

Reduction of by-catch and discards in the Algarve small-scale coastal fishery using a monofilament trammel net rigged with a guarding net

Monika J. Szynaka, Luís Bentes, Pedro Monteiro, Mafalda Rangel, Karim Erzini

Supplementary material

Table S1. – Two-way PERMANOVA table with factors net type (Ne) and depth (De), net type (Ne) and season (Se), and net type and target catch (Ta) for abundance of combined catch (includes commercial, commercial discard and by-catch).

Source	df	SS	MS	Pseudo-F	P(perm)	perms
Ne	1	3252.9	3252.9	1.5533	0.104	999
De	1	23236	23236	11.096	0.001	998
NexDe	1	1317.8	1317.8	0.62927	0.828	999
Res	36	75389	2094.1			
Total	39	1.04E+05				
Ne	1	2806.5	2806.5	1.1325	0.282	999
Se	1	10077	10077	4.0661	0.002	999
NexSe	1	650.25	650.25	0.26239	0.994	998
Res	36	89215	2478.2			
Total	39	1.04E+05				
Ne	1	3455.5	3455.5	1.4542	0.131	997
Ta	1	21301	21301	8.964	0.001	999
NexTa	1	1088.8	1088.8	0.45821	0.935	999
Res	36	85546	2376.3			
Total	39	1.11E+05				

Table S2. – SIMPER analysis for the discards (commercial discards and by-catch) data for abundance with the factor season (autumn and winter).

Autumn and winter groups Average dissimilarity = 75.87 Species	Autumn group		Winter group		Av.Diss	Diss/sd	Contrib%	Cum.%
	Av.Abund	Av.Abund	Av.Abund	Av.Abund				
<i>Scomber colias</i>	1.76	1.36	6.08	1.15	8.01	8.01	8.01	
<i>Chelidonichthys obscurus</i>	2.6	1.77	5.6	1.35	7.38	15.39		
<i>Trachinus draco</i>	2.11	0.83	5.37	1.35	7.08	22.47		
<i>Microchirus azevia</i>	0.09	1.43	4.12	1	5.43	27.9		
Porifera n.i.	0.5	0.97	3.71	1.03	4.89	32.8		
<i>Trisopterus luscus</i>	0.05	1.17	3.42	1.04	4.51	37.31		
<i>Sphaerechinus granularis</i>	0.99	0.1	3.25	0.74	4.28	41.59		
<i>Pagellus erythrinus</i>	0.99	0.3	2.94	1.07	3.88	45.48		
<i>Cymbium olla</i>	0.81	0.1	2.45	0.77	3.23	48.71		
<i>Boops boops</i>	0.69	0.1	2.27	0.85	2.99	51.7		
<i>Rhizostoma pulmo</i>	0.52	0.2	2.15	0.79	2.83	54.53		
<i>Chelidonichthys cuculus</i>	0	0.66	2.1	0.64	2.77	57.3		
<i>Trachurus trachurus</i>	0.48	0.48	2.09	0.95	2.75	60.05		
<i>Calliactis parasitica</i>	0	0.54	1.77	0.73	2.33	62.38		
<i>Pagellus acarne</i>	0.24	0.46	1.74	0.76	2.3	64.68		
<i>Atrina pectinata</i>	0.15	0.44	1.49	0.65	1.96	66.63		
<i>Astropecten aranciatus</i>	0.24	0.3	1.45	0.75	1.91	68.54		
<i>Merluccius merluccius</i>	0	0.49	1.42	0.6	1.87	70.41		
<i>Scorpaena notata</i>	0	0.46	1.38	0.62	1.81	72.23		
<i>Phallusia mammillata</i>	0.37	0.1	1.3	0.6	1.71	73.94		
<i>Charonia lampas</i>	0	0.34	1.07	0.6	1.41	75.35		
<i>Sepia officinalis</i>	0.23	0.1	1	0.54	1.32	76.68		
<i>Alosa fallax</i>	0.06	0.24	0.94	0.51	1.24	77.92		
<i>Raja undulata</i>	0.14	0.2	0.86	0.61	1.13	79.05		
<i>Spondylisoma cantharus</i>	0.26	0	0.84	0.54	1.11	80.16		
<i>Myliobatis aquila</i>	0.19	0.1	0.79	0.52	1.05	81.2		
<i>Diplodus bellottii</i>	0.11	0.14	0.77	0.45	1.01	82.21		
<i>Marthasterias glacialis</i>	0	0.2	0.75	0.48	0.99	83.21		
<i>Pegusa lascaris</i>	0.21	0	0.69	0.45	0.91	84.12		
<i>Diplodus annularis</i>	0.21	0	0.66	0.43	0.87	84.98		
<i>Conger conger</i>	0.07	0.2	0.63	0.55	0.83	85.81		
<i>Chelidonichthys lastoviza</i>	0.12	0.1	0.63	0.46	0.82	86.63		
<i>Dardanus arrosor</i>	0	0.2	0.57	0.48	0.75	87.39		
<i>Veretillum cynomorium</i>	0.04	0.14	0.56	0.38	0.74	88.13		
<i>Leptogorgia sarmentosa</i>	0	0.2	0.56	0.48	0.74	88.87		
<i>Serranus cabrilla</i>	0.04	0.1	0.53	0.37	0.7	89.57		
<i>Stichopus regalis</i>	0.04	0.1	0.51	0.36	0.67	90.24		

Table S3. – Simper analysis for the discards (commercial discards and by-catch) data for biomass with the factor season (autumn and winter).

Autumn and winter groups Average dissimilarity = 73.89		Autumn group	Winter group				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/sd	Contrib%	Cum.%	
<i>Chelidonichthys obscurus</i>	34.21	19.83	10.39	1.32	14.07	14.07	
<i>Trachinus draco</i>	18.64	5.75	6.97	1.18	9.43	23.49	
<i>Scomber colias</i>	12.64	9.08	6.47	0.99	8.76	32.26	
<i>Microchirus azevia</i>	0.97	12.69	4.79	0.78	6.48	38.74	
<i>Raja undulata</i>	3.5	5.68	3.35	0.49	4.53	43.26	
<i>Pagellus erythrinus</i>	6.52	1.94	3.03	0.82	4.1	47.37	
<i>Pagellus acarne</i>	1.4	5.8	2.9	0.62	3.93	51.3	
<i>Sepia officinalis</i>	5.72	1.39	2.8	0.52	3.79	55.08	
<i>Trachurus trachurus</i>	3.92	2.55	2.6	0.7	3.51	58.59	
<i>Merluccius merluccius</i>	0	5.92	2.29	0.61	3.1	61.7	
<i>Boops boops</i>	4.64	1.08	2.29	0.66	3.1	64.79	
<i>Trisopterus luscus</i>	0	6.44	2.17	0.57	2.93	67.72	
<i>Alosa fallax</i>	0.9	3.83	1.81	0.51	2.45	70.17	
<i>Pagrus auriga</i>	0	3.89	1.66	0.32	2.25	72.42	
<i>Dicentrarchus labrax</i>	0	4.2	1.63	0.32	2.2	74.62	
<i>Myliobatis aquila</i>	2.96	0	1.38	0.38	1.86	76.48	
<i>Balistes capriscus</i>	3.69	0	1.37	0.32	1.85	78.33	
<i>Pegusa lascaris</i>	3.05	0	1.33	0.42	1.8	80.14	
<i>Conger conger</i>	0.17	3.93	1.33	0.49	1.8	81.94	
<i>Prionace glauca</i>	3.37	0	1.26	0.19	1.7	83.64	
<i>Scorpaena notata</i>	0	2.87	1.16	0.48	1.57	85.21	
<i>Phycis phycis</i>	0	3.11	1.11	0.32	1.5	86.71	
<i>Synapturichthys kleinii</i>	1.89	0	1.1	0.24	1.49	88.2	
<i>Spondyliosoma cantharus</i>	2.52	0	0.93	0.35	1.25	89.46	
<i>Sarda sarda</i>	2.04	0	0.86	0.27	1.16	90.62	

Table S4. – Simper analysis for the discards (commercial discards and by-catch) data for abundance with the factor target catch (sole season and cuttlefish season).

Soles and cuttlefish group Average dissimilarity = 73.64		Soles group	Cuttlefish group				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/sd	Contrib%	Cum.%	
<i>Scomber colias</i>	2.19	1.06	6.66	1.21	9.05	9.05	
<i>Trachinus draco</i>	2.41	1.07	5.31	1.26	7.21	16.26	
<i>Chelidonichthys obscurus</i>	2.53	2.21	5.2	1.28	7.06	23.33	
Porifera n.i.	0	1.31	4.21	0.92	5.71	29.04	
<i>Sphaerechinus granularis</i>	1.08	0.4	3.83	0.83	5.2	34.24	
<i>Pagellus erythrinus</i>	1.26	0.3	3.65	1.28	4.96	39.2	
<i>Cymbium olla</i>	1.13	0.06	3.37	1	4.58	43.78	
<i>Boops boops</i>	0.97	0.06	3.11	1.13	4.23	48.01	
<i>Microchirus azevia</i>	0	0.93	2.72	0.73	3.69	51.7	
<i>Rhizostoma pulmo</i>	0.63	0.22	2.33	0.88	3.16	54.86	
<i>Trisopterus luscus</i>	0	0.73	2.09	0.7	2.84	57.7	
<i>Trachurus trachurus</i>	0.51	0.46	2.09	0.94	2.83	60.53	
<i>Phallusia mammillata</i>	0.05	0.58	1.83	0.74	2.49	63.02	
<i>Pagellus acarne</i>	0.1	0.53	1.73	0.78	2.35	65.36	
<i>Atrina pectinata</i>	0	0.48	1.41	0.56	1.92	67.29	
<i>Astropecten aranciatus</i>	0.24	0.28	1.36	0.72	1.85	69.14	
<i>Chelidonichthys cuculus</i>	0	0.37	1.16	0.44	1.58	70.72	
<i>Sepia officinalis</i>	0.1	0.31	1.14	0.6	1.54	72.26	
<i>Spondyliosoma cantharus</i>	0.32	0.06	1.11	0.65	1.51	73.77	
<i>Myliobatis aquila</i>	0.05	0.3	1.03	0.59	1.4	75.17	
<i>Calliactis parasitica</i>	0	0.3	0.98	0.49	1.33	76.5	
<i>Pegusa lascaris</i>	0.3	0	0.97	0.55	1.32	77.82	
<i>Diplodus annularis</i>	0.24	0.06	0.89	0.51	1.2	79.02	
<i>Raja undulata</i>	0.2	0.11	0.83	0.58	1.13	80.16	
<i>Merluccius merluccius</i>	0	0.27	0.78	0.41	1.06	81.22	
<i>Scorpaena notata</i>	0	0.25	0.76	0.42	1.03	82.25	
<i>Chelidonichthys lastoviza</i>	0	0.25	0.75	0.51	1.02	83.27	
<i>Diplodus bellottii</i>	0.1	0.13	0.74	0.45	1.01	84.28	
<i>Alosa fallax</i>	0.09	0.13	0.66	0.4	0.89	85.17	
<i>Charonia lampas</i>	0	0.19	0.59	0.42	0.81	85.98	
<i>Balistes capriscus</i>	0.17	0	0.53	0.4	0.71	86.69	
<i>Conger conger</i>	0.1	0.11	0.51	0.47	0.69	87.39	
<i>Veretillum cynomorium</i>	0	0.13	0.46	0.34	0.63	88.01	
<i>Serranus cabrilla</i>	0	0.11	0.45	0.34	0.61	88.62	
<i>Marthasterias glacialis</i>	0	0.11	0.42	0.34	0.57	89.19	
<i>Holothuria arguinensis</i>	0.14	0	0.41	0.3	0.56	89.74	
<i>Stichopus regalis</i>	0	0.11	0.4	0.33	0.54	90.28	

Table S5. – Simper analysis for the discards (commercial discards and by-catch) data for biomass with the factor target catch (sole season and cuttlefish season).

Soles and cuttlefish group Average dissimilarity = 70.88 Species	Soles group Av.Abund	Cuttlefish group Av.Abund	Av.Diss	Diss/sd	Contrib%	Cum.%
<i>Chelidonichthys obscurus</i>	33.93	26.54	9.28	1.26	13.09	13.09
<i>Trachinus draco</i>	21.55	8.26	7.2	1.22	10.16	23.24
<i>Scomber colias</i>	14.86	8.19	6.72	1	9.48	32.72
<i>Pagellus erythrinus</i>	8.42	1.86	3.59	0.96	5.06	37.79
<i>Sepia officinalis</i>	2.25	7.17	3.19	0.58	4.51	42.29
<i>Microchirus azevia</i>	0	8.56	3.11	0.61	4.39	46.68
<i>Raja undulata</i>	4.9	3.15	3.04	0.51	4.29	50.97
<i>Boops boops</i>	6.5	0.6	2.91	0.81	4.1	55.07
<i>Trachurus trachurus</i>	3.86	3.24	2.53	0.76	3.57	58.65
<i>Pagellus acarne</i>	0.37	4.98	2.19	0.58	3.09	61.74
<i>Balistes capriscus</i>	5.17	0	1.86	0.39	2.63	64.37
<i>Myliobatis aquila</i>	0.31	4.26	1.84	0.5	2.6	66.97
<i>Pegusa lascaris</i>	4.28	0	1.8	0.51	2.53	69.5
<i>Prionace glauca</i>	0	5.24	1.79	0.24	2.52	72.03
<i>Synapturichthys kleinii</i>	2.65	0	1.48	0.28	2.08	74.11
<i>Merluccius merluccius</i>	0	3.29	1.26	0.42	1.78	75.89
<i>Spondyliosoma cantharus</i>	3.53	0	1.26	0.43	1.77	77.66
<i>Alosa fallax</i>	1.27	2.13	1.25	0.41	1.76	79.42
<i>Trisopterus luscus</i>	0	3.58	1.19	0.4	1.69	81.1
<i>Lagocephalus lagocephalus</i>	4.04	0	1.15	0.23	1.62	82.72
<i>Sarda sarda</i>	1.4	1.62	1.14	0.32	1.6	84.33
<i>Diplodus annularis</i>	1.87	0.53	1.04	0.38	1.47	85.8
<i>Chelidonichthys lastoviza</i>	0	2.66	0.99	0.42	1.4	87.19
<i>Pagrus auriga</i>	0	2.16	0.91	0.23	1.29	88.48
<i>Dicentrarchus labrax</i>	0	2.33	0.9	0.24	1.26	89.74
<i>Conger conger</i>	0.23	2.18	0.8	0.38	1.13	90.88

Table S6. – Simper analysis for the combined catch (commercial catch, commercial discards, and by-catch) data for abundance with the factor depth (10-20 m and 20-30 m).

10-20 and 20-30 groups Average dissimilarity = 85.09 Species	10-20 group Av.Abund	20-30 group Av.Abund	Av.Diss	Diss/sd	Contrib%	Cum.%
<i>Microchirus azevia</i>	0.13	17.81	14.92	1.01	17.53	17.53
<i>Chelidonichthys obscurus</i>	8.83	4.75	8.2	1.14	9.64	27.17
<i>Scomber colias</i>	7.42	3.44	7.9	0.85	9.29	36.46
<i>Trachinus draco</i>	7.21	1.81	6.22	0.93	7.31	43.77
Porifera n.i.	0	3.81	4.19	0.7	4.92	48.69
<i>Sphaerechinus granularis</i>	3.42	0.13	3.55	0.55	4.18	52.87
<i>Sepia officinalis</i>	0.38	2.94	3.05	1.16	3.59	56.46
<i>Trisopterus luscus</i>	0.04	3.13	2.85	0.9	3.35	59.8
<i>Pagellus erythrinus</i>	2.92	0.63	2.62	0.89	3.08	62.88
<i>Merluccius merluccius</i>	0.08	2.19	2.1	0.82	2.46	65.34
<i>Pegusa lascaris</i>	2.04	0	2.09	0.96	2.45	67.79
<i>Cymbium olla</i>	2.17	0.06	1.92	0.54	2.26	70.05
<i>Solea senegalensis</i>	1.92	0.31	1.86	0.87	2.19	72.24
<i>Boops boops</i>	1.38	0.06	1.43	0.73	1.68	73.92
<i>Maja squinado</i>	0.21	0.69	1.32	0.4	1.55	75.47
<i>Rhizostoma pulmo</i>	0.92	0.31	1.22	0.71	1.43	76.9
<i>Trachurus trachurus</i>	0.75	0.69	1.11	0.82	1.3	78.21
<i>Phallusia mammillata</i>	0.04	1.13	1.07	0.65	1.26	79.47
<i>Pagellus acarne</i>	0.17	1.25	1.03	0.74	1.21	80.68
<i>Chelidonichthys cuculus</i>	0	0.81	0.96	0.39	1.13	81.82
<i>Atrina pectinata</i>	0	1	0.96	0.51	1.13	82.95
<i>Balistes capriscus</i>	0.88	0.13	0.94	0.73	1.1	84.05
<i>Raja undulata</i>	0.63	0.19	0.74	0.67	0.87	84.92
<i>Alosa fallax</i>	0.29	0.25	0.59	0.4	0.69	85.61
<i>Octopus vulgaris</i>	0.33	0.25	0.57	0.66	0.66	86.27
<i>Astropecten aranciacus</i>	0.29	0.31	0.56	0.72	0.66	86.93
<i>Calliactis parasitica</i>	0	0.5	0.53	0.45	0.62	87.56
<i>Myliobatis aquila</i>	0.04	0.44	0.53	0.58	0.62	88.18
<i>Phycis phycis</i>	0	0.44	0.5	0.44	0.58	88.76
<i>Scorpaena notata</i>	0	0.44	0.5	0.4	0.58	89.35
<i>Mullus surmuletus</i>	0.04	0.38	0.47	0.42	0.55	89.89
<i>Pagrus auriga</i>	0	0.25	0.45	0.33	0.52	90.42

Table S7. – Simper analysis for the combined catch (commercial catch, commercial discards and by-catch) data for biomass with the factor depth (10-20 m and 20-30 m).

10-20 and 20-30 groups Average dissimilarity = 87.25 Species	10-20 group Av.Abund	20-30 group Av.Abund	Av.Diss	Diss/sd	Contrib%	Cum.%
<i>Microchirus azevia</i>	15.85	2499.54	11.84	0.95	13.57	13.57
<i>Sepia officinalis</i>	209.26	2190.07	10.4	1.17	11.92	25.48
<i>Raja undulata</i>	1205.35	420.62	7.19	0.66	8.24	33.73
<i>Chelidonichthys obscurus</i>	1448.58	810.74	6.49	1.2	7.44	41.16
<i>Octopus vulgaris</i>	750	500	5.65	0.67	6.47	47.63
<i>Solea senegalensis</i>	837.04	159.86	4.29	0.87	4.92	52.55
<i>Balistes capriscus</i>	679.23	97.33	3.6	0.72	4.13	56.69
<i>Homarus gammarus</i>	0	649.24	3.13	0.35	3.59	60.28
<i>Trachinus draco</i>	658.73	153.81	3.12	0.7	3.58	63.86
<i>Merluccius merluccius</i>	31.22	536.23	2.76	0.73	3.17	67.02
<i>Pegusa lascaris</i>	451.02	0	2.46	0.99	2.82	69.84
<i>Scomber colias</i>	369.54	216.24	2.46	0.75	2.82	72.66
<i>Prionace glauca</i>	0	555.37	2	0.25	2.29	74.95
<i>Pagrus auriga</i>	0	257.62	1.94	0.35	2.22	77.17
<i>Maja squinado</i>	79.97	235.24	1.8	0.47	2.06	79.23
<i>Synapturichthys kleinii</i>	277.38	0	1.52	0.41	1.74	80.97
<i>Trisopterus luscus</i>	4	213.27	1.26	0.63	1.44	82.42
<i>Pagellus erythrinus</i>	239.96	72.44	1.18	0.83	1.35	83.77
<i>Plectorhinchus mediterraneus</i>	0	155.27	1.12	0.24	1.29	85.06
<i>Lagocephalus lagocephalus</i>	272.32	0	0.96	0.2	1.11	86.16
<i>Loligo vulgaris</i>	38.11	163.81	0.87	0.32	0.99	87.16
<i>Pagellus acarne</i>	4.59	191.11	0.85	0.52	0.97	88.13
<i>Alosa fallax</i>	84.92	74.45	0.85	0.41	0.97	89.1
<i>Dicentrarchus labrax</i>	0	110.38	0.77	0.24	0.88	89.98
<i>Torpedo marmorata</i>	0	133.97	0.65	0.35	0.75	90.73