Agreement on the Conservation of Albatrosses and Petrels

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Toolbox for seabird bycatch mitigation advice in purse seine fisheries

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SUMMARY

The present document is an updated version of the advice on mitigating seabird bycatch in purse seine fisheries, last compiled in 2024 (SBWG12 Inf 12). It encompasses a range of proposed mitigation measures tailored to purse seine fisheries, taking into account their operational dynamics, ongoing trials assessing effectiveness, and the constraints and considerations associated with onboard implementation by decision-makers.

In addition, the document provides background information on purse seine fisheries, including guidance on identifying hotspots of seabird bycatch in fishing gear and onboard facilities, as described in SBWG11 Doc 14. It also includes discussion and original evidence highlighting key considerations related to commonly proposed mitigation measures for this type of fishery, such as the use of water spraying.

The objective of this document is to serve as a practical resource for communicating the feasibility of seabird bycatch mitigation measures specific to purse seine fisheries. Accordingly, it synthesizes mitigation measures identified as early as 2017 (SBWG8 Inf 26), including sensory and physical deterrents, as well as structural modifications to purse seine gear. Some of these measures are complemented by best practices involving decision-making by crew members with key roles on the bridge and deck.

RECOMMENDATIONS

1. The Working Group endorses the format and updated contents of the bycatch mitigation toolbox for purse seine fisheries (SBWG13 version).
2. The Working Group endorses the format and messaging regarding effectiveness and awareness of associated risks when promoting mitigation measures for purse seine fisheries, as well as complementary onboard best practices.
3. The Working Group reviews and updates the purse seine toolbox and encourages other fisheries to adopt it as a user-friendly and informative resource for users and decision-makers.

Caja de herramientas de mitigación de la captura incidental en pesquerías de cerco

RESUMEN

El presente documento es una versión actualizada de las recomendaciones para mitigar la captura incidental de aves marinas en pesquerías de cerco, compiladas por última vez en 2024 (SBWG12 Inf 12). Este documento abarca una serie de medidas de mitigación propuestas, adaptadas a las pesquerías de cerco, considerando sus dinámicas operacionales, los ensayos en curso que evalúan su eficacia, así como las limitaciones y consideraciones asociadas a su implementación a bordo por parte de quienes toman decisiones.

Además, el documento proporciona información de base sobre las pesquerías de cerco, incluyendo orientaciones para identificar zonas críticas de captura incidental de aves marinas en los artes de pesca y en las instalaciones a bordo, tal como se describe en SBWG11 Doc 14. Asimismo, incluye discusión y evidencia original que destacan consideraciones clave relacionadas con medidas de mitigación comúnmente propuestas para este tipo de pesquería, como el uso de cañones y cortinas de agua.

El objetivo de este documento es servir como un recurso práctico para comunicar la viabilidad de las medidas de mitigación de la captura incidental de aves marinas específicas para las pesquerías de cerco. En este sentido, sintetiza medidas de mitigación identificadas desde 2017 (SBWG8 Inf 26), incluyendo disuasores sensoriales y físicos, así como modificaciones estructurales a las artes de cerco. Algunas de estas medidas se complementan con buenas prácticas que implican la toma de decisiones por parte de miembros de la tripulación con roles clave en el puente y la cubierta

RECOMENDACIONES

1. El grupo de trabajo respalda el formato y los contenidos actualizados de la caja de herramientas de mitigación de la captura incidental en pesquerías de cerco (versión SBWG13).
2. El grupo de trabajo respalda el formato y el mensaje relativo a la eficacia y a la concienciación sobre los riesgos asociados al promover medidas de mitigación en pesquerías de cerco, así como las buenas prácticas complementarias a bordo.
3. El grupo de trabajo revisa y actualiza la caja de herramientas para pesquerías de cerco y alienta a otras pesquerías a adoptarla como un recurso accesible, fácil de usar e informativo para usuarios y responsables de la toma de decisiones.

Boîte à outils pour la réduction des captures accessoires dans les pêcheries à senne coulissant

RÉSUMÉ

Le présent document constitue une version actualisée des recommandations visant à atténuer les captures accessoires d'oiseaux marins dans les pêcheries à senne coulissante, compilées pour la dernière fois en 2024 (SBWG12 Inf 12). Il présente un ensemble de mesures d'atténuation proposées, adaptées à ces pêcheries, en tenant compte de leurs dynamiques opérationnelles, des essais en cours évaluant leur efficacité, ainsi que des contraintes et considérations liées à leur mise en œuvre à bord par les décideurs.

En outre, le document fournit des informations de base sur les pêcheries à senne coulissante, notamment des orientations pour identifier les zones critiques de capture accessoire d'oiseaux marins dans les engins de pêche et les installations à bord, comme décrit dans le document SBWG11 Doc 14. Il inclut également des discussions et des données originales mettant en évidence des éléments clés relatifs aux mesures d'atténuation couramment proposées pour ce type de pêcherie, telles que l'utilisation de pulvérisation d'eau.

L'objectif de ce document est de servir de ressource pratique pour communiquer la faisabilité des mesures d'atténuation des captures accessoires d'oiseaux marins spécifiques aux pêcheries à senne coulissante. À ce titre, il synthétise des mesures d'atténuation identifiées dès 2017 (SBWG8 Inf 26), incluant des dispositifs dissuasifs sensoriels et physiques, ainsi que des modifications structurelles des engins de pêche. Certaines de ces mesures sont complétées par des bonnes pratiques impliquant la prise de décision par des membres d'équipage occupant des rôles clés sur la passerelle et le pont.

RECOMMANDATIONS

1. Le Groupe de travail approuve le format et le contenu mis à jour de la boîte à outils pour la réduction des captures accessoires dans les pêcheries à senne coulissante (version SBWG13).
2. Le Groupe de travail approuve le format et le message relatifs à l'efficacité et à la sensibilisation aux risques associés lors de la promotion de mesures d'atténuation dans les pêcheries à senne coulissante, ainsi que les bonnes pratiques complémentaires à bord.
3. Le Groupe de travail examine et met à jour la boîte à outils pour les pêcheries à senne coulissante et encourage les autres pêcheries à l'adopter comme un outil accessible, convivial et informatif pour les utilisateurs et les décideurs.

BACKGROUND

Since 2016, purse seine fisheries have become a part of the ACAP agenda (Baker & Hamilton 2016; Debski et al. 2016). These discussions have focused on understanding the fishing gear configuration and its operation, as well as identifying seabird species involved in bycatch incidents in both industrial and small-scale vessels.

As early as described in Suazo et al. (2017a), the list of purse seine fisheries showing signs of seabird bycatch included at least eight countries, spanning seven FAO marine areas, impacting 33 seabird and 2 waterbird species, primarily concentrated in coastal fishing grounds.

As showed in Melvin et al. (2023), purse seine fisheries involve a surrounding net used to encircle shoals of pelagic target species like tuna, sardines, and squids. The fishing gear consists of a wall of netting fitted with an upper line of buoys or floats and a lower line of weights (Fig. 1).

In the lower part of the net, a system of steel rings connected by cables allows for the net to be closed, preventing fish/squid from escaping through the lower part of the net. The dimensions of the net, as well as the mesh size, vary depending on whether the net is for small-scale or industrial vessels and the target species, respectively.

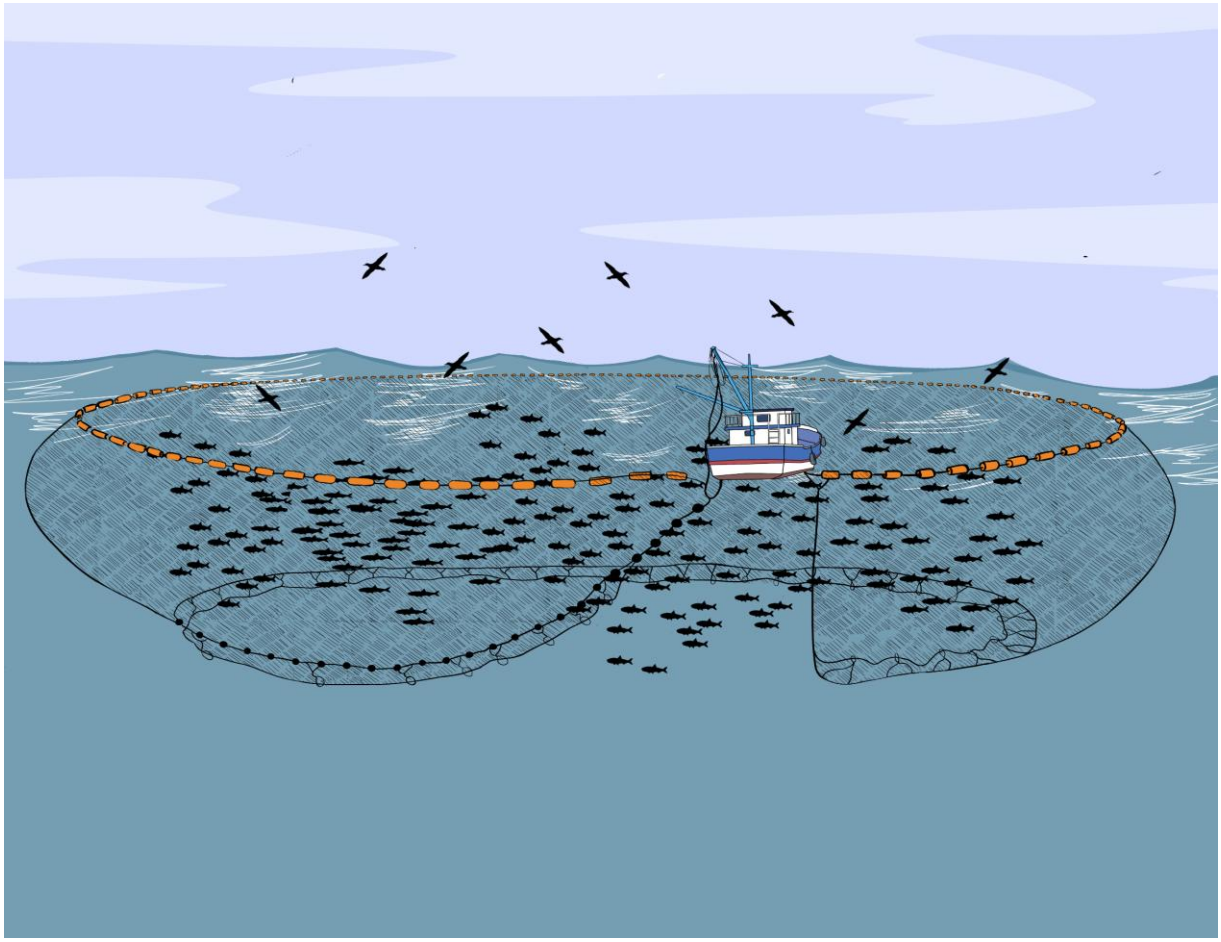

Figure 1. Example of a small-scale purse seine fishing operation. The net encircles the fish shoal, with its upper part buoyed and the lower part weighted. Steel wires are then winched together to close the net, forming a bowl shape (© C.G. Suazo).

2. A TOOLBOX APPROACH FOR SEABIRD BYCATCH REDUCTION IN PURSE SEINE FISHERIES

2.1. Identifying seabird bycatch for effective mitigation measures in purse seine fisheries

Purse seine fisheries are among the least studied in terms of their impact on non-target species, with more frequent records involving marine mammals, marine reptiles, seabirds, and other taxa with an emphasis in industrial scale operations (Soykan et al. 2008). Thus, in the case of industrial purse seine operations for tuna, these fisheries have been recognized as non-problematic for seabirds (Gilman & Lundin, 2010). There is a set of voluntary best practices aimed at reducing the chances of bycatch, such as avoiding sets in areas with a presence of non-target species and implementing fishing gear entanglement prevention measures for cetaceans, sharks, and sea turtles (Swimmer et al. 2020).

However, seabird bycatch has also been documented in other industrial and small-scale vessels targeting small pelagic fish, with entanglements occurring at different stages of the fishing operation (i.e., setting or hauling) and across various components of purse seine gear and onboard facilities. It is strongly recommended that these features be systematically identified through monitoring systems or observer programmes in order to detect bycatch hotspots across fleets (e.g., Suazo et al., 2016) and to incorporate this information into data collection protocols.

Among mitigation measures, some studies have suggested the use of sound and lasers as deterrents. Coastal seabird species, such as gulls, have shown reduced abundance in response to noise in northern Chile, whereas Procellariiform species, such as shearwaters and petrels, have shown limited response (Diez, 2017). The use of lasers in purse seine fisheries in the same region has not proven effective, as most sets are conducted during daylight hours. Indeed, controlled trials in trawl fisheries have demonstrated that laser effectiveness depends on specific operating conditions, including light levels and vessel speed (Melvin et al., 2016).

Other mitigation measures for purse seine fisheries involve structural modifications of the gear, such as the Modified Purse Seine (MPS). This entails a series of adjustments including buoy mounting and mesh size, among others. These adjustments have demonstrated a reduction in entanglement and capture of birds belonging to ACAP-listed species, such as the pink-footed shearwater *Ardenna creatopus* and the black-browed albatross *Thalassarche melanophris*, in Chile (Suazo et al. 2017b, 2019). The effectiveness of these structural modification measures has been evaluated against the best practice criteria adopted by ACAP to inform decision-makers (Melvin et al. 2023).

Another modification to the typical structure of purse seine gear involves the use of “escape windows,” based on opportunistic observations of diving seabirds such as shearwaters and penguins. These windows consist of sections of the buoyline without floats, allowing some seabird species to escape from the encircled net. This approach has been documented in northern Chile in industrial vessels targeting anchovy, where it has been observed for the pink-footed shearwater, the sooty shearwater *Ardenna grisea*, and potentially for the Humboldt penguin *Spheniscus humboldti* (Auger Lancellotti, 2019).

Recent sensory mitigation measures include the use of a bird-scaring device (scaring kite) in purse seine fisheries in Portugal (Oliveira et al. 2021). This device has proven effective in reducing the number and activity of some seabird species like gulls, but its effect on other seabird species such as shearwaters requires further research. If these measures prove effective, they may contribute to the reduction of bycatch in ACAP-listed species (e.g., Balearic shearwater *Puffinus mauretanicus*) previously reported for purse seine vessels in these waters (Oliveira et al. 2015).

2.2. The communication of mitigation effectiveness based on evidence through the toolbox approach

The diversity of mitigation measures and the need to communicate these options on their evidence and effectiveness have led to the development of the "toolbox" approach, which serves as an informative instrument to support mitigation decisions (Mangel et al. 2016, 2017). This approach, initially proposed for artisanal and small-scale fisheries, is also applicable to different scales and fishing gears like purse seine fisheries.

Moreover, the information summarized in tables reporting the features of each potential measure can be supplemented by guided questions on the feasibility of the measure, which are largely covered in the assessment under the ACAP best practice criteria (Suazo et al. 2017). In addition, conservative approaches should be adopted, or at minimum, notes of concern should be included regarding implementation standards and expected performance when proposed mitigation measures are based more on anecdotal evidence than on experimental support. This is particularly relevant when measures are perceived by fleets as very low-cost and easy to implement using in situ resources, such as water spraying recommended to prevent seabirds from entering the encircled net.

The use of water spraying or water curtains as deterrents should only be considered when the pumped water does not contain traces of edible oil originating from wastewater generated during fishing operations. For example, we conducted experiments to evaluate the effects of different concentrations of edible oil derived from target fish species in purse seine fisheries in south-central Chile.

Soaked seabirds and associated mortality are frequently linked to the critical stage when the net is lifted from the water surface at the end of the haul (i.e., net retrieval), which is a key moment for seabird bycatch in fishing operations. This has been documented for species such as the common gull (Larus canus), herring gull (Larus argentatus), great black-backed gull (Larus marinus), and several unidentified gull species in purse seine fisheries targeting herring (Clupea harengus) in Norway (Christensen-Dalsgaard et al., 2022).

To address the impact of fish oil on feathers, we conducted experiments evaluating feather agglutination and weight gain following exposure to different concentrations of sardine-derived edible oil. Increasing oil concentrations led to greater agglutination and disruption of barb structure in both back and pectoral feathers of the pink-footed shearwater. Notably, exposure to a 50% oil–seawater mixture resulted in an 18-fold and 29-fold increase in the weight of pectoral and back feathers, respectively (Fig. 2).

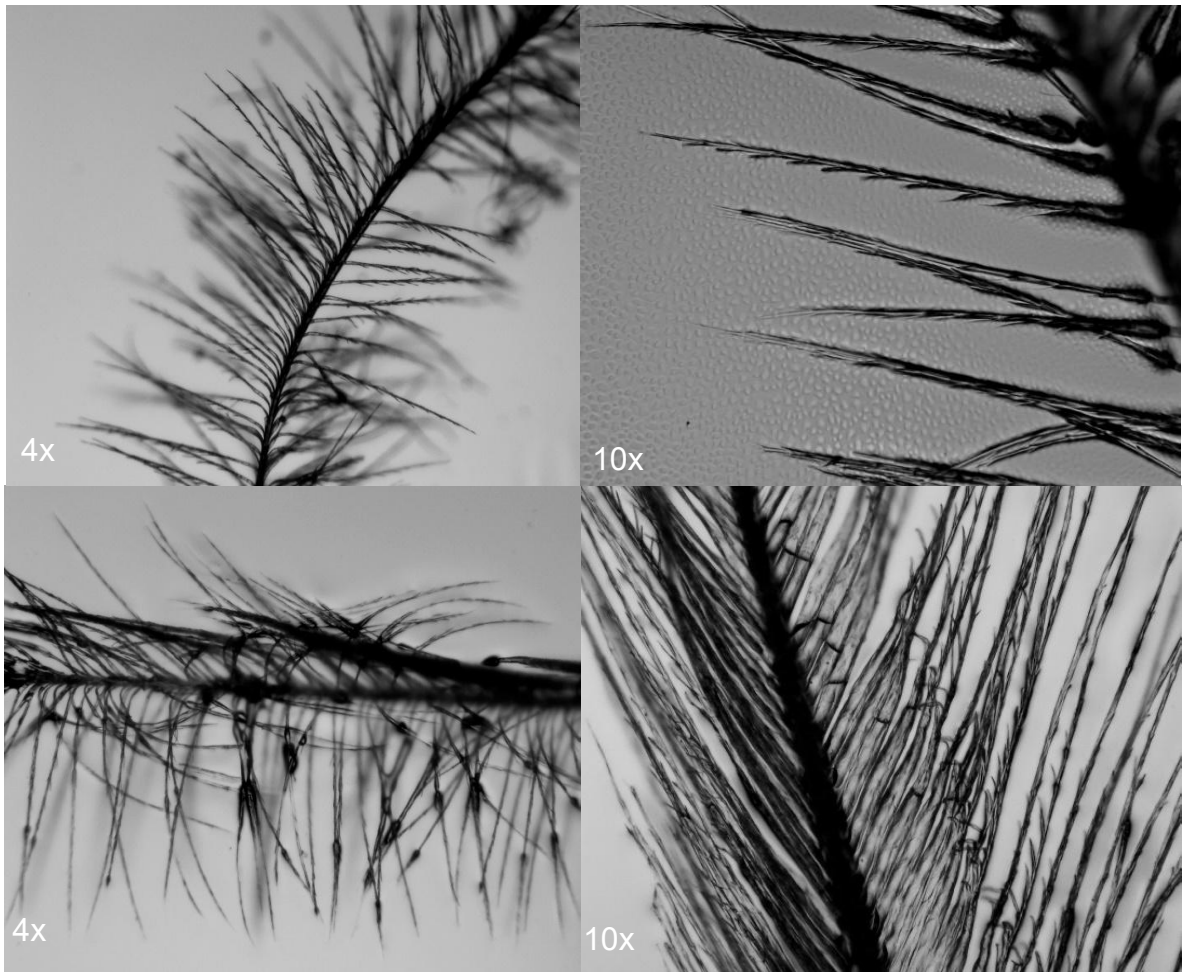

Figure 2. Example of agglutination due to edible oil exposure in the feather of the pink-footed shearwater. The disruption of the connection between barbs of feathers (both in bottom) is noted when compared to control feathers in the two upper photographs (© ATF-Chile).

This example encourages the incorporation of evidence-based minimum standards for the effective performance of mitigation measures, preventing inappropriate application and identifying key features (e.g., materials, dimensions, and supplies) that minimize unintended effects. This is particularly relevant when water curtains are proposed as mitigation solutions in major purse seine fleets, such as those operating in the Humboldt Current System (López & Vega, 2023).

We present a bycatch mitigation toolbox for purse seine fisheries, incorporating multiple levels of evaluation of mitigation function, empirical findings, limitations, and effectiveness in reducing seabird bycatch overall, including for species listed as priorities by the Agreement on the Conservation of Albatrosses and Petrels (Table 1).

A practical compilation on the status of different levels of our knowledge on emergent and established measures for Best Practices Advice in priority fisheries like purse seine is provided (Baker et al. 2024).

It addresses important dimensions to consider as our understanding of the interaction between seabirds and purse seine fishing continues to increase in significant fleets globally (e.g., Rivadeneyra-Villafuerte et al. 2021), as well as the increase in emergent ideas for mitigation that must be evaluated for tailored conservation actions in these widely distributed fisheries (Table 1).

TABLE 1. MITIGATION TOOLBOX FOR PURSE SEINE FISHERIES WITH STATUS ON EFFICACY. FISHING OPERATION: MITIGATION TO REDUCE BYCATCH EVENTS LINKED TO "SET" OR "HAUL" OF THE PURSE SEINE GEAR. ADDITIONAL BENEFITS: NO AVAILABLE (N/A).

Mitigation	Function	Fishing operation	Findings	Additional benefits	Limitations, Considerations, and minimum standards	Source	Status *
Modified purse seine (MPS)	Structural package of on fishing gear for the reduction of entanglement of seabirds with the purse seine gear (Chile)	Set-Haul	Trials showed the reduction in seabird bycatch for diving seabird species by 98% related to the reduction of entanglement in fishing gear	1. Modified purse seine showed improvement in catch success of the target fish species 2. Reduction in netting material with savings in future maintenance or new fishing gear	1. Mesh size has been proved to use a minimum size of 3 ½ inches to avoid the entanglement of small seabird species like shearwaters.	Suazo *et al.* (2016; 2017a,b; 2019)	
Bird scaring device (Scaring kite)	Physical barrier to reduce the presence of seabirds in risk areas (Portugal)	Set-Haulk	Trials showed the effect of this scaring device on activity of seabirds but with no bycatch events recorded for treatment and control sets. Reduction in numbers of certain seabird species like gulls and potentially for ACAP species like the Balearic shearwater	1. Just need one person to be handled	1. Need to be assessed in areas of high occurrence of ACAP listed species 2. Also applicable to other fisheries (e.g., gillnets) 3. Effectiveness is more related to short distance of the device to the vessel	Oliveira et al. (2021); Almeida et al. (2023)	

Mitigation	Function	Fishing operation	Findings	Additional benefits	Limitations, Considerations, and minimum standards	Source	Status *
Water spraying	Physical barrier for seabirds (Mexico)	Haul	Preliminary trials may affect seabird presence in risk areas into the net (e.g., pelicans)	1. Needs to be handled by one person in a reduced crew (e.g., small-scale purse seine)	2. Absence of appropriate facilities and training would be harmful for seabirds (water cannon instead of water spraying) 3. The use of waters pumped from the same waste waters may contain edible oils can potentially affect seabird plumage through the loss of feather's architecture and waterproofing	Suazo et al. (2017a)	
Escape windows of buoyline (Escape windows)	Sections without mounted buoys on the upper mainline allow diving seabirds to escape from the encircled purse seine gear (Chile)	Haul	Occasional records show diving seabird species such as penguins and shearwaters using these gaps in the buoyline to move away from the risk area of the encircled net and its bunt	Potentially beneficial to marine mammals and turtles	1. It is necessary to assess the critical dimensions of windows and materials for the effective escape of non-target species and the efficient performance of gear on target species	Auger Lancellotti (2019)	

Mitigation	Function	Fishing operation	Findings	Additional benefits	Limitations, Considerations, and minimum standards	Source	Status *
Edible oil release	Sensorial / physical deterrent to keep away seabirds (Australia)	Set	Trials demonstrated no effects of shark oil *vs* controls on seabird feeding activity of shearwaters	N/A	1. Oil should attract other seabird or non-target taxa to fishing operations 2. Available re-supplies on board are needed 3. The use of oil may have other detrimental effects (e.g., plumage)	Puglisi (2007)	
Sound	Sensorial deterrent to keep away seabirds (Chile)	Set-Haul	Trials demonstrated effects of noise deterrents on the abundance of some sensitive seabird species (*e.g.,* gulls) in contrast to Procellariiform species	N/A	1.Recommended additional sound devices to influence in other seabird species than gulls with unexpected harmful effects on seabirds and crews 2. Consideration of noise pollution when communal fishing exists (e.g., small scale purse seine)	Diez (2017)	
Laser	Sensorial deterrent to keep away seabirds (Chile)	Set	Preliminary trials showed operational limitations during daylight and for certain seabird species like gulls	N/A	1. Potential detrimental effects on seabirds and crews must be considered and evaluated 2. Not recommended without an appropriate experimental design and safety protocols	Diez (2017)	

* Legend (proposed categorisation of status in terms of mitigation efficacy):

	Systematically trialled: Reduced bycatch of ACAP species
	Need systematic evaluation/Testing in progress
	Systematically trialled: not recommended due to associated effects

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