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# The Effect of Light Emitting Devices (LEDs) on Pelagic Longline Baited Hook Sink Rate and Relevance in ACAP Best Practice Line Weighting Guidelines

***Nigel Brothers***

## SUMMARY

Use of various light emitting devices (LEDs) for improving fish catch is widespread in pelagic longline fisheries. Since 2024, these and other fishing accessories have not been recommended unless the ACAP sink rate criterion of 0.5m/s to 5 m depth is being met (AC14 Doc12 Rev 1 Para 7.1, Jimenez et al 2024).

While the baited hook sink rate of many line configurations has been extensively quantified (Barrington et al 2016, Robertson et al 2013, Brothers 2009), there has been no measurement of LED performance specifically, although Jimenez et al (2024) point out the negative impact of LED's on gear sink rate.

The sink rate of four different and typical LED types was assessed and found to not meet minimum performance irrespective of the closeness to hook attachment distance, unless they were used concurrently with the recommended line weighting options. As expected, performance diminished as LED attachment distance was increased. Considering the total mass of even the heaviest LED type was 137 g, by comparison to the somewhat smaller line weighting guideline amounts, the findings not only highlight understandable misconceptions about LED performance, but the importance of the current ACAP advice, to not use such fishing accessories alone unless 'they achieve the sink rate criterion' (AC14 Doc 12 Rev 1). The reality is that light emitting fishing devices do increase seabird capture risk and even if manufacturers were to address the buoyancy issues of LED's, their use would still require adherence to the guidelines of ACAP line weighting best practice.

## RECOMMENDATIONS

1. A review of the 2024 guideline is required to reinforce the mitigation performance-related deficiencies associated with LED. Specifically, there is no seabird-safe way in which LED devices in their current form can be used without strict adherence to conventional line weighting guidelines. This can also ensure maintenance of optimal mitigation performance when hooks on the same line are set without LEDs.

2. Improve understanding of seabird mitigation practices and performance of certain longline sectors, particularly of EU swordfish operations in higher latitudes of greater seabird interaction risk.

# El efecto de los dispositivos emisores de luz (LED) en la tasa de hundimiento de anzuelos cebados en pesquerías de palangre pelágico y su relevancia en las recomendaciones sobre mejores prácticas de lastrado de líneas del ACAP

## RESUMEN

El uso de diversos dispositivos emisores de luz (LED) para mejorar la captura de peces está muy extendido en las pesquerías de palangre pelágico. Desde 2024, estos accesorios de pesca y otros no se recomiendan a menos que se cumpla el criterio de tasa de hundimiento del ACAP de 0,5 m/s a 5 m de profundidad (CA14 Doc12 Rev 1, párrafo 7.1; Jiménez et al., 2024).

Si bien la tasa de hundimiento de los anzuelos cebados de muchas configuraciones de líneas se ha cuantificado ampliamente (Barrington et al., 2016; Robertson et al., 2013; Brothers, 2009), no se ha medido específicamente el desempeño de los LED, aunque Jiménez et al. (2024) señalan el impacto negativo de los LED en la tasa de hundimiento de los aparejos.

Se evaluó la tasa de hundimiento de cuatro tipos diferentes de LED típicos y se reveló que no alcanzaban el desempeño mínimo independientemente de la cercanía a la distancia de fijación del anzuelo, a menos que se usaran en simultáneo con las opciones de lastrado de líneas recomendadas. Como era de esperar, el desempeño disminuía a medida que aumentaba la distancia de conexión del LED. Considerando que la masa total del tipo de LED más pesado era de 137 g, mientras que las cantidades orientativas de lastrado de líneas eran algo más pequeñas, estos hallazgos no solo ponen de relieve ideas equivocadas comprensibles sobre el desempeño de los LED, sino también la importancia de las recomendaciones actuales del ACAP de no utilizar dichos accesorios de pesca solos a menos que “cumplan con el criterio de la tasa de hundimiento” (CA14 Doc 12 Rev 1). La realidad es que los LED de pesca aumentan el riesgo de captura de aves marinas e incluso aunque los fabricantes resolvieran sus problemas de flotabilidad, su uso aún debería cumplir las recomendaciones sobre mejores prácticas de lastrado de líneas del ACAP.

## RECOMENDACIONES

1. Se requiere una revisión de las recomendaciones de 2024 para reforzar las deficiencias relacionadas con el desempeño de mitigación asociadas con los LED. Específicamente, no existe una forma segura para las aves marinas de usar estos dispositivos en su forma actual si no se observan estrictamente las recomendaciones convencionales sobre lastrado de líneas. Esto también puede garantizar el mantenimiento de un desempeño óptimo en materia de mitigación cuando los anzuelos en una misma línea se calan sin LED.

2. Mejorar la comprensión de las prácticas de mitigación de aves marinas y su desempeño de determinados sectores palangreros, en particular de operaciones pesqueras de pez espada de la UE en latitudes más elevadas que presentan un mayor riesgo de interacción con las aves marinas.

# Effet des dispositifs émetteurs de lumière (DEL) sur le taux d'immersion des hameçons appâtés en palangre pélagique et pertinence au regard des lignes directrices de bonnes pratiques de l'ACAP en matière de lestage des lignes

## RÉSUMÉ

L'utilisation de divers dispositifs émetteurs de lumière (DEL) pour améliorer les captures est largement répandue dans les pêcheries pélagiques à la palangre. Depuis 2024, ces accessoires de pêche, ainsi que d'autres, ne sont pas recommandés à moins que le critère de taux d'immersion de l'ACAP (0,5 m/s jusqu'à 5 m de profondeur) ne soit respecté (CC14 Doc 12 Rev 1, par. 7.1 ; Jimenez et al., 2024).

Bien que le taux d'immersion des hameçons appâtés pour de nombreuses configurations de ligne ait été largement quantifié (Barrington et al., 2016 ; Robertson et al., 2013 ; Brothers, 2009), aucune mesure spécifique de la performance des dispositifs émetteurs de lumière (DEL) n'a été réalisée, bien que Jimenez et al. (2024) soulignent l'impact négatif des DEL sur le taux d'immersion des engins de pêche.

Le taux d'immersion de quatre types différents et courants de dispositifs émetteurs de lumière (DEL) a été évalué et s'est révélé ne pas atteindre les performances minimales, quelle que soit la distance de fixation par rapport à l'hameçon, sauf lorsqu'ils étaient utilisés conjointement avec les options de lestage de ligne recommandées. Comme prévu, la performance a diminué à mesure que la distance de fixation des DEL augmentait. Étant donné que la masse totale même du type de DEL le plus lourd était de 137 g, comparée aux valeurs quelque peu inférieures prévues par les lignes directrices de lestage de la ligne, les résultats mettent en évidence non seulement des idées reçues compréhensibles concernant la performance des DEL, mais aussi l'importance des recommandations actuelles de l'ACAP de ne pas utiliser de tels accessoires de pêche seuls, à moins qu'ils ne satisfassent au critère de taux d'immersion (CC14 Doc 12 Rev 1). La réalité est que les dispositifs de pêche émettant de la lumière augmentent le risque de captures d'oiseaux marins et que, même si les fabricants devaient remédier aux problèmes de flottabilité des DEL, leur utilisation nécessiterait toujours le respect des lignes directrices de l'ACAP en matière de bonnes pratiques de lestage des lignes.

## RECOMMANDATIONS

1. Un examen des lignes directrices de 2024 est nécessaire afin de mettre en évidence les lacunes liées à la performance des mesures d'atténuation associées aux DEL. Plus précisément, il n'existe actuellement aucun mode d'utilisation des dispositifs DEL, dans leur forme actuelle, qui soit sans danger pour les oiseaux marins sans le respect strict des lignes directrices conventionnelles de lestage des lignes. Cela peut également garantir le maintien d'une performance optimale des mesures d'atténuation lorsque des hameçons sur une même ligne sont déployés sans dispositifs DEL.

2. Améliorer la compréhension des pratiques d'atténuation des interactions avec les oiseaux marins et de la performance de certains secteurs de la palangre, en particulier des opérations de pêche à l'espadon de l'UE dans des latitudes plus élevées où le risque d'interaction avec les oiseaux marins est accru.

## LED TYPES PHYSICAL PROPERTIES

There are a variety of commercially available multi-coloured light emitting devices made of clear plastic material. When LED's are attached up to 1.5 m from hooks, the light initially attracts small 'bait fish' which in turn attract target fish species such as swordfish to the vicinity of the baited hook. The light itself is also believed to attract target species.

For assessing the impact of LEDs on baited hook sink rate, two different forms of each LED type were selected (Fig 1). The proportion of each in general use is unknown, although it is assumed the options selected are reasonably representative of widespread use. Of the four LED's tested (Fig 1), two were reusable units that run on battery power - either two AA size lead-acid batteries with combined weight of 47 g (LED type A) or three lithium button batteries with a combined weight of 6 g) (LED type B). Testing included two single use chemical-based clear plastic 'glow-sticks'/'chem-lights'/'Cyalumes', types available in various sizes and colours (LED types C & D).


Fig 1. LED types used to measure impact on baited hook sink rate.
Type A negatively buoyant 136.6 g battery powered
Type B negatively buoyant 69.3 g battery powered
Type C Positively buoyant 6.8 g chemical function
Type D Positively buoyant 9.6 g chemical function

Table 1. Physical characteristics of four light emitting fishing device types (LEDs) which were used to measure the impact of LED's on baited pelagic longline hook sink times to 5 m depth and performance against the ACAP criterion.

| **Physical Characteristics** | **LED type A** | **LED type B** | **LED type C** | **LED type D** |
|---|---|---|---|---|
| **Total weight (g) including batteries** | 136.6 | 69.3 | NA | NA |
| **Total weight (g) without batteries** | 89.4 | 63.7 | 6.8 | 9.6 |
| **Total weight (g) without line attachment device** | 115.9 | 53.9 | NA | NA |
| **Adjustment to attain neutral buoyancy (g) with attachment device** | -13.7 | -4.8 | +2.0 | +1.5 |
| **Adjustment to attain neutral buoyancy without attachment device (g)** | +34.3 | +20.2 | NA | NA |
| **Dimensions (mm)** | 100x40 | 160x30 | 160x10 | 110x10 |

LED devices have been designed for ease of line attachment and removal which occurs on a daily basis. There is no argument for using LED's to aid sink rate – LED'S actually slow sink rate, but even if they were modified to assist sink rate, they are a discretionary item that is not attached permanently, so cannot be considered a bycatch management tool.

## METHODS, RESULTS & DISCUSSION

Using the methodology described in Brothers (2009), baited hook sink times to a depth of 5 m were measured 10 times for each LED device at various attachment distances and with extra line weight added (Table 2). Measuring was discontinued once sink times equalled or exceeded the ACAP threshold criterion of 10 sec or less, to 5 m depth. Because of little performance difference between LED types C and D, measurement of D was discontinued. All LED types failed the sink time criterion to 5 m depth, with times similar to or even up to 1 second slower than entirely unweighted baited hooks, these failing the ACAP threshold by almost 3 seconds. (although, by as much as 5 seconds depending upon hook weight and bait weight alone (Brothers 2009). However, the threshold was readily met by all LEDs when the ACAP line weighting guideline was followed (in this instance with the addition of 40 g at 0.5 m), regardless of using the maximum LED attachment distance of 3 m, when typical LED attachment distance is around 1.5 m. Since the other recommended line weight options of 60 g within 1 m or 80 g within 2 m of hooks deliver equivalent sink performance to 40 g at 0.5 m, it is to be expected those configurations would be similarly influential upon LEDs because, irrespective of LED attachment distance increase, acceptable sink performance remained constant with 40 g at 0.5 m. The difference in performance between more weight (50 g) at the hook, and less weight (40 g), further from the hook, suggests that the change in LED orientation affecting the extent of water resistance during sinking may be additionally impacting sinking performance. Even the orientation of bait during sinking was recognised as a factor that similarly affects sink rate (SBWG13 Doc 12). There was a slightly improved overall performance of 40 g at 0.5 m, compared to 50 g at the hook, but there is greater sink rate variability associated with 40 g at 0.5 m which could reduce overall mitigation performance (SBWG 13 Doc 12). It is important to note that less total weight if placed at the hook instead of further away (0.5 m), improves sink performance by a substantial amount - nearly 1 second!

In so far as LED types and their buoyancy affect sink times, despite the two heaviest LED types (A and B) actually being negatively buoyant by up to 14 g (Table 1), they nevertheless all failed to meet the criterion without additional weight. Considering the heaviest LED weighed 137 g, it failed to meet the criterion even when attached within 0.5 m of baited hooks. This result was unexpected and explains the fishing industry perception - that such heavy LEDs could only benefit sink rate. Although the least buoyant LEDs (A and B) performed best, that was in addition to being significantly larger in dimensions. With all LED types actually responding similarly to the addition of weight, this again indicates that the much larger devices might be heavier but their size counteracts the benefit of being less buoyant.

Table 2. The sink time in seconds, of baited pelagic longline hooks to 5 m depth when four types of light emitting devices (LEDs) are attached at varying distances from hooks, with and without additional line weight to meet the ACAP performance criterion (sink time means and standard deviation ( ) of 10 repetitions for each LED type, attachment distance and weight increment – a total of 410 repetitions).

| | **Time in seconds to 5 m depth & (SD)** | | | |
|---|---|---|---|---|
| **LED type & distance from hook** | **0 added weight** | **40 g inclusive of hook at 0 m** | **50g inclusive of hook at 0 m** | **40 g @ 0.5 m** |
| 22 g hook only | 12.76 (1.94) | 9.29 (1.26) | 8.61 (0.93) | 9.46 (0.83) |
| LED A @ 0.5 m | 10.45 (1.0) | 10.69 (1.15) | 9.55 (0.99) | 8.62 (0.53) |
| 1.0 | 11.17 (0.99) | - | 9.64 (1.26) | 8.63 (0.56) |
| 1.5 | 12.39 (1.12) | - | 11.15 (1.36) | 8.71 (0.83) |
| 2.0 | 13.42 (1.35) | - | 11.18 (0.75) | 9.20 (1.01) |
| 3.0 | 13.82 (0.76) | - | 8.24 (1.07) | - |
| LED B @ 0.5 m | 11.72 (1.10) | - | - | 9.39 (0.71) |
| 1.0 | 9.41 (0.41) | - | - | 8.60 (0.72) |
| 1.5 | 17.17 (1.26) | - | - | 8.89 (0.70) |
| 2.0 | 13.42 (1.35) | - | - | - |
| 3.0 | 15.51 (1.49) | - | - | - |
| LED C @0.5 m | 14.15 (0.81) | 13.72 (1.34) | 10.18 (0.92) | 10.26 (0.61) |
| 1.0 | 11.15 (1.01) | - | 13.20 (1.27) | 9.21 (0.55) |
| 1.5 | 25.94 (3.41) | 20.81 (3.1) | 11.92 (1.71) | 9.69 (1.47) |
| 2.0 | 26.45 (3.42) | - | 10.92 (0.86) | - |
| 3.0 | - | - | 10.72 (1.02 | - |
| LED D @ 0.5 m | 13.43 (0.88) | - | - | - |
| 1.0 | - | - | - | - |
| 1.5 | - | - | - | - |
| 2.0 | - | - | - | - |

The results suggest that relatively minor changes in some but not all LED types design could ensure the ACAP criterion is met without the need for use of additional weight. While in this instance line attachment method of LED types A and B was a 15 g to 20 g stainless steel clip (Table 1, Fig 1) which positively contributes to sink rate performance, lighter attachment methods would result in the opposite outcome. This aspect of variable impact on performance was not measured. Also, the minimum additional weight required to meet the criterion was not determined because readily detachable LEDs are not always attached, making essential the more permanent and dependable line weighting options, including in combination with all LEDs. Furthermore, if target fishing entailing high LED dependence happens to involve predominantly day-time setting of lines, the baited hooks can pose a high seabird capture risk similar to conventional baited hooks used with insufficient or no line weight. With all these problems and variables, it is little wonder there is a worsening seabird conservation crisis!

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