cable wear. Recommended on the basis that reducing the aerial extent of monitoring cables should reduce the risk of seabird strikes with these cables.

Minimum standards

None established.

Need for combination

Should be combined with offal/discard management and BSL specifically positioned to deter birds away from net monitoring cables while fishing.

Implementation monitoring

Port-based inspection, on-board observer or electronic monitoring.

Research needs

Needs to be trialled in a range of fisheries and areas to further demonstrate efficacy. Development of technical specifications is also required.

2.3 Warp scarers

ACAP advice

Insufficient evidence. Not recommended as a mitigation measure at this time.

Scientific evidence for effectiveness in trawl fisheries

Warp scarers (weighted devices attached to each warp with clips or hooks, allowing the device to slide up and down the warp freely and stay aligned with each warp) create a protective area around the warp (see Bull 2009, Fig.2; Sullivan *et al*. 2006a).

Warp scarers have been shown to reduce contact rates but not significantly, and were not as effective as BSLs (Sullivan *et al*. 2006b, Abraham *et al*., cited in Bull 2009).

Notes and Caveats

Attachment to the warp eliminates problems associated with crosswinds as the mitigation devices do not behave independently of warps. Warp scarers cannot be deployed while the warp cable is being set, or remain in place during hauling, leaving periods when warps are not protected.

Concerns have been raised regarding associated practicality and safety issues (Melvin *et al.* 2004; Sullivan *et al.* 2006a; Abraham *et al.*, cited in Bull 2009;).

Minimum standards

Not applicable, as not recommended.

Need for combination

Not applicable, as not recommended.

Implementation monitoring

Not applicable, as not recommended.

Research needs

None identified.

2.4 Bird bafflers

ACAP advice

Insufficient evidence. Not recommended as a mitigation measure at this time.

Scientific evidence for effectiveness in trawl fisheries

Bird bafflers comprise two booms attached to both stern quarters of a vessel. Two of these booms extend out from the sides of the vessel and the other two extend backwards from the stern. Dropper lines are attached to the booms, to create a curtain to deter seabirds from the warp-water interface zone (see Bull 2009, Fig.3; Sullivan *et al.* 2006a).

Generally, bird bafflers are not regarded as providing as much protection to the warp cables as BSLs or warp scarers (Sullivan *et al.* 2006a), because they don't tend to extend beyond the warp-water interface area, hence leaving the most dangerous part of the warp exposed.

Notes and Caveats

Various designs exist including the Brady Baffler and "curtain baffler" (Cleal *et al*. 2013).

While bafflers were designed to minimise warp interactions, the Brady Baffler has been used (inappropriately) within CCAMLR icefish fisheries to mitigate net entanglements where they have been found to be consistently ineffective (Sullivan *et al*. 2009).

The great variability in the design and deployment of bird bafflers may influence their overall effectiveness. Designs may also be very vessel-specific to ensure adequate coverage of the warp-water interface. In contrast to some other warp mitigation methods bird bafflers can remain deployed during the full duration of fishing activities.

Minimum standards

Not applicable, as not recommended.

Need for combination

Not applicable, as not recommended.

Implementation monitoring

Not applicable, as not recommended.

Research needs

The full range of baffler designs have not been experimentally tested. Trials should be conducted in a range of fisheries and areas to demonstrate efficacy.

2.5 Cones on warp cables

ACAP advice

Insufficient evidence. Not recommended as a mitigation measure at this time.

Scientific evidence for effectiveness in trawl fisheries

A plastic cone attached to each warp cable reduced the number of birds entering the warp-water interface in Argentine Hake Trawl Fishery by 89% and no seabirds were killed while cones were attached to the warp (Gonzalez-Zevallos *et al.* 2007).

Notes and Caveats

Applicable for small vessels.

Minimum standards

Not applicable, as not recommended.

Need for combination

Not applicable, as not recommended.

Implementation monitoring

Not applicable, as not recommended.

Research needs

Needs to be trialled in a range of fisheries and areas to demonstrate efficacy.

2.6 Warp boom

ACAP advice

Insufficient evidence. Not recommended as a mitigation measure at this time.

Scientific evidence for effectiveness in trawl fisheries

A boom with streamers extending to the water forward of the stern and warps can divert birds feeding on offal away from the warps; however, Melvin *et al*. (2010) did not identify a statistically significant reduction is seabird interactions with the warp.

Notes and Caveats

None.

Minimum standards

Not applicable, as not recommended.

Need for combination

Not applicable, as not recommended.

Research needs

Longer-term studies are required to identify effectiveness including work to identify suitable configuration and materials.

2.7 Warp deflector

ACAP advice

Insufficient evidence. Not recommended as a mitigation measure at this time.

Scientific evidence for effectiveness in trawl fisheries

The *warp deflector,* consisting of a pinkie buoy clipped to each of the warp cables and connected back to the vessel via a retrieval line, is designed to hang at the warp-water interface to deflect birds away from the danger area. The device was found to significantly reduce heavy interactions of shy-type albatross (*Thalassarche*) with trawl warps by Pierre *et al.* (2014). The authors, however, urged for wider testing of the device to support results. Kuepfer (2017) identified numerous practical issues which impacted on the safe and effective deployment of the device in non-experimental conditions.

Notes and Caveats

The east Australia trawl fishery found the device to be impractical and of limited effectiveness, and therefore the warp deflector is now no longer accepted as a stand-alone mitigation measure.

Minimum standards

Not applicable, as not recommended.

Need for combination

Not applicable, as not recommended.

Implementation monitoring

Not applicable, as not recommended.

Research needs

None identified.

3. MITIGATION MEASURES TO REDUCE NET ENTANGLEMENTS

The range of mitigation measures available to prevent net entanglements is limited, and most have not been adequately (and quantitatively) tested. Consequently, there is a need to identify and test measures aimed at addressing the problem of seabirds becoming entangled in nets of trawl vessels, particularly during hauling operations.

3.1 Net cleaning

ACAP advice

Recommended for reducing bycatch during both shooting and hauling of trawl gear in both pelagic and demersal trawl fisheries.

Scientific evidence for effectiveness in trawl fisheries

Removal from nets of all fish 'stickers' and other material is a critical step to reducing net entanglement during shooting (Hooper *et al*. 2003; Sullivan *et al.* 2009).

Notes and Caveats

None.

Minimum standards

Remove all stickers from net prior to shooting gear.

Need for combination

Should be used in combination with net binding and net weights to minimise the time net is on water's surface during both setting and hauling (Sullivan *et al.* 2009), as well as in combination with waste management to avoid the discharge of waste during shooting thereby minimising the attraction of seabirds to the stern of the vessel.

Implementation monitoring

On-board observers or electronic monitoring.

Research needs

None identified.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1713-fs-14-trawl-fisheries-net-entanglement/file

3.2 Net binding

ACAP advice

Recommended for reducing bycatch when shooting gear in pelagic trawl fisheries.

Scientific evidence for effectiveness in trawl fisheries

Shown to be a highly effective mitigation measure in CCAMLR icefish trawl fishery, reducing seabird bycatch to minimal levels (Sullivan *et al.* 2009).

Notes and Caveats

Not suitable for demersal trawl gear (Iriarte et al. 2023).

Sisal string has been used to bind the sections of the net which pose the greatest threat to seabirds prior to shooting (Sullivan *et al*. 2004). Bindings are simply tied onto the net to prevent the net from lofting and the mesh opening as the tension created by the vessel speed of between 1-3 knots is lost due to waves and swell action. Once shot-away, the net remains bound on the surface until it sinks. Once the trawl doors are paid away and the net has sunk beyond the diving depth of seabirds the force of the water moving the doors apart is sufficient to break the bindings and the net spreads into its standard operational position.

Minimum standards

3–ply sisal string (typical breaking strength of c.110 kg), or a similar inorganic material should be applied to the net on the deck, at intervals of approximately 5 m to prevent net from spreading and lofting at the surface. Net binding should be applied to mesh ranging from 120–800 mm as these are known to cause the majority of seabird entanglements (Sullivan *et al*. 2010). When applying string, tie an end to the net to prevent string from slipping down the net and ensure it can be removed when net is hauled.

Need for combination

Should be used in combination with net cleaning and net weights to minimise the time the net is on the surface (Sullivan *et al*. 2009), as well as in combination with waste management to avoid the discharge of waste during shooting thereby minimising the attraction of seabirds to the stern of the vessel.

Implementation monitoring

On-board observer or electronic monitoring.

Research needs

None identified.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1713-fs-14-trawl-fisheries-net-entanglement/file

3.3 Net weighting

ACAP advice

Recommended for reducing bycatch during both shooting and hauling in both pelagic and demersal trawl fisheries.

Scientific evidence for effectiveness in trawl fisheries

Evidence suggests net weighting on or near the cod end increases the angle of ascent of the net during hauling operations, thus reducing the time the net is on the water's surface. In addition, good deck practices to minimise the time that the net is on the water's surface have been the key factors in reducing seabird entanglements during hauling in South Atlantic trawl fisheries (Hooper *et al.* 2003; Sullivan *et al.* 2009).

Notes and Caveats

All attempts should be made to retrieve the net as quickly as possible.

Minimum standards

None established.

Need for combination

Should be used in combination with net binding and net cleaning to minimise the time the net is on the water's surface during both setting and hauling (Sullivan *et al.* 2009), as well as in combination with waste management to avoid the discharge of waste during shooting and hauling thereby minimising the attraction of seabirds to the stern of the vessel.

Implementation monitoring

On-board observers or electronic monitoring.

Research needs

Development of minimum standards for amount and placement of weight (cod end, wings, footrope, mouth, belly), to build on work to date in CCAMLR trawl fisheries (Sullivan *et al*. 2009).

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1713-fs-14-trawl-fisheries-net-entanglement/file

3.4 Minimise pooling area

ACAP advice

Insufficient evidence to recommend as an effective measure at this time.

Scientific evidence for effectiveness in trawl fisheries

Trials summarised by Steele-Mortimer & Wells (2023) indicate the merits of turning the vessel to close the net (by bunching it against a stern quarter of the trawl ramp) as a mitigation approach. While there is no empirical evidence that operations to close the headline of the net will reduce net entanglements, it is logical that minimising the surface area of the exposed risk will reduce risk.

Notes and Caveats

Some vessels may be unable to turn the vessel while hauling for operational reasons (i.e. the structure of the vessel doesn't allow for it, limited sea space, or vessel which directly haul nets onto a net drum).

Minimum standards

None established.

Need for combination

Should be used in combination with good net cleaning and other applicable best practice measures.

Implementation monitoring

None established.

Research needs

Further testing, preferably in a range of fisheries, to determine quantitatively if measure is effective.

3.5 Reduced mesh size

ACAP advice

Insufficient evidence to recommend as an effective measure at this time.

Scientific evidence for effectiveness in trawl fisheries

Roe (2005) reported on the use of reduced mesh size from 200 to 140 mm in the pelagic icefish fishery in CCAMLR waters, but did not quantify the effectiveness of the measure.

Notes and Caveats

Theoretically this measure could be effective in reducing the incidence of seabird entanglements in net; however, measure may be impractical and lead to higher bycatch of smaller sized fish. Reduced mesh size was believed to have caused severe damage to the net because of increased water pressure during trawling (Roe 2005), although the use of chain weights in the net may also have been influential.

Minimum standards

Not applicable, as not recommended.

Need for combination

Not applicable, as not recommended.

Implementation monitoring

Not applicable, as not recommended.

Research needs

Thorough testing in a range of fisheries is required to determine if measure is practical and effective, as well as to identify potential impact on target catch and bycatch species.

3.6 Net jackets

ACAP advice

Unproven and not recommended as a mitigation method at this time.

Scientific evidence for effectiveness in trawl fisheries

Free-floating panels of net attached to the most dangerous mesh sizes have been trialled in CCAMLR's icefish trawl fishery, with uncertain efficiency (Sullivan *et al*. 2009).

Caveats /Notes

Found to cause serious drag and subsequent damage to the net. Drag also slows vessel speed and increases fuel consumption (Sullivan *et al*. 2009).

Minimum standards

Not applicable, as not recommended.

Need for combination

Not applicable, as not recommended.

Implementation monitoring

Not applicable, as not recommended.

Research needs

Efficacy of measure remains to be demonstrated.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1713-fs-14-trawl-fisheries-net-entanglement/file

3.7 Acoustic deterrents

ACAP advice

Unproven and not recommended as a primary mitigation method at this time.

Scientific evidence for effectiveness in trawl fisheries

The use of acoustic 'scaring' devices on nine vessels in CCAMLR trawl fisheries indicated that loud noises (bells and flares/fireworks) had limited effect and birds quickly became habituated to the sound, no longer causing an aversion response (Sullivan *et al*. 2009).

Notes and Caveats

May be a useful back-up measure for circumstances when another measure is needed immediately (Sullivan *et al*. 2009).

Minimum standards

Not applicable, as not recommended.

Need for combination

Not applicable, as not recommended.

Implementation monitoring

Not applicable, as not recommended.

Research needs

None identified.

3.8 Net restrictor

ACAP advice

Unproven and not recommended as a primary mitigation method at this time.

Scientific evidence for effectiveness in trawl fisheries

The net restrictor was identified as a potential mitigation device in response to observed net captures in the New Zealand scampi trawl fishery, where multiple nets are deployed adjacently (Pierre *et al.* 2013). The net restrictor acts to restrict the opening of the net on haul when captures tend to occur. Video footage confirmed that the restrictor was effective in reducing the size of the net opening at hauling; although empirical testing of the device has not been conducted.

Notes and Caveats

May be a useful measure in demersal trawl fisheries where multiple nets are deployed adjacently, and nets (particularly the middle net) are liable to billow open at or near the surface on haul.

Minimum standards

Not applicable, as not recommended.

Need for combination

Not applicable, as not recommended.

Implementation monitoring

Not applicable, as not recommended.

Research needs

At-sea testing required to determine effectiveness.

4. GENERAL MEASURES

4.1 Time-Area closures

ACAP advice

Recommended as a general mitigation measure (but need to be aware of displacing the risk to adjacent areas).

Scientific evidence for effectiveness in trawl fisheries

Avoiding fishing at peak areas and during periods of intense foraging activity has been used effectively to reduce bycatch in longline fisheries. The principles are directly transferrable to trawl and other net fisheries.

In some studies, longline-associated mortality has been almost exclusively within the breeding season of seabirds. Several studies have also shown that proximity to breeding colonies is an important determinant of seabird bycatch rates (Moreno *et al.* 1996; Nel *et al*. 2002) and temporal closures around breeding areas contributed to a substantial reduction in seabird bycatch (Croxall & Nicol 2004).

Notes and Caveats

An important and effective management response, especially for high risk areas, and when other measures prove ineffective. There is a risk that temporal/spatial closures could displace fishing effort into neighbouring or other areas which may not be as well regulated, thus leading to increased incidental mortality elsewhere.

Minimum standards

None established.

Need for combination

Must be combined with other recommended measures, both in the specific areas when the fishing season is opened, and also in adjacent areas to ensure displacement of fishing effort does not merely lead to a spatial shift in the incidental mortality.

Implementation monitoring

VMS/AIS systems or at-sea surveillance.

Research needs

Further information about the seasonal variability in patterns of species abundance around trawl fisheries is required.

5. OTHER CONSIDERATIONS

5.1 Lasers

ACAP advice

High Energy Lasers Strongly Discouraged.

Scientific evidence for effectiveness in trawl fisheries

Available evidence shows that high energy lasers (Class 4 lasers, the highest class in terms of laser hazards) are ineffective at deterring seabirds from danger areas around fishing vessels (Melvin *et al.* 2016) and likely damage seabird visual systems with negative effects on foraging behaviour of laser exposed seabirds (Fernandez-Juricic, 2023).

Notes and Caveats

Concerns are ongoing regarding the safety (to both humans and birds) and efficacy of laser technology of unknown energy levels as a seabird bycatch mitigation tool, as they continue to be used currently in various fisheries. Available evidence shows that high energy lasers are no longer marketed for fishery applications. Currently evidence is lacking on the possibility that lasers of lower energy levels delivered in different ways (scanning, blinking, wave-length, etc.) could be used safely and be effective in some applications.

Minimum standards

Not applicable, as strongly discouraged.

Need for combination

Not applicable, as strongly discouraged.

Implementation monitoring

Not applicable, as strongly discouraged.

Research needs

As high energy lasers continue to be used in some fisheries, we encourage reporting of the extent and output power levels of laser use by ACAP Parties, including any information on effectiveness, as well as bird welfare effects.

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ANNEX 3. ACAP REVIEW OF SEABIRD BYCATCH MITIGATION MEASURES FOR DEMERSAL LONGLINE FISHERIES[8]

Agreement on the Conservation of Albatrosses and Petrels

ACAP Summary Advice for Reducing the Impact of Demersal Longline Fisheries on Seabirds

Reviewed at the Thirteenth Meeting of the Advisory Committee
Edinburgh, United Kingdom, 22-26 May 2023

3. BEST PRACTICE MEASURES - LINE HAULING

3.1. Bird Exclusion Device (BED)

Seabirds can be accidentally hooked as gear is retrieved. A Bird Exclusion Device (BED) consists of a horizontal support several metres above the water that encircles the entire hauling bay. Vertical streamers are positioned between the horizontal support and water surface. The BED configuration can also include a line of floats on the water surface connected to the vertical streamers to stabilize movement in strong winds. This configuration is the most effective method to prevent birds entering the area around the hauling bay, either by swimming or by flying. BEDs are retrieved and stowed when not hauling. For small vessels (<20 m in length), where the application of mitigation devices requiring robust support structures and on-water sections can be challenging, the use of simple haul mitigation devices has been demonstrated to be both practical and effective at deterring birds from hauling points.

[8] Only the amended component of the review document is presented here as noted in 6.1, and not the full advice and review document.

Agreement on the Conservation of Albatrosses and Petrels

ACAP Review of Seabird Bycatch Mitigation Measures for Demersal Longline Fisheries

Reviewed at the Thirteenth Meeting of the Advisory Committee
Edinburgh, United Kingdom, 22-26 May 2023

MITIGATION MEASURES UNDER DEVELOPMENT OR WHICH REQUIRE FURTHER DEVELOPMENT OR INVESTIGATION

7. Haul bird exclusion devices (BED)

Scientific evidence for effectiveness in demersal fisheries

Proven and recommended as a haul mitigation measure. BEDs must be used in combination with line setting mitigation measures – bird scaring lines, line weighting, night setting and offal management. The use of a BED can effectively reduce the incidence of birds becoming foul hooked when the line is being hauled (Brothers *et al.* 1999; Sullivan 2004; Otley *et al*. 2007; Reid *et al*. 2010). For small vessels (<20 m in length), where the application of mitigation devices requiring robust support structures and on-water sections can be challenging, the use of simple haul mitigation devices has been demonstrated to be both practical and effective at deterring birds from hauling points (Goad et al 2023).

17. Lasers

High Energy Lasers Strongly Discouraged

Scientific evidence for effectiveness in demersal longline fisheries

Available evidence shows that high energy lasers (Class 4 lasers, the highest class in terms of laser hazards) are ineffective at deterring seabirds from danger areas around fishing vessels (Melvin *et al.* 2016) and likely damage seabird visual systems with negative effects on foraging behaviour of laser exposed seabirds (Fernandez-Juricic, 2023).

Notes and Caveats

Concerns are ongoing regarding the safety (to both humans and birds) and efficacy of laser technology of unknown energy levels as a seabird bycatch mitigation tool, as they continue to

be used currently in various fisheries. Available evidence shows that high energy lasers are no longer marketed for fishery applications. Currently evidence is lacking on the possibility that lasers of lower energy levels delivered in different ways (scanning, blinking, wave-length, etc.) could be used safely and be effective in some applications

Minimum standards

Not Applicable as strongly discouraged.

Need for combination

Not Applicable as strongly discouraged.

Implementation monitoring

Not Applicable as strongly discouraged.

Research needs

As high energy lasers continue to be used in some fisheries, we encourage reporting of the extent and output power levels of laser use by ACAP Parties, including any information on effectiveness, as well as bird welfare effects.

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ANNEX 4. ACAP REVIEW OF SEABIRD BYCATCH MITIGATION MEASURES FOR PELAGIC LONGLINE FISHERIES

Agreement on the Conservation of Albatrosses and Petrels

ACAP Summary Advice for Reducing the Impact of Pelagic Longline Fisheries on Seabirds

Reviewed at the Thirteenth Meeting of the Advisory Committee
Edinburgh, United Kingdom, 22-26 May 2023

BEST PRACTICE MEASURES

ACAP recommends that the most effective way to reduce seabird bycatch in pelagic longline fisheries is to use the following three best practice measures **simultaneously: branch line weighting, night setting and bird scaring lines**. Alternatively, the use of an assessed hook-shielding device or underwater bait setting device is recommended. A hook-shielding device encases the point and barb of baited hooks until a prescribed depth or immersion time has been reached, and an underwater bait setting device deploys encapsulated baited hooks at the stern of the vessel releasing the baited hooks at a pre-determined depth. These devices are designed to release baited hooks at a depth beyond the diving range of most seabirds to avoid or minimise the risk of seabirds gaining access to the hook and becoming hooked during line setting.

The simultaneous use of the three ACAP recommended mitigation measures optimize seabird bycatch reduction in longline fisheries. All three recommended measures are demonstrated to be effective; however, each have limitations when used alone. 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 Consequently, the simultaneous use of the three ACAP recommended seabird bycatch mitigation measures compensate for these limitations.

1. Branch line weighting

Branch lines should be weighted to sink the baited hooks rapidly out of the diving range of feeding seabirds. Studies have demonstrated that branch line weighting where there is more mass closer to the hooks, sink most rapidly and consistently; thereby, dramatically reducing seabird attacks on baits and most likely reducing mortalities. Studies of a range of weighting regimes, including placing weights at the hook, have shown no negative effect on target catch rates. Continued refinement of line weighting configurations (mass, number and position of

weights and materials) with regard to effectively reducing seabird bycatch and safety concerns through controlled research and application in fisheries, is encouraged.

Increased weighting will shorten but not eliminate the distance behind the vessel in which birds can be caught. Line weighting has been shown to improve the effectiveness of other mitigation methods such as night setting and bird scaring lines, in reducing seabird bycatch. Priority should be accorded to line weighting, providing certain pre-conditions can be met, among other things: (a) weighting regime adequately specified; (b) safety issues adequately addressed; and (c) issues concerning application to artisanal fisheries being taken into account.

Current recommended minimum standards for branch line weighting configurations include the following:

(a) 40 g or greater attached within 0.5 m of the hook; or

(b) 60 g or greater attached within 1 m of the hook; or

(c) 80 g or greater attached within 2 m of the hook.

Line weighting is integral to the fishing gear and, compared to bird scaring lines and night setting, has the advantage of being more consistently implemented, hence facilitating compliance and port monitoring.

2. Night setting

Setting longlines at night (defined as the time between the end of nautical twilight and before nautical dawn as set out in the Nautical Almanac tables for relevant latitude, local time and date) is highly effective at reducing incidental mortality of seabirds because the majority of vulnerable seabirds are inactive at night. However, night setting is not as effective for crepuscular/ nocturnal foragers (e.g. White-chinned Petrels, *Procellaria aequinoctialis*). The effectiveness of this measure may be reduced during bright moonlight and when using intense deck lights, and is less practical in high latitudes during summer, when the time between nautical dusk and dawn is limited.

Night setting is recognised as consistently defined, widely reflected in conservation and management measures and has benefit as a primary mitigation measure, as it has the potential for compliance monitoring through VMS and other tools.

3. Bird scaring lines

Properly designed and deployed bird scaring lines (BSLs) deter birds from sinking baits, dramatically reducing seabird attacks and related mortalities. A bird scaring line runs from a high point at the stern to a device or mechanism that creates drag at its terminus. Brightly coloured streamers hanging from the aerial extent of the line scare birds from flying to and under the line, preventing them from reaching the baited hooks.

BSLs should be the lightest practical strong fine line. Lines should be attached to the vessel with a barrel swivel to minimise rotation of the line from torque created as it is dragged behind the vessel. Long streamers should be attached with a swivel to prevent them from rolling up onto the BSL. Towed objects should be attached at the terminus of the BSL to increase drag. BSLs are at risk of tangling with float lines leading to lost bird scaring lines, interruptions in

vessel operations and in some cases lost fishing gear. Alternatives, such as adding short streamers to the in-water portion of the line, can enhance drag while minimising tangles with float lines. Weak links (breakaways) should be incorporated into the in-water portion of the line for safety reasons and to minimize operational problems associated with lines becoming tangled.

It is recommended to use a weak link to allow the BSL to break-away from the vessel in the event of a tangle with the main line, and, a secondary attachment between the bird scaring line and the vessel to allow the tangled BSL to be subsequently attached to mainline and recovered during the haul.

Sufficient drag must be created to maximise aerial extent and maintain the line directly behind the vessel during crosswinds. To avoid tangling, this is best achieved using a long in-water section of rope or monofilament.

Given operational differences in pelagic longline fisheries due to vessel size and gear type, bird scaring lines specifications have been divided into recommendations for vessels greater than 35 metres and those less than 35 metres in length.

3. a) Recommendations for vessels ≥35 m total length

Simultaneous use of two BSLs, one on each side of the sinking longline, provides maximum protection from bird attacks under different wind conditions. The setup for BSLs should be as follows:

- BSLs should be deployed to maximise the aerial extent, which is a function of vessel speed, height of the attachment point to the vessel, drag, and weight of bird scaring line materials.
- To achieve a minimum recommended aerial extent of 100 m, BSLs should be attached to the vessel such that they are suspended from a point a minimum of 8 m above the water at the stern.
- BSLs should contain a mix of brightly coloured long and short streamers placed at intervals of no more than 5 m. Long streamers should be attached to the line with swivels to prevent streamers from wrapping around the line. All long streamers should reach the sea-surface in calm conditions.
- Baited hooks should be deployed within the area bounded by the two BSLs. If using bait-casting machines, they should be adjusted so as to land baited hooks within the area bounded by the BSLs.

If large vessels use only one BSL, it should be deployed windward of the sinking baits. If baited hooks are set outboard of the wake, the BSL attachment point to the vessel should be positioned several metres outboard of the side of the vessel that baits are deployed.

3. b) Recommendations for vessels <35 m total length

Two designs have been shown to be effective:

1. a design with a mix of long and short streamers, that includes long streamers placed at 5 m intervals over at least the first 55 m of the BSL. Streamers may be modified over the first 15 m to avoid tangling, and

2. a design that does not include long streamers. Short streamers (no less than 1 m in length) should be placed at 1 m intervals along the length of the aerial extent.

In all cases, streamers should be brightly coloured. To achieve a minimum recommended aerial extent of 75 m, BSLs should be attached to the vessel such that they are suspended from a point a minimum of 6 m above the water at the stern.

4. Hook-shielding devices

Hook-shielding devices encase the point and barb of baited hooks to prevent seabird attacks during line setting until a prescribed depth is reached (a minimum of 10 metres), or until after a minimum period of immersion has occurred (a minimum of 10 minutes) that ensures that baited hooks are released beyond the foraging depth of most seabirds. The following performance requirements are used by ACAP to assess the efficacy of hook-shielding devices in reducing seabird bycatch:

(a) the device shields the hook until a prescribed depth of 10 m or immersion time of 10 minutes is reached;

(b) the device meets current recommended minimum standards for branch line weighting described in Section 1; and

(c) experimental research has been undertaken to allow assessment of the effectiveness, efficiency and practicality of the technology against the ACAP best practice seabird bycatch mitigation criteria developed for assessing and recommending best practice advice on seabird bycatch mitigation measures.

Devices assessed as having met the performance requirements listed above will be considered best practice. At this time, the following devices have been assessed as meeting these performance requirements and are therefore considered to represent best practice:

1. '**Hookpod-LED**' – 68 g minimum weight that is positioned at the hook, encapsulating the barb and point of the hook during setting, and remains attached until it reaches 10 m in depth, when the hook is released (Barrington 2016a, Sullivan *et al*. 2018,).

2. **'Hookpod-mini'** – 48 g minimum weight that is positioned at the hook, encapsulating the barb and point of the hook during setting, and remains attached until it reaches 10 m in depth, when the hook is released (Goad *et al.* 2019, Gianuca *et al.* 2021, Sullivan & Barrington 2021).

3. '**Smart Tuna Hook**' – 40 g minimum weight that is positioned at the hook, encapsulating the barb and point of the hook during setting, and remains attached for a minimum period of 10 minutes after setting, when the hook is released (Baker *et al*. 2016, Barrington 2016b)

The assessment of these devices as best practice is conditional on continuing to meet the above performance requirements.

5. Underwater Bait Setting devices

Underwater Bait Setting devices deploy baited hooks at a pre-determined depth immediately at the stern of the vessel. Underwater Bait Setting devices deploy baited hooks individually

underwater down a track fitted to the fishing vessel's transom enclosed in a capsule or similar device to eliminate any visual stimulus for seabirds following the vessel. The capsule is pulled quickly underwater to a predetermined target depth that can be adjusted in response to the dive capabilities of seabirds attending the vessel during line setting to prevent interactions. The following performance requirements are used by ACAP to assess the efficacy of underwater bait setting devices in reducing seabird bycatch:

(a) the device deploys encapsulated hooks in a vertical manner at the stern of the vessel until a minimum prescribed depth of 5 m is reached;

(b) branch lines meet current recommended minimum standards for branch line weighting described in Section 1; and

(c) experimental research has been undertaken to allow assessment of the effectiveness, efficiency and practicality of the technology against the ACAP best practice seabird bycatch mitigation criteria developed for assessing and recommending best practice advice on seabird bycatch mitigation measures.

Devices assessed as having met the performance requirements listed above will be considered best practice. At this time, the following device has been assessed as meeting these performance requirements and is therefore considered to represent best practice:

1. **'Underwater Bait Setter (Skadia Technologies)'** – a computer operated and hydraulically powered machine that deploys baited hooks individually underwater in a capsule, and where recommended minimum standards for branch line weighting are met. The capsule is pulled down a removable track fitted to the vessel's transom and then catapulted to a target depth. The capsule descends along the track at 6 $m.sec^{-1}$ and thereafter at ≥3 $m.sec^{-1}$ (Robertson et al, 2015, Robertson et al. 2018, Barrington 2021).

The assessment of an Underwater Bait Setting device as best practice is conditional on the device continuing to meet the above performance requirements.

6. Time-Area fishery closures

The temporary closure of important seabird foraging areas (e.g. areas adjacent to important seabird colonies during the breeding season or highly productive waters when large numbers of aggressively feeding seabirds are present) to fishing will eliminate incidental mortality of seabirds in that area.

OTHER RECOMMENDATIONS

Side-setting with line weighting and bird curtain (North Pacific): Research conducted in the North Pacific indicates that side-setting was more effective than other simultaneously trialled mitigation measures, including setting chutes and blue-dyed bait (Gilman *et al.,* 2003b). It should be noted that these tests were conducted in a single pilot scale trial of 14 days in the Hawaiian pelagic longline fishery for tuna and swordfish with an assemblage of surface-feeding seabirds. This method requires testing in the Southern Ocean with deeper-diving species and at a larger spatial scale, before it can be considered as a recommended approach beyond the pilot fishery.

Side-setting **must** be used in combination with ACAP best practice recommendations for line weighting in order to increase sink rates forward of the vessel's stern, and hooks should be cast well forward of the setting position, but close to the hull of the vessel, to allow hooks time to sink as far as possible before they reach the stern. Bird curtains, a horizontal pole with vertical streamers, positioned aft of the setting station, may deter birds from flying close to the side of the vessel. The combined use of side-setting, line weighting and a bird curtain should be considered as a single measure.

Mainline tension: Setting longlines into propeller turbulence (wake) should be avoided because it slows the sink rates of baited hooks.

Live vs. dead bait: Use of live bait should be avoided. Individual live baits can remain near the water surface for extended periods, thus increasing the likelihood of seabird captures.

Hook mass and design: Changes to hook mass and design may reduce the chance of seabird mortality in longline fisheries but have not been adequately studied.

Bait hooking position: Baits hooked in either the head (fish), or tail (fish and squid) are recommended because they sink significantly faster than baits hooked in the mid-back (fish) or upper mantle (squid).

Offal and discard discharge management: Offal and discards should not be discharged during line setting. During line hauling, offal and used baits should preferably be retained or discharged on the opposite side of the vessel from that on which the line is hauled. All hooks should be removed and retained on board before discards are discharged from the vessel.

MITIGATION MEASURES THAT ARE NOT RECOMMENDED

ACAP considers that the following measures lack scientific substantiation as technologies or procedures for reducing the impact of pelagic longlines on seabirds.

Line shooters: No experimental evidence of effectiveness in pelagic longline fisheries.

Olfactory deterrents: No evidence of effectiveness in pelagic longline fisheries.

Blue dyed bait: No experimental evidence of effectiveness in pelagic longline fisheries. Insufficiently researched.

Bait thaw status: No evidence that the thaw status of baits has any effect on the sink rate of baited hooks set on weighted lines.

Laser technology: There is currently no evidence of effectiveness, and serious concerns remain regarding the potential impacts on the health of individual birds.

The ACAP review of seabird bycatch mitigation measures for pelagic longline fisheries is presented in the following section.

Agreement on the Conservation of Albatrosses and Petrels

ACAP Review of Seabird Bycatch Mitigation Measures for Pelagic Longline Fisheries

Reviewed at the Twelfth Meeting of the Advisory Committee
Virtual meeting, 31 August – 2 September 2021

INTRODUCTION

A range of technical and operational mitigation methods have been designed or adapted for use in pelagic longline fisheries to reduce incidental mortality of seabirds. Operationally, peak areas and periods of seabird foraging activity should be avoided. Effective technical methods include actively deterring birds from, and minimising the visibility of, baited hooks. Vessels need to be made less attractive to birds, and the distance astern and time baited hooks are available to birds should be reduced. Mitigation methods need to be easy and safe to implement, cost effective, enforceable and should not reduce catch rates of target species or increase the bycatch rates of other protected species.

The feasibility, effectiveness and specifications of mitigation measures may vary by area, seabird assemblage, fishery, vessel size, and gear configuration. Some of the mitigation methods are well established and explicitly prescribed in pelagic longline fisheries; however, additional measures are undergoing further testing and refinements.

The Seabird Bycatch Working Group (SBWG) of ACAP has comprehensively reviewed the scientific literature dealing with seabird bycatch mitigation in pelagic fisheries and this document is a distillation of that review. Currently, simultaneous use of weighted branch lines, bird scaring lines and night setting, or use of one of the assessed hook-shielding and underwater bait setting devices, is considered best practice mitigation for reducing seabird bycatch in pelagic longline fisheries. Three hook-shielding devices (the ‘Hookpod-LED’, the ‘Hookpod-mini’ and the ‘Smart Tuna Hook’) and one underwater bait setting device (the ‘Underwater Bait Setter (Skadia Technologies)’) have been assessed.

THE ACAP REVIEW PROCESS

At each of its meetings, the ACAP SBWG considers any new research or information pertaining to seabird bycatch mitigation in pelagic longline fisheries. The following criteria are used by ACAP to guide the assessment process, and to determine whether a particular fishing technology or measure can be considered best practice to reduce the incidental mortality of albatrosses and petrels in fishing operations.

Best Practice Seabird Bycatch Mitigation Criteria and Definition

i. Individual fishing technologies and techniques should be selected from those shown by experimental research to significantly[9] reduce the rate of seabird incidental mortality[10] to the lowest achievable levels. Experimental research yields definitive results when performance of candidate mitigation technologies is compared to a control (no deterrent), or to status quo in the fishery. When testing relative performance of mitigation approaches, analysis of fishery observer data can be plagued with a myriad of confounding factors. Where a significant relationship is demonstrated between seabird behaviour and seabird mortality in a particular system or seabird assemblage, significant reductions in seabird behaviours, such as the rate of seabirds attacking baited hooks, can serve as a proxy for reduced seabird mortality. Ideally, where simultaneous use of fishing technologies and practices is recommended as best practice, research should demonstrate significantly improved performance of the combined measures.

ii. Fishing technologies and techniques, or a combination thereof, should have clear and proven specifications and minimum performance standards for their deployment and use. Examples would include: specific bird scaring line designs (lengths, streamer length and materials; etc.), number (one vs. two) and deployment specifications (such as aerial extent and timing of deployment); night fishing defined by the time between the end of nautical dusk and start of nautical dawn; and, line weighting configurations specifying mass and placement of weights or weighted sections.

iii. Fishing technologies and techniques should be demonstrated to be practical, cost effective and widely available. Commercial fishing operators are likely to select for seabird bycatch reduction measures and devices that meet these criteria including practical aspects concerning safe fishing practices at sea.

iv. Fishing technologies and techniques should, to the extent practicable, maintain catch rates of target species. This approach should increase the likelihood of acceptance and compliance by fishers.

v. Fishing technologies and techniques should, to the extent practicable not increase the bycatch of other taxa. For example, measures that increase the likelihood of catching other protected species such as sea turtles, sharks and marine mammals, should not be considered best practice (or only so in exceptional circumstances).

vi. Minimum performance standards and methods of ensuring compliance should be provided for fishing technologies and techniques, and clearly specified in fishery regulations. Relatively simple methods to check compliance should include, but not be limited to, port inspections of branch lines to determine compliance with branch line weighting, determination of the presence of davits (tori poles) to support bird scaring lines, and inspections of bird scaring lines for conformance with design requirements.

[9] Any use of the word ‘significant’ in this document is meant in the statistical context

[10] This may be determined by either a direct reduction in seabird mortality or by reduction in seabird attack rates, as a proxy

Compliance monitoring and reporting should be a high priority for enforcement authorities.

On the basis of these criteria, the scientific evidence for the effectiveness of mitigation measures or fishing technologies/techniques in reducing seabird bycatch is assessed, and explicit information is provided on whether the measure is recommended as being effective, and thus considered best practice, or not. The ACAP review also indicates whether the measure needs to be combined with additional measures, and provides notes and caveats for each measure, together with information on performance standards and further research needs. Following each meeting of ACAP's SBWG and Advisory Committee, this review document and ACAP's best practice advice, is updated (if required). A summary of ACAP's current best practice advice is provided in the preceding section of this document.

SEABIRD BYCATCH MITIGATION FACT SHEETS

A series of seabird bycatch mitigation fact sheets have been developed by ACAP and BirdLife International to provide practical information, including illustrations, on seabird bycatch mitigation measures (http://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets). The sheets, which include information on the effectiveness of the specific measure, their limitations and strengths and best practice recommendations for their effective adoption, are linked to the ACAP review process, and are updated following ACAP reviews. Links to the available fact sheets are provided in the relevant sections below. The mitigation fact sheets are currently available in English, French, Spanish, Portuguese, Japanese, Korean, Simplified Chinese, Traditional Chinese, and Indonesian.

BEST PRACTICE MEASURES

1. Branch line weighting

Scientific evidence for effectiveness in pelagic fisheries

Proven and recommended mitigation method. Should be used in combination with night setting and bird scaring lines (Brothers 1991; Boggs 2001; Sakai *et al*. 2001; Brothers *et al*. 2001; Anderson & McArdle 2002; Hu *et al*. 2005; Melvin *et al*. 2013; 2014, Jiménez *et al*. 2017; 2019).

Notes and Caveats

Branch lines should be weighted to sink the baited hooks rapidly out of the diving range of feeding seabirds. Studies have demonstrated that branch line weighting where there is more mass closer to the hooks, results in hooks sinking most rapidly and consistently (Gianuca *et al*. 2011; Robertson *et al*. 2010a; 2013; Barrington et al. 2016), and reduces seabird attacks on baits (Gianuca *et al*. 2011; Ochi *et al*. 2013, Jiménez *et al*. 2019) as well as seabird mortalities (Jiménez *et al*. 2017; 2019: Santos *et al*. 2019). Studies of a range of weighting regimes have shown no negative effect on target catch rates (Jiménez *et al*. 2013; 2017; 2019; Robertson *et al*. 2013; Gianuca *et al*. 2013; Santos *et al.* 2019). However, an experimental

weighted fishing hook, with a mass of 32 g added to the shank of the hook, showed a decrease in the catch rates of pooled retained species (Gilman et al. 2022).

Increased weighting will shorten but not eliminate the distance behind the vessel in which birds can be caught. Line weighting has been shown to improve the effectiveness of other mitigation methods such as night setting and bird scaring lines, in reducing seabird bycatch (Brothers 1991; Boggs 2001; Sakai *et al*. 2001; Anderson & McArdle 2002; Gilman *et al.* 2003a, Hu *et al*. 2005; Melvin *et al*. 2013; 2014). Line weighting is integral to the fishing gear and, compared to bird scaring lines and night setting, has the advantage of being more consistently implemented, hence facilitating compliance and port monitoring. On this basis it is important to enhance the priority accorded to line weighting, providing certain pre-conditions can be met, among other things: (a) that the weighting regime is adequately specified; (b) safety issues are adequately addressed; and (c) issues concerning application to artisanal fisheries are being taken into account.

Minimum standards

On the basis of sink-rate data (Barrington *et al*. 2016) and seabird attack and bycatch rates (Gianuca *et al*. 2011; Jiménez *et al*. 2019; Santos *et al*. 2019), current recommended minimum standards for branch line weighting are as follows:

(a) 40 g or greater attached within 0.5 m of the hook; or

(b) 60 g or greater attached within 1 m of the hook; or

(c) 80 g or greater attached within 2 m of the hook.

Need for combination

Should be combined with bird scaring lines and night setting. There is a period of time when hooks are accessible to birds even when branch lines are weighted.

Implementation monitoring

Vessels <35 m total length: Line weights crimped into branch lines are very difficult to remove at sea. Inspection before departure from port of all gear bins on vessels is therefore considered an acceptable form of implementation monitoring.

Vessels ≥35 m total length: It is possible to remove and/or re-configure gear at sea. Consequently, implementation monitoring requires using appropriate methods (e.g., observer inspection of line setting operations; video surveillance; at-sea compliance checks). Video surveillance may be possible, subject to the mainline setter being fitted with motion sensors to trigger cameras.

Research needs

Continued refinement of line weighting configurations (mass, number and position of weights and materials) with regard to effectively reducing seabird bycatch and safety concerns, through controlled research and application in fisheries, is encouraged. Studies should also include evaluations of the effects of branch line weighting on the catch rate of pelagic fish and provide data that allow evaluation of the relative safety and practicality attributes of various weighting configurations.

Mitigation Fact Sheet

https://www.acap.aq/en/bycatch-mitigation/bycatch-mitigation-fact-sheets

2. Night setting

Scientific evidence for effectiveness in pelagic fisheries

Proven and recommended mitigation method. Should be used in combination with weighted branch lines and bird scaring lines (Duckworth 1995; Gales *et al.* 1998; Klaer & Polacheck 1998; Brothers *et al*. 1999; McNamara *et al*. 1999; Gilman *et al*. 2005; 2023; Baker & Wise 2005; Jiménez *et al*. 2009; 2014; 2020; Melvin *et al*. 2013; 2014; Rollinson *et al*. 2016; Rollinson 2017; Melvin *et al.* 2023, Meyer and MacKenzie 2022).

Notes and Caveats

Setting longlines at night (defined as the time between the end of nautical twilight and before nautical dawn as set out in the Nautical Almanac tables for relevant latitude, local time and date) is highly effective at reducing incidental mortality of seabirds because the majority of vulnerable seabirds are inactive at night. For example, a Pacific Ocean albacore tuna longline fishery had dramatically lower albatross bycatch rates when making sets completely at night compared to sets made partially in the daytime, with no reduction in the target species catch rate (Gilman et al., 2023).Night setting is not as effective for crepuscular/ nocturnal foragers (e.g. White-chinned Petrels, *Procellaria aequinoctialis*). Consequently, night setting should be used in combination with weighted branch lines and bird scaring lines (Klaer & Polacheck 1998; Brothers *et al*. 1999; McNamara *et al*. 1999; Gilman *et al*. 2005; Baker & Wise 2005; Jiménez *et al*. 2009; 2014; 2020; Melvin *et al*. 2013; 2014). The effectiveness of this measure may be reduced during bright moonlight and when using intense deck lights, and is less practical in high latitudes during summer, when the time between nautical dusk and dawn is limited.

Minimum standards

No setting should take place between nautical dawn and nautical dusk. Nautical dawn and nautical dusk are defined as set out in the Nautical Almanac tables for relevant latitude, local time and date. Setting longlines across night and day does not represent night setting: either when setting commences at night and finishes after the nautical dawn, or when setting commences prior to the nautical dusk and continues into the night.

Need for combination

Should be used in combination with bird scaring lines and weighted branch lines. Night setting used alone is less effective at reducing seabird bycatch for nocturnally active birds and during bright moon light conditions.

Implementation monitoring

Requires Vessel Monitoring Systems (VMS) or fishery observers. Vessel speed and direction vary between transiting, line setting, line hauling and when vessels are stationary on fishing grounds. VMS-derived assessment of vessel activity in relation to time of nautical dawn and dusk are considered acceptable for implementation monitoring. Alternatively, VMS-linked sensors fitted to mainline setting and hauling drum could be used to indicate compliance, as

could sensors to trigger video surveillance cameras. This facility is currently unavailable and requires development.

Research needs

Assessing the effectiveness of bird scaring lines and branch line weighting at night needs to be determined, possibly by way of using thermal or night vision technologies.

Mitigation Fact Sheet

https://www.acap.aq/en/bycatch-mitigation/bycatch-mitigation-fact-sheets/1824-fs-05-demersal-pelagic-longline-night-setting/file

3.a Bird scaring lines for vessels ≥35 m in total length

Scientific evidence for effectiveness in pelagic fisheries

Proven and recommended mitigation method. Should be used in combination with weighted branch lines and night setting. (Imber 1994; Uozumi & Takeuchi 1998; Brothers *et al.* 1999; Klaer & Polacheck 1998; McNamara *et al.* 1999; Boggs 2001; CCAMLR 2002; Minami & Kiyota 2004; Melvin 2003; Rollinson et al. 2016; Rollinson 2017). For vessels ≥35 m in length, the use of two bird scaring lines (BSLs) is considered best practice. BSLs with the appropriate aerial extent can be more easily rigged on large vessels. Two BSLs are considered to provide better protection of baited hooks in crosswinds than single BSLs (Melvin *et al*. 2004; 2013; 2014; Sato *et al*. 2013). Hybrid BSLs (with long and short streamers) are more effective than BSLs with short streamers only in deterring diving seabirds (e.g. White-chinned Petrels *Procellaria aequinoctialis*, Melvin *et al*. 2010; 2013; 2014).

Notes and Caveats

Properly designed and deployed BSLs deter birds from sinking baits, dramatically reducing seabird attacks and related mortalities. A bird scaring line runs from a high point at the stern to a device or mechanism that creates drag at its terminus. Brightly coloured streamers hanging from the aerial extent of the line scare birds from flying to and under the line, preventing them from reaching the baited hooks. It is important to note that the BSLs only provide protection to the baited hooks within the area protected by its aerial extent. This is why it is particularly important to use BSLs in combination with weighted branch lines (and night setting), which ensure that the baited hooks have sunk beneath the diving depth of most seabirds beyond the aerial extent of the BSLs. The presence of diving species increases the vulnerability of surface foragers (e.g., albatrosses) due to secondary interactions (i.e. albatrosses attacking baited hooks that are brought back to the surface by diving birds).

BSLs should be the lightest practical strong fine line. Lines should be attached to the vessel with a barrel swivel to minimise rotation of the line from torque created as it is dragged behind the vessel. Long streamers should be attached with a swivel to prevent them from rolling up onto the BSL. BSLs are at risk of tangling with float lines leading to lost BSLs, interruptions in vessel operations and in some cases lost fishing gear.

BSLs potentially increase the likelihood of entanglements, particularly if the attachment points on davits (tori poles) are insufficiently outboard of vessels. To achieve a minimum aerial extent BSLs should be attached to the vessel such that it is suspended from a point a minimum of 8 m above the water at the stern. Attaching towed objects to the terminus of the in-water extent

of bird scaring lines to increase drag has proven problematic in pelagic longline fisheries, as float lines tend to tangle with bird scaring lines. For this reason, the addition of short streamers woven into the in-water extent of the bird scaring line or lengthening or increasing the diameter of the in-water extent, are encouraged to increased drag while minimizing tangles. Weak links (breakaways) should be incorporated into the in-water portion of the line for safety reasons and to minimize operational problems associated with lines becoming tangled.

Minimum standards

Simultaneous use of two BSLs, one on each side of the sinking longline, provides maximum protection from bird attacks under different wind conditions (Melvin *et al.* 2004; 2013; 2014; Sato *et al*. 2013). The setup for BSLs should be as follows:

- BSLs should be deployed to maximise the aerial extent, which is a function of vessel speed, height of the attachment point to the vessel, drag, and weight of bird scaring line materials.
- To achieve a minimum recommended aerial extent of 100 m, BSLs should be attached to the vessel such that they are suspended from a point a minimum of 8 m above the water at the stern.
- BSLs should contain a mix of brightly coloured long and short streamers placed at intervals of no more than 5 m. Long streamers should be attached to the line with swivels to prevent streamers from wrapping around the line. All long streamers should reach the sea-surface in calm conditions.
- Baited hooks should be deployed within the area bounded by the two BSLs. If using bait-casting machines, they should be adjusted so as to land baited hooks within the area bounded by the BSLs.

If large vessels use only one BSL, it should be deployed windward of the sinking baits. If baited hooks are set outboard of the wake, the BSL attachment point to the vessel should be positioned several meters outboard of the side of the vessel that baits are deployed.

Need for combination

Should be used in combination with appropriate line weighting and night setting. BSLs used alone can rarely protect baited hooks beyond the aerial extent of the line.

Implementation monitoring

Requires fisheries observers, video surveillance or at-sea surveillance (e.g. patrol boats or aerial over-flights).

Research needs

Developing methods that minimise entanglements of the in-water portion of BSLs with longline floats remains the highest priority for research on bird-scaring lines. Other research priorities include: (1) evaluating the effectiveness of one vs. two BSLs; and, (2) BSLs design features including streamer lengths, configurations and materials.

Mitigation Fact Sheet

https://www.acap.aq/en/bycatch-mitigation/bycatch-mitigation-fact-sheets/1497-fs-07a-pelagic-longline-streamer-lines-vessels-35-m/file

3.b Bird scaring lines for vessels <35m in total length

Scientific evidence for effectiveness in pelagic fisheries

Proven and recommended mitigation method. For vessels <35 m in length, a single BSL in combination with night setting and appropriate line weighting, has been found to be effective for mixed and short BSLs (ATF 2011; Domingo *et al.* 2017, Gianuca *et al.* 2011, Meyer and MacKenzie 2022).

Notes and Caveats

Vessels <35 m total length should deploy BSLs with a minimum aerial extent of 75 m. To achieve this minimum aerial extent, BSLs should be attached to the vessel such that it is suspended from a point a minimum of 6 m above the water at the stern. Sufficient drag must be created to maximise aerial extent and maintain the line directly behind the vessel during crosswinds. This may be achieved using either towed devices or longer in-water sections (Goad & Debski 2017). Diving species increase vulnerability of surface foragers (albatrosses) due to secondary interactions.

Minimum standards

To achieve a minimum recommended aerial extent of 75 m, BSLs should be attached to the vessel such that they are suspended from a point a minimum of 6 m above the water at the stern. Short streamers (>1 m) should be placed at 1 m intervals along the length of the aerial extent. Two designs have been shown to be effective:

(i) a mixed design that includes long and short streamers. Long streamers should be placed at 5 m intervals over at least the first 55 m of the BSL (Domingo *et al*. 2017). Streamers may be modified over the first 15 m to avoid tangling (Goad & Debski 2017); and,

(ii) a design that only includes short streamers. In all cases, BSLs should be brightly coloured and the lightest practical strong fine line. Lines should be attached to the vessel with a barrel swivel to minimise rotation of the line from torque (created as it is dragged behind the vessel).

Sufficient drag must be created to maximise aerial extent and maintain the line directly behind the vessel during crosswinds. To avoid tangling, this is best achieved using a long in-water section of rope or monofilament. Alternatively, short streamers can be tied into the line to 'bristle' the line (creating a bottlebrush like configuration) to generate drag while minimising the chance of fouling streamer lines on float lines.

To minimise safety and operational problems it is recommended to use a weak link to allow the bird scaring line to break-away from the vessel in the event of a tangle with the main line, and, a secondary attachment between the bird scaring line and the vessel to allow the tangled bird scaring line to be subsequently attached to mainline and recovered during the haul (Goad & Debski 2017).

Need for combination

Should be used with appropriate line weighting and night setting. BSLs used alone can rarely protect baited hooks beyond the aerial extent of the line.

Implementation monitoring

Requires fisheries observers, video surveillance, or at-sea surveillance (e.g. patrol boats or aerial over-flights).

Research needs

Developing methods that minimise entanglements of the in-water portion of BSLs with longline floats remains the highest priority for research on bird-scaring lines. Other research priorities include: (i) evaluating the effectiveness of one vs. two BSL, (ii) BSL design features including steamer lengths, configurations and materials, especially for very small vessels.

Mitigation Fact Sheet

https://www.acap.aq/en/bycatch-mitigation/bycatch-mitigation-fact-sheets/1867-fs-07b-pelagic-longline-streamer-lines-vessels-less-than-35-m/file

4. Hook-shielding devices

Scientific evidence for effectiveness in pelagic longline fisheries

Proven and recommended mitigation method. Hook-shielding devices encase the point and barb of baited hooks to prevent seabird attacks during line setting until a prescribed depth is reached (a minimum of 10 meters), or until after a minimum period of immersion has occurred (a minimum of 10 minutes) that ensures that baited hooks are released beyond the foraging depth of most seabirds. The following performance requirements are used by ACAP to assess the efficacy of hook-shielding devices in reducing seabird bycatch:

(a) the device shields the hook until a prescribed depth of 10 m or immersion time of 10 minutes is reached

(b) the device meets current recommended minimum standards for branch line weighting described in Section 1

(c) experimental research has been undertaken to allow assessment of the effectiveness, efficiency and practicality of the technology against the ACAP best practice seabird bycatch mitigation criteria developed for assessing and recommending best practice advice on seabird bycatch mitigation measures

At this time, the 'Hookpod-LED' (Sullivan *et al*. 2018, Barrington 2016a), 'Hookpod-mini' (Goad *et al.* 2019, Gianuca *et al.* 2021, Sullivan & Barrington 2021) and the 'Smart Tuna Hook' (Baker *et al*. 2016, Barrington 2016b) have been assessed as having met the performance requirements and are therefore considered to represent best practice.

Notes and Caveats

The assessment of these three devices as best practice is conditional on continuing to meet the above performance requirements.

Minimum standards

'Hookpod-LED' – 68 g minimum weight that is positioned at the hook, encapsulating the barb and point of the hook during setting, and remains attached until it reaches 10 m in depth, when the hook is released.

'Hookpod-mini' – 48 g minimum weight that is positioned at the hook, encapsulating the barb and point of the hook during setting, and remains attached until it reaches 10 m in depth, when the hook is released.

'Smart Tuna Hook' – 40 g minimum weight that is positioned at the hook, encapsulating the barb and point of the hook during setting, and remains attached for a minimum period of 10 minutes after setting, when the hook is released.

Need for combination

Both of these assessed hook-shielding devices have been designed as stand-alone measures that do not need to be combined with other mitigation measures. However, it is useful to note that they integrate two performance components: i) protecting and ii) increasing the sink rate of the baited hooks to reduce the opportunities for seabirds to access them.

Implementation monitoring

A combination of port-based inspections and vessel based monitoring and surveillance (e.g. observer inspection of line setting operations; video surveillance; at-sea compliance checks) will be required to assess use and compliance.

Research needs

Conduct further field research to evaluate the relative contributions of the sink rates and hook protection components of hook-shielding devices in reducing seabird bycatch.

5. Underwater Bait Setting devices

Scientific evidence for effectiveness in pelagic longline fisheries

Proven and recommended mitigation method. Underwater Bait Setting devices deploy baited hooks at a pre-determined depth immediately at the stern of the vessel. Underwater Bait Setting devices deploy baited hooks individually underwater down a track fitted to the fishing vessel's transom in a vertical manner enclosed in a capsule or similar device to eliminate any visual stimulus for seabirds following the vessel. The capsule is pulled quickly underwater to a predetermined target depth that can be adjusted in response to the dive capabilities of seabirds attending the vessel during line setting to prevent interactions. The following performance requirements are used by ACAP to assess the efficacy of underwater bait setting devices in reducing seabird bycatch:

(a) the device deploys encapsulated hooks in a vertical manner at the stern of the vessel until a minimum prescribed depth of 5 m is reached;

(b) branch lines meet current recommended minimum standards for branch line weighting described in Section 1; and

(c) experimental research has been undertaken to allow assessment of the effectiveness, efficiency and practicality of the technology against the ACAP best practice seabird

bycatch mitigation criteria developed for assessing and recommending best practice advice on seabird bycatch mitigation measures.

At this time, the 'Underwater Bait Setter (Skadia Technologies)' (Robertson et al, 2015, Robertson et al. 2018, Barrington 2021) has been assessed as having met the performance requirements and are therefore considered to represent best practice.

Notes and Caveats

The assessment of this devices as best practice is conditional on continuing to meet the above performance requirements.

Minimum standards

'Underwater Bait Setter (Skadia Technologies)' – a computer operated and hydraulically powered machine that deploys baited hooks individually underwater in a capsule, and where recommended minimum standards for branch line weighting are met. The capsule is pulled down a removable track fitted to the vessel's transom and then catapulted to a target depth. The capsule descends along the track at 6 $m.sec^{-1}$ and thereafter at ≥3 $m.sec^{-1}$.

Need for combination

The assessed underwater bait setting device has been assessed on the basis that branch lines meet current recommended minimum standards for branch line weighting. However, it is useful to note that the device integrates two performance components: i) protecting and ii) increasing the sink rate of the baited hooks to reduce the opportunities for seabirds to access them.

Implementation monitoring

A combination of port-based inspections and vessel-based autonomous data collection and surveillance (e.g. observer inspection of line setting operations; autonomous electronic surveillance and data collection; at-sea compliance checks) will be required to assess use and compliance.

Research needs

Conduct further field research to evaluate the effect of shallow set (e.g. 4-5 m depth) baits and deep set baits (e.g. 6-10 m depth) on seabird ship-following behaviour and attacks on bait with an Underwater Bait Setter (Skadia Technologies) in *constant* use*.* This was not assessed by Robertson et al. (2018) who set alternate groups of hooks underwater and groups of hooks at the surface to compare relative effects). Conduct further field research to evaluate the performance of the Underwater Bait Setter (Skadia Technologies) with unweighted branch lines.

6. Time - Area closures

Scientific evidence for effectiveness in pelagic fisheries

Proven and recommended mitigation method. Avoiding fishing in peak areas and/or during periods of intense foraging activity, has been used effectively to reduce rapidly and substantially bycatch in longline fisheries.

Notes and Caveats

This is an important and effective management response, especially for high-risk areas, and when other measures prove ineffective**.** Although this can be highly effective in targeted locations and/or during a specific season, time-area closures may displace fishing effort into areas that are not as well regulated, leading to greater incidental mortality levels.

Minimum standards

None defined, but highly recommended.

Need for combination

Must be combined with other measures, both in the targeted areas when they are subsequently opened again for fishing, and also in adjacent areas to ensure displacement of fishing effort does not merely lead to a spatial shift in the incidental mortality.

Implementation monitoring

Vessels equipped with VMS combined with monitoring of activities by appropriate management authority is considered appropriate monitoring. Areas/seasons should be patrolled to ensure effectiveness if Illegal, Unreported and Unregulated (IUU) fishing activities are suspected.

Research needs

Further research is required on the seasonal variability in patterns of seabird distribution and behaviour in relation to fisheries, including whether closing areas to fishing causes a shift in the distribution of seabirds to adjacent areas.

OTHER CONSIDERATIONS

7. Side-setting with line weighting and bird curtain

Scientific evidence for effectiveness in pelagic fisheries

Shown to be more effective than other simultaneously tested mitigation measures, including setting chutes and blue dyed bait, on relatively small vessels in the Hawaiian pelagic longline tuna and swordfish fisheries (Gilman *et al*. 2003b). **Effectiveness in southern hemisphere fisheries has not been researched and consequently it is not recommended as a proven mitigation measures in these fisheries at this time** (Brothers & Gilman 2006; Yokota & Kiyota 2006).

Notes and Caveats

Hooks must be sufficiently below the surface and protected by a bird curtain by the time they reach the stern of the vessel. In Hawaii, side-setting trials were conducted with a bird curtain and 45-60 g weighted swivels placed within 0.5 m of hooks. Japanese research concludes it must be used in combination with other measures (Yokota & Kiyota 2006). The Hawaiian trial was conducted in an area with an assemblage of largely surface-feeding seabirds, and this measure requires testing in other fisheries and areas where seabird abundance is higher and

secondary ingestion (hooks retrieved by diving birds and secondarily – subsequently - attacked by surface foragers) is more important. Hence, it cannot be recommended for use in other fisheries at this time.

Minimum standards

Clear definition of side setting is required. Hawaiian definition is a minimum of only 1 m forward of the stern, which is likely to reduce effectiveness. The distance forward of the stern refers to the position from which baits are manually deployed. Baited hooks must be thrown by hand forward of the bait deployment location if they are to be afforded "protection" by being close to the side of the vessel.

Need for combination

Lines set from the side of vessels must be appropriately weighted in accordance with ACAP best practice advice and protected by an effective bird curtain.

Implementation monitoring

Requires fisheries observers or video surveillance.

Research needs

Currently untested in Southern Hemisphere fisheries against assemblages of diving seabirds (e.g. *Procellaria* sp. Petrels and *Puffinus* sp. Shearwaters) and albatrosses - urgent need for research.

Mitigation Fact Sheet

https://www.acap.aq/en/bycatch-mitigation/bycatch-mitigation-fact-sheets/769-fs-09-pelagic-longline-side-setting/file

8. Blue dyed bait

Scientific evidence for effectiveness in pelagic fisheries

Unproven and not recommended as a mitigation method (Boggs 2001; Gilman *et al*. 2003b; Minami & Kiyota 2001; Minami & Kiyota 2004; Lydon & Starr 2005, Cocking *et al*. 2008; Ochi *et al.* 2011).

Notes and Caveats

The available data suggest only effective with squid bait (Cocking *et al*. 2008). Onboard dyeing requires labour and is difficult under stormy conditions. Results are inconsistent across studies.

Minimum standards

Mix to standardised colour placard or specify (*e.g.* use 'Brilliant Blue' food dye [Colour Index 42090, also known as Food Additive number E133] mixed at 0.5% for minimum 20 minutes).

Need for combination

Must be combined with bird scaring lines or night setting.

Implementation monitoring

The current practice of dyeing bait on board vessels at sea requires observer presence or video surveillance to monitor implementation. Assessment of implementation in the absence of on-board observers or video surveillance requires baits be dyed on land and monitored through port inspection of all bait on vessels prior to departure on fishing trips.

Research needs

Further testing is needed in the Southern Ocean.

Mitigation Fact Sheet

https://www.acap.aq/en/bycatch-mitigation/bycatch-mitigation-fact-sheets/770-fs-10-pelagic-longline-blue-dyded-bait-squid/file

9. Line shooter

Scientific evidence for effectiveness in pelagic fisheries

Unproven and not recommended as a mitigation measure (Robertson *et al*. 2010b).

Notes and Caveats

Use of a line shooter to set gear deep cannot be considered a mitigation measure. Mainline set into propeller turbulence with a line shooter without tension astern (e.g. slack), as is the case in deep setting, significantly slows the sink rates of hooks (Robertson *et al*. 2010b).

Minimum standards

Not Applicable.

Need for combination

Not Applicable.

Implementation monitoring

Not Applicable.

Research needs

Not Applicable.

Mitigation Fact Sheet

https://www.acap.aq/en/bycatch-mitigation/bycatch-mitigation-fact-sheets/771-fs-11-pelagic-longline-bait-caster-and-line-shooter/file

10. Bait caster

Scientific evidence for effectiveness in pelagic fisheries

Unproven and not recommended as a mitigation measure (Duckworth 1995; Klaer & Polacheck 1998).

Notes and Caveats

Not a mitigation measure unless bait casting machines are available with the capability to control the distance at which baits are cast. This is necessary to allow accurate delivery of baits under a bird scaring line. Current machines (without variable power control) likely to deploy baited hooks well beyond the streaming position of bird scaring lines, increasing risks to seabirds. Few commercially-available machines have variable power control. Needs more development.

Minimum standards

Not Applicable.

Need for combination

Not Applicable.

Implementation monitoring

Not Applicable

Research needs

Develop (and implement) casting machine with a variable power control.

Mitigation Fact Sheet

https://www.acap.aq/en/bycatch-mitigation/bycatch-mitigation-fact-sheets/771-fs-11-pelagic-longline-bait-caster-and-line-shooter/file

11. Underwater setting chute

Scientific evidence for effectiveness in pelagic fisheries

Unproven and not recommended as a mitigation measure (Brothers 1991; Boggs 2001; Gilman *et al*. 2003a; Gilman *et al*. 2003b; Sakai *et al*. 2004; Lawrence *et al*. 2006).

Notes and Caveats

In pelagic fisheries, existing equipment is not yet sturdy enough for large vessels in rough seas. Problems with malfunctions and performance inconsistencies have been reported (e.g. Gilman *et al*. 2003a, and Australian trials cited in Baker & Wise 2005).

Minimum standards

Not yet established

Need for combination

Not recommended for general application at this time.

Implementation monitoring

Not Applicable.

Research needs

Design problems to overcome.

12. Strategic offal discharge

Scientific evidence for effectiveness in pelagic fisheries

Unproven and not recommended as a primary mitigation measure in pelagic longline fisheries, but should be considered good practice (McNamara *et al*. 1999; Cherel *et al*. 1996).

Notes and Caveats

This should be considered a supplementary measure (i.e. used in addition to primary best practice mitigation measures). Offal attracts birds to vessels, and also conditions birds to attend vessels. Where practical, the discharge of offal should be eliminated or restricted to periods when not setting or hauling. Strategic discharge during line setting (dumping of homogenised offal to the side of the vessel during setting to attract birds to this area and away from the baited hooks, Cherel *et al.* 1996) can increase interactions and should be discouraged. Offal retention and/or incineration may be impractical on small vessels.

Minimum standards

Not yet established for pelagic fisheries. In the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), discharge of offal is prohibited during line setting for demersal longline fisheries. During line hauling, storage of waste is encouraged, and if discharged must be discharged on the opposite side of the vessel to the hauling bay.

Need for combination

Must be combined with other measures.

Implementation monitoring

Requires offal discharge practices and events to be monitored by fisheries observers or video surveillance.

Research needs

Further information needed on opportunities and constraints for the application of offal management in pelagic fisheries (short and long term).

13. Live bait

Scientific evidence for effectiveness in pelagic fisheries

Not recommended, as use of live bait may lead to increased rates of seabird bycatch (Robertson *et al*. 2010a; Trebilco *et al*. 2010).

Notes and Caveats

Live fish bait sinks significantly slower than dead bait (fish and squid), increasing the exposure of baits to seabirds. Use of live bait is associated with higher seabird bycatch rates.

Minimum standards

Not Applicable.

Need for combination

Not Applicable.

Implementation monitoring

Not Applicable.

Research needs

Not Applicable.

14. Bait thaw status – use of thawed baits rather than frozen baits

Scientific evidence for effectiveness in pelagic fisheries

Unproven and not recommended as a primary mitigation measure (Brothers 1991; Duckworth 1995; Klaer & Polacheck 1998; Brothers *et al*.1999; Robertson & van den Hoff 2010).

Notes and Caveats

Thawed baits are believed to sink faster than frozen baits. However, Robertson & van den Hoff (2010) concluded that the bait thaw status has no practical bearing on seabird mortality in pelagic fisheries. Baits cannot be separated from others in frozen blocks of bait, and hooks cannot be inserted into baits unless they are partially thawed (it is not practical for fishers to use fully frozen baits). Partially thawed baits sink at similar rates to fully thawed baits.

Minimum standards

Not Applicable.

Need for combination

Not Applicable.

Implementation monitoring

Not Applicable.

Research needs

Not Applicable.

15. Haul Mitigation

Scientific evidence for effectiveness in pelagic fisheries

Strategies to reduce seabird hooking during the haul have yet to be developed and properly tested for pelagic longline fisheries.

Notes and Caveats

The development and testing of seabird bycatch mitigation measures in pelagic longline fisheries has focussed almost exclusively on how to minimise or prevent bycatch during setting operations. Although some measures, such as Bird Curtains, have been designed and tested in demersal longline fisheries to reduce the incidence of haul captures, these methods are not directly transferable to pelagic longline fisheries.

Need for combination

No information

Research needs

Developing methods that minimize seabird hooking during line hauling in pelagic longline fisheries remains an urgent research priority.

Minimum standards

No information

Implementation monitoring

No information

Mitigation Fact Sheet

Note that this fact sheet is directed mostly at haul mitigation in demersal longline fisheries, and is not directly applicable to pelagic longline fisheries.

https://www.acap.aq/en/bycatch-mitigation/bycatch-mitigation-fact-sheets/1907-fs-12-demersal-pelagic-longline-haul-mitigation/file

16. Lasers

High Energy Lasers Strongly Discouraged

Scientific evidence for effectiveness in pelagic longline fisheries

Available evidence shows that high energy lasers (Class 4 lasers, the highest class in terms of laser hazards) are ineffective at deterring seabirds from danger areas around fishing vessels (Melvin *et al.* 2016) and likely damage seabird visual systems with negative effects on foraging behaviour of laser exposed seabirds (Fernandez-Juricic, 2023).

Notes and Caveats

Concerns are ongoing regarding the safety (to both humans and birds) and efficacy of laser technology of unknown energy levels as a seabird bycatch mitigation tool, as they continue to be used currently in various fisheries. Available evidence shows that high energy lasers are no longer marketed for fishery applications. Currently evidence is lacking on the possibility that lasers of lower energy levels delivered in different ways (scanning, blinking, wave-length, etc.) could be used safely and be effective in some applications.

Minimum standards

Not Applicable as strongly discouraged.

Need for combination

Not Applicable as strongly discouraged.

Implementation monitoring

Not Applicable as strongly discouraged.

Research needs

As high energy lasers continue to be used in some fisheries, we encourage reporting of the extent and output power levels of laser use by ACAP Parties, including any information on effectiveness, as well as bird welfare effects.

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