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Improving the sampling efficiency of benthic species and communities using complementary gears: beam trawl and bottom trawl

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Table S1. Mean values (Mean) and standard errors (SE) of the abundance (individuals/250 m²) by taxonomic group, depth stratum (B, 51-100 m; C, 101-200 m; D, 201-500 m and E, 501-800 m), and sampling gear (BT, Jennings beam trawl; GOC, experimental bottom trawl GOC-73). Algae and Porifera are presented in kg/250 m². Results of the paired-samples Wilcoxon test are shown (WX statistic and WX p-value). Significant differences are denoted by asterisks: * (<0.05), **(<0.01), *** (<0.001).

Stratum	Group	BT		GOC		Statistics	
		Mean A	SE	Mean A	SE	WX statistic	WX p-value
B	Algae	23.215	6.352	0.330	0.085	148	***
	Ascidiacea	67.483	45.847	0.780	0.282	80	***
	Bivalvia	15.167	4.273	0.111	0.044	30	***
	Brachiopoda	0.436	0.429	0	0	0	0.371
	Cephalopoda	0.77	0.20	0.39	0.08	589	0.264
	Cnidaria	2.44	0.69	0.07	0.02	84	**
	Crustacea	164.13	41.00	0.58	0.12	0	***
	Echinodermata	39.66	10.42	3.11	0.97	111	***
	Pisces	28.38	3.97	2.79	0.45	18	***
	Gastropoda	44.49	17.00	0.05	0.02	3	***
	Porifera	0.307	0.097	0.014	0.006	201	**
C	Algae	0	0	0	0	-	-
	Ascidiacea	1.144	0.423	0.020	0.012	70	**
	Bivalvia	32.934	27.968	0.066	0.030	11	***
	Brachiopoda	19.323	10.467	0.026	0.014	3	*
	Cephalopoda	0.355	0.066	0.798	0.282	358	0.080
	Cnidaria	6.851	3.326	0.466	0.181	70	**
	Crustacea	48.721	17.675	0.266	0.062	0	***
	Echinodermata	116.373	53.227	4.062	2.445	47	***
	Pisces	12.803	2.618	2.733	0.394	31	***
	Gastropoda	8.969	4.668	0.014	0.011	1	***
	Porifera	0.007	0.006	0.000	0.000	58	0.623
D	Algae	0	0	0	0	-	-
	Ascidiacea	0.028	0.014	0.000	0.000	1	0.106
	Bivalvia	1.712	0.416	0.001	0.000	1	***
	Brachiopoda	0.360	0.313	0.000	0.000	3	*

Continued

Table S1 continued

Stratum	Group	BT		GOC		Statistics	
		Mean A	SE	Mean A	SE	WX statistic	WX p-value
	Cephalopoda	0.364	0.078	0.297	0.053	372	0.989
	Cnidaria	0.439	0.270	0.145	0.085	169	0.445
	Crustacea	26.335	3.277	2.127	0.381	4	***
	Echinodermata	12.179	5.299	0.022	0.008	0	***
	Pisces	8.653	4.481	3.953	0.766	308	0.372
	Gastropoda	3.089	1.735	0.001	0.000	6	***
	Porifera	0.004	0.003	0.000	0.000	5	***
E	Algae	0	0	0	0	-	-
	Ascidiacea	0	0	0.000	0.000	1	1.000
	Bivalvia	0.418	0.094	0	0	0	***
	Brachiopoda	0.012	0.012	0	0	0	1.000
	Cephalopoda	0.016	0.011	0.036	0.011	192	**
	Cnidaria	0.032	0.021	0.001	0.000	15	0.726
	Crustacea	11.840	2.848	0.822	0.105	6	***
	Echinodermata	0.194	0.101	0.000	0.000	1	**
	Pisces	0.508	0.088	0.603	0.089	140	0.411
	Gastropoda	0.245	0.109	0.005	0.003	21	0.093
	Porifera	0.000	0.000	0.000	0.000	1	1.000

Table S2. Mean values (Mean S) and standard errors (SE) of Species richness (number of species or taxa) by taxonomic group, depth stratum (B, 51-100 m; C, 101-200 m; D, 201-500 m and E, 501-800 m) and sampling gear ('BT, Jennings beam trawl; GOC, experimental bottom trawl GOC-73). Results of the paired-samples Wilcoxon test are shown (WX statistic and WX p-value). Significant differences are denoted by asterisks: * (<0.05), **(<0.01), *** (<0.001).

Stratum	Group	BT		GOC		Statistics	
		Mean S	SE	Mean S	SE	WX statistic	WX p-value
B	Algae	5.057	0.835	5.811	1.084	412	0.551
	Ascidiacea	3.057	0.399	4.132	0.578	641	0.163
	Bivalvia	2.396	0.260	0.811	0.145	160	***
	Brachiopoda	0.057	0.042	0.000	0.000	0	0.371
	Cephalopoda	0.792	0.102	5.075	0.207	1431	***
	Cnidaria	1.113	0.192	1.245	0.184	383	0.635
	Crustacea	14.925	0.721	5.623	0.379	15.5	***
	Echinodermata	5.887	0.531	6.075	0.438	606.5	0.853
	Pisces	7.774	0.406	16.623	0.606	1355	***
	Gastropoda	3.396	0.316	1.245	0.159	43.5	***
	Porifera	3.679	0.668	1.774	0.281	263.5	0.030
C	Algae	0	0	0	0	-	-
	Ascidiacea	0.656	0.153	0.688	0.158	154	0.917
	Bivalvia	2.063	0.205	0.469	0.119	21	***
	Brachiopoda	0.250	0.090	0.188	0.070	7	0.484
	Cephalopoda	0.906	0.151	6.156	0.242	528	***
	Cnidaria	1.281	0.243	1.281	0.243	95.5	1.000
	Crustacea	13.656	0.806	4.219	0.559	0	***
	Echinodermata	5.781	0.582	4.188	0.403	117	*
	Pisces	8.469	0.759	18.844	0.743	492.5	***
	Gastropoda	3.063	0.345	0.344	0.096	5	***
	Porifera	0.750	0.336	0.531	0.142	56	0.846
D	Algae	0.000	0.000	0.000	0.000	-	-
	Ascidiacea	0.132	0.067	0.026	0.026	2.5	0.203
	Bivalvia	1.553	0.187	0.132	0.056	4.5	***
	Brachiopoda	0.158	0.060	0.053	0.037	9	0.181
	Cephalopoda	0.763	0.110	6.711	0.258	741	***
	Cnidaria	0.395	0.096	0.684	0.107	247	*
	Crustacea	15.132	0.860	10.553	0.799	156.5	**
	Echinodermata	3.605	0.429	1.789	0.309	71	***
	Pisces	5.184	0.381	20.342	0.567	741	***
	Gastropoda	2.184	0.301	0.395	0.110	33	***
	Porifera	0.500	0.098	0.132	0.077	33	*
E	Algae	0.000	0.000	0.000	0.000	-	-
	Ascidiacea	0.000	0.000	0.048	0.048	1	1.000
	Bivalvia	1.048	0.176	0.000	0.000	0	***
	Brachiopoda	0.048	0.048	0.000	0.000	0	1.000
	Cephalopoda	0.095	0.066	3.095	0.275	231	***
	Cnidaria	0.143	0.078	0.238	0.095	22.5	0.529
	Crustacea	10.571	1.061	12.095	0.768	130.5	0.349
	Echinodermata	0.619	0.146	0.095	0.066	5	**

Continued

Table S2 continued

Stratum	Group	BT		GOC		Statistics	
		Mean S	SE	Mean S	SE	WX statistic	WX p-value
	Pisces	2.381	0.355	14.714	0.694	231	***
	Gastropoda	0.476	0.164	0.476	0.148	32	0.963
	Porifera	0.048	0.048	0.048	0.048	1.5	1.000

Table S3. Results of SIMPER analysis, estimated from standardized biomass data showing mean biomass (B, g/250 m²) and percentage contribution (%C) of each taxon contributing up to 90% of within-group similarity by depth stratum, and sampler (BT, Jennings beam trawl; GOC, experimental bottom trawl GOC-73).

Stratum	Taxa	BT		Taxa	GOC	
		B	%C		B	%C
B (51-100 m)	Corallinaceae	8436.21	20.61	<i>Scyliorhinus canicula</i>	26.06	12.12
	<i>Turritellinella tricarinata</i>	20.31	9.44	<i>Octopus vulgaris</i>	27.42	11.69
	<i>Citharus linguatula</i>	7.99	7.8	<i>Mullus barbatus</i>	12.25	9.48
	<i>Lithothamnion valens</i>	2903.55	6.71	<i>Illex coindetii</i>	4.3	9.05
	<i>Arnoglossus laterna</i>	4.64	6.47	<i>Merluccius merluccius</i>	3.93	7.69
	<i>Astropecten irregularis</i>	2.9	2.81	<i>Spatangus purpureus</i>	181.82	6.18
	<i>Neopycnodonte cochlear</i>	87.79	2.71	<i>Pagellus erythrinus</i>	7.7	5.28
	<i>Peyssonnelia</i> spp.	2329.15	2.57	<i>Trisopterus minutus</i>	3.76	4.32
	<i>Spongites fruticulosus</i>	3072.63	2.46	<i>Lophius budegassa</i>	3.97	4.19
	<i>Phyllophora crispa</i>	581.7	2.24	Corallinaceae	39.49	2.85
	<i>Serranus hepatus</i>	7.94	2.07	<i>Mullus surmuletus</i>	16.25	2.13
	<i>Symphurus nigrescens</i>	2.19	2.04	<i>Parastichopus regalis</i>	2.09	2
	<i>Phymatolithon calcareum</i>	1265.15	2.04	<i>Serranus cabrilla</i>	9.3	1.65
	<i>Polybius depurator</i>	3.03	1.94	<i>Lithothamnion valens</i>	27.61	1.59
	<i>Lesueurigobius friesii</i>	1.62	1.94	<i>Spongites fruticulosus</i>	21.79	1.48
	<i>Alpheus glaber</i>	1.29	1.93	<i>Osmundaria volubilis</i>	51.66	1.2
	<i>Lepidotrigla cavillone</i>	3.9	1.81	<i>Chelidonichthys lastoviza</i>	8.33	1.01
	<i>Osmundaria volubilis</i>	678.8	1.63	<i>Halopteris filicina</i>	14.65	0.9
	<i>Lithothamnion corallioides</i>	1508.86	1.54	<i>Raja clavata</i>	4.99	0.75
	<i>Ascidia mentula</i>	44.49	1.23	<i>Pagellus acarne</i>	16.24	0.75
	<i>Parastichopus regalis</i>	17.42	1.15	<i>Trachinus draco</i>	2.33	0.75
	<i>Halopteris filicina</i>	281.96	1.01	<i>Serranus hepatus</i>	2.01	0.7
	<i>Alcyonium palmatum</i>	3.31	0.97	<i>Sphaerechinus granularis</i>	16.82	0.67
	<i>Parapenaeus longirostris</i>	1.44	0.93	<i>Phyllophora crispa</i>	20.31	0.64
	<i>Solenocera membranacea</i>	0.75	0.87	<i>Codium bursa</i>	7.25	0.62
	<i>Goneplax rhomboides</i>	0.61	0.81	<i>Laminaria rodriguezii</i>	60.04	0.57
<i>Ascidella</i> spp.	8.28	0.77				
<i>Dardanus arrosor</i>	18.59	0.66				
<i>Trisopterus minutus</i>	0.91	0.53				
<i>Aegaeon cataphractus</i>	0.73	0.51				
C (101-200 m)	<i>Parastichopus regalis</i>	20.61	17.21	<i>Scyliorhinus canicula</i>	16.5	18.65
	<i>Gracilechinus acutus</i>	27.9	12.18	<i>Raja clavata</i>	21.93	16.78
	<i>Leptometra phalangium</i>	131.59	9.82	<i>Merluccius merluccius</i>	11.81	13.28
	<i>Parapenaeus longirostris</i>	8.5	8.51	<i>Illex coindetii</i>	9.62	11.08
	<i>Gryphus vitreus</i>	105.38	8.31	<i>Chelidonichthys cuculus</i>	8.7	6.95

Continued

Table S3 continued

Stratum	BT			GOC		
	Taxa	B	%C	Taxa	B	%C
	<i>Lesueurigobius friesii</i>	5.28	4.28	<i>Mullus barbatus</i>	6.13	4.48
	<i>Symphurus nigrescens</i>	3.21	3.9	<i>Lophius budegassa</i>	4.44	2.93
	<i>Astropecten irregularis</i>	3.55	3.54	<i>Parastichopus regalis</i>	8.16	2.82
	<i>Asciidiella</i> spp.	5.55	3.01	<i>Zeus faber</i>	4.03	2.43
	<i>Serranus hepatus</i>	5.45	2.53	<i>Mullus surmuletus</i>	4.83	2.02
	<i>Arnoglossus laterna</i>	1.69	1.79	<i>Leucoraja naevus</i>	4.45	1.61
	<i>Lophius budegassa</i>	7.75	1.38	<i>Serranus hepatus</i>	2.38	1.51
	<i>Chlorotocus crassicornis</i>	0.98	1.35	<i>Trisopterus minutus</i>	2.1	1.2
	<i>Alpheus glaber</i>	0.87	1.27	<i>Gracilechinus acutus</i>	4.84	1.18
	<i>Solenocera membranacea</i>	1.03	1.26	<i>Octopus vulgaris</i>	2.23	1.18
	<i>Neopycnodonte cochlear</i>	290.73	1.22	<i>Serranus cabrilla</i>	2.03	0.9
	<i>Callionymus maculatus</i>	0.78	1.11	<i>Trachinus draco</i>	1.3	0.82
	<i>Funiculina quadrangularis</i>	6.76	1.04	<i>Scaevurgus unicirrhus</i>	0.89	0.81
	<i>Citharus linguatula</i>	2.28	1.0			
	<i>Alcyonium palmatum</i>	3.22	0.95			
	<i>Anapagurus laevis</i>	4.76	0.74			
	<i>Xenophora crispa</i>	4.51	0.74			
	<i>Tethyaster subinermis</i>	6.4	0.73			
	<i>Arnoglossus rueppelii</i>	1.16	0.72			
	<i>Goneplax rhomboides</i>	0.4	0.63			
	<i>Lophogaster typicus</i>	0.46	0.55			
	<i>Trisopterus minutus</i>	1.48	0.54			
D (201-500 m)	<i>Parapenaeus longirostris</i>	7.03	26.3	<i>Scyliorhinus canicula</i>	16.27	29.37
	<i>Plesionika heterocarpus</i>	3.86	12.19	<i>Phycis blennoides</i>	5.32	11.27
	<i>Chlorotocus crassicornis</i>	3.48	9.89	<i>Illex coindetii</i>	10.63	9.48
	<i>Symphurus nigrescens</i>	2.31	4.16	<i>Parapenaeus longirostris</i>	3.12	6.12
	<i>Gadiculus argenteus</i>	7.52	3.95	<i>Gadiculus argenteus</i>	6.38	4.61
	<i>Nephrops norvegicus</i>	0.95	2.44	<i>Coelorinchus caelorhincus</i>	4.77	3.92
	<i>Brissopsis lyrifera</i>	4.2	2.42	<i>Merluccius merluccius</i>	4.03	3.88
	<i>Goneplax rhomboides</i>	0.79	2.39	<i>Raja clavata</i>	7.87	3.17
	<i>Alpheus glaber</i>	1.03	2.21	<i>Micromesistius poutassou</i>	14	2.65
	<i>Lepidorhombus boscii</i>	2.26	2.15	<i>Helicolenus dactylopterus</i>	7.58	2.58
	<i>Solenocera membranacea</i>	0.48	2.08	<i>Galeus melastomus</i>	3.82	2.46
	<i>Monodaeus couchii</i>	0.64	1.75	<i>Lophius budegassa</i>	2.91	2.43
	<i>Astropecten irregularis</i>	1	1.66	<i>Nephrops norvegicus</i>	1.44	2.05
	<i>Scyliorhinus canicula</i>	3.17	1.61	<i>Eledone cirrhosa</i>	1.45	1.69
	<i>Phycis blennoides</i>	2.61	1.44	<i>Plesionika heterocarpus</i>	2.38	1.52
	<i>Processa canaliculata</i>	0.46	1.4	<i>Lepidorhombus boscii</i>	1.26	1.29
	<i>Euspira fusca</i>	0.46	1.34	<i>Chlorophthalmus agassizi</i>	4.54	1.29
	<i>Parastichopus regalis</i>	9.61	1.32	<i>Trigla lyra</i>	7.51	1.2
	<i>Dardanus arrosor</i>	1.68	1.15			
	<i>Aporrhais serresiana</i>	0.64	1.1			
	<i>Iridonida speciosa</i>	1.8	1.07			
	<i>Plesionika gigliolii</i>	1.11	1.06			

Continued

Table S3 continued

Stratum	BT			GOC		
	Taxa	B	%C	Taxa	B	%C
	<i>Gaidropsarus biscayensis</i>	0.53	1.01			
	<i>Macropipus tuberculatus</i>	0.68	0.95			
	<i>Thenaea muricata</i>	3.46	0.86			
	<i>Calocaris macandreae</i>	0.47	0.83			
	<i>Lophogaster typicus</i>	0.45	0.73			
	<i>Aegaeon lacazei</i>	0.23	0.69			
E (501-800 m)	<i>Geryon longipes</i>	11.61	49.34	<i>Galeus melastomus</i>	29.44	53.78
	<i>Calocaris macandreae</i>	2.58	10.97	<i>Phycis blennoides</i>	5.17	11.12
	<i>Polycheles typhlops</i>	1.14	7.22	<i>Geryon longipes</i>	5.85	10.12
	<i>Gaidropsarus biscayensis</i>	0.39	4.02	<i>Aristeus antennatus</i>	2.09	6.42
	<i>Phycis blennoides</i>	2.97	3.48	<i>Todarodes sagittatus</i>	3.26	3.62
	<i>Nezumia aequalis</i>	1.31	3.3	<i>Plesionika martia</i>	1.3	2.35
	<i>Aristeus antennatus</i>	1.22	2.65	<i>Etmopterus spinax</i>	1	1.76
	<i>Monodaeus couchii</i>	0.9	2.46	<i>Conger conger</i>	1.09	1.72
	<i>Plesionika acanthonotus</i>	0.44	2.03			
	<i>Pagurus alatus</i>	0.36	1.87			
	<i>Parapenaeus longirostris</i>	1	1.81			
	<i>Plesionika martia</i>	0.54	1.44			

Table S4. ANOSIM results comparing the composition of the Jennings beam trawl samples and the experimental bottom trawl GOC-73 samples by depth stratum (B, 51-100 m; C, 101-200 m; D, 201-500 m and E, 501-800 m). Significant differences are denoted by asterisks: * (<0.05), **(<0.01), *** (<0.001).

Stratum	R Statistic	Significance Level	Possible Permutations	Actual Permutations	Number >= Observed
B	0.47	***	Very large	999	0
C	0.577	***	Very large	999	0
D	0.552	***	Very large	999	0
E	0.488	***	Very large	999	0