 <p>Agreement on the Conservation of Albatrosses and Petrels</p>	<p><b>Ninth Meeting of the Seabird Bycatch Working Group</b> <i>Florianópolis, Brazil, 6 - 8 May 2019</i></p> <p><b>Updates to the ACAP Review and Best Practice Advice for Reducing the Impact of Pelagic and Demersal Trawl Fisheries on Seabirds</b></p> <p><b><i>Amanda Kuepfer and Igor Debski</i></b></p>
---	---

### **SUMMARY**

Among the important tasks undertaken at each meeting of the SBWG is the updating of the reviews and best practice (summary) advice relating to bycatch mitigation measures for longline and trawl fisheries. Prior to SBWG6, an intersessional review of ACAP's technical review and best practice advice documents highlighted areas in which the presentation of the information could be improved. SBWG8 Doc 06 presented the revised 'Best Practice Advice' documents for demersal longline and trawl fisheries using the format developed for pelagic longline, and endorsed by AC9.

At SBWG8, it was agreed to routinely keep the best practice documents up to date during the intersessional periods. This would be led by champions for each fishing method, and any changes other than minor updates would be presented as Working Papers to the next SBWG meeting.

At SBWG8 it was recognised that there was merit in further improving the clarity and consistency of the best practice mitigation advice for trawl fisheries. We present here a track-changed version of the advice document to provide this improvement.

### **RECOMMENDATIONS**

We recommend that the Seabird Bycatch Working Group:

1. consider the revised ACAP Review and Best Practice Advice for Reducing the Impact of Pelagic and Demersal Trawl Fisheries on Seabirds, and provide any further recommendations for improvement.
2. recommend the Advisory Committee endorse the updated advice document.

## **Actualización de la revisión y las recomendaciones de mejores prácticas del ACAP para reducir el efecto de las pesquerías de arrastre pelágico y demersal en las aves marinas**

### **RESUMEN**

Entre las importantes tareas llevadas a cabo durante cada reunión del GdTCS, se encuentra la actualización de las revisiones y de las recomendaciones —resumidas— sobre mejores prácticas en materia de medidas de mitigación de la captura secundaria para las pesquerías de palangre y de arrastre. Durante el período entre sesiones, antes de la reunión GdTCS6, se analizaron los documentos sobre revisión técnica y recomendaciones de mejores prácticas del ACAP y se identificaron aspectos para mejorar a la hora de presentar información. En GdTCS8 Doc 6, se presentaron los documentos modificados sobre recomendaciones de mejores prácticas para las pesquerías de palangre demersal y de arrastre utilizando el formato desarrollado para las pesquerías de palangre pelágico y ratificado por la CA9.

En GdTCS8, se acordó que los documentos sobre mejores prácticas se mantendrían actualizados en forma periódica durante los períodos entre sesiones. Esto sería encabezado por los principales exponentes de cada método de pesca, y todos los cambios que no sean actualizaciones menores se presentarían como Documentos de Trabajo en la próxima reunión del GdTCS.

En GdTCS8 se reconoció el mérito de continuar mejorando la claridad y la coherencia de las medidas de mitigación recomendadas para las pesquerías de arrastre. Aquí presentamos una versión del documento de recomendación con control de cambios para brindar esta mejora.

### **RECOMENDACIONES**

Se recomienda al Grupo de Trabajo sobre Captura Secundaria de Aves Marinas realizar las siguientes acciones:

1. Considerar la revisión y recomendaciones de mejores prácticas del ACAP para reducir el efecto de las pesquerías arrastre de palangre pelágico y demersal en las aves marinas ACAP y formular recomendaciones de mejora adicionales.
2. Recomendar que el Comité Asesor ratifique el documento de recomendación actualizado.

## **Mises à jour de la révision de l'ACAP et des conseils en matière de bonnes pratiques pour la réduction de l'impact des pêches au chalut pélagique et démersale sur les oiseaux de mer**

### **RÉSUMÉ**

Parmi les tâches les plus importantes entreprises à chaque réunion du GTCA figure la mise à jour des avis en matière de révisions et de bonnes pratiques (résumé) relatives aux mesures d'atténuation des captures accessoires dans les pêcheries palangrières et chalutières. Préalablement au GTCA 6, une révision intersessions des documents présentant les avis en matière d'examen technique et de bonnes pratiques de l'ACAP mettait en évidence un certain nombre de points pour lesquels les informations pouvaient être mieux présentées. Le document GTCA8 Doc 06 présente les documents révisés sur les « bonnes pratiques » pour les pêcheries démersales à la palangre et au chalut avec le format élaboré pour la palangre pélagique approuvé par le CC9.


Lors du GTCA8, il a été convenu d'actualiser régulièrement les documents de bonnes pratiques lors de la période intersessions. Cette tâche pourrait être menée par les défenseurs de chaque méthode de pêche, et tout changement autre qu'une mise à jour mineure sera présenté comme dans les documents de travail soumis à la prochaine réunion du GTCA.

Lors du GTCA8, il a été reconnu qu'il serait utile de clarifier davantage et d'améliorer la cohérence des conseils en matière de bonnes pratiques à destination des pêcheries au chalut. Nous présentons ici une version avec suivi des modifications de l'avis pour y apporter ces améliorations.

### **RECOMMANDATIONS**

Nous recommandons que le Groupe de travail sur la capture accessoire des oiseaux de mer :

1. Examine les mises à jour de la révision de l'ACAP et des avis en matière de bonnes pratiques pour la réduction de l'impact des pêches au chalut pélagique et démersale sur les oiseaux de mer, et émettre d'autres recommandations afin d'apporter des améliorations.
2. Recommande au Comité consultatif d'adopter l'avis actualisé.

 <p>Agreement on the Conservation of Albatrosses and Petrels</p>	<h2 style="text-align: center;">ACAP Review and Best Practice Advice for Reducing the Impact of Pelagic and Demersal Trawl Fisheries on Seabirds</h2> <p style="text-align: center;"><i>Reviewed at the <del>Tenth</del> <u>Eleventh</u> Meeting of the Advisory Committee Wellington, New Zealand 11 – 15 September 2017 <u>Florianopolis, Brazil 13-17 May 2019</u></i></p>
---	---

## INTRODUCTION

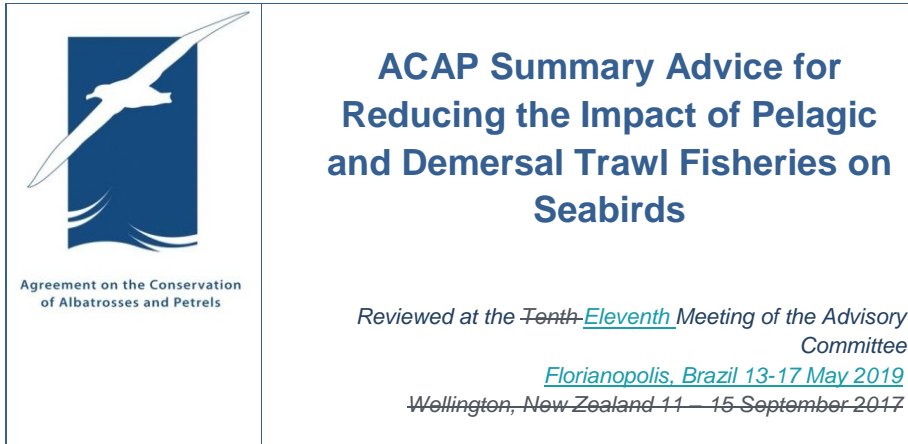
The incidental mortality of seabirds in trawl fisheries continues to be a serious global concern, especially for threatened albatrosses and petrels. In trawl fisheries, birds foraging on discards or offal may be injured or killed on collision with net monitoring and warp cables, dragged underwater and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



## 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<sup>1</sup>, warp cables<sup>2</sup> 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 the discharge of offal and discards<sup>3</sup>, 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:

### Measures to reduce general attractiveness to seabirds

#### Management of offal and discards

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

1. **Full retention of waste** – ~~Avoiding any~~ **No discharge during fishing activities (when cables or net are in the water);**
2. **Mealing waste** – Converting offal into fish meal where practicable, and retaining

**Commented [A1]:** If any periods of discharge occur during fishing, it will be classified as batching

**Commented [A2]:** Providing better definition

<sup>1</sup> The netsonde monitor cable connects the echo-sounder or net-sounder on the headline of the trawl net to the vessel.

<sup>2</sup> The warp cables or trawl warps are the cables used to tow nets.

<sup>3</sup> 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).

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

all waste material with any discharge restricted to liquid discharge / sump water);

3. **Batching waste** – Where meal production and full retention of offal and discards are impracticable, waste should be stored temporarily for two hours or longer before strategically discharging it in batches;
4. **Mincing of waste** – Reducing waste to smaller particles (currently only recommended as a mitigation for bycatch of large *Diomedea* spp.).

**Additional Measures to reduce the risk of cable strikes**

**Warp cables**

1. Deploy ~~bird~~ **Bird scaring** ~~Scaring lines~~ **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.

**Additional Measures to reduce the risk of net entanglement**

1. Clean nets after every ~~shot~~ **haul** to remove entangled fish (“stickers”) and benthic material to discourage bird attendance during gear shooting;
2. Minimise the time the net is on the water surface during hauling through proper maintenance of winches and good deck practices; and
3. For pelagic trawl gear, apply net binding to large meshes in the wings (120–800 mm), together with a minimum of 400-kg weight incorporated into the net belly prior to setting.

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

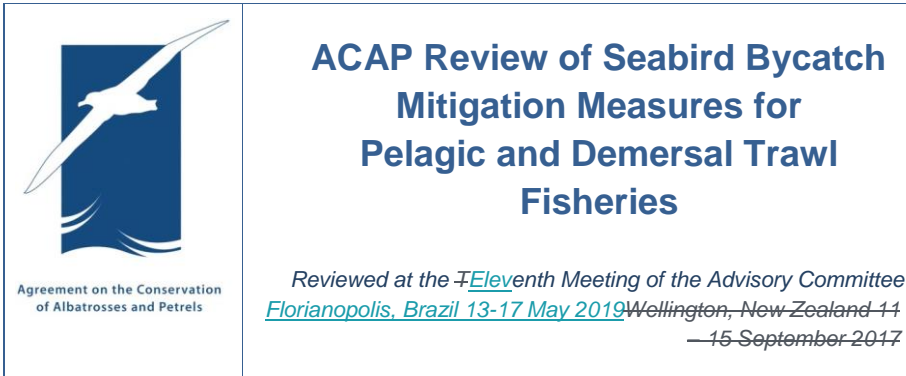
The ACAP review of seabird bycatch mitigation measures for pelagic and demersal trawl fisheries is presented in the following section.

**Commented [A3]:** This measure was moved to the end of the list as it has only been shown to be effective for larger species.

**Commented [A4]:** Recognising that reducing bird attendance through management of offal and discards should be the primary method

**Commented [A5]:** For consistency

**Commented [A6]:** Recognising that reducing bird attendance through management of offal and discards should be the primary method



## INTRODUCTION

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

**Commented [A7]:** Separating offal and discard management from additional methods

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.

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

**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<sup>4</sup> reduce the rate of seabird incidental mortality<sup>5</sup> 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, should have clear and proven specifications and minimum performance standards for their deployment and use. Examples would include: specific bird scaring line designs (lengths, streamer length and materials; etc.), number (one vs. two) and deployment specifications (such as aerial extent and timing of deployment); night fishing defined by the time between the end of nautical dusk and start of nautical dawn; and, line weighting configurations specifying mass and placement of weights or weighted sections.
- iii. Fishing technologies and techniques should be demonstrated to be practical, cost effective and widely available. Commercial fishing operators are likely to select for seabird bycatch reduction measures and devices that meet these criteria including practical aspects concerning safe fishing practices at sea.
- iv. Fishing technologies and techniques should, to the extent practicable, maintain catch rates of target species. This approach should increase the likelihood of acceptance and compliance by fishers.
- v. Fishing technologies and techniques should, to the extent practicable, not increase the bycatch of other taxa. For example, measures that increase the likelihood of catching other protected species such as sea turtles, sharks and marine mammals, should not be considered best practice (or only so in exceptional circumstances).
- vi. Minimum performance standards and methods of ensuring compliance should be provided for fishing technologies and techniques, and 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

---

<sup>4</sup> Any use of the word 'significant' in this document is meant in the statistical context.

<sup>5</sup> This may be determined by either a direct reduction in seabird mortality or by reduction in seabird attack rates, as a proxy.



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

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 TO REDUCE GENERAL ATTRACTIVENESS TO SEABIRDS

### 1. Offal discharge<sup>6</sup> 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; Favero *et al.* 2011). Methods used to reduce the attractiveness of vessels to seabirds through management of offal discharge and fish discards include: full retention (~~avoid any~~ no discharge during fishing activities when cables or net are in the water), mealing (the conversion of waste into fish meal waste reducing discharge to sump water), batching (storage or controlling release of discards / discharge during fishing operations), mincing waste to a nominal maximum particle size of 25 mm diameter prior to discharge).

**Commented [A8]:** Numbering removed as this is overarching text for this section

<sup>6</sup> 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).

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

## 1.1. Full retention

### ACAP advice

~~Suitable~~ Proven and recommended as the most effect mitigation method for both pelagic and demersal trawl fisheries.

### Scientific evidence for effectiveness in trawl fisheries

~~Proven and recommended as a mitigation method.~~ Repeated studies have shown that in the absence of offal discharge / fish discards seabird interactions and mortality levels are negligible (Sullivan *et al.* 2006; Watkins *et al.* 2008; Melvin *et al.* 2010; SBWG3 Doc 14 Rev 1; Abraham & Thompson 2009). Storage of all fish discard and offal, either for processing or for controlled release when cables and net are not in the water, has resulted in a significant reductions in the attendance of all groups of seabirds (Abraham *et al.* 2009).

Commented [A9]: New formatting to provide greater clarity

### Notes and Caveats

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

~~Suitable for both pelagic and demersal trawl gear.~~

Commented [A10]: Removed as repetition.

### Minimum standards

~~None established~~ Any discharge is restricted to times when cables and net are out of the water.

### Need for combination

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

### Implementation monitoring

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

Commented [A11]: This subsection had previously been omitted from the trawl review, now added for each mitigation method

### Research needs

None identified.

### Mitigation Fact Sheet

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

## 1.2. Mealing

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

**ACAP advice**

Proven and recommended as a mitigation method for both pelagic and demersal trawl fisheries when full retention is not possible.

**Commented [A12]:** Added for consistency of interpretation

**Scientific evidence for effectiveness in trawl fisheries**

~~Recommended as a mitigation measure.~~ Meal grinding resulted in significant reduction in the number of seabird species feeding behind vessels, relevant to the discharge of unprocessed fish waste (Abraham *et al.* 2009; Wienecke & Robertson 2002; Favero *et al.* 2011) or minced waste (Melvin *et al.* 2010).

**Notes and Caveats**

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

**Commented [A13]:** repeat of above

**Minimum standards**

None established.

**Commented [A14]:** for consistency

**Need for combination**

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

**Commented [A15]:** For clarity regarding the types of mitigation covered

**Implementation monitoring**

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

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>

**1.3. Batching**

**ACAP advice**

Proven and recommended as a mitigation method for both pelagic and demersal trawl fisheries when full retention or meal grinding is not possible.

**Commented [A16]:** Added for consistency in interpretation

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

**Scientific evidence for effectiveness in trawl fisheries**

~~Recommended as a mitigation when full retention or mealing is not possible.~~ Batching (temporary storage and periodic, (controlled), and fast release of discards / discharge during trawling) has been trailed in New Zealand (Pierre *et al.* 2010; SBWG4 Doc 14 Rev 1; Pierre *et al.* 2012b) and in the Falkland Islands (Islas Malvinas)<sup>7</sup> (Kuepfer *et al.* 2016; Kuepfer & Pompert 2017). Results showed that batching can significantly reduce numbers of seabirds and associated bycatch risk, although adequate storage period and minimal duration of batching events are important.

**Notes and Caveats**

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

**Commented [A17]:** To capture this key element of effectiveness

**Minimum standards**

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

**Commented [A18]:** Recognising that shorter batching periods may still have significant benefits compared to no batching/retention

**Need for combination**

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

**Commented [A19]:** For clarity regarding the types of mitigation covered

**Implementation monitoring**

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

**Research needs**

~~Robust trialling to i~~investigate through robust trialling the extent to which reduced seabird abundance affects seabird interaction rates.

**Commented [A20]:** To make style consistent.

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

**Mitigation Fact Sheet**

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

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

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

## 1.4. Mincing

### ACAP advice

~~Insufficient evidence to recommend this as a primary mitigation measure in pelagic and demersal trawl fisheries at present.~~ Insufficient evidence to recommend this as a primary mitigation measure in pelagic and demersal trawl fisheries at present, although reduced bird abundance should decrease cable impacts and mortality for larger albatross species, when full retention, mealing or batching is not possible.

Commented [A21]: Added for consistency

Commented [A22]: for consistency

### Scientific evidence for effectiveness in trawl fisheries

~~Insufficient evidence to recommend this as a primary mitigation measure at present, although reduced bird abundance should decrease cable impacts and mortality for larger albatross species.~~ Mincing waste to maximum 25 mm significantly reduced the number of large albatrosses (*Diomedea* spp) attending vessels but had no effect on other groups of seabirds (Abraham *et al.* 2009; Abraham 2010). Pierre *et al.* (2012a) showed that whilst reduced particle size (10-40 mm and 30-60 mm) reduced seabird attendance compared with untreated waste, the effect was lowest for small albatross species, and not significant for the 10-40 mm treatment.

### Notes and Caveats

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

### Minimum standards

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

### Need for combination

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

Commented [A23]: For consistency

Commented [A24]: For clarity regarding the types of mitigation covered

### Implementation monitoring

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

### Research needs

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

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

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

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

ACAP advice

Proven and recommended as a mitigation measure for pelagic and demersal trawl fisheries.

Commented [A25]: Added for consistency

Commented [A26]: Highlighting here rather than in the notes section for consistency

**Scientific evidence for effectiveness in trawl fisheries**

~~Proven and recommended as a mitigation measure for pelagic and demersal trawl fisheries.~~ Attachment of a Bird Scaring Line (BSL) to both the port and starboard sides of a vessel, above and outside of the warp blocks, greatly reduces the access of birds to the danger zone where warps enter the water (Watkins *et al.* 2006; Reid & Edwards 2005; Melvin *et al.* 2010). An off-setting towed device has been demonstrated to improve BSL performance (ACAP 2013; Tamini *et al.* 2015).

Commented [A27]: Highlighting here rather than in the notes section for consistency

**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. BSLs cannot be deployed while the warp cable is being set, or remain in place during hauling, leaving periods when warps are not protected. Bird mortality as a result of entanglement with the bird scaring line BSL is known to occur (Snell *et al.* 2011; Kuepfer 2016).

**Minimum standards**

BSL are recommended even when appropriate offal discharge and fish discard management practices are in place (Melvin *et al.* 2010). A BSL should be fitted to the outside of both the starboard and the port-side cable. The main line should extend beyond the warp-water interface and should maintain its tension under normal tow speed. Streamer lines should be attached at maximum 5 m intervals and should be long enough to extend beyond the point at which warp and net monitoring cables reach the water's surface. It is recommended that for every metre of block height, 5 m of backbone be deployed and 1.2 kg of terminal object drag weight be used. BSLs should be deployed once the trawl doors are submerged and retrieved as net hauling commences.

**Need for combination**

Should be combined used in combination with offal/discard management.

Commented [A28]: for consistency

Implementation monitoring

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

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

**Research needs**

Further research is required on the effectiveness of the design and performance of an off-setting towed device under operational conditions (see 4.1). [Further research is also required on reducing the entanglement risk of birds in the BSL.](#)

**Mitigation Fact Sheet**

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

**2.2. Warp scarers**

**ACAP advice**

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

Commented [A29]: Added for consistency

Commented [A30]: For consistency

**Scientific evidence for effectiveness in trawl fisheries**

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

Commented [A31]: For consistency

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**

~~Not applicable, as not recommended.~~

Commented [A32]: New wording now used consistently in this document

None. Insufficient evidence to recommend this measure.

**Need for combination**

~~Not applicable, as not recommended.~~

Commented [A33]: New wording now used consistently in this document

**Implementation monitoring**

~~Not applicable, as not recommended.~~

Commented [A34]: New wording now used consistently in this document

None identified.

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

**Research needs**

None identified.

**2.3. Bird bafflers**

ACAP advice

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

**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-water interface zone (see Bull 2009, Fig.3; Sullivan *et al.* 2006a).

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

**Notes and Caveats**

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

Commented [A35]: This terminology is not being used

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

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

Commented [A36]: New wording to also capture potential advantages

**Minimum standards**

Not applicable, as not recommended.

~~None. Insufficient evidence to recommend this measure.~~

**Need for combination**

Not applicable, as not recommended.

Implementation monitoring

Not applicable, as not recommended.

~~None identified~~ Not applicable.



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

**Research needs**

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

**2.4. Cones on warp cables**

ACAP advice

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

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

Not applicable, as not recommended.

None. Insufficient evidence to recommend this measure.

**Need for combination**

Not applicable, as not recommended.

Implementation monitoring

Not applicable, as not recommended.

None identified ~~Not applicable.~~

**Research needs**

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

**2.5. Warp boom**

ACAP advice

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

Commented [A37]: Added for consistency

Formatted: Font: Not Bold

Commented [A38]: Added for consistency

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

**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 and warps can divert birds feeding on offal away from the warps; however, Melvin *et al.* (2010) did not identify a statistically significant reduction in seabird interactions with the warp.

**Notes and Caveats**

None.

Commented [A39]: added for clarity

**Minimum standards**

Not applicable, as not recommended.

~~None. Insufficient evidence to recommend this measure.~~

**Need for combination**

Not applicable, as not recommended.

~~None identified. Not applicable.~~

**Research needs**

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

**2.6. Snatch block**

**ACAP advice**

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

Commented [A40]: Added for consistency

Commented [A41]: Recognising that not using an additional cable (i.e. using wireless monitoring) is the preferred option

**Scientific evidence for effectiveness in trawl fisheries**

~~Recommended as a mitigation measure to reduce the aerial extent of net monitoring cables, when their use can not be avoided, in pelagic and demersal trawl fisheries.~~ A snatch block, placed on the stern of a vessel to draw the third-wire close to the water to reduce its aerial extent, reduced seabird strikes, although performance varied by vessel (Melvin *et al.* 2010).

Commented [A42]: Recognising that not using an additional cable (i.e. using wireless monitoring) is the preferred option

**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.

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

**Minimum standards**

None established.

**Need for combination**

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

**Commented [A43]:** For consistency  
**Commented [A44]:** For consistency with existing advice

**Implementation monitoring**

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

**Research needs**

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

**2.7. Warp deflector**

**ACAP advice**

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

**Commented [A45]:** Added for consistency

**Scientific evidence for effectiveness in trawl fisheries**

~~Insufficient evidence. Not recommended as a mitigation measure at this time.~~ The warp deflector, consisting of a pinkie buoy clipped to each of the warp cables and connected back to the vessel via a retrieval line, is designed to hang at the warp-water interface to deflect birds away from the danger area. The device was found to significantly reduce heavy interactions of shy-type albatross (*Thalassarche*) with trawl warps by Pierre *et al.* (2014). The authors, however, urged for wider testing of the device to support results. Kuepfer (2017) identified numerous practical issues which impacted on the safe and effective deployment of the device in non-experimental conditions.

**Notes and Caveats**

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

**Minimum standards**

Not applicable, as not recommended.

None. Insufficient evidence to recommend this measure.

**Need for combination**

Not applicable, as not recommended.

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

**Implementation monitoring**

Not applicable, as not recommended.

Not applicable.

**Research needs**

None identified.

**3. MITIGATION MEASURES DESIGNED TO REDUCE NET ENTANGLEMENTS**

**3.1. Net binding**

**ACAP advice**

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

Commented [A46]: Added for consistency

***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***

Not suitable for demersal trawl gear.

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

***Minimum standards***

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

***Need for combination***

~~Recommend~~ Should be used in combination with net cleaning and net weights to minimise the time the net is on the surface (Sullivan *et al.* 2009), as well as in combination with waste

Commented [A47]: for consistency

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

management to avoid the discharge of waste during shooting thereby minimising the attraction of seabirds to the stern of the vessel.

**Implementation monitoring**

On-board -observer or electronic monitoring.

**Research needs**

None identified.

**Mitigation Fact Sheet**

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

### 3.2. Net weighting

**ACAP advice**

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

Commented [A48]: Added for consistency

Commented [A49]: For consistency

**Scientific evidence for effectiveness in trawl fisheries**

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

Commented [A50]: For consistency

**Notes and Caveats**

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

**Minimum standards**

None established.

**Need for combination**

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

Commented [A51]: for consistency

**Implementation monitoring**

On-board observers or electronic monitoring.

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

**Research needs**

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

**Mitigation Fact Sheet**

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

**3.3. Net cleaning**

ACAP advice

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

Commented [A52]: Added for consistency

Commented [A53]: for consistency

**Scientific evidence for effectiveness in trawl fisheries**

~~Recommended for reducing bycatch during both shooting and hauling of trawl gear (for both pelagic and demersal).~~ Removal from nets of all fish 'stickers' and other material is a critical step to reducing net entanglement during shooting (Hooper *et al.* 2003; Sullivan *et al.* 2009).

**Notes and Caveats**

None.

**Minimum standards**

Remove all stickers from net prior to shooting gear.

**Need for combination**

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

Commented [A54]: for consistency

Implementation monitoring

On-board observers or electronic monitoring.

**Research needs**

None identified.

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

**Mitigation Fact Sheet**

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

**3.4. Reduced mesh size**

**ACAP advice**

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

**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**

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

**Minimum standards**

Not applicable, as not recommended.

~~Not currently recommended.~~

**Need for combination**

Not applicable, as not recommended.

**Implementation monitoring**

Not applicable, as not recommended.

~~Not applicable.~~

**Research needs**

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

**3.5. Net jackets**

**ACAP advice**

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

Commented [A55]: Added for consistency

Commented [A56]: For consistency

Commented [A57]: Added for consistency

Commented [A58]: For consistency

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

**Scientific evidence for effectiveness in trawl fisheries**

~~Unproven and not recommended as a mitigation method at this time.~~ Free-floating panels of net attached to the most dangerous mesh sizes have been trialled in CCAMLR's icefish trawl fishery, with uncertain efficiency (Sullivan *et al.* 2009).

Commented [A59]: For consistency

**Caveats /Notes**

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

**Minimum standards**

Not applicable, as not recommended.

Not currently recommended.

**Need for combination**

Not applicable, as not recommended.

**Implementation monitoring**

Not applicable, as not recommended.

Not applicable.

**Research needs**

Efficacy of measure remains to be demonstrated.

**Mitigation Fact Sheet**

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

**3.6. Acoustic deterrents**

ACAP advice

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

Commented [A60]: Added for consistency

**Scientific evidence for effectiveness in trawl fisheries**

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



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

**Minimum standards**

[Not applicable, as not recommended.](#)

~~None. Insufficient evidence to recommend this measure. Not currently recommended.~~

Commented [A61]: For consistency

**Need for combination**

[Not applicable, as not recommended.](#)

**Implementation monitoring**

[Not applicable, as not recommended.](#)

~~Not applicable.~~

**Research needs**

None identified.

**3.7. Net restrictor**

**ACAP advice**

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

Commented [A62]: Added for consistency

**Scientific evidence for effectiveness in trawl fisheries**

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

Commented [A63]: For consistency

**Notes and Caveats**

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

**Minimum standards**

~~None. Insufficient evidence to recommend this measure at present.~~ [Not applicable, as not recommended.](#)

**Need for combination**

[Not applicable, as not recommended.](#)

**Implementation monitoring**

[Not applicable, as not recommended.](#)

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

~~None identified/Not applicable.~~

Commented [A64]: For consistency

**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.

**4. GENERAL MEASURES**

**4.1. Time-Area closures**

ACAP advice

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

Commented [A65]: Added for consistency

**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**

None established.

Commented [A66]: for consistency?

**Need for combination**

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

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

**Implementation monitoring**

VMS/AIS systems or at-sea surveillance.

**Research needs**

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

**4.2. Lasers**

**ACAP advice**

Unproven and not recommended as a mitigation method at this time, bird welfare issues need to be addressed.

**Commented [A67]:** Added for consistency

**Commented [A68]:** for consistency, and to avoid repetition in research needs

**Scientific evidence for effectiveness in trawl fisheries**

~~Unproven and not recommended, bird welfare issues need to be addressed.~~ Preliminary research using lasers in a North Pacific trawl fishery did not show a detectable response in daylight hours, and that reactions to the laser at night varied between species, and whether the seabirds were feeding in the offal plume or following the vessel (Melvin *et al.* 2016).

**Notes and Caveats**

There are ongoing concerns about the safety (to both humans and birds) and efficacy of laser technology as a seabird bycatch mitigation tool.

**Minimum standards**

Not applicable, as not recommended.

Not Applicable.

**Need for combination**

Not applicable, as not recommended.

Not Applicable.

**Implementation monitoring**

Not applicable, as not recommended.

Not Applicable.

**Research needs**

Bird (and human) welfare issues must be addressed before further at-sea testing.

## 5. MEASURES UNDER DEVELOPMENT

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

In order to improve the performance of Bird Scaring Lines [BSLs](#), an off-setting towed device (Tamini Tabla) is under development in Argentina (Tamini *et al.* 2015). 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.

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

## REFERENCES

- Abraham, E.R. 2010: *Mincing offal to reduce the attendance of seabirds at trawlers*. Report prepared by Dragonfly for Department of Conservation, Wellington, New Zealand. 28 pp.
- Abraham, E.; and Pierre, J. 2007. Mincing, mealing and batching: waste management strategies aimed at reducing seabird interactions with trawl vessels. WG-FSA-07-42, SC-CAMLR XXVII, Hobart, Australia
- Abraham, E.R.; Pierre, J.P.; Middleton, D.A.J.; Cleal, J.; Walker, N.A.; Waugh, S.M. 2009. Effectiveness of fish waste management strategies in reducing seabird attendance at a trawl vessel. *Fisheries Research* **95**: 210–219.
- Abraham, E.R.; Thompson, F.N. 2009: Warp strike in New Zealand trawl fisheries, 2004-05 to 2006-07. *New Zealand Aquatic Environment and Biodiversity Report No. 33*. 21 pp.
- Bull, L.S. 2009. New mitigation measures reducing seabird bycatch in trawl fisheries. *Fish and Fisheries* **10**: 408–427.
- Cleal, F.V.; Pierre, J.P.; Clement, G. 2013. Warp strike mitigation devices in use on trawlers  $\geq$  28 m in length operating in New Zealand fisheries. Research report for the Department of Conservation, Wellington, New Zealand.
- Crofts, S. 2006a. Environmental effects and practicality of paired tori-line performance: testing buoys vs cones. Falklands Conservation, Stanley, Falkland Islands, 23 pp.
- Crofts, S. 2006b. Seabird interactions in the Falkland Islands Loligo Trawl Fishery 2005/2006. Falklands Conservation, Stanley, Falkland Islands, 22 pp.
- Crofts, S. 2006c. Preliminary assessment: seabird interactions in the Pelagic Southern Blue-whiting (*Micromesistius australis*) Surimi Fishery in the Falkland Waters – December 2006. Falklands Conservation, Stanley, Falkland Islands, 15 pp.
- Croxall, J.P. and Nicol, S. 2004. Management of Southern Ocean fisheries: global forces and future sustainability. *Antarctic Science* **16**: 569–584.
- Favero, M.; Blanco, G.; Garcia, G.; Copello, S.; Seco Pon, J.P.; Frere, E.; Quintana, F.; Yorio, P.; Rabuffetti, F.; Canete, G.; Gandini, P. 2011. Seabird mortality associated with ice trawlers in the Patagonian shelf: effect of discards on the occurrence of interactions with fishing gear. *Animal Conservation* **14**: 131–139.
- Gonzalez-Zevallos, D. and Yorio, P. 2006. Seabird use of discards and incidental captures at the Argentine hake trawl fishery in the Golfo San Jorge, Argentina. *Marine Ecology Progress Series* **316**: 175–183.
- Gonzalez-Zevallos, D.; Yorio, P.; Caille, G. 2007. Seabird mortality at trawler warp cables and a proposed mitigation measure: A case of study in Golfo San Jorge, Patagonia, Argentina. *Biological Conservation* **136**: 108–116.
- Hooper, J.; Agnew, D.; Everson, I. 2003. Incidental mortality of birds on trawl vessels fishing for icefish in Subarea 48.3. WG-FSA-03/79, SC-CAMLR XXII, Hobart, Australia.
- Kuepfer A. 2016. An Assessment of Seabird Bycatch in Falkland Islands Trawl Fisheries, July 2015 to June 2016. Falkland Islands Fisheries Department, Stanley, Falkland Islands, 33 pp.
- [Kuepfer, A. 2017. The Warp Deflector \(pinkie system\): Practical implications of a physical seabird bycatch mitigation device trialled in the Falkland Islands trawl fishery. Agreement on the Conservation of Albatrosses and Petrels, Eighth Meeting of the Seabird Bycatch Working Group, Wellington, New Zealand 4-6 September 2017, SBWG8 Inf 17.](#)

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

- Kuepfer, A., Gras, M.; Pompert, J. 2016. Discard management as a seabird by-catch mitigation tool: The effect of batch-discarding on seabird interactions in the Falkland Islands trawl fishery. Agreement on the Conservation of Albatrosses and Petrels, Seventh Meeting of the Seabird Bycatch Working Group, La Serena, Chile, 2- 4 May 2016, [SBWG7 Inf 25](#).
- Kuepfer, A. and Pompert, J. 2017 Discard management as a seabird bycatch mitigation tool: Results from further batch-discard trials in the Falkland Islands trawl fishery. Agreement on the Conservation of Albatrosses and Petrels, Eighth Meeting of the Seabird Bycatch Working Group, Wellington, New Zealand, 4 - 6 September 2017 [SBWG8 Inf 16](#).
- Melvin, E.F.; Dietrich, K.S.; Fitzgerald, S.; Cordoza, T. 2010. Reducing seabird strikes with trawl cables in the Pollock Catcher-Processor Fleet in the Eastern Bering Sea. *Polar Biology* **34**: 215–226.
- Melvin, E.F.; Asher, W.E.; Fernandez-Juricic, E.; Lim, A. 2016. Results of initial trials to determine if laser light can prevent seabird bycatch in North Pacific Fisheries. Agreement on the Conservation of Albatrosses and Petrels, Seventh Meeting of the Seabird Bycatch Working Group, La Serena, Chile, 2 - 4 May 2016, [SBWG7 Inf 12](#).
- Moreno, C.A.; Rubilar, P.S.; Marschoff, E.; Benzaquen, L. 1996. Factors affecting the incidental mortality of seabirds in the *Dissostichus eleginoides* fishery in the south-west Atlantic (Subarea 48.3, 1995 season). *CCAMLR Science* **3**: 79–91.
- Munro, G.M. 2005. Waste Discard Management in the Falkland Islands Trawl Fishery. *In*: Falklands Conservation, Stanley, Falkland Islands, 61pp.
- Nel, D. C.; Ryan, P.G.; Watkins, B.P. 2002. Seabird mortality in the Patagonian toothfish longline fishery around the Prince Edward Islands, 1996-2000. *Antarctic Science* **14**: 151–161.
- Pierre, J.P.; Abraham, E.R.; Middleton, D.A.J.; Cleal, J.; Bird, R.; Walker, N.A.; Waugh, S.M. 2010. Reducing interactions between trawl fisheries and seabirds: responses to foraging patches provided by fish waste batches. *Biological Conservation* **143**: 2779-2788.
- Pierre, J.P.; Abraham, E.R.; Cleal, J.; Middleton, D.A.J. 2012a. Reducing effects of trawl fishing on seabirds by limiting foraging opportunities provided by fishery waste. *Emu* **112**: 244–254.
- Pierre, J.P.; Abraham, E.R.; Richard, Y.; Cleal, J.; Middleton, D.A.J. 2012b. Controlling trawler waste discharge to reduce seabird mortality. *Fisheries Research* **131–133**: 30–38.
- Pierre, J.P.; Cleal, F.V.; Thompson, F.N.; Butler, H.; Abraham, E.R. 2013. Seabird mitigation in New Zealand's scampi trawl fishery. Research report for the Department of Conservation, Wellington, New Zealand.
- Pierre, J.; Gerner, M.; Penrose, L. 2014. Assessing the Effectiveness of Seabird Mitigation Devices in the Trawl Sectors of the Southern and Eastern Scalefish and Shark Fishery in Australia. 28 pp.
- Reid, T. and Edwards, M. 2005. Consequences of the introduction of Tori lines in relation to seabird mortality in the Falkland Islands trawl fishery, 2004/2005. Falklands Conservation, Stanley, Falkland Islands, 41 pp.
- Roe, J.O. 2005. Mitigation trials and recommendations to reduce seabird mortality in the pelagic icefish (*Champscephalus gunnari*) fishery (Sub-area 48.3). WG-FSA-05/ 59, SC-CAMLR XXIV. CCAMLR, Hobart, Australia, 18 pp.
- Snell, K.R.S.; Brickle, P.; Wolfaardt, A.C. 2011. Refining Tori lines to further reduce seabird mortality associated with demersal trawlers in the South Atlantic. *Polar Biology* **35**: 677–687.

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

- Sullivan, B.; Clark, J.; Reid, K.; Reid, E. 2009. Development of effective mitigation to reduce seabird mortality in the icefish (*Champsocephalus gunnari*) trawl fishery in Subarea 48.3. CCAMLR Working Group on Incidental Mortality Associated with Fishing. WG-IMAF-09/15.
- Sullivan, B.; Liddle G.M.; Munro, G.M. 2004. Mitigation trials to reduce seabird mortality in pelagic trawl fisheries (Subarea 48.3). WG-FSA-04/80. CCAMLR, Hobart.
- Sullivan, B.J.; Brickle, P.; Reid, T.A.; Bone, D.; Middleton, D.A.J. 2006b. Mitigation of seabird mortality on factory trawlers: trials of three devices to reduce warp cable strikes. *Polar Biology* **29**: 745–753.
- Sullivan, B.J. and Reid, T.A. 2003. Seabird mortality and Falkland Island trawling fleet 2002/03. WG-FSA-03/91. CCAMLR, Hobart.
- Sullivan, B.J.; Reid, T.A.; Bugoni, L. 2006a. Seabird mortality on factory trawlers in the Falkland Islands and beyond. *Biological Conservation* **131**: 495–504.
- Tamini, L.L.; Chavez, L.N.; Góngoora, M.E.; Yates, O.; Rabuffetti, F.L.; Sullivan, B. 2015. Estimating mortality of black-browed albatross (*Thalassarche melanophris*, Temminck 1882) and other seabirds in the Argentinean factory trawl fleet and the use of bird-scaring lines as a mitigation measure. *Polar Biology* **38**: 1867–1879.
- Weimerskirch, H.; Capdeville, D.; Duhamel, G. 2000. Factors affecting the number and mortality of seabirds attending trawlers and long-liners in the Kerguelen area. *Polar Biology* **23**: 236–249.
- Wienecke, B. and Robertson, G. 2002. Seabird and seal-fisheries interactions in the Australian Patagonian toothfish *Dissostichus eleginoides* trawl fishery. *Fisheries Research* **54**: 253–265.