Department of Conservation
Te Papa Atawhai

SOUTHERN SEABIRDS

Seabird-Safe Fishing Toolkit Methodology

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Contents

1 Summary

The Seabird-Safe Fishing Toolkit (the toolkit) is a website[1] for fishing companies who want to make their pelagic longline fishing business more seabird-safe. Seabird-safe fishing is when fishers use and monitor effective practices to avoid catching seabirds.

We (Southern Seabirds Trust and the New Zealand Department of Conservation) developed the toolkit to provide longline fishing business the information they need to meet consumer demands for seabird-safe fishing.

We developed the toolkit over 2022 – 2024 through social research processes to engage seabird bycatch mitigation science experts and end users. We will regularly update the toolkit 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 monitoring methods
- defining 'seabird risk 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. The 'seabird-safety' ratings take into consideration both the seabird risk zone in which the fishing operation occurs, and the seabird-safe practices used
- categorising the level of confidence that the seabird-safe practices are being used on vessels. The 'monitoring methods' ratings take into consideration whether different monitoring methods can determine whether seabird-safe practices are being used, and whether specifications are being met.

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

2 Introduction

2.1 Seabird bycatch – a problem for seabirds and fisheries businesses

The world's albatrosses and petrels face an urgent 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 in fisheries operations[2]. 'Seabird bycatch' is the accidental capture and often death of seabirds in fishing gear.

Large pelagic longline fisheries targeting tuna and swordfish on the high seas pose the highest threat to many ACAP listed species (Anderson, et al. 2011; Dias, et al. 2019; and Phillips, et al. 2016). Some species, such as the Antipodean albatross face imminent extinction unless mortality from bycatch in these fisheries is minimised (Richard, et al, 2024).

Seabird bycatch also threatens the economic success of tuna longline businesses. Every seabird on a hook means less tuna is caught, and removing bycaught birds disrupts fishing. However, the economic costs are no longer just marginal. Tuna longline businesses may be excluded from high-value markets unless they can meet sustainability policies and requirements of their buyers.

There is growing pressure from consumer markets for sustainably caught tuna. Some large retailers will only sell tuna with sustainability credentials such as Marine Stewardship Council certification (MSC). The MSC certification requirements released in July 2024[3] mean that fisheries will need to implement seabird-safe practices and show that they are minimising seabird bycatch.

2.2 The solutions – bycatch mitigation that makes fishing safe for seabirds

Highly effective methods have been developed to mitigate the bycatch of seabirds in fisheries, including pelagic longline fisheries. ACAP provides global leadership in seabird bycatch best practice advice. Evidence shows that using ACAP best practice mitigation can reduce seabird bycatch to close to zero.

[2] ACAP Resolution to address the conservation crisis faced by albatrosses and petrels due to the threat of fisheries bycatch (Resolution 8.5)
[3] The MSC Fisheries Standard version 3.1 | Marine Stewardship Council

While seabird-safe practices are available, they are not being widely adopted on vessels. Solving the seabird bycatch problem requires addressing a range of barriers to implementing seabird-safe fishing.

2.3 How the toolkit can help

One key barrier to implementing seabird-safe fishing is 'information inaccessibility.' Businesses working on the seabird bycatch issue seek information about whether they are fishing in an area where there are threatened seabirds, what the best seabird-safe practices are for that area, and how to best monitor if the practices are being used on vessels. The information does exist, but it is hard to find. It is often buried in academic papers and in databases around the world.

The objective of the toolkit is to make evidence-based information available for tuna companies and those supporting them to:

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

The toolkit contains three main elements:

1. **seabird risk zone maps** – where we have zoned the world's oceans according to the seabird species present, their status, and vulnerability to longline fishing
2. **seabird safety ratings** – describing the effectiveness of seabird-safe practices at reducing seabird captures in the different seabird risk zones
3. **monitoring ratings** – describing the level of reliability of different monitoring methods, in terms assuring seabird-safe practices are being used, and meeting specifications.

The scope of the toolkit is for seabird species listed on Appendix I of ACAP or species being actively considered as candidates for listing[4] (see Table 1). The toolkit is applicable for large pelagic longline fishing vessels greater than 24 meters, working in all ocean basins.

3 Collecting background information

At the start of the process, we commissioned two reports to help us develop the toolkit ratings and content. The first is a literature review of information on five seabird-safe

[4] Those species with the same or higher score for suitability of listing than currently listed species (Tasker et al 2024).

practices and combinations of practices for pelagic longline fisheries. The practices include bird-scaring lines, line weighting (on the branchlines), night setting, hook-shielding devices and underwater bait setting devices.

For each seabird-safe practice, the report provides the:

- key design elements and specifications and information on the efficacy in reducing seabird captures
- 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).

We 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.

4 Engaging stakeholders

Two advisory groups were set up to ensure that the toolkit reflects best available science and makes the information accessible for users.

The expert panel are experts on the practicalities of implementing seabird-safe practices and monitoring on high seas vessels. This group 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 monitoring methods in relation to seabird-safe practices. 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 non-governmental organisations (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, we consulted with the tuna industry more widely as part of the Asia-Pacific Economic Cooperation (APEC) Ocean and Fisheries Working Group. We held an APEC business roundtable event on 29 November 2023. It was 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 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).

5 Developing the seabird risk zones

The toolkit 'seabird risk zones' provide a simple delineation of ocean areas into zones of relative risk of bycatch of seabird species by large vessel pelagic longline fisheries. Noting that 'risk' has multiple meanings in fisheries management, for the Toolkit, 'risk' describes the presence of threatened seabirds vulnerable to bycatch.

The zones were defined based on the distribution of each in scope seabird species. The risk layer reflects 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 simplify the complex spatial data, we first developed bespoke seabird distribution layers based on the best available information. Where sufficient tracking data was available, we defined each species distribution into areas of three categories of likely occurrence. Using the criteria outlined below we were then able to categorise ocean areas into simple high, medium and low risk areas. At the time of writing (November 2025), we have completed this assessment in the Southern Hemisphere only. Work continues to broaden the range of seabird input data to ensure the seabird zones can be applied at a global scale.

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

5.1 Species distributions

The species distributions used to develop the ocean zones were initially 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 tracks include 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 included over 10,000 bird tracks, with close to five million position data points.

Additional data were obtained from the Seabird Tracking Database and directly from relevant researchers for species considered as candidates for listing on Appendix I of ACAP. We also obtained additional tracking data for a range of New Zealand breeding species, and we continue to seek access to other relevant datasets for future updates.

We developed individual species maps by integrating all available data for each species. The mapping methodologies were determined by data availability, resulting in three distinct approaches:

- **Representative data** available: we applied the methodology described by Fischer et al. (2024), using 99%, 95%, and 75% kernel utilisation densities derived exclusively from tracking data.
- **Partially representative data available**: we based the 99% kernel utilisation densities on range maps sourced from the BirdLife Data Zone; we combined tracking data and range maps to develop the 95% densities; and we derived the 75% densities from tracking data using the methodology described by Fischer et al. (2024).
- **Low/No representative data available**: we based the 99% kernel utilisation densities on range maps from the BirdLife Data Zone and did not develop any further densities.

A breakdown of the methodology used for each species is provided in Appendix Table 1. For the Overlap Assessment Tool, only the 99% utilisation density or range map was used for each species. The SeaSketch mapping tool displays all available utilisation densities (99%, 95%, and 75%).

To prioritise our workload, we initially focused on species found in the Southern Hemisphere. At the time of writing (November 2025) ocean zone maps have been produced only for the Southern Hemisphere. We will continue to process data for the remaining species necessary to generate global seabird risk zones.

Table 1. The seabird species for which data has been used to develop seabird risk zones, their IUCN Red List status and the number of colonies for which tracking data were available to us. CR = Critically Endangered, EN = Endangered; VU = Vulnerable; NT = Near Threatened, LC = Least Concern. * - species for which bespoke distribution layers were not yet complete at the time of writing (November 2025). Colony groups are as defined by ACAP (https://data.acap.aq/).

Common name	IUCN Status	*N* colonies tracked
Amsterdam Albatross	EN	1
Antipodean Albatross	EN	4
Atlantic Yellow-nosed Albatross	EN	4
Balearic Shearwater	CR	5
Black Petrel	VU	2
Black-browed Albatross	LC	13
Black-footed Albatross	NT	3
Campbell Albatross	VU	1
Campbell Albatross	VU	1
Cory's Shearwater	LC	*
Flesh-footed Shearwater	NT	4
Gibson's albatross	EN	1
Grey Petrel	NT	4
Grey-headed Albatross	EN	6
Indian Yellow-nosed Albatross	EN	3
Laysan Albatross	NT	4
Light-mantled Albatross	NT	9
Northern Buller's albatross	NT	1
Northern Fulmar	LC	*
Northern Giant Petrel	LC	5
Northern Royal Albatross	EN	3
Pink-footed Shearwater	VU	3
Polynesian Storm Petrel	EN	*
Salvin's Albatross	VU	2
Scopoli's Shearwater	LC	*
Short-tailed Albatross	VU	2
Shy Albatross	NT	3
Sooty Albatross	EN	6
Sooty Shearwater	NT	*
Southern Buller's Albatross	NT	2
Southern Giant Petrel	LC	*
Southern Royal Albatross	VU	1
Spectacled Petrel	VU	*
Tristan Albatross	CR	2
Wandering Albatross	VU	7
Waved Albatross	CR	1
Wedge-tailed Shearwater	LC	*
Westland Petrel	EN	1
White-capped Albatross	NT	2
White-chinned Petrel	VU	8
Yelkouan Shearwater	VU	*

The data used represents the most complete input data set that could be accessed within the time bounds of the project. However, there are other data sets (mostly data sets that have not yet been deposited in the BirdLife Seabird Tracking Database) and gaps in collective tracking effort. Some species have never been tracked; and for others, we may only have data on adult life-history stages, but not juveniles.

Table 1 presents a summary of the available data by colony group. For species marked with an asterisk (*), no individual tracking data is currently available; instead, range maps from the BirdLife Data Zone have been used. We will continue to incorporate new data as it becomes available and explore the potential of distribution modelling techniques to address gaps where tracking data is absent.

5.2 Threatened species layer

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

- **High occurrence** - ocean areas within the combined 95% distribution kernels, or range (for species without 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, or range (for species without distribution kernels), of critically endangered species, 95% distribution kernels, or range (for species without distribution kernels), of endangered species and 75% distribution kernels of vulnerable species.
- **Low occurrence** – ocean areas outside of high and medium occurrence areas.

5.3 Species diversity layer

Using the individual distributions of all species, we classified areas of high diversity 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, or range (for species without 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, or range (for species without distribution kernels), of four or more species overlap.

- **Low diversity** – ocean areas outside of high and medium diversity areas.

5.4 Procellaria petrel layer

We merged individual utilization distributions of the four *Procellaria* petrel species into a single distribution and weighted each component species to population size. The resulting distribution shows the relative occurrence of *Procellaria* petrels of any species. We classified areas 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 95% distribution kernel of combined Procellaria species.
- **Low Procellaria occurrence** – ocean areas outside of high and medium Procellaria occurrence.

5.5 Seabird risk zones

The overall seabird risk zones represent relative risk of bycatch of ACAP species. We developed these by merging each of the three component layers, and classified them as:

- **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.

The risk layer polygons generated directly from processed bird location data resulted in fragmented and irregular boundaries. To improve consistency and interpretability of the risk zones, a multi-step smoothing process was applied. First, a marginal expansion was performed to eliminate isolated polygon fragments. This was followed by kernel smoothing to generalise the shape and produce curved, coherent boundaries. Finally, the polygons were shrunk back to their original extent to preserve spatial accuracy while maintaining a cleaner and more interpretable visual output.

6 Developing the seabird-safe ratings

The toolkit is designed to allow fishing companies know how seabird-safe their current fishing is, and how they can improve. To do this we needed to assess the seabird safety of each practice and combination of practices.

The seabird-safe ratings take into account: 1) where the fishery is taking place relative to the seabird risk zones and 2) how effective the practices are at reducing captures of seabirds (Figure 1).

The development of 'seabird risk zones' is described in section 5 above and the method for determining the 'effectiveness' of seabird-safe practices is described in section 6.1 below.

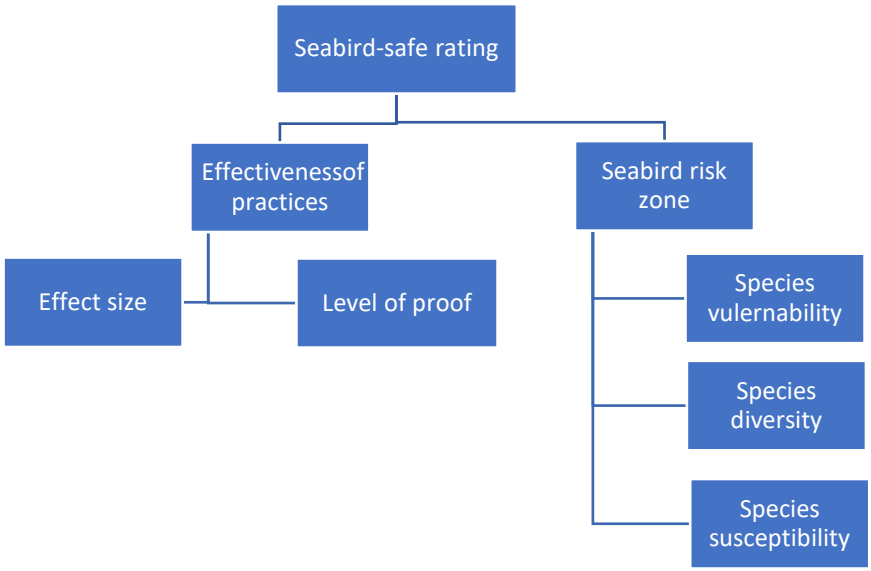

Figure 1 Process for determining the overall seabird-safe rating based on seabird risk zone and practice effectiveness.

6.1 Determining the effectiveness of seabird-safe practices

The toolkit's seabird-safe practices 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.

To determine how effective each practice is at reducing seabird captures (hereafter "effect size"), we compiled information from Pierre 2023a in an Excel spreadsheet. We included information about:

- each practice and combination of practices
- the region where study took place

- bycatch or interaction rate when the practice is applied (treatment)
- bycatch or interaction rate when practice is not applied (control)
- the information source.

Where quantitative information was available, e.g. a bycatch rate or interaction rate, we used this information to calculate a % reduction in seabird interactions for each study. We only included studies that had a clear treatment using the practice, and a control not using the practice.

We used this information, along with inputs from the Expert Panel, to assign practice **effect size** 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, we assigned the category where there was most evidence (hereafter "proof"). For example, if the majority of studies showed that the reduction in seabird captures was 40-80%, we assigned the Medium category. Where there was an even split in the number of studies between two ratings, we assigned the more precautionary (lower) category.

We developed a decision tree in consultation with the Expert Panel to determine the level of proof (high, medium or low) associated with the bycatch effectiveness (Figure 2). We applied the decision tree to the whole body of proof for each practice or combination of practices.

We used the decision tree 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.

We used a threshold minimum sample size to remove any short-term trials or ad-hoc observations that may not have collected enough proof to robustly determine an effect. We based the threshold of 30,000 hooks 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, we automatically assigned "low" level of proof.

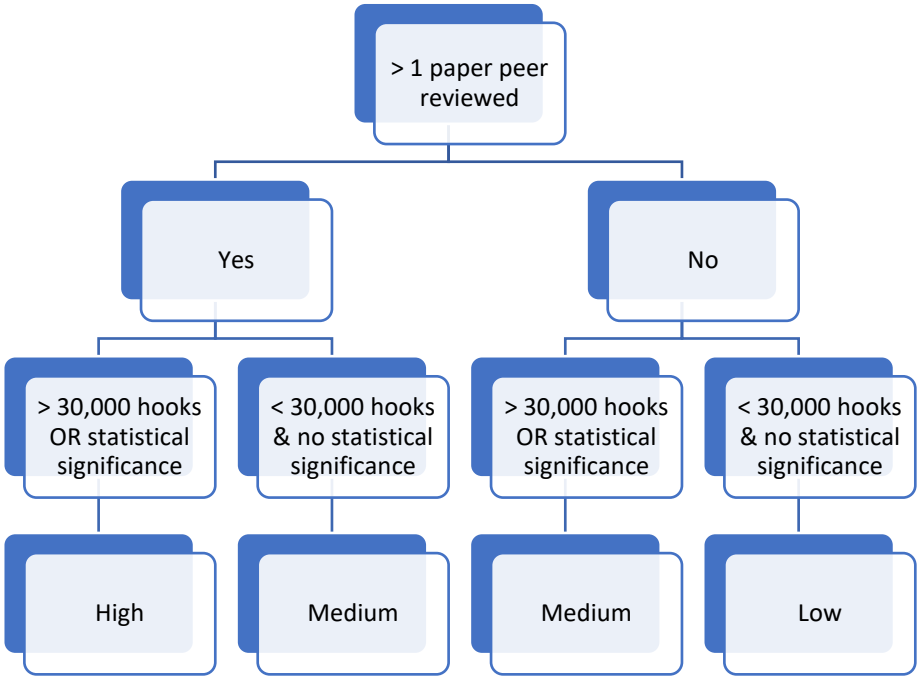

Figure 2 Decision tree used to determine level of proof of practice effectiveness

Once we determined the effect size and level of proof for each practice or combination of practices, we assigned an overall category to the practice effectiveness (see Table 2).

Table 2 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

6.2 Seabird-safe ratings – definitions and results

The overall seabird-safe ratings are based on the seabird risk zone and the practice effectiveness. The results in Table 3 show that more effective practices are needed in zones which are high risk for threatened seabirds.

For example, vessels fishing in high seabird risk zones need to use practices that have "very high" effectiveness to achieve a rating of "best" seabird safety. Whereas vessels fishing in low seabird risk zones can use practices with "medium" effectiveness to achieve a rating of "best."

The seabird-safe rating definitions are:

- **Best:** Threatened seabirds are unlikely to be caught (i.e. you have minimised captures).
- **Partial:** Threatened seabirds might still be caught.
- **Poor:** Threatened seabirds are likely to be caught.
- **None:** Threatened seabirds are highly likely to be caught.

Table 3 Seabird-safe ratings based on risk zone and practice effectiveness

Seabird-safe category	Seabird risk zone (risk)	Practice effectiveness
Best	High	Very high (Minimised)
	Medium	High or Very high (Minimised)
	Low	Medium, High or Very high (Minimised)
Partial	High	High
	Medium	Medium
	Low	Low
Poor	High	Medium
	Medium	Low
	Low	Nil
None	High	Low or Nil
	Medium	Nil

The seabird-safe risk ratings for each seabird risk zone are provided in Table 4.

Table 4 Seabird-safe risk ratings for each practice in the high, medium and low risk zones.

Seabird 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	None
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

7 Developing the monitoring ratings

The toolkit also provides information on the reliability of independent monitoring methods for specific seabird-safe practices when applied at the vessel level.

We assigned the reliability category (High, Medium, Low, None) based on whether it was possible to monitor that a specific seabird-safe practice is being used, and whether the specifications are adhered to.

The monitoring ratings are divided into verification of single mitigation practices and combined mitigation practices.

The monitoring ratings definitions are:

- Best - can monitor if seabird-safe practices are used and if all specifications are met.
- Partial - can monitor if seabird-safe practices are used, and if some but not all specifications are met.
- Poor - cannot monitor if seabird-safe practices are used but can verify if some specifications are met.
- None - cannot monitor if seabird-safe practices are used or if specifications are met.

A sub-group of the Expert Panel met to review whether independent monitoring methods would be able to verify if single seabird-safe practices are used and whether they followed specifications (Tables 5-9). We used this information to assess the reliability of different monitoring methods where combined seabird-safe practices are used.

We selected monitoring methods based on whether they were effective for one or more seabird-safe practice and whether they were commercially available. We used this information to determine the reliability category. Only independent monitoring methods were considered, as fisheries reporting provides lower confidence due to a perceived conflict of interest.

We did not consider methods for at-sea inspections (aerial or vessel-based) 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. Monitoring methods 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 counter

Using a combination of independent monitoring methods gives a higher level of reliability than using a monitoring method in isolation (Tables 10-13). For example, a combination dockside inspection and electronic monitoring can provide a high level of reliability for monitoring the presence and correct use of hook shielding devices.

The analysis can also be used to identify areas to improve the development of monitoring systems. For example, Table 5 shows that electronic monitoring only provides “Partial” reliability for bird-scaring lines line weighting. However, this could be improved to “best” reliability if the electronic monitoring system could monitor distance from weight and hook, and the aerial extent of bird-sacring lines.

Table 5 Reliability of monitoring methods for bird-scaring lines

Monitoring method	Can verify if used (BSL deployed)	Attachment height	Adjustable attachment point	Aerial extent	Streamer configuration	In water section (post swivel)	Reliability
Human observers	Y	Y	Y	Y	Y	Y	Best
Dockside inspection	N	Y	Y	N	Y	Y	Poor
Remote monitoring (VMS/AIS)	N	N	N	N	N	N	None
Electronic monitoring	Y	N	Y	N	Y	N	Partial
EM & Dockside monitoring	Y	Y	Y	N	Y	Y	Partial
BSL tension devise	Y	N	N	N	N	N	Partial
Underwater bait setter counter	N	N	N	N	N	N	None
Underwater bait setter counter & EM	Y	N	Y	N	Y	N	Partial
Human observers & Dockside inspection	Y	Y	Y	Y	Y	Y	Best
Human observers & Remote monitoring	Y	Y	Y	Y	Y	Y	Best
Human observers & EM	Y	Y	Y	Y	Y	Y	Best
Human observers & BSL tension device	Y	Y	Y	Y	Y	Y	Best
Human observers & UBS counter	Y	Y	Y	Y	Y	Y	Best
Dockside inspection & Remote monitoring	N	Y	Y	N	Y	Y	Poor
Dockside monitoring & BSL tension device	Y	Y	Y	N	Y	Y	Partial
Dockside monitoring & UBS counter	N	Y	Y	N	Y	Y	Poor
EM & BSL tension device	Y	N	Y	N	Y	N	Partial
Remote monitoring & EM	Y	N	Y	N	Y	N	Partial

Monitoring method	Can verify if used (BSL deployed)	Attachment height	Adjustable attachment point	Aerial extent	Streamer configuration	In water section (post swivel)	Reliability
Remote monitoring & BSL tension device	Y	N	N	N	N	N	Partial
Remote monitoring & UBS counter	N	N	N	N	N	N	None
BSL tension devise & UBS counter	Y	N	N	N	N	N	Partial

Table 6 Reliability of monitoring methods for line weighting

Monitoring method	Can verify if used	Distance from Hook	Weight in water	Reliability
Human observers	Y	Y	Y	Best
Dockside inspection	Y	N	Y	Partial
Remote monitoring (VMS/AIS)	N	N	N	None
Electronic monitoring	Y	N	N	Partial
EM & Dockside monitoring	Y	N	N	Partial
BSL tension devise	N	N	N	None
Underwater bait setter counter	N	N	N	None
Underwater bait setter counter & EM	Y	N	N	Partial
Human observers & Dockside inspection	Y	Y	Y	Best
Human observers & Remote monitoring	Y	Y	Y	Best
Human observers & EM	Y	Y	Y	Best
Human observers & BSL tension device	Y	Y	Y	Best
Human observers & UBS counter	Y	Y	Y	Best
Dockside inspection & Remote monitoring	Y	N	Y	Partial
Dockside monitoring & BSL tension device	Y	N	Y	Partial
Dockside monitoring & UBS counter	Y	N	Y	Partial
EM & BSL tension device	Y	N	N	Partial
Remote monitoring & EM	Y	N	N	Partial
Remote monitoring & BSL tension device	N	N	N	None
Remote monitoring & UBS counter	N	N	N	None
BSL tension devise & UBS counter	N	N	N	None

Table 7 Reliability of monitoring methods for night setting

Monitoring method	**Can verify if used (time occurs)**	**Location**	**Reliability**
Human observers	Y	Y	Best
Dockside inspection	N	N	None
Remote monitoring (VMS/AIS)	Y	Y	Best
Electronic monitoring	Y	Y	Best
EM & Dockside monitoring	Y	Y	Best
BSL tension devise	N	N	None
Underwater bait setter counter	N	N	None
Underwater bait setter counter & EM	Y	Y	Best
Human observers & Dockside inspection	Y	Y	Best
Human observers & Remote monitoring	Y	Y	Best
Human observers & EM	Y	Y	Best
Human observers & BSL tension device	Y	Y	Best
Human observers & UBS counter	Y	Y	Best
Dockside inspection & Remote monitoring	Y	Y	Best
Dockside monitoring & BSL tension device	N	N	None
Dockside monitoring & UBS counter	N	N	None
EM & BSL tension device	Y	Y	Best
Remote monitoring & EM	Y	Y	Best
Remote monitoring & BSL tension device	Y	Y	Best
Remote monitoring & UBS counter	Y	Y	Best
BSL tension devise & UBS counter	N	N	None

Table 8 Reliability of monitoring methods for hook shielding devices

Monitoring method	Verification whether attached to branch line	Verification whether hook inserted in pod before setting	Verification whether it is an approved HSD	Reliability
Human observers	Y	Y	Y	Best
Dockside inspection	Y	N	Y	Poor
Remote monitoring (VMS/AIS)	N	N	N	None
Electronic monitoring	Y	Y	N	Partial
EM & Dockside monitoring	Y	Y	Y	Best
BSL tension devise	N	N	N	None
Underwater bait setter counter	N	N	N	None
Underwater bait setter counter & EM	Y	Y	N	Partial
Human observers & Dockside inspection	Y	Y	Y	Best
Human observers & Remote monitoring	Y	Y	Y	Best
Human observers & EM	Y	Y	Y	Best
Human observers & BSL tension device	Y	Y	Y	Best
Human observers & UBS counter	Y	Y	Y	Best
Dockside inspection & Remote monitoring	Y	N	Y	Poor
Dockside monitoring & BSL tension device	Y	N	Y	Poor
Dockside monitoring & UBS counter	Y	N	Y	Poor
EM & BSL tension device	Y	Y	N	Partial
Remote monitoring & EM	Y	Y	N	Partial
Remote monitoring & BSL tension device	N	N	N	None
Remote monitoring & UBS counter	N	N	N	None
BSL tension devise & UBS counter	N	N	N	None

Table 9 Reliability of monitoring methods for underwater bait setter

Monitoring method	**Verification whether installed**	**Verification if baited hooks inserted in capsule**	**Set at ACAP-prescribed depth and sink rate**	**Reliability**
Human observers	Y	Y	Y	Best
Dockside inspection	Y	N	N	Poor
Remote monitoring (VMS/AIS)	N	N	N	None
Electronic monitoring	Y	Y	N	Partial
EM & Dockside monitoring	Y	Y	N	Partial
BSL tension devise	N	N	N	None
Underwater bait setter counter	Y	N	Y	Partial
Underwater bait setter counter & EM	Y	Y	Y	Best
Human observers & Dockside inspection	Y	Y	Y	Best
Human observers & Remote monitoring	Y	Y	Y	Best
Human observers & EM	Y	Y	Y	Best
Human observers & BSL tension device	Y	Y	Y	Best
Human observers & UBS counter	Y	Y	Y	Best
Dockside inspection & Remote monitoring	Y	N	N	Poor
Dockside monitoring & BSL tension device	Y	N	N	Poor
Dockside monitoring & UBS counter	Y	N	Y	Partial
EM & BSL tension device	Y	Y	N	Partial
Remote monitoring & EM	Y	Y	N	Partial
Remote monitoring & BSL tension device	N	N	N	None
Remote monitoring & UBS counter	Y	N	Y	Partial
BSL tension devise & UBS counter	Y	N	Y	Partial

Table 10 Reliability of monitoring methods for bird scaring lines and night setting

Monitoring method	**Can verify if BSL used**	**BSL Attachment height**	**BSL Adjustable attachment point**	**BSL Aerial extent**	**BSL Streamer config**	**BSL In water section (post swivel)**	**Can verify if NS used (time occurs)**	**NS Location**	**Overall Rating**
Human observers	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Dockside inspection	N	Y	Y	N	Y	Y	N	N	**Poor**
Remote monitoring (VMS/AIS)	N	N	N	N	N	N	Y	Y	**Poor**
Electronic monitoring	Y	N	Y	N	Y	N	Y	Y	**Partial**
EM & Dockside monitoring	Y	Y	Y	N	Y	Y	Y	Y	**Partial**
BSL tension devise	Y	N	N	N	N	N	N	N	**Poor**
Underwater bait setter counter	N	N	N	N	N	N	N	N	**None**
Underwater bait setter counter & EM	Y	N	Y	N	Y	N	Y	Y	**Partial**
Human observers & Dockside inspection	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & Remote monitoring	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & EM	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & BSL tension device	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & UBS counter	Y	Y	Y	Y	Y	Y	Y	Y	**Best**

Monitoring method	Can verify if BSL used	BSL Attachment height	BSL Adjustable attachment point	BSL Aerial extent	BSL Streamer config	BSL In water section (post swivel)	Can verify if NS used (time occurs)	NS Location	Overall Rating
Dockside inspection & Remote monitoring	N	Y	Y	N	Y	Y	Y	Y	**Partial**
Dockside monitoring & BSL tension device	Y	Y	Y	N	Y	Y	N	N	**Partial**
Dockside monitoring & UBS counter	N	Y	Y	N	Y	Y	N	N	**Poor**
EM & BSL tension device	Y	N	Y	N	Y	N	Y	Y	**Partial**
Remote monitoring & EM	Y	N	Y	N	Y	N	Y	Y	**Partial**
Remote monitoring & BSL tension device	Y	N	N	N	N	N	Y	Y	**Partial**
Remote monitoring & UBS counter	N	N	N	N	N	N	Y	Y	**Poor**
BSL tension devise & UBS counter	Y	N	N	N	N	N	N	N	**Poor**

Table 11 Reliability of monitoring methods for bird scaring lines and line weighting

Monitoring method	**Can verify if BSL used**	**BSL Attachment height**	**BSL Adjustable attachment point**	**BSL Aerial extent**	**BSL Streamer config**	**BSL In water section (post swivel)**	**Can verify if LW used**	**LW Distance from Hook**	**LW Weight in water**	**Overall rating**
Human observers	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Dockside inspection	N	Y	Y	N	Y	Y	Y	N	Y	**Poor**
Remote monitoring (VMS/AIS)	N	N	N	N	N	N	N	N	N	**None**
Electronic monitoring	Y	N	Y	N	Y	N	Y	N	N	**Partial**
EM & Dockside monitoring	Y	Y	Y	N	Y	Y	Y	N	N	**Partial**
BSL tension devise	Y	N	N	N	N	N	N	N	N	**Poor**
Underwater bait setter counter	N	N	N	N	N	N	N	N	N	**None**
Underwater bait setter counter & EM	Y	N	Y	N	Y	N	Y	N	N	**Partial**
Human observers & Dockside inspection	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & Remote monitoring	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & EM	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & BSL tension device	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & UBS counter	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Dockside inspection & Remote monitoring	N	Y	Y	N	Y	Y	Y	N	Y	**Poor**
Dockside monitoring & BSL tension device	Y	Y	Y	N	Y	Y	Y	N	Y	**Partial**
Dockside monitoring & UBS counter	N	Y	Y	N	Y	Y	Y	N	Y	**Poor**

Monitoring method	Can verify if BSL used	BSL Attachment height	BSL Adjustable attachment point	BSL Aerial extent	BSL Streamer config	BSL In water section (post swivel)	Can verify if LW used	LW Distance from Hook	LW Weight in water	Overall rating
EM & BSL tension device	Y	N	Y	N	Y	N	Y	N	N	**Partial**
Remote monitoring & EM	Y	N	Y	N	Y	N	Y	N	N	**Partial**
Remote monitoring & BSL tension device	Y	N	N	N	N	N	N	N	N	**Poor**
Remote monitoring & UBS counter	N	N	N	N	N	N	N	N	N	**None**
BSL tension devise & UBS counter	Y	N	N	N	N	N	N	N	N	**Poor**

Table 12 Reliability of monitoring methods for night setting and line weighting

Monitoring method	**Can verify if NS used (time occurs)**	**NS Location**	**Can verify if LW used**	**LW Distance from Hook**	**LW Weight in water**	**Overall rating**
Human observers	Y	Y	Y	Y	Y	**Best**
Dockside inspection	N	N	Y	N	Y	**Poor**
Remote monitoring (VMS/AIS)	Y	Y	N	N	N	**Poor**
Electronic monitoring	Y	Y	Y	N	N	**Partial**
EM & Dockside monitoring	Y	Y	Y	N	N	**Partial**
BSL tension devise	N	N	N	N	N	**None**
Underwater bait setter counter	N	N	N	N	N	**None**
Underwater bait setter counter & EM	Y	Y	Y	N	N	**Partial**
Human observers & Dockside inspection	Y	Y	Y	Y	Y	**Best**
Human observers & Remote monitoring	Y	Y	Y	Y	Y	**Best**
Human observers & EM	Y	Y	Y	Y	Y	**Best**
Human observers & BSL tension device	Y	Y	Y	Y	Y	**Best**
Human observers & UBS counter	Y	Y	Y	Y	Y	**Best**
Dockside inspection & Remote monitoring	Y	Y	Y	N	Y	**Partial**
Dockside monitoring & BSL tension device	N	N	Y	N	Y	**Poor**
Dockside monitoring & UBS counter	N	N	Y	N	Y	**Poor**

Monitoring method	Can verify if NS used (time occurs)	NS Location	Can verify if LW used	LW Distance from Hook	LW Weight in water	Overall rating
EM & BSL tension device	Y	Y	Y	N	N	**Partial**
Remote monitoring & EM	Y	Y	Y	N	N	**Partial**
Remote monitoring & BSL tension device	Y	Y	N	N	N	**Poor**
Remote monitoring & UBS counter	Y	Y	N	N	N	**Poor**
BSL tension devise & UBS counter	N	N	N	N	N	**None**

Table 13 Reliability of monitoring methods for bird scaring lines, night setting and line weighting

Monitoring method	**Can verify if BSL used**	**BSL Attachment height**	**BSL Adjustable attachment point**	**BSL Aerial extent**	**BSL Streamer config**	**BSL In water section (post swivel)**	**Can verify if NS used (time occurs)**	**NS Location**	**Can verify if LW used**	**LW Distance from Hook**	**LW Weight in water**	**Overall Rating**
Human observers	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Dockside inspection	N	Y	Y	N	Y	Y	N	N	Y	N	Y	**Poor**
Remote monitoring (VMS/AIS)	N	N	N	N	N	N	Y	Y	N	N	N	**Poor**
Electronic monitoring	Y	N	Y	N	Y	N	Y	Y	Y	N	N	**Partial**
EM & Dockside monitoring	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	**Partial**
BSL tension devise	Y	N	N	N	N	N	N	N	N	N	N	**Poor**
Underwater bait setter counter	N	N	N	N	N	N	N	N	N	N	N	**None**
Underwater bait setter counter & EM	Y	N	Y	N	Y	N	Y	Y	Y	N	N	**Partial**
Human observers & Dockside inspection	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & Remote monitoring	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & EM	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & BSL tension device	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Human observers & UBS counter	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Best**
Dockside inspection & Remote monitoring	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	**Poor**
Dockside monitoring & BSL tension device	Y	Y	Y	N	Y	Y	N	N	Y	N	Y	**Poor**

Monitoring method	Can verify if BSL used	BSL Attachment height	BSL Adjustable attachment point	BSL Aerial extent	BSL Streamer config	BSL In water section (post swivel)	Can verify if NS used (time occurs)	NS Location	Can verify if LW used	LW Distance from Hook	LW Weight in water	Overall Rating
Dockside monitoring & UBS counter	N	Y	Y	N	Y	Y	N	N	Y	N	Y	**Poor**
EM & BSL tension device	Y	N	Y	N	Y	N	Y	Y	Y	N	N	**Partial**
Remote monitoring & EM	Y	N	Y	N	Y	N	Y	Y	Y	N	N	**Partial**
Remote monitoring & BSL tension device	Y	N	N	N	N	N	Y	Y	N	N	N	**Poor**
Remote monitoring & UBS counter	N	N	N	N	N	N	Y	Y	N	N	N	**Poor**
BSL tension devise & UBS counter	Y	N	N	N	N	N	N	N	N	N	N	**Poor**

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10 Appendix

Table 1: Expanded methodology and data confidence.

Asterix (*) represents species for which, due to lack of available tracking data, range maps are the only source of distribution information.

Species common name	IUCN status	*N* colonies tracked	Input tracking data representation	Distribution map methodology	
				Overlap assessment tool	Mapping tool (seasketch)
Amsterdam Albatross	EN	1	representative	99 UD	99,95 and 75 UD
Antipodean Albatross	EN	4	representative	99 UD	99,95 and 75 UD
Atlantic Yellow/no-nosed Albatross	EN	4	representative	99 UD	99,95 and 75 UD
Balearic Shearwater	CR	5	representative	99 UD	99,95 and 75 UD
Black Petrel	VU	2	representative	99 UD	99,95 and 75 UD
Black-browed Albatross	LC	13	representative	99 UD	99,95 and 75 UD
Black-footed Albatross	NT	3	representative	99 UD	99,95 and 75 UD
Campbell Albatross	VU	1	representative	99 UD	99,95 and 75 UD

Campbell Albatross	VU	1	representative	99 UD	99,95 and 75 UD
Cory's Shearwater	LC	*	low/no representation	range map	range map
Flesh-footed Shearwater	NT	4	partial	range map	range map, 95 and 75 UD
Gibson's albatross	EN	1	representative	99 UD	99,95 and 75 UD
Grey Petrel	NT	4	representative	99 UD	99,95 and 75 UD
Grey-headed Albatross	EN	6	representative	99 UD	99,95 and 75 UD
Indian Yellow/no-nosed Albatross	EN	3	representative	99 UD	99,95 and 75 UD
Laysan Albatross	NT	4	representative	99 UD	99,95 and 75 UD
Light-mantled Albatross	NT	9	representative	99 UD	99,95 and 75 UD
Northern Buller's albatross	NT	1	representative	99 UD	99,95 and 75 UD
Northern Fulmar	LC	*	low/no	range map	range map
Northern Giant Petrel	LC	5	representative	99 UD	99,95 and 75 UD
Northern Royal Albatross	EN	3	representative	99 UD	99,95 and 75 UD
Pink-footed Shearwater	VU	3	representative	99 UD	99,95 and 75 UD

Polynesian Storm Petrel	EN	*	low/no	range map	range map
Salvin's Albatross	VU	2	representative	99 UD	99,95 and 75 UD
Scopoli's Shearwater	LC	*	low/no	range map	99,95 and 75 UD
Short-tailed Albatross	VU	2	representative	99 UD	99,95 and 75 UD
Shy Albatross	NT	3	representative	99 UD	99,95 and 75 UD
Sooty Albatross	EN	6	representative	99 UD	99,95 and 75 UD
Sooty Shearwater	NT	*	low/no	range map	range map
Southern Buller's Albatross	NT	2	representative	99 UD	99,95 and 75 UD
Southern Giant Petrel	LC	*	low/no	range map	range map
Southern Royal Albatross	VU	1	representative	99 UD	99,95 and 75 UD
Spectacled Petrel	VU	*	low/no	range map	range map
Tristan Albatross	CR	2	representative	99 UD	99,95 and 75 UD
Wandering Albatross	VU	7	representative	99 UD	99,95 and 75 UD
Waved Albatross	CR	1	representative	99 UD	99,95 and 75 UD

Wedge-tailed Shearwater	LC	*	low/no	range map	range map
Westland Petrel	EN	1	representative	99 UD	99,95 and 75 UD
White-capped Albatross	NT	2	representative	99 UD	99,95 and 75 UD
White-chinned Petrel	VU	8	representative	99 UD	99,95 and 75 UD
Yelkouan Shearwater	VU	*	low/no	range map	range map