 <p>Agreement on the Conservation of Albatrosses and Petrels</p>	<p>Thirteenth Meeting of the Seabird Bycatch Working Group</p> <p><i>Swakopmund, Namibia, 27 - 29 May 2026</i></p> <p>Sink rate variability in pelagic longline hook weighting regimes and methodology to demonstrate acceptable performance against the ACAP 2024 sink rate criterion</p> <p><i>Nigel Brothers</i></p>
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SUMMARY

Sink rate comparison experiments were performed with a variety of weighted hooks that meet ACAP criterion-qualifying mean sink rate. The frequency with which these various weighted hooks failed to meet the sink performance criterion was found to increase with both **too little** and **too much** weight. Failure frequency also increases with **larger bait** size irrespective of the amount of line weight. Instances of criterion failure also occurred around the mean rate of ACAP recommended weighting regime - which is the performance basis of the criterion.

The important issue is whether the higher or lower frequency of not meeting sink rate criteria and the amount of variability (while still meeting criterion) has any mitigation performance implications. This of course varies depending on the methodology used to measure sink rates. This is aside from ascertaining what is 'sufficient' sink rate data to prove adequate performance of any line weighting regime.

The ACAP criterion can be met with as little as 40 g inclusive of size 16/O hook weight - or in the case of smaller size 14/O hooks - weight as little as 35 g in total. It would seem logical that lower variability around a mean criterion-qualifying sink performance will provide the best mitigation outcome. Even so, it needs to be recognised that when weight is placed at the hook, adequate sink performance can be achieved with the least amount (totalling 40 g inclusive of hook) and there is minimal or no additional benefit of adding more weight. This has important implications for general line weighting acceptance as well as costs.

RECOMMENDATIONS

1. Replace the minimum 50 g (inclusive of hook weight) with 40 g at-hook weight - under the 0.5m/s to 5 m sink rate criterion.
2. Sink rate criterion should include a limit on variability (frequency and magnitude) in order to meet the criterion in the BP guidelines.

3. Suitability of the sink-rate-measuring methodology compared to more typical practices (eg TDR) requires evaluation against the alternatives to develop more comprehensive options of line weighting dimensions (mass and distances) for meeting the sink rate criterion in a practical way.

La variabilidad de la tasa de hundimiento en los regímenes de lastrado de anzuelos de palangre pelágico y la metodología para demostrar un desempeño aceptable respecto al criterio de la tasa de hundimiento del ACAP 2024

RESUMEN

Se realizaron experimentos de comparación de tasas de hundimiento con una amplia gama de anzuelos lastrados que alcanzan la tasa de hundimiento media que satisface el criterio del ACAP. Se comprobó que la frecuencia con la que estos diversos anzuelos lastrados incumplían el criterio de desempeño de hundimiento aumentaba tanto con **peso insuficiente** como con **demasiado peso**. La frecuencia de los fallos también aumenta con un tamaño de **cebo más grande**, independientemente de la cantidad de lastre de la línea. También se produjeron casos de incumplimiento del criterio de la tasa media del régimen de lastrado recomendado por el ACAP, que constituye la base de desempeño del criterio.

La cuestión importante es si la frecuencia más alta o más baja de incumplimiento de los criterios de tasa de hundimiento y la cantidad de variabilidad (a pesar de cumplir con el criterio) tienen alguna implicancia en el desempeño de la mitigación. Naturalmente, esto varía dependiendo de la metodología utilizada para medir las tasas de hundimiento. Otra cuestión es la determinación de los datos de tasa de hundimiento “suficientes” para demostrar un desempeño adecuado de cualquier régimen de lastrado de líneas.

El criterio del ACAP se puede alcanzar con tan solo 40 g, incluyendo el peso del anzuelo de tamaño 16/O, o en el caso de anzuelos más pequeños, de tamaño 14/O, con un peso total de tan solo 35 g. Suena lógico que una variabilidad más baja en un desempeño de hundimiento medio de conformidad con el criterio proporcione el mejor resultado en materia de mitigación. Aun así, cabe reconocer que cuando se colocan pesas en el anzuelo, se puede lograr un desempeño de hundimiento adecuado con el peso más bajo posible (un total de 40 g, incluido el anzuelo) y agregar más peso produce un beneficio mínimo o nulo. Esto tiene importantes implicancias para la aceptación general del lastrado de líneas y para los costos.

RECOMENDACIONES

1. Reemplazar el mínimo de 50 g (incluido el peso del anzuelo) con 40 g de peso en el anzuelo, de acuerdo con el criterio de una tasa de hundimiento de 0,5 m/s a 5 m.

2. El criterio de tasa de hundimiento debe incluir un límite de la variabilidad (frecuencia y magnitud) para cumplir con el criterio en las recomendaciones sobre mejores prácticas.
3. La idoneidad de la metodología de medición de la tasa de hundimiento en comparación con prácticas más típicas (p. ej., con TDR) requiere cotejarla con alternativas para desarrollar opciones más completas de dimensiones de lastrado de líneas (masa y distancias) para cumplir con el criterio de tasa de hundimiento de manera práctica.

Variabilité des taux d'immersion dans les régimes de lestage des hameçons de palangre pélagique et méthodologie visant à démontrer une performance acceptable au regard du critère d'immersion de l'ACAP (2024)

RÉSUMÉ

Des expériences de comparaison des taux d'immersion ont été menées à l'aide d'une variété d'hameçons lestés répondant au critère de l'ACAP en matière de taux d'immersion moyen. Il a été constaté que la fréquence à laquelle ces différents hameçons lestés ne satisfaisaient pas au critère de performance d'immersion augmentait aussi bien lorsque le **poids était insuffisant** que lorsqu'il **était excessif**. La fréquence d'échec augmente également avec une **taille d'appât** plus importante, indépendamment du niveau de lestage de la ligne. Des cas de non-respect du critère ont également été observés autour du taux moyen du régime de lestage recommandé par l'ACAP, lequel constitue la base de performance du critère.

La question essentielle est de savoir si une fréquence plus élevée ou plus faible de non-respect des critères de taux d'immersion, ainsi que le degré de variabilité (tout en respectant le critère), ont des implications pour l'efficacité des mesures d'atténuation. Cela varie bien sûr en fonction de la méthodologie utilisée pour mesurer les taux d'immersion. Cela est indépendant de la détermination de ce qui constitue des données de taux d'immersion « suffisantes » pour démontrer la performance adéquate de tout régime de lestage de ligne.

Le critère de l'ACAP peut être respecté avec un poids total d'à peine 40 g, y compris le poids de l'hameçon de taille 16/0 — ou, dans le cas d'hameçons plus petits de taille 14/0, avec un poids total d'à peine 35 g. Il semblerait logique qu'une variabilité plus faible autour d'une performance moyenne d'immersion conforme au critère permette d'obtenir le meilleur résultat en matière d'atténuation. Néanmoins, il convient de reconnaître que lorsque le poids est placé au niveau de l'hameçon, une performance d'immersion adéquate peut être obtenue avec une quantité minimale de lest (40 g au total, y compris l'hameçon), et qu'il n'existe que peu, voire aucun, bénéfice supplémentaire à ajouter davantage de poids. Cela a des implications importantes tant pour l'acceptation générale du lestage de la ligne que pour les coûts.

RECOMMANDATIONS

1. Remplacer le minimum de 50 g (y compris le poids de l'hameçon) par 40 g de lest positionné à l'hameçon, conformément au critère de taux d'immersion de 0,5 m/s mesuré jusqu'à 5 m.
2. Le critère de taux d'immersion devrait inclure une limite de variabilité (en termes de fréquence et d'ampleur) afin de satisfaire au critère tel qu'énoncé dans les lignes directrices de bonnes pratiques (BP).
3. La pertinence de la méthodologie de mesure du taux d'immersion, par rapport à des pratiques plus courantes (p. ex. les TDR), doit être évaluée au regard des méthodes alternatives afin d'élaborer des options plus complètes de dimensions de lestage de la ligne (masse et distances), permettant de satisfaire au critère de taux d'immersion de manière opérationnelle.

INTRODUCTION

ACAP created a sink rate criterion in 2024 which stipulates that baited hooks need to reach 5 m depth in less than 10 seconds. This made it necessary to qualify how sink performance can be practically and reliably demonstrated against the criterion. Previously, line weighting was reliant on the prescription of line weight mass and attachment distance options. The information to inform this topic was included in AC14 Work Programme 2023 - 2025, 3.2a and, 3.3a in the 2026 - 2028 Work Programme.

Since slower sinking baited hooks are at greater seabird interaction risk, the question of variability in sink rate of line weighting options is an important issue relating to the criterion and the measuring methodologies used to demonstrate compliance. Is a mean rate within the sink rate criterion good enough, or should a specific frequency of sink rates falling outside the criterion disqualify certain weighting regimes?

To demonstrate this problem, a simple sink rate comparison was undertaken. This experiment aimed to quantify variability, i.e. how frequently different weighting regimes result in occasions of the criterion not being met, irrespective of their producing a criterion-qualifying mean sink rate.

Even for a regime producing a satisfactory mean sink rate, occasions when the criterion is not met represent a significantly higher potential seabird interaction risk on an ongoing basis. The question of precisely what is an acceptable frequency of increased baited hook availability largely depends on what other mitigation measures are concurrently used.

METHODS, RESULTS & DISCUSSION

Sink rates were measured against the ACAP criterion using the methodology of Brothers (2009). To illustrate the problem of basing the meeting of criterion **only** on mean sink rate values without taking frequency and amount of variability into account, baited hook sink times were measured 30 times instead of the usual 10 repetitions per treatment. Five different

weighting regimes, 30, 40, 45, 50, 60 g inclusive of hook weight (22 g) were measured to a depth of 5 m. The variable of bait size was included to illustrate how this mostly uncontrollable variable can significantly influence the outcome of any criterion compliance demonstration. When hook size was a practical constraint, sink rate experiments used baits of a smaller size which is typical for smaller size hooks. For comparative purposes, the ACAP weighting regime of 40 g @ 0.5 m performance was assessed. A total of 760 measurements of sink times were taken (additional to a similar quantity in existing data sets).

Irrespective of the amount of weight added to baits of different size, individual sink times and their mean sink times were mostly faster than the criterion and always faster when smaller baits are used (Table 1). The only exception was for the combination of lightest weight (30 g) with either bait size, which failed the criterion on 77% of occasions. The other weighting regime sink times failed to meet the criterion on 18% of occasions but for individual line weight regimes, this varied between 3.3% and 45%, with 50 g weight category delivering the fastest overall mean sink time of 8.27 seconds. The criterion failure frequency of the ACAP weighting regime specifically, was 58%, with mean sink time just failing the criterion time limit. With a combined total weight (22 g hook plus 40 g @ 0.5 m) at-hook equivalent of 60 g inclusive of hook weight, it had a two second slower mean sink time with double the incidence of criterion failure.

Table 1. Pelagic longline sink time in seconds to 5 m depth of five at-hook weighting regimes (inclusive of 22 g hook weight) measured 30 times each for two categories of bait fish size, with performance outcomes compared to the ACAP criterion. A total of 320 sink times were measured.

Weight (g) inclusive of hook (22 g)	Bait weight (g) approx	Sample size of sink times to 5 m depth	Number of times ACAP sink criteria not met	Mean sink time (sec) to 5 m depth	SD	Combined Mean	Combined SD	Criterion failure rate %
30	100	30	16	10.16	0.67	13.36	3.52	77
	250	30	30	16.55	1.99			
40	100	30	6	8.83	1.28	9.78	1.64	45
	250	30	21	10.73	1.37			
45	100	10	0	8.1	0.93	8.53	0.93	5
	250	10	1	9.26	0.69			
50	100	30	0	7.69	0.98	8.27	1.10	3.3
	250	30	2	8.86	0.88			
60	100	30	0	7.31	1.09	8.56	1.68	20
	250	30	12	8.27	1.15			
ACAP regime 40 g @ 0.5 m	100	30	15	9.73	1.16	10.82	2.06	58
	250	30	20	11.90	2.19			

The overall best performing weight regime possibly indicates a 'happy medium' where the right amount of weight interacts best with optimal baited hook orientation to result in a consistently faster sink time because sinking is more often vertical (less water resistance). Weight at the hook takes a bait downward immediately whereas a conventional weighting regime delays the downward motion then pulls it from underneath which introduces a greater chance of variation in bait orientation which can impede descent. With too little weight (30 g), criterion failure can be high. This can be halved by using 40 g but more than halved again by adding an additional 5 g to 10 g - where criterion is met (based on mean performance) - after which additional weight made little change.

It is important to consider the bycatch implications of a mean sink rate meeting criterion with different amounts of weight despite having a highly variable frequency of criteria failure. Taking the worst-case example that met the criterion using least weight (40 g), and assume an even mix of bait sizes in a longline set of 1,000 hooks, there would be a total of 450 baits putting birds at increased capture risk each set. By contrast, the best performing weight (50 g) would provide only 33 such opportunities in the same set. Using 60 g at the hook actually increases criterion failure to 200 per 1000 hooks set. However, the real mitigation performance outcome of this is unknown, but the answer is likely to be complicated by required additional mitigation options which give extra bait protection.

Ignoring any criterion failure of less than 0.5 seconds, the criterion failure rate of ACAP 40 g at 0.5 m weight regime becomes 383/1000 hook equivalent, with the actual slowest time to 5 m depth being 15.28 sec, occurring at a frequency equivalent of 16/1000 hooks. This is arguably a sufficiently low bird capture risk and none of the other four weighting regimes failed the criterion to the same extent and as frequently (Table 2). Should the difference in overall criterion failure rate be what excludes 40 g or less, but not 50 g and 60 g from meeting the criterion, despite 40 g actually qualifying on the basis of mean sink time?

Weighted at the hook with either 50 or 60 g does lower the extent and frequency of criterion failure (between 16 and 133/1000 hooks) compared to 40 g, although the ACAP weighting regime failed to a greater extent more often but to a similar extent as did 40 g. So, despite high criterion failure incidence, frequency of bird capture risk (slower sinking baits) would appear to suggest acceptable mitigation performance equivalent to or better than ACAP best practice can be accomplished with as little as the 40 g total weight arrangement. This has quite important practical implications for successful smaller size hook and weight integration, as well as to overall operational acceptance and economic advantage in the heavier hook approach to mitigation performance improvement.

Table 2. The number of occasions and the amount of time each of the five line-weighting regimes failed the ACAP pelagic longline baited hook sink rate criterion based on 60 repetitions measured to 5 m depth for each regime (total 150 repetitions for each of two bait size categories).

Time (sec) in excess of criteria	At hook weight regime (g)				22 g hook + 40 @ 0.5 m
	30	40	50	60	
0.01 0.49	9	4	0	4	10
0.5	3	9	1	2	1
1	1	7	0	3	4
1.5	2	4	0	1	3
2	1	1	0	2	0
2.5	0	2	0	0	3
3	0	0	0	0	2
3.5	1	0	0	0	4
4	1	1	0	0	4
4.5	2	0	0	0	1
5	0	0	0	0	1
6 & over	24	0	0	0	0
Totals	44	28	1	12	33

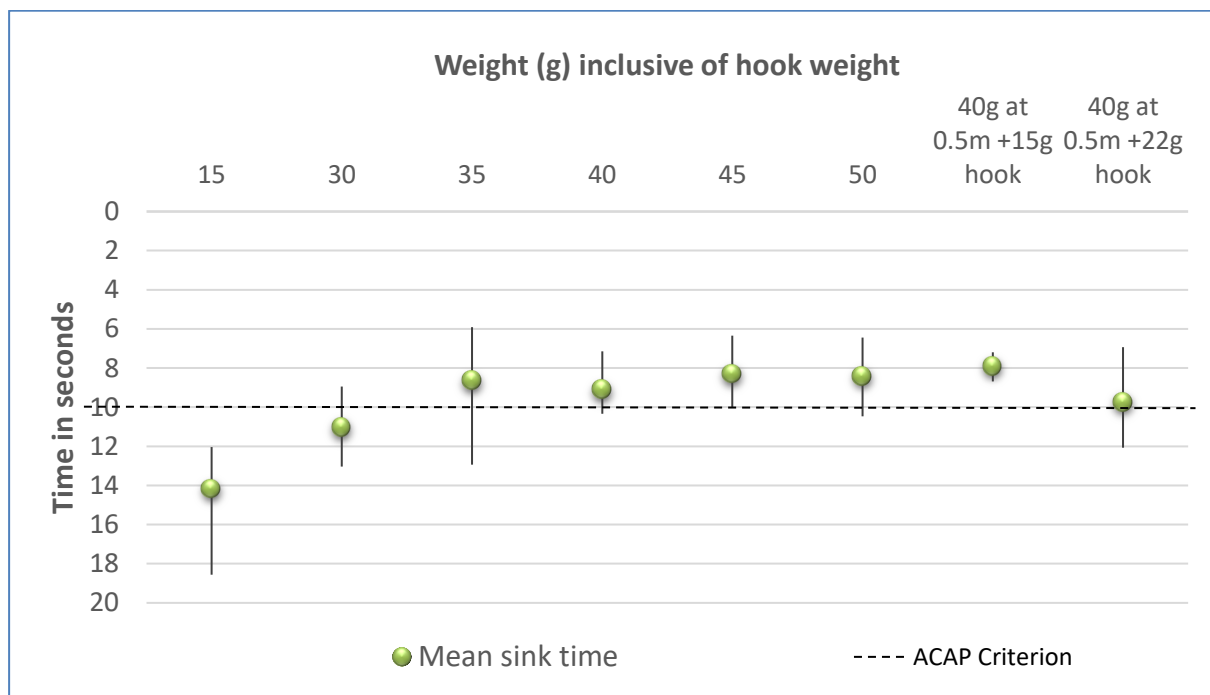


Fig 1. Mean and range of baited hook sink performance plotted against the ACAP criterion (5 m depth in less than 10 secs), for six weight regimes (weight includes hook weight), compared to two variations of line weighting recommended by ACAP (derived from table 2).

THE CASE FOR HOOK WEIGHTING MINIMUM ALLOWANCES

The operational and economic viability and acceptance of heavier hooks is largely dependent on how much weight needs to be added, as well as any constraints of actual hook size. While it might be acceptable in the case of LP50 created by adding 30 g to a 22 g size 16/O hook, to make a 15 g 14/O hook weight into 50 g is not achievable. Because size 14/O hooks are widely used preferentially in albacore target fisheries with high seabird overlap and issues of mitigation measure compliance, it is desirable that more agreeable methods of mitigation be created such as 14/O weighted hooks - this might mean acceptance of lower total weight particularly if it meets sink rate criteria.

By evaluating sink rate performance against ACAP criterion, of size 14/O hooks with various amounts of weight added, it is apparent that 20 g would be the least amount (total hook weight then 35 g) to meet the criterion, with minimal or no additional performance gain if total hook weight was to be increased to as much as 50 g (Table 3, Fig 1). There is also similar variability in performance within this additional weight range, meaning actual seabird interaction risk remains constant although a little higher than ACAP 40 g @ 0.5 m performance. That difference was however lost when performance of size 14/O and size 16/O hooks on the ACAP regime were combined, or if kept separate, the lighter weight 14/O hook actually performed better than the heavier (by 7 g) 16/O hook, presumably because the greater influence on sink performance is the 40 g @ 0.5 m which encounters least resistance from the lighter of the two hooks.

Table 3. Difference in pelagic longline baited hook sink time in seconds to 5 m depth due to weight increase on 15 g size 14/O hook with performance relative to the ACAP criterion and two examples of the recommended weight regime 40 g @ 0.5 m.

	Total line weight (g) inclusive of 15 g hook						ACAP 40 g @ 5 m regime	
	15	30	35	40	45	50	14/O hook (15 g)	16/O hook (22 g)
Mean sink time (sec)	14.17	11.03	8.64	9.1	8.29	8.41	7.9	9.73
SD	1.76	1.10	1.96	0.92	1.10	1.04	0.49	1.16
Frequency of failure to reach ACAP criterion	10/10	8/10	7/30	2/10	1/10	1/10	0/10	15/30

The degree to which different hooks (lightest versus heaviest) might contribute to change in sink performance and criterion qualifying is also a factor to consider in any sink measurement protocols, particularly when bait size-related performance variability is added. Including data of three hook sizes assessed in Brothers (2009), the sink performance to 5 m depth of five different size hooks with a weight range from 8 g to 24 g, varied from between 12.5 sec to 18.5 sec. None of the baited hooks without added line weight met the sink performance criterion. However, the mean sink time of all hook types met the criterion with as little as 20 g added - provided it was at the hook.

Such refinement of hook weighting can provide important product manufacturing and supply cost savings (less cost in materials and shipping), relative to the price of other line weighting options. In addition, operational gains could entice mitigation uptake without loss of mitigation efficacy. Importantly if predominant use of size 14/O hooks is currently with unweighted lines then gaining acceptance for weighted 14/O hook would undoubtedly be contingent on the factor of least weight, and least cost. The addition of even sub-optimal amount of weight to a 14/O hook could result in substantial seabird bycatch reductions. Because smaller bait is mostly used on the smaller 14/O hooks this immediately confers a sink rate advantage, and 40 g size 14/O hooks with smaller baits meet the criterion more consistently than when larger baits are included on hooks with 40 g at 0.5 m weighting (ACAP regime).

Compared to unweighted lines, weighted lines demonstrate sink time reductions of five to six seconds to 5 m depth which can provide an additional 25 to 30 m of bird-scaring line protection, even with fastest line setting (5.2 m/sec).

To conclude, although evidence of actual mitigation performance is supposed to have validated the adequacy of a minimum sink time of 10 sec to 5 m depth irrespective of variability in the sinking performance of the particular weighting regime, the question remains whether equal mitigation performance can be achieved using other weighting regimes that might have higher variability of sink rates but same criterion-qualifying mean rate. Such regimes might have greater economic and operational acceptance prospects. In so far as data needs for specifically measuring mean performance against the criterion, repetition requirements can be readily set, provided variability frequency and magnitude limits aren't needed, in which case the data required would warrant further consideration.

REFERENCES

Brothers, N. (2009) Analysis of factors that affect pelagic longline fishing hook sink rate and practical safe options for making hooks sink faster to minimize risk of seabird capture. *National Marine Fisheries Service USA Unpublished Report* (2009). NMFS Project Number AB133F07SE5293/NFFR 7400-7-18718.