 <p>Agreement on the Conservation of Albatrosses and Petrels</p>	<p>Tenth Meeting of the Seabird Bycatch Working Group <i>Virtual meeting, 17 - 19 August 2021 (UTC+10)</i></p> <p>In Pursuit of Procella – a Heavy Hook for Pelagic Longlines to Reduce Procellariiforme Bycatch</p> <p><i>Nigel Brothers</i></p>
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SUMMARY

Alternative seabird mitigation prospects were demonstrated in 2019 by the uptake in New Zealand by several fishers, of hooks purchased with weighted swivels directly attached. This led Humane Society International Australia (HSI) and Southern Seabirds New Zealand (SS) to collaboratively explore options of a purpose-built 'heavy hook'. Through a process of consultation with various hook manufacturers and supply companies, the most viable heavy hook option Procella evolved and this has now been taken through to the point of factory fabrication, with manufacturing viability and supply established in May 2021. With financial assistance from Australian Fisheries Management Authority (AFMA) and New Zealand Department of Conservation (DOC) the initial manufacture of a minimum order quantity is imminent so it is hoped that industry might have the opportunity to evaluate Procella later in 2021.

Weight is an integral part of the Procella hook. The principal of the Procella hook is to optimise sinking and sink rate from the moment of deployment by the addition of sufficient weight where it is most effective, at or within the hook.

The rationale along with perceived advantages and disadvantages of having the weight in the hook itself to provide operational and mitigation benefits are outlined. Also discussed is a technicality arising from the Procella concept amidst the current ACAP recommended best practice (BP) line weighting in pelagic longline fisheries.

If proven viable, Procella would be the first 'bird friendly' hook, and this type suits both J and C hooks.

1. INTRODUCTION

This is a progress report to the SBWG about efforts to develop a new hook type, one that takes weight off the line and puts it where it will be most effective, at the hook, indeed as an integral part of the hook. While the benefits to birds are reasonably assured, there are many other important operational aspects of Procella that need to be quantified by comprehensive fishing trials. It is hoped that by providing this information about Procella, other countries fisheries may be interested in evaluating Procella in their own fleets with a view to accelerating progress and providing an acceptable mitigation measure option.

A concept such as this depends on industry interest in hook weighting (as seen recently in NZ) and the potential for hook weighting to become accepted economically and operationally. Even the concept of adding weight to hooks faces problems of long-established traditions involving hook types, preferences and economics, (hooks have to date been inexpensive and considered to some extent expendable), so a redesigned hook does face major hurdles. The obstacles to acceptance of a new hook design include its cost relative to traditional hooks, and safety and catch performance concerns. The name 'Procella' is used to distinguish a 'heavy hook' from conventional line weighting.

ACAP recommended BP line weighting is based on considerable evidence (ACAP 2018 & 2019, Debski et al 2017) of benefit to seabird bycatch reduction but importantly, maintenance of target species catch rates (eg, Jimenez et al 2013, Robertson et al 2013, Rodrigo et al 2019). However, there has been only one study of actual hook weighting (Gilman et al 2020) and that study implied that heavy hooks will have a detrimental impact on fish catch. However, in this instance, two possible hook weighting-related design flaws were most likely responsible for this outcome – rather than the additional weight of the hook. Quite simply, there is no evidence that added weight has any detrimental impact on fish catch. Further evaluation using corrected hook design faults in this instance is unlikely to occur, which leaves uncertainty about heavy hook impact on fish catch to be ascertained during the Procella development process. One must take into account the possible visual deterrence of Procella, and the potential of shape to impact hooking capability. These factors can only be minimally adjusted in design, such as by maintaining the lowest surface area by increasing metal thickness (see visual presentation comparisons). There are however, multiple advantages beyond the very best bait sink rate, in moving line weight to the hook itself. The advantages and disadvantages of Procella are outlined below.

2. ABOUT PROCELLA AND THE HEAVY HOOK SELECTION PROCESS

The following four examples of alternate hook weighting methods were selected as the best prospects from the 10 variations constructed. From these, Procella (1 Figure below), was deemed to offer the most economical fabrication prospects with least impact on fish-catching characteristics of hooks – essential to maintaining fishing efficiency, and for mitigation uptake. Illustrated below are the four designs in order of preference, followed by a summary description of each.

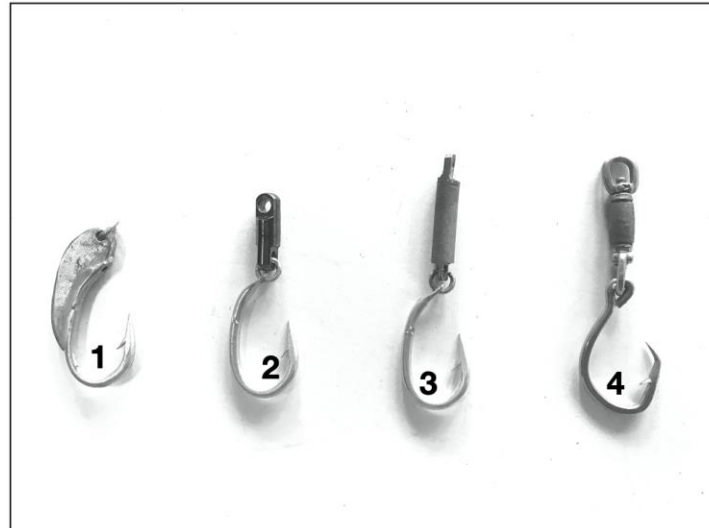


Figure 1. Visual comparison – Procella with other heavy hook options

1. Procella, if constructed in a single process using one metal type, could be the most economical and innovative all-in-one heavy (50 g) hook. In this example the hook shank diameter determines the overall metal thickness and therefore the surface area and shape provide the weight or alternatively, metal thickness can increase from shank diameter so as to reduce overall surface area. Preferably, options of hook with and without ring would be made available although one without ring would require further shaping around the hook eye.
2. This is perhaps the most compact and versatile (swivel with weight) means of creating a 50 g hook by the addition of a weighted component to the hook eye and or the hook ring. These are single action swivels which best suit being applied at the hook, by comparison to use of double action swivels such as the type indicated here in sample 4. Viability will depend to some extent on the added hook cost when a swivel of this type (35 - 40 g barrel) is added and currently such swivels are prohibitively expensive but their current 'cost' would appear to be overinflated. Ideally, swivel metal needs to be the same or similar to the hook and the hook eye dimension must conform well to the swivel hole diameter (less critical when the swivel is attached to the hook by a ring).
3. Perhaps the least expensive means of ready-applied hook weight, a simple metal rod approximately 50mm in length and around 8mm diameter weighing no less than 35 g. This design has the added cost saving advantage of reducing frequency of hook loss via hook bite-offs. Preferably, with and without hook ring options and metal type similar to or the same as the hook.
4. This is similar to that of the 2019 uptake in NZ, incorporating a conventional lead-centre swivel to the hook. This is probably more economically viable than option 2. The swivel needs to weigh not less than 35 g and ideally be of a type that is capable of turning only at its line attachment end. The hook eye orientation needs to align with the hook tip as depicted, because otherwise the swivel interferes and can obstruct the gape of the hook (see elsewhere for more detail). Also, a swivel of this type would ideally not include lead.



Figure 2 – Procella, manufacturer's pre-production prototype.

3. WHY USE 50 GRAMS?

A hook weighing 50 gms will result in a sink rate equal to, or exceeding any ACAP recommended weighting options prescribed in many pelagic longline fisheries to mitigate seabird bycatch. The weight of a conventional hook alone reduces the sink rate of a bait over 5 metres, from 49 seconds to 15.5 seconds. So simply by increasing the weight of a conventional hook from 16gms to 50gms (an addition of 34gms) essentially halves that sink rate – to 8.5 seconds. Current required weighting options based on ACAP recommended PB, produce a slower sink rate of between 9 and 11 sec. (Brothers 2009). Procella would be manufactured to weigh a total of 50 gms, as adding even a further 10 gms would not dramatically improve sink rate, while costing more and possibly impacting safety and/or fish catch rate.

If an additional 10 g was to be added (total hook weight becomes 60 g), sink time to 5 m would be reduced by 1.5 sec or just 0.3 sec per metre. If, as in this example, additional weight does not appreciably improve sink rate, less weight is preferable.

Evidence indicates the greatest sink rate improvements can actually be achieved with the addition of lesser amounts of weight - provided this is added at or very near to the hook. The addition of conventional greater amounts of weight away from the hook will not equal (or exceed) this performance. For example, even the addition of 20 g to a hook will sink a bait faster than will the addition of 98 g placed 3.5 m from the hook, or if 40 g was placed 0.5 m

from the hook. Of note however, there is greater sink rate variability when using smaller weights at the hook, and because the slowest will present the highest bird capture risk this should be addressed by a slight weight increase, (eg from 20 g to 34 g) to remove the variability.

In terms of regulations and meeting BP weighting criteria, a hook weighing 50 g in total exceeds the current weighting option of 40 g within 0.5 m of a hook (discounting here inclusion of hook weight) and has a comparable sink rate to the various weighting options of BP (60 g < 1 m, 80 g < 2 m) and others that are not consistent with BP but allowed in certain fisheries by regulations (60 g < 3.5 m, 98 g < 4 m). Technically, use of a 50 g weighted hook would be 6 g less than the legal limit option of adding 40 g, if added at the hook, but only **if** hook weight itself was around 16 g and not as it could be, 9 g (the lightest hooks being used) or say, 24 g (heaviest hook). Besides, a 50 g hook will equal or even exceed the mean sink rate if 40 g is attached at its maximum allowable distance of 0.5 m from the hook, and this is what counts most to a bird.

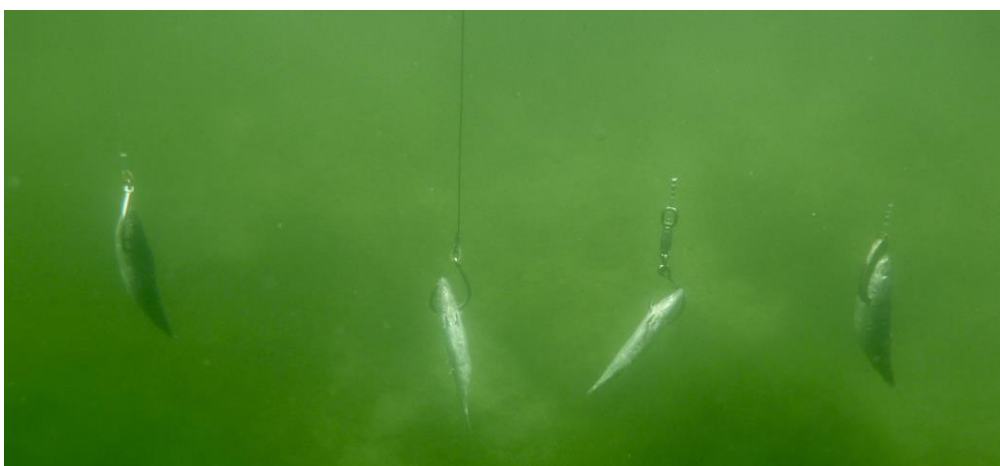


Figure 3 & 4. Above Visual presentations on line soak left to right
a) Procella b) lead swivel, c) hook on wire trace and d) hook on mono trace

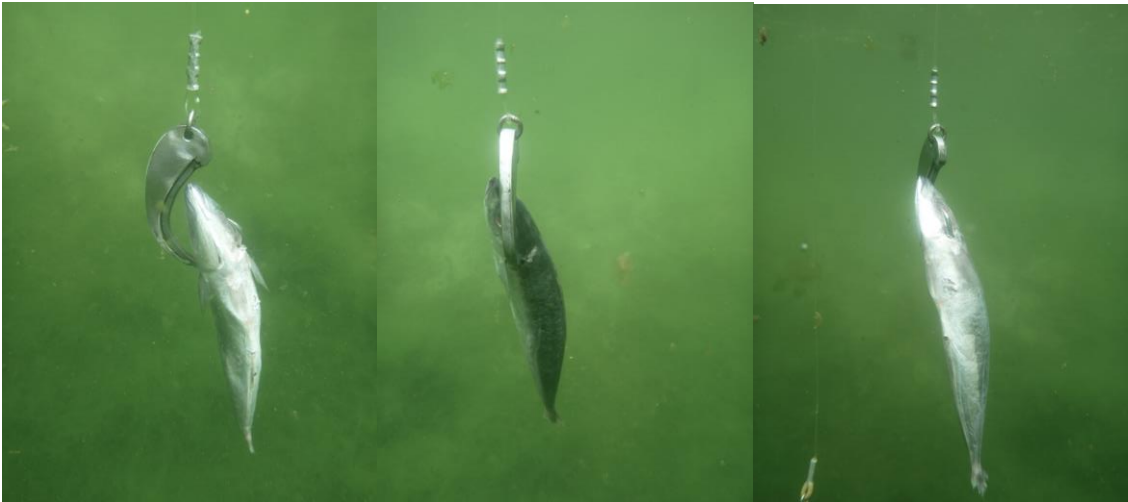


Figure 5 & 6. Above: Visual presentations of Procella hook - three orientations



Figure 7. Above: Visual comparison of a) conventional hook, b) lead swivel on hook and c) Procella

4. ADVANTAGES OF PROCELLA (A HEAVY HOOK)

1. A heavier hook will make all other seabird mitigation measures or combinations of measures more reliable and effective.
2. Less bait will be lost to birds from hooks.
3. Procella will provide the greatest improvement in baited hook sink rate, and achieve this with the least number of components.
4. Procella should provide more reliable live bait descent performance. (As opposed to using a weighted swivel – bait fish fight against the downward drag of the swivel by swimming upward which exacerbates bait losses to birds).
5. Procella will greatly reduce branchline bin tangles. (Weighted swivels create tangles by allowing the line to move freely about and get inadvertently looped through preceding branchlines in the bin, - this leads to bird capture). And in the case of prevalent coiled branchline method, there will be much improved bait throwing and coiling efficiency, unlike the inefficiencies created with alternate line weighting practices.
6. Procella will keep branchlines in good condition for longer through reducing instances of bin and coiled branchline tangles.
7. Procella ensures the hooks reach and maintain the desired target fishing depth because line lofting in current/tide is reduced, thereby offering bycatch avoidance advantage (eg sea turtle). To realise this advantage, compensatory adjustments in longline gear dimensions such as buoy line length, branchline length, distance between line floats and or number of branchlines between floats, may be needed.
8. Procella will reduce risk of branchline descent collapse and consequential line twisting. This can occur if weights are distant from the hook.
9. In the event of bait being lost from the hook, target fish species may still be attracted to Procella during the haul as it has the appearance of a conventional fishing lure.
10. Procella will deliver an equivalent or better line weighting performance than the current recommended ACAP best practice pelagic longline weighting.
11. Procella offers less flyback risk than when separate weighted swivels are used. In instances when the line trace gets severed, there are no lead swivels to contend with after the hook is lost.
12. There will be less flyback velocity if a Procella hook is pulled free, because when this occurs many hooks are still underwater and, in this situation Procella's return velocity would be slower than regular hooks. Also, there will no longer be a weighted swivel above this point to endanger the operator.
13. For fisheries shallow-setting, heavier hooks will not so readily come back up to the surface with hooked fish – this is an issue for shallow-set fisheries which results in seabirds being captured during the line soak (Brothers 2016).
14. For those fisheries progressively losing the bird bycatch mitigation benefit of wire leader usage, Procella will likely be a more attractive and safer alternative to having lead swivels somewhere in the wire replacement mono leaders.

5. DISADVANTAGES OF PROCELLA (OR ALTERNATIVE HEAVY HOOK)

1. Procella will be more expensive than a conventional hook on its own. (This may be offset to some degree through combining weight and hook).
2. There will be more economic impact with each lost hook, (this should be offset by the economic gains from most of the positive aspects listed above.)
3. Many of the advantages predicted require fishery trials for substantiation.
4. Satisfactory catch performance needs to be proven.
5. Extra hook metal could be an undesirable added burden to escaped or cut-away bycatch although the rate of post-release hook shedding is not known.
6. Increased cost per hook could lead to higher bycatch species mortality because of a reluctance to lose hooks (less cutting away of unwanted bycatch including hook or landing and killing bycatch just to recover hooks).
7. Despite helping to reduce incidence of flyback by comparison to the conventional weighting options, the nature of Procella flyback compared to conventional hook flyback in higher risk circumstances, is uncertain.
8. There is uncertainty about ultimate fishery uptake of Procella, irrespective of satisfactory economic and operational performance.

The above outline of pros and cons may also apply to an alternative 'heavy hook' design. Ultimately weighting of hooks instead of lines may involve a more appropriate hook plus swivel combination, including with a conventional 38g not 45g lead swivel attached. Procella doesn't have a swivelling capability (although it could), and it is not yet known if the branchline can perform satisfactorily without the swivel capability incorporated, such as at the clip or at whatever point leaders connect to the rest of the branchline. Heavy hook choice could come down to the question of cost alone, and at the time this paper was prepared, hook manufacturers had not yet provided a cost estimate of Procella in large volume if produced by the most efficient and cost-effective process.

6. WHERE TO NOW?

Discussion with hook manufacturers is ongoing about options for creating Procella most economically because the process in use to make the start-up test order is costly in labour and materials. Manufacturers have offered a lower cost if lead is used to replace the stainless-steel weighted part of the hook – however this idea presents its own environmental issues and safety considerations.

A large economically viable order of Procella would of course depend on successful trials in fisheries. It is hoped that Procella's performance will be demonstrated by initial limited trials using the small start-up order about to be placed. If proved operationally acceptable, Procella will be one of very few mitigation measures which in time will simply lose that 'mitigation label'.

7. ACKNOWLEDGEMENTS

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