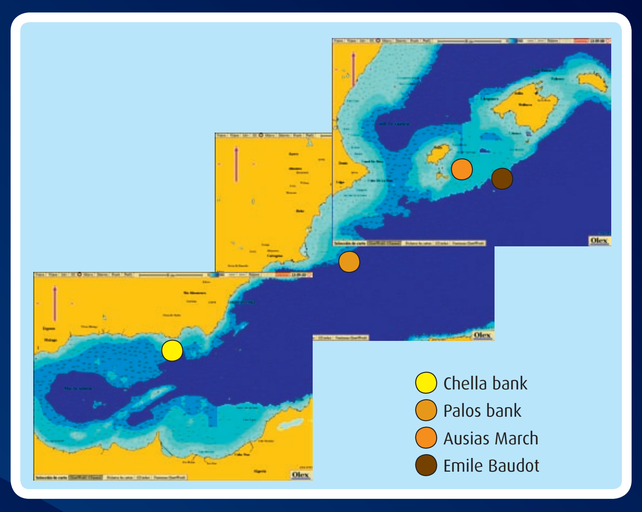
DEEP-SEA CORALLIGENOUS BEDS OBSERVED WITH ROV ON FOUR SEAMOUNTS IN THE WESTERN MEDITERRANEAN

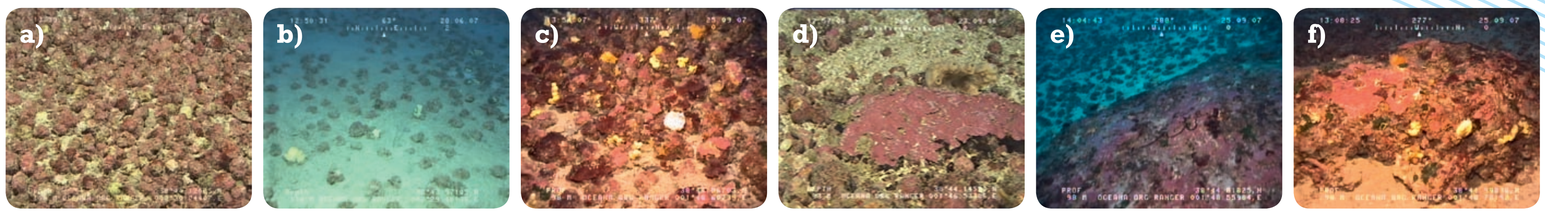
Ricardo AGUILAR, Xavier PASTOR, Ana de la TORRIENTE & Silvia GARCÍA · OCEANA, Leganitos, 47. 28011 Madrid-SPAIN. raguilar@oceana.org



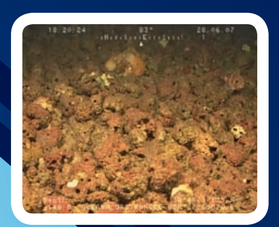
Abstract

In 2006 and 2007, Oceana carried out several investigations on four Western Mediterranean seamounts, finding red algae bio-concretions down to 150-160 meters depth. The areas surveyed were the Ausias March seamount and the Emile Baudot seamount in the Mallorca Channel (Balearic Islands), the Chella Bank (Andalusia-Alboran Sea) and the Palos seamount (in front of Palos Cap, in Murcia). More than 40 hours of video material was collected with an ROV. Species known only to be in shallow waters, like carnivorous sponges (Asbestopluma hypogea), were found on small seamounts with peaks between 80 and 170 meters depth. Sponge aggregations were filmed on coralligenous beds and new data on the distribution of anthozoans (e.g., Paramuricea macrospina) was recorded. Nearly 300 species living on these bottoms were identified, giving new perspectives on their range and habitat dependence and preferences.

Key words: seamounts, coralligenous, bio-concretions, maërl, carnivorous sponge.



Steps of different stages of coralligenous concretions found on the seamounts researched: a) maërl o rhodoliths bed, b) "cobbled" bio-concretions, c) rhodoliths-cobbled, d) thin sheets, e) transition from cobbled to large bio-concretion, and f) large bio-concretion.



Rhodoliths bed at 146 m of depth in Emile Baudot seamount.

Introduction

Red calcareous algae have been widely studied in the shallow waters of the Western Mediterranean (Ballesteros, 2006), but there is very little information about their distribution and function in deep areas. Two main infralittoral and circalittoral ecosystems created by calcareous red algae have been mentioned: maërl and coralligenous beds (Pérès & Picard, 1964; Picard, 1965). These have been described as areas of high diversity and ecological importance (Bosence, 1983; Barberá et al., 2003), being two of the most productive ecosystems in temperate regions (Martin et al., 2007). Seamounts and smaller marine elevations are considered hotspots, "stepping stones" and zones with high biodiversity (Matthiessen et al. 2003; Butler at al. 2001; Morato & Pauly (eds), 2004). Those with shallow peaks are often found to be areas of high biological productivity (Rogers 1994), as in the four seamounts researched, with tops between 80 and 100 m. depth, where red algae can grow and develop.

Materials and methods

The research was carried out during from June to September of 2006 and 2007 onboard the Oceana "Ranger" catamaran, equipped with a HSB2-plus Raymarine digital sonar with a high-powered transducer, linked to software to create bathymetric maps. Nineteen dives were carried out on four marine seamounts (Fig.1). Transects were filmed by a camera with 750 lines of resolution, a F1.2 lens and a 1:12 zoom, attached to an ROV Phantom H2+2. The ROV provided real time data on its position, depth, course, day and time. All of the identifications were made visually.

Results

Two main red algae formations were registered: (i) maërl o rhodolith beds and (ii) coralligenous formations. Most of the rhodolith beds found on these mounds and seamounts reached down to 140-150 meters depth, although the most important ones were between 80 and 120 meters. The formations were especially common over the top of Ausias March, but could also be found on Emile Baudot and the Chella Bank; they were absent from the Palos seamount. Three forms of coralligenous beds were detected: (i) large bio-concretions, (ii) "cobbled" bio-concretions and (iii) thin sheets and small patches. Although some smaller patches were found at 160-170 meters depth, large concretions were more common between 80 and 120 meters depth. Flat areas on the top of the seamounts showed the largest bio-concretions, normally formed by red calcareous algae of the genera *Lithophyllum, Mesophyllum* and *Neogoniolithon*, usually with other red algae, like *Peyssonnelia* spp. and the green algae *Palmophyllum crassum*. The most important ones were found on Ausias March and Chella Bank. Large bio-concretions forming round circles of around two meters in diameter and ten to 20 centimetres high were found on top of the Ausias March mound. These kinds of geometrical concretions were not found over the other seamounts. Coralligenous beds did not always form large bio-concretions but instead small, spotted blocks of some 10 to 30 centimetres in diameter fixed in the substratum. It was very often found as a transitory substratum between maërl and large coralligenous beds. They were very common on Ausias March and Emile Baudot. Patches of red algae were found on all of the seamounts. They were very common on the Palos mount, but were also the most common bio-concretion over the 120-130 meter range.

	Ausias March 38°44'N-001°48'E	Emile Baudot 38°42'N-002°20'E	Palos seamount 37°53'N-000°01'W	Chella Bank 36°31'N-002°51'W
Dives	3	4	6	6
Nautical miles	1.85	3.7	1,77	1.96
Area observed m²	5,140	10,278	4,917	5,445
Filming time	5h29m	9h40m	8h24m	14h57m

Fig.1 Summary of dives, time and areas observed with the ROV on the four seamounts

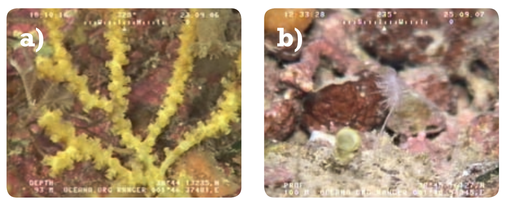
Some 300 species were identified. 150 of them were most commonly found in red algae bio-concretions, but none of them were exclusive from these beds. Two biological communities were widely distributed on bio-concretion beds: sponge aggregation (genera *Haliclona, Aplysina, Tedania, Axinella*, etc.) and fields of dead man´s fingers (*Alcyonium palmatum* and *Paralcyonium spinulosum*). Species like *Paramuricea clavata, P. macrospina, Anthias anthias, Muraena helena, Lappanella fasciata* and *Phycis phycis* were recorded mainly on coralligenous beds. The carnivorous sponge *Asbestopluma hypogea* was first found in deep areas, but not always connected to bio-concretions. The specimen found on Ausias March was on a coralligenous bio-concretion at 100 meters depth, but the one found in Chella Bank was at 167 meters in a rocky area on a small pinnacle beside the main summit. Some other protected species included in the annexes of BARCOM-SPAM were also found. For example, the elephant ear sponge (*Spongia agaricina*) was found on Emile Baudot and the triton snail (*Charonia lampas*) on Ausias March.

Discussion and conclusions

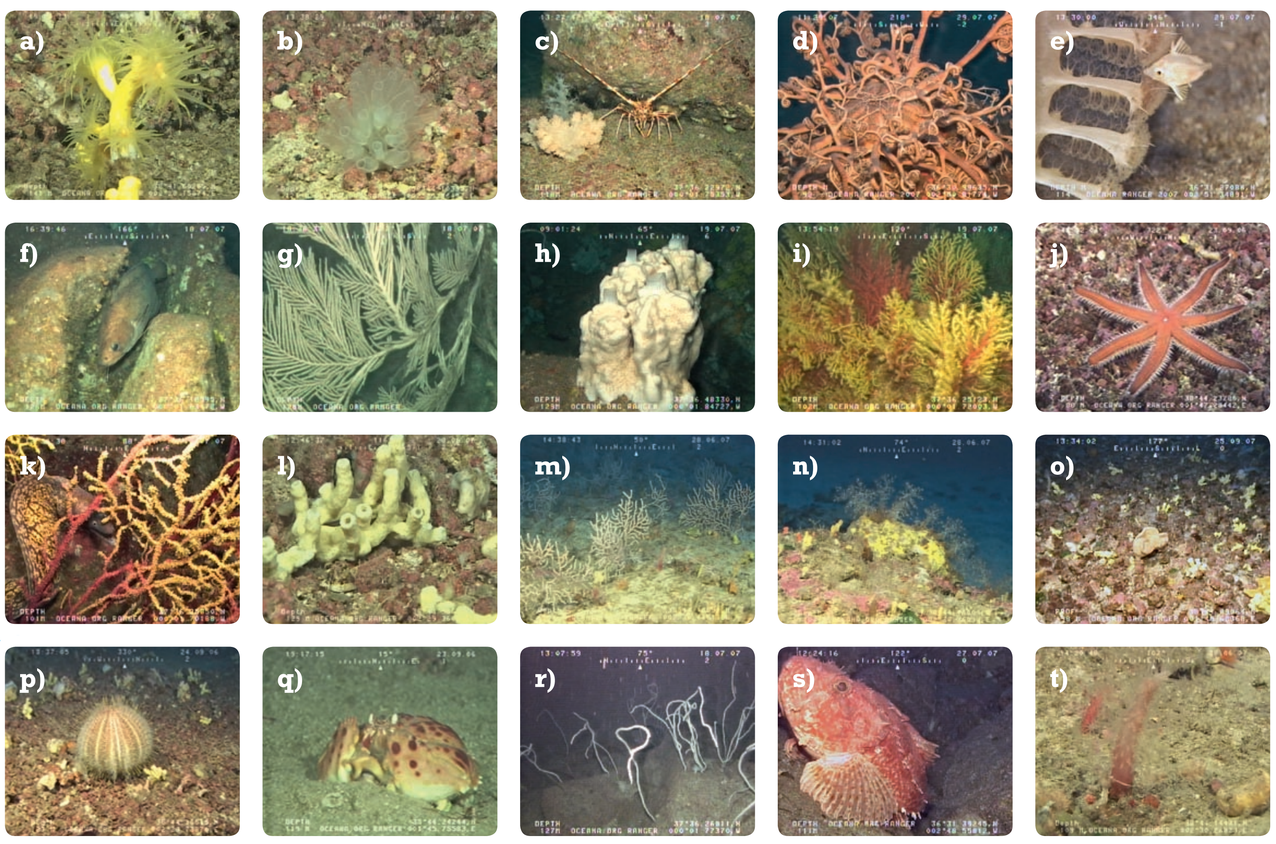
Maërl was mainly formed by rounded rodoliths, instead of the branched forms more common in shallower areas. Hydrodynamism and bathymetric distribution can determine morphology and maërl ramification (Bosence, 1983, Steller and Foster, 1995, Yabur-Pacheco and Riosmena-Rodríguez, 2007). Coralligenous concretions went from thin patches to large concretions -including circular geometric formations not yet described - many times looking like steps or visible different stages as it builds up. As Laborel (1961) affirms, morphology and interim structure could depend on depth, topography and algae species. Some concretions give an aspect of a cobbled seabed, likely due to the lack of fusion or coalescence between several patches of algae, as in the large bio-concretions. Although red algae bio-concretions were found in all of the areas researched, from the surface down to 160-170 meters depth, distribution of the communities had a spatial segregation.

Most of the species found associated with the coralligenous beds were also found in surrounding areas without red algae, including *Anthias anthias, Lappanella fasciata, Muraena helena* and *Phycis phycis*, although they were apparently less abundant, showing their preferences for irregular bottoms. Only a few species, like *Paramuricea clavata,* seem to be strongly related to these bio-concretions, although depth distribution is probably a more important factor. Sponge aggregations were more common on maërl and "cobbled" coralligenous beds, while dead man's finger colonies were more often found on "cobbled" coralligenous, large coralligenous and rocky areas. *Asbestopluma hypogea,* since it was discovered in 1995 (Vacelet & Boury-Esnault, 1996), was so far only recorded in shallow caves in France and Croatia. Although Bakran-Petricioli et al. (2007), mentioned the possibility, this is the first time this species has been found in deep areas, both in coralligenous beds and rocky bottoms.

Protected species included in the annexes of BARCOM-SPAM recorded on the seamounts: a) triton snail (*Charonia lampas*) in Ausias March and b) Elephant ear sponge (*Spongia agaricina*) in Emile Baudot.



Species recorded in deep areas of Ausias March seamount: a) anthozoans *Paramuricea macrospina* b) carnivorous sponge.



Species widely distributed on bio-concretions bed found on the four seamounts researched: a) *Dendrophyllia cornigera*, b) *Diazona violacea*, c) *Palinurus elephas*, *Paralcyonium spinulosum* and unknown nephteidae , d) *Astropartus mediterraneus*, e) *Capros aper* and *Pteroides griseum*, f) *Phycis phycis*, g) *Callogorgia verticillata*, h) Sponge not identified, i) *Paramuricea clavata*, j) *Luida ciliaris*, k) *Muraena helena* in *Paramuricea clavata* garden, l) *Aplysina aerophoba*, m) *Eunicella verrucosa*, n) *Paralcyonium spinulosum*, o) Sponge field on maërl, p) *Echinus melo*, q) *Calappa granulata*, r) *Viminella flagellum*, s) *Scorpaena* sp. t) *Alcyonium palmatum*.

Distribution of species on maërl and coralligenous bed (Bio-concretions) and in other ecosystems without relationship with red algae (Others)

Species	Bioconcretions	Others
RODOPHICEA		
Kallymenia sp.	A	A
Lithophyllum cabiochae	A	A
Lithophyllum sp.	A-E-P-C	A-E-P-C
Mesophyllum sp.	A	A
Osmundaria volubilis	A	A
Neogoniolithon mamillosum	*A-P-C*	*A-P-C*
Peyssonnelia cf. *rosa-marina*	A	
Peyssonnelia sp.	E-P	A-P
Peyssonnelia squamaria	A	
Rodophicea n.i.	A-E-P-C	A-E-P-C
CLOROPHICEA		
Palmophyllum crassum	A	
Valonia macrophysa	A	A
FEOPHICEA		
Halopteris filicina	A	A
PORIFERA		
Adocia sp.	C	C
Agelas oroides	E	E
Aplysina aerophoba	A-E-C	C
Aplysina cavernicola	A-E	C
Asbestopluma hypogea	A	C
Asconema setubalense		C
Axinella damicornis	A	A
Axinella infundibuliformis	A-E	A-E
Axinella polypoides	A-E-C	A-E-C
Axinella sp.	E-P	E-P
Calyx nicaeensis	C	C
Chondrosia reniformis	A-E	A-E
Clathrina sp.	E	E-C
Demospongiae n.i.	A-E-C	A-E-P-C
Desmacydon sp.		C
Geodia sp.		P-C
Haliclona simulans	A	A-E
Haliclona sp.	A-C	A-C
Hexadella racovitzai	C	C
Hymedesmia paupertas	A-E-C	A-E-C
Myxilla sp.	A	A
Petrosia ficiformis	A	A
Phakellia sp.		E-P
Phakellia ventilabrum		E-C
Pleraplysilla spinifera	C	C
Sarcotragus sp.	E	E
*Spirastrella cunctatrix***	A	A
Spirastrella sp.	A	A-C
Spongia agaricina	A-E-C	A-E-C
Spongosorites sp.	E-P-C	E-P-C
Suberites domuncula	C	E-C
Sycon sp.		C
Tedania sp.	A	
Tethya sp.	E	E
CRUSTACEA		
Balssia gasti	C	
Calappa granulata		A-P-C
Calliostoma sp.	C	C
Caprelidae	C	
Cirripedia	C	
Dardanus sp.		E-P-C
Dromia personata	E	E
Galathea cf. *nexa*	A-P	A-P
Galathea strigosa	C	C
Inachus sp.	A	A
Liocarcinus depurator		A
Munida rugosa	E-P-C	E-P-C
Mysidacea		C
Natantia n.i.	A	A
Pagurus prideaux		A
Pagurus sp.		C
Palinurus elephas	E-P-C	E-P-C
Paramola cuvieri		E-C
Periclimenes cf. *scriptus*		E
Pseudoprotella phasma	C	
MOLLUSCA		C
Ananemia gorgonophila	E-C	C
Charonia lampas	A	A
Eledone cirrhosa		A-C
Erosaria spurca	E	E
*Fasciolaria lignaria**	E	E
Marionia blainvillea	A	A
Muricidae		C
Octopus vulgaris	C	C
Pteria hirundo	P-C	
*Pleurobranchaea meckeli**		C
Ranella olearia	E	E
*Sconsia striata**		C
Sepia officinalis		C
Tritonidae n.i.	P	
BRIOZOA		
Briozoa n.i.	A-C	A-E-C
Crisia sp.	A-C	A-C
Hornera fronticulata	P-C	P-C
Hornera sp.	E-C	E-C
Myriapora truncata	E	E
Sertella septentrionalis	E-P-C	E-P-C
Smittina cervicornis	A-C	A

Species	Bioconcretions	Others
BRACHIOPODA		
Gryphus vitreus		E
*Terebratulina rettusa**	A-E-C	A-E-C
FORAMINIFERA		
Miniacina miniacea	A-P-C	A-P-C
CNIDARIA		
Acanthogorgia hirsuta		E-C
Adamsia carcinopados		A
Alcyonium palmatum	E-P-C	E-P-C
Amphianthus dohrni	A-C	
Antennella sp.	C	
Anthozoa n.i.	A-E-P-C	A-E-P-C
*Antipathes dichotoma**		C
*Arachnanthus oligopodus**		E-C
Bebryce mollis	C	E-C
Callogorgia verticillata	C	E-P-C
Caryophyllia ciathus	E-P-C	E-P-C
Caryophyllia smithi		C
Caryophyllia sp.	A-E	A-E-C
Cerianthus membranaceus	E-C	E-C
Clavularia carpediem		C
Corallium rubrum	C	C
Cotylorhiza tuberculata		C
Dendrophyllia cornigera	E-C	E-C
Dendrophyllia ramea	C	C
Diphasia nigra	C	C
Elisella paraplexauroides	C	C
Epizoanthus arenaceus		C
Epizoanthus sp.		A
Eudendrium sp.	C	C
Eunicella cavolini	C	C
Eunicella filiformis		C
Eunicella verrucosa	A-E-C	A-E-C
Funiculina quadrangularis		C
Guynidae		P
Hacelia attenuata	A-C	A-C
Hidrozoa n.i.	A-E-P-C	A-E-P-C
Holothuria forskali	A-E-C	A-E-C
Kophobelemnon stelliferum		C
Lafoea dumosa	C	C
Leiopathes glaberrima		E
Leptogorgia sarmentosa	C	C
Muriceides lepida		E-C
Nemertesia antenninna		C
Nemertesia racemosa		C
Nephtheidae	P	P
Octocorallia n.i.	A-E-P-C	E-C
Paralcyonium spinulosum	E-P-C	E-C
Paramuricea clavata	E-P-C	E-P-C
Paramuricea macrospina	A-C	A-C
Parerythropodium coralloides	P-C	P-C
Pelagia noctiluca		E-C
Pennatula phosphorea		C
Pennatula rubra		C
Placogorgia sp.		C
Pteroides griseum		C
Rolandia rosea	C	C
Sertularella grayi	C	C
Solmissus albescens		C
Swiftia pallida	C	E-P-C
Veretillum cynomorium		C
Villogorgia bebrycoides		C
Viminella flagellum	C	E-P-C
Virgularia mirabilis		C
ECHINODERMATA		
Antedon mediterranea	A-E	A-E
Astropartus mediterraneus	C	C
Astropecten aranciacus		C
Astropecten irregularis		C
Brissus unicolor		A-C
Chaetaster longipes	A-E-P-C	A-E-P-C
Cidaris cidaris	C	E-C
Echinaster sepositus	A	A
Echinus acutus		C
Echinus melo	E-P-C	E-P-C
Holothuria sanctori	A	A
Holothuria tubulosa	A	A-E-C
Leptometra phalangium		E
Leptometra sp.		E
Leptosynapta sp.	A	A
Luidia ciliaris	A	A
Marthasterias glacialis	C	
Ophiothrix sp.	E-P-C	E-P-C
Spatangus purpureus		C
Stichopus regalis	A	A-C
Stylocidaris affinis		A-E
EQUIUROIDEA		
Bonellia viridis	A-E-C	A-E-C
ANNELIDA		
Filograna implexa	A-C	A-C
Hyalinoecia tubicola		A-E-P-C
Lanice conchilega		E-C
Megalomma vesiculosum		A
Myxicola infundibulum		C
Myxicola sp.		A
Polichaetes n.i.	A-E-P-C	A-E-P-C

Species	Bioconcretions	Others
Polydora sp.		C
Protula intestinalis	A	A
Protula sp.	A	A
Protula tubularia	C	C
Sabella pavonina	E-C	E-C
Serpula vermicularis	A-E-C	A-E-C
SIPHONOPHORA		
Velella velella		P
CTENOPHORA		
Leucothea multicornis		E
TUNICATA		
Ascidia mentula	E	E-C
Ciona intestinalis	C	C
Diazona violacea	E-P-C	E-P-C
*Didemnum commune**		C
Halocynthia papillosa	A	A
Didemnum sp.	A-P	A-P
Lissoclinum perforatum	C	C
Pyrosoma atlanticus		C
*Rophalaea neapolitana***		E
Salpa maxima		A-C
Styela clava		C
Tunicata n.i.	A-C	A-E-P-C
PISCES		
Acantholabrus palloni	E-P-C	E-P-C
Anguilla anguilla		C
Anthias anthias	A-E-P-C	A-E-P-C
Arnoglossus cf. *rueppelli**		E
Arnoglossus sp.		A
Arnoglossus thori		P
Aspitrigla cuculus		P-C
Aspitrigla obscura		C
Aulopus filamentosus	A-E-P	A-E-P-C
Blennius ocellaris		A
Callionymus sp.		A-C
Callyonimus lyra		A-C
Capros aper	A	A-E-C
Centracanthus cirrus		C
Cetorhinus maximus		P
Cinoglosidae		C
Conger conger	P-C	P-C
Coris julis	A-E-P-C	A-E-P-C
Crystallogobius linearis	A	A
Epinephelus caninus	P-C	P-C
Gadella maraldi		P
Gadiculus aregenteus		C
Gobius sp.	A	C
Helicolenus dactylopterus	E-P-C	E-P-C
Hexanxhus griseus		P
Labrus bimaculatus	E-C	E-C
Lappanella fasciata	E-P	E-P
Lepadogaster sp.		
Lepidorhombus whiffiagonis		P
Lophius sp.	C	P-C
Macroramphosus scolopax		A-C
Merluccius merluccius		A-P
Micromesistius poutassou		C
Mola mola	P	P
Mullus barbatus	A	A-C
Mullus surmuletus	A-P-C	A-P-C
Muraena helena	E-P-C	E-P-C
Ophisurus serpens		P-C
Pagellus bogaraveo		C
Pagellus erythrinus		C
Peristedion cataphractum		A-E
Phycis blennoides		C
Phycis phycis	E-P-C	E-P-C
Pisces n.i.	A-C	E-C
Pontinus kuhli	E	
*Scorpaena elongatus**	E	C
Scorpaena scrofa	A-E-P-C	A-E-P-C
Scyliorhinus canicula	A-C	A-C
Serranus cabrilla	A-E-P-C	A-E-P-C
Soleidae		C
Synchiropus phaeton		P
Thunnus thynnus		*P*
Torpedo marmorata	C	
Trachinus draco		A
Trachurus sp		A-C
Trichiurus lepturus		P
Trigla lucerna		E
Trigla lyra		E
Trigloporus lastoviza	A-E-C	A-E-C
Xiphias gladius		P
CETACEA		
Tursiops truncatus		E-C
Physeter macrocephalus		P
Stenella coeruleoalba		P
Globicephala melas		P-C
REPTILIA		
Caretta caretta		E-P-C

A = Ausias March E = Emile Baudot P = Palos seamount C = Chella Bank
* = Possible species ** = Possible genus and species

Acknowledgments

This work would not be possible without the financial help from Fundación Biodiversidad and La Obra Social de "La Caixa".

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