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Hook shielding devices to mitigate seabird bycatch: review of effectiveness

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Abstract

Bycatch of seabird species in pelagic longline fisheries is recognised as one of the most important and prevalent sources of their mortality, contributing to an increased risk of extinction. In 2016 the Agreement on the Conservation of Albatrosses and Petrels (ACAP) recognised hook-shielding devices as a best practice seabird mitigation option, providing a stand-alone alternative to their established advice which recommends the simultaneous use of branchline weighting, night setting and bird-scaring lines.

In this paper we describe the function of the Hookpod, one of the novel hook-shielding devices, which has been in development since 2007. It aims to provide a 'one stop' solution to seabird bycatch in pelagic longline fisheries. We summarise the results from numerous trials of Hookpods, highlighting evidence for their effectiveness at reducing seabird bycatch rates as well as any effect on catch rates of target fish species and other bycatch. We also discuss findings related to their influence on hook sink rates, their durability and cost, and their applicability in different fisheries.

Experimental trials clearly indicate Hookpods are extremely effective at reducing seabird bycatch to rates equal to or better than those achieved using existing mitigation methods, such as line weighting, bird-scaring lines and night setting. No negative effect on target fish catch rates have been found, and trials have been conducted across pelagic longline fisheries in the Pacific, South Atlantic and Indian Oceans, indicating their wide applicability.

Hook-shielding devices represent an important advancement in the range of options to reduce seabird bycatch in pelagic longline fisheries. While some fishing operators may continue to prefer using existing methods, others seeking a stand-alone option will prefer hook-shielding devices, which may be particularly suited to fisheries where there have been challenges implementing other mitigation measures, such as line weighting or bird-scaring lines, or where seabird bycatch risk is particularly high. For example, the high diversity of vulnerable seabirds in New Zealand, the "seabird capital of the world", provides challenges to mitigating bycatch. Having a greater range of proven and effective mitigation options to choose from will help fishing operators overcome these challenges. We make recommendations that hook-shielding devices should be added to the current list of mitigation measures as a stand-alone option in the Commission's Conservation and Management Measure to mitigate the impact of fishing for highly migratory fish stocks on seabirds.

1. Introduction

The incidental mortality of seabirds, mostly albatrosses and petrels, in longline fisheries continues to be a serious global concern and was major reason for the establishment of the Agreement on the Conservation of Albatrosses and Petrels (ACAP). In longline fisheries seabirds are killed when they become hooked and drown while foraging for baits on longline hooks as the gear is deployed. Most seabird bycatch mitigation is targeted at preventing or reducing the hooking of seabirds during setting.

The Commission's Conservation and Management Measure to mitigate the impact of fishing for highly migratory fish stocks on seabirds (CMM2017-06) requires the use of certain combinations of mitigation measures in certain areas. These mitigation measures include branchline weighting, tori lines, night setting and side setting with a bird curtain and weighted branchlines. These measures are specified to broadly align with the best practice mitigation advice provided by ACAP.

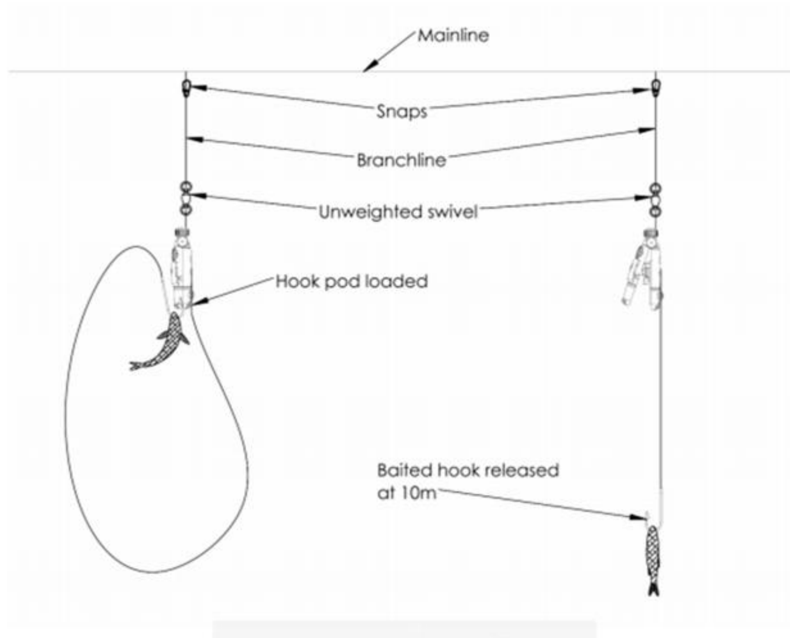
For a number of years, ACAP has defined best practice mitigation advice for pelagic longline fisheries as the simultaneous use of branchline weighting, tori lines and night setting, based on a set of criteria spanning practicality, cost effectiveness, impact on intended catch, and efficacy as seabird bycatch mitigation. In 2016, at ACAP's Ninth Meeting of their Advisory Committee, an alternative stand-alone mitigation option of hook-shielding devices was added to their best practice advice.

Hook-shielding devices represent a novel type of seabird mitigation. They are devices that encase the point and barb of baited hooks to prevent seabird attacks during line setting until a prescribed depth is reached (e.g. 10 m), or until after a minimum period of immersion has occurred (e.g. 10 minutes) that ensures that baited hooks are released beyond the foraging depth of most seabirds.

This paper considers evidence for one type of hook-shielding device, the Hookpod, We do not consider other types of hook-shielding devices in this paper. There has been considerable research and development of Hookpods, and the purpose of this paper was to review and summarise findings from the literature to assess their suitability for use in WCPFC fisheries (Appendix 1 summarises some key relevant publications). In particular, the review we present here is aimed to assist the SC in advising WCPFC15 if hook-shielding devices are effective options for seabird bycatch mitigation in WCPFC fisheries and whether to incorporate them in the seabird CMM as additional mitigation options (Paragraph 347, WCPFC14 Summary Report).

2. Hookpod function

2.1 Hookpod design and deployment



The Hookpod is a polycarbonate capsule that is attached to each individual branchline using a simple locking collar mechanism that grips the monofilament at any desired distance from the hook. During line setting operations the baited hook is loaded into the Hookpod to encase the point and bard of the hook, preventing seabirds from becoming hooked as they scavenge for baits at the stern of vessels. The device encompasses a pressure release system that opens the Hookpod and releases the baited hook at a predetermined depth while the Hookpod remains attached to the snood. During hauling, the Hookpod, still attached to the branchline in an open state, is recovered and rearmed by closing it by hand. It is then stored with the branchline in the normal manner, ready for the next set. The Hookpod includes a light-emitting diode (LED), which operates on a magnetic switch triggered when the pod opens to release the baited hook. The LED is powered by two small, alkaline (AG13 LR44) cell batteries that operate for up to 400 h (around 40 sets). The batteries cost approximately US$0.10 each and are quick to replace. The LED was incorporated to provide a financial incentive to fishermen by offering a cheaper light source that replaces the disposable chemical light sticks that are used in swordfish and many tuna fisheries globally. The polycarbonate material used for the housing is extremely durable and resistant to damage by ultraviolet (UV) rays and seawater. In addition, all hinges and springs are made from the marine grade 316 stainless steel, making the Hookpod well fit for lasting several years under typical fishing operations (Sullivan et al 2017).

Another version of the Hookpod, the Hookpod-mini, was developed and trialled in 2015. This version does not contain the LED light and is around 30% smaller and 25% lighter than the original Hookpod. This version allows flexibility in changing whether lights are added to snoods on a set-by-set basis (Goad et al 2017).

2.2 History of development

The Hookpod has been in development since 2007. Since that time the pod has undergone many iterations and modifications. The first trials of an early Hookpod prototype were undertaken in Tasmania in 2009, with a prototype that used closed cell foam to achieve the appropriate release depth, but this was a temporary solution as the foam required replacing after a few sets and did not open with the precision required. In 2010, further trials were conducted with a prototype pressure-release mechanism incorporated for the first time. In 2010, lead weight was added to the inside of the pod to increase its weight. The trials in 2010 provided more useful data including the second set of trials when the pod was used successfully with a range of bait types and hooking positions. However, some difficulties were encountered, including some release mechanism failures and latches loosening, which enabled hooks to fall out of the pod. These difficulties experienced in November 2010 led to a redesign of the diaphragm, and a completely new approach was taken for the release mechanism. This resulted in the development of the current pressure-release system designed to open at 10 ± 1 m, with the advantage of being easily adjusted to open at any target depth down to 100 m (Sullivan, 2011).

In 2010/11 a LED light and associated circuitry was developed specifically to be incorporated into the housing of the pod. This was designed to replace disposable chemical light sticks, and thereby reducing marine debris, as well as making the economics of the pod much more attractive to fishermen. The prototype was a flashing light operated by a magnetic 'read' switch, so it is turned on when the pod opens and releases the hook; and is switched off during the haul when the pod is closed. The LED was driven by two small alkaline batteries that last up to 1000h in flashing mode. The inclusion of the LED meant that the lead weight that had been incorporated inside the pod could no longer be housed internally. To replace this, the collar which attaches the pod to the branchline, originally made of polycarbonate, was replaced with a brass collar. This made the collar more rigid/stronger and gave the pod a total weight of around 75g, an increase from 60g (Sullivan, 2011).

3. Mitigation effectiveness and operational practicality

To date, research has been undertaken in various geographical regions throughout the world: (i) Brazil, (ii) South Africa, (iii) Uruguay, (iv) Australia, and (v) New Zealand (Sullivan et al., 2017; BirdLife International, 2014; Goad et al., 2017). Seabird abundances varied considerably between research locations in terms of the species present and their densities, but each study reported seabirds present during the trip. In total, over 124,000 Hookpods and over 109,000 control hooks were set and reported, spanning 324 sets during 32 discrete at-sea trips.

3.1 Seabird bycatch effectiveness

Sullivan et al (2017) reported comprehensive results from 18 at-sea trials conducted between 2011–2015 onboard pelagic longliners targeting tuna and swordfish in South African, Brazilian and Australia. They observed 59,130 experimental branchlines over 129 sets and recorded a single seabird mortality on the Hookpod branchlines compared to 24 on the control branchlines, a bycatch rate of 0.04 birds/1000 hooks and 0.8 birds/1000 hooks, respectively.

Goad et al (2017) reported on two New Zealand trials of Hookpod-minis. In one trial, Hookpod-minis were deployed on approximately half the hooks set (7,864 hooks) over 20 experimental sets on two vessels. The control gear (8,736 hooks) comprised the vessels' normal setup of either unweighted snoods or snoods with 60g sliding weights at 1m from the hook, plus tori lines. One white-capped albatross was caught on each treatment, indicating a similar level of seabird bycatch effectiveness between the treatments. The second trial consisted of fisher-reported data from a ten-month period during which there were 38,152 Hookpod-mini deployments and 52,404 control hooks over 110 sets. The control in this instance consisted of the fisherman's normal mitigation use (under New Zealand regulations requiring the use of a tori line and either branchline weighting or night setting). There were three seabirds caught on Hookpod-minis and 13 caught on control snoods, equating to 0.079 birds/1000 hooks and 0.248 birds/1000 hooks, respectively.

Silva-Costa et al (2017) reported preliminary results from trials under commercial fishing conditions in the Brazilian pelagic longline fleet. A total of three trips, 17 sets and 11,380 hooks were deployed, all with Hookpod-minis. Only a single bird was bycaught, a black-browed albatross (*Thalassarche melanophris*), equating to a bycatch rate of 0.1 birds/1,000 hooks.

3.2 Assessment of fish catch rates

An assessment of the impact on catch rate of target fish was included in all the experimental trials report by Sullivan et al (2017) and Goad et al (2017). Across all these trials in Australia, New Zealand, Brazil and South Africa no significant effect on fish catch rate was found.

3.3 Reliability

With respect to reliability, several studies have reported metrics including breakage and loss rate. As described by Sullivan, et al (2017) "The pod has been designed to last for several years under typical fishing operations. The polycarbonate material used for the housing is extremely durable and resistant to damage by ultra violet (UV) rays and seawater and all hinges and springs are made from marine grade 316 stainless steel". In Brazilian trials Silva-Costa et al. (2017) reported a 0.57% rate of damage to Hookpod-minis (broken pods, missing collars, pods not closing and not open). Taking into account that missing collars (0.07% of losses) can be replaced easily with spare collars, actual loss is even lower (0.5%). In New Zealand, the 10-month trial under normal commercial fishing reported a malfunction rate of approximately 0.4%, a damage rate of 0.086% and a loss rate of 0.53%. The loss rate will in a large part be related to the bite-off of fishing gear by sharks etc and will vary from fishery to fishery. It will also be dependent on the precise fishing strategy employed. Because Hookpods (incl. Hookpod-minis) can be placed at any position on the branchline, the option exists to target placement at a point closer to the mainline to reduce the chances of loss following bite-off close to the hook.

3.3 Other aspects impacting operational practicality

Studies have also included the views of fishermen who have employed the Hookpods on their vessels. Indeed, beyond efficacy as a mitigation device, detailed consideration of the fishermen's needs is a factor that has been addressed through the technology's development. This new technology shows encouraging results, even though the first few sets may take slightly longer to deploy. Many of the fishermen commended the bycatch technique as effective and simple to implement. For example, Silva-Costa et al (2017) note, "Despite [initial] concerns, after the first day the crew noted that the new gear was stowed perfectly within hook bins, and the Hookpod fitted easily into setting and hauling operations. The Hookpod therefore was readily accepted by the crew and skipper, and did not interfere with or delay the fishing operations."

Barrington (2016) highlights that deployment of Hookpods offers an opportunity for fishing fleets to reduce their costs. This is due to the reduced cost of using chemical light sticks, since Hookpods already include an LED light. This LED function may also reduce set up time required since an additional set of adding a chemical light stick is no longer required.

Recent trials in French Polynesia (Dave Goad, *pers. com.*) found that the 13/0 circle hooks being used in that operation were too small to properly fit the Hookpod-minis being trialled. There may be other sizes of hooks used in pelagic longline fishing that have not been tested with Hookpods. Therefore, at present, Hookpods may not be suited to all pelagic longline fishing operations, although a new version of Hookpod that will fit smaller hook sizes is currently under development (Becky Ingham, Hookpod Ltd, *pers. com.*).

As development and production of the product continues to grow, costs have dropped. Hookpod units are currently priced at £4.95 (US $6.50), with up to 20% further reduction for bulk orders (Becky Ingham, Hookpod Ltd, *pers. com.*).

Lastly, some additional unexpected benefits have been noted throughout the studies. These include the potential for the Hookpod to reduce plastic marine debris caused by the standard use of disposable chemical light sticks (Birdlife International, 2014); the potential for reduced sea turtle bycatch. Indeed, a new version of Hookpod that will open at an increased depth of 20m to enhance potential turtle bycatch reduction is currently in development (Becky Ingham, Hookpod Ltd, *pers. com.*).

4. Conclusions

Trials conducted in various pelagic longline fisheries, including trials in WCPFC fleets in New Zealand and Australia, have all found Hookpods to be a highly effective seabird bycatch mitigation option. Where trials have tested Hookpod against existing mitigation options in line with CMM2017-06, the Hookpod was found to be as effective or more effective in mitigating seabird bycatch. Across all these trials no statistical difference in target fish catch rates has been found.

Providing the option to use Hookpods as a possible alternative to existing mitigation methods will provide more choice to fishermen, allowing them to choose the best option for their particular operation and help overcome challenges that fishermen may face in using other methods.

5. Recommendations

From this review, we recommend that the SC recommends that the Commission:

- agree that hook shielding devices represent a proven and effective seabird bycatch mitigation option that is relevant to pelagic long line fishing operations in the WCPFC area.
- note that for some fisheries hook shielding devices could be a preferred stand-alone seabird mitigation option, such as fishing operations that may have difficulties deploying other mitigation options.
- agree that sufficient evidence is available to support the option of using hook shielding devices to mitigate seabird bycatch, while still supporting the provision for existing mitigation options.
- agree to recommend that TCC consider and WCPFC revise CMM 2017-06 to include the use of hook shielding devices as a stand-alone seabird bycatch mitigation option to provide more choice and greater flexibility to the fishing industry to mitigate seabird bycatch in their fishing operations.

6. References

Barrington, J.H.S. 2016. 'Hook Pod' as best practice seabird bycatch mitigation in pelagic longline fisheries. SBWG7 Doc 10. Seventh Meeting of the Seabird Bycatch Working Group, Agreement on the Conservation of Albatrosses and Petrels. La Serena, Chile, 2 - 4 May 2016

Birdlife International 2014. Hookpod Update. SBWG6 Inf 12. Sixth Meeting of the Seabird Bycatch Working Group, Agreement on the Conservation of Albatrosses and Petrels. Punta del Este, Uruguay, 10 - 12 September 2014

Goad, D., Sullivan, B., Debski, I. 2017. Testing the Hookpod-mini in the New Zealand pelagic longline fishery. SBWG8 Inf 18. Eighth Meeting of the Seabird Bycatch Working Group, Agreement on the Conservation of Albatrosses and Petrels. Wellington, New Zealand, 4 – 6 September 2017.

Silva-Costa, A.,Neves, T., Marques, G., Gianuca, D., Winnard, S., Yates, O. 2017. The performance of Hookpods under commercial fishing conditions in the Brazilian pelagic longline fleet. SBWG8 Inf 08. Eighth Meeting of the Seabird Bycatch Working Group. Wellington, New Zealand, 4 – 6 September 2017.

Sullivan, B. 2011. Hook Pod Update. SBWG-4 Doc 10 Rev 1. Fourth Meeting of the Seabird Bycatch Working Group, Agreement on the Conservation of Albatrosses and Petrels. Guayaquil, Ecuador, 22 – 24 August 2011.

Sullivan, B.J. et al. 2017. At-sea trialling of the Hookpod: a ‘one-stop’ mitigation solution for seabird bycatch in pelagic longline fisheries. *Animal Conservation*, 21(2), 159-167.

Appendix 1. Summary of the studies investigating Hookpod/Hookpod-mini.

The table indicates the nature of the publication and the elements of analyses in each.

Publication	Scope	Review paper	Bycatch effectiveness	Fish catch assessment	Durability / Reliability	Safety	Cost data	Hook types & xizes trialled
Sullivan, B. J. et al. (2017). At-sea trialling of the Hookpod: a 'one-stop' mitigation solution for seabird bycatch in pelagic longline fisheries. *Animal Conservation*, 21(2), 159-167.	Summarises catch rates from 18 at-sea trials in Australia, Brazil and South Africa		X	X	X		US$8.50 per unit	Circle Hooks - 15/0 &16/0
Birdlife International (2014). Hookpod Update. Sixth Meeting of the Seabird Bycatch Working Group. SBWG6 Inf 12. Punta del Este, Uruguay, 10 - 12 September 2014	Provides raw catch, bycatch, and pod durability data on a trip by trip basis from South Africa (2012), Uruguay (2013), and Brazil (2013).		X	X	X			
Barrington, J. HS. (2016). 'Hook Pod' as best practice seabird bycatch mitigation in pelagic longline fisheries. Seventh Sixth Meeting of the Seabird Bycatch Working Group. SBWG7 Doc 10. La Serena, Chile, 2 - 4 May 2016	Provides assessment of six criteria for Hookpod as best practice seabird bycatch mitigation in pelagic longline fisheries.	X						
Silva-Costa, et al. (2017) The performance of Hookpods under commercial fishing conditions in the Brazilian pelagic longline fleet. Eighth Meeting of the Seabird Bycatch Working Group. SBWG8 Inf 08. Wellington, New Zealand, 4 – 6 September 2017.	Compares Hookpods with and without LED lights to evaluate the performance of Hookpods under commercial fishing conditions in the Brazilian pelagic longline fleet.		X	X	X			
Goad, D., et al. (2017). Testing the Hookpod-mini in the New Zealand pelagic longline fishery. Eighth Meeting of the Seabird Bycatch Working Group. SBWG8 Inf 18. Wellington, New Zealand, 4 – 6 September 2017.	Summarises catch and durability rates from 16 observed and 110 self-reported at-sea trial sets in New Zealand of a newer model, the Hookpod-mini.		X	X	X	X		Circle Hooks - 16/0 J-Hooks