Methodology for developing the Seabird-safe Fishing Toolkit

Summary

The Seabird-Safe Fishing Toolkit (the toolkit) is for fishing companies who want to make their pelagic longline fishing business more seabird-safe. The toolkit website[1] is designed to provide companies the information they need to meet consumer demands for seabird safe fishing.

The toolkit has been developed over 2022 – 2024 with social research processes to engage seabird bycatch mitigation science experts and end users. It will be regularly updated to ensure it contains the best available information.

This document outlines the methodology for developing the toolkit. Key steps were:

- thorough review of the available literature on the effectiveness of mitigation options (hereafter "seabird-safe practices") and verification techniques.
- defining ocean zones that reflect the seabird species present, their threat status, and vulnerability to longline fishing.
- categorising the effectiveness of seabird-safe practices at reducing seabird captures and the seabird-safeness of specific fisheries. These 'seabird-safety' categories take into consideration both the ocean zone in which the fishing operation occurs as well as the seabird-safe practices used
- categorising the level of confidence that the seabird-safe practices are implemented. These 'verification reliability' categories take into consideration whether different verification methods can determine whether seabird safe practices are being used, and whether specifications are being met.

Introduction

The world's albatrosses and petrels are facing an urgent and continuing conservation crisis. The international expert body the Agreement on the Conservation of Albatrosses and Petrels (ACAP) reports that thousands of albatrosses and petrels are continuing to die every year as a result of fisheries operations (ACAP 2024).

There is growing pressure on the tuna fishing industry to improve their sustainability credentials, and this includes marine wildlife conservation issues. Markets are increasingly responding by setting sustainability procurement policies. In many instances, large retailers will only sell tuna with sustainability credentials such as Marine Stewardship Council certification (MSC).

The Seabird-Safe Fishing Toolkit (hereafter "the toolkit") was developed by the Southern Seabirds Trust in partnership with the New Zealand Department of Conservation. It was developed in recognition that there are solutions available to reduce captures of seabirds,

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[1] www.doc.govt.nz/seabird-safe-fishing-toolkit

but that these solutions are not being widely adopted on vessels. Initial research revealed that a key challenge is that the best available information about how to reduce bycatch and verify good practices is fairly inaccessible for tuna businesses. The objective of the toolkit was therefore to make evidence-based information available to assist tuna companies and those supporting them to:

- make informed decisions that support reductions in seabird captures and
- transparently demonstrate the use of seabird-safe practices.

The toolkit contains four main elements:

1) zoning of the world's oceans according to the ACAP species present, their status, and vulnerability to longline fishing.
2) categories describing the effectiveness of seabird-safe practices at reducing seabird captures
3) categories describing the seabird-safeness of different seabird-safe practices in the different ocean zones.
4) categories describing the level of confidence different verification tools can provide, in terms of ensuring seabird-safe practices are in use, and meeting specifications.

The scope of the toolkit is for threatened seabird species, for which those listed on Appendix I of ACAP were used (Table 1), in all ocean basins and for large pelagic longline fishing vessels greater than 24 meters.

Background information collection

At the start of the process, two reports were commissioned. The first contained a literature review of information on five seabird-safe practices (as well as combinations of practices) for pelagic longline fisheries, specifically: bird-scaring lines, branchline weighting, night setting, hook-shielding devices and underwater bait setting devices. For each, the key design elements and specifications are provided, along with information on the efficacy in reducing seabird captures, the effects on target and other non-target catches, strengths and limitations and operational considerations (Pierre 2023a).

The second report compiled information on five main tools available to verify the implementation of seabird-safe practices: vessel position monitoring, dockside monitoring, at-sea inspections, at-sea fishery observers and electronic monitoring. Tools were characterised in terms of how they work, which practices they can be used to verify, limitations and constraints (Pierre 2023b).

These reports were predominately used as resources for the development of toolkit categories and content.

The project team also reviewed the frameworks, tools and organisations that support the fishing industry in improvements to better understand the wider landscape that the toolkit would exist in, and to ensure that it was aligned or could be easily integrated into existing frameworks. This provided a starting point for targeted engagement with specific organisations and frameworks.

Stakeholder engagement

To ensure that the toolkit reflected best available science and expertise and that it will provide useful information in an accessible format to end users, two advisory groups were set up. The expert panel included individuals with experience conducting pelagic longline mitigation studies, experience with seabird-safe practices on high seas vessels, or practical knowledge of fisheries management and verification tools in relation to seabird-safe practices. This group therefore had collective expertise on the practicalities of implementing seabird-safe practices and verification on high seas vessels. They were tasked with using an evidence-based approach to inform toolkit decisions, relying on scientific and technical information (to the extent it exists), and using the panel's own knowledge and direct experience.

The ground-truthing group included members from tuna fishing companies, tuna suppliers, fisheries managers, environmental NGOs who work directly with fisheries and fisheries ecolabels. This group was tasked with ensuring that the different needs of end users are reflected in the design and content of the toolkit.

Both groups were engaged through a variety of methods, including: online meetings, in-person sub-group meetings, surveys and requests for feedback on specific documents.

In addition to these two groups, the toolkit project team consulted with the tuna industry more widely as part of the Asia-Pacific Economic Cooperation Ocean and Fisheries Working Group. A Roundtable event was held on 29 November 2023 attended by 73 people from ten APEC economies, representing around 30 different fishing companies or industry bodies (APEC 2024). This event provided information on the market drivers mobilising the industry to improve bycatch management and on how the toolkit can assist seafood companies working to address bycatch of seabird species.

Participants actively engaged in discussion at the roundtable and provided input on toolkit development, such as content and the need for capacity building (APEC 2024). In addition, information was collected prior to the event via a web-based survey, completed by 34 participants, which explored levels of pre-existing knowledge and reasons for interest in seabirds and seabird bycatch (APEC 2024). Results indicated that there was a high interest in the seabird bycatch issue from participants, but that knowledge of the threats to seabirds is low to medium, suggesting an area for future engagement (APEC 2024).

Development of seabird-safe categories

The toolkit was designed to allow fishing companies to determine how seabird-safe their current fishing is or investigate how seabird-safe a practice or suite of practices is. The seabird-safe categories were assigned based on two things: 1) where the fishery is taking place relative to the seabird ocean zones identified on the toolkit maps and 2) how effective the practice(s) selected are at reducing captures of seabirds (Figure 1). The ocean zones were developed to reflect species vulnerability (areas where birds of high conservation status are present), species diversity (areas where high species diversity occurs) and susceptibility (areas where *Procellaria* petrels are present, which increase susceptibility of other species to bycatch). The effectiveness of a seabird-safe practice or combination of practices was based on the magnitude of the effect and the level of evidence. To easily communicate to the toolkit audience, we use the term "proof" instead of "evidence."

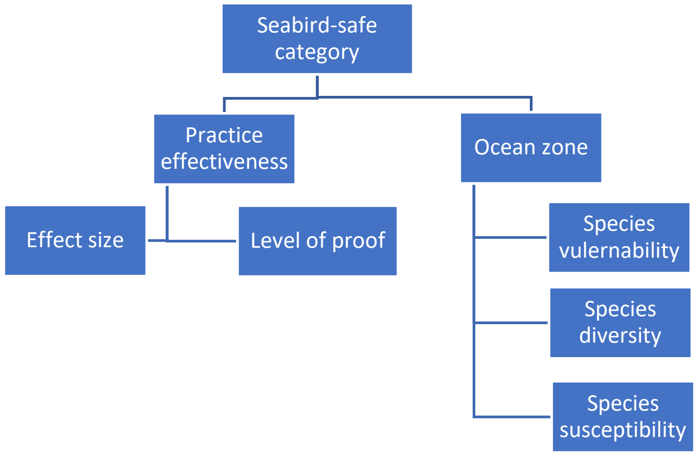

Figure 1 Process for determining the overall seabird-safe category based on ocean zone and practice effectiveness.

Development of ocean zones

The toolkit ocean zones provide a simple delineation of ocean areas into zones of high, medium and low risk of bycatch of ACAP-listed species by large vessel pelagic longline fisheries. These zones were defined around three separate aims to identify areas where i) birds of high conservation status are present (threaten species layer, reflecting species vulnerability), ii) high species diversity occurs (species diversity layer) and, iii) where *Procellaria* petrels are present (*Procellaria* petrel layer). The *Procellaria* petrel layer was included due to the important role that *Procellaria* petrels can play, through their aggressive feeding and diving capabilities, in increasing the availability of baited hooks available to other seabirds such as albatross species (Jiménez et al 2012).

A key over-arching objective of the toolkit is to make information readily available and easy to understand. To achieve this for the complex spatial data used, each constituent layer was categorised into simple high, medium and low categories using the criteria outlined below. This categorisation is based on initial development work based on considering seabird species in the South Pacific region. At the time of writing (July 2024), work was continuing to broaden the range of seabird input data and further refine the methods used to ensure the ocean zones can be suitably applied at a global scale.

In order to share the resulting spatial data with toolkit users a dedicated SeaSketch (https://www.seasketch.org/) project was developed. This platform was chosen for its simple and intuitive user experience, flexibility and ease of adding additional relevant data layers such as boundaries of fisheries management areas.

Species distributions

The species distributions used to develop the ocean zones were based on tracking data deposited in the BirdLife Seabird Tracking Database (http://seabirdtracking.org/) as requested and downloaded by ACAP and BirdLife International (BLI) in late 2023 for the primary purpose of updating the ACAP Species Assessment distribution maps. The request to data owners specified the intended use of resulting maps in the toolkit, and a further update on the development of the toolkit has been provided to relevant data owners. The tracks included data collected by a variety of devices, including Global Positioning System (GPS) loggers, Platform Terminal Transmitters (PTTs) and Global Location Sensor (GLS) loggers. This data request gives access to over 10,000 bird tracks, with close to five million position data points, to inform the development of the species distributions for the toolkit, as summarised by Rowely et al (2024). Further to this data request additional recent tracking data was obtained for a range of New Zealand breeding species.

All 31 ACAP-listed species are shown in Table 1. For the purpose of the toolkit, Antipodean (*Diomedea antipodensis antipodensis*), Gibson's (*D. a. gibsoni*), Southern Buller's (*Thalassarche bulleri bulleri*) and Northern Buller's (*T. b. platei*) albatrosses were treated as separate taxa, giving a total of 33 taxa in Table 1.

Table 1. The seabird species in scope of the toolkit, their IUCN Red List status and the number of island groups for which tracking data was available to us compared to the total number of Island Groups where that species breed. CR = Critically Endangered, EN = Endangered; VU = Vulnerable; NT = Near Threatened, LC = Least Concern. Island groups are as defined by ACAP (https://data.acap.aq/). Island groups with breeding populations of <10 pairs were excluded from totals. Data from species in bold were included in the initial ocean zones developed for the South Pacific as of July 2024.

Species	IUCN status	*n* tracked island groups Adult	Juv/Imm	Total island groups
Northern Royal Albatross	EN	2	1	2
Southern Royal Albatross	VU	1	0	2
Wandering Albatross	VU	4	0	4
Antipodean Albatross	EN	1	1	1
Gibson's Albatross	EN	1	1	1
Amsterdam Albatross	EN	1	1	1
Tristan Albatross	CR	1	1	1
Sooty Albatross	EN	3	2	5
Light-mantled Albatross	NT	4	0	9
Waved Albatross	CR	1	0	1
Black-footed Albatross	NT	1	1	5
Laysan Albatross	NT	1	0	5
Short-tailed Albatross	VU	1	0	2
Atlantic Yellow-nosed Albatross	EN	2	0	2
Indian Yellow-nosed Albatross	EN	2	0	4
Grey-headed Albatross	EN	5	1	7
Black-browed Albatross	LC	7	2	14
Campbell Albatross	VU	1	0	1
Northern Buller's Albatross	NT	1	1	1
Southern Buller's Albatross	NT	2	1	2
Shy Albatross	NT	1	1	1
White-capped Albatross	NT	1	0	2
Chatham Albatross	VU	1	0	1
Salvin's Albatross	VU	1	0	2
Southern Giant Petrel	LC	6	3	22
Northern Giant Petrel	LC	2	3	9
White-chinned Petrel	VU	6	2	8
Spectacled Petrel	VU	1	0	1
Black Petrel	VU	1	0	1
Westland Petrel	EN	1	0	1
Grey Petrel	NT	3	0	8

Pink-footed shearwater	VU	0	0	2
Balearic Shearwater	CR	1	1	1

Individual species maps that combined all available data for each species were developed using the methodology described by Fischer et al (2024). To prioritise our workload, an initial focus was made on species found in the Pacific Ocean, and at the time of writing (July 2024) those species shown in bold in Table 1 have been processed and included in initial ocean zone maps for the South Pacific Ocean. The project team will continue to process data for the remaining species necessary to generate global ocean zones.

Whilst the data used represents the most complete input data set that could be accessed within the time bounds of the project, it is important to note that there are other existing data sets (mostly data sets that have not yet been deposited in the BirdLife Seabird Tracking Database) and that there remain gaps in collective tracking effort. In particular, there remain colonies of some species which have never been tracked, and life-history states that have not been tracked at numerous colonies, particularly juvenile and immature birds. The availability of data to us by island group and life-history stage is summarised in Table 1. Ongoing efforts will be made to add any additional existing data and consideration will be given to ways to extrapolate or predict the distribution of birds from breeding sites that have not been tracked. This could involve using distribution modelling techniques, with the use of such generated data sets improving the underlying species distributions used in the toolkit.

In order to achieve global-scale ocean zones representative of bycatch risk to seabirds consideration will be given to including data from other candidate seabird species in addition to those species currently listed by ACAP. An additional consideration is that some species have populations of particular concern, such the ACAP recognised High Priority Populations. Our methods would allow for distributions of these populations to be generated and considered as separate, highly threatened taxa.

Threatened species layer

Using the individual distributions of all species, each species was classified according to its IUCN Red List status (Table 1). To identify where threatened species occur, areas were classified according to the following working definitions:

- High occurrence – ocean areas within the combined 95% distribution kernels of all critically endangered species, 75% distribution kernels of all endangered species and 50% distribution kernels of vulnerable species.
- Medium occurrence – ocean areas outside of the high occurrence areas and within the combined area of 99% distribution kernels of critically endangered species, 95% distribution kernels of endangered species and 75% distribution kernels of vulnerable species.
- Low occurrence – ocean areas outside of high and medium occurrence areas.

Species diversity layer

Using the individual distributions of all species, areas of high diversity were classified according to the following working definitions:

- High diversity – ocean areas where either the 50% distribution kernels of two or more species overlap, the 75% distribution kernels of three or more species overlap or the 95% distribution kernels of four or more species overlap.
- Medium diversity – ocean areas outside of high diversity areas where ether the 75% distribution kernels of two or more species overlap, the 95% distribution kernels of three or more species overlap or the 99% distribution kernels of four or more species overlap.
- Low diversity – ocean areas outside of high and medium diversity areas.

Procellaria petrel layer

Individual utilization distributions of the four *Procellaria* petrel species were merged into a single utilization, with each component species contribution weighted according to population size. The resulting distribution shows the relative occurrence of *Procellaria* petrels of any species and was classified according to the following working definitions:

- High Procellaria occurrence – ocean areas within the 75% distribution kernel of combined Procellaria species.
- Medium Procellaria occurrence – ocean areas outside of high Procellaria occurrence and within the 75% distribution kernel of combined Procellaria species.
- Low Procellaria occurrence – ocean areas outside of high and medium Procellaria occurrence.

Ocean zones

The overall ocean zones, indicative of relative risk of bycatch of ACAP species, were then developed by merging each of the three component layers, and classified accordingly:

- High risk zone – ocean areas where there is high threatened species occurrence, high species diversity or high Procellaria occurrence.
- Medium risk zone – ocean areas outside of high risk areas where there is medium threatened species occurrence, medium species diversity or medium Procellaria occurrence.
- Low risk zone – ocean areas outside of high and medium risk areas.

Assigning effectiveness categories for seabird-safe practices

The seabird-safe practices selected are those that have been demonstrated to be effective and are commercially available. This means that practices such as blue-dyed bait and lasers, for which there is no proof of effectiveness, are not included in the toolkit. A note is included in the toolkit explaining this.

To determine the effect size, information from Pierre 2023a (see section 2.1) was compiled in an Excel spreadsheet. Information recorded included practice/combination of practices, region where study took place, bycatch or interaction rate when practice applied (treatment), bycatch or interaction rate when practice is not applied (control) and the source. Where quantitative information was available, e.g. a bycatch rate or interaction rate, this information was used to calculate a % reduction in seabird interactions for each study. Only those studies that had a clear treatment using the practice and a control not using the practice were included. This information is provided in Annex 1.

This information, along with inputs from the Expert Panel, was used to assign practice effect categories as follows:

- Very high (interactions with threatened seabirds is minimised): >95% reduction in bycatch AND overall bycatch of threatened is seabirds ≤0.05birds/1000 hooks.
- High (a few threatened seabirds may still be caught): 80-95% reduction in bycatch.
- Medium (threatened seabirds can still be caught): 40-80% reduction in bycatch.
- Low (threatened seabirds can still be caught): <40% reduction in bycatch.

In cases where there were multiple studies and the results varied, the category where there was most evidence (hereafter "proof) was assigned. For example, if the majority of studies showed that the reduction in seabird captures was 40-80%, the Medium category was assigned. Where there was an even split in the number of studies between two categories, the more precautionary (lower) category was assigned.

A decision tree was developed in consultation with the Expert Panel to determine the level of proof (high, medium or low) associated with the bycatch effectiveness (Figure 2). The decision tree was applied to the whole body of proof for each practice or combination of practices. It was used to evaluate whether there was more than one peer reviewed paper in the studies reviewed, whether any individual study used more than 30,000 hooks in the trial or statistical significance was indicated in the results. A threshold minimum sample size was used to remove any short-term trials or ad-hoc observations that may not have collected enough proof to robustly determine an effect. The threshold of 30,000 hooks was based on reviewing the number of hooks used in each study and selecting a natural cut-off point indicative of a minimum value used in peer-reviewed quality research outputs. Where no studies on the effect of a seabird-safe practice exists, it was automatically assigned as low level of proof.

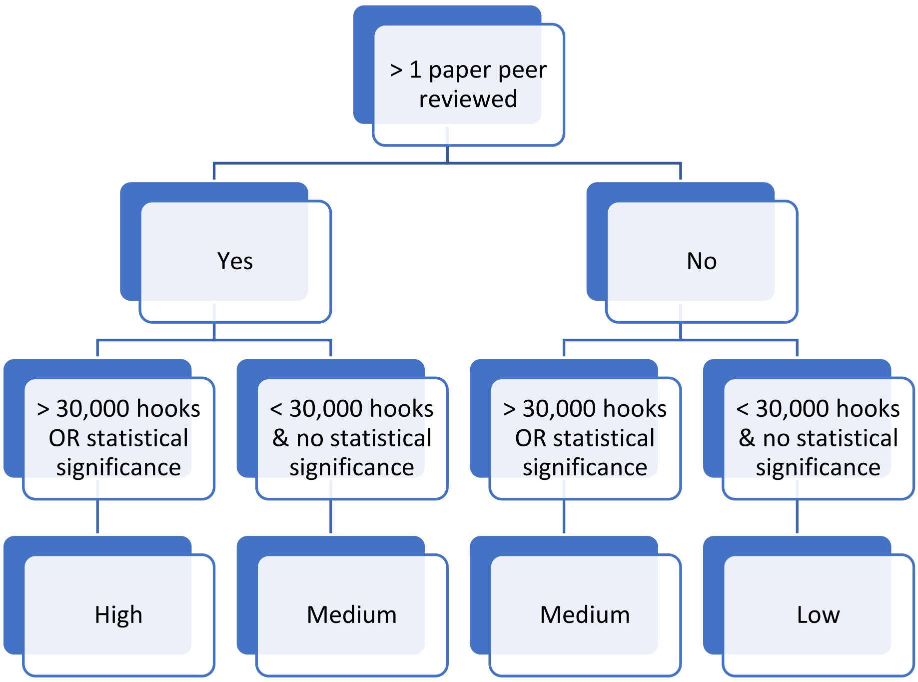

Figure 2 Decision tree used to determine level of proof of practice effectiveness

Once the effect size and level of proof was determined for each practice or combination of practices, an overall category was assigned to the practice effectiveness by applying Table 1. More detail on how this was determined for each practice and combination is provided in Annex 1.

Table 1 Categorisation of mitigation effectiveness based on effect size and level of proof

Effect size	Level of proof	Practice effectiveness (overall)
Very high (Minimised)	High	Very high (Minimised)
Very high (Minimised)	Medium	High
Very High (Minimised)	Low	Medium
High	High	High
High	Medium	Medium
High	Low	Low
Medium	High	Medium
Medium	Medium	Low
Medium	Low	Low
Low	High	Low
Low	Medium	Low
Low	Low	Low

Assigning seabird-safe categories

The overall seabird-safe category was applied considering the ocean zone and the practice effectiveness by applying Table 2.

Table 2 Categorisation of seabird-safe level based on risk zone and practice effectiveness

Seabird-safe category	Ocean zone (risk)	Practice effectiveness
Best seabird safety: Threatened seabirds are unlikely to be caught (i.e. you have minimised captures).	High	Very high (Minimised)
	Medium	High or Very high (Minimised)
	Low	Medium, High or Very high (Minimised)
Partial seabird safety: Threatened seabirds might still be caught.	High	High
	Medium	Medium
	Low	Low
Poor seabird safety: Threatened seabirds are likely to be caught.	High	Medium
	Medium	Low
	Low	Nil
No seabird safety: Threatened seabirds are highly likely to be caught.	High	Low or Nil
	Medium	Nil

Based on the available information, the seabird safe risk categories for each ocean zone are provided in Table 3.

Table 3 Seabird safe risk categories for each practice in the high, medium and low risk zones.

Ocean zone (risk)	seabird-safe practices	Combined practice effectiveness + level of proof	Seabird-safe category
High	BSL + Night setting + Line weighting	Very high (Minimised)	Best
	Hookpods	Very high (Minimised)	Best
	Underwater bait setter	High	Partial
	Night setting + Line weighting	High	Partial

	BSL + Night setting	High	Partial
	BSL + Line weighting	High	Partial
	BSL	Medium	Poor
	Night setting	Medium	Poor
	Line weighting	Low	No
Medium	BSL + Night setting + Line weighting	Very high (Minimised)	Best
	Hookpods	Very high (Minimised)	Best
	Underwater bait setter	High	Best
	Night setting + Line weighting	High	Best
	BSL + Night setting	High	Best
	BSL + Line weighting	High	Best
	BSL	Medium	Partial
	Night setting	Medium	Partial
	Line weighting	Low	Poor
Low	BSL + Night setting + Line weighting	Very high (Minimised)	Best
	Hookpods	Very high (Minimised)	Best
	Underwater bait setter	High	Best
	Night setting + Line weighting	High	Best
	BSL + Night setting	High	Best
	BSL + Line weighting	High	Best
	BSL	Medium	Best
	Night setting	Medium	Best
	Line weighting	Low	Partial

1. *Assigning reliability categories for verification*

The toolkit also provides information on the reliability of independent verification tools for specific seabird-safe practices when applied at the vessel level. The reliability category (High, Medium, Low, None) was assigned based on whether it was possible to verify that a specific seabird-safe practice is being used and whether the specifications are adhered to. The categories are:

- **Best** reliability: Can verify the seabird-safe practice is being used and all specifications are met.
- **Partial** reliability: Can verify the seabird-safe practice is being used and some, but not all, specifications are met.
- **Poor** reliability: Cannot verify the seabird-safe practice is being used but can verify that some specifications are met.
- No reliability: Cannot verify the seabird-safe practice is being used or if specifications are met.

A sub-group of the Expert Panel met to review whether independent verification tools would be able to verify if specific seabird-safe practices are used and whether they followed specifications (Tables 4-8). Verification tools were selected based on whether they were effective for one or more seabird-safe practice and whether they were commercially available. This information was used to determine the reliability category. Only independent verification tools were considered, as fisheries reporting provides lower confidence due to a perceived conflict of interest. In addition, tools for at-sea inspections (aerial or vessel-based) were not considered as these are typically used by Government to detect non-compliance across a fleet or fishery, so the vessel-level sample would be too small to verify practices are being used. Verification tools included in the toolkit are:

- Human observers
- Dockside inspection
- Remote Monitoring Systems (VMS/AIS)
- Electronic monitoring
- Dockside inspection and electronic monitoring
- Bird-scaring line tension device
- Underwater bait setter sensor

Using a combination of independent verification tools, a higher level of reliability can be gained than by using verification process in isolation. For example, when used together a combination dockside inspection and electronic monitoring can provide a high level of reliability for verifying the presence and correct use of hook shielding devices. This would suggest that to achieve a high level of reliability in all ACAP best practice options that a tool for verifying aerial extent and line weighting regimes should be a top priority to ensure that fleets opting for electronic monitoring can be effectively monitored.

Table 4 Reliability of verification methods for bird-scaring lines

Verification method	Can verify if used (BSL deployed)	Specifications					Comments	Reliability
		Attachment height	Adjustable attachment point	Aerial extent	Streamer config	In water section (post swivel)		
Human observers (independent)	Y	Y	Y	Y	Y	Y	Aerial extent monitoring - day only Measuring aerial extent is inherently difficult but observers are the best placed to do so	**Best**
Dockside inspection (independent)	N	Y	Y	N	Y	Y	Assumes no change at-sea Presence on board: pre-departure can tell whether they are on the vessel; post-trip not helpful as could have lost gear at sea	**Poor**
Remote Monitoring Systems (VMS/AIS)	N	N	N	N	N	N		**No**

Verification method	Can verify if used (BSL deployed)	Specifications					Comments	Reliability
		Attachment height	Adjustable attachment point	Aerial extent	Streamer config	In water section (post swivel)		
Electronic monitoring (independent)	Y	N	Y	N	Y (low confidence)	N	Could be improved if put markers on the line There is potential to develop methods to confirm attachment height and aerial extent	**Partial**
Dockside monitoring + EM	Y	Y	Y	N	Y	Y	Note potential to develop EM methods to confirm aerial extent	**Partial**
BSL tension devise	Y	N	N	N	N	N	Can only tell if it was used during setting, but not for which part of the set Only a reliable tool when integrated into other systems to detect setting (i.e., EM)	**Partial**
Underwater bait setter sensor	N	N	N	N	N	N		**No**

Table 5 Reliability of verification methods for line weighting

Verification method	Can verify if used (presence on branch line)	Specifications		Comments	Reliability
		Distance from hook on set	Weight in water		
Human observers (independent)	Y	Y	Y	Feasible, but to get accurate weight in water requires work to be done	**Best**
Dockside inspection (independent)	Y	N	Y	Relies on no change when at sea; replacement of lost gear Underlying uncertainty if unweighted gear on board Feasible, but to get accurate weight in water requires work to be done	**Partial**
Remote Monitoring Systems (VMS/AIS)	N	N	N		**No**
Electronic monitoring (independent)	Y	N	N	Same for night setting Capturing presence becomes difficult if water on lens and/or at night	**Partial**

Verification method	**Can verify if used (presence on branch line)**	**Specifications**		**Comments**	**Reliability**
		Distance from hook on set	**Weight in water**		
				Issue with swivels - won't be able to tell whether there's enhanced weighting in place	
Dockside inspection + EM	Y	N	Y	Note priority to confirm distance from hook	**Partial**
BSL tension devise	N	N	N		**No**
Underwater bait setter sensor	N	N	N		**No**

Table 6 Reliability of verification methods for night setting

Verification method	Can verify if used (time setting occurs)	Location	Comments	Reliability
VMS	Y - Indirect	Y - Indirect	tamper proof but low resolution	**Best**
AIS	Y - Indirect	Y - Indirect	not tamper proof but better resolution	**Best**
Dockside inspection (independent)	N	N	N	**Best**
Human observers (independent)	Y - direct	Y - direct	Issues - only 1 obs for 24hr, accuracy of reporting	**Best**
Electronic monitoring (EM) (independent)	Y - direct	Y - direct	Requires minimum specs, on-board system standards, data processing standards Note winch sensors may be used as part of the system	**Best**
Dockside inspection + EM	Y	Y		**Best**
BSL tension devise	N	N	Only if data integrity can be confirmed and maintained Same issue as company & independent monitoring/observers	**No**

Verification method	Can verify if used (time setting occurs)	Location	Comments	Reliability
			Only records when BSL in use	
Underwater bait setter sensor	N	N		**No**

Table 7 Reliability of verification methods for Hookpods

Verification method	**Can verify if used**		**Specifications**	**Comments**	**Reliability**
	Verification whether attached to branch line	**Verification whether hook inserted in pod before setting**	**ACAP-approved Hook Shielding Device**		
VMS	N	N	N		**No**
AIS	N	N	N		**No**
Dockside inspection (independent)	Y	N	Y	Assumes no change at sea	**Poor**
Human observers (independent)	Y	Y	Y	Would be 100%. What proportion of hooks need to be observed?	**Best**
Electronic monitoring (independent)	Y	Y	N		**Partial**
Dockside inspection + EM	Y	Y	Y		**Best**
BSL tension devise	N	N	N		**No**

Verification method	Can verify if used		Specifications	Comments	Reliability
	Verification whether attached to branch line	Verification whether hook inserted in pod before setting	ACAP-approved Hook Shielding Device		
Underwater bait setter sensor	N	N	N		No

Table 8 Reliability of verification methods for underwater bait setter

Verification method	Can verify if used		Specifications	Comments	Reliability
	Verification whether installed	Verification if baited hooks inserted in capsule	Set at ACAP-prescribed depth and sink rate		
VMS	N	N	N		No
AIS	N	N	N		No
Dockside inspection (independent)	Y	N	N		Poor
Human observers (independent)	Y	Y	Y		Best

Verification method	Can verify if used		Specifications	Comments	Reliability
	Verification whether installed	Verification if baited hooks inserted in capsule	Set at ACAP-prescribed depth and sink rate		
Electronic monitoring (independent)	Y	Y	N		**Partial**
Dockside inspection + EM	Y	Y	N		**Partial**
BSL tension devise	N	N	N		**No**
Underwater bait setter sensor	Y	Y	Y		**Best**

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References

APEC. 2024. Report on the APEC Roundtable – The Seabird-Safe Longline Fishing Toolkit. APEC Ocean and Fisheries Working Group. APEC project: OFWG 07 2023S. Online: https://www.apec.org/docs/default-source/publications/2024/3/224_ofwg_report-on-the-apec-roundtable-the-seabird-safe-longline-fishing-toolkit.pdf?sfvrsn=4d93f83b_2

Fischer, J.H.; Carneiro, A.; Rowley, A.; Debski, I. 2024. An update on the New Zealand large-scale monitoring and tracking programme with improved insights into trends and distribution. PaCSWG8 Doc 03. Eighth Meeting of the Population and Conservation Status Working Group. Lima, Peru, 9 August 2024

Jiménez, S., Domingo, A., Abreu, M. and Brazeiro, A. 2012. Bycatch susceptibility in pelagic longline fisheries: are albatrosses affected by the diving behaviour of medium-sized petrels? Aquat. Conserv: Mar. Freshw. Ecosyst. 22: 436–445.

Rowley, A.; Carneiro, A.; Debski, I. 2024. Developing Ocean Zones for the Seabird-Safe Fishing Toolkit. Joint SBWG12/PaCSWG8 Inf 12. Joint Twelfth Meeting of the Seabird Bycatch Working Group and Eighth Meeting of the Population and Conservation Status Working Group. Lima, Peru, 9 August 2024

Pierre, J.P. 2023a. Mitigation of seabird bycatch in pelagic longline fisheries: Best practice measures, evidence and operational considerations. Report prepared for Southern Seabirds and NZ Department of Conservation.

Pierre, J.P. 2023b. Verifying the implementation of seabird bycatch mitigation measures in pelagic longline fisheries: Methods, capabilities and applications. Report prepared for Southern Seabirds and NZ Department of Conservation.