Using mitigation measures (contrast panels and modified hooks) to reduce seabird bycatch in the SPA Ilhas Berlengas

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Introduction

Seabird bycatch in fishing gears has been one of the main causes for the decreasing of several seabird populations and is actually an important topic of global conservation. Along the Portuguese Atlantic coast, bycatch of the endangered Balearic shearwater *Puffinus mauretanicus* and the vulnerable Razorbill *Alca torda* has been recorded (Oliveira *et al*., 2015). Fisheries are a very important economic activity in the Special Protection Area (SPA) Ilhas Berlengas and bycatch on gillnets and demersal longline has been reported in previous works. Under the "Gillnet" and "Life Berlengas" projects, two mitigation measures were tested in these fishing gears.

Objective

The focus of this study was on testing and assessing the effectiveness and impact (economic and biologic) of two experimental technical gear modifications (contrast panels and modified hooks) for bycatch reduction on gillnet and longline fishing gears in SPA Ilhas Berlengas.

Methods

Contrast panels were attached to gillnets. Modified hooks (black and without shine) were used on demersal longline. The contrast panels were installed on gillnets with 37m to 50m of length, separated by ~6m. 100 modified hooks were submerged in acid for 8 hours to darken and set in one longline with 500m length.
Between January 2017 and March 2018, 22 daily trips were monitored aboard 3 different fishing boats (with length between 8 and 9m) using contrast panels. During the same period, 10 daily trips were monitored aboard other 3 different fishing boats (with length between 6 and 11m) using modified hooks.
Monitoring was carried onboard by experient fishery observers. A control gear was also monitored in similar conditions. Economic data (gear manufacturing, installation process and fish catches) information on the receptivity to modified gear by fishermen was also collected.

Figures 1 and 2. Fisheries observers installing contrast panels on the nets (left image) and modified hooks (darker) and normal hooks (silver) (right image).

Results and discussion

● Effectiveness of net panels and modified hooks as mitigation measures

No seabirds were bycaught during the test or control events, preventing us to evaluate the efficiency of the measures in terms of bycatch. The reduced number of trips may be the cause of such result. Bycatch events depend on season, species and small details of the operability of the fishing gear. This means that bycatch is likely to have occurred, just not on the vessels where the trial took place.

● Economic impact study - Contrast panels

The cost to equip a gillnet with high contrast panels was ~0.43 Euro per metre and the cost represents a 26 - 40% increase (Table 1). When considering implementation of the focal mitigation measures at fleet level it should be acknowledged that modifying gillnets will represent a relatively significant increase to the original cost of manufacturing gillnets. For modified hooks it 's difficult to analyze the economic impact because there were no associated extra work hours, the acid has a symbolic value but this affects the durability of the hooks.

Table1. Break down of costs in Euro to equip gillnets used in the field trials with seabird bycatch mitigation measures. The length of the nets, materials used, costs of materials, modification time, and costs of labour associated with each of the nets are provided alongside total modification cost and cost per metre. Comparison of costs to manufacture a bottom set gillnet per metre against the costs to modify the same nets with the focal mitigation measures is in this table too. From "Study on Mitigation Measures to Minimise Seabird Bycatch in Gillnet fisheries ".

Material	Net	Net length	Cost of materials	Cost of material per net metre	Modification time (hrs)	Cost of labour to modify net	Total Cost to modify net	Original cost to manufacture net per metre	Cost to modify net with mitigation measure per metre	Increase in price per metre for modification (%)
High	1	600	281.25	0.47	18	56.9	338.15	1.4	0.56	40
contrast	2	1170	384.38	0.33	17.50	55.3	439.68	1.03	0.38	36.9
material	3	500	134.38	0.27	12	37.9	172.28	1.3	0.34	26.2

●Impact of panel and hooks mitigation gear on fish catches

In total, the catches were 50.57kg and 49.33kg for the mitigated and control nets. For the modified and control hooks the catches were 9,6kg and 23,9kg (see Table 2). There were no significant differences in fish catches between test and control events for the nets (U=157.5, p=0.510, Mann-Whitney test) neither for the hooks (U = 53.00, p = 0.85, Mann-Whitney test). However, it must be highlighted that these results should be interpreted with caution due to the limitations of the study, such as the reduced sample size and extremely low fisheries catches in both tests. In this work the sample size for the fisheries catches data set is small, and the observed fisheries catches in both tests are extremely low.

Table 2. Summary of fisheries catches from control net/hooks and net/hooks with mitigation measures. From "Study on Mitigation Measures to Minimise Seabird Bycatch in Gillnet fisheries ".

Experimental nets		**Experimental hooks**	
Total catch, all nets (kg)	**50.57**	**Total catch, all groups of hooks (kg)**	**9,6**
Mean catch per net/trip (kg)	2.53	Mean catch per group of hooks/trip (kg)	1,6
Max catch per net/trip (kg)	12.33	Max catch per group of hooks/trip (kg)	4,4
Min catch per net/trip (kg)	0	Min catch per group of hooks /trip (kg)	0
Sample size (n)	20	Sample size (n)	10
Control nets		**Control hooks**	
Total catch, all nets (kg)	**49.33**	**Total catch, all groups of hooks (kg)**	**23,9**
Mean catch per net/trip (kg)	2.74	Mean catch per group of hooks/trip (kg)	4,1
Max catch per net/trip (kg)	9.98	Max catch per group of hook/trip (kg)	14,8
Min catch per net/trip (kg)	0	Min catch per group of hooks/trip (kg)	0
Sample size (n)	18	Sample size (n)	10

● Acceptability of mitigation gear to fishers

Data from the fisherman interviews indicate that contrast panels may influence the fishing dynamics by increasing the weight on the gear, leading to a significant reduction on the gillnet lifetime. Also the modified hooks last for less time than the control ones (just since four days to two weeks and the normal were used during one year more and less).
All fishers regarded the high contrast panels and modified hooks to have a minimal impact on fish catches. This evidence suggests fishers using these nets would not incur losses on their income from fisheries catches through reduced fish catches.

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● Conclusion

Even without positive results on the effect of the measures tested to reduce seabird bycatch, sharing such information is crucial to find efficient measures, adjusted to the reality of our fisheries.
This was an important first opportunity to trial operability of the panels in the Peniche fishing fleet and to examine acceptability of the mitigation measures by fishers. This work was also essential to improve the relation between biologists and fishermen, allowing a collaborative work for the conservation of seabirds.

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