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Effect of reduced distance between the hook and weight in pelagic longline branchlines on seabird attack and bycatch rates and on the catch of target species

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SUMMARY

Increasing the sink rate of baited hooks in longline fisheries reduces seabird bycatch. In pelagic longline fisheries the sink rate of baited hooks can be increased by increasing the weight and/or reducing the distance between the weight and the hook. In this study we test the effectiveness of reducing the distance between weights and the baited hook in reducing seabird attack rates on baited hooks and seabird bycatch. Taking into account that a mitigation measure must significantly reduce bycatch without reducing the capture of target species, we also study the effect on the capture of these species. Two branch-line types were tested: a control treatment of standard Uruguayan branch-lines with a 75gswivel at4.5m from the hook and an experimental branch-line of 65grs Safe Lead 1m from the hooks. The experiment was carried out during five trips on a research vessel on the Uruguayan shelf slope from 2009 to2012. Seabird attacks were assessed during ten daylight sets with the longline comprised of half experimental and half control branchlines. The capture of target fish species was assessed during an additional r 43 fishing sets and sink rate of both the experimental and control branch lines were assessed during five of these trips. The seabird attack rate was 59% lower on the experimental branch-line than the control treatment. For multiples attacks (i.e. more than one birds attacking the same baited hook), the rate was 70% lower on the experimental branchline treatment. Seabird bycatch rate was 50% lower on the experimental branch line than the control treatment No statistical differences were found for the main target species between the two branch line treatments. Sink profiles showed that baited hooks on the experimental branch line reached at least 4 m depth within the average toriline aerial coverage (~ 65-70m). In contrast, using standard branch lines on average the baited hooks were located at 2m depth beyond the area covered by the tori line. Results demonstrate that reducing the hooks-weight distance in the pelagic longline branch line can reduce the seabird attacks (including multiple attacks) and bycatch. Furthermore, this modification appears not to significantly affect the catch of target species, a pre requisite for a mitigation measure. The use of this measure simultaneously with the tori line could further reduce seabird bycatch.

RECOMMENDATIONS

1. The use of 65 g weight at 1 m from the hook in pelagic longline branch lines is recommended for pelagic longline vessels operating in the southwest Atlantic and in other regions of high seabird-longline interactions.
2. The use of this measure simultaneously with the tori line could further reduce seabird bycatch. Therefore, they combined effect should be addressed in further studies.

Efecto de la distancia reducida entre el anzuelo y el peso en los reinales de los palangres pelágicos en el ataque de las aves marinas y las tasas de captura secundaria y en la captura de las especies objetivo

El aumento de la tasa de hundimiento de los anzuelos cebados en las pesquerías de palangre reduce la captura secundaria de aves marinas. En las pesquerías con palangre pelágico se puede aumentar la tasa de hundimiento de los anzuelos cebados al aumentar el peso y/o reducir la distancia entre las pesas y el anzuelo. En este estudio, evaluamos la efectividad de reducir la distancia entre las pesas y el anzuelo cebado para reducir las tasas de ataques de las aves marinas a los anzuelos cebados y la captura secundaria de aves marinas. Teniendo en cuenta que una medida de mitigación debe reducir significativamente la captura secundaria sin reducir la captura de las especies objetivo, también debemos estudiar el efecto en la captura de tales especies. Se evaluaron dos tipos de reinales: un tratamiento de control formado por reinales uruguayos estándar con un destorcedor de 75g a 4,5m del anzuelo y un reinal experimental con un Safe Lead de 65g a 1m de distancia de los anzuelos. El experimento se llevó a cabo durante cinco expediciones en un buque de investigación en la plataforma continental uruguaya entre 2009 y 2012. Se evaluaron los ataques de las aves marinas durante diez lances diurnos con la mitad del palangre formado por el reinal experimental y la mitad por el reinal de control. Se evaluó la captura de las especies de peces objetivo durante otros 43 lances de pesca y la tasa de hundimiento, tanto para los reinales experimentales y los de control durante cinco de estas expediciones. La tasa de ataques de las aves marinas fue el 59% más baja en el reinal experimental comparado con el tratamiento de control. En cuanto a los ataques múltiples (es decir, cuando más de un ave ataca el mismo anzuelo cebado) la tasa fue el 70% más baja en el reinal de tratamiento experimental. La tasa de captura secundaria de aves marinas fue el 50% más baja en el reinal experimental comparado con el tratamiento de control. No se observaron diferencias estadísticas para las especies objetivo principales entre ambos reinales de tratamiento. Los perfiles de hundimiento indicaron que los anzuelos cebados en el reinal experimental alcanzó al menos 4 m de profundidad dentro de la cobertura aérea de la línea espantapájaros promedio (aproximadamente 65-70m). Por el contrario, al usar los reinales estándar, en general, los anzuelos cebados se ubicaron a 2m de profundidad más allá del área cubierta por la línea espantapájaros. Los resultados demuestran que al reducir la distancia entre los anzuelos y las pesas en los reinales del palangre pelágico se pueden reducir los ataques de las aves marinas (incluidos los ataques múltiples) y la captura secundaria. Asimismo, esta modificación parece no afectar significativamente la captura de las especies objetivo, un requisito previo para una medida de mitigación. El uso de esta medida en forma simultánea

con la línea espantapájaros puede reducir aún más la captura secundaria de aves marinas.

RECOMENDACIONES

1. El uso de pesas de 65 g a 1 m de distancia del anzuelo en los reinales del palangre pelágico se recomienda para los buques de pesca con palangre pelágico que operan en el suroeste del Atlántico y en otras regiones con fuerte interacción entre las aves marinas y el palangre.
2. El uso de esta medida en forma simultánea con la línea espantapájaros puede reducir aún más la captura secundaria de aves marinas. Por lo tanto, su efecto combinado debería abordarse en otros estudios.

Réduction de la distance entre l'hameçon et le lestage d'une palangre pélagique sur le taux d'attaque des oiseaux de mer, leur capture accessoire et la capture des espèces ciblées

L'augmentation de la vitesse d'immersion des appâtages dans les pêcheries à la palangre réduit la capture accessoire des oiseaux de mer. Cette augmentation de la vitesse d'immersion peut s'effectuer, dans les eaux pélagiques en particulier, en accroissant le lestage de la palangre et/ou en réduisant la distance entre le lest et l'hameçon. Notre étude porte sur cette réduction de la distance et son impact sur les taux d'attaque des oiseaux de mer et sur leur capture accessoire dans la palangre. Tenant compte du fait que toute mesure d'atténuation doit viser à réduire la capture accessoire d'oiseaux sans pour autant réduire la capture de l'espèce ciblée, nous avons également étudié l'effet de la réduction de la distance lest-hameçon sur le taux de capture de l'espèce ciblée. Deux types de branches de palangre ont été mis à l'essai : le premier se composant d'une branche de palangre étalon pour l'Uruguay dotée d'un émerillon de 75g situé à 4.5m de l'hameçon, et le deuxième, plus expérimental, doté d'un émerillon de 65g de type SafeLead et placé à 1m de l'hameçon. Les essais se sont effectués pendant cinq campagnes menées à bord d'un navire de recherche, sur les rebords continentaux de l'Uruguay de 2009 à 2012. Les attaques des oiseaux de mer ont été répertoriées au cours de six poses de jour, la palangre du navire se divisant en deux moitiés, l'une se composant de la branche étalon et l'autre de la branche expérimentale. La capture des espèces de poissons ciblées a été évaluée sur une pose additionnelle de r 43 appâtages. Les vitesses d'immersion de la branche étalon et de la branche expérimentale ont été estimées sur la totalité des cinq campagnes de pêche. Il en résulte que le taux d'attaque des oiseaux de mer s'est avéré réduit de 59% sur la branche expérimentale comparée à la branche étalon. Dans le cas d'attaques multiples (c.à.d., plusieurs oiseaux attaquant le même appâtage) le taux d'attaque a été réduit de 70% sur la branche expérimentale. Le taux de capture accessoire des oiseaux s'est élevé à 50% de moins sur la branche expérimentale. Il n'y a pas eu de différence statistique entre les deux branches en ce qui concerne le taux de capture des poissons ciblés. Les profilés de la vitesse d'immersion ont indiqué que les appâtages de la branche expérimentale ont pu atteindre une profondeur de 4 m au moins à l'intérieur d'une zone de couverture aérienne pour une ligne de banderoles (~ 65-70m). En revanche les appâtages de la branche étalon n'ont atteint que 2 m de profondeur et ont dépassé la même couverture. Ces résultats démontrent que la réduction de la distance lest-hameçon sur une palangre pélagique est efficace pour réduire les attaques des oiseaux (y compris des attaques multiples) ainsi que leur capture accessoire. En outre la modification de cette distance ne semble pas altérer le taux de capture des espèces ciblées de manière significative, ce qui correspond à la première exigence à l'égard d'une mesure

d'atténuation de ne pas nuire à la capture de l'espèce ciblée. Cette mesure pourrait être utilisée conjointement avec une ligne de banderoles afin de réduire encore plus le taux de capture accessoire des oiseaux de mer.

RECOMMANDATIONS

1. L'utilisation d'un lestage de 65 g en poids placé à 1 m de l'hameçon sur des palangres pélagiques est recommandé pour les palangriers de l'Atlantique du Sud-ouest et d'autres régions où l'interaction entre la palangre et les oiseaux de mer est élevée.
2. Cette mesure si utilisée simultanément avec une ligne de banderoles pourrait réduire de manière encore plus accentuée le taux de capture accessoire des oiseaux de mer et leur effet conjoint devrait être sujet à des études ultérieures.

1. INTRODUCTION

Increasing the sink rate of the baited hooks in longline fisheries has a large potential effect of reducing seabird bycatch. In pelagic longline fisheries sink rate canbe increased in several ways, including the reduction the distance between the weight and hook (Robertson et al. 2010, 2013). In the present work we test the effectiveness of reducing the hook to weight distance on both seabird attack rates on baited hooks and seabird bycatch in an area of high seabird-longline interactions. Taking into account that a mitigation measure must significantly reduce bycatch without reducing the capture of target species, we also study the effect on the capture of these species.

2. MATERIALS AND METHODS

2.1. Study area

The present study was carried out over the Uruguayan slope and adjacent waters within the period of the year (i.e May-November) where historically the major seabird bycatch events have been recorded in the South-western Atlantic (Jiménez et al. 2009a). Five trips were made between May 2009 and August 2012 in a research vessel (R/V).

2.2. Fishing gear and branch line description

In the R/V the entire fishing operation was conducted by a longline fishing skipper, a boatswain and a couple of experienced fishermen in the commercial longline fishery. The fishing gear (American style) of the R/V had the same characteristics of a commercial fishing vessel (F/V) of the Uruguayan fleet (see Jiménez et al. 2009 and Domingo et al. 2012 for descriptions). The main difference between the R/V and the F/V was the number of hooks in each set (RV: 360 – 450 hook; F/V: 700 – 1550 hooks).The main line had a 3.6mm diameter. Five branch lines of 2mm diameter between buoys were deployed. Hooks were baited with squid and deployed from the stern of the vessel toward the port side, entering to the water between the middle and edge of the wash.

Two branch line types were constructed for the experiment. Both branch lines consisted of two sections, one of approx. 8.4 m and other of ca. 4.5 m. The first section goes from the snap (145 x 3.75 mm with a8/0swivel) to a swivel (see below) and the second from swivel to hook (J N9/0). The differences between the two branch lines were based in the swivel used, type of weight and distance from it to the hook. We used a branch line with similar characteristics to that used by the commercial fleet, with a lead swivel weighing 75 g located 4.5 m from the hook. In addition, we constructed an alternative branch line, with anunleaded swivel (4/0; 2.5grs) located 4.5 m from the hook and safe lead of 65 g at 1 m from the hook.

In the case of the standard branch lines we followed the typical setting procedure. First the lead swivel is thrown into the water and then the baited hook is pulled into the water at which point the snap is placed in the main line. In the case of the alternative branch lines, the safe lead and hook were released together as the snap was attached to the main line. The buoys were deployed to the starboard and radio buoys to the port side.

2.3. Experimental design

2.3.1. Bait attack rates and bycatch

In order to determine the effect of the two branch line configurations on seabird attacks on baited hooks, an experiment was carried out during daylight hours. We performed a total of ten sets where a section of the line (100-150 hooks) was divided into two blocks. Each of these blocks had 50 to 75 hooks per treatment (standard or alternative branch lines). To evaluate seabird attacks on baited hooks in each of the treatments we followed the methodology described in Jimenez et al. (2012). This included primary (when a bird descended over a baited hook or submerged itself to retrieve the bait after the hook had sunk) and multiple attacks (i.e. more than one bird attacking the same baited hook).

A seabird count was conducted at the beginning of each member of the pair (each block).During line hauling incidentally captured birds were recorded and identified to species level. We recorded whether they were caught by getting caught on a hook (noting the location) or tangled in the branch line.

2.3.2. Catch of target species

In order to determine the effect on the catch of target species, during 43 fishing sets conducted to operational fishing standards of the commercial longline fleet (i.e. beginning the set before sunset or dusk and hauling from the next morning), an experiment of paired sections of the line was conducted. Each member of the pair had 75 branch lines, one with standard branch lines and the other with alternative branch lines. In total there were 47 pairs with an effort of 7210 hooks. During the hauling the fish catch of each hook was recorded.

A randomization test was used to assess catch differences between branch line types.The null hypothesis of no differences in catches between paired sections was tested. Data were randomized and resampled 99,999 times and scored for whether or not the resampled value was equal to or greater than the original observed value. This process resulted in a probability of randomness (P) estimate that was used as a measure of statistical significance against a null hypothesis. If the null hypothesis was not rejected, then all possible orders for the data were equally likely to have occurred.

2.3. Sinkrate

During 2011 and 2012 an experiment was conducted to determine the sink rate of baited hooks forthe two types of branch lines (standard and alternative branch lines). The experiment was conducted during five fishing trips, two of them on the research vessel. In addition, three trips were conducted on a commercial fishing vessel of the Uruguayan pelagic longline fleet. During 30 longline sets, the sink rate of baited hooks for 134 branch lines (67 of each type) was estimated with Cefas G5 time-depth recorders (TDRs) attached to branch lines<30cm from the hook. Time and depth were recorded at 1 second intervals.

3. RESULTS AND DISCUSSION

3.1. Bait attack rates and bycatch

Seventeen species were present during the observation, including all the species that interact with fishing hooks and discards in this fishery. During the ten diurnal longline sets observed, a total of 220 attacks (15.2 attacks/100 hooks) on baited hooks were recorded, comprising 52 multiple attacks. For the treatment with standard branch lines the number of attacks was 156(21.5 attacks/100 hooks), with 40 of them resulting in a multiple attack. In contrast, the number of attacks for alternative branch lines was 64(8.8 attacks/100 hooks), including 12 multiple attacks. Therefore, the attack rate was 59% lower in the branch line with a 65grs swivel at 1 m from the hook than the standard branch line used in the Uruguayan fishery. The same trend was observed for the multiple attacks, at70% lower for alternative branch line.

During these longline sets, a total of 19 seabirds were caught. Twelve of these seabirds were captured on standard branch lines, while seven seabirds were captured on branch lines with a 65grs swivel at 1 m from the hook. It is important to note, that during one of the sets with in the treatment of alternative branch lines, the vessel stopped for a few minutes, because the longline mainline became stuck. At this time, the fishing gear remained suspended at the surface and the capture of an albatross was recorded. Excluding this event, the seabird bycatch was 50% lower in the branch line with a 65grs swivel at 1 m from the hook than the standard branch line. Bycatch of seabirds on standard branch lines included ten black browed albatross *Thalassarche melanophrys*, a southern royal albatross (*Diomedea epomophora*) and a northern giant petrel (*Macronectes halli*). For alternative branch lines the captured seabirds were six *T. melanophrys* and a northern royal albatross (*Diomedea sanfordi*).

3.2. Catch of target species

During the 47 paired sections sampled 915 individuals were caught. None statistical differences were found for the main target species between the two branch line types (Table 1).

3.2. Sink rate

The mean sink rate obtained for the two branchline type is presented in figure 1. The baited hooks on the branch line with a 65grs swivel at 1 m from the hook sank faster than the baited hooks on the standard branch line (i.e. with 75 grs swivel at 4.5m form the hook).Baited hooks on branch lines with a 65 g Safe Lead at1m from the hook had a mean sink rate of

0.27, 0.29 and 0.30 m s-1 to reach 2m, 4m and 6mdepths, respectively. For alternative branch lines, the baited hooks reached these depths at a mean rate of 0.15, 0.18 and 0.20, respectively.

The alternative branch line could ensure that hooks reach at least 4 m depth with in the average toriline aerial coverage (~ 65-70m). In contrast, using standard branch lines, the results suggest that beyond the protection of a toriline the baited hooks are located at 2m depth. The results suggests that using 65 g weight at 1m from the hook combined with a tori line may reduce attacks on baits and therefore bycatch.

4. CONCLUSION

Results demonstrate that reducing the hook-weight distance in pelagic longline branch lines reduces seabird attacks (including multiple attacks) and bycatch. Furthermore, this modification appears not to affect the catch of target species, a pre requisite of a mitigation measure. Since the Uruguayan waters are recognized by high seabird-longline interactions, the branch line described in this paper should be useful for other regions of the world.

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Figure 1. Mean sink rate for the baited hooks in standard branch lines (SB; 75 grs swivel at 4.5 m from the hook) and alternative branch lines (AB; 65 grs safe lead at 1 m from the hook) obtained from 5 fishing trips (xx profiles for SB and yy for AB). Standard branch line = black line; alternative branch line =grey line.

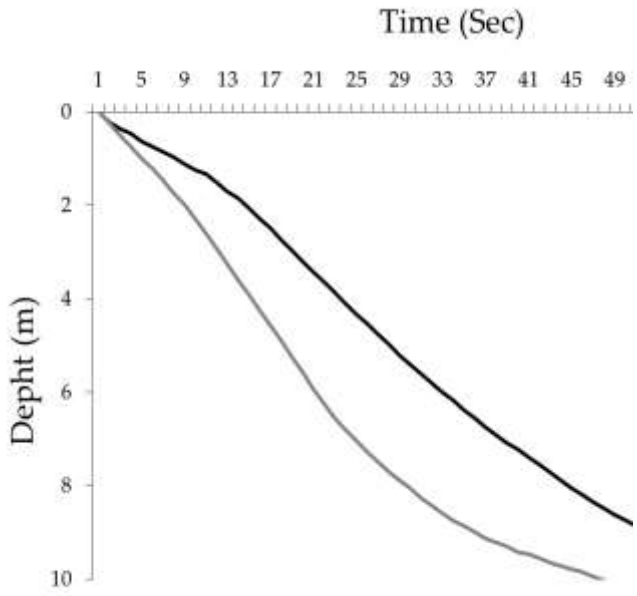

Tabla1.Number of individuals of the main target species captured in standard branch lines (SB; 75 grs swivel at 4.5 m from the hook) and alternative branch lines (AB; 65 grs safe lead at 1 m from the hook). P corresponds to the probability value of the randomization test.

Species	SB	AB	total	P
swordfish (*Xiphiasgladius*)	45	34	79	0.38
Albacore (*Thunnusalalunga*)	108	95	203	0.76
Yellowfin tuna (*Thunnusalbacares*)	26	29	55	0.92
Blue shark (*Prionceglauca*)	185	175	360	0.85