Agreement on the Conservation of Albatrosses and Petrels

Eighth Meeting of the Seabird Bycatch Working Group

Wellington, New Zealand, 4 – 6 September 2017

Recommended revisions to the presentation of information in the ACAP review and best practice advice documents for mitigating seabird bycatch in demersal longline and trawl fisheries

Anton Wolfaardt

SUMMARY

At SBWG6 it was agreed that the presentation of information in ACAP's review and best practice (summary) advice documents on bycatch mitigation for longline and trawl fisheries could be improved in a number of areas. Areas for improvement included ensuring greater consistency of format and terminology between documents, and ensuring references are correct and up-to-date. On the basis of discussions at SBWG6, a revised version of the Review and Best Practice Advice documents was prepared using pelagic longline fisheries as a pilot (SBWG7 Doc 16), and presented to SBWG7. The Working Group supported the revised format, and agreed that it should be extended to the remaining Review and Best Practice Advice documents (i.e. for demersal longline and trawl fisheries). This document presents the revised 'Best Practice Advice' documents for demersal longline and trawl fisheries using the format agreed at SBWG7.

RECOMMENDATIONS

That the Seabird Bycatch Working Group:

1. Notes that the review process was restricted to the format and presentation of the documents, and did not include issues of substance relating to ACAP best practice advice.
2. Reviews the revised format of the bycatch mitigation documents for demersal longline and trawl fisheries, and recommends that the Advisory Committee endorses the revised format of these Best Practice Advice documents.

Modificaciones recomendadas para la presentación de información en los documentos sobre revisión y recomendaciones de mejores prácticas del ACAP para la mitigación de la captura secundaria de aves marinas en pesquerías de palangre demersal y de arrastre

RESUMEN

En GdTCS6, se convino en que podrían mejorarse varios aspectos de la presentación de información en los documentos de revisión y recomendaciones (resumidas) de mejores prácticas para la mitigación de la captura secundaria en pesquerías de palangre y de arrastre. Estos aspectos por mejorar incluían asegurar una mayor uniformidad de formato y terminología entre documentos y garantizar la precisión y actualización de las referencias. Sobre la base de las deliberaciones mantenidas en GdTCS6, se elaboró una versión revisada de los documentos sobre revisión y recomendaciones de mejores prácticas partiendo de las pesquerías de palangre pelágico a modo de estudio piloto (GdTCS7 Doc 16) y se la presentó ante GdTCS7. El Grupo de Trabajo respaldó el formato modificado y acordó que debería hacerse lo mismo con el resto de los documentos sobre revisión y recomendaciones de mejores prácticas (es decir, para las pesquerías con palangre demersal y de arrastre). Este documento presenta los documentos modificados sobre recomendaciones de mejores prácticas para las pesquerías con palangre demersal y de arrastre utilizando el formato acordado en GdTCS7.

RECOMENDACIONES

Que el Grupo de Trabajo sobre Captura Secundaria de Aves Marinas realice las siguientes acciones:

1. Tenga en cuenta que el proceso de revisión se limitó al formato y a la presentación de los documentos y que no incluyó asuntos considerables relativos a las recomendaciones de mejores prácticas del ACAP.
2. Revise el formato modificado de los documentos sobre mitigación de la captura secundaria para pesquerías de palangre demersal y de arrastre y que recomiende que el Comité Asesor refrende el formato modificado de estos documentos.

Révisions recommandées pour la présentation des informations dans les documents relatifs à l'examen et aux bonnes pratiques de l'ACAP concernant l'atténuation de la capture accessoire des oiseaux de mer dans les pêcheries démersales à la palangre et au chalut

RÉSUMÉ

Il a été convenu lors du GTCA6 que la présentation des informations dans les documents relatifs à l'examen et aux bonnes pratiques (résumés) de l'ACAP concernant l'atténuation de la capture accessoire des oiseaux de mer dans les pêcheries démersales à la palangre et au chalut pouvait être améliorée à différents niveaux. Parmi les points à améliorer, il était notamment question d'uniformiser le format et la terminologie entre les documents et de garantir l'exactitude et l'actualisation des références. En se fondant sur les discussions du GTCA6, une version révisée des documents relatifs à l'examen et aux bonnes pratiques a été préparée en utilisant les pêcheries à la palangre pélagiques comme modèles (GTCA7 Doc 16) et présentée au GTCA7. Le Groupe de travail a soutenu le format révisé et est convenu que celui-ci devrait être appliqué aux autres documents relatifs à l'examen et aux bonnes pratiques (c.-à-d. pour les pêcheries démersales à la palangre et au chalut). Ce document présente les documents révisés sur les « bonnes pratiques » pour les pêcheries démersales à la palangre et au chalut avec le format approuvé lors du GTCA7.

RECOMMANDATIONS

Que le Groupe de travail sur la capture accessoire des oiseaux de mer :

1. Prenne acte que la procédure de révision portait uniquement sur le format et la présentation des documents, et non sur des questions de fond relatives aux bonnes pratiques de l'ACAP.
2. Examine le format révisé des documents sur l'atténuation de la capture accessoire pour les pêcheries démersales à la palangre et au chalut, et recommande que le Comité consultatif approuve le format révisé de ces documents sur les bonnes pratiques.

1. BACKGROUND

At each of its meetings, the ACAP Seabird Bycatch Working Group (SBWG) reviews research relating to seabird bycatch mitigation, and the formal outputs of this review process – the review and ACAP summary advice on seabird bycatch mitigation – are updated accordingly. The updated review and summary advice documents are made available on the ACAP website as a resource for scientists, managers and decision makers from Parties and other relevant organisations, such as Regional Fisheries Management Organisations (RFMOs). The main objective of these documents is to present a comprehensive scientific assessment of the efficacy of seabird bycatch mitigation measures that have been proposed, used or tested, and on the basis of this assessment, to articulate clearly ACAP's advice on best practice bycatch mitigation. Due to time constraints within the meetings, the review and updating process has generally involved adding or editing relevant sections of the documents, rather than reviewing in detail the entire documents.

Prior to SBWG6, an intersessional review of ACAP's review and best practice advice documents highlighted a number of areas in which the presentation of information could be improved. These included consistency of format and terminology between documents, and ensuring references are correct and up-to-date. Following discussion at SBWG6, it was agreed that a revised version of the review and best practice advice documents should be prepared using pelagic longline fisheries as a pilot, and, following feedback from the SBWG, to extend the revised format to other gear types. On the basis of these discussions, a revised version of the Review and Best Practice Advice documents was prepared using pelagic longline fisheries as a pilot (SBWG7 Doc 16), and presented to SBWG7. The Working Group supported the revised format, and agreed that it should be extended to the remaining Review and Best Practice Advice documents (i.e. for demersal longline and trawl fisheries). This document presents the revised 'Best Practice Advice' documents for demersal longline (**ANNEX 1**) and trawl fisheries (**ANNEX 2**) using the format agreed at SBWG7.

2. REVISED FORMAT OF REVIEW AND BEST PRACTICE SUMMARY ADVICE DOCUMENTS FOR SEABIRD BYCATCH MITIGATION IN DEMERSAL LONGLINE AND TRAWL FISHERIES

Using the revised format agreed at SBWG7, the review and best practice advice documents for demersal longline and trawl fisheries are presented in Annexes 1 and 2, respectively. The main guiding principles for the revision of these documents were: clear, efficient and consistent presentation of information, ensuring that references are correct and up to date, better definition of some terminology, the use of illustrations where possible and the inclusion of a category catering for measures that show potential, but which are still under development. The review process was restricted to the format and presentation of the review and best practice advice documents, and did not include issues of substance relating to our reviews and advice

2.1. Summary of the main changes

2.1.1. Combining the review and best practice advice documents

In some previous versions, the review and best practice summary advice documents were treated as separate entities. In order to facilitate a more explicit and seamless link between ACAP's review of mitigation measures and its best practice advice (which is underpinned by the former), the revised version has combined these two components into a single document.

2.1.2. Links to mitigation fact sheets

Rather than inserting illustrations into the ACAP review document, we have inserted hyperlinks to the relevant BirdLife/ACAP Bycatch Mitigation Fact Sheets.

2.1.3. Outline of the ACAP review process and criteria used to assess the effectiveness of seabird bycatch mitigation measures

In order to facilitate a greater understanding of the ACAP review process and the development of best practice advice, an outline of the review process and the criteria that are used in the assessment framework has been inserted at beginning of the review section of the documents.

2.1.4. Clearer definitions of terminology

In the revised documents, we have sought to clarify any terminology that was considered to be unclear or ambiguous. Previously, the SBWG considered the possibility of developing a glossary of terminology, or linking to other glossaries that may exist or are under development, but this has not been included in the revised documents. Any links to external web-sites would need to be considered carefully to ensure that the information does not conflict with, or confuse, the ACAP best practice advice.

2.2. Issues for discussion

In addition to the revised format of the review and best practice advice documents, it would be useful for the SBWG to consider the following issues:

- The inclusion of information regarding the magnitude of bycatch reductions achieved with particular bycatch mitigation measures, or combinations thereof. This information could be included in the sections dealing with scientific evidence for efficacy. It is not envisaged that some metric of bycatch reduction would be used as a threshold for determining best practice, but rather that data quantifying bycatch reductions, where available, would be explicitly reported in the review. If this approach is adopted, it may be prudent to include some caveats highlighting that the extent of bycatch reduction will likely be influenced by a range of variables, including fishery, geographic area and the composition of seabird assemblages.
- Whether it would be useful to include a glossary of terms, or link to an appropriate external glossary.
- Future reviews: it is important to routinely maintain and update these documents at and after each meeting of the SBWG and Advisory Committee. It will also be important to ensure that the relevant mitigation fact sheets are similarly updated, and that the information in these documents is consistent, and that all hyperlinks to external documents/resources are checked and updated if necessary. Posting the review and best practice advice documents as Information Papers prior to each meeting, and requesting members and meeting participants to review them, may be a useful mechanism to facilitate an efficient review process.

ANNEX 1

Agreement on the Conservation of Albatrosses and Petrels

ACAP REVIEW AND BEST PRACTICE ADVICE FOR REDUCING THE IMPACT OF DEMERSAL LONGLINE FISHERIES ON SEABIRDS

Reviewed at the Ninth Meeting of the Advisory Committee
La Serena, Chile, 9 – 13 May 2016

INTRODUCTION

The incidental mortality of seabirds in demersal longline fisheries continues to be a serious global concern, especially for threatened albatrosses and petrels. The need for international cooperation in addressing this concern was a major reason for establishing the Agreement on the Conservation of Albatrosses and Petrels (ACAP). In demersal longline fisheries seabirds are killed when they become hooked or entangled and drowned while foraging for baits on longline hooks as the gear is deployed. Seabirds can also be hooked or entangled as the gear is hauled; however, many of these seabirds can be released alive with careful handling.

There have been significant efforts internationally to develop mitigation measures to avoid or minimise the risk of incidental catch of seabirds in longline fisheries. Although most mitigation measures are broadly applicable, the application and specifications of some will vary with local methods and gear configurations. ACAP has comprehensively reviewed the scientific literature dealing with seabird bycatch mitigation in demersal longline fisheries (see review section below) and this document is a summary of the advice informed by the review. Most of this scientific literature relates to large vessels, with lesser research attention given to small vessels and gear configurations and methods used in artisanal or semi-industrial fleets. Seabird bycatch mitigation advice for these fisheries is currently under development.

This document provides advice about best practices for reducing the impact of demersal longline fishing on seabirds. ACAP's best practice advice is that the combined use of weighted branch lines, bird scaring lines and night setting represents the most effective approach to mitigate seabird bycatch in demersal longline fisheries. These best practice bycatch mitigation measures should be applied in areas where fishing effort overlaps with seabirds vulnerable to bycatch to reduce the incidental mortality to the lowest possible levels. The ACAP review process recognises that factors such as safety, practicality and the characteristics of the fishery should also be taken into account when considering the efficacy of seabird bycatch mitigation measures and consequently in the development of advice and guidelines on best practice.

This document also provides information regarding measures that are currently under active development, and which show promise as future best practices in demersal longline fisheries. ACAP will continue to monitor the development of these practices and the results of scientific research about their effectiveness.

Additionally, this document provides information about mitigation measures that are not recommended. A wide range of potential seabird bycatch mitigation measures have been proposed over time; however, not all of these have proven effective. ACAP considers that certain mitigation measures are ineffective, based either on scientific studies, or a lack of evidence in substantiation of claims made about the mitigation measure.

The document comprises two components. The first component provides a summary of ACAP's advice regarding best practice measures for reducing seabird bycatch in demersal longline fisheries, and the second component outlines the review of mitigation measures that have been assessed for pelagic longline fisheries.

Agreement on the Conservation of Albatrosses and Petrels

ACAP SUMMARY ADVIE FOR REDUCING THE IMPACT OF DEMERSAL LONGLINE FISHERIES ON SEABIRDS

Reviewed at the Ninth Meeting of the Advisory Committee
La Serena, Chile, 9 – 13 May 2016

BEST PRACTICE MEASURES

The most effective measures to reduce incidental catch of seabirds in demersal longline fisheries are:

- use of an appropriate **line weighting regime** to maximise hook sink rates close to vessel sterns to reduce the availability of baits to seabirds.
- actively deterring birds from baited hooks by means **of bird scaring lines**, and
- setting at **night**.

Further measures include bird deterrent curtains at the hauling bay, responsible offal management and avoiding peak areas and periods of seabird foraging activity. Current knowledge indicates that the Chilean, or trotline, system with appropriate line weighting and branch line length, will prevent albatross and petrel mortality and is considered best practice mitigation for demersal longline fishing.

It is important to note that there is no single solution to reduce or avoid incidental mortality of seabirds, and that the most effective approach is to use the measures listed above in combination.

Best practice mitigation measures for demersal longline fisheries are listed individually below; The recommendations are categorised into general best practice measures (1), followed by best practice measures for line setting (2) and line hauling (3) operations.

1. BEST PRACTICE MEASURES - GENERAL

1.1 Area and seasonal closures

The temporary closure of important foraging areas (e.g. areas adjacent to important seabird colonies during the breeding season when large numbers of aggressively feeding seabirds are present) has been a very effective mechanism to reduce incidental mortality of seabirds in fisheries in those areas.

2. BEST PRACTICE MEASURES - LINE SETTING

2.1 Line weighting

Lines should be weighted to get the baited hooks rapidly out of the range of feeding seabirds. Weights should be deployed before line tension occurs to ensure that the line sinks rapidly out of reach of seabirds.

2.2 Weighted lines for Spanish gear

The use of steel weights are considered best practice. The mass should be a minimum of 5kg at 40m intervals.

Where steel weights are not used, longlines should be set with a minimum of 8.5kg at 40m intervals when using rocks, and a minimum of 6kg at 20m intervals when using concrete weights.

2.3 Weighted lines for Chilean (trotline with nets) system gear

Line weights should conform to those for the Spanish system (see above).

2.4 Weighted lines for autoline gear

Integrated weight longlines (IWL) are designed with a ead core of 50g/m. Their key characteristic is that they sink with a near-linear profile from the surface (minimal lofting in propeller turbulence) and are effective at sinking quickly out of reach of foraging seabirds. IWL should average ≥ 0.24 to 10 m depth.

Where it is practical to use IWL gear in a fishery, IWL is preferred over externally weighted alternatives because of its linear sink profile from the surface and consistent ability to achieve the minimum sink rate.

When using external weights on non-IWL autoline gear, the minimum average sink rate should be 0.3 m/s to 10 m depth. A faster sink rate is necessary with this configuration to minimise the lofting of sections of line between line weights in propeller turbulence. The sink rate can be achieved with a minimum of 5kg at no more than 40m intervals.

2.5 Night setting

Setting longlines at night (between the end of nautical twilight and before nautical dawn) is effective at reducing incidental mortality of seabirds because the majority of vulnerable seabirds are diurnal foragers.

2.6 Bird scaring lines

Bird scaring lines are designed to provide a physical deterrent over the area where baited hooks are sinking.

Two (paired) bird scaring lines should be used simultaneously.

The design of the bird scaring lines should include the following specifications:

- The attachment height should be at least 7m above sea level.

- The lines should be at least 150m long to ensure the maximum possible aerial extent.
- Streamers should be brightly coloured and reach the sea-surface in calm conditions, and placed at intervals of no more than 5m.
- A suitable towed device should be used to provide drag, maximise aerial extent and maintain the line directly behind the vessel during crosswinds.

2.7 Offal and discard discharge management

Seabirds are attracted to offal that is discharged from vessels. Ideally offal should be retained onboard but if that is not possible, offal and discards should not be discharged while setting lines.

3. BEST PRACTICE MEASURES - LINE HAULING

3.1. Bird Exclusion Device (BED)/Brickle curtain

During hauling operations birds can accidentally become hooked as gear is retrieved. A Bird Exclusion Device (BED) consists of a horizontal support several metres above the water that encircles the entire line hauling bay. Vertical streamers are positioned between the support and water surface. The seabird deterrent effectiveness of this streamer line configuration can be increased by deploying a line of floats on the water surface and connecting this line of floats to the support with downlines. This configuration is the most effective method to prevent birds entering the area around the hauling bay, either by swimming or by flying.

3.2. Offal and discard discharge management

Ideally offal should be retained onboard, but if that is not possible offal and discards should preferably be retained on board during hauling (and definitely during setting) or released on the opposite side of the vessel to the hauling bay.

All hooks should be removed and retained on board before discards are discharged from the vessel.

4. OTHER RECOMMENDATIONS

4.1. Chilean method

The Chilean method of longline fishing was designed to prevent toothed whale depredations of fish. Because weights are deployed directly below the hooks, and because hook-bearing lines sink with a vertical profile in the seabird foraging depths (not horizontally, as in the traditional Spanish method), lines sink rapidly, making it an effective method for avoiding bycatch of foraging seabirds.

To eliminate the ingestion of hooks by seabirds during line hauling operations, care must be taken to retain all hooks onboard and not discard them overboard, either as unwanted hooks or as hooks embedded in discarded fish.

5. MITIGATION MEASURES THAT ARE NOT RECOMMENDED

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

Hook design – insufficiently researched

Olfactory deterrents – insufficiently researched

Underwater setting chutes - insufficiently researched.

Side setting - insufficiently researched and operational difficulties.

Blue-dyed bait, thawed bait - not relevant in demersal longline gear

Use of a line setter - not relevant in demersal longline gear.

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

Agreement on the Conservation of Albatrosses and Petrels

ACAP REVIEW OF SEABIRD BYCATCH MITIGATION MEASURES FOR DEMERSAL LONGLINE FISHERIES

Reviewed at the Ninth Meeting of the Advisory Committee
La Serena, Chile, 9 – 13 May 2016

INTRODUCTION

A range of technical and operational mitigation methods have been designed or adapted for use in demersal longline fisheries. These methods aim to reduce incidental mortality of seabirds by avoiding peak areas and periods of seabird foraging activity, reducing the time baited hooks are available to birds, actively deterring birds from baited hooks, making the vessel less attractive to birds, and minimising the visibility of baited hooks. Apart from being technically effective at reducing seabird bycatch, mitigation methods need to be easy and safe to implement, cost effective, enforceable and should not reduce catch rates of target species.

The suite of mitigation measures available may vary in their feasibility and effectiveness depending on the area, seabird assemblages, fishery and vessel type, 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 demersal longline fisheries and this document is a distillation of that review. At each of its meetings, the SBWG reviews any recent research or information regarding seabird bycatch mitigation, and updates the review and best practice advice accordingly. Currently, the combined use of weighted branch lines, bird scaring lines and night setting, is considered best practice mitigation for reducing seabird bycatch in pelagic longline fisheries.

THE ACAP REVIEW PROCESS

At each of its meetings, the ACAP SBWG considers any new research or information pertaining to seabird bycatch mitigation in demersal 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[1] reduce the rate of seabird incidental mortality[2] to the lowest achievable levels. Experience has shown that experimental research comparing the performance of candidate mitigation technologies to a control of no deterrent, where possible, or to status quo in the fishery, yields definitive results. Analysis of fishery observer data after it has been collected on the relative performance of mitigation approaches are plagued with a myriad of confounding factors. Where a significant relationship is demonstrated between seabird behaviour and seabird mortality in a particular system or seabird assemblage, significant reductions in seabird behaviours, such as the rate of seabirds attacking baited hooks, can serve as a proxy for reduced seabird mortality. Ideally, when simultaneous use of fishing technologies and practices is recommended as best practice, research should demonstrate significantly improved performance of the combined measures.

ii. Fishing technologies and techniques, or a combination thereof, shall have clear and proven specifications and minimum performance standards for their deployment and use. Examples would include: specific bird scaring line designs (lengths, streamer length and materials; etc.), number (one vs. two) and deployment specifications (such as aerial extent and timing of deployment); night fishing defined by the time between 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 shall be demonstrated to be practical, cost effective and widely available. Commercial fishing operators are likely to select for seabird bycatch reduction measures and devices that meet these criteria including practical aspects concerning safe fishing practices at sea.

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

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

vi. Minimum performance standards and methods of ensuring compliance should be provided for fishing technologies and techniques, and should be clearly specified in fishery regulations. Relatively simple methods to check compliance 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

[1] Any use of the word 'significant' in this document is meant in the statistical context
[2] This may be determined by either a direct reduction in seabird mortality or by reduction in seabird attack rates, as a proxy

requirements. 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 and Mandarin.

BEST PRACTICE MEASURES

1. Area and seasonal closures

Scientific evidence for effectiveness in demersal fisheries

Proven and recommended. Must be combined with other 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. A number of studies have reported marked seasonality in seabird bycatch rates, with the majority of deaths taking place during the breeding season (Moreno *et al.* 1996; Ryan *et al*. 1997; Ashford & Croxall 1998; Ryan & Purves 1998; Ryan & Watkins 1999; Ryan & Watkins 2000; Weimerskirch *et al*. 2000; Kock 2001; Nel *et al*. 2002; Ryan & Watkins 2002; Croxall & Nicol 2004; Reid *et al*. 2004; Delord *et al*. 2005). In some studies, mortality has been almost exclusively within the breeding season. 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). The much higher rate of seabird bycatch during the breeding period led to the temporal closure of the fishery in CCAMLR sub-area 48.3 from 1998, which contributed to a ten-fold reduction in seabird bycatch (Croxall & Nicol 2004). Movement of fishing effort away from the Prince Edward Islands coincided with a reduction in seabird bycatch in the sanctioned Prince Edward Island fishery.

Notes and Caveats

It's difficult to separate the temporal closure from the increased uptake/implementation of other mitigation measures, but it is clearly 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

Currently, the area around South Georgia (Islas Georgias del Sur)[3] (CCAMLR Subarea 48.3) is closed for fishing between September and mid-April each year (which coincides with the breeding seasons of most seabirds at South Georgia), as provided for by CCAMLR Conservation Measures in force (41-02/2007).

Implementation monitoring

Via VMS or fishery observers within national economic zones, and via aerial and at-sea surveillance if IUU fishing is suspected.

Research needs

Further information about the seasonal variability in patterns of species abundance, and particularly how these interact with the spatial and temporal characteristics of fishing effort, especially for high risk areas (e.g. adjacent to important breeding colonies). In some studies, incidental mortality has been greatest during the chick-rearing period (Nel *et al*. 2002; Delord *et al*. 2005), whereas others have reported highest mortality during the incubation period (Reid *et al*. 2004). This difference likely relates to where the birds are foraging in relation to fishing effort at the time, and highlights the importance of understanding this interaction. Research is also required to determine the regional impact of closures on catches of target species.

2. Externally weighted lines:

a) Spanish system

Scientific evidence for effectiveness in demersal fisheries

Proven and recommended mitigation method. Should be combined with other measures, especially effective bird scaring lines, judicious offal management and/or night setting (Agnew *et al.* 2000; Robertson 2000; Robertson *et. al*. 2008a; 2008b; Melvin *et al*. 2001; Moreno *et al*. 2006; Moreno *et al*. 2008).

Notes and Caveats

Spanish system longlines are buoyant and weights must be attached to sink gear to fishing depth. Longlines with externally added weights sink unevenly, faster at the weights than at the midpoint between weights. Although gear configuration and setting speed influence the sink

[3] "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 Sandwich del Sur) and the surrounding maritime areas".

profiles of the hook lines (Seco Pon *et al*. 2007), the principle determinants of sink rates are the mass of the weights and the distance between weights (Robertson *et al*. 2008a). It is critical that tension astern is eliminated to ensure the smooth flow of hooks from gear baskets. This can be done by ensuring the correct packing of lines and snoods in baskets, preventing hooks snagging on snood baskets and by ensuring that weights are released from the vessel before line tension occurs (Robertson *et al*. 2008a,b). Weights must be attached and removed for each set-haul cycle, which is onerous and potentially hazardous for crew members. Weights comprised of rocks enclosed in netting bags and concrete blocks deteriorate and require ongoing maintenance/replacement and monitoring to ensure weights are the required mass (Otley 2005); weights made of solid steel are preferred, in terms of mass consistency, handling, minimal-to-no maintenance and compliance (Robertson *et al*. 2008b).

Minimum standards

Global minimum standards have not been established. Requirements vary by fishery and vessel type. For example, CCAMLR minimum requirements for vessels using the Spanish method of longline fishing are 8.5kg mass at 40m intervals (if rocks are used), 6kg mass at 20m intervals for traditional (concrete) weights, and 5kg weights at 40m intervals for solid steel weights.

Implementation monitoring

Fishing gear is deployed manually. Weights are attached by hand during line setting and removed during line hauling. Distance between weights and the mass of the weight used may vary in accordance with fishing strategy and for operational reasons. Observer presence on vessel is required to assess implementation.

Research needs

Sink rates and profiles of line weighting regimes may vary according to vessel type, setting speed and deployment position in relation to propeller turbulence. It is important that the sink rate relationships of different line weighting regimes are understood for a particular fishery (or fishery method) and that the effectiveness of the line weighting regime and the sink profile in reducing seabird mortality is tested.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/762-fs-02-demersal-longline-line-weighting-external-weights/file

2. Externally weighted lines:

b) Chilean method (trot line with nets)

Scientific evidence for effectiveness in demersal fisheries

Proven and recommended mitigation method. Although effectively preventing mortality as a sole measure, prudent to use in combination with a single bird scaring streamer line. This method (first tested on large longline vessels in 2005) is a variant of the traditional Spanish double line method of longlining and was developed in Chile to minimise depredation of Patagonian toothfish by toothed whales (Figure 1). This system makes use of net sleeves or

'cachaloteras' which envelop captured fish during hauling. Hooks are clustered on secondary lines to which weights are attached, resulting in very fast hook sink rates (mean: 0.8 m/s c.f. 0.15 m/s for the Spanish system) in the first 15-20 m (the length of the secondary lines) of water column. Has the capacity to reduce (or eliminate) seabird mortality to negligible levels (Moreno *et al*. 2006; Moreno *et al*. 2008; Robertson *et al*. 2008b). Because of its effectiveness in reducing impacts of toothed whales, this method is currently used in many longline fleets operating in South American waters (Moreno *et al*. 2008), as well as in the south west Atlantic.

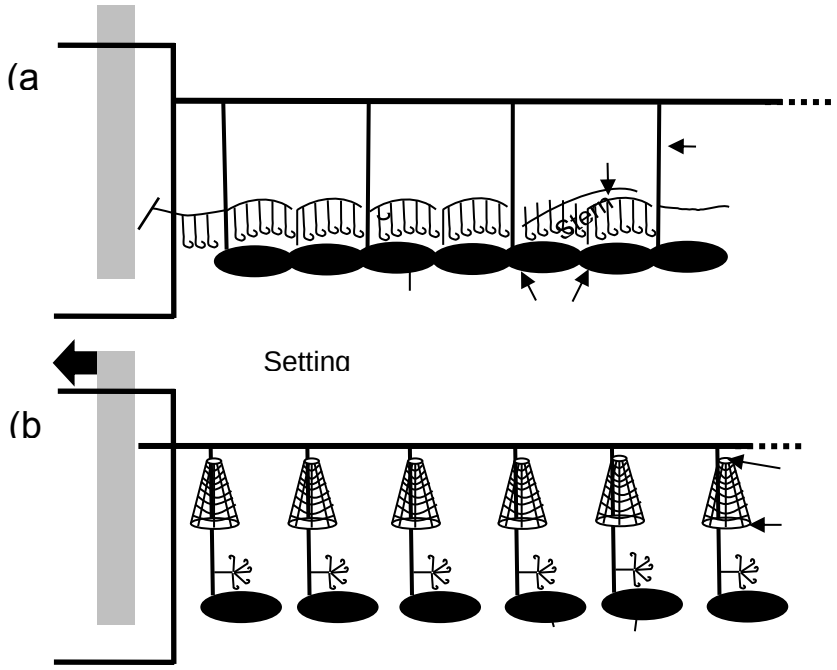

Figure 1. Typical configurations of the traditional Spanish double line system (a) and Chilean (trotline) system (b) showing differences in gear design and location of weights in relation to hooks. The open-ended secondary/connecting lines (not joined by a continuous hook line) and proximity of weights to hooks of the Chilean system enables hooks to sink rapidly and with a linear profile (no lofting in propeller turbulence) from the surface close to vessel sterns. Drawings not to scale.

Notes and Caveats

This is a relatively new system, is possibly still in the evolutionary stages, and should be monitored and possibly refined further. Concern has been raised about the excessive discarding of fish bycatch (e.g. grenadiers) with embedded hooks and the ingestion of these hooks by albatrosses following vessels (Phillips *et al*. 2010). The solution to this problem is to stop hooks from being discarded in the first place. This is best achieved by banning the discarding of hooks as part of the licence conditions, as is already done in many fisheries, and also increasing awareness amongst fishers, observers and operators to facilitate compliance with such a ban. Another concern is that vessels can switch between Spanish method and Chilean method within fishing trips and even within sets of the longline; this is a key reason why further monitoring is required.

Minimum standards

No global standards yet.

Implementation monitoring

Hook-bearing secondary lines require weights be attached in order to sink. However, alternating between this fishing method and the traditional Spanish method within fishing trips is problematic. While this capacity exists the requirements for the Spanish system should apply (see "2a", above).

Research needs

Effective as a solitary measure against albatrosses and most likely effective against *Procellaria* sp petrels due to the very rapid sink rates to depths beyond the known diving range of this group of seabirds. Research is required to determine effectiveness against *Puffinus* sp shearwaters.

This is a relatively new fishing method and may be in the process of refinement. It is important to monitor changes to gear design, especially those likely to affect the sink rates of baited hooks.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1799-fs-04-demersal-longline-line-weighting-chilean-system/file

2. Externally weighted lines:

c) Autoline

Scientific evidence for effectiveness in demersal fisheries

Proven and recommended mitigation method. Must be used in combination with an effective bird scaring streamer line. In the Southern Hemisphere evidence pertains to effect of added external weights on longline sink rates, not effectiveness in deterring seabirds. Attachment of 5 kg weights at no more than 40 m intervals increased mean sink rate from 0.1 m/s (unweighted gear) to 0.3 m/s on the section of longline mid-way between line weights (Robertson 2000). This rate exceeds that of integrated with longlines, which have been thoroughly tested against seabirds (see below). Attachment of external weighs necessary in Antarctic toothfish fisheries to comply with the minimum sink rate (0.3 m/s) required by CCAMLR operating in high latitude areas in summer, where it was not possible to set lines at night.

Notes and Caveats

As for the Spanish system it is important that external weights be released from vessels in a manner that avoids tension astern (tension astern may lift sections of the longline already deployed out of the water).

Minimum standards

CCAMLR requires as a minimum 5 kg mass at intervals no more than 40 m. It is also required that weights be released before line tension occurs. In the New Zealand fisheries, a minimum of 4 kg (metal weight) or 5 kg (non-metal weight) be attached every 60 m if the hook bearing line is 3.5 mm or greater in diameter, and a minimum of 0.7 kg of weight every 60m when the

line is less than 3.5 mm diameter. The New Zealand minimum standards also include requirements relating to the use of floats.

Implementation monitoring

Weights are attached to longlines manually. Observer presence on-board vessel is required to assess implementation.

Research needs

Likely to be effective in deterring albatrosses and *Procellaria* sp seabirds. Evidence is lacking for effectiveness against *Puffinus* sp shearwaters.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/762-fs-02-demersal-longline-line-weighting-external-weights/file

3. Integrated weighting of lines

Scientific evidence for effectiveness in demersal fisheries

Proven and recommended mitigation method. Should be used in combination with bird scaring lines, judicious offal management and/or night setting. Apart from the practical advantages of integrated weight (IW) longlines – superior handling qualities and practically inviolable – the IW longlines sink more quickly and uniformly out of reach of most seabirds compared with externally weighted lines. IW longlines have been shown to reduce substantially mortality rates of surface foragers and diving seabirds, while not affecting catch rates of target species (Robertson *et al.* 2002; Robertson *et al*. 2003; Robertson *et al.* 2006; Dietrich *et al*. 2008).

Notes and Caveats

Restricted to autoline vessels. The sink rate of IW longlines can vary depending on vessel type, setting speed and deployment of line relative to propeller wash (Melvin & Wainstein 2006; Dietrich *et al.* 2008). Setting speed influences the extent of the seabird access window – the area in which most seabirds are still able to access the baited hooks in the absence of bird scaring lines (Dietrich *et al*. 2008). Use of IW lines is likely to increase the portion of the line on the seafloor, and may lead to increases in the bycatch of vulnerable fish, shark and ray species. This may be mitigated by placing a weight and a float on a 10 m line at the point of the dropper line attachment, thus ensuring the line sinks rapidly to 10 m, out of reach of vulnerable seabirds, but remains off the seabed (Petersen 2008).

Minimum standards

Global minimum standards not in place. CCAMLR currently require as a minimum IW lines with a lead core of 50g/m, which is also required in the New Zealand demersal longline fishery.

Implementation monitoring

Weight (lead core) integrated into fabric of longline, so compliance is intrinsic in this measure. It is expensive and time consuming to alter longline when at sea, including for vessels with

long transit times to fishing grounds (e.g. Antarctic and sub Antarctic fisheries). Port inspection of all longline on board prior to embarkation on fishing trips considered adequate for assessment of compliance.

Research needs

The relationship between line-weighting regime, setting speed, sink rates/profiles and the seabird access window should be investigated for other fisheries (i.e. those that haven't already been tested –Bering Sea, Alaska, and New Zealand ling fishery) including with additional mitigation measures (particularly bird scaring lines); these investigations would be useful in determining the necessary aerial extent of the bird scaring lines.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1504-fs-03-demersal-longline-integrated-weight-longlines/file

4. Night setting

Scientific evidence for effectiveness in demersal longline fisheries

Proven and recommended mitigation method. Should be used in combination with bird scaring lines and/or weighted lines, especially to reduce incidental mortality of birds that forage at night (Ashford *et al*. 1995; Cherel *et al*. 1996; Moreno *et al*. 1996; Barnes *et al*. 1997; Ashford & Croxall 1998; Klaer & Polacheck 1998; Weimerskirch *et al*. 2000; Belda & Sánchez 2001; Nel *et al*. 2002; Ryan & Watkins 2002; Sánchez & Belda 2003; Reid *et al*. 2004; Gómez Laich *et al.* 2006).

Notes and Caveats

Bright moonlight and deck lights reduce the effectiveness of this mitigation measure. Not as effective for crepuscular/nocturnal foragers such as the white-chinned petrel but even for these species night setting is more effective than setting during the day. In order to maximise effectiveness of this mitigation measure, deck lights should be off or kept to an absolute minimum, and used in combination with additional mitigation measures, especially when setting in bright moonlight conditions. Night setting is not a practical option for fisheries operating at high latitudes during summer. Setting should be completed at least 3 hours before sunrise to avoid the predawn activity of white-chinned petrels

Minimum standards

Night is defined as the period between the times of nautical twilight (nautical dark to nautical dawn as set out in the Nautical Almanac tables for relevant latitude, local time and date.).

Implementation monitoring

Requires Vessel Monitoring Systems (VMS) and fishery observers.

Research needs

Effect of night setting on catch rates of target species for different fisheries.

Mitigation Fact Sheet

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

5. Single bird scaring line

Scientific evidence for effectiveness in demersal fisheries

Proven and recommended mitigation method. Effectiveness is increased when using multiple bird scaring lines and when used in combination with other measures – e.g. night setting, appropriate weighting of line and judicious offal management. The use of a single bird scaring line has been shown to be an effective mitigation measure in a range of demersal longline fisheries, especially when used properly (Moreno *et al.* 1996; Løkkeborg 1998, 2001; Melvin *et al.* 2001; Smith 2001; Løkkeborg & Robertson 2002; Løkkeborg 2003).

Notes and Caveats

Effective only when streamers are positioned over sinking hooks. Single bird scaring lines can be less effective in strong crosswinds (Løkkeborg 1998; Brothers *et al.* 1999; Agnew *et al.* 2000; Melvin *et al.* 2001; Melvin *et al.* 2004). In the event of strong crosswinds, bird scaring lines should be deployed from the windward side. This problem can also be overcome by using paired bird scaring lines (see below).The effectiveness of the bird scaring lines is also dependent on the design, the aerial coverage of the bird scaring line, seabird species present during line setting (proficient divers being more difficult to deter from baits than surface feeding birds) and the proper use of the bird scaring line. The aerial coverage and the position of the bird scaring line relative to the sinking hooks are the most important factors influencing their performance. There have been a few incidents of birds becoming entangled in bird scaring lines (Otley *et al*. 2007). However it must be stressed that the numbers are minuscule, especially when compared with the number of mortalities recorded in the absence of bird scaring lines. Bird scaring lines remain a highly effective mitigation measure, and efforts should be directed to improving further their design and use so that their effectiveness can be improved further.

Minimum standards

Current minimum standards vary. CCAMLR was the first conservation body that required all longline vessels in its area of application to use bird scaring lines (Conservation Measure 29/X adopted in 1991). The bird scaring line has gone on to become the most commonly applied mitigation measure in longline fisheries worldwide (Melvin et al. 2004). CCAMLR currently prescribes a range of specifications relating to the design and use of bird scaring lines. These include the minimum length of the line (150m), the height of the attachment point on the vessel (7m above the water), and details about streamer lengths and intervals between streamers. Other fisheries have adapted these measures. Some, such as those in New Zealand and Alaska have set explicit standards for the aerial coverage of the bird scaring lines, which varies according to the size of the vessel.

Implementation monitoring

Bird scaring lines are usually deployed and retrieved on a set-by-set basis (they are not a fixed part of fishing gear/operations). Requires fisheries observers, video surveillance or at-sea surveillance (e.g. patrol boats or aerial over-flights).

Research needs

The use and specifications/performance standards are fairly well established in demersal longline fisheries. However, there is scope to improve further the effectiveness and practical use of bird scaring lines on individual vessels or vessel type.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1912-fs-01-demersal-longline-streamer-lines/file

6. Paired or multiple bird scaring lines

Scientific evidence for effectiveness in demersal fisheries

Proven and recommended mitigation method. Effectiveness is increased when used in combination with other measures – e.g. night setting, appropriate weighting of line and judicious offal management. Several studies have shown that the use of two or more streamer lines is more effective at deterring birds from baited hooks than streamer line (Melvin *et al.* 2001; Sullivan & Reid 2002; Melvin 2003; Melvin *et al.* 2004; Reid *et al.* 2004). The combination of paired streamer lines and IW longlines is considered the most effective mitigation measure in demersal longline fisheries using autoline systems (Dietrich *et al.* 2008).

Notes and Caveats

Potentially increased likelihood of entanglement with other gear. Use of an effective towed device that keeps lines from crossing surface gear essential to improve adoption and compliance. See also above comment about bird entanglements in bird scaring lines. Manually attached and operated paired or multiple bird scaring lines requires some effort to operate (a 150m double line takes about 8-10 men to retrieve). One way of overcoming this is to make use of electronic winches.

Minimum standards

Paired streamer lines required in Alaskan fisheries and encouraged/recommended by CCAMLR, except in the French exclusive economic zone (CCAMLR Subarea 58.6 and Division 58.5.1), where paired streamer lines have been compulsory since 2005. Paired streamer lines have also been required in the Australian longline fisheries off Heard Island since 2003 (Dietrich *et al*. 2008)

Implementation monitoring

Bird scaring lines are usually deployed and retrieved on a set-by-set basis (they are not a fixed part of fishing gear/operations).Requires fisheries observers, video surveillance or at-sea surveillance (e.g. patrol boats or aerial over-flights.

Research needs

Further trialling in fisheries which currently only use single streamer lines.

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/1912-fs-01-demersal-longline-streamer-lines/file

7. Haul bird exclusion devices

Scientific evidence for effectiveness in demersal fisheries

Proven and recommended as a HAUL MITIGATION MEASURE. Must be used in combination with other mitigation measures – bird scaring lines at setting, line weighting, night setting and judicious offal management. The use of a bird exclusion device such as a Brickle curtain 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).

Notes and Caveats

Some species, such as the black-browed albatross and cape petrel, can become habituated to the curtain, so it is important to use it strategically – when there are high densities of birds around the hauling bay (Sullivan 2004).

Minimum standards

A device designed to discourage birds from accessing baits during hauling operations is required in high risk CCAMLR areas (exact design not specified, but it is required that they fulfil two operational characteristics: 1) deter birds from flying into the area where the line is being hauled, and 2) prevents birds that are sitting on the surface from swimming into the hauling bay area). Also required in the Falkland Islands[4] (Islas Malvinas) longline fishery, where the Brickle Curtain is recommended (A. Wolfaardt pers. comm.).

Implementation monitoring

Bird exclusion devices are usually deployed and retrieved on a haul-by-haul basis (they are not a fixed part of fishing gear/operations. Requires fisheries observers, video surveillance or at-sea surveillance.

Mitigation Fact Sheet

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

[4] "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 Sandwich del Sur) and the surrounding maritime areas".

OTHER CONSIDERATIONS

8. Side-setting

Scientific evidence for effectiveness in demersal fisheries

Not recommended as a specific mitigation measure at this time. Must be used in combination with other mitigation measures, especially the use of a bird curtain (Gilman *et al*. 2007), and bird scaring lines. Has not been widely tested in demersal longline fisheries. In trials in the New Zealand ling fishery, side setting appeared to reduce seabird bycatch; however, the results were not convincing and there were practical/operational difficulties, with the line becoming entangled in the propeller (Bull 2007). Sullivan (2004) reported that side setting has been used in some demersal fisheries (e.g. shark fisheries) which have experienced negligible incidental mortality.

Notes and Caveats

Practical difficulties, especially in difficult weather/sea conditions. In many cases it may be difficult and expensive converting the vessel's deck design to employ a side setting system.

Minimum standards

Only tested in Hawaii for the pelagic longline fisheries, where it is used in conjunction with a bird curtain and weighted branch lines (45g within 1m of hook); side setting is defined as a minimum of 1m forward of the stern.

Implementation monitoring

Requires longline to be set with the aid of a device(s) (e.g., autobaiter; line shooter) from a fixed position on vessels that is crucial to the operational effectiveness of line setting. Port inspection of line deployment set-up considered to be adequate to assess implementation.

Research needs

Largely untested in the demersal fisheries, especially in the Southern Ocean, where the seabird assemblages include proficient diving seabirds. Research urgently needed.

Mitigation Fact Sheet (for pelagic longline vessels)

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

9. Underwater setting funnel/chute

Scientific evidence for effectiveness in demersal fisheries

Unproven and not recommended as a mitigation measure at this time. An underwater setting funnel has been tested in demersal longline fisheries in Alaska, Norway and South Africa, with all studies showing a reduction in the mortality rate, although the extent of the reduction varied between studies (Løkkeborg 1998, 2001; Melvin *et al*. 2001; Ryan & Watkins 2002).

Notes and Caveats

Present design is mainly for a single line system. Results from studies to date have been inconsistent, likely due to the depth at which the device delivers the baited hooks and the diving ability of the seabirds in the fishing area studied. The pitch angles of the vessel, which are influenced by the loading of weight and sea conditions, affect the performance of the funnel (Løkkeborg 2001).

Minimum standards

Not yet established.

Implementation monitoring

On-board monitoring, such as full-time observer coverage, video surveillance or at-sea inspection is recommended to monitor implementation.

Research needs

Need to investigate improvements to the current design to increase the depth at which the line is set, especially during rough seas. Should also be tested with integrated weight lines to determine whether this improves bycatch reduction. Also need to investigate optimal use of device together with other mitigation measures (bird scaring lines and weighted lines).

Mitigation Fact Sheet

https://www.acap.aq/en/resources/bycatch-mitigation/mitigation-fact-sheets/766-fs-06-demersal-longline-underwater-setting-chute/file

10. Line-setter/shooter

Scientific evidence for effectiveness in demersal fisheries

Unproven and not recommended as a mitigation measure at this time. Less used in demersal long-line fisheries; variation in the precise method of operation is cause of variation in efficacy. In Norway, no statistical differences were detected in catch rates of northern fulmars between sets with and without a line shooter (Løkkeborg & Robertson 2002; Løkkeborg 2003). In Alaska, use of a line shooter increased seabird bycatch (Melvin *et. al*. 2001). However, the reasons for this finding are unclear.

Notes and Caveats

Robertson *et al.* (2008c) found no significant difference between the sink rates of integrated weight longlines of autoline vessels that were set with and without a line setter in the Ross Sea, and were doubtful that the use of line setters would lead to substantial reductions in interactions between seabirds and longlines. Unequivocal evidence of effectiveness in reducing seabird bycatch is lacking. In need of further refinement.

Minimum standards

Not considered a mitigation measure at this time.

Research needs

Need to investigate whether refinement/modification of the device will be able to overcome the problem of propeller wash and ensure consistently rapid sink rates and significantly reduced seabird mortality. Not considered a mitigation measure at this time.

Mitigation Fact Sheet (for pelagic longline fisheries)

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

11. Thawing bait

Scientific evidence for effectiveness in demersal fisheries

Unproven and not recommended as a primary mitigation measure. Not as much of an issue compared with pelagic longlining. For autoliners, the bait must be at least partially thawed before they can be sliced by the automated baiting system; in the Spanish system, the interval between manually baiting the hooks and setting the lines is sufficiently long to allow for thawing (except in very low ambient temperatures); and the line weighting regime overcomes most of the problems with frozen bait (Brothers *et al.* 1999).

Notes and Caveats

Effect is likely to be very minor. Not a primary measure.

Research needs

No priority research needs.

12. Olfactory deterrents

Scientific evidence for effectiveness in demersal fisheries

Unproven, and not recommended as a mitigation measure at this time. Dripping shark liver oil on the sea surface behind vessels has been shown to effectively reduce the number of seabirds (restricted to burrow-nesting birds) attending vessels and diving for bait in New Zealand (Pierre & Norden 2006; Norden & Pierre 2007).

Notes and Caveats

The shark liver oil investigated did not deter albatrosses, giant petrels, or Cape petrels from boats (Norden & Pierre 2007). The potential impact of releasing large amounts of concentrated fish oil into the marine environment is unknown, as is the potential for contaminating seabirds attending vessels and the potential of seabirds to become habituated to the deterrent (Pierre & Norden 2006).

Minimum standards

None yet.

Implementation monitoring

Monitoring of line setting operations by observer placement or video surveillance is required to assess implementation.

Research needs

Testing should be extended to candidate/suitable species of conservation concern, such as white-chinned petrels and sooty shearwaters. Research is also required to identify the key ingredients in the shark oil that are responsible for deterring seabirds, and the mechanism by which the birds are deterred. The potential "pollution" effects also need to be investigated.

13. Strategic management of offal discharge

Scientific evidence for effectiveness in demersal fisheries

Not recommended as a primary mitigation measure. Some studies have shown that dumping homogenised offal (which is generally more easily available and thus attractive to seabirds than bait) during setting attracts birds away from the baited line to the side of the vessel where the offal is being discharged, and thus reduces bycatch of seabirds on the baited hooks (Cherel *et al*. 1996; Weimerskirch et al. 2000).

Notes and Caveats

Although strategic offal discharge has been shown to be effective at reducing seabird bycatch around Kerguelen Island, there are many risks associated with the practice. Offal discharge needs to be continued throughout the setting operation so as to ensure the birds do not move on to the baited hooks. This will only be possible in fisheries where line setting is short, and there is sufficient offal to sustain the discharge during the entire line-setting period. This measure also has the potential to foul hook birds if offal is discharged with hooks. It is crucial, then, that all offal is checked for hooks before being discharged. Given these risks, and the fact that the presence of offal is a critical factor affecting seabird numbers attending vessels, most fisheries management regimes require that no offal can be discharged during line setting, and that if discarding is necessary at other times it should take place on the side of the vessel opposite to where the lines are being hauled.

Minimum standards

In CCAMLR demersal fisheries, discharge of offal is prohibited during line setting. 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. A system to remove fish hooks from offal and fish heads prior to discharge is required. Similar requirements are prescribed by other demersal longline fisheries (e.g. Falkland Islands[1] (Islas Malvinas), South Africa and New Zealand).

Implementation monitoring

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

Research needs

Further information needed on opportunities to manage offal more effectively – considering both practical aspects and seabird bycatch mitigation – in the short and long term.

14. Blue-dyed bait

Scientific evidence for effectiveness in demersal fisheries

Unproven and not recommended as a mitigation measure at this time. The performance of this measure has only been tested in the pelagic longline fishery (Boggs 2001; Minami & Kiyota 2004; Gilman *et al.* 2007; Cocking *et al.* 2008), and with mixed success.

Notes and Caveats

New data suggests that this measure is only effective with squid bait (Cocking *et al.* 2008). It has not been tested in demersal fisheries, possibly due to larger number of hooks deployed and thus the need for considerably more bait (Bull 2007). There is no commercially available dye. Onboard dyeing is practically onerous, especially in inclement weather. In the long-term birds may become habituated to blue-dyed bait.

Minimum standards

Mix to standardized 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 a minimum of 20 minutes).

Implementation monitoring

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

Research needs

Need for tests of efficacy and practical feasibility in demersal longline fisheries, especially in the Southern Ocean to determine its effectiveness as a long-term mitigation measure. Research would also need to determine the effect of dyed bait on catches of target species.

Mitigation Fact Sheet

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

15. Hook size and shape

Scientific evidence for effectiveness in demersal fisheries

Unproven and not recommended as a primary mitigation measure. Must be used in combination with other mitigation measures – bird scaring lines. line weighting, night setting and judicious offal management. Hook size was found to be an important determinant in seabird bycatch rates of Argentinean and Chilean longline vessels fishing in Subarea 48.3 in the 1995 season, with smaller hooks killing significantly more seabirds than larger hooks (Moreno *et al.* 1996).

Notes and Caveats

Other than the finding in Moreno *et al.* (1996), little or no work has been conducted to investigate the impact of hood design and shape on seabird bycatch levels.

Minimum standards

No global standard

Implementation monitoring

Port inspection of all hooks on board considered adequate for monitoring implementation.

Research needs

Determine impact on seabird bycatch and on catch of target species.

MITIGATION MEASURES UNDER DEVELOPMENT

16. Kellian Line Setter

Scientific evidence for effectiveness in demersal fisheries

Unproven and not recommended as a mitigation measure at this time. The Kellian Line Setter was identified as a potential mitigation device in New Zealand inshore bottom longline fisheries, (Goad 2011). The Kellian Line Setter is an underwater setting device and involves running the mainline through a set of rollers towed behind the vessel at depth.

Notes and Caveats

An initial prototype had been developed through a series of at-sea trials which were conducted during 2011. While these trials were encouraging, the issue of weights and floats fouling on the rollers required resolution (Goad 2011). A new prototype has been developed and refined in a flume tank (Baker and Frost 2013) for application in a range of demersal longline operations.

Minimum standards

Not considered a mitigation measure at this time.

Research needs

Resolution of mainline loss issues under flume tank conditions prior to further evaluation in at-sea trials.

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ANNEX 2

Agreement on the Conservation of Albatrosses and Petrels

ACAP REVIEW AND BEST PRACTICE ADVICE FOR REDUCING THE IMPACT OF PELAGIC AND DEMERSAL TRAWL FISHERIES ON SEABIRDS

Reviewed at the Ninth Meeting of the Advisory Committee
La Serena, Chile, 9 – 13 May 2016

INTRODUCTION

The incidental mortality of seabirds in trawl fisheries continues to be a serious global concern, especially for threatened albatrosses and petrels. In trawl fisheries, birds foraging on discards or offal may be injured or killed on collision with net monitoring and warp cables, dragged underwater and drowned when their wings become entangled around the warp, or become entangled in nets.

There have been considerable efforts internationally to develop mitigation measures to avoid or minimise the risk of incidental catch of seabirds in trawl fisheries. Although the focus of efforts to mitigate seabird bycatch was initially directed at longline fisheries, trawl fleets have also now been shown to incidentally kill large numbers of seabirds. The FAO Best Practice Guidelines for IPOA/NPOA-Seabirds were amended in 2009 to include trawl fisheries in addition to longline fisheries (FAO 2009), demonstrating increased serious concern and awareness of seabird mortality on global trawl fisheries. Although most mitigation measures are broadly applicable, the application and specifications of some will vary with local methods and gear configurations. ACAP has comprehensively reviewed the scientific literature dealing with seabird bycatch mitigation in trawl fisheries (see review section below) and this document is a summary of the advice informed by the review.

This document provides advice about best practices for reducing the impact of trawl fishing on seabirds. The ACAP review process recognises that factors such as safety, practicality and the characteristics of the fishery should also be taken into account when considering the efficacy of seabird bycatch mitigation measures and consequently in the development of advice and guidelines on best practice.

This document also provides information regarding measures that are currently under active development, and which show promise as future best practices in trawl fisheries. ACAP will continue to monitor the development of these practices and the results of scientific research about their effectiveness.

The document comprises two components. The first component provides a summary of ACAP's advice regarding best practice measures for reducing seabird bycatch in pelagic and demersal trawl fisheries, and the second component outlines the review of mitigation measures that have been assessed for these 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 Ninth Meeting of the Advisory Committee
La Serena, Chile, 9 – 13 May 2016

BEST PRACTICE MEASURES

The causes of mortality in trawl fisheries depend upon the nature of the fishery (pelagic or demersal), the species being targeted and the fishing area. Seabird mortalities may be categorised into two broad types: (1) cable-related mortality, including collisions with net-monitoring cables[5], warp cables[6] and paravanes; and (2) net-related mortality, which includes deaths caused by net entanglements. Seabird interactions with trawl gear have been demonstrated to be significantly reduced by the use of mitigation measures that include managing offal discharge and discards, protecting the warp and other cables, and reducing the time the net is exposed on the surface of the water. The following measures have been shown to be effective at reducing seabird bycatch in trawl fisheries and are recommended as best practice measures:

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 are recommended:

1. Avoid any discharge during shooting and hauling the net.

2. Where practicable, convert offal into fish meal and retain all waste material with any discharge restricted to liquid discharge / sump water to reduce the number of birds attracted to a minimum; and

3. Where meal production from offal and full retention of are impracticable, batching waste (preferably for two hours or longer) has been shown to reduce seabird attendance at the stern of the vessel. Mincing of waste has also been shown to reduce the attendance of large albatross species.

[5]The netsonde monitor cable connects the echo-sounder or net-sounder on the headline of the trawl net to the vessel.
[6] The warp cables or trawl warps are the cables used to tow nets.

Measures to reduce the risk of cable strikes

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. 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 the risk of net entanglement

1. Clean nets after every shot 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 Ninth Meeting of the Advisory Committee
La Serena, Chile, 9 – 13 May 2016

INTRODUCTION

A range of technical and operational mitigation methods have been designed or adapted for use in trawl fisheries. These methods generally aim to manage offal and discards to reduce the abundance of seabirds attending trawl vessels, thereby mitigating the associated risk, or deterring birds from the high risk areas, such as the warp cables. Apart from being technically effective at reducing seabird bycatch, mitigation methods need to be easy and safe to implement, cost effective, enforceable and should not reduce catch rates of target species.

The suite of mitigation measures available may vary in their feasibility and effectiveness depending on the area, seabird assemblages, fishery and vessel type, 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 and this document is a distillation of that review. At each of its meetings, the SBWG reviews any recent research or information regarding seabird bycatch mitigation, and updates the review and best practice advice accordingly.

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[7] reduce the rate of seabird incidental mortality[8] to the lowest achievable levels. Experience has shown that experimental research comparing the performance of candidate mitigation technologies to a control of no deterrent, where possible, or to status quo in the fishery, yields definitive results. Analysis of fishery observer data after it has been collected on the relative performance of mitigation approaches are plagued with a myriad of confounding factors. Where a significant relationship is demonstrated between seabird behaviour and seabird mortality in a particular system or seabird assemblage, significant reductions in seabird behaviours, such as the rate of seabirds attacking baited hooks, can serve as a proxy for reduced seabird mortality. Ideally, when simultaneous use of fishing technologies and practices is recommended as best practice, research should demonstrate significantly improved performance of the combined measures.

ii. Fishing technologies and techniques, or a combination thereof, shall have clear and proven specifications and minimum performance standards for their deployment and use. Examples would include: specific bird scaring line designs (lengths, streamer length and materials; etc.), number (one vs. two) and deployment specifications (such as aerial extent and timing of deployment); night fishing defined by the time between 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 shall be demonstrated to be practical, cost effective and widely available. Commercial fishing operators are likely to select for seabird bycatch reduction measures and devices that meet these criteria including practical aspects concerning safe fishing practices at sea.

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

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

vi. Minimum performance standards and methods of ensuring compliance should be provided for fishing technologies and techniques, and should be clearly specified in fishery regulations. Relatively simple methods to check compliance 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

[7] Any use of the word 'significant' in this document is meant in the statistical context
[8] This may be determined by either a direct reduction in seabird mortality or by reduction in seabird attack rates, as a proxy

requirements. 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 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 (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.

1. MITIGATION MEASURES DESIGNED TO REDUCE NET ENTANGLEMENTS

1.1. Net binding

Scientific evidence for effectiveness in trawl fisheries

Recommended for reducing bycatch when shooting gear in pelagic 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

Sisal string has been used to bind the sections of the net which pose the greatest threat 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

Recommend combination with net cleaning and net weights to minimise the time the net is on the surface (Sullivan *et al*. 2009)

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

1.2. Net weighting

Scientific evidence for effectiveness in trawl fisheries

Recommended for reducing bycatch during both shooting and hauling of gear. 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. All attempts should be made to retrieve the net as quickly as possible. 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

Suitable for both pelagic and demersal trawl gear.

Minimum standards

None established.

Need for combination

Recommend 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).

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

1.3. Net cleaning

Scientific evidence for effectiveness in trawl fisheries

Recommended for reducing bycatch during both shooting and hauling of gear. 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

Suitable for both pelagic and demersal gear.

Minimum standards

Remove all stickers from net prior to shooting gear.

Need for combination

Recommend 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).

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

1.4. Reduced mesh size

Scientific evidence for effectiveness in trawl fisheries

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

Measure may be impractical. 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

None. Insufficient evidence to recommend this measure, although theoretically it could be effective in reducing the incidence of seabird entanglements in nets.

Need for combination

None identified.

Research needs

Thorough testing in a range of fisheries required to determine if measure is practical.

1.5. Net jackets

Scientific evidence for effectiveness in trawl fisheries

Unproven and not recommended as a mitigation method. Free-floating panels of net attached to the most dangerous mesh sizes have been trialled in CCAMLR's icefish trawl fishery, with uncertain effeciency (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 recommended.

Need for combination

None identified.

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

1.6. Acoustic deterrents

Scientific evidence for effectiveness in trawl fisheries

Unproven and not recommended as a primary mitigation method. 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

None. Insufficient evidence to recommend this measure.

Need for combination

None identified.

Research needs

None identified.

1.7. Net restrictor

Scientific evidence for effectiveness in trawl fisheries

Unproven and not recommended as a primary mitigation method. 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 were observed.

Notes and Caveats

May be a useful 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

None. Insufficient evidence to recommend this measure at present.

Need for combination

None identified.

Research needs

At-sea testing required to determine effectiveness.

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.

2. MITIGATION MEASURES DESIGNED TO REDUCE INTERACTIONS OF SEABIRDS WITH TRAWL CABLES

2.1. Offal discharge[9] and fish discard management

The most important factor influencing contacts between seabirds and warp cables is the presence of discharge (Wienecke & Robertson 2002; Sullivan *et al.* 2006a). Methods used to reduce the attractiveness of vessels to seabirds through management of offal discharge and fish discards include: mealing (the conversion of waste into fish meal waste reducing discharge to sump water), mincing waste to a nominal maximum particle size of 25 mm diameter prior to discharge, batching (storage or controlling release of discards / discharge during fishing operations). Where practicable the full retention of all waste material is recommended.

2.1.1. Mealing

Scientific evidence for effectiveness in trawl fisheries

Recommended as a mitigation measure. Mealing resulted in significant reduction in the number of seabirds species feeding behind vessels, relevant to the discharge of unprocessed fish waste (Abraham *et al.* 2009; Wienecke & Robertson 2002; Favero *et al*. 2010) 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 stick / sump water is highly effective in reducing seabird bycatch. Suitable for both pelagic and demersal trawl gear.

Minimum standards / Recommendation

None established.

Need for combination

None identified.

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

[9] 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)

2.1.2. Mincing

Scientific evidence for effectiveness in trawl fisheries

Insufficient evidence to recommend this as a primary mitigation measure at present, although reduced bird abundance should reduce cable impacts and mortality for larger albatross species. **Mincing** 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).

Notes and Caveats

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

Minimum standards

Insufficient evidence to recommend this as a primary measure at present, although reduced bird abundance should reduce cable impacts and mortality for larger albatross species.

Need for combination

Should be used in combination with other mitigation methods.

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).

2.1.3. Batching

Scientific evidence for effectiveness in trawl fisheries

Recommended as a mitigation when when full retention or mealing is not possible. **Batching** (storage or controlling release of discards / discharge during) has been trialed in New Zealand and was shown to significantly reduce the number of seabirds associated with vessels (Pierre *et al*. 2010; SBWG-4 Doc 14 Rev1).

Notes and Caveats

Effectiveness of batching relies on efficient (fast) dumping of batched material.

Minimum standards

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

Need for combination

Should be used in combination with other mitigation methods.

Research needs

Robust trialling to investigate 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

2.1.4. Full retention

Scientific evidence for effectiveness in trawl fisheries

Proven and recommended as a mitigation method. Repeated studies have shown 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; SBWG-3 Doc 14 Rev 1; Abraham & Thompson 2009)**.** Storage of all fish discard and offal, either for processing or for controlled release when cables are not in the water, has resulted in a significant reductions in the attendance of all groups of seabirds (Abraham et al 2009).

Notes and Caveats

Suitable for both pelagic and demersal trawl gear

Minimum standards

None established.

Need for combination

None identified.

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

2.2. Bird Scaring Lines (BSL) to reduce interaction with warp cables

Scientific evidence for effectiveness in trawl fisheries

Proven and recommended as a mitigation measure. Attachment of a Bird Scaring Line 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 (BirdLife 2010).

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. Suitable for both pelagic and demersal trawl gear.

Minimum standards

BSL are recommended even when appropriate offal discharge and fish discard management practices in place (Melvin *et al*. 2010). The main line should consist of 50 m of 9 mm line. Streamer lines should be attached at 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. BSLs should be deployed once the trawl doors are submerged and retrieved as net hauling commences.

Need for combination

Should be combined with offal/discard management.

Research needs

Further research is required on the effectiveness on the design and performance of an off-setting towed device under operational conditions (see 4.1).

Mitigation Fact Sheet

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

2.3. Warp scarers

Scientific evidence for effectiveness in trawl fisheries

Insufficient evidence. Not recommended as a mitigation measure. 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 (Sullivan *et al.* 2006a; Abraham *et al.*, cited in Bull 2009).

Minimum standards

None. Insufficient evidence to recommend this measure.

Need for combination

None identified.

Research needs

None identified.

2.4. Bird bafflers

Scientific evidence for effectiveness in trawl fisheries

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

Notes and Caveats

Various designs exist including the Brady Baffler, the Burka and a modified Burka design or "curtain baffler" (Cleal et al 2013).

While bafflers where 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.

Minimum standards

None. Insufficient evidence to recommend this measure.

Need for combination

None identified.

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

Scientific evidence for effectiveness in trawl fisheries

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

None. Insufficient evidence to recommend this measure.

Need for combination

None identified.

Research needs

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

2.6. Warp boom

Scientific evidence for effectiveness in trawl fisheries

Insufficient evidence. Not recommended as a mitigation measure at this time. A boom with streamers extending to the water forward of the stern can divert birds feeding on offal away from the warps (Melvin *et al.* 2010).

Notes and Caveats

Results from the Melvin *et al*. (2010) study did not identify a statistically significant reduction is seabird interactions with the warp.

Minimum standards

None established.

Need for combination

None identified.

Research needs

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

2.7. Snatch block

Scientific evidence for effectiveness in trawl fisheries

Recommended as a mitigation measure to reduce the aerial extent of net monitoring cables. A snatch block, placed on 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 used in combination with other recommended mitigation methods.

Research needs

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

3. GENERAL MEASURES

3.1. Time-Area closures

Scientific evidence for effectiveness in trawl fisheries

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

No general minimum standards. Will depend on the particular area and fishery.

Need for combination

Must be combined with other 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.

Research needs

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

4. MEASURES UNDER DEVELOPMENT

4.1. Tamini Tabla off-setting towed device for Bird Scaring Lines

In order to improve the performance of Bird Scaring Lines, an off-setting towed device (Tamini Tabla) is under development in Argentina. 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.

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