

## Effects of habitat on spillover from marine protected areas to artisanal fisheries

Aitor Forcada<sup>1,\*</sup>, Carlos Valle<sup>1</sup>, Patrick Bonhomme<sup>2</sup>, Géraldine Criquet<sup>3</sup>, Gwenaél Cadiou<sup>2</sup>, Philippe Lenfant<sup>3</sup>, José L. Sánchez-Lizaso<sup>1</sup>

<sup>1</sup>Unidad de Biología Marina, Departamento de Ciencias del Mar y Biología Aplicada, Universidad de Alicante, POB 99, 03080 Alicante, Spain

<sup>2</sup>GIS Posidonie, Parc Scientifique & Technologique de Luminy, Case 901, 13288 Marseille Cedex 09, France

<sup>3</sup>Laboratoire Ecosystèmes Aquatiques Tropicaux et Méditerranéens, UMR 5244 CNRS-EPHE-UPVD 'Biologie et Ecologie Tropicale et Méditerranéenne', Université de Perpignan, 52 avenue Paul Alduy, 66860 Perpignan Cedex, France

Email: forcada@ua.es

Marine Ecology Progress Series 379:197–211 (2009)

**Appendix 1.** Species captured in the experimental fishing carried out in *Posidonia oceanica* meadows and on sandy bottoms adjacent to the studied marine protected areas

Table A1. Total catch of the recorded species in the experimental fishing carried out in *Posidonia oceanica* meadows adjacent to Tabarca and Carry-le-Rouet Marine Reserves

Class	Family	Species	Total catch (g)	
			Tabarca	Carry-le-Rouet
Cephalopoda	Sepiidae	<i>Sepia officinalis</i> Linnaeus, 1758	58921	75878
	Octopodidae	<i>Octopus vulgaris</i> Cuvier, 1797	11116	53520
Crustacea	Scyllaridae	<i>Scyllarus arctus</i> (Linnaeus, 1758)	–	23
	Palinuridae	<i>Palinurus elephas</i> (Fabricius, 1787)	–	835
Chondrichthyes	Scyliorhinidae	<i>Scyliorhinus canicula</i> (Linnaeus, 1758)	249	2957
		<i>Scyliorhinus stellaris</i> (Linnaeus, 1758)	–	4174
	Torpedinidae	<i>Torpedo marmorata</i> Risso, 1810	6199	13269
Osteichthyes	Rajidae	<i>Raja</i> spp.	25	–
	Myliobatidae	<i>Myliobatis aquila</i> (Linnaeus, 1758)	5832	–
	Clupeidae	<i>Sardina pilchardus</i> Walbaum, 1792	–	61
		<i>Sardinella aurita</i> Valenciennes, 1847	–	32
	Synodontidae	<i>Synodus saurus</i> (Linnaeus, 1758)	40	33
	Muraenidae	<i>Muraena helena</i> Linnaeus, 1758	38999	4630
	Congridae	<i>Conger conger</i> (Linnaeus, 1758)	13677	30326
	Lophiidae	<i>Lophius piscatorius</i> Linnaeus, 1758	–	6996
	Gadidae	<i>Phycis phycis</i> (Linnaeus, 1766)	896	18995
		<i>Zeus faber</i> Linnaeus, 1758	375	–
	Serranidae	<i>Epinephelus costae</i> (Linnaeus, 1758)	973	–
		<i>Epinephelus marginatus</i> (Lowe, 1834)	3994	–
		<i>Serranus cabrilla</i> (Linnaeus, 1758)	34	77
		<i>Serranus scriba</i> Linnaeus, 1758	3180	440
		<i>Dicentrarchus labrax</i> Linnaeus, 1758	13305	2488
	Apogonidae	<i>Apogon imberbis</i> (Steindachner, 1878)	55	–
	Haemulidae	<i>Pomadasys incisus</i> (Bowdich, 1825)	260	–
Carangidae	<i>Seriola dumerili</i> (Risso, 1810)	2760	–	
	<i>Trachurus</i> spp.	1173	2219	
Sciaenidae	<i>Sciaena umbra</i> Linnaeus, 1758	87741	–	
Mullidae	<i>Mullus surmuletus</i> Linnaeus, 1758	15097	5815	
	<i>Boops boops</i> (Linnaeus, 1758)	–	324	
Sparidae	<i>Dentex dentex</i> (Linnaeus, 1758)	24649	555	
	<i>Diplodus annularis</i> (Linnaeus, 1758)	2483	47197	
	<i>Diplodus puntazzo</i> , Cetti, 1789	6032	661	
	<i>Diplodus sargus</i> (Linnaeus, 1758)	24275	11093	
	<i>Diplodus vulgaris</i> (Geoffroy Saint-Hilaire, 1817)	22286	3954	
	<i>Lithognathus mormyrus</i> (Linnaeus, 1758)	276	473	
	<i>Oblada melanura</i> (Linnaeus, 1758)	6014	5282	
	<i>Pagellus erythrinus</i> (Linnaeus, 1758)	570	582	

Table A1 (continued)

	<i>Pagellus acarne</i> (Risso, 1827)	292	3994
	<i>Pagrus pagrus</i> (Linnaeus, 1758)	4003	145
	<i>Sarpa salpa</i> (Linnaeus, 1758)	15440	4400
	<i>Sparus aurata</i> Linnaeus, 1758	11903	9818
	<i>Spondyliosoma cantharus</i> (Linnaeus, 1758)	489	1181
Centracanthidae	<i>Spicara maena</i> (Linnaeus, 1758)	41	7110
Pomacentridae	<i>Chromis chromis</i> (Linnaeus, 1758)	45	5
Labridae	<i>Coris julis</i> (Linnaeus, 1758)	30	–
	<i>Labrus merula</i> (Linnaeus, 1758)	217538	34797
	<i>Labrus mixtus</i> Linnaeus, 1758	–	526
	<i>Labrus viridis</i> Linnaeus, 1758	–	18452
	<i>Symphodus cinereus</i> (Bonnaterre, 1788)	88	–
	<i>Symphodus mediterraneus</i> (Linnaeus, 1758)	90	116
	<i>Symphodus melanocercus</i> (Risso, 1810)	12	–
	<i>Symphodus ocellatus</i> (Forsskål, 1775)	13	17
	<i>Symphodus roissali</i> (Risso, 1810)	62	–
	<i>Symphodus rostratus</i> (Bloch, 1791)	43	23
	<i>Symphodus tinca</i> (Linnaeus, 1758)	103770	64246
	<i>Thalassoma pavo</i> (Linnaeus, 1758)	–	28
Uranoscopidae	<i>Uranoscopus scaber</i> Linnaeus, 1758	–	362
Trachinidae	<i>Trachinus draco</i> Linnaeus, 1758	–	75
Scombridae	<i>Euthynnus alletteratus</i> (Rafinesque, 1810)	1335	–
	<i>Sarda sarda</i> (Bloch, 1793)	398	–
Scophthalmidae	<i>Psetta maxima</i> (Linnaeus, 1758)	–	900
	<i>Scophthalmus rhombus</i> (Linnaeus, 1758)	–	747
Gobiidae	<i>Gobius cruentatus</i> Gmelin, 1789	19	–
	<i>Gobius</i> spp.	–	28
Sphyraenidae	<i>Sphyraena sphyraena</i> (Linnaeus, 1758)	2410	–
Mugilidae		1690	–
Scorpaenidae	<i>Scorpaena notata</i> Rafinesque, 1810	462	1032
	<i>Scorpaena porcus</i> Linnaeus, 1758	115125	87033
	<i>Scorpaena scrofa</i> (Linnaeus, 1758)	12925	3894
Triglidae	<i>Chelidonichthys lucernus</i> (Linnaeus, 1758)	–	195
	<i>Trigla</i> spp.	–	225
Dactylopteridae	<i>Dactylopterus volitans</i> (Linnaeus, 1758)	124	–
Bothidae	<i>Bothus podas</i> (Delaroche, 1809)	101	93
Soleidae	<i>Monochirus hispidus</i> Rafinesque, 1814	–	8
	<i>Solea solea</i> (Linnaeus, 1758)	–	758
	<i>Solea</i> spp.	431	–
Total		840391	533097

Table A2. Total catch of the recorded species in the experimental fishing carried out on sandy bottoms adjacent to Tabarca and Cerbère-Banyuls Marine Reserves

Class	Family	Species	Total catch (g)	
			Tabarca	Cerbère-Banyuls
Cephalopoda	Sepiidae	<i>Sepia officinalis</i> Linnaeus, 1758	21463	13992
	Loliginidae	<i>Loligo vulgaris</i> Lamarck, 1798	–	500
	Octopodidae	<i>Octopus vulgaris</i> Cuvier, 1797	13223	–
Crustacea	Scyllaridae	<i>Scyllarus arctus</i> (Linnaeus, 1758)	–	82
	Palinuridae	<i>Palinurus elephas</i> (Fabricius, 1787)	–	2986
	Nephropidae	<i>Homarus gammarus</i> (Linnaeus, 1758)	–	4918
	Calappidae	<i>Calappa granulata</i> (Linnaeus, 1758)	–	646
	Chondrichthyes	Scyliorhinidae	<i>Scyliorhinus canicula</i> (Linnaeus, 1758)	1116
Triakidae		<i>Mustelus mustelus</i> (Linnaeus, 1758)	1017	–
Torpedinidae		<i>Torpedo marmorata</i> Risso, 1810	31420	–
Rajidae		<i>Raja clavata</i> Linnaeus, 1758	–	5930
		<i>Raja polystigma</i> Regan, 1923	–	620
		<i>Raja</i> spp.	14157	–
Osteichthyes	Dasyatidae	<i>Dasyatis pastinaca</i> (Linnaeus, 1758)	7565	–
	Myliobatidae	<i>Myliobatis aquila</i> (Linnaeus, 1758)	27280	–
	Clupeidae	<i>Sardinella aurita</i> Valenciennes, 1847	398	–
	Synodontidae	<i>Synodus saurus</i> (Linnaeus, 1758)	173	–
	Muraenidae	<i>Muraena helena</i> Linnaeus, 1758	2611	–
	Congridae	<i>Conger conger</i> (Linnaeus, 1758)	8488	7138
	Ophichthidae	<i>Ophisurus serpens</i> (Linnaeus, 1758)	–	1160
	Lophiidae	<i>Lophius piscatorius</i> Linnaeus, 1758	623	890
	Merlucciidae	<i>Merluccius merluccius</i> (Linnaeus, 1758)	5251	–
	Gadidae	<i>Phycis phycis</i> (Linnaeus, 1766)	5320	37166
		<i>Trisopterus minutus</i> (Linnaeus, 1758)	–	524
	Zeidae	<i>Zeus faber</i> Linnaeus, 1758	1892	724
	Serranidae	<i>Epinephelus aeneus</i> Geoffroy Saint-Hilaire, 1817	206	–
		<i>Epinephelus marginatus</i> (Lowe, 1834)	–	1700
		<i>Serranus cabrilla</i> (Linnaeus, 1758)	480	464
		<i>Serranus scriba</i> (Linnaeus, 1758)	287	–
		<i>Dicentrarchus labrax</i> (Linnaeus, 1758)	–	1635
	Apogonidae	<i>Apogon imberbis</i> (Linnaeus, 1758)	66	–
	Haemulidae	<i>Pomadasys incisus</i> (Bowdich, 1825)	1796	–
	Pomatomidae	<i>Pomatomus saltatrix</i> (Linnaeus, 1766)	391	–
	Carangidae	<i>Seriola dumerili</i> (Risso, 1810)	1368	–
		<i>Trachurus</i> spp.	–	420
	Sciaenidae	<i>Sciaena umbra</i> Linnaeus, 1758	28240	–
		<i>Umbrina cirrosa</i> (Linnaeus, 1758)	130	–
	Mullidae	<i>Mullus barbatus</i> Linnaeus, 1758	1539	66
		<i>Mullus surmuletus</i> Linnaeus, 1758	6248	5373
	Sparidae	<i>Boops boops</i> (Linnaeus, 1758)	39	234
<i>Dentex dentex</i> (Linnaeus, 1758)		4615	688	
<i>Diplodus annularis</i> (Linnaeus, 1758)		3495	184	
<i>Diplodus puntazzo</i> (Cetti, 1777)		2954	–	
<i>Diplodus sargus</i> (Linnaeus, 1758)		1017	2206	
<i>Diplodus vulgaris</i> (Geoffroy Saint-Hilaire, 1817)		20922	512	
<i>Lithognathus mormyrus</i> (Linnaeus, 1758)		–	402	
<i>Oblada melanura</i> (Linnaeus, 1758)		1021	–	
<i>Pagellus erythrinus</i> (Linnaeus, 1758)		13926	7015	
<i>Pagellus acarne</i> (Risso, 1827)		4199	16314	
<i>Pagrus auriga</i> Valenciennes, 1843		389	–	
<i>Pagrus pagrus</i> (Linnaeus, 1758)		22818	1014	
<i>Sarpa salpa</i> (Linnaeus, 1758)		3576	–	
<i>Sparus aurata</i> Linnaeus, 1758		–	1945	
<i>Spondylisoma cantharus</i> (Linnaeus, 1758)		11729	–	
Centracanthidae	<i>Spicara maena</i> (Linnaeus, 1758)	8297	–	
Labridae	<i>Labrus merula</i> (Linnaeus, 1758)	16499	2186	
	<i>Symphodus rostratus</i> (Bloch, 1791)	11	–	
	<i>Symphodus tinca</i> (Linnaeus, 1758)	11243	–	
Uranoscopidae	<i>Uranoscopus scaber</i> Linnaeus, 1758	8489	9217	
Trachinidae	<i>Trachinus draco</i> Linnaeus, 1758	18	2150	
Sphyraenidae	<i>Sphyraena sphyraena</i> (Linnaeus, 1758)	–	1210	

Table A2 continued

Mugilidae		2024	–
Scorpaenidae	<i>Scorpaena notata</i> (Rafinesque, 1810)	544	1894
	<i>Scorpaena porcus</i> (Linnaeus, 1758)	63517	13622
	<i>Scorpaena scrofa</i> (Linnaeus, 1758)	31477	15553
Triglidae	<i>Aspitrigla cuculus</i> (Linnaeus, 1758)	–	212
	<i>Chelidonichthys lastoviza</i> (Bonnaterre, 1788)	4997	–
	<i>Chelidonichthys lucernus</i> (Linnaeus, 1758)	2697	1394
	<i>Eutrigla gurnardus</i> (Linnaeus, 1758)	–	258
	<i>Trigla lyra</i> Linnaeus, 1758	25	–
Dactylopteridae	<i>Dactylopterus volitans</i> (Linnaeus, 1758)	7055	–
Bothidae	<i>Bothus podas</i> (Delaroche, 1809)	813	–
Soleidae	<i>Microchirus ocellatus</i> (Linnaeus, 1758)	–	122
	<i>Pegusa lascaris</i> (Risso, 1810)	–	8868
	<i>Solea</i> spp.	13015	–
Total		444197	174134