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The Viability of Lead Replacement Weighting Material for Seabird Safe Pelagic Longline Hooks

Nigel Brothers

SUMMARY

Investigating non-toxic alternatives to the use of lead for weighting hooks is an action listed in AC14 Report 2023-2025 Work Programme Annex 5 (3.17) and, 2026-2028 Work Programme Annex 6 (3.8).

One of the objectives of the Procella heavy hook development project (ACAP Small Grants 2023 -10), was to find a satisfactory weighting material to replace lead, with SBWG12 recommending against lead use due to environmental concerns. In addition to the possible lead contamination of escaped or released bycatch species, crew safety in repetitive daily lead product handling was a motivating factor throughout Procella development. Most, if not all other readily available and widely used line weighting options include a lead component.

Despite considerable effort and expense during the course of Procella development (see SBWG 13 Inf 07), no replacement for lead was found to be economically or technically viable. The next best option is the application of a safe-coating over lead components. Various potentially suitable coating products were investigated and their effectiveness tested. Of all the safe-coat products, a combination of copper, nickel and chromium applied at the final stage of hook manufacture proved the most robust in maintaining lead-coverage during typical fishing operations. There may be commercial market viability issues due to the increased product cost of safe-coating (in this instance of around 25%, US$0.32). It must be remembered however, that this is possibly the first instance of safe-coated lead fishing gear.

The development of Procella using lead allowed the Korean hook manufacturer Segye Co Ltd to work with other Korean companies in the metal foundry, coatings and fabrication businesses to explore and develop safe-coating materials and application methods.

RECOMMENDATIONS

1. SBWG 13 note the information provided and implications for AC 2025-2026 Work Programme item 3.17 and AC 2026 - 2028 Work Programme item 3.8.

2. Lead to be considered an appropriate hook weighting material when safe-coated due to the importance of line weighting for seabird bycatch mitigation and in light of the fact that a replacement for lead has so far proven technically and economically problematic.
3. More accurately quantify the actual circumstances of individual hook losses, including deliberate cut offs versus bite offs, as well as the proportion of internal versus external hooking across all target and bycatch species.

La viabilidad de un material de lastrado alternativo al plomo para fabricar anzuelos de palangre pelágico seguros para las aves marinas

RESUMEN

Evaluar la eficiencia del uso de alternativas no tóxicas al plomo para lastrar anzuelos es una tarea incluida en los Anexos 5 (Programa de Trabajo del Comité Asesor para el período 2023-2025, punto 3.17) y 6 (Programa de Trabajo del Comité Asesor para el período 2026-2028, punto 3.8) del Informe de la CA14.

Uno de los objetivos del proyecto de desarrollo del anzuelo pesado Procella (Pequeñas Subvenciones del ACAP 2023-10) fue encontrar un material de lastrado satisfactorio para reemplazar el plomo, ya que la GdTCS12 desaconsejó el uso de plomo debido a preocupaciones ambientales. Además de la posible contaminación por plomo de las especies de captura secundaria que escapan o se liberan, la seguridad de la tripulación en la manipulación repetitiva diaria de productos de plomo fue un factor de motivación durante todo el desarrollo del anzuelo Procella. La mayoría, si no todas las demás opciones de lastrado de líneas de amplia disponibilidad y muy utilizadas, incluyen un componente de plomo.

A pesar de los considerables esfuerzos y gastos invertidos en el desarrollo de Procella (véase SBWG 13 Inf 07), no se encontró un reemplazo económica o técnicamente viable para el plomo. La mejor alternativa es la aplicación de un revestimiento seguro sobre los componentes de plomo. Se investigaron varios productos de revestimiento que podían llegar a ser adecuados y se comprobó su eficacia. De todos los productos de revestimiento seguro, una combinación de cobre, níquel y cromo aplicada en la etapa final de fabricación del anzuelo resultó ser la más robusta para mantener el revestimiento de plomo durante las operaciones de pesca típicas. Puede haber problemas de viabilidad en el mercado comercial debido al aumento del costo del producto con el revestimiento seguro (en este caso, de alrededor del 25 %, USD 0,32). Sin embargo, cabe recordar que posiblemente esta sea la primera instancia de un arte de pesca de plomo con revestimiento seguro.

El desarrollo de Procella con plomo permitió que el fabricante coreano de anzuelos Segye Co Ltd trabajara con otras empresas coreanas en los rubros de fundición de metales, revestimientos y fabricación para evaluar y desarrollar materiales de revestimiento seguro y métodos de aplicación.

RECOMENDACIONES

1. Que la GdTCS13 tome nota de la información proporcionada y las implicancias para el punto 3.17 del Programa de Trabajo del Comité Asesor para el período 2025-2026 y el punto 3.8 del Programa de Trabajo del Comité Asesor para el período 2026-2028.
2. Que el plomo se considere un material de lastrado adecuado para los anzuelos cuando está recubierto de forma segura debido a la importancia del lastrado de líneas para la mitigación de la captura secundaria de aves marinas y dado que la búsqueda de un reemplazo para el plomo ha resultado problemática tanto desde el punto de vista técnico como económico.
3. Que se cuantifiquen con más precisión las circunstancias reales de las pérdidas de anzuelos individuales, incluido un cotejo de los cortes deliberados con los cortes por mordida y la proporción de enganches internos y externos en todas las especies objetivo y de captura secundaria.

La viabilité de matériaux de lest de remplacement au plomb pour des hameçons de palangre pélagique sans danger pour les oiseaux marins

RÉSUMÉ

L'étude d'alternatives non toxiques à l'utilisation du plomb pour le lestage des hameçons constitue une action inscrite à l'annexe 5 (3.17) du rapport du CC14 – Programme de travail 2023–2025, ainsi qu'à l'annexe 6 (3.8) du Programme de travail 2026–2028.

L'un des objectifs du projet de développement de l'hameçon lourd Procella (Petites subventions de l'ACAP 2023-10) était de trouver un matériau de lest satisfaisant pour remplacer le plomb, le SBWG12 (GTCA12) ayant recommandé de ne pas utiliser le plomb en raison de préoccupations environnementales. Outre le risque potentiel de contamination au plomb des prises accessoires qui s'échappent ou sont relâchées, la sécurité de l'équipage liée à la manipulation répétée et quotidienne de produits contenant du plomb a constitué un facteur de motivation tout au long du développement de Procella. La plupart, sinon la totalité, des autres options de lestage de ligne facilement disponibles et largement utilisées comportent un composant en plomb.

Malgré des efforts considérables et des dépenses importantes engagées au cours du développement de Procella (voir SBWG13 Inf 07), aucun matériau de remplacement du plomb ne s'est révélé économiquement ou techniquement viable. La meilleure option suivante consiste à appliquer un revêtement protecteur sur les composants en plomb. Différents produits de revêtement potentiellement adaptés ont été étudiés et leur efficacité testée. De tous les produits de revêtement protecteur, une combinaison de cuivre, de nickel

et de chrome, appliquée lors de la dernière étape de la fabrication des hameçons, s'est avérée la plus robuste pour maintenir le recouvrement du plomb dans le cadre d'opérations de pêche typiques. Il peut exister des enjeux de viabilité commerciale en raison de l'augmentation du coût du produit liée au revêtement protecteur (dans ce cas, d'environ 25 %, soit 0,32 USD). Il convient toutefois de rappeler qu'il s'agit peut-être du premier cas d'équipement de pêche au plomb doté d'un revêtement protecteur.

Le développement de Procella utilisant le plomb a permis au fabricant coréen d'hameçons Segye Co Ltd de collaborer avec d'autres entreprises coréennes actives dans les secteurs de la fonderie de métaux, des revêtements et de la fabrication afin d'explorer et de développer des matériaux de revêtement protecteur ainsi que des méthodes d'application.

RECOMMANDATIONS

1. Le SBWG13 (GTCA13) prend note des informations fournies ainsi que de leurs implications pour le point 3.17 du Programme de travail du CC 2025–2026 et le point 3.8 du Programme de travail du CC 2026–2028.
2. Le plomb devrait être considéré comme un matériau de lestage d'hameçon approprié lorsqu'il est doté d'un revêtement protecteur, compte tenu de l'importance du lestage de la ligne pour les mesures d'atténuation des prises accessoires d'oiseaux marins, et du fait qu'un matériau de remplacement du plomb s'est jusqu'à présent avéré techniquement et économiquement problématique.
3. Quantifier plus précisément les circonstances réelles des pertes d'hameçons, y compris les sectionnements volontaires par rapport aux pertes dues aux morsures, ainsi que la proportion d'accrochages internes par rapport aux accrochages externes pour l'ensemble des espèces cibles et des prises accessoires.

LEAD REPLACEMENT OPTIONS

The only potentially acceptable alternative to lead was higher grade stainless steel. Being less dense, it requires greater quantity for equivalent weight, although that difference does not unacceptably compromise the dimensions of an all-stainless product (Fig 1). There was no other material found to have the necessary practical, economic and durability attributes.

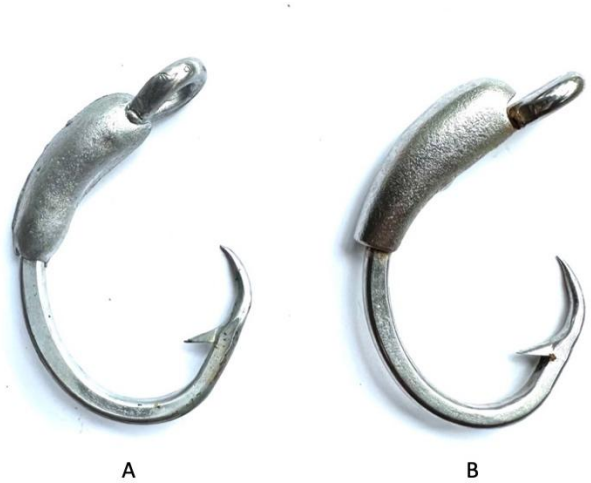

Fig 1. Size comparison between the weighting component of Procella hooks. A is 50g safe-coated lead Procella, and B is 50g is all-stainless Procella.

SUITABILITY OF STAINLESS STEEL AS A LEAD REPLACEMENT FOR WEIGHTING HOOKS

Because the process of hook manufacture centres around stainless steel initially in its workable pre-hardened state, followed by high heat treatment to then temper the metal (harden and strengthen), the stainless-steel weight component was pre-cast in a shape to conform to and then be welded to the hook, thus causing least alteration to critical hook dimensions.

LEAD REPLACEMENT ECONOMIC VIABILITY

The cost of cast stainless steel in equivalent weight to lead proved to be 25% more expensive. For a hook weighting 22 g, 30 g of stainless steel needed to be added.

This amounts to US$0.32 more per hook – a total of US$1.48 as opposed to US$1.12 per uncoated lead hook. While a reduced production cost could be achieved through fabrication in China instead of South Korea (cost of $US1.07), the risks to product quality from potential technical issues ruled out that option. Even at this lowest potential production cost, prospects of fishing industry acceptance of price were considered unlikely, given typical hook turnover rates and cost by comparison to the standard hook types. The added cost of lead weight component and safe-coating means that a Procella hook costs almost double a standard unweighted hook. Only recently has Procella become commercially available to fisheries.

LEAD REPLACEMENT TECHNICAL VIABILITY

Owing to the specific aspects of high quality (strength and durability) hook production, options of materials and methods for successful integration or addition of weight proved very limited. However, an all-stainless weighted version of Procella (SP50) was produced (at high cost) in sufficient quantity (6,000) to allow for assessment of performance. Technical shortcomings of this product eventually became apparent – there were issues relating to hook strength, along with a superficial but undesirable amount of corrosion (Fig 2). The casting process used in the making of SS Procella makes the stainless steel itself more susceptible to corrosion. This is the reason for the metal surface discolouration apparent after any exposure to the marine environment. There were no economical alternatives to the use of casting for production of SS Procella.

Fig 2. All-stainless 50g Procella exhibiting corrosion and breakage during fishing operations.

After several months of typical hook use, small numbers of hooks snapped adjacent to welds (Fig 2), suggesting that excess heat from the welding process increased metal strength reducing its ability to bend, leading to breakage. However, it is not known if the frequency of hook breakage was consistent with typical bending rates, which would mean equivalent fish catch losses anyway. It is also unclear whether optimal hook strength could be retained by altering the timing of metal heat tempering and the welding process.
The efficacy of safe-coating has not been quantified, although after two month's fishing, the safe-coating on Procella hooks appeared to be intact.

Initially there were only 100 hooks produced specifically for the assessment of the safe-coating. A further 1900 safe-coated hooks in two hook sizes were subsequently produced for promotion and performance assessment (Fig 3).

Fig 3. Examples of Procella 40g safe-coated lead in two hook sizes. A is 14/O hook and B is 16/O hook

Although average hook life expectancy can vary considerably across fishing grounds due to local bycatch species abundance and preferred discarding practices, including indiscriminate line cutting, and unavoidable hook bite-offs (sharks), a loss rate of around 17/1000 hooks was documented in the study which suggests a short average hook life expectancy of around 60 days and this indicates that safe-coating is sufficiently durable to last the average useful life of hooks. However, in worst case circumstances of safe-coated lead items being ingested by bycatch species discarded alive, coating durability and possible contamination levels remain unknown. The prevalence of ingestion of regular hooks (without added lead) is not even known.

CONCLUSIONS

Due to the statements 'weights of high density and mass, but low volume' being preferred (AC14 Doc12 Rev1 2024) but 'use of non-toxic alternatives to lead' encouraged, extensive efforts were made in this direction and the viability of safe-coated lead was indicated in successful testing of a suitable product.

Safe-coating remains an ongoing area of product improvement which has significant wider application potential, as ignorance of the lead contamination issue persists in fisheries worldwide. In any event, a price gap favouring lead over alternate materials will see the use of lead persist whether safe-coated or not, unless change is forced through internationally agreed regulatory processes.

REFERENCES

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