MINOUW

Case study results

3.1 - Algarve bivalve dredge, Portugal

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SUMMARY

Off Fuzeta and Vila Real de Santo António, in the southern Portugal and off Lagoa de Santo André, along the Western coast of Portugal, experiments were performed on profession vessels to evaluate the possible reduction of by-catch, discards and debris collection in bivalve dredges using a Bycatch Reduction Device (BRD) inside the dredge. 96 tows using two dredges simultaneously were carried out with a standard bivalve dredge and with a BRD-equipped bivalve dredge. Catches were identified, measured and weighted. The amount of debris in the catch was also weighted. It has been seen that using BRD in dredges can reduce significantly by-catch, discards and debris in the catch. Notwithstanding, it was also observed a decrease of the fishing yield and consequently a loss of income, higher than it was expected, probably due to the decrease of the dredge efficiency during the tow.

CASE STUDY RESULTS

Type of intervention

BRD devices in the dredge

Aim of the experiment

To evaluate reduction of by-catch,discards and debris in bivalve dredges using a Bycatch Reduction Device inside the dredge.

Main activities carried out

Fishing surveys were carried out in 2017 (off Fuzeta and Vila Real de Santo António, southern Portugal and off Lagoa de Santo André, Occidental coast of Portugal) on-board the IPMA research vessel "Diplodus". The samples were collected on sandy bottoms between 3 and 8 m depth.

Six types of BRDs were tested and consisted of a rigid grid, made of stainless steel mounted at a 45-50º degree angle in the middle of the retention system of the dredge, aiming to guide part of by-catch individuals and debris to an opening on the top of the dredge. Three of the BRDs had a square mesh grid (mesh size of 31, 41 and 51mm) whereas the other 3 consisted in a grid with 31, 41 or 51mm bar spacing. BRDs with square meshed grids and bar grids are referred to as SM and BG, respectively. To compare the catch from dredges equipped with BRDs with standard dredges, two identical dredges were towed simultaneously side-by-side. For each BRD, 5 to 11 tows were performed.

Every tow was conducted for 5 min at 2 knots, the speed currently used by commercial dredgers. The duration of dredge hauls was measured from the time the winch stopped paying out the towing cable to the time when the winch was restarted. A total of 96 tows were performed.

The catches were sorted on-board and the debris fraction was weighed. For each tow, damaged specimens were immediately recorded, weighed and whenever possible measured. In the laboratory all individuals caught were identified to the lowest taxonomic level possible, weighed to nearest g, using a top loading electronic balance, and measured to the nearest mm using a digital calliper or an ichtyometer.
GoPro cameras were used to observe the behaviour of the BRD dredge during the tow.

Main results

- The proportion of bycatch in number and biomass is in general low in this fishery (less than 12%).
- Both bycatch and discards in abundance and biomass were fewer (62.04% and 76.53% less in numbers and in biomass, respectively) in the BRD-equipped dredge.
- The BRD-equipped dredge resulted in a decrease of 46.89% in numbers and 44.68% in biomass of the target species probably due to the decrease of the dredge efficiency.
- The amount of debris was lower in the dredges equipped with BRDs, being almost two to four-fold less the debris retained in standard dredges decreasing the timing needed to sort the catch.

Discussion of the results

During the fishing trials there were caught 115,198 individuals that corresponded to 667.72 kg. Catches from BRD-equipped dredge accounted for 40,380 specimens and for 231.08 kg of total catch, whereas catches from standard dredges accounted for 74,818 individuals and for 436.63 kg of total catch. The target species (Spisula solida and Chamelea gallina) dominated the catches, comprising respectively 96.14% and 89.86% of the total catch in abundance and biomass, being of 95.82% and 87.57% for the standard dredge and of 96.74% and 94.24% for BRD-equipped dredge.

A total of 49 taxa were identified belonging to 9 taxonomic groups (Cnidaria, Nemertina, Polychaeta, Gastropoda, Bivalvia, Cephalopoda, Echinodermata, Decapoda and Vertebrata). Bivalvia was the most common taxon with 22 species, followed by Decapoda with 9 species (Table 1). For overall catches the most abundant bycatch species in BRD-equipped dredges were Atelecyclus undecimdentatus (450; 9.40±12.43), Echinocardium cordatum (380; 7.91±42.26), Diogenes pugilator (199; 4.15±5.35), Liocarcinus vernalis (74; 1.53±3.67) and Nassarius reticulatus (52; 1.08±3.2). In the case of the standard dredge the most abundant bycatch species in number of individuals were A. undecimdentatus (1949; 45.70±77.54), D. pugilator (220; 4.15±5.45), E. mediterraneum (187; 3.60±4.47), L. vernalis (138; 3.19±6.34) and Dosinia lupinus (56; 0.68±1.66). In weight the most represented bycatch species were A. undecimdentatus (9.4 kg; 195.86±250.71 g), E. meditteraneum (1.7 kg; 36.08±62.88 g), D. pugilator (0.37 kg; 7.63±31.12 g) and Laevicardium crassum (0,36 kg; 7.45±34.57 g) for the dredge with BRD. In the case of the standard dredge A. undecimdentatus, E. mediteraneum, Acanthocardia tubercülta, L. crassum and Raja clavata were the most abundant bycatch species in weight with 38.1 kg (793.96±1225.34 g), 4.0 kg (83.25±118.91 g), 2.3 kg (48.42±122.60 g), 1,5 kg (31.28±76.27 g) and 0.97 kg (20.21±140.01 g), respectively (Table 1).

The proportion of by-catch was always higher in the catches from St-D than from BRD-D either in weight or number. The mean proportion of by-catch in weight varied from 2.3 to 22.2% (12.3±6.9%) in BRD-D and ranged between 11.4 and 37.6% (23.5±9.5%) in St-D. In number, the mean proportion of by-catch ranged between 1.6 and 26.4% for BRD-D and between 3.1 and 23.8% for St-D. The ANOVA on ranks analyses carried out revealed the inexistence of significant differences on the proportion of by-catch in weight and number. However, pair comparisons analysis, showed statistically significant differences between the dredges with and without squares mesh BRD devices. In what concern fishing yields (the proportion of the catch that is landed) it was observed that for all pairs the mean fishing yield were consistently higher for the St-D.
Mean fishing yields ranged from 6,434 to 10,452 g/5 min. tow and between 2772 and 5786 g/5 min. tow for St-D and BRD-D, respectively. Notwithstanding, Kruskal-Wallis Anova and paired t-test analysis (or Mann-Whitney) did not detect statistically significant differences between dredges, independently of the dredge pair comparison analysed.
The length frequency distributions obtained for Spisula solida and for each tow combination (BRD-D vs St-D) are shown in Figure 3. The mean SL obtained for all combinations ranged between 26.88 mm and 28.55 being similar for all pairs (For BRD-D and St-D respectively: SM31- 28.05, 28.55mm; SM41- 27.13, 27.04mm; SM51- 26.86; 27.36mm; BG31- 27.65, 27.81mm; BG41- 27.30, 27.03mm; BG51- 27.40, 27.88mm). Despite the similarity of both mean SL and shape of the SL frequency distributions, the results from the Kolmogorov–Smirnov test showed statistically significant differences between all of them (SM31- D=0.1011> D10486=0.0282; SM41- D=0.0660> D24159=0.0183; SM51- D=0.1488> D31355=0.0157; RB31- D=0.0738> D10049=0.0279; RB41- D=0.0894> D21955=0.0185; RB51- D=0.0674> D21455=0.0191).
As it was expected, the amount of debris was lower in the BRD-D, being almost two to four-fold less the debris retained in St-D (Mean values. For BRD-D and St-D respectively: SM31- 4.66 kg, 15.52 kg; SM41- 5.46 kg, 12.52 kg; SM51- 8.01 kg, 13.81 kg; BG31- 7.65 kg, 20.92 kg; BG41- 5.98 kg, 16.35 kg; BG51- 1.81 kg, 7.44 kg). Nevertheless, the results of both ANOVA (ANOVA, F=0.273, P=0.989) and t-test or Mann-Whitney showed that these differences are not statistically significant.

How practical is it for a fisherman to implement this improvement, technically and financially?

The use of BRD in dredges implies a slightly modification in the dredges currently used with a cost of around 40€.

Is there sufficient evidence to support wider adoption of the method/technology?

Our experiments have shown that the use of a BRD inside the dredge can significantly reduce by-catch, discards and debris, thereby reducing sorting time. However, since it also decreases fishing yields it is difficult for the fishermen to acept this gear modification

CONCLUSION

Although the use of BRD was effective in reducing bycatch, discards and debris it also affected the amount of the target species that entered the dredges, decreasing fishing yields, which is related to the decrease of the dredge efficiency during the tow. The loss of fishing yields by around 40% is certainly outside the limits for fishermen to accept the use of BRD in dredgers, even if bycatch reduction is exceptionally good. Notwithstanding, the use of BRDs show promise for bycatch and discards reduction in the Portuguese dredge fishery.

ADDITIONAL RELEVANT RESOURCES OR LINKS

EU Common Fisheries Policy (CFP) Reform: https://ec.europa.eu/fisheries/cfp_en
International Guidelines on Bycatch Management and Reduction of Discards: http://www.fao.org/fishery/nems/40157/en

Table 1. Mean abundance (No. ind.) and mean weight (g) per species for each tow combination (BRD-equipped dredge vs standard dredge).

	SM31_BRD		SM31_Std		SM41_BRD		SM41_Std		SM51_BRD		SM51_Std		BG31_BRD		BG31_Std		BG41_BRD		BG41_Std		BG51_BRD		BG51_Std	
	No. Ind	Weight (g)	No. Ind	Weight (g)	No. Ind	Weight (g)	No. Ind	Weight (g)	No. Ind	Weight (g)	No. Ind	Weight (g)	No. Ind	Weight (g)	No. Ind	Weight (g)	No. Ind	Weight (g)	No. Ind	Weight (g)	No. Ind	Weight (g)	No. Ind	Weight (g)
Cnidaria																								
Anthozoa									0,11	0,14											0,20	0,12		
Nemertea																								
Nemertea							0,11	0,67																
Polychaeta																								
Glycera unicornis	0,50	1,85	0,17	0,90							0,41	0,08							0,27	0,44				
Lumbrineridae	0,17	0,17									0,41	0,24												
Nephtys sp.											0,41	0,32							0,52	0,30				
Ophelia neglecta	0,17	0,10															0,25	0,10						
Panthalis oerstedi	0,17	0,13																						
Gastropoda																								
Cymbium olla							0,11	1,01																
Euspira guilleminii											0,11	0,34												
Euspira nitida	0,17	1,23	0,17	1,72	0,22	1,66	2,56	11,69	0,33	1,74	1,56	7,61	0,38	2,09	2,13	10,33	0,36	2,17	0,73	4,89	0,60	3,02	1,60	10,46
Mesalia sp.									0,11	0,13														
Tritia reticulata					0,44	1,34	0,78	2,09	1,89	5,07	0,56	1,52	0,38	0,89	0,63	1,99	2,36	6,45	1,00	2,75	0,40	1,14	1,20	3,44
Bivalvia																								
Acanthocardia aculeata					0,11	0,70									0,13	1,84							0,20	9,46
Acanthocardia tuberculata							1,78	75,08	0,11	3,66	1,11	41,26			0,38	14,54			0,82	39,15			3,40	146,06
Anomia ephippium							0,11	0,07											0,09	0,06				
Callista chione			0,41	17,32			0,48	40,82																
Chamelea gallina	2,83	26,85	7,74	85,20	20,63	135,83	43,67	292,34	28,02	151,13	36,40	240,92	17,79	106,29	58,49	350,68	20,80	133,75	36,11	180,31	19,73	98,47	50,06	303,09
Donax trunculus																			0,18	1,05				
Dosinia exoleta	0,33	3,83	0,83	11,17	0,22	1,47	1,72	23,78			1,63	26,48					0,36	6,55	1,25	27,07				
Dosinia lupinus							1,00	4,29	0,11	0,54	1,63	9,51	0,25	1,35	0,38	1,86			0,55	2,87	0,20	1,46	4,72	8,38
Ensis siliqua	0,17	2,15									0,22	1,84			0,13	0,78	0,55	4,55	0,43	1,78	0,40	4,36	0,40	3,32
Laevicardium crassum	0,17	3,57					0,71	36,51			0,63	33,77			1,33	66,06	0,27	10,30	0,70	29,61	0,61	44,56	0,20	2,92
Macomangulus tenuis											0,41	0,24												
Mactra stultorum var. atlantica															0,13	0,68			0,18	0,79	0,80	4,38	0,80	4,36
Mactra stultorum var. corallina																							0,20	1,54
Mactra stultorum var. stultorum					0,11	0,69	0,78	3,87			0,78	3,44	0,38	2,56	1,38	12,06	0,18	1,44	0,27	2,42			3,00	31,34
Mactra glauca							1,07	51,30									0,18	3,73						
Mactra glauca var. SS			0,17	2,83			0,11	0,89			0,38	16,66	0,33	1,72	0,63	13,74								
Pandora inaequivalvis									0,11	0,08														
Spisula solida	602,99	3471,38	1884,23	8612,80	979,64	5649,85	1739,88	10159,74	988,41	5293,09	1341,24	6691,97	489,18	2665,22	1201,12	6083,93	812,54	4645,15	1161,95	6893,38	791,18	4094,95	1676,46	8583,25
Spisula subtruncata													0,13	0,09			0,18	0,45			0,20	0,60	0,40	0,94
Cephalopoda																								
Sepia officinalis							0,11	13,33											0,18	22,73				
Decapoda																								
Atelecyclus undecimdentatus	2,17	32,87	35,08	886,37	9,17	190,73	25,43	650,84	17,42	353,85	57,53	1391,47	11,23	225,26	33,01	819,81	9,12	214,20	58,25	543,96	1,54	28,93	17,41	373,81
Diogenes pugilator	0,83	0,50	2,97	2,06	4,88	3,16	6,15	4,68	2,81	3,06	3,48	2,37	4,14	29,38	3,42	2,99	6,27	4,75	6,09	4,04	4,60	3,96	4,24	3,12
Liocarcinus spp.	0,67	4,95	2,33	14,57	0,89	5,66	0,78	4,33	0,11	0,51	1,33	9,90	0,63	4,85	0,13	1,25	2,09	13,66	2,27	14,53				
Liocarcinus vernalis	0,17	1,28	0,91	4,06	1,89	8,40	3,83	17,05	1,84	9,59	3,61	18,39	3,33	17,59	4,82	23,46	0,42	2,09	1,51	6,81	1,54	5,77	2,03	8,67
Parthenope angulifrons							0,11	0,98							0,13	1,74			0,09	0,88				
Penaeus kerathurus																			0,09	1,59				
Polybius henslowii			0,83	12,07			1,15	14,52	0,11	2,06	0,85	12,60	0,76	7,18	0,78	13,35	0,45	4,70	1,64	20,09			0,40	2,50
Spiropagurus elegans	0,50	1,47	0,67	1,97	0,22	0,56	0,56	3,48	0,22	1,49	0,82	1,63	0,25	0,70	0,13	0,33	0,09	0,12	0,45	1,59			0,20	0,38
Thia scutelata					0,26	0,46					0,41	0,20												
Echinodermata																								
Amphiura filiformis																					0,20	0,04		
Astropecten irregularis					0,11	0,42	0,67	15,48			0,22	12,79			1,88	46,54	0,09	0,64	0,73	10,21			1,00	17,34
Echinocardium cordatum																							0,20	0,96
Echinocardium mediterraneum	0,50	5,42	4,81	126,95	1,70	32,82	5,90	131,50	1,55	22,98	2,53	38,08	0,88	18,79	1,78	22,52	28,58	67,78	4,56	76,82	5,24	60,25	3,62	136,62
Ophiura ophiura	0,17	0,05					1,00	0,64	0,33	0,21	0,11	0,10	0,50	0,48	0,75	0,59	0,09	0,10	0,82	0,56	1,60	1,06		
Chordata																								
Raja clavata							0,11	107,78																
Torpedo torpedo							0,11	9,17																
Trachinus draco							0,11	10,30			0,33	40,04			0,13	6,10			0,18	17,05			0,20	20,32
Total	612,65	3557,80	1941,31	9779,98	1020,50	6033,73	1840,89	11688,21	1043,61	5849,33	1459,09	8603,80	530,51	3084,42	1313,76	7497,13	885,26	5122,68	1281,90	7907,74	829,04	4353,07	1771,95	9672,28

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