

Environmental drivers explain regional variation of changes in fish and invertebrate functional groups across the Mediterranean Sea from 1994 to 2012

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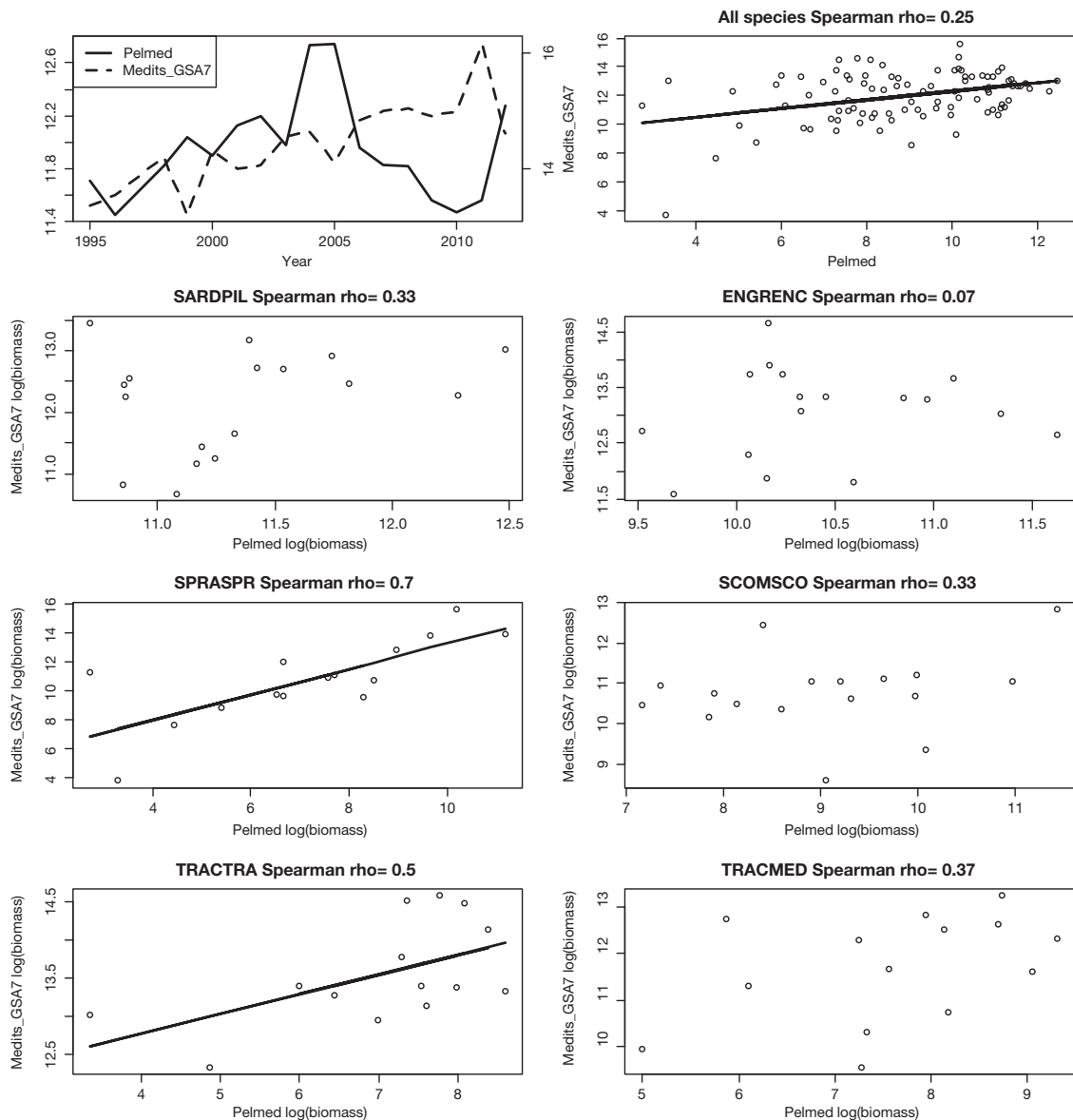


Figure S1. Comparison of time series of pelagic group (FG5, FG1) and of six pelagic species in the Gulf of Lions between acoustic derived biomass estimates with the bottom trawl derived estimates used in this study. SARDPIL: *Sardina pilchardius*. ENGRENC: *Engraulis encrasicolus*. SPRASPR: *Sprattus sprattus*. SCOMSCO: *Scomber scombrus*. TRACTRA: *Trachurus trachurus*. TRACMED: *Trachurus mediterraneus*. Linear trends are indicated for significant correlations.

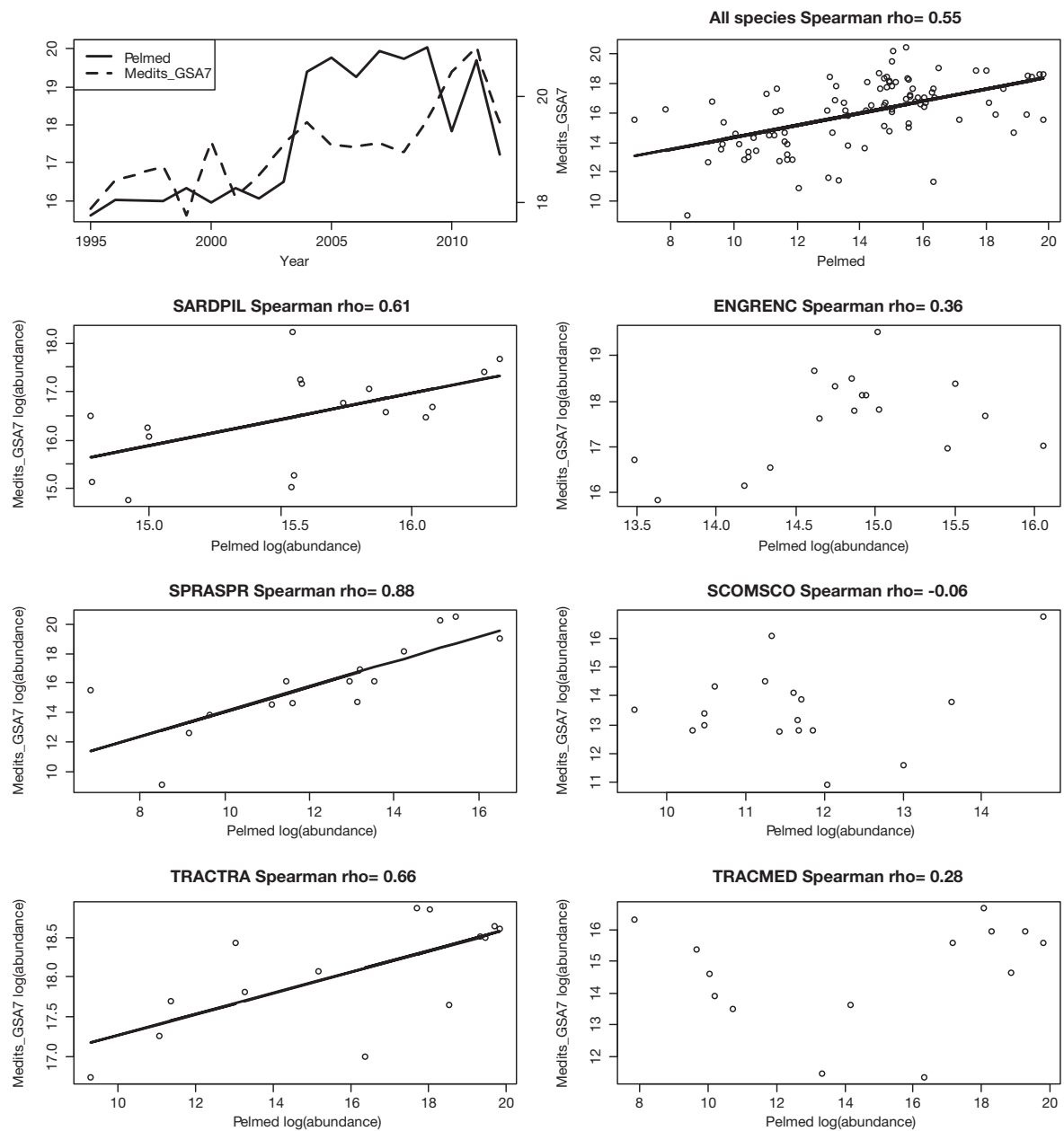


Figure S2. Comparison of time series of pelagic group (FG5, FG1) and of six pelagic species in the Gulf of Lion between acoustic derived abundance estimates with the bottom trawl derived estimates used in this study. SARDPIL: *Sardina pilchardius*. ENGRENC: *Engraulis encrasicolus*. SPRASPR: *Sprattus sprattus*. SCOMSCO: *Scomber scombrus*. TRACTRA: *Trachurus trachurus*. TRACMED: *Trachurus mediterraneus*. Linear trends are indicated for significant correlations.

Table S1: Species classification for different grouping methods. I : Invertebrate, F: Fish, P: Pelagic, D: Demersal, B: benthic, REEF: Reef.

Species	Morphology (this study)	Diet (Stergiou & Karpouzi 2002, Harmelien-Vivien et al. 1989, Relini et al. 2002, Le Bourg et al. 2015)	Habitat (Stergiou & Karpouzi 2002)	Food & Habitat
<i>Argentina sphyraena</i>	1	IF	BD	IF_BD
<i>Boops boops</i>	1	PL	D	PL_D
<i>Engraulis encrasicolus</i>	1	PL	P	PL_P
<i>Gadiculus argenteus</i>	1	IF	P	IF_P
<i>Micromesistius poutassou</i>	1	IF	BP	IF_BP
<i>Sardina pilchardius</i>	1	PL	P	PL_P
<i>Scomber japonicus</i>	1	IF	P	IF_P
<i>Scomber scombrus</i>	1	IF	P	IF_P
<i>Spicara maena</i>	1	I	D	I_D
<i>Spicara smaris</i>	1	PL	P	PL_P
<i>Sprattus sprattus</i>	1	PL	P	PL_P
<i>Trachurus mediterraneus</i>	1	IF	P	IF_P
<i>Trachurus trachurus</i>	1	IF	P	IF_P
<i>Trisopterus minutus</i>	1	IF	BP	IF_BP
<i>Arnoglossus imperialis</i>	2	I	B	I_B
<i>Arnoglossus laterna</i>	2	I	B	I_B
<i>Arnoglossus rueppelii</i>	2	I	B	I_B
<i>Arnoglossus thori</i>	2	I	B	I_B
<i>Bothus podas</i>	2	I	B	I_B
<i>Citharus linguatula</i>	2	IF	B	IF_B
<i>Lepidorhombus boscii</i>	2	IF	D	IF_D
<i>Lepidorhombus whiffiagonis</i>	2	IF	BD	IF_BD
<i>Microchirus variegatus</i>	2	I	B	I_B
<i>Monochirus hispidus</i>	2	I	B	I_B
<i>Solea solea</i>	2	I	B	I_B
<i>Symphurus nigrescens</i>	2	I	D	I_D
<i>Torpedo marmorata</i>	2	IF	B	IF_B
<i>Aspitrigla cuculus</i>	3	IF	D	IF_D
<i>Chelidonichthys lastoviza</i>	3	IF	D	IF_D
<i>Chelidonichthys lucernus</i>	3	IF	D	IF_D
<i>Chelidonichthys obscurus</i>	3	IF	D	IF_D
<i>Eutrigla gurnardus</i>	3	IF	D	IF_D
<i>Lepidotrigla cavillone</i>	3	PL	D	PL_D
<i>Lepidotrigla dieuzeidei</i>	3	I	D	I_D
<i>Peristedion cataphractum</i>	3	I	D	I_D
<i>Trigla lyra</i>	3	I	D	I_D
<i>Trigloporus lastoviza</i>	3	I	D	I_D
<i>Blennius ocellaris</i>	4	I	D	I_D
<i>Helicolenus dactylopterus</i>	4	IF	D	IF_D
<i>Lophius budegassa</i>	4	P	BD	P_BD
<i>Lophius piscatorius</i>	4	P	BD	P_BD
<i>Scorpaena elongata</i>	4	IF	D	IF_D
<i>Scorpaena notata</i>	4	IF	D	IF_D

Species	Morphology (this study)	Diet (Stergiou & Karpouzi 2002, Harmelien-Vivien et al. 1989, Relini et al. 2002, Le Bourg et al. 2015)	Habitat (Stergiou & Karpouzi 2002)	Food & Habitat
<i>Scorpaena porcus</i>	4	IF	D	IF_D
<i>Scorpaena scrofa</i>	4	IF	D	IF_D
<i>Capros aper</i>	5	PL	D	PL_D
<i>Diplodus annularis</i>	5	I	BP	I_BP
<i>Diplodus vulgaris</i>	5	I	BP	I_BP
<i>Macroramphosus scolopax</i>	5	PL	D	PL_D
<i>Pagellus acarne</i>	5	IF	BP	IF_BP
<i>Pagellus bogaraveo</i>	5	IF	BP	IF_BP
<i>Pagellus erythrinus</i>	5	IF	BP	IF_BP
<i>Spondyliosoma cantharus</i>	5	I	BP	I_BP
<i>Zeus faber</i>	5	P	BP	P_BP
<i>Cepola macrophthalma</i>	6	I	D	I_D
<i>Conger conger</i>	6	IF	BD	IF_BD
<i>Echelus myrus</i>	6	IF	D	IF_D
<i>Lepidopus caudatus</i>	6	IF	BP	IF_BP
<i>Galeus melastomus</i>	7	IF	BD	IF_BD
<i>Merluccius merluccius</i>	7	IF	D	IF_D
<i>Merlangius merlangus</i>	7	IF	BP	IF_BP
<i>Mullus barbatus</i>	7	I	D	I_D
<i>Mullus surmuletus</i>	7	IF	D	IF_D
<i>Phycis blennoides</i>	7	IF	BP	IF_BP
<i>Scyliorhinus canicula</i>	7	IF	D	IF_D
<i>Serranus cabrilla</i>	7	IF	REEF	IF_REEF
<i>Serranus hepatus</i>	7	IF	D	IF_D
<i>Raja asterias</i>	8	I	D	I_D
<i>Raja clavata</i>	8	I	D	I_D
<i>Trachinus draco</i>	9	IF	D	IF_D
<i>Trachinus radiatus</i>	9	I	B	I_B
<i>Uranoscopus scaber</i>	9	P	D	P_D
<i>Eledone cirrhosa</i>	10	Additional functional groups		
<i>Eledone moschata</i>	10			
<i>Octopus vulgaris</i>	10			
<i>Illex coindetii</i>	11			
<i>Loligo vulgaris</i>	11			
<i>Sepia officinalis</i>	11			
<i>Aristaeomorpha foliacea</i>	12			
<i>Aristeus antennatus</i>	12			
<i>Nephrops norvegicus</i>	12			
<i>Parapenaeus longirostris</i>	12			

Table S2: Relative difference in species biomass ($\text{Biom}_{\text{last}} - \text{Biom}_{\text{first}} / \text{Biom}_{\text{first}}$) between the end and the beginning of the study period. The letters (A to D) correspond to the grouping of GSA obtained with multiple regression tree analysis.

Functional Group	Species	South Adriatic-Ionian Sea (A)			Tyrrhenian Sea-Sicily(B)		Enclosed bays and shallow areas (C)				Western areas (D)		
		GSA18	GSA19	GSA20	GSA10	GSA16	GSA5	GSA7	GSA17	GSA22	GSA8	GSA9	GSA11
Schooling pelagic feeders (FG1)	<i>Argentina sphyraena</i>	0.03	0.07	1.17	-1.59			-1.30	-0.01	4.40	-0.30	-0.43	-0.07
	<i>Boops boops</i>	-0.46	0.00	3.27	2.39	-1.16	-3.77	3.54	-0.82	0.39	0.27	-0.43	1.73
	<i>Engraulis encrasicolus</i>	15.43		-3.97	6.18	-1.35		0.16	20.66	-2.50		-3.16	0.08
	<i>Gadiculus argenteus</i>	-0.07	0.36		-0.42	0.21	2.65	-1.21	-0.19		2.83	0.08	-2.46
	<i>Micromesistius poutassou</i>	-3.06	-0.82	4.70	-1.00	-0.76	-3.52	-2.58	-1.31	3.31	9.74	-3.78	-3.27
	<i>Sardina pilchardius</i>	2.58	0.48	3.24	-6.49	-14.15	-0.28	2.20	-8.98	-6.05	-0.46	-8.33	-1.52
	<i>Scomber scombrus</i>							-0.12	-1.11				
	<i>Spicara maena</i>	4.65	3.25	8.74	-0.10	-0.15	17.19	0.02	0.07	4.12	-20.50	-0.48	-4.19
	<i>Spicara smaris</i>	1.56						22.90	28.44				
	<i>Trachurus mediterraneus</i>	1.09	-0.27	1.20	1.07	0.29	-9.86	1.90	0.00	-1.20	1.07	0.65	1.23
	<i>Trachurus trachurus</i>	-5.20	1.18	8.68	-2.17	-13.41	11.18	-0.14	-1.30	-0.11	1.80	-1.82	4.67
<i>Trisopterus minutus</i>	-0.75	-0.26	-1.71	0.11	-0.21		-6.79	-2.93	-0.95		-0.70	-1.03	
Flatfish (FG2)	<i>Arnoglossus imperialis</i>					-0.15	-0.03	-0.02					
	<i>Arnoglossus laterna</i>	0.23	0.06			-0.04	-0.01	-0.38	-0.11			0.06	
	<i>Arnoglossus rueppelii</i>	0.04	0.10				-0.24	-0.03			0.00		
	<i>Arnoglossus thori</i>		0.41				-0.06	-0.04	-0.01				
	<i>Bothus podas</i>												1.19
	<i>Citharus linguatula</i>			0.04	0.08	0.33		-1.03	0.03	-0.14		0.02	0.09
	<i>Lepidorhombus boscii</i>	0.23	0.12	-0.22	0.04	0.11		-0.31	-0.16	-0.29	0.15	0.35	0.02
	<i>Lepidorhombus whiffiagonis</i>	-0.03			-0.02	0.08					-0.01		-0.21
	<i>Microchirus variegatus</i>					0.00	0.00	-0.07	-0.08				
	<i>Solea solea</i>			-0.36				-0.39	-0.07	-0.05			
	<i>Symphurus nigrescens</i>	0.03	0.32			-0.01		-0.01	0.00			0.02	0.01
<i>Torpedo marmorata</i>				-0.04	-0.06	0.03					0.11		
Benthic scorpaeniformes (FG3)	<i>Aspitrigla cuculus</i>	1.55		0.13	0.65	1.24		-0.29	0.03	1.04	-0.44	-0.41	-1.09
	<i>Eutrigla gurnardus</i>	-0.02	-0.02	0.03				-3.58	-0.02	0.08		0.23	
	<i>Lepidotrigla cavillone</i>	0.95	0.06	0.27	-0.99	1.57		-2.56	-0.52	0.34	0.00	0.31	-0.06
	<i>Lepidotrigla dieuzeidei</i>												0.57
	<i>Peristedion cataphractum</i>		0.04		0.07	0.37					0.11	0.04	-0.40
	<i>Trigla lyra</i>	0.18	0.29			1.46	0.68	0.42			-0.25	0.34	-0.23
	<i>Trigloporus lastoviza</i>			-1.79		-0.60				0.33	0.01		-0.39
Benthic ambush feeders (FG4)	<i>Blennius ocellaris</i>						-0.08	0.01	-0.04			0.01	0.02
	<i>Helicolenus dactylopterus</i>	-2.07	1.02	1.00	0.35	1.13	-0.82	0.37		0.63	-0.04	0.15	-0.14
	<i>Lophius budegassa</i>	-0.72	1.10	-2.17	-0.77	1.24	-1.91	-2.34	-0.46	-2.65	-0.23	0.86	-0.11
	<i>Lophius piscatorius</i>	-2.25	0.17			0.20	-0.52	-0.20		-0.89	-0.08	0.74	0.45
	<i>Scorpaena elongata</i>					0.32	0.07						0.14
<i>Scorpaena notata</i>	0.05				-0.50	-0.51	-0.13	0.07	-0.36		0.02	-0.19	

Functional Group	Species	South Adriatic-Ionian Sea (A)			Tyrrhenian Sea-Sicily(B)		Enclosed bays and shallow areas (C)				Western areas (D)			
		GSA18	GSA19	GSA20	GSA10	GSA16	GSA5	GSA7	GSA17	GSA22	GSA8	GSA9	GSA11	
	<i>Scorpaena porcus</i>							-0.01	0.00		-0.04	-0.05	-0.36	
	<i>Scorpaena scrofa</i>							-0.10						
Laterally-compressed benthopelagic feeders (FG5)	<i>Capros aper</i>	-0.22	0.21			2.39		1.09	1.51		-0.53	0.94	0.29	
	<i>Diplodus annularis</i>	0.34	-0.28	-1.91	-0.01	-0.09				-0.26	-1.93	-0.03	-2.51	-0.20
	<i>Macroramphosus scolopax</i>	0.25	4.86			0.59		-0.05		0.01		-0.28	0.05	-0.05
	<i>Pagellus acarne</i>	1.15	7.12	-0.32	-0.49	0.11		-0.04	-0.58		-0.12	-0.12	0.26	-0.20
	<i>Pagellus bogaraveo</i>	0.96		2.13	1.63	0.02			0.25		-0.08	-0.08	-0.08	
	<i>Pagellus erythrinus</i>		1.66	-1.71	0.95	-0.07		0.01	0.36	0.36	0.17	0.01	1.06	0.50
	<i>Zeus faber</i>	0.38	1.31	0.18	0.38	0.85		-0.74	0.04	-0.02	-0.24	0.34	0.54	0.21
Elongated body hard substrate living (FG6)	<i>Cepola macrophthalma</i>	0.08	0.22		-0.11			-0.09	-0.74	-1.17			0.01	0.03
	<i>Conger conger</i>	-0.53	0.69	0.09	0.03	0.55		-0.21	-1.10	-0.08	0.01		0.52	0.01
	<i>Lepidopus caudatus</i>	-28.03	-45.19	-20.98	-14.08				-0.51	-10.74	-0.33	-0.25	-7.03	-1.48
Fusiform with dorsally positioned eyes (FG7)	<i>Galeus melastomus</i>	1.67	7.54	0.87	11.03	6.60		-3.42	-2.09		0.18	2.47	2.77	-0.58
	<i>Merluccius merluccius</i>	-4.78	-0.46	2.05	0.15	2.79		0.33	-1.24	-10.36	1.57	-0.07	3.10	-0.79
	<i>Mullus barbatus</i>	5.93	5.35	-0.58	-2.67	3.25			0.69	0.73	-0.34	2.33	3.98	3.28
	<i>Mullus surmuletus</i>	-0.16	-0.29		0.14	-2.05		-3.53	0.03		-0.04	0.00	0.27	0.51
	<i>Phycis blennoides</i>	1.71	4.28	0.14	0.27	0.60		-1.57	-0.39	0.02	-0.28	0.01	1.67	-0.92
	<i>Scyliorhinus canicula</i>	3.65		-0.45	0.20	-1.20		-2.61	-1.74		-1.15	1.29	2.14	-0.04
	<i>Serranus cabrilla</i>	0.03	0.12	-0.73		-0.08			-0.07		0.45	0.00	0.04	0.12
	<i>Serranus hepatus</i>	0.53	0.38		0.60	-0.65			-0.16	-4.99		-0.13	0.07	0.02
Rays & skates (FG8)	<i>Raja asterias</i>										0.03			1.38
	<i>Raja clavata</i>			-2.35	1.17	7.80		2.16	-1.32		-2.38	0.92	2.06	2.16
Round-bodied demersal species (FG9)	<i>Trachinus draco</i>	-0.01	-0.21		-0.01	0.07		0.13	-0.01	-0.01			-0.05	0.18
	<i>Trachinus radiatus</i>													0.34
	<i>Uranoscopus scaber</i>	0.01				-0.14		-0.17	-0.29	-0.08			0.41	0.32
Benthic cephalopods (FG10)	<i>Eledone cirrhosa</i>	-3.87	0.29	-0.03	-0.17	-0.23		-0.89	-1.12	-1.41	0.10	0.17	-1.50	0.57
	<i>Eledone moschata</i>	-0.07	-0.33	-0.04	-0.14	-0.86		-0.24	-0.42	-2.55	-0.09		-0.05	0.14
	<i>Octopus vulgaris</i>	0.80		-1.41	0.40	-0.40			0.49		0.28	0.09	0.69	0.85
Pelagic & demersal cephalopods (FG11)	<i>Illex coindetii</i>	3.82	2.50	2.68	-0.28	0.78		1.79	0.32	1.24	4.98	-0.03	0.03	0.24
	<i>Loligo vulgaris</i>	1.48		0.88	0.01	-0.13		-0.07		0.00	0.14	-0.20	0.28	-0.61
	<i>Sepia officinalis</i>			-0.11		-0.33				-0.66	-0.08	-0.05	0.02	0.08
Mobile mega-fauna (FG12)	<i>Aristaeomorpha foliacea</i>	0.25	0.32		1.12	0.39					0.31	-0.08	0.77	-0.39
	<i>Aristeus antennatus</i>		0.81		0.13	-0.01		-1.50	-0.19				0.75	-0.28
	<i>Nephrops norvegicus</i>	-0.35	-0.35	-1.02	0.05	0.66			0.27	-1.14	-0.31	0.57	1.28	-0.12
	<i>Parapenaeus longirostris</i>	0.99	1.78	0.35	2.36	2.82		-0.50		-0.06	-0.32	0.06	3.13	0.00

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