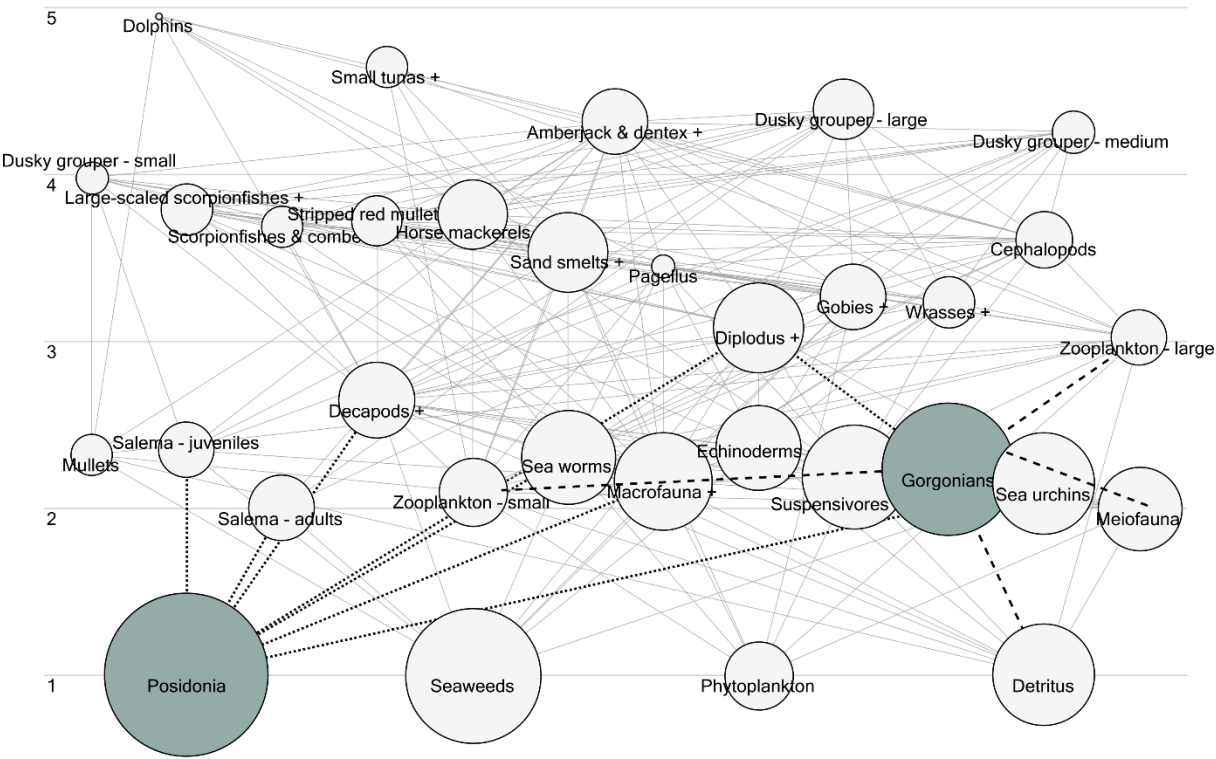


1 **Supplementary Materials**



2

3 **Fig. S1: Food web in the study area.** All lines represent trophic interactions between functional groups. The HFSs are represented in blue.

4

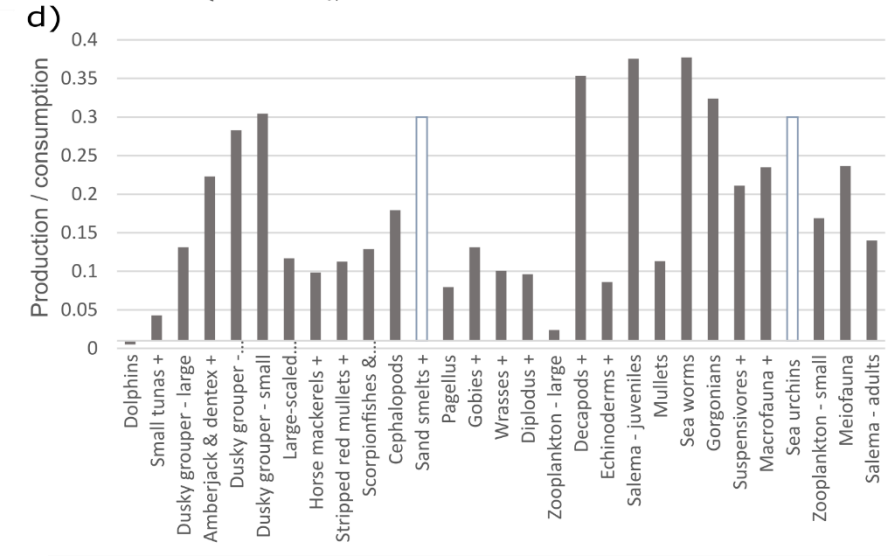
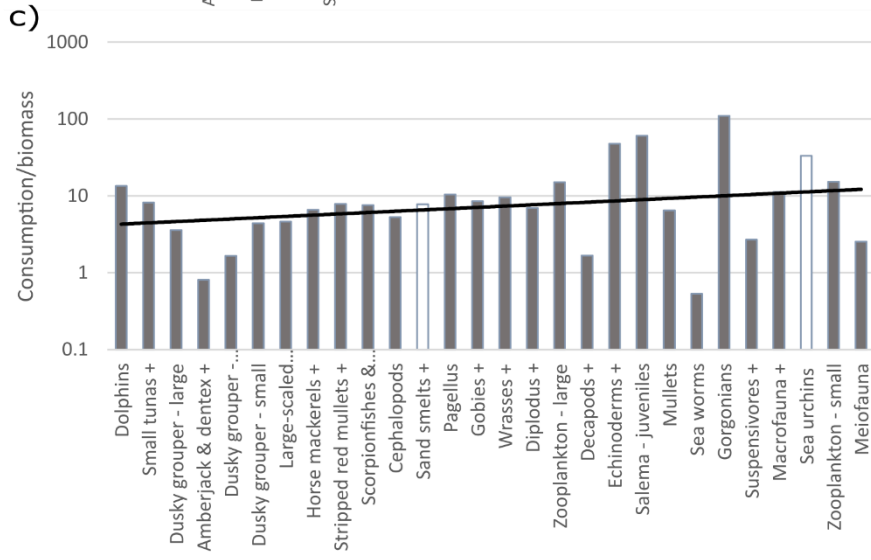
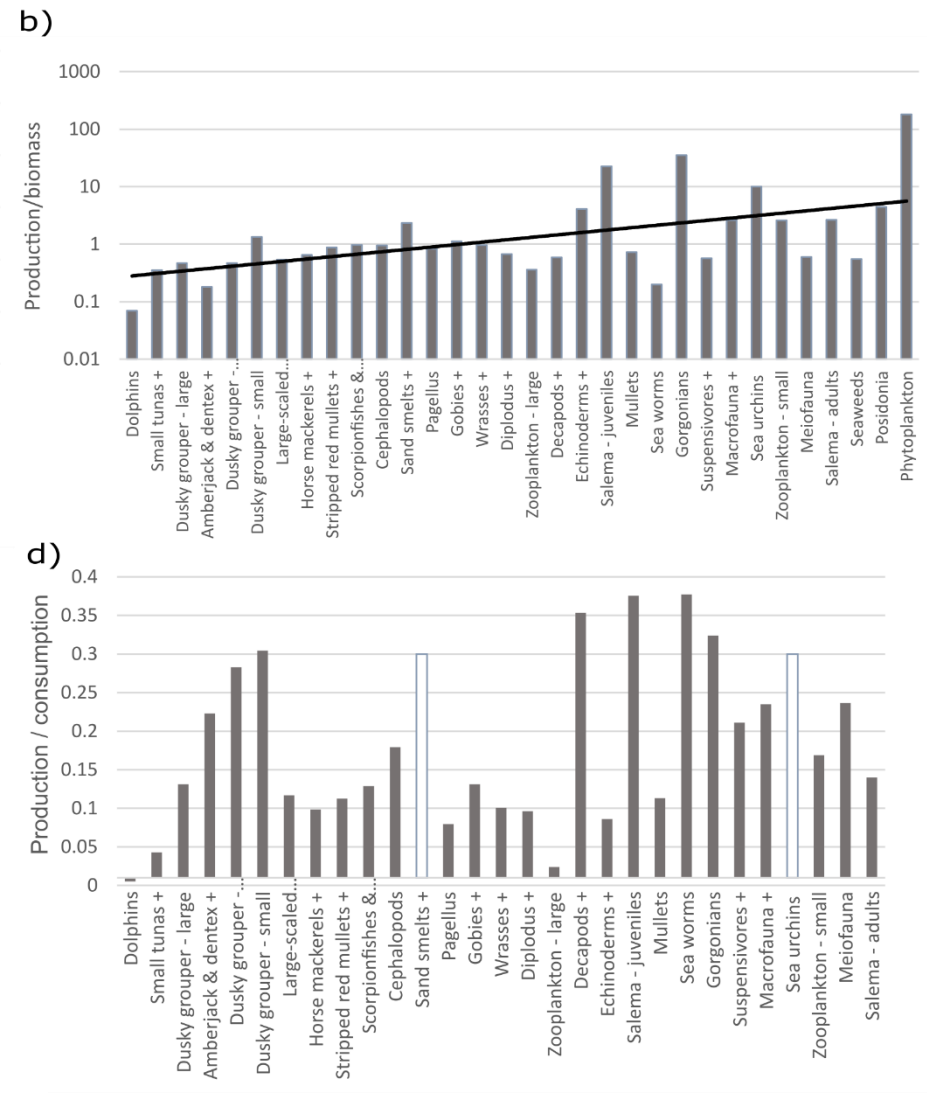
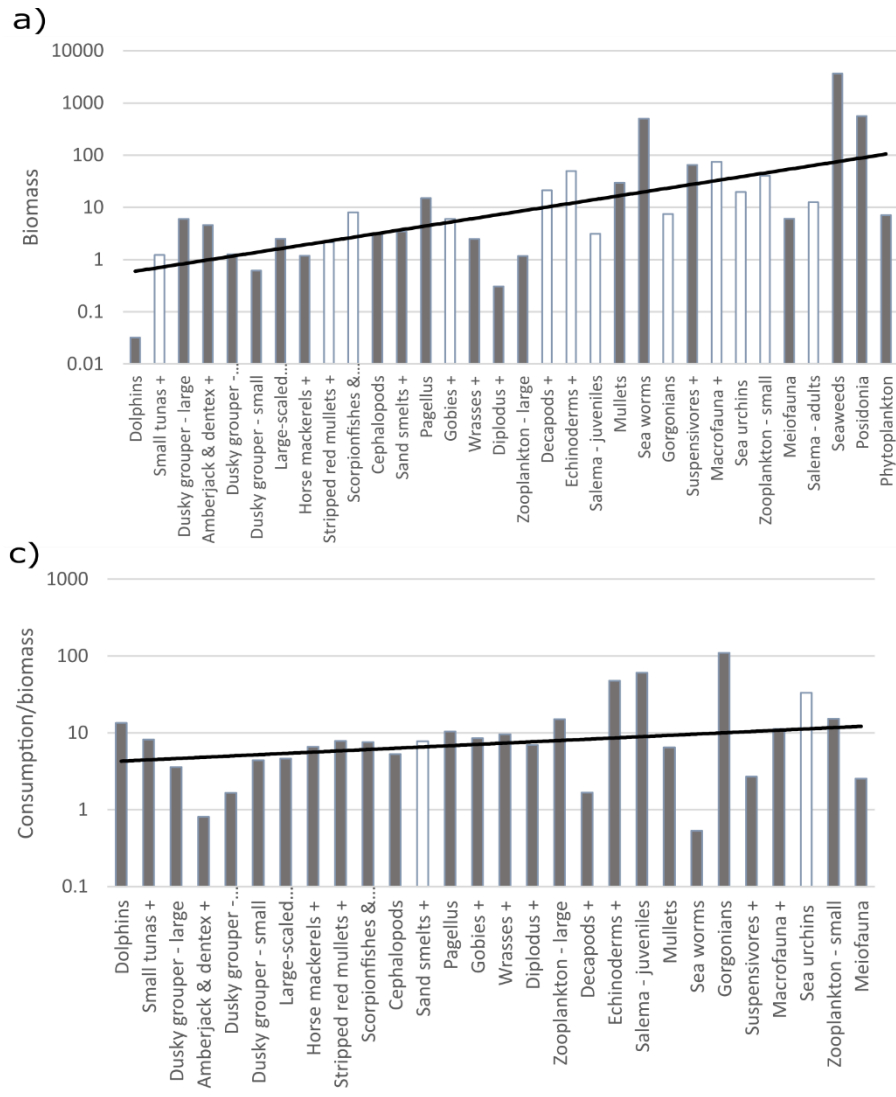
5

6

Table S 1: Functional group species. A detailed description of the species composing the functional groups as reported in the Portofino MPA Ecopath model

Functional group	Species name
Dusky grouper	<i>Epinephelus marginatus</i>
Amberjack+	<i>Seriola dumerili</i> , <i>Conger conger</i> , <i>Lophius piscatorius</i> , <i>Dicentrarchus labrax</i> , <i>Muraena helena</i> , <i>Scyliorhinus canicula</i> , <i>Dentex dentex</i> , <i>Sphyraena viridensis</i>
Scorpionfishes & combers	<i>Phycis phycis</i> , <i>Labrus merula</i> , <i>Labrus viridis</i> , <i>Sciaena umbra</i> , <i>Scorpaena scrofa</i> , <i>Pagrus pagrus</i> , <i>Zeus faber</i>
large scaled Scorpionfishes+	<i>Scorpaena notata</i> , <i>Scorpaena porcus</i> , <i>Serranus cabrilla</i> , <i>Serranus hepatus</i> , <i>Serranus scriba</i> , <i>Synodus saurus</i>
Striped red mullet+	<i>Arnoglossus laterna</i> , <i>Bothus podas</i> , <i>Gaidropsarus mediterraneus</i> , <i>Gaidropsarus vulgaris</i> , <i>Trisopterus</i> spp., <i>Mullus surmuletus</i> , <i>Ophisurus serpens</i> , <i>Ophidion rochei</i> , <i>Parophidion vassali</i>
Wrasses	<i>Coris julis</i> , <i>Symphodus cinereus</i> , <i>Symphodus doderleini</i> , <i>Symphodus mediterraneus</i> , <i>Symphodus melanocercus</i> , <i>Symphodus ocellatus</i> , <i>Symphodus roissali</i> , <i>Symphodus rostratus</i> , <i>Symphodus tinca</i> , <i>Thalassoma pavo</i>
Gobies	<i>Deltentosteus colonianus</i> , <i>Deltentosteus quadrimaculatus</i> , <i>Gobius auratus</i> , <i>Gobius cruentatus</i> , <i>Gobius fallax</i> , <i>Gobius geniporus</i> , <i>Gobius paganellus</i> , <i>Gobius vittatus</i> , <i>Pomatoschistus minutus</i> , <i>Pomatoschistus quagga</i> , <i>Thorogobius ephippiatus</i> , <i>Thorogobius macrolepis</i>
Pagellus	<i>Pagellus</i> spp.
Diplodus+	<i>Diplodus puntazzo</i> , <i>Diplodus sargus</i> , <i>Diplodus vulgaris</i> , <i>Lithognathus mormyrus</i> , <i>Sparus aurata</i> , <i>Spondylisoma cantharus</i>
Blennies+	<i>Blennius ocellaris</i> , <i>Diplodus annularis</i> , <i>Parablennius gattorugine</i> , <i>Parablennius rouxi</i>
Sand smelts+	<i>Atherina</i> spp., <i>Trachurus</i> spp., <i>Spicara maena</i> , <i>Spicara smaris</i> , <i>Chromis chromis</i> , <i>Anthias anthias</i> , <i>Boops boops</i> , <i>Oblada melanura</i>
Mullets	<i>Mugilidae</i>

Salema	Sarpa salpa
Decapods	Crabs, decapods
Suspensivores+	bivalves, suspensivores
Macrofauna	macrofaunal invertebrates (amphipods, small crustaceans, gastropods, and brittle stars)
Echinoderms+	sea stars, sea cucumbers
Small tunas+	Sarda sarda, Auxis rochei, Euthynnus alletteras
Horse mackerels+	Scomber spp., Sardinella aurita



9 **Fig. S2: PREBAL of the Marine Protected Area in the NW Mediterranean Sea (Prato and others 2016).** The plots represent (a) biomass estimates (t/km²), (b)
10 production/biomass ratio (per year), and (c) consumption/biomass (per year) on a log scale vs species ranked by trophic level, from highest to lowest trophic level. Solid bars
11 indicate input to the model and white bars indicate model estimated parameters.

12

13 **Table S2: Mediation functions.** Assignment of mediation functions to functional groups in the EwE model.

EwE group	Weight	Mediation function	Mediation parameter (prey, predator)
Decapods	P. oceanica; Gorgonians	M1	(+)v Decapods, all predators
Echinoderm	“	M1	(+)v Echinoderm, all predators
Sea urchin	“	M1	(+)v Sea urchin, all predators
Meiofauna	“	M1	(+)v Meiofauna, all predators
Macrofauna	“	M1	(+)v Macrofauna, all predators
Grouper small	P. oceanica; Gorgonians	M2	(-)a Scorpionfishes & combers, Grouper small
	“	M2	(-)a Stripped red mullets, Grouper small
	“	M2	(-)a Horse mackerels, Grouper small
	“	M2	(-)a Diplodus, Grouper small
	“	M2	(-)a Gobies, Grouper small
	“	M2	(-)a Wrasses, Grouper small
	“	M2	(-)a Mulletts, Grouper small
	“	M2	(-)a Salema - juveniles, Grouper small
	“	M2	(-)a Decapods, Grouper small
Salema - juveniles	P. oceanica; Gorgonians	M2	(-)a Macrofauna, Salema - juveniles
Amberjack & Dentex	1/2 P. oceanica; 1/2 Gorgonians	M3	(-)a All prey, Amberjack & Dentex
Dusky grouper	“	M3	(-)a All prey, Dusky grouper
Large-scaled scorpionfishes	“	M3	(-)a All prey, Large-scaled scorpionfishes
Scorpionfish & combers	“	M3	(-)a All prey, Scorpionfish & combers
Stripped red mullets	“	M3	(-)a All prey, Stripped red mullets
Pagellus	“	M3	(-)a All prey, Pagellus
Sand smelts	“	M3	(-)a All prey, Sand smelts
Cephalopods	“	M3	(-)a All prey, Cephalopods
Horse mackerel	1/2 Gorgonians	M3	(-)a All prey, Horse mackerel
Small tunas	1/2 Gorgonians	M3	(-)a All prey, Small tunas

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21

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[illegible]

Amberjack & dentex +	-0.3	-0.4; -0.1	-1.3	-1.9; -0.8	-2.1	-2.9; -1.5	-2.7	-4; -1.7	-3.1	-4.7; -1.9	-0.5	-0.9; -0.1	0.5	-0.9; 2.1	2.8	0.4; 6.1	10.7	2.7; 19.3	-4.0	-39.4; -2
Cephalopods	-2.6	-2.9; -2.4	-8.2	-8.8; -7.7	-12.4	-13.3; -11.6	-15.1	-16.1; -13.8	-16.9	-18.8; -14.9	-4.0	-4.4; -3.6	-10.8	-12.9; -8.6	-11.5	-15.4; -4.9	-7.9	-18.8; 20.6	-16.7	-18.9; -13.7
Decapods +	-5.6	-5.7; -5.5	-17.9	-18.2; -17.5	-29.4	-29.9; -28.5	-40.0	-41; -38.9	-47.8	-48.7; -47.1	-9.6	-9.9; -9.3	-30.0	-31; -28.1	-46.6	-48.5; -44.6	-55.0	-57.9; -52.6	-48.3	-50.1; -46.4
Detritus	-2.9	-3.1; -2.8	-9.4	-9.8; -8.9	-15.7	-16.3; -14.5	-21.0	-22.1; -19.9	-25.1	-26.1; -24.3	-1.4	-1.5; -1.2	-4.5	-5.1; -4.2	-7.5	-8.6; -6.6	-9.8	-11.3; -8.5	-23.2	-25.6; -11.4
Diplodus +	-2.4	-2.6; -2.3	-7.4	-7.8; -6.9	-11.4	-12.2; -10.7	-14.8	-15.8; -13.4	-16.4	-17.5; -15.7	0.4	0.1; 0.6	1.1	0.4; 1.8	2.3	0.7; 3.6	6.9	4.2; 8.7	-14.7	-16.9; 15
Dolphins	0.8	0.6; 1	2.0	1.5; 2.7	3.9	2.9; 4.5	6.4	4.8; 7.6	10.2	8; 12	6.1	5.7; 6.6	27.0	25.2; 28.9	61.5	56.9; 66	135.2	119.4; 143.8	12.4	9.7; 165.5
Dusky grouper - large	-4.8	-6.4; -3.3	-15.1	-16.8; -13.6	-25.2	-26.4; -23.9	-34.8	-36.8; -33	-43.5	-45.6; -41	-10.8	-12.7; -9.5	-38.4	-40.7; -35.1	-71.4	-75.7; -66.6	-96.1	-97.3; -93.3	-45.6	-99.3; -42
Dusky grouper - medium	-9.3	-16.8; -0.2	-24.6	-31; -16.1	-38.9	-42.2; -31.7	-52.3	-57.1; -47.1	-63.8	-66.8; -59.2	-13.0	-21.6; -4	-43.2	-47.8; -36.5	-78.4	-82.6; -74.7	-98.3	-99; -97.4	-68.5	-99.9; -62.1
Dusky grouper - small	-7.6	-19; 5.8	-22.2	-32.6; -15.1	-36.8	-43.1; -26.8	-49.7	-55.2; -43.7	-61.3	-66; -53.2	-14.8	-23.3; -3.9	-40.8	-47.7; -34	-75.5	-80.7; -71.5	-97.4	-98.4; -95.9	-67.0	-99.8; -58.3
Echinoderms +	-4.0	-4.2; -3.8	-12.7	-13.2; -11.8	-20.6	-21.6; -18.9	-27.2	-28.6; -25.6	-31.6	-33.8; -30.6	-3.7	-4; -3.4	-9.8	-10.3; -8.9	-12.6	-14.1; -11.2	-12.0	-14.6; -9.6	-29.1	-32.4; -10
Gobies +	-3.5	-3.7; -3.3	-10.8	-11.3; -10.4	-17.2	-18.2; -16.2	-22.2	-23.6; -21.5	-26.0	-27.8; -24.9	2.5	2.2; 2.9	7.3	6.2; 8.6	11.8	8.8; 14.5	18.9	14.8; 23.7	-23.8	-27.1; 61.3
Gorgonians	-15.1	-15.4; -14.9	-40.4	-40.9; -39.5	-67.4	-68.2; -65.9	-88.7	-89.6; -87.9	-100.0	-100; -100	-13.0	-13.3; -12.7	-33.4	-34.2; -32.7	-56.6	-57.9; -55.2	-78.3	-79.7; -77.2	-100.0	-100; -100
Horse mackerels +	2.1	2; 2.3	6.8	6.3; 7.2	11.7	11; 12.3	17.1	15.7; 18.1	20.2	18.5; 21.9	4.8	4.4; 5.1	22.3	21; 23.4	43.6	40.6; 46.3	105.0	86.2; 131.6	21.4	18.7; 32.7
Large-scaled scorpionfishes +	-5.7	-5.9; -5.3	-17.5	-18.2; -16.8	-28.3	-29; -27.3	-36.8	-38.3; -35.9	-43.5	-44.6; -42.3	-8.8	-9.5; -8.4	-30.1	-31.6; -28.3	-52.7	-56.2; -48.6	-81.7	-84.3; -78.5	-45.3	-98; -43
Macrofauna +	-6.1	-6.2; -6	-19.2	-19.5; -18.8	-31.2	-31.8; -30.4	-41.7	-42.5; -40.5	-48.9	-49.8; -47.9	-9.8	-10; -9.5	-29.3	-30; -28.5	-47.9	-49.3; -46.4	-68.8	-71.4; -66.4	-50.4	-92.7; -48.8
Meiofauna	-3.0	-3.2; -2.8	-9.9	-10.3; -9.2	-16.4	-17.4; -14.9	-21.9	-23.5; -20.3	-26.6	-27.9; -25.5	-6.9	-7.2; -6.6	-21.3	-22.1; -20.3	-32.5	-34.7; -31.1	-39.5	-41.2; -37.2	-29.6	-35.8; -25.6

Mullets	-3.1	-3.3; -2.9	-9.6	-10.2; -9.1	-16.0	-16.7; -14.2	-20.6	-21.8; -19.5	-24.4	-25.8; -23.1	2.6	2.4; 2.8	9.4	8.6; 10.2	19.7	18.2; 21.3	36.2	33.9; 38.3	-21.8	-24.9; 59.2
Pagellus	-5.2	-5.4; -5	-16.3	-16.9; -15.9	-26.5	-27.8; -25.2	-35.6	-37.2; -33.8	-43.0	-44; -41	-8.2	-8.8; -7.7	-29.5	-31.7; -27.1	-55.5	-61.3; -52.6	-82.5	-87.6; -75.5	-45.5	-97.2; -41.4
Phytoplankton	0.0	0; 0.1	0.1	0; 0.2	0.0	-0.2; 0.3	-0.1	-0.4; 0.2	-0.3	-0.6; 0.1	0.2	0.1; 0.2	0.6	0.3; 0.7	0.5	0.1; 0.9	-0.9	-1.4; -0.2	-0.8	-2.8; -0.1
Posidonia	-10.1	-10.1; -10	-32.4	-32.6; -32.2	-53.9	-54.3; -53.6	-74.5	-74.8; -74	-89.8	-90.2; -89.5	-8.0	-8.2; -7.9	-26.5	-26.8; -26	-44.9	-45.7; -43.9	-62.9	-63.8; -61.6	-89.1	-89.9; -78.9
Salema - adults	-9.3	-10.9; -7.3	-31.1	-34.2; -28.8	-54.1	-56.3; -51.5	-73.9	-76.1; -70.6	-90.2	-92.3; -87.2	-11.0	-12.8; -9	-37.7	-39.9; -35.8	-67.7	-70.1; -65	-95.7	-96.9; -93.7	-92.8	-100; -89.5
Salema - juveniles	-4.6	-12.2; 4.5	-18.1	-27.9; -9.2	-37.1	-43.1; -28.4	-60.1	-66.3; -52	-84.5	-88.7; -77.7	-10.4	-17.3; -0.7	-36.2	-42.8; -29.7	-68.1	-72.8; -64.4	-96.7	-97.6; -94.8	-89.9	-100; -83.2
Sand smelts +	1.7	1.5; 1.8	5.3	4.9; 5.9	9.3	8.3; 10	13.8	12.3; 15.2	16.8	14.7; 19.1	3.2	2.9; 3.5	7.8	6; 9.4	9.0	5.8; 12.5	4.3	-0.7; 10.7	17.7	15.1; 21.6
Scorpionfishes & combers +	-5.0	-5.3; -4.7	-15.4	-16.1; -14.5	-24.2	-25.5; -23	-31.9	-33.6; -29.9	-35.8	-37.6; -32.8	-6.1	-6.6; -5.2	-10.1	-13.9; -7.5	-5.2	-12.8; 2.7	0.6	-15.7; 14.9	-34.8	-37.9; -28.3
Sea urchins	-6.8	-6.9; -6.7	-21.8	-22.1; -21.5	-35.8	-36.3; -35.4	-49.1	-49.7; -48.5	-59.0	-59.6; -58.2	-9.4	-9.6; -9	-30.1	-31; -29.2	-50.2	-51.8; -49	-69.1	-70.5; -66.7	-59.7	-82.2; -58.6
Sea worms	-3.1	-3.3; -3	-9.8	-10.2; -9.4	-15.9	-16.6; -15	-21.2	-22.2; -20.1	-24.8	-25.7; -23.6	-1.0	-1.3; -0.9	-3.6	-4.2; -2.8	-6.6	-8.1; -4.8	-7.9	-10.8; -5	-22.7	-25; -2.7
Seaweeds	0.6	0.6; 0.7	2.2	2.1; 2.3	3.9	3.8; 4.2	5.7	5.4; 6.1	7.5	7; 8	1.7	1.6; 1.8	5.6	5.3; 6	10.0	9.4; 10.5	15.3	14.5; 15.8	8.2	7.3; 20.7
Small tunas +	3.0	2.8; 3.2	9.7	8.9; 10.3	17.0	15.8; 17.7	25.1	23.3; 26.5	31.1	28.5; 33.1	0.8	0; 1.4	13.1	10.6; 15.3	14.6	8.4; 19.6	-7.4	-19.7; 2.8	28.1	-100; 32.2
Stripped red mullets +	-4.4	-4.6; -4.2	-13.9	-14.4; -13.5	-22.2	-23.3; -21.6	-30.0	-31.1; -28.6	-34.9	-36.5; -33.9	-5.3	-5.6; -4.8	-16.2	-17.9; -14.4	-22.0	-24.3; -18.4	-10.3	-18.5; 3.7	-33.2	-35.9; 1.5
Suspensivores +	-0.7	-0.8; -0.6	-2.4	-2.6; -1.9	-3.8	-4.3; -3	-4.9	-5.6; -4.2	-5.7	-6.5; -5	0.9	0.7; 1	2.4	2.1; 2.9	4.4	3.8; 5.3	8.4	7.4; 9.3	-4.2	-6; 14.8
Wrasses +	-6.4	-6.6; -6.2	-19.9	-20.5; -19.3	-32.4	-33.4; -31.5	-43.1	-44.7; -41.8	-50.6	-52.7; -49.4	-3.8	-4.2; -3.2	-9.1	-11; -7.3	-12.5	-16.1; -9.3	-11.1	-20.4; 0	-49.0	-52.1; -33.5
Zooplankton - large	1.2	1.1; 1.3	3.7	3.3; 4.1	6.4	5.6; 7.1	9.3	8.2; 10.5	11.4	9.9; 12.8	7.2	6.9; 7.4	24.3	23.6; 25.7	46.2	44.2; 48.6	78.9	74.8; 82.6	13.1	10.7; 135.5
Zooplankton - small	0.0	-0.1; 0.1	0.4	0.2; 0.7	0.9	0.3; 1.5	1.6	0.8; 2.3	2.4	1.4; 3.4	1.8	1.5; 1.9	5.8	5.1; 6.7	10.4	8.4; 11.9	17.3	14; 20.5	3.9	1.9; 19.7

Table S4: Indicators analysis. For each scenarios analysis are reported the median, IQR and p-value of the pairwise Wilcoxon test. The Wilcoxon test was performed to assess the significant differences between the indicator at the basic scenarios and under each impacted scenarios.

		0	-10% HFS			-30% HFS			-50% HFS			-70% HFS			-90% HFS		
Index		Median	Median	IQR	p	Median	IQR	p	Median	IQR	p	Median	IQR	p	Median	IQR	p
Total Biomass	FF		4673.19	198.73	***	3705.81	130.26	***	2758.48	90.39	***	1882.65	74.36	***	1255.46	62.67	***
	FM	5129	4765.94	193.28	***	3953.49	136.48	***	3146.1	116.37	***	2409.86	116.92	***	1806.22	103.62	***
TST	FF		15090.45	1176.92	*	14261.91	1079.22	***	13517.49	952.51	***	12857.9	911.26	***	12386.03	835.1	***
	FM	15479	14989.93	1209.53	**	13991.57	1115.15	***	13092.81	1067.07	***	12292.22	924.13	***	11648.88	748	***
Capacity	FF		76225.95	6401.96	*	71847.86	5994.88	***	67747.92	5370.53	***	63790.41	5061.44	***	60765.19	4859.18	***
	FM	78367	75924.4	6539.82	**	70818.24	6092.6	***	65931.65	5546.86	***	61120.08	5083.54	***	56219.42	4392.25	***
Ascendency	FF		19897.15	1701.34	*	18659.15	1586.79	***	17578.27	1415.9	***	16600.21	1343.94	***	15954.55	1280.22	***
	FM	20500	19813.6	1751	***	18396.92	1635.78	***	17136.27	1569.13	***	16133.26	1224.37	***	15247.01	1253.51	*
A/C	FF		26.08	0.21	*	25.91	0.22	***	25.84	0.23	***	25.92	0.25	***	26.14	0.28	>0.05
	FM	26.2	26.05	0.22	***	25.89	0.24	***	25.92	0.27	***	26.29	0.39	***	27.01	0.56	***
PFD	FF		0.38	0.02	>0.05	0.37	0.02	***	0.36	0.02	***	0.34	0.02	***	0.34	0.02	***
	FM	0.38	0.38	0.02	*	0.36	0.02	***	0.35	0.02	***	0.33	0.02	***	0.32	0.02	***
mTLco	FF		1.23	0.01	>0.05	1.24	0.02	***	1.25	0.01	***	1.28	0.02	***	1.35	0.01	***
	FM	1.23	1.23	0.01	>0.05	1.24	0.01	*	1.24	0.02	***	1.26	0.01	***	1.24	0.02	***
MPL	FF		2.86	0.13	>0.05	2.96	0.15	***	3.08	0.16	***	3.2	0.17	***	3.29	0.18	***
	FM	2.82	2.87	0.14	**	3	0.16	***	3.15	0.18	***	3.32	0.19	***	3.52	0.26	***
AMI	FF		1.32	0.01	**	1.3	0.02	***	1.29	0.02	***	1.28	0.03	***	1.28	0.03	***
	FM	1.32	1.32	0.01	*	1.31	0.02	***	1.3	0.02	***	1.31	0.03	***	1.3	0.04	***
Entropy	FF		5.05	0.04	>0.05	5.03	0.05	***	5	0.06	***	4.95	0.07	***	4.9	0.08	***
	FM	5.06	5.06	0.04	>0.05	5.06	0.05	>0.05	5.03	0.07	***	4.98	0.09	***	4.81	0.13	***

Redundancy	FF	55	55.22	0.37	***	55.72	0.43	***	56.16	0.48	***	56.52	0.57	***	56.71	0.63	***
	FM		55.18	0.39	***	55.52	0.47	***	55.78	0.56	***	55.71	0.63	***	55.67	1.03	***
FCI	FF	4.96	5.06	0.37	>0.05	5.26	0.41	***	5.42	0.44	***	5.52	0.49	***	5.53	0.52	***
	FM		5.06	0.38	>0.05	5.25	0.41	***	5.37	0.45	***	5.26	0.5	***	4.1	0.7	***
Evenness	FF	1	1.03	0	***	1.11	0	***	1.22	0.01	***	1.37	0.02	***	1.47	0.04	***
	FM		1.02	0	***	1.08	0	***	1.16	0.01	***	1.25	0.03	***	1.28	0.08	***
Q90	FF	5.6	5.54	0.26	>0.05	5.34	0.32	***	5.14	0.26	***	4.86	0.34	***	4.73	0.31	***
	FM		5.46	0.25	***	4.96	0.24	***	4.49	0.36	***	2.3	0.51	***	1.08	0.28	***
Total Catches	FF	10.1	9.7	0.23	***	8.95	0.25	***	8.26	0.24	***	7.65	0.22	***	7.2	0.24	***
	FM		9.72	0.26	***	9.01	0.28	***	8.33	0.38	***	8.03	0.58	***	7.47	2.08	***

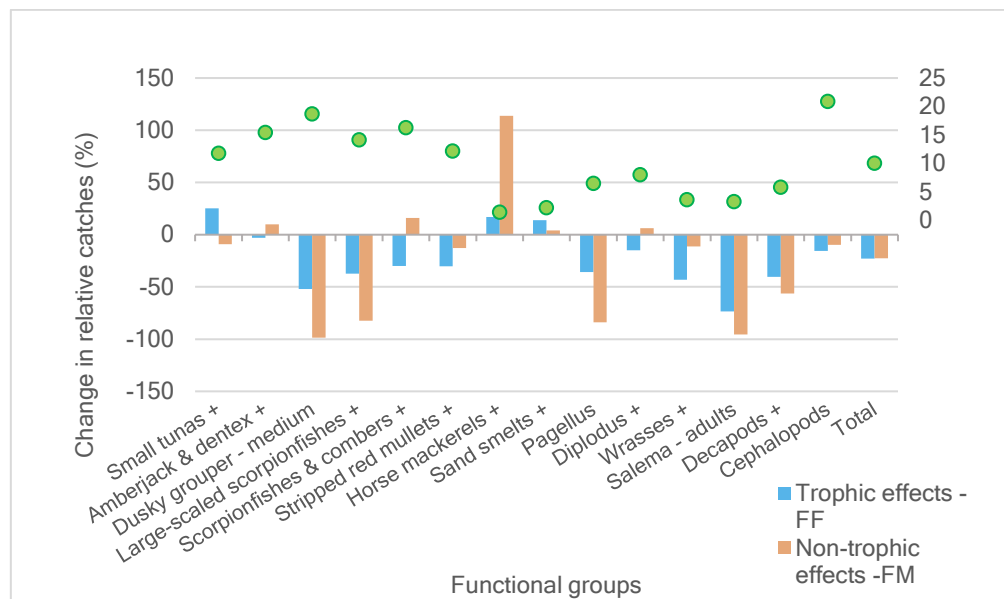


Fig S4: Change in relative catches. Proportional changes (%) in catch biomass under scenarios representing trophic effects (Scenario FF4-70% in blue) and trophic and nontrophic effects (Scenario FM4-70% in orange). The green dots represent the monetary value of the catches in the market in the present-state scenario (right y-axis)