OVERVIEW OF THE CONSERVATION STATUS OF MEDITERRANEAN ANTHOZOA

María del Mar Otero, Catherine Numa, Marzia Bo, Covadonga Orejas, Joaquim Garrabou, Carlo Cerrano, Petar Kružić, Chryssanthi Antoniadou, Ricardo Aguilar, Silvija Kipson, Cristina Linares, Alejandro Terrón-Sigler, Justine Brossard, Diego Kersting, Pilar Casado-Amezúa, Silvia García, Stefano Goffredo, Oscar Ocaña, Erik Caroselli, Manuel Maldonado, Giorgio Bavestrello, Riccardo Cattaneo-Vietti and Bariş Özalp

MEDITERRANEAN

The IUCN Red List of Threatened Species™ – Regional Assessment

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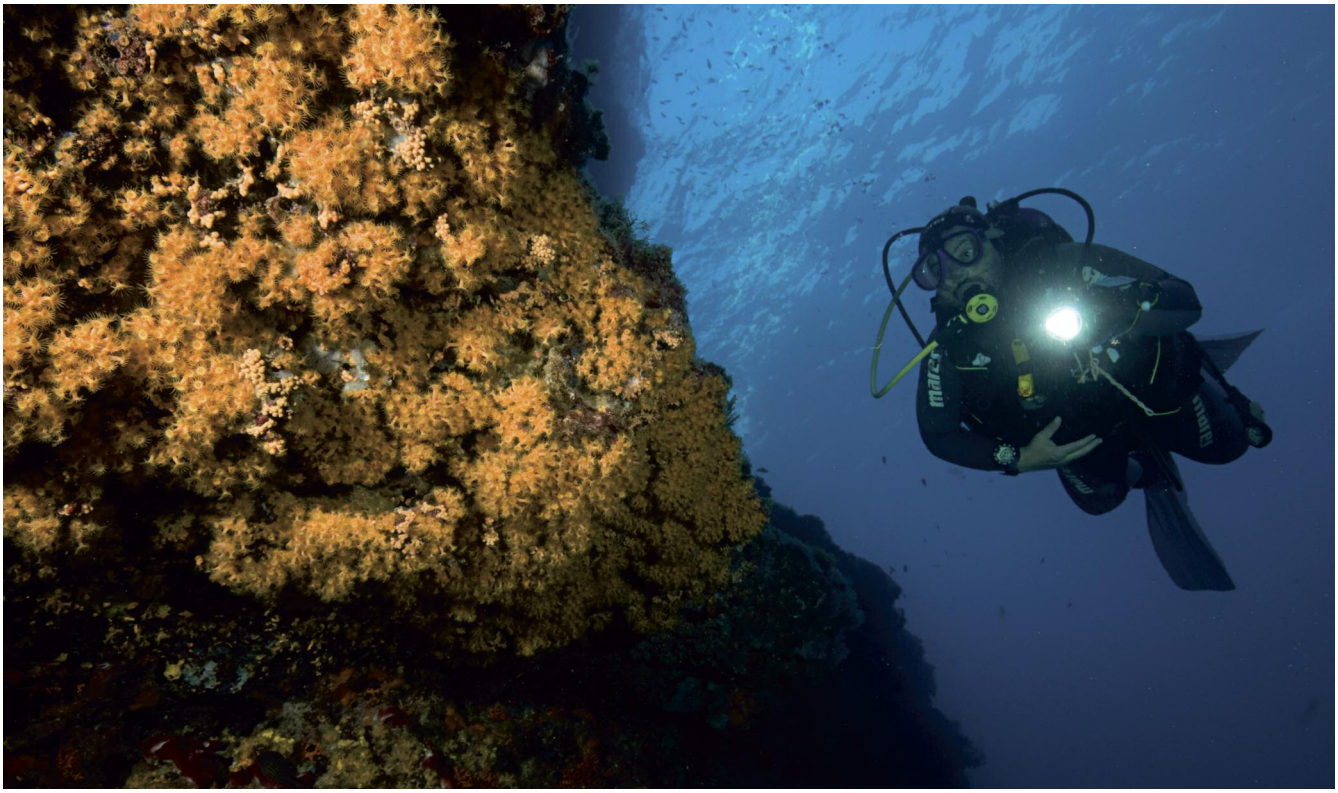


Colonies of *Parazoanthus*. © Jose Elias Cabrera.

Polyps of *Dendrophyllia ramea*. © Jose Elias Cabrera.

Foreword

The Mediterranean basin is home to a high variety of life forms that are found nowhere else on Earth. It is also recognized as a Global Biodiversity Hotspot, an area that besides being extremely rich in biodiversity is also under threat.

In recent decades the region has been put under tremendous pressure due to the growing human population. As a result of coastal development, the overexploitation of natural resources and changing climatic conditions, biodiversity is now highly threatened by habitat loss and degradation. Unsurprisingly, the Mediterranean basin is one of the four most significantly altered biodiversity hotspots in the world.

In a changing environment, it is critical to understand flora and fauna are faring, what the main threats affecting their populations are, and which conservation measures are in place, or should be implemented, to minimize their extinction risk. Assessing the conservation status of species at the Mediterranean level is particularly important to guide and inform regional policy instruments. When done regularly, such assessments help track changes over time such as continuing deterioration or improvements due to conservation action. The IUCN Red List of Threatened Species™ is also an important way to monitor progress towards achieving the new global Sustainable Development Goals, in particular numbers 14 and 15 which seek to halt marine and terrestrial biodiversity loss.

The Mediterranean Red List is a regional initiative focused on assessing the extinction risk of species in the Mediterranean basin. It is in the Mediterranean region that, 10 years ago, IUCN developed its first regional Red List with the support of Fondation MAVA, a successful model that was later replicated in other regions. Many groups have already been comprehensively assessed, namely mammals, amphibians, reptiles, birds, freshwater fishes, marine fishes, crabs and crayfish, dragonflies and butterflies giving a good picture of the status of biodiversity in the region.

Anthozoa constitute a relatively well known group of "flower-like" marine organisms comprising species such as gorgonians, corals and anemones. As for other species groups, the Mediterranean Sea offers a great diversity of Anthozoa with a significant proportion of endemism. Their assessment is the latest addition to the already impressive number of species assessed at this regional level. Adding another invertebrate group also makes an important contribution towards making the Mediterranean Red List more representative of the overall Mediterranean biodiversity.

There are about 150 species within the Mediterranean Sea, of which at least 26 species are endemic. This publication reveals that 13% (24 species) of the 136 species assessed are threatened with extinction, and that 2 of those threatened species are endemic. The main threat to Anthozoans is the damage from various fishing techniques and gears and the resulted bycatch.

However, for more than 50% of the species there was not enough available information to assess their extinction risk, and these species were classified as Data Deficient. Regional cooperation among Mediterranean countries is urgently needed in order to improve the knowledge on the status of marine invertebrate biodiversity, and to minimize their extinction risk throughout the Mediterranean Sea.

I hope this publication will serve as a source of sound scientific data to decision-makers for policy development and management of natural resources, and that it will provide a basis for future conservation work on Mediterranean marine biodiversity. In addition, I hope it will inspire people to learn more about, and care for, these remarkable creatures.

Jean-Christophe Vié
Deputy Director, IUCN Global Species Programme
Director, SOS - Save Our Species Partnership

Foreword

Over last years, the Mediterranean has seen good efforts and commitments on marine conservation, particularly on expanding marine protected areas. Yet today, the Mediterranean Sea is increasingly at risk because of human activities. Among them, the intensifying and mechanical disturbance from fishing activities, marine pollution and litter dumping; expanding coastal populations and developments together with climate change and ocean acidification. These threats accumulate and interact to affect marine species and ecosystems.

The results presented here through the Mediterranean Red List of Anthozoans, makes clear the need of stronger protection measures and provide options and recommendations to address these challenges.

The Mediterranean hosts some of the most sensitive species and ecosystems. Development of spatial management options for the protection of these vulnerable marine ecosystems and some of the most endangered corals and seapens on these areas are one of the major priorities concluded in this assessment.

At the regional level, relevant measures that play an important role include those adopted by the Barcelona Convention and its Protocols as well as the recommendations and resolutions undertaking by the General Fisheries Commission or other international instruments relevant to the conservation and sustainable use of the Mediterranean space and resources within and beyond areas of national jurisdiction. A roadmap for the future conservation of anthozoan species in the Mediterranean needs also effective means for the protection of this natural heritage and bring policies and legislations into practice at the country level.

At the 2016 International Union for the Conservation of Nature's World Conservation Congress, a motion was passed by an overwhelming majority urging protection for at least 30% of each marine habitat in a network of MPAs with the ultimate aim of creating a fully sustainable ocean. Building and strengthen an ecologically representative marine protected area network will be invaluable to achieve this aim and build awareness and understanding of the great value of the Mediterranean anthozoans.

I hope the present work assist to achieve all these aims, advance recovery plans and develop frameworks to prioritise species and sites. Continue working in partnership and through our diverse culture heritage will be the way forward to address the present and future challenges to conserve this treasured marine biodiversity.

Antonio Troya
Director
IUCN Centre for Mediterranean Cooperation

Executive summary

This report presents the conservation status of the anthozoans occurring in the Mediterranean Sea, based on the assessment of 136 species using the IUCN Red List methodology. It identifies those species that are threatened with extinction at the regional level to guide appropriate conservation actions in order to improve their status.

Scope

The geographical scope of this assessment was the Mediterranean Sea, from the Gibraltar Strait to the Marmara Sea. The Black Sea and the adjacent Atlantic waters were not included in this assessment.

Conservation Status assessment

The species conservation status was assessed using the IUCN Red List Criteria (IUCN 2012a) and followed the guidelines for application of IUCN Red List Criteria at regional levels (IUCN 2012b). The assessments were compiled from a group of more than 25 experts of the region, and reviewed during a workshop in Santa Margherita Ligure, in the province of Genoa (Italy).

All the assessments are available on the IUCN Red List website: *http://www.iucnredlist.org/initiatives/mediterranean*

Mediterranean anthozoans

A total of 212 species are known for the Mediterranean Sea based on literature records with 62 considered of problematic taxa as their origin, taxonomic position and/or Mediterranean distribution is uncertain. Of the confirmed 150 anthozoan native species occurring in the Mediterranean Sea, 136 species have been assessed for their risk of extinction. Twenty-six of them are endemic (which means that they are unique to the Mediterranean Sea and are found nowhere else in the world). One hundred and twelve species occur partially in the region. Fourteen taxa which were confirmed as valid species after the assessment workshop were not included in this analysis. Other 62 taxa which were identified as non-native or with a taxonomic status or presence dubious, were also excluded from the analysis.

Results

Overall, about 13% (17 species) of the 136 anthozoans assessed, are threatened in the Mediterranean region and more than half of the species (69 species) lack enough information to estimate their risk of extinction and were classified as Data Deficient. About 7% (10 species) are considered Near Threatened. Six of the 17 threatened species are granted protection under different International Protocols while the fishing of the endangered Red Coral (*Corallium rubrum*) is regulated in some countries.

The orange coral, *Astroides calycularis* in the Alboran Sea. © Mar Otero.

Mediterranean anthozoans are suffering the effects of damage (mostly by-catch) from various fishing techniques and gears, particularly bottom trawling and towed dredges. Commercial collection of some anthozoans also exerts considerable pressure. The increase in seawater temperature due to climate change is having a particularly strong impact on gorgonians and some other coral populations, and mass mortality events have occurred in recent years along the Mediterranean coast. Other important threats such as pollution, increased sedimentation, exotic invasive species, eutrophication and other human disturbance are also affecting the populations.

Recommendations

To reverse the decline of anthozoans in the Mediterranean region urgent conservation actions are needed:

- Increase efficient national and international legal protection to threatened species. This should also include building and strengthening ecologically representative marine protected area (MPA) networks that include deep sea environments with adaptive management programmes.
- Improve threatened species knowledge in order to assess their population trends, distribution and their conservation status. Particularly, knowledge of fishing intensity and possible conservation (and restoration) measures, as well as of the geographical areas of North Africa and Levantine Sea.
- Enhance basic biological research for Data Deficient species and long term monitoring programmes for endemic or near endemic threatened species that help to design and implement conservation actions at local and regional levels.
- Enforce and expand fishing restrictions on bottom trawling and towed dredges as well as designate tools for reducing vulnerable anthozoan species bycatch.
- Take climate change into consideration as well as other major threats. Existing vulnerable sites of large and well-developed populations of threatened anthozoans need to be identified, and adequate measures developed to protect these communities.
- Revise the present management for Red Coral exploitation and adopt a Regional Adaptation Management Plan in all Mediterranean countries to ensure the recovery of shallow populations and the survival of the species. This plan should also increase the efforts to reduce the illegal harvesting of this and other anthozoans currently exploited.
- Ensure that the strong regional cooperation between experts continues, and increase the capacity in countries where information is scarce (particularly North Africa and Levantine Sea area), so that the work carried out to produce the first evaluation of the conservation status of native Mediterranean anthozoans can be updated as new information becomes available.

The red dead man's fingers *Alcyonium palmatum* in the Adriatic Sea. © Petar Kružić.

Chapter 1. Introduction

In September and October 2014, the IUCN Centre for Mediterranean Cooperation, in collaboration with the International Union for the Conservation of Nature (IUCN) Global Species Programme established a regional group of experts to complete an assessment of the conservation status of anthozoans in the Mediterranean region.

A summary of the overall results of these assessments is presented in this report, highlighting the species of greatest conservation concern as well as listing those of lesser concern and those data deficient. It is envisaged that the information contained in this report will help to facilitate the development of priority research, conservation and management actions for the region, as well as to raise awareness on the status of anthozoans species in the Mediterranean Sea.

The class Anthozoa

The phylum Cnidaria, including the hydroids, jellyfish, anemones, and corals, contains approximately 9,000 living species worldwide (Kikuchi *et al*. 2010). Anthozoans (meaning "flower-animals")

Specimens of the gorgonian *Eunicella cavolini*. © Joaquim Garrabou.

constitute a class within this phylum and comprise a relatively well-known group with the familiar hard and soft corals, the gorgonians, the sea pens, the black corals and the anemones.

Anthozoans are widely distributed in all seas of the world from the intertidal to the deep sea. There are between 6,142-7,500 living species (Daly *et al.* 2007; Crowther 2011). Unlike the other classes of cnidarians, anthozoans never produce medusae during their life cycle.

Within the anthozoans, the subclass Octocorallia refers to the colonial species with eight tentacles arranged in a single cycle. It is composed of three orders: the soft corals and gorgonians (order Alcyonacea), the blue corals with calcified skeletons of crystalline aragonite (order Helioporacea) and the sea pens (order Pennatulacea). The latter, with more than 3,000 living species within.

On the other hand, the other subclass, the Hexacorallia, includes anthozoan species that can be solitary, colonial or aggregated. It includes the sea anemones (order Actiniaria), the black corals (order Antipatharia), the tube-dwelling anemones (order Ceriantharia), the corallimorpharians (order Corallimorpharia), the hard or stony corals (order Scleractinia) and the zoanthids (order Zoanthinaria). This subclass currently contains about 4,300 species (Daly *et al*. 2007; Crowther 2011) and the stony corals (order Scleractinia) make up the largest order with more than 1,300 presently recognized species. They are the species primarily responsible for laying the foundations of, and building up, reef structures, mostly in tropical and subtropical seas.

1.1. Status of the world's anthozoan species

Several anthozoan species play a vital role as bio-constructors, creating habitats that act as a shelter for many other organisms and harbour a great biodiversity. The first global IUCN Red List assessment for a group of anthozoans concluded that 32% of 704 reef-building coral species from tropical and subtropical areas were threatened with global extinction. An additional 20% were Near Threatened, and 17% were Data Deficient (Carpenter *et al*. 2008). The declines in their abundance were associated with coral bleaching and disease events driven by elevated sea surface temperatures, with extinction risk further exacerbated by local-scale anthropogenic disturbances.

Unfortunately, this tendency continues, for example, 234 anthozoans (27%) from the 866 species currently assessed are threatened at global level (Critically Endangered, Endangered or Vulnerable) (IUCN Red List 2016).

The results from the present assessment add to the list a number of species also threatened at the Mediterranean level, and the main threats affecting their populations.

1.2. The anthozoan fauna of the Mediterranean Sea: diversity and endemism

The Mediterranean Sea covers an area of about 2.5 million km^2 representing approximately 0.82% of the world ocean surface. It is bordered by 23 states and its coastline extends for around 45,500 km (Sacchi 2011). With an average depth of 1,500 m, it reaches the deepest area at 5,267 m in the Calypso Deep of the Ionian Sea. Today the Mediterranean Sea is known to host more than 17,000 marine species and contributes to an estimated 4-18% of the world's marine biodiversity (Bianchi and Morri 2000; Coll *et al*. 2010).

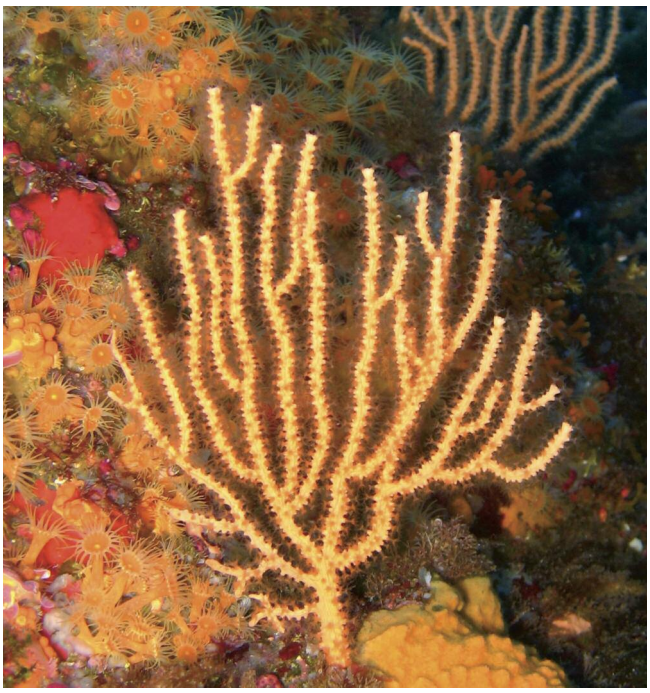
Its present biodiversity can be traced back to its geological history and the diverse biogeographical influences and conditions that allow the co-occurrence of cold, temperature and subtropical species, making the Mediterranean Sea a hotspot for marine biodiversity.

The Mediterranean Sea is the descendant of the ancient Tethys Sea, the equatorial ocean that separated the Eurasian continent to the north from Africa, Arabia, and India to the south, more than 50 million years ago. As most of the Tethys disappeared with the tectonic drift of the continents towards the north, a single oceanic outlet to the Atlantic Ocean via the Strait of Gibraltar separating modern Spain from Morocco was formed thereafter. This connection between the Atlantic basin and the Mediterranean closed approximately 5.96 million years ago, cutting off the proto-Mediterranean's oceanic water supply and triggering what is known as the Messinian salinity crisis with the drying up of almost the entire basin (Montadert *et al*. 1978; Taviani 2002). This process followed several events of filling, draining, and refilling over a period that consequently led to the survival of only some paleo-endemic species, whereas the rest of the local biota went through a mass extinction.

The subsequent gash created in the Strait of Gibraltar and the discharge of Atlantic waters through this channel into the Mediterranean basin and eventually through the Strait of Sicily, gave origin to the Mediterranean Sea known today with its present biota.

The Mediterranean basin is therefore a complex sea that could be well considered a mosaic of small basins intertwined and connected, yet separated by strong hydrological and geomorphological differences and current fronts that establish the ecological particularities among different sub regions. It is also influenced by a marked seasonality. Surface temperatures range between 11-13°C (with extremes of 4-5°C in the Gulf of Trieste) in winter and 25-30°C in summer, determining cold temperate to warm-temperate conditions in the cold season, and tropical conditions in the warm one. Deep-water temperature is relatively warm compared to other seas and oceans with an average of 13°C and, normally, this is also the surface temperature in winter, when the basin becomes homoeothermic. The

The rare endemic coral, *Cladopsammia rolandi* in the small volcanic island of Vulcano, off the Tyrrhenian Sea. © Oscar Ocaña.



The endemic gorgonian *Eunicella cavolini* in Scandola Marine Protected Area, Corsica. © Cristina Linares.

summer thermocline, which is the transition layer between the warmer mixed water at the surface and the cooler deep water below, also divides the surface waters from the more stable, deep water masses.

The Mediterranean marine fauna and flora is consequently a combination of some relicts (paleo-endemic species) of the Tethys Sea and those species of Atlantic origin (the majority, about 60%), of boreal or subtropical origin, having entered through Gibraltar from either the African or the European portion of the Atlantic Ocean (Boero 2003; Blondel *et al.* 2010). In more recent times, an additional group of species entered the Mediterranean Sea through the Suez Canal connecting the species from the Red Sea or through other means (e.g. maritime transport).

Endemism is as high as 18%, with species of both boreal and subtropical origin. The compartmentalization of the sea into fairly isolated sectors together with the past strong fluctuations of seawater temperature and salinity, and the cyclical interruptions of gene flow through Gibraltar over geological time scales are probably the reasons for the high level of endemism (Table 1).

Table 1. Anthozoan orders included in the Mediterranean regional assessment.

Subclass	Order	Number of species	Number of endemic species
Octocorallia	Alcyonacea	38	5
	Pennatulacea	10	1
Hexacorallia	Actinaria	33	9
	Antipatharia	5	0
	Ceriantharia	3	1
	Corallimorpharia	1	0
	Scleractinia	32	2
	Zoanthinaria	14	8

1.2.1. Soft corals and gorgonians (class Anthozoa, order Alcyonacea)

The alcyonaceans (orders Alcyonacea and Gorgonacea, now combined under the single name Alcyonacea) are a morphologically diverse group made up of at least 38 species from 11 families, with only four endemic species in the Mediterranean Sea. Most species are predominantly colonial, found at shallow and deep waters, but the group contains some rarer shallow water octocorals. Species in the Plexauridae, Gorgoniidae, Coralliidae and Ellisellidae families are the best documented, primarily because of their larger form, but also because they are most abundant in coralligenous assemblages or forming dense aggregations from the infralittoral waters to bathyal Mediterranean environments.

The Paralcyoniidae is only represented by the soft coral *Paralcyonium spinulosum* in Mediterranean waters, and *Acanthogorgia armata* is the only species from the family Acanthogorgiidae, with a distribution restricted within the Alboran Sea.

Most of the alcyonaceans from the genera *Acanthogorgia*, *Clavularia* and *Swiftia* are species of deep waters, while other species within the Plexauridae for example, range throughout shallow shelf waters to the upper continental slope above 200 m, and are widespread in the Mediterranean basin. Many of the alcyonaceans from this group are important architectural components of the coralligenous assemblages, increasing their biodiversity and complexity. Among them, the soft corals *Alcyonium acaule* and *A. palmatum* (family Alcyoniidae) can be considered the most abundant in the Mediterranean Sea (Gili and Ballesteros 1991). *A. acaule* is one of the key ecosystem engineers in the Mediterranean coralligenous and circalittoral communities and another species, *Alcyonium digitatum,* of Atlantic-Mediterranean distribution, can also form dense aggregations on infralittoral rocky environments.

Viminella flagellum is another Atlantic-Mediterranean species living in temperate and subtropical waters. This whip coral together with *Ellisella paraplexauroides*, are the only two Mediterranean components of the Family Ellisellidae. They may form dense monospecific aggregations, but they have also been recorded in mixed assemblages with other alcyonaceans such as *Callogorgia verticillata, Swiftia pallida* and several species of Eunicella or

Mediterranean gorgonian forest. © Frhojdysz | Dreamstime.com.

the endemic *Paramuricea macrospina*, whose bathymetric range can span from 40 to 1000 m depth (Giusti *et al*. 2012).

Gorgonian forests constitute one of the most emblematic Mediterranean marine communities, showing a high diversity and great structural complexity. Their conservation is crucial to maintaining the biodiversity that they harbor. Several gorgonian species, such as the Red Gorgonian *Paramuricea clavata*, the White Gorgonian *Eunicella singularis*, the Yellow Gorgonian *Eunicella cavolini* (family Plexauridae) or the Red Coral *Corallium rubrum* (family Corallidae) can develop dense forests and are key species in the maintenance of the biomass and the structural complexity of the Mediterranean communities that they inhabit (Ponti *et al*. 2014). *Eunicella* species such as *Eunicella gazella* and *E. labiata* are examples of species of subtropical affinity from north-western Africa (Ocaña *et al*. 2009; Zenetos *et al*. 2010).

Paramuricea clavata, on the other hand, is a temperate species that can be found from 10 m to 200 m, in locations subjected to strong currents (Gori *et al*. 2007), and it is widely distributed in the western basin of the Mediterranean Sea, in the Adriatic Sea and in some areas of the Aegean Sea, as well as in the neighboring Atlantic Ocean.

As with other anthozoans, taxonomic revision is ongoing and new records of soft corals are increasing the Mediterranean list of Alcyonacea. Examples of these are the recently reported soft coral *Nidalia studeri* (family Nidaliidae) as a new endemic species from the north-western Mediterranean (López-González *et al*. 2012) and the new genetically identified bamboo corals *Acanella arbuscula* and *A. furcata* (family Isididae), first identified macroscopically as *Isidella elongata* (Heestand Saucier and France 2016) from the western Mediterranean and the eastern Ionian Sea.

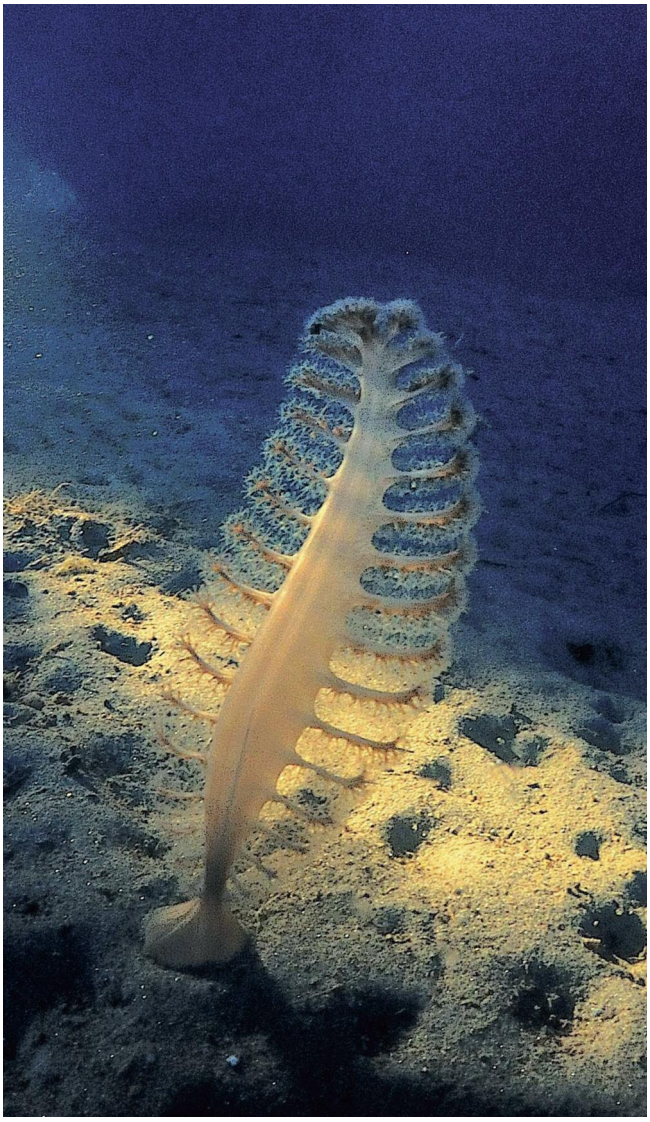
1.2.2. Sea pens (class Anthozoa, order Pennatulacea)

All species within the order Pennatulacea are commonly known as sea pens, due to fact that many of them have a feather-like shape that resembles old quill pens. Pennatulaceans are found worldwide, from subtidal to hadal zones, and are the most common representatives of not only soft corals but anthozoans in soft bottoms.

Eleven species of sea pens are known to occur in the Mediterranean Sea: *Veretillum cynomorium*, *Cavernularia pusilla*, *Kophobelemnon stelliferum*, *Funiculina quadrangularis*, *Virgularia mirabilis*, *Pennatula rubra*, *P. phosphorea*, *P. aculeata*, *Pteroeides spinosum*, *Crassophyllum thessalonicae* and *Protoptilum carpenteri*, which was only recently discovered in the Mediterranean basin. With the exception of *C. thessalonicae*, which is a Mediterranean endemic, all of the sea pens listed are Atlantic-Mediterranean species. The validity of two species (*Pteroeides griseum* and *Kophobelemnon leuckarti*) is under debate and several scientists consider them to be synonyms of other Mediterranean species of the same genera.

Pennatulaceans, together with bamboo corals (family Isidiidae), are very important for forming forest-like habitats on soft bottoms. These habitats are considered key sites of aggregation for biodiversity, which also support a high abundance of species of commercial interest. Important aggregations of *F. quadrangularis* have been found in the Sicilian Channel, the Adriatic Sea, the Gulf of Lion, the Algerian waters or the Balearic Islands, while *Pennatula* spp. and *Pteroeides spinosum* are abundant in several spots, including on or around seamounts in the Alboran and Tyrrhenian seas.

As a result of recent deep-sea research projects and oceanographic expeditions, valuable information is becoming available about the distribution of sea pens around the Mediterranean Sea, revealing clearer patterns of species preferences for bottom type and depth, as well as species associations:



The sea pen *Pteroeides spinosum* at 54 m depth in Palmi, Calabria, Italy. © Francesco Pacienza.

- *K. stelliferum* normally lives on muddy bottoms below 400 metres. It can occur in large aggregations on deep bottoms, and also appears mixed with *Isidella elongata* or, in some cases, *Funiculina quadrangularis* and *Pennatula phosphorea,* which can also be found in these mixed aggregations.

- *Veretillum cynomorium* is more commonly found on sandy and detritic beds –even mäerl and cobble beds– in shallower areas.

- *Virgularia mirabilis* and *Funiculina quadrangularis* inhabit both sandy and muddy bottoms over a wide depth range, although *F. quadrangularis* has a much deeper distribution and is more common on compact muds in bathyal zones.

- *Cavernularia pusilla* can live in coarse detritic bottoms, mäerl beds and even among rocks in circalittoral and bathyal zones.

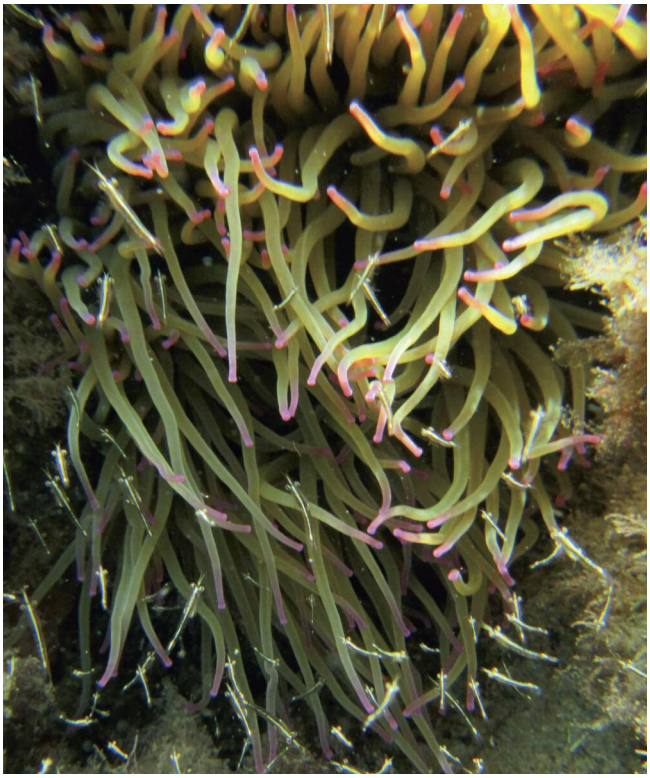
- *Pteroeides spinosum* and *Pennatula* spp. may be widely distributed, *Pennatula rubra* and *Pteroeides spinosum* are more abundant in shallow waters, while *P. aculeata* and especially *P. phosphorea* prefer deeper, muddy bottoms.

- The rare *Crassophyllum thessalonicae* appears to be found predominantly in shallow waters.

- To date, *Protoptilum carpenteri* has only been found in muddy bathyal bottoms, in a few locations in the western and central Mediterranean Sea.

- Mixed pennatulacean forests of *Pennatula* spp., *Pteroeides spinosum* and *Veretillum cynomorium* can also be found.

1.2.3. Sea anemones (class Anthozoa, order Actiniaria)



The sea anemone *Anemonia viridis* in coastal rocks. © Mar Otero.

Records of sea anemone species for the Mediterranean Sea are scattered in diverse studies, dealing with taxonomy, biological interactions and also a few descriptions of symbiotic associations, mostly with crustaceans.

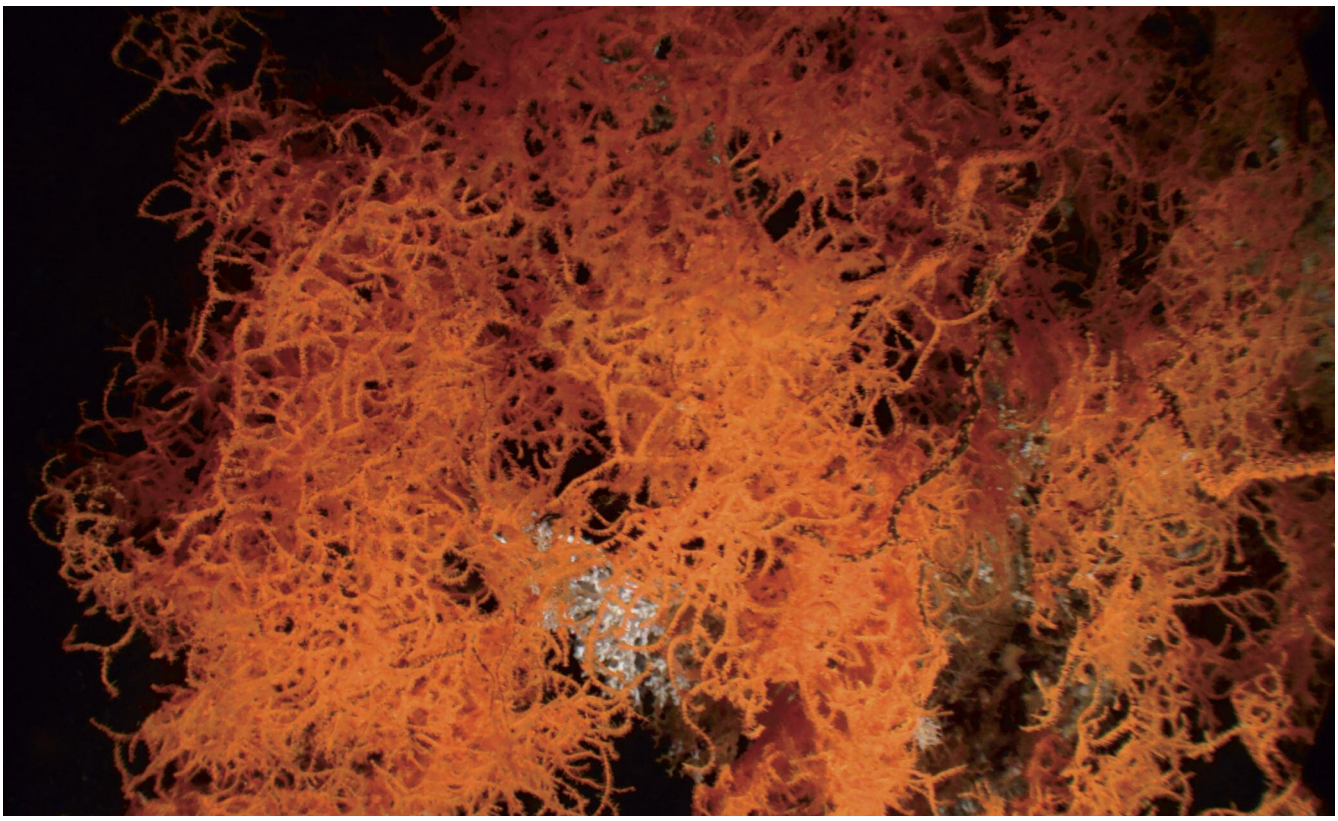
Twenty-one shallow water species of sea anemones are known to occur along coastal environments in the Mediterranean basin with a few of them recently reported in the Alboran Sea (Ocaña *et al*. 2015). Actinarians inhabit deep waters and shallow environments among seagrass meadows and rocks, in sandy sediment with pebbles and gravels, attached to rocks, algae or other species like crustaceans, in lagoons, bays or open coasts. Within this group there are at least seven known endemic species.

The most well-known representatives of this group are species that can live in association with mysid shrimps, brachyuran crabs and fishes such as *Anemonia viridis* or *Condylactis aurantiaca* (Patzner 2004; Wittmann *et al.* 2014, references herein). Specific associations are formed also among hermit crabs and small anemones such as *Adamsia palliata* and *Calliactis parasitica*. Most of them have an Atlantic-Mediterranean distribution, while others, such as *Diadumene lineata*, are cosmopolitan.

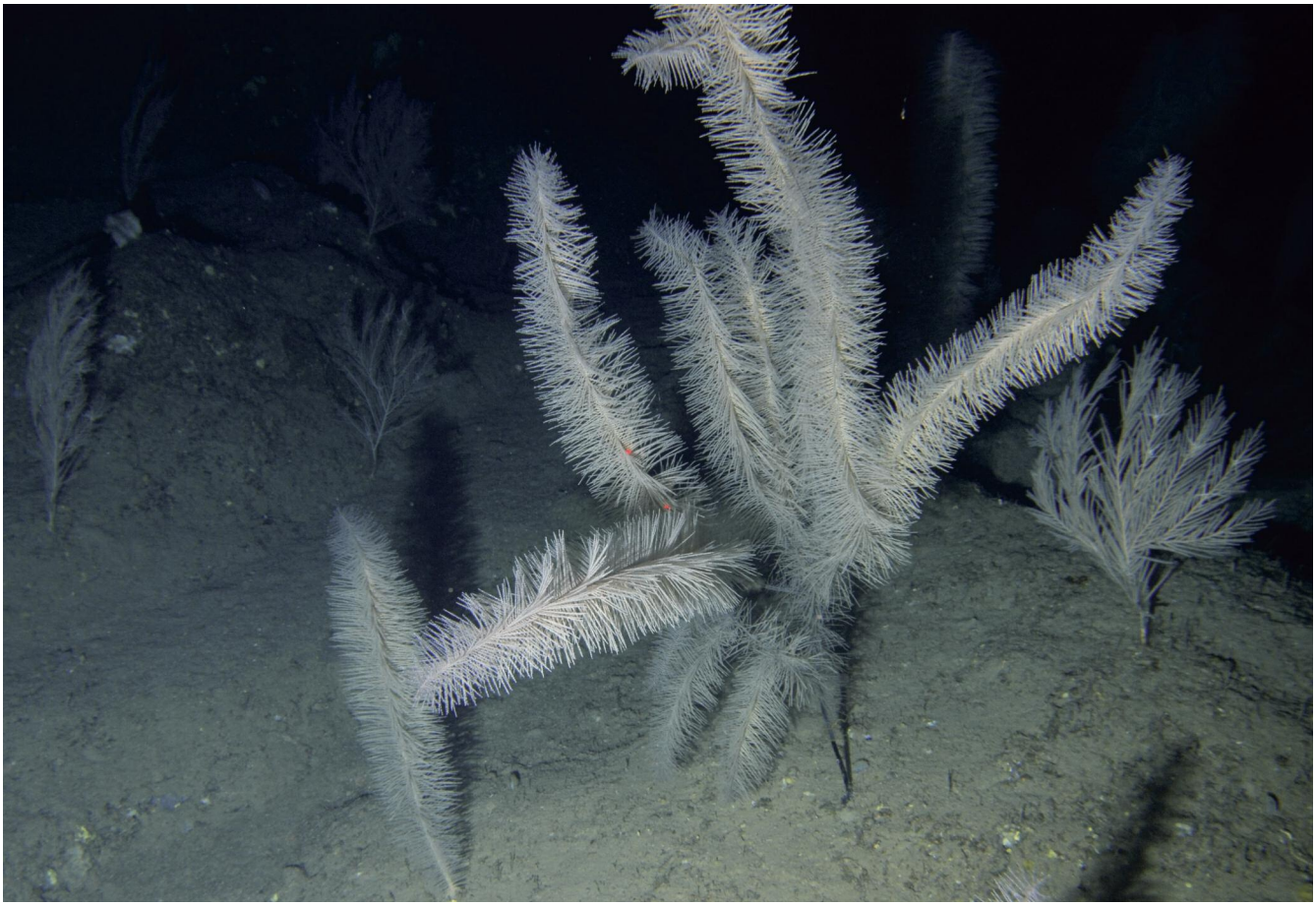
1.2.4. Black corals (class Anthozoa, order Antipatharia)

Antipatharians, commonly known as black corals, have been recognized in the last decade among the most important anthozoan components of Mediterranean deep coral gardens. Thanks to their large tree-like colonies –they are considered *ecosystem engineers*– structure-forming species able to create complex three-dimensional habitats promoting high levels of biodiversity and ecosystem functioning (shelter, nursery, secondary substrate for colonization and settlement for other species) (Bo *et al*. 2015). Their patchy distribution and limited larval dispersal ability, together with their slow growth rates, emphasize the fragility of these species and highlight the potential impacts that localized anthropogenic events may have on these unique Mediterranean resource communities.

Nowadays, six species of black corals have been described for the Mediterranean Sea: *Antipathes dichotoma*, *Antipathes*



Black coral, *Leiopathes glaberrima* in the Sea Mount of Seco de Olivos, Almeria, Spain. © OCEANA.

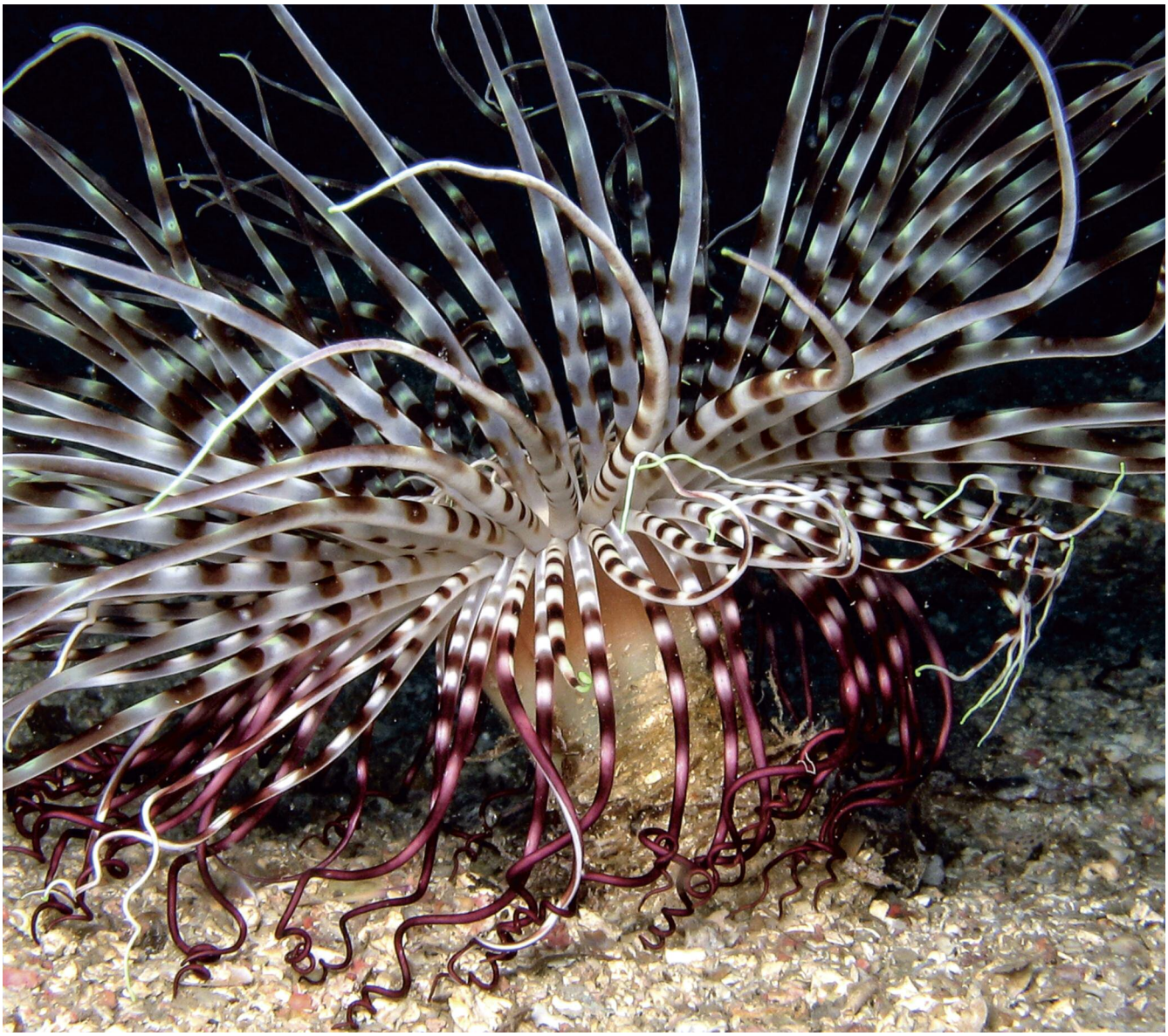


Parantipathes larix from Montecristo shoal (Tuscany, Italy). © Marzia Bo (UNIGE) & Simonepietro Canese (ISPRA).

fragilis, *Parantipathes larix*, *Leiopathes glaberrima*, *Antipathella subpinnata* and *Antipathella wollastoni*. Of these species, two species are lacking information about their Mediterranean population. *A. wollastoni* has been reported, so far, only in shallow waters in the proximity of the Gibraltar Strait (Ocaña *et al*. 2007) and is likely to be distributed only in the Alboran Sea, while *A. fragilis*, whose holotype has been lost, has never been reported again and may be considered taxonomically doubtful. The other four species, are widely distributed in the western Mediterranean basin including the Ionian Sea and, at least *L. glaberrima*, also in the Levantine area. In terms of abundance, *A. subpinnata* is by far the most common black coral species in the basin (Bo *et al*. 2011). These species are found on flat or gently sloping rocky hardgrounds subjected to moderate current conditions and variable silting conditions and, when aggregating into large forests, they are inhabited by a large variety of sessile and vagile organisms, for shelter or food.

1.2.5. Tube-dwelling anemones (class Anthozoa, order Ceriantharia)

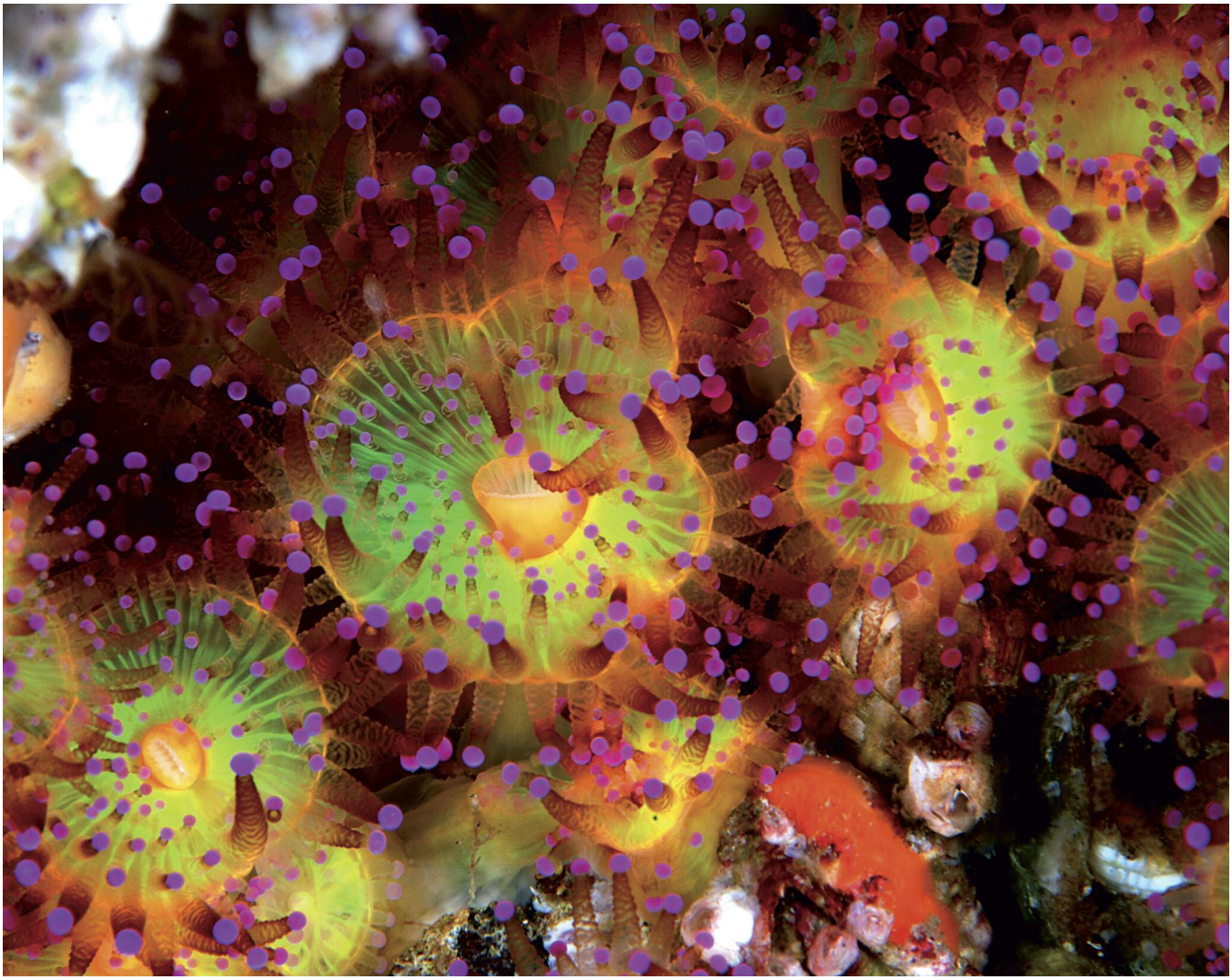
Three cerianthid species, also called 'tube anemones', from the Arachnatidae and Cerianthidae families are known in the Mediterranean Sea. All of them live primarily in soft sediment bottoms of shallow or intermediate waters and sometimes, like in the case of the endemic, although taxonomically debated, *Arachnanthus oligopodus*, can form extensive fields in some sandy areas. Detailed taxonomic studies about cerianthid species in the Mediterranean and biological and ecological information of the species are scarce, and some studies are currently ongoing to determine the number of species in the region.



The cerianthid *Cerianthus membranaceus*. © Gasparij | Dreamstime.com.

1.2.6. Corallimorpharians (class Anthozoa, order Corallimorpharia)

Corynactis viridis is the only jewel anemone (corallimorpharian) confirmed for the Mediterranean Sea (Bell 2001). Another species, the deep *Sideractis glacialis*, is still under taxonomic debate as it has been cited only once in the Mediterranean (den Hartog *et al*. 1993). The species *C. viridis* may form dense aggregations of separate individuals that occasionally may cover large areas of hard substrate and is often found on wrecks, occasionally in brackish waters. The group is known to successfully compete for space with other anthozoans, such as scleractinians.



The Jewel Anemone *Corynactis viridis*. © OCEANA/Sergio Gosálvez.

1.2.7. Hard or stony corals (class Anthozoa, order Scleractinia)

Stony corals (or scleractinians) are the second largest group of anthozoans in the Mediterranean Sea with at least 33 native species from eight families. They are a regular component of the benthic fauna of the Mediterranean basin and several taxa act as primary engineers of extensive carbonate constructions from shallow to deep waters, most of them on the continental shelf or along the margins of canyons.

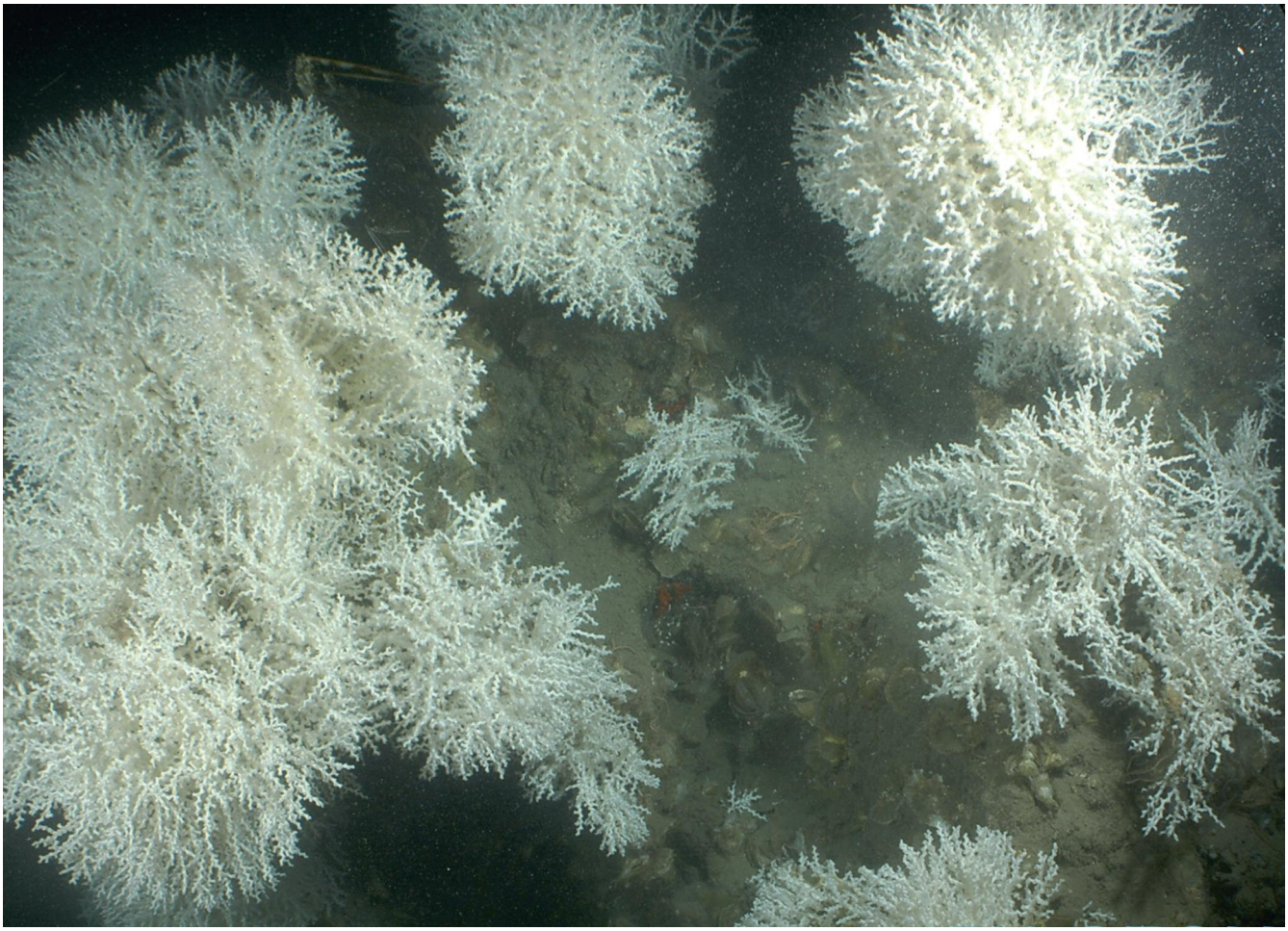
Both zooxanthellate and azooxanthellate hard corals (living in symbiosis with unicellular algae called zooxanthellae, or not, respectively) are found in the benthic fauna of the Mediterranean basin. *Cladocora caespitosa* (family Scleractinia incertae sedis) is the only Mediterranean zooxanthellate colonial coral that can form bioconstructions as reefs (Zibrowius 1980). Another congeneric species that has recently been discovered in the Scandola Marine Reserve of Corsica, *Oulastrea crispata* is thought to be a non-indigenous species of Indo-Pacific origin that may have reached the Mediterranean Sea by ship, either as a fouling organism or in larval stage in ballast waters (Hoeksema and Ocaña 2014).

Other scleractinian shallow water corals characteristic of the Mediterranean Sea, such as *Astroides calycularis* (family Dendrophylliidae), can act as secondary bio-constructional species and contribute to an increase in habitat complexity and surface topography, promoting biodiversity (Terrón-Sigler 2015). The endemic *Balanophyllia europaea* is an abundant solitary coral present in shallow waters in some Mediterranean regions (Goffredo *et al*. 2002).

Deep-water corals (including stony corals, but also gorgonians, black corals and seapens) are widely distributed within the earth's oceans, with large reefs in the far north-western and eastern Atlantic Ocean, as well as in the tropics in places such as off Florida. In the Mediterranean Sea, the principal coral species that contribute to reef formation are *Lophelia pertusa* (family Caryophylliidae and recently suggested to belong to the genus *Desmophyllum*, Addamo *et al*. 2016), *Madrepora oculata* (family Oculinidae*), Desmophyllum dianthus* and *Dendrophyllia cornigera* (family Dendrophylliidae). The latter, together with its congeneric, *D. ramea,* are known as 'yellow and pink corals' respectively and live in the circalittoral zone, especially in the south-western areas of the Mediterranean below 80 m; however, dense deep populations (around 130 m depth) of *D. ramea* have recently been discovered off Cyprus in the Levantine Mediterranean (Orejas *et al*. 2016). This species also occurs in shallower waters in some localities of the Alboran Sea (Terrón-Sigler *et al*. 2015).

The cold water coral communities (CWC) in the Mediterranean Sea are dominated by two azooxanthellate reef forming species*: Lophelia pertusa* and *Madrepora oculata* with the dominance of *Madrepora* on most of the locations discovered up to date. They are usually found below the photic zone at depths between 190 and 1,000 m where they can build large three-dimensional structures (Freiwald *et al*. 2009).

Deep sea corals are important for Mediterranean biodiversity. The reefs play a key structural and functional role in the continental shelves and slopes providing various biogenic microhabitats (within, on and surrounding colonies), either formed by the live coral species or by their remains after death (Freiwald *et al*. 2009; Mastrototaro *et al*. 2010). Commercial species like the Blackspot Seabream *Pagellus bogaraveo*, the deep-water Rose Shrimp *Parapenaeus longirostris* or the Conger Eel *Conger conger*, have been found associated with these coral habitats, often at higher abundance than in nearby areas (D'Onghia *et al*. 2010, 2012).



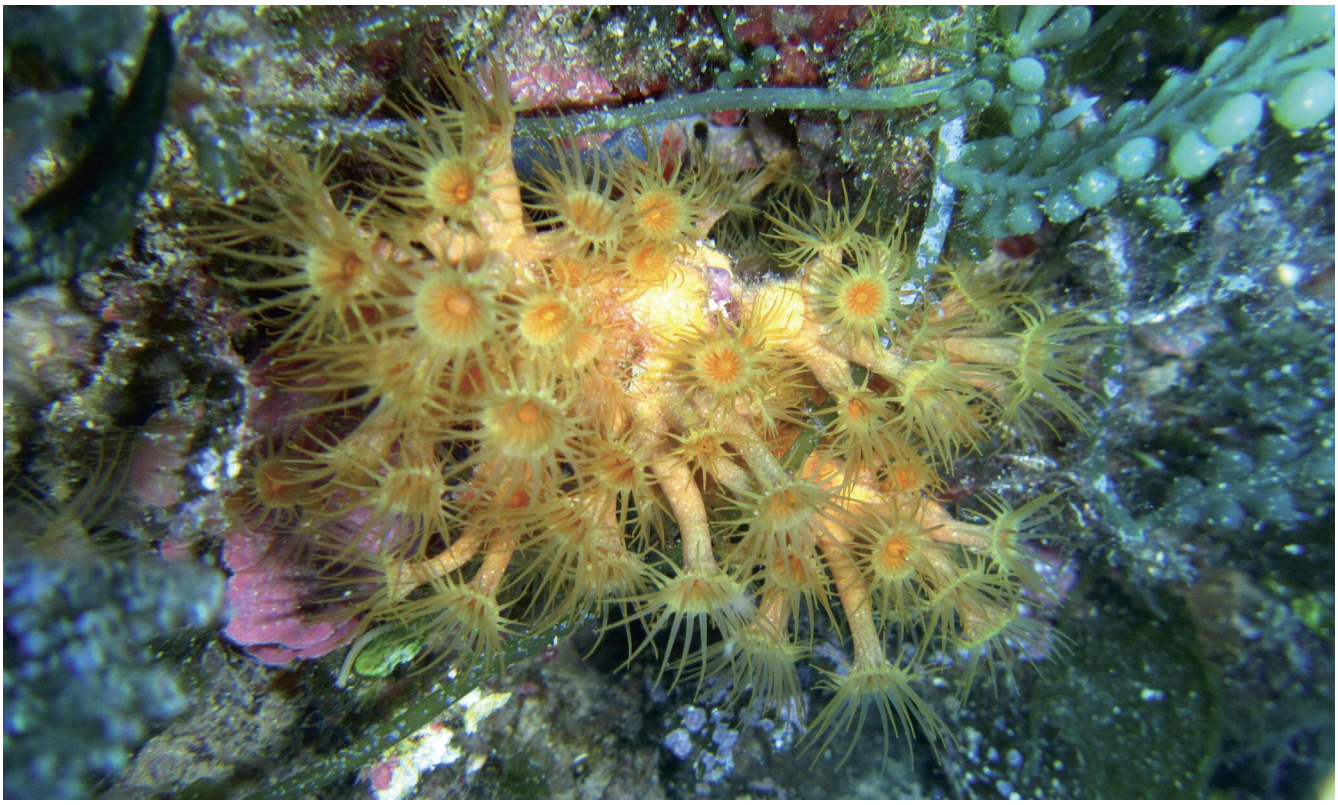
Madrepora oculata cold-water reefs are found from the continental shelf to bathyal zones, mostly in canyons and seamounts or rocky promontories, like this in Cap de Creus, Spain. © IFM-GEOMAR/ICM-CSIC.

1.2.8. Zoanthids (class Anthozoa, order Zoantharia)

The last order, the order Zoantharia, includes both solitary and colonial forms and most of them do not secrete hard skeletons. The zoanthinarians that have been described from the Mediterranean Sea include at least 14 species belonging to two families, the Parazoanthidae and the Epizoanthidae.

The yellow cluster anemone *Parazoanthus axinellae* is probably the most common Mediterranean species within the Parazoanthidae family, usually found forming encrustations of variable thickness and shape over the sponges *Axinella* spp. or attached to coralligenous rocks. Another remarkable species within this group is the gold coral, *Savalia savaglia*, the largest of this group of species. With a tree-like morphology similar to that of gorgonians, this parasitic species is able to form facies with gorgonians that can have a significant role in benthic assemblages due to their relatively long life span (Cerrano *et al*. 2010).

Epizoanthus species from the Mediterranean are, on the other hand, largely unknown; very few studies have been carried out on Mediterranean species and identification remains challenging due to the intraspecific plasticity and lack of research on their biogeography and biology. These species that look like sea anemones, are mostly known to colonise rocky shores, overhangs, artificial substrates, and can also be found attached to other sessile invertebrates, particularly on the shell of hermit crabs (Ates 2003).



Parazoanthus axinellae, the yellow cluster anemone. © Mar Otero.

1.3 Objectives of the regional assessment

The main objective of this regional assessment was to evaluate the risk of extinction of the native anthozoans present in the Mediterranean region using the IUCN Red List Categories and Criteria by:

- developing a network of regional experts to enable species assessments and provide expert opinion on policy and management recommendations, and;
- providing support to regional and national planning initiatives, and policy processes for the conservation of Mediterranean anthozoans with comprehensive species factsheet reports informing on their current status.

The main outputs presented in this report are:

- a summary of the status and distribution of, and main threats to Mediterranean anthozoans;
- a series of recommendations for the future conservation of Mediterranean anthozoans and their habitats.

Chapter 2. Methodology

2.1. The IUCN Red List of Threatened Species

The IUCN Red List of Threatened Species™ (IUCN Red List) is widely recognized as the most comprehensive, scientifically-based source of information on the global conservation status of plant and animal species. IUCN Red List Categories (Figure 1) and Criteria are applied to individual species assessments (which contain information on aspects such as biology, ecology and life history, distribution, habitat, threats, current population trends and conservation measures), to determine their relative threat of extinction. Threatened species are listed as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). Taxa that are either close to meeting the threatened thresholds, or would be threatened were it not for ongoing conservation programmes, are classified as Near Threatened (NT). Taxa evaluated as having a relatively low risk of extinction are classified as Least Concern (LC). Also highlighted within the IUCN Red List are taxa that cannot be evaluated due to insufficient knowledge, and which have therefore been assessed as Data

Expert participants at the Mediterranean anthozoans Red List workshop, September-October 2014, Santa Margherita Ligure, Italy.
© IUCN/C. Numa.

Deficient (DD). This category does not necessarily mean that the species is not threatened, only that its risk of extinction cannot be assessed from current data (IUCN 2012a).

IUCN Red List assessments can be used as a tool for measuring and monitoring changes in the risk of extinction of the anthozoan biodiversity and the present knowledge of the individual taxa. They are an essential basis for providing targets for management priorities, and for monitoring the long term success of management and conservation initiatives.

2.2. The IUCN Mediterranean biodiversity assessment initiative

The present regional assessment for the Mediterranean region not only evaluates the conservation status of this taxonomic group at the regional level, but also contributes to their more comprehensive assessment at the global level. One species can have a different category in the Global Red List and a Regional Red List. For example, a species that is common worldwide and classed as Least Concern (LC) in the Global Red List could face a high level of threat and fit the Endangered category (EN) in a particular region. Following the same rationale, an endemic species should have the same category at regional and global level, as it is not present in any other part of the world (IUCN 2012a).

2.3. Geographic scope

The geographical scope for this report is the Mediterranean Sea, from the Gibraltar Strait to the Marmara Sea. The Black Sea and the adjacent Atlantic waters are not included in this study (Figure 2).

2.4. Taxonomic scope

A total of 212 species are known for the Mediterranean Sea based on literature records. 62 of them are considered problematic taxa as their origin, taxonomic position and/or Mediterranean distribution is uncertain. Therefore a total of 150 species can be conservatively considered, so far, valid taxa and/or valid Mediterranean records. Within this group, 14 species were confirmed as valid species after the assessment workshop (Appendix 2), therefore 136 taxa are those finally assessed. Of these taxa, 112 show an Atlanto-Mediterranean distribution and the remaining 24 are considered endemic. A checklist of all of these regionally assessed species is provided in Appendix 1.

2.5. Data collection, assessment and review

Experts from across the region were identified and information on habitats and ecology, distribution, threats and conservation measures, etc. was sourced and collated for the species selected

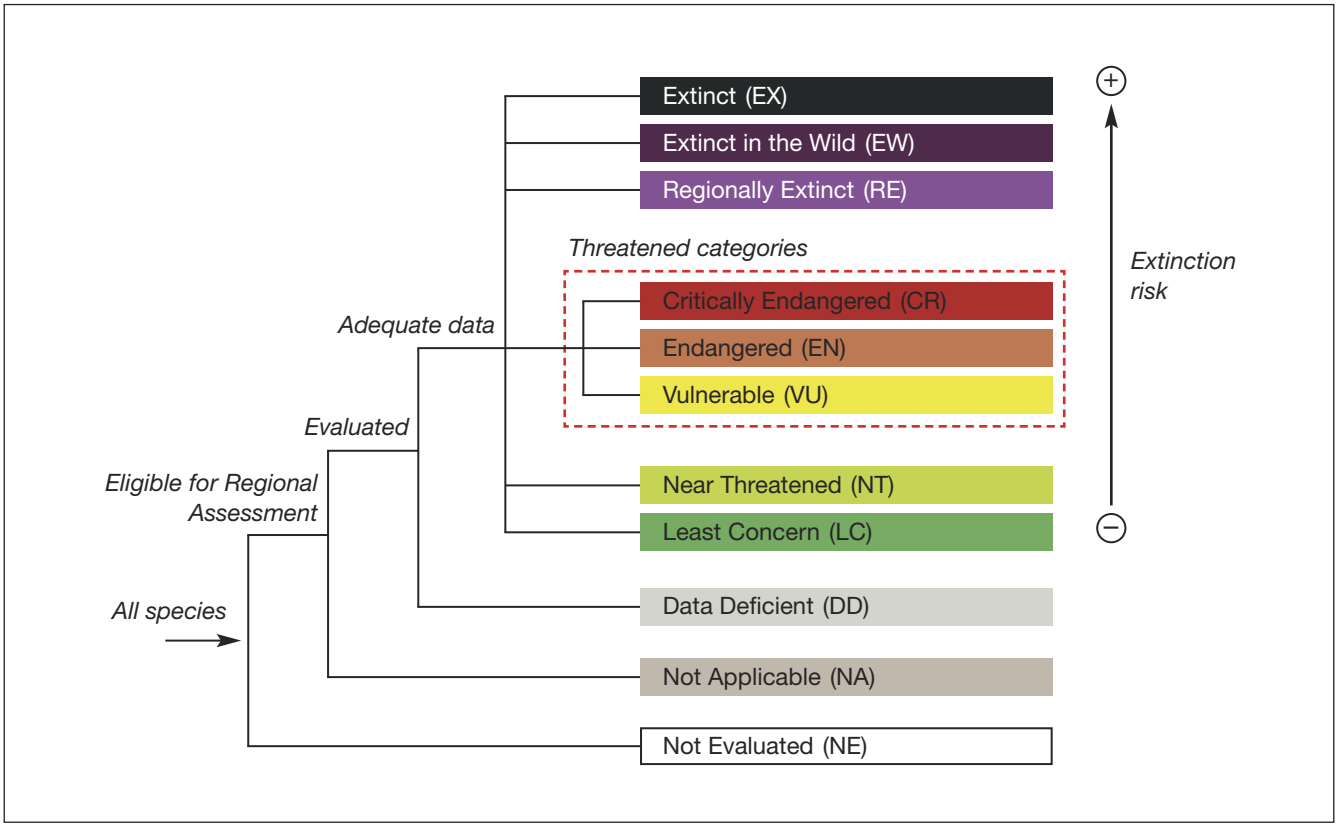


Figure 1. IUCN Red List Categories at the Regional level (IUCN 2012b). For a description of each of the global IUCN Red List Categories visit: http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria.

for assessment in the Mediterranean region. Thereafter, all the relevant and available information on each species was input within the IUCN species database (Species Information Service-SIS). Spatial data was sourced for the production of species distribution maps using Arcview GIS software using expert knowledge and published reports besides scientific literature.

The species information was then reviewed at a regional workshop where each species assessment was evaluated to ensure that the information presented was complete and correct, and that the Red IUCN List category initially identified (Figure 1) had been applied correctly. This workshop was held in Santa Margherita Ligure, Italy, from 29 September to 3 October 2014.

The status of each species with the results from the workshop was assessed according to the IUCN basic Red Listing procedures and documents, including the *Guidelines for Application of IUCN Red List Criteria at the Regional Level* (IUCN 2012b) and *IUCN Red List Categories and Criteria* (IUCN 2012a).

Application of Criteria A

Population size reduction based on the longer of 10 years or three generation lengths

Following the IUCN Red List guidelines and the methodology used for the global assessment of reef-building corals (Carpenter *et al*. 2008), a group of the assessor experts agreed that given the variety and versatility of coral reproduction and life history strategies for Mediterranean species, the colony of the species should be considered as a mature individual, that is, the basic unit of survival. For those non-colonial species or solitary corals (i.e. single polyp), the mature individual was the individual polyp.

To be classified as Critically Endangered, Endangered or Vulnerable (the three IUCN threatened categories) a species needed to undergo a reduction in population size at least over 80%, 50% or 30% respectively over ten years or three generations (or have a very small or small and declining population or geographic range). Under these criteria, A2, A3, and A4, population reduction could be estimated or inferred for different anthozoan species mostly in a decline in the area of occupancy (AOO), the extent of occurrence (EOO) and/or habitat quality. However, given the limited information, particularly on past trends, only few species could be considered under criterion A2 (e.g. *Corallium rubrum*) and most qualified under criterion A3 or A4 with an estimated decline over three generation lengths.

As the information on the generation length of all the species is unknown, a proxy for the different taxonomic groups of species was also agreed at the Red List workshop (Table 2).

Figure 2. The Mediterranean Sea as defined for this project from the Gibraltar Strait to the Sea of Marmara.

Table 2. Estimated generation length of some taxonomic groups occurring in the Mediterranean Sea.

Taxonomic group	Generation length
Alcyonacea	unknown
Gorgonacea	30 years
Pennatulacea	5-10 years
Actinaria	unknown
Antipatharia	20 years
Ceriantharia	unknown
Corallimorpharia	unknown
Ptychodactiaria	unknown
Scleractinia (*)	30 years
Zoanthinaria	Less than 20 years

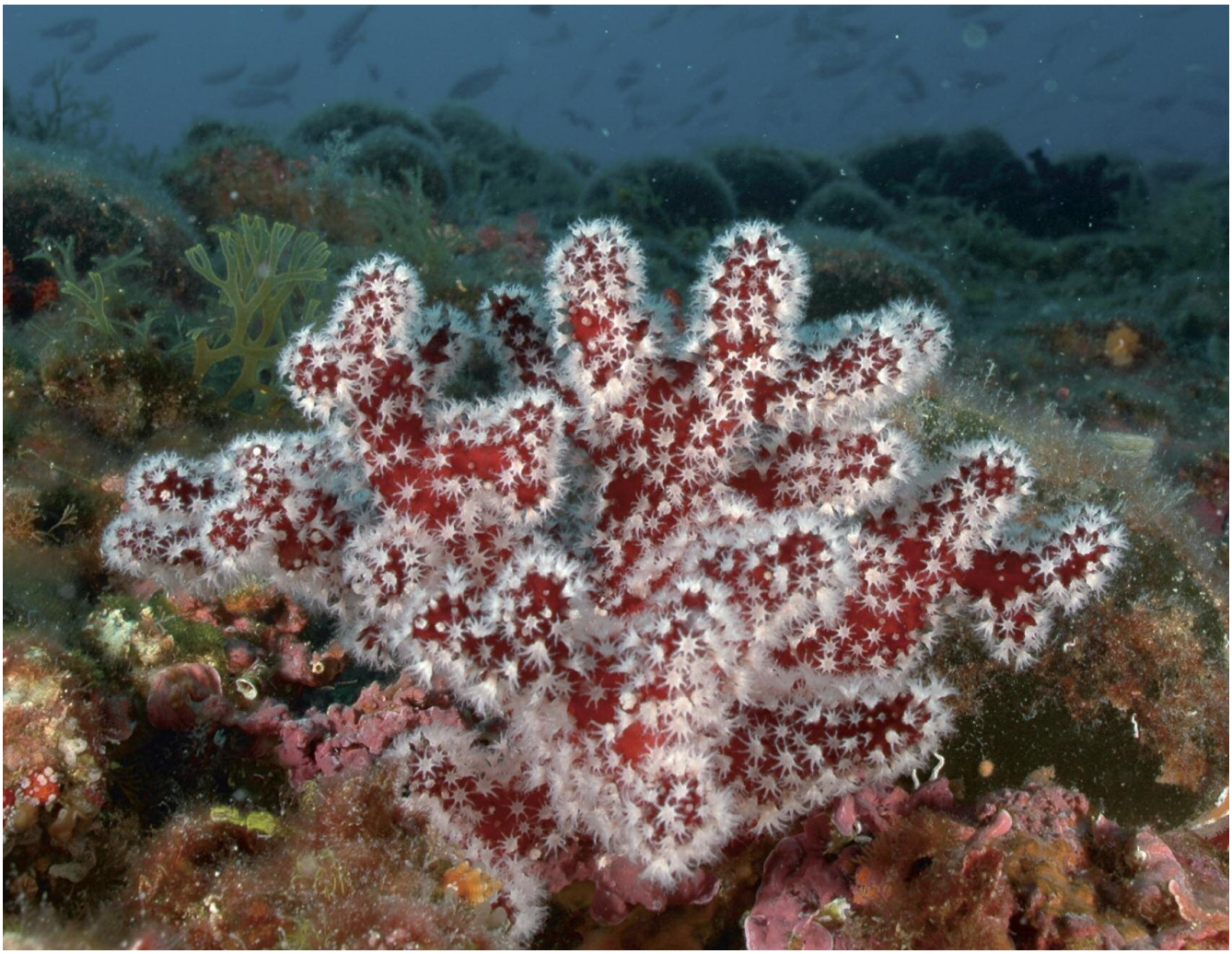
(*) Estimated value only for species present in shallow waters; for intermediate or deep waters, value unknown

The large variability of ecosystems and geomorphology present in the Mediterranean Sea has resulted in some anthozoan species being adapted to live in shallow and in deeper water environments (below the continental platform). For those species, the average age or generation length was considered different for each habitat/depth range.

2.6. Assessment review process

All the Mediterranean anthozoans assessments were finalised by June 2015. Experts from Mediterranean countries as well as from the IUCN Coral Specialist Group were then asked to review the species summary reports using a peer-review methodology. Their comments, together with any additional up-to-date information, were included in the final assessments.

The final regional assessments are the outcome of the entire review process and the agreement between the Mediterranean specialists involved on this process. New information might have come up since then, and it will be used to prepare the updates of these assessments in the near future.



Soft coral *Alcyonium acaule* in Kornati National Park, Croatia. © Joaquim Garrabou.

Chapter 3. Assessment results

3.1. Conservation status of Mediterranean anthozoans

Of the 150 anthozoan native species ocurring in the Mediterranean Sea, 136 species taxonomically valid at the moment of the assessment workshop, have been assessed for their risk of extinction during this work. Fourteen taxa which were confirmed as valid species after the assessment workshop was not included in this analysis (Appendix 2). A further 62 species were excluded from further analysis because they are considered non native to the Mediterranean Sea (four species), they refer to unconfirmed presence reports (27 species) or their taxonomic status is dubious (31 taxa) (Appendix 2).

Out of these, 13% of the assessed species were found to be threatened with extinction (Critically Endangered, Endangered or Vulnerable). It is also worth mentioning that the current proportion of threatened species could be higher as there is a large number of Data Deficient (DD) species with not enough data available. Taking this into account, the actual proportion of threatened anthozoan species in the Mediterranean Sea may lie between 13% (if all DD species are not threatened) and 63% (if all DD species are threatened) in the Mediterranean Sea (IUCN 2011, Table 3). Thus, the mid-point figures provide the best estimation of the proportion of threatened species, which in this case is 25%.

Of the 17 threatened species, one species (0.7%) is listed as Critically Endangered (CR), which is the highest category of threat, nine species (6.7%) are listed as Endangered (EN), and seven species (5.2%) as Vulnerable (VU). A further 10 species (7.4%) were assessed as Near Threatened (NT). On the other side, 40 species (29%) are listed as Least Concern (LC), meaning that for those, there is no immediate risk of extinction, and that population trends do not trigger the criteria for any of the threatened categories (Figure 3, Table 4).

The extent of gaps in the knowledge of Mediterranean anthozoans can be identified by the numbers and proportion of species listed as Data Deficient (DD). This category means that there is not enough data available for these species in the Mediterranean Sea to

Table 3. Proportion of threatened anthozoan species in the Mediterranean region following IUCN guidelines (2011) with the mid-point figure and lower and upper bound figures as a range.

	% Threatened Mediterranean anthozoan species
Lower bound (CR + EN + VU) / (assessed)	**13**
Mid point (CR + EN + VU) / (assessed – DD)	**25**
Upper bound (CR + EN + VU + DD) / (assessed)	**63**

Table 4. Summary of the Red List status of anthozoans in the Mediterranean region. Threatened categories are emphasized in colours.

IUCN Red List Categories	No. native species	No. endemic species
Critically Endangered (CR)	1	0
Endangered (EN)	9	2
Vulnerable (VU)	7	0
Near Threatened (NT)	10	0
Least Concern (LC)	40	3
Data Deficient (DD)	69	21
Not Applicable (NA)	2	0
Total number of species assessed	**136**	**26**

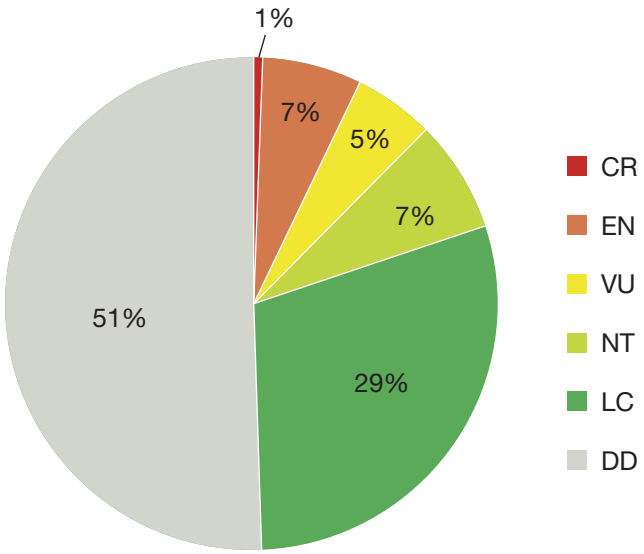


Figure 3. Red List status of anthozoans in the Mediterranean region.

place them in one of the Red List categories although it does not imply that these species are not threatened. The present analysis indicates that 69 species (51%) of Mediterranean anthozoans species were listed as Data Deficient (DD). This relatively high number highlights the strong need for a continued targeted research on these species from which knowledge is very scarce.

3.2. Endemic species

There are 26 anthozoan species assessed (19%) which are endemic to the Mediterranean region (Table 4). Two of them, the sea pen *Crassophyllum thessalonicae* and the anemone *Paranemonia vouliagmeniensis* (Box 1), both from Greece, are threatened with extinction and listed as Endangered while two other species, threatened *Isidella elongata* (Box 2) and *Cladocora caespitosa* (Box 3) are near-endemic threatened species with only few records outside the Mediterranean basin, on the adjacent Atlantic coasts of Morocco and Portugal (Figure 4).

Box 1. The endemic Greek anemone *Paranemonia vouliagmeniensis*

Paranemonia vouliagmeniensis is a sea anemone that occurs only on a small tectonic lagoon, Lake Vouliagmeni, located close to Saronikos Gulf and the city of Athens (Attiki, Greece). The lagoon, formed about 2,000 years ago, has quite unique environmental conditions: it is supplied with warm seawater (28-35 °C) via an underground channel spreading through a network of flooded caves, so its temperature never drops below 18 °C (usually ranges around 21-24 °C), whereas a freshwater spring reduces its salinity to brackish levels (14.5-18 psu). Today, Lake Vouliagmeni has been declared a natural monument by the Greek State and is part of a Natura 2000 site (Ymittos - Aisthitiko Dasos Kaisarianis - Limni Vouliagmenis).

The anemone *Paranemonia vouliagmeniensis* lives exclusively within this lagoon on mixed coarse sediments, rocky bottoms, artificial substrates, or living attached as an epibiont on algae or seagrass meadows. Interestingly, this anemone has two migrations during its life cycle: first, when they are young, individuals migrate to deeper waters to feed and look for shelter to avoid intra-specific competition. Larger individuals then migrate back to the shallows when mature (Chintiroglou *et al.* 1996, 2000).

Because the lake's thermal spring water is rich in hydrogen sulphide, the area has been exploited as a spa since the end of 19th century and currently attracts a large number of visitors (Chintiroglou *et al.* 2008). Regular maintenance takes place in the lagoon that severely affect the species' population; young recruits are either directly killed by the denudation of flora from the bottom of the lake or by increasing mortality due to habitat loss, while larger individuals suffer from trampling. Though the population has not been continuously monitored, a 50% reduction has been inferred to have occurred over the last decade. As a result *Paranemonia vouliagmeniensis* is listed as Endangered and this classification imposes an urgent need for establishing conservation measures for the entire ecosystem of the lake with appropriate regulations on maintenance, reduction of trampling by visitors, and appropriate monitoring of the anemone populations to estimate trends and conservation status.

Paranemonia vouliagmeniensis at Lake Vouliagmeni, Greece. © Vasilis Gerovasileiou.

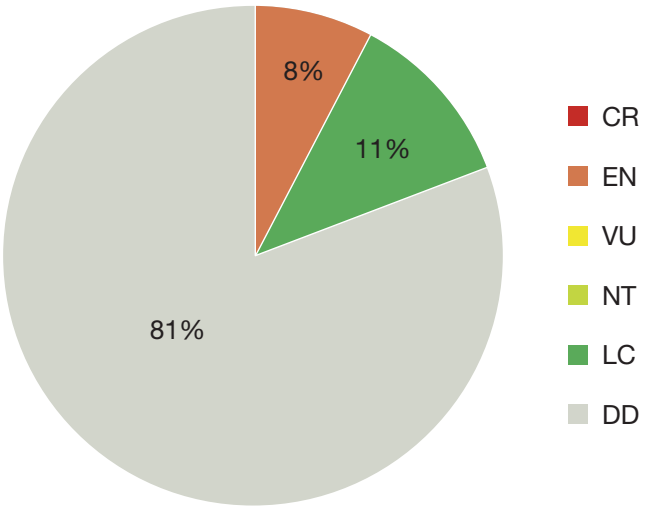


Figure 4. Red List status of Mediterranean endemic Anthozoans.

Critically, 21 of the endemic species are Data Deficient, a proportion of 81%, almost double the proportion of 44% for the non-endemic species (48 non-endemics are Data Deficient, out of 110 total). Unsurprisingly, the endemic species are even more poorly known than more widely distributed species. Endemics are often rarer, have smaller distributions and may be restricted to smaller and more ephemeral or severe habitats compared to more widespread species. These characteristics increase their threat assessment against the criteria of the Red List, so we can expect them to be more threatened than widespread species. Therefore, filling this large knowledge gap on the 21 Data Deficient endemic species is a priority action.

3.3. Threatened species

Seventeen species assessed in this report are threatened, belonging to one of the three IUCN threat categories (Critically Endangered, Endangered and Vulnerable) (Table 5).

Table 5. Anthozoan species listed as threatened at the Mediterranean regional level. Endemic species are those considered native to, and restricted to the Mediterranean Sea.

Family	Species name	Category	Endemic
ISIDIDAE	*Isidella elongata*	CR	
ACTINIIDAE	*Paranemonia vouliagmeniensis*	EN	endemic
CORALLIIDAE	*Corallium rubrum*	EN	
LEIOPATHIDAE	*Leiopathes glaberrima*	EN	
PENNATULIDAE	*Crassophyllum thessalonicae*	EN	endemic
CARYOPHYLLIIDAE	*Desmophyllum dianthus*	EN	
CARYOPHYLLIIDAE	*Lophelia pertusa*	EN	
DENDROPHYLLIIDAE	*Dendrophyllia cornigera*	EN	
SCLERACTINIA incertae sedis	*Cladocora caespitosa*	EN	
OCULINIDAE	*Madrepora oculata*	EN	
ELLISELLIDAE	*Ellisella paraplexauroides*	VU	
PLEXAURIDAE	*Paramuricea clavata*	VU	
FUNICULINIDAE	*Funiculina quadrangularis*	VU	
PENNATULIDAE	*Pennatula rubra*	VU	
PENNATULIDAE	*Pennatula phosphorea*	VU	
PENNATULIDAE	*Pteroeides spinosum*	VU	
DENDROPHYLLIIDAE	*Dendrophyllia ramea*	VU	

The threatened species listed as Critically Endangered is the bamboo coral *Isidella elongata*, a near-endemic species to the Mediterranean Sea, reaching as far as the adjacent Atlantic waters of Gulf of Cadiz to north Morocco and the Canary Islands. Trawling activities, bottom line fishing and pollution, and land based activities that increase sedimentation, are the main threats to bamboo corals.

Nine species (6.6%) are listed as Endangered. These include several scleractinians from the Oculinidae, Faviidae*, Dendrophylliidae and Caryophylliidae families with deep-water and shallow water corals; an endemic anemone (family Actiniidae), the rare sea pen from the Thermaikos Gulf, *Crassophyllum thessalonicae* (family Pennatulidae) and the black coral *Leiopathes glaberrima* (family Leiopathidae). The biology of these species and their distribution range are diverse and they are consequently affected by different anthropogenic factors.

Seven species (5.1%) are listed as Vulnerable including four sea pens (families Pennatulidae and Funiculinidae) from deep and shallow mud habitats, two gorgonians (families Ellisellidae and Plexauridae) that occur on infralittoral and circalittoral bottoms, and a stony cup coral (family Dendrophyllidae) of rocky and coralligenous environments.

3.4. Near Threatened (NT) species

Ten species (7.4%) were assessed as Near Threatened, reflecting concern that they are close to qualifying for a threatened category and could do so in the near future. They include three black corals (antipatharians: *Antipathes dichotoma, Antipathella subpinnata,* and *Parantipathes larix*) that sometimes can be found forming mixed communities; four shallow water gorgonians of the family Plexauridae (*Eunicella* spp.); one zoanthid, the golden coral *Savalia savaglia* (family Parazoanthidae) (Box 4) and the gorgonian *Callogorgia verticillata* (family Primnoidae) frequently observed forming mixed 'coral gardens' with other branched gorgonian species, but especially also with the Near Threatened whip coral *Viminella flagellum* (family Ellisellidae) on seamounts and slopes.

It is essential that these species are monitored closely and, where possible, management actions are taken to avoid that these species become listed as threatened in the future.

3.5. Least Concern (LC) species

Least Concern species, meaning those species not considered to be under any known threat of extinction now or in the foreseeable future, represent only 29% of the anthozoan species assessed in the Mediterranean Sea (40 species). Many of them are generally abundant and/or relatively widespread (as individuals or forming clusters), are not particularly susceptible to fishing or they are well adapted to a wide range of habitats and environmental conditions. Some of them are relatively productive and resilient to other threats and pressures.

However, although the majority of these species are still common in their distribution areas and do not meet the threatened thresholds of the IUCN Red List criteria, they have experienced at least local declines due to threats such as habitat degradation through pollution and increase in sedimentation originating from anthropogenic activities. Therefore, they may still benefit from conservation management action. Examples from these species are included in the groups of the sea anemones (family Actiniidae), soft corals (family Alcyoniidae) or cup corals (family Caryophylliidae).

3.6. Data Deficient (DD) species

More than half of the species assessed are categorized as Data Deficient as quantitative estimates of population sizes and trends and impacts of major threats are lacking. The poor information is often due to scarce research, or because species are (or have become) rare, or have an unknown or poorly known geographic distribution. It is thus possible that some of these Data Deficient species are threatened by anthropogenic threats.

Most of the Data Deficient species have Mediterranean (28%) or Atlantic-Mediterranean distributions (48%). Research focusing on species for which there is currently little knowledge must therefore be increased, as some of these species may be amongst the most threatened. It is therefore essential to direct research effort and funding towards these species as well as those in the threatened categories. This is particularly important when there are apparent threats yet virtually no available data on population sizes or biological parameters.

3.7. Patterns of species richness

Anthozoans distribution in the Mediterranean Sea is not homogeneous. The highest species richness is found in the western Mediterranean including the north Alboran Sea, Balearic Islands, the Catalan coast, reaching the Gulf of Lion, the Ligurian Sea with Corsica, the southern Tyrrhenian Sea, the western Adriatic Sea and the northern Aegean Sea (Figure 5). This geographical gradient (north-west to south-east decrease in species numbers) can be partially related to the gradient of production as nutrient concentrations decrease from the West to the East of the Mediterranean Sea resulting in variations in the structure of the food webs. Exceptions to this pattern can be related to the availability of coastal rocky substrata where many anthozoans live or the highly eutrophic conditions found in some regions.

* Nomenclature revision is still in progress.

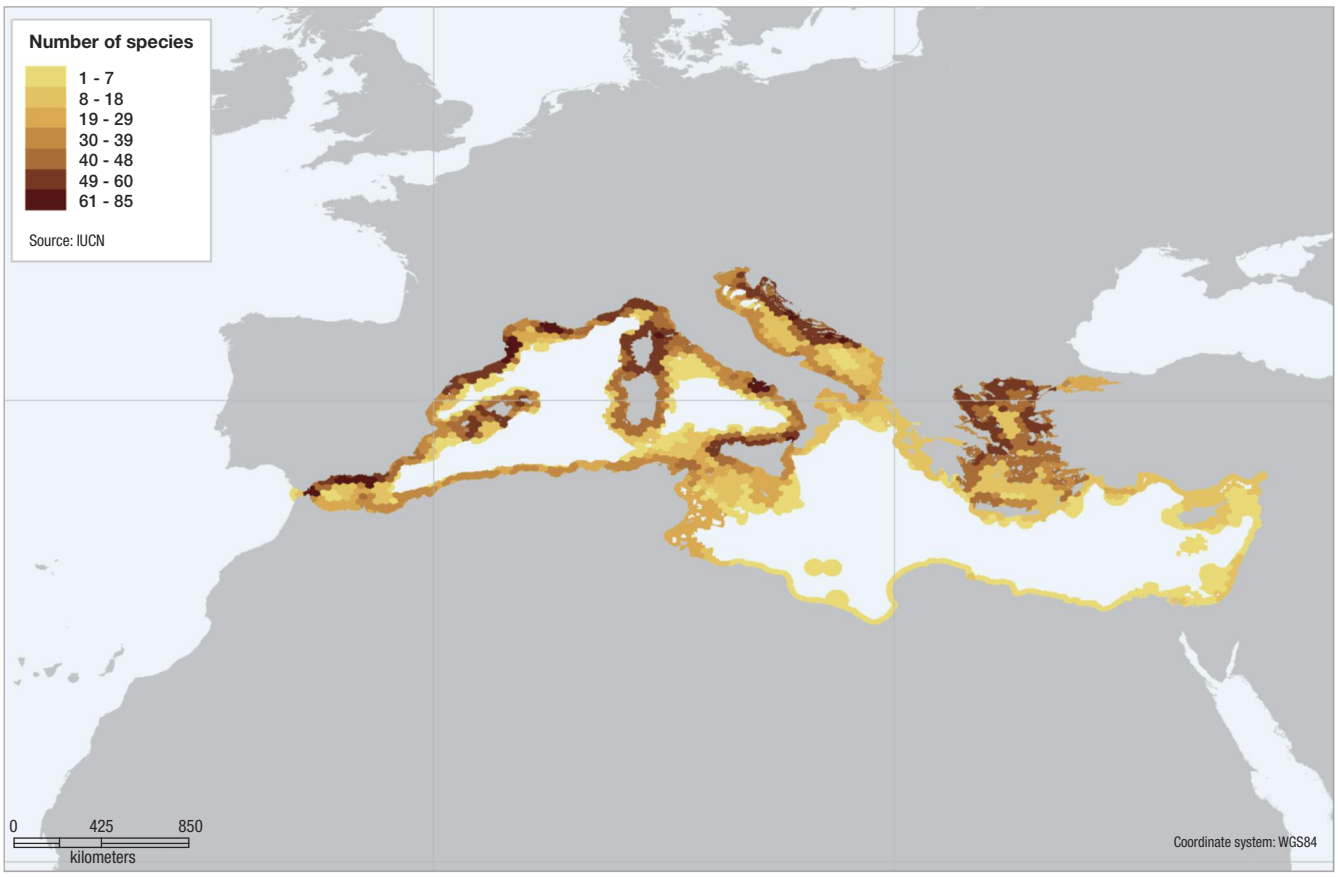


Figure 5. Species richness of anthozoans in the Mediterranean Sea.

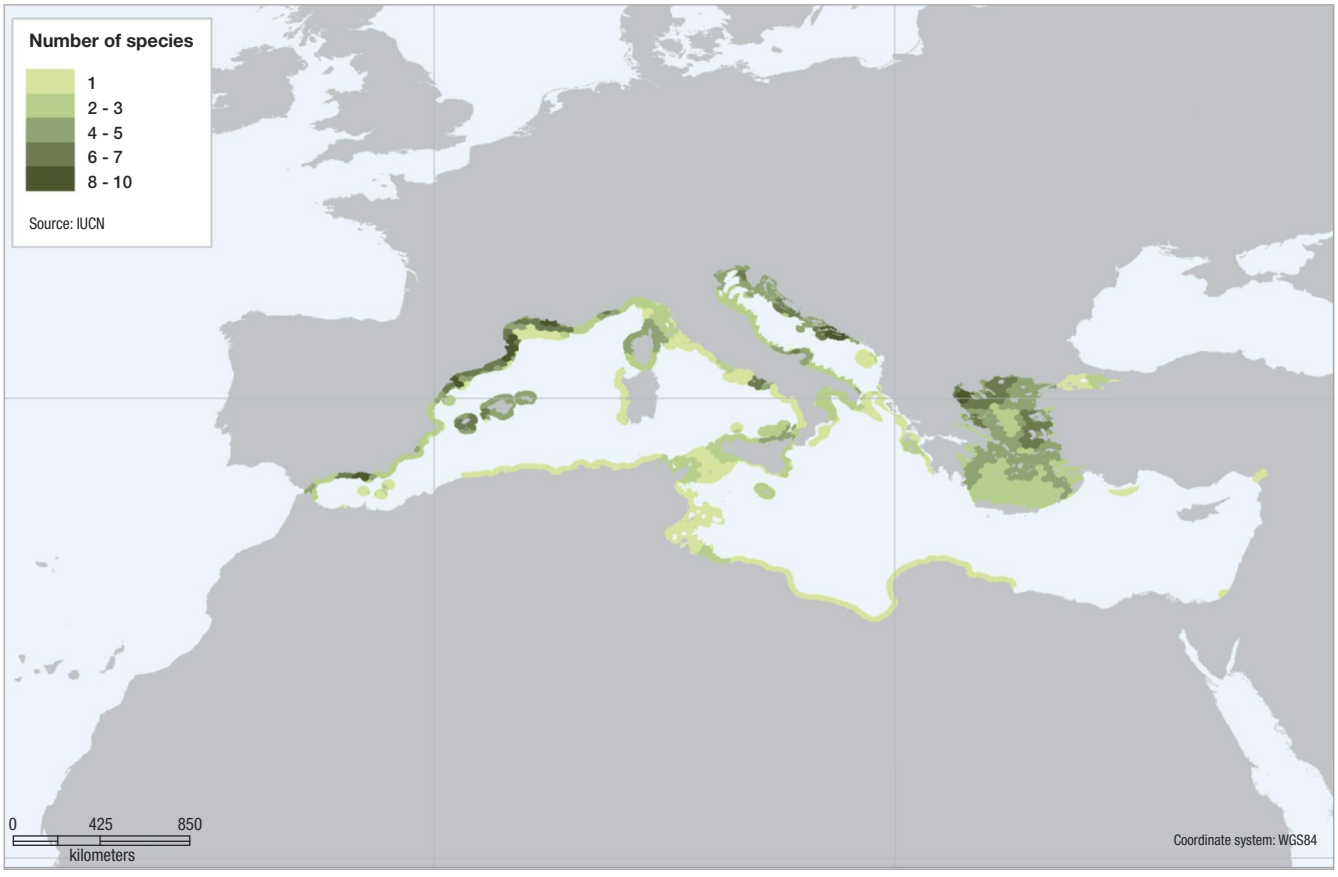
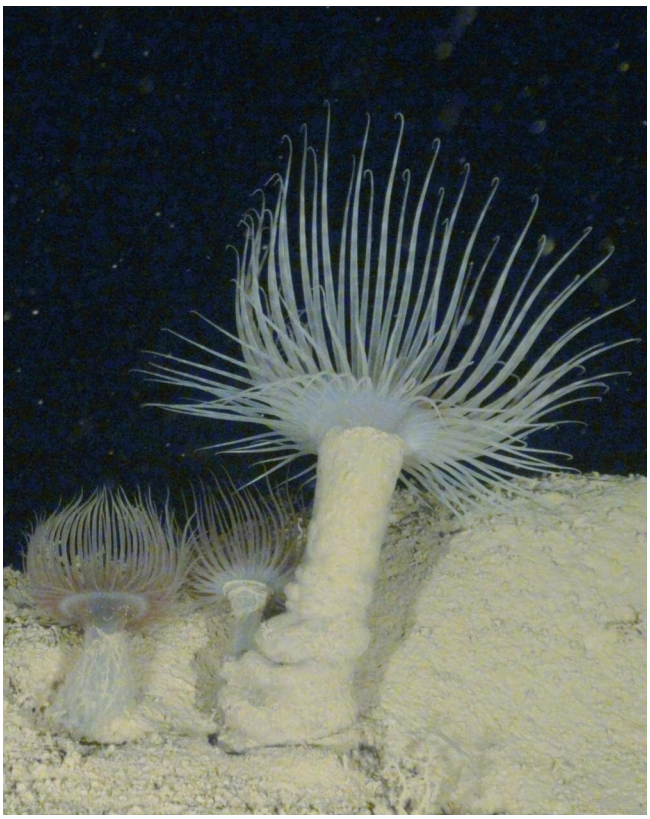


Figure 6. Species richness of endemic anthozoans in the Mediterranean Sea.

Notably, although the assessed species represent an important percentage of the Mediterranean anthozoan biodiversity, there is no certainty that the regions which shows high diversity exactly coincide with the true species richness distribution in the Mediterranean basin, and rather could be a reflection of the research efforts conducted at different regions. Moreover, the high number of species with insufficient data to determine a risk of extinction (more than 50% of species) indicates that the level of knowledge is still very low and mainly biased to the species occurring in shallow waters.

The majority of the endemic species are concentrated in the western part of the Mediterranean basin as well as the Adriatic and Aegean seas (Figure 6). Again, the high percentage of endemic species with insufficient data (almost 80% of the assessed endemic species) indicates that the distribution patterns of endemism in the Mediterranean Sea are still to be defined, especially along the North African coast and the Levantine Sea.

The areas with high concentrations of threatened anthozoan species are distributed along the coastal areas of the western part of the Mediterranean Sea to the Strait of Sicily and the Adriatic and Aegean Seas (Figure 7). These areas coincide mainly with the coastal areas with the highest human population densities and intensive exploitation of marine resources by fisheries which cause trawling and dredging disturbance, as well as coastal based pollution and observed impacts of climate change that extend to the shelves and slopes (e.g. Coll *et al*. 2010, 2012).



Cerianthus membranaceus in Lebanon. © OCEANA/IUCN/RAC-SPA Deep Sea Lebanon project.

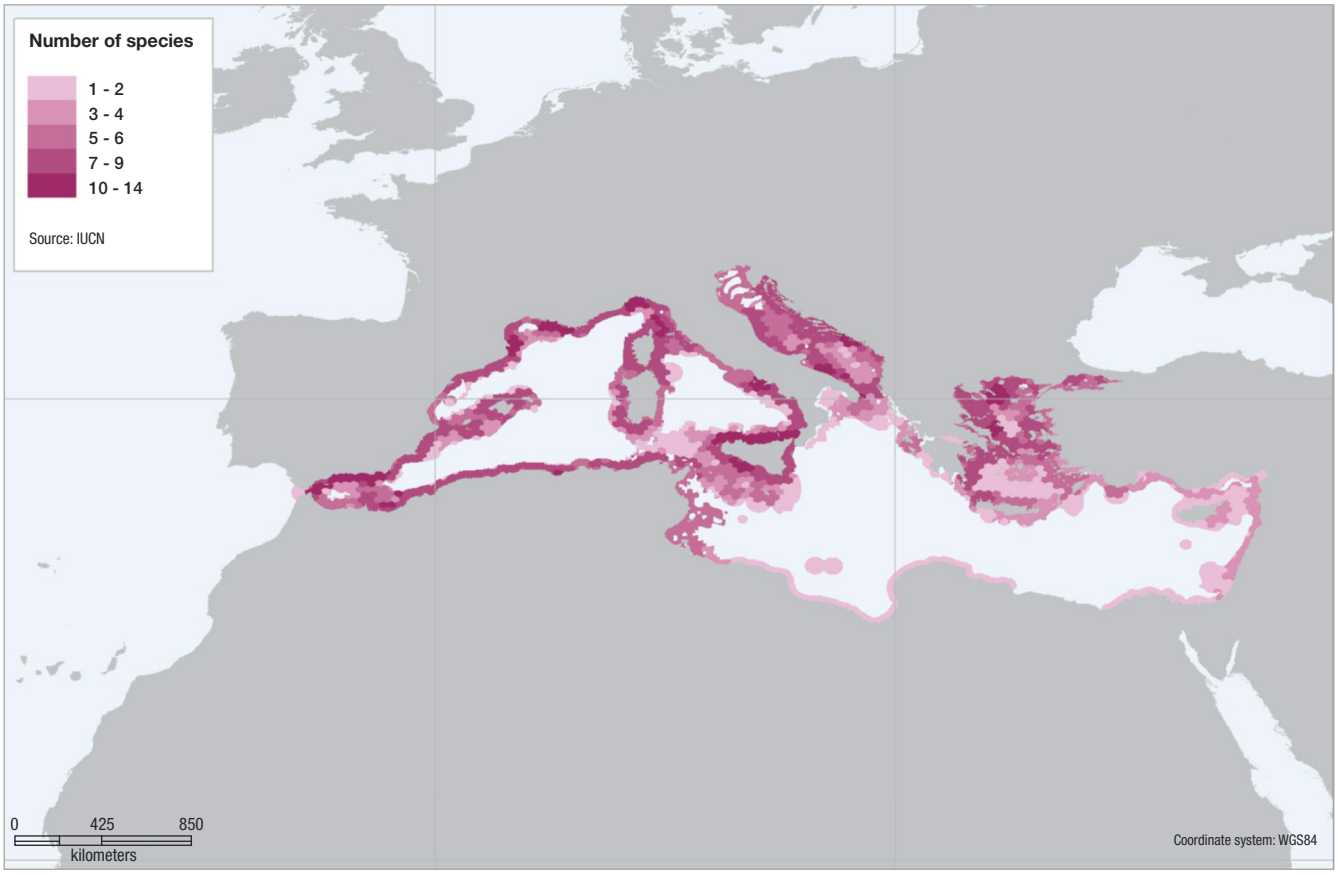


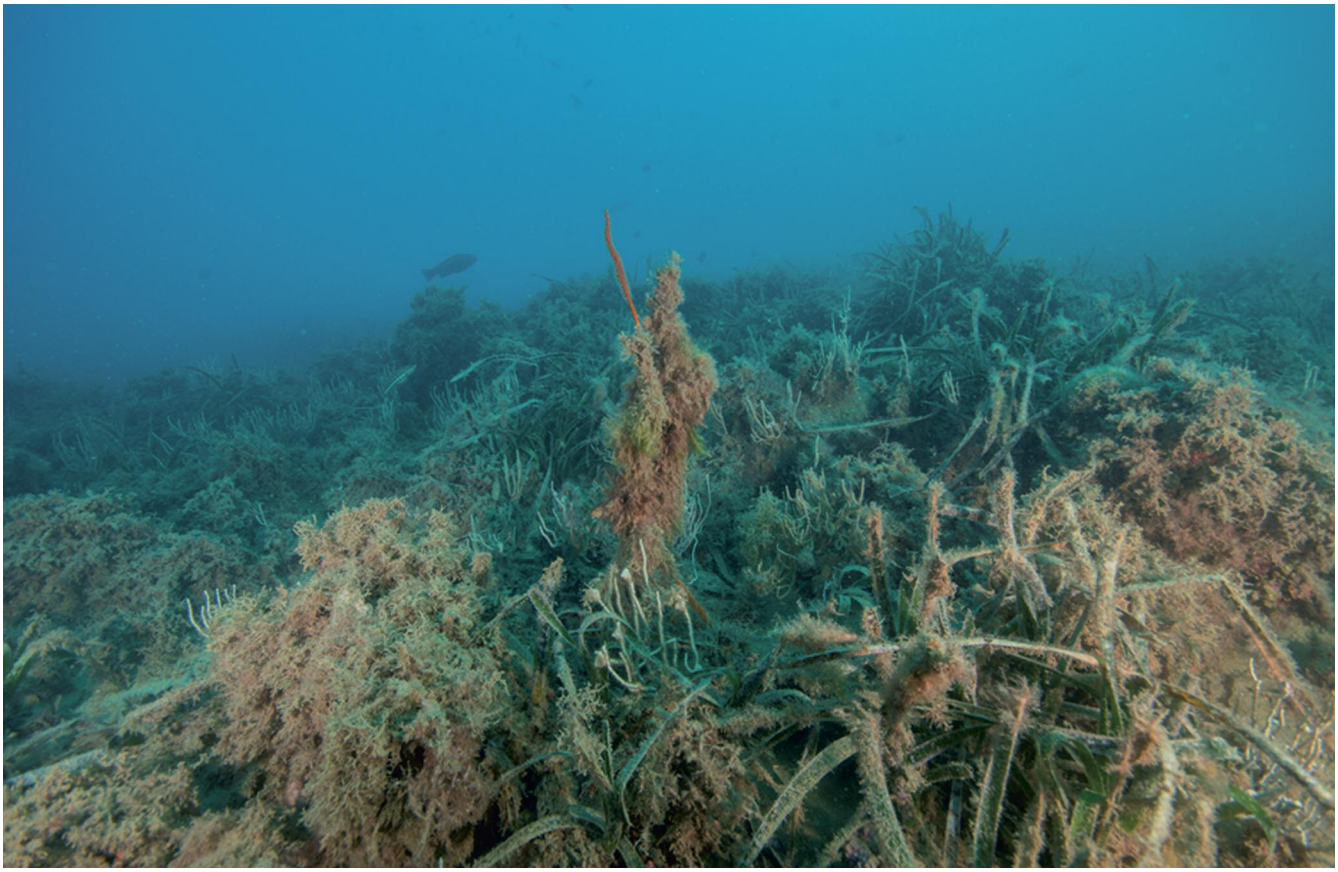
Figure 7. Distribution of threatened anthozoans in the Mediterranean Sea.

Chapter 4. Major threats to anthozoans in the Mediterranean region

The major threats to each anthozoan species were coded using the IUCN Threats Classification Scheme. A summary of the relative importance of the different threats is shown in Figure 8. Overall, the most important (frequently listed) threats are 'biological resource use' due to accidental damage by various fishing techniques and gears, 'climate change and severe weather', 'human intrusions and disturbance' particularly driven by tourism, and 'pollution'. These and other threats are described in more detail below.

4.1. Biological resource use

The main threat for many anthozoan species in the Mediterranean is mechanical disturbance from fishing activities, particularly bottom trawling gear and beam trawls and dredges. Bottom trawling, together with other fishing methods, physically impact the sea floor and have consequences for the benthic communities that can lead to changes in the trophic structure and function of these benthic communities (Sanchez *et al*. 2000,



Increasing coastal disturbances and anthropogenic activities can alter water chemistry and increase turbidity and sedimentation affecting coastal communities and gorgonians. Here, algae covering a *Posidonia* meadow and a colony of *Ellisella paraplexauroides* in Chafarinas Islands, Alboran Sea. © Luis Sanchez Tocino.

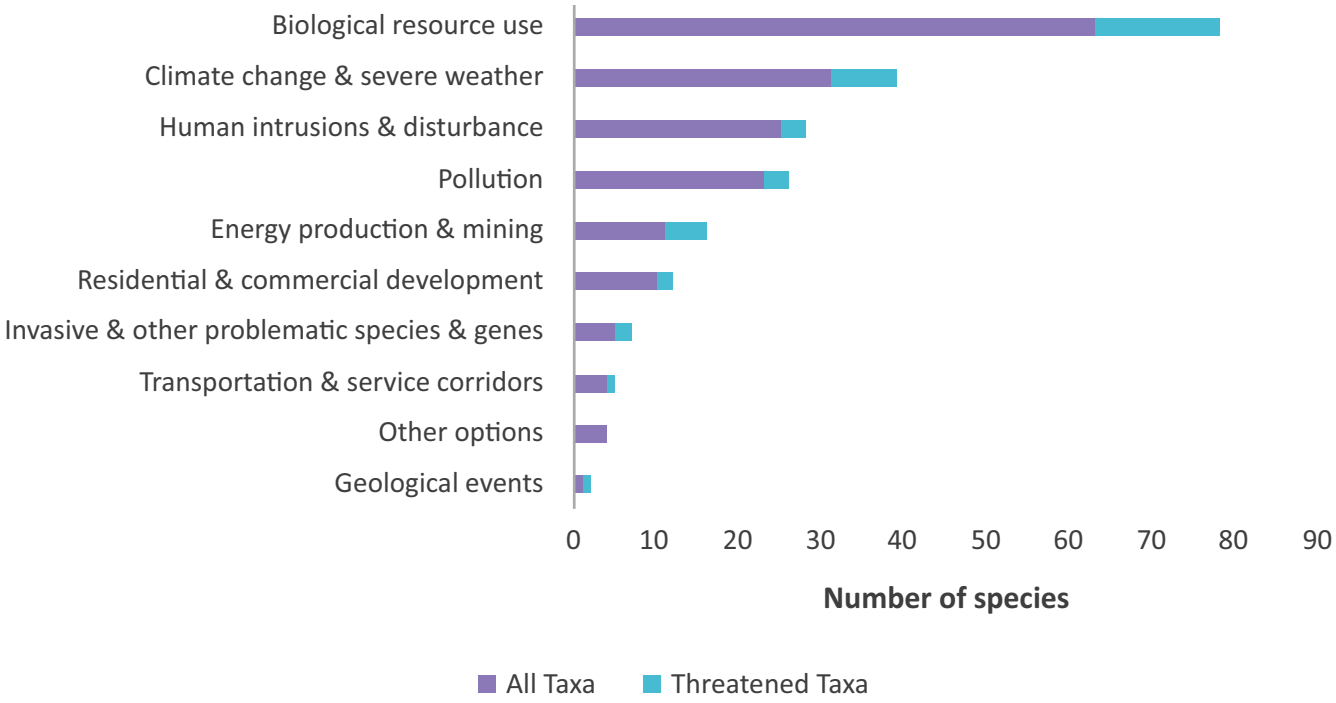


Figure 8. Summary of threats to all 136 native species assessed in the Mediterranean region as identified in the IUCN Major Threats Authority File.

Tudela 2004, UNEP/MAP 2012, Vassilopoulou 2012). This is particularly important for species that live on soft sediments, such as the bamboo coral *Isidella elongata* or sea pens (*Funiculina quadrangularis, Pennatula rubra, Pennatula phosphorea,* etc). The endemic sea pen *Crassophyllum thessalonicae*, only known from the Thermaikos Gulf, is an example of a species strongly affected by high trawling intensity along the southern area of the gulf (Antoniadou *et al.* 2015).

Few Mediterranean studies have looked at the decline of different anthozoan populations by fishing activities. Since the 1960s, at depths below 200 m and on the continental shelf throughout the Mediterranean basin, there are major commercial fishing grounds for red shrimps (*Aristaeomorpha foliacea* and *Aristeus antennatus*), Norway Lobster (*Nephrops norvegicus*) and other important multispecies fisheries such as for European Hake (*Merluccius merluccius*) or the Rose Shrimp *Parapenaeus longirostris* (Bas *et al.* 1985). Here, the trawl fisheries use non-selective gears with small mesh sizes, generating by-catch that is thrown overboard, most of the time dead or dying (ICES 2007). At present, this percentage of discards from the Mediterranean Sea is estimated to be between 15 and 65% (FAO 2016).

The destructive potential of this type of fishing has been demonstrated at multiple Mediterranean sites (as well as in other regions) with a strong reduction in the density of bamboo corals along both the western and eastern Mediterranean basins (Cartes *et al.* 2013; Peres and Picard 1964, Arena and LiGreci 1973; Relini 1986; Fabri *et al.* 2014), and in the density of sea pens such as *F. quandrangularis* in Adriatic grounds and elsewhere (Tudela 2004). The negative effects of bottom trawling on cold water coral communities has also been documented over several years in the Atlantic, especially in relation to *Lophelia pertusa* and *Madrepora oculata*. Here the gears break up the structure of the cold water coral reefs, resulting in complete disintegration of the coral matrix. In addition, there is a negative effect on the associated fauna with the modification of the sea floor (Rogers 1999; Fosså *et al.* 2002). Another known effect from trawling is the resuspension of sediment, which can cover large areas, negatively affecting filter feeding sessile organisms.

Considering the destructive effect of bottom trawling and dredges on several anthozoan species, combined with their slow growth rates, reduced larval dispersal and the patchy and highly episodic nature of recruitment events for some of these species, the damage to these communities might have dramatic consequences for the sustainability of their populations.

Longlining and benthic gillnets used by recreational and professional fisheries are also very damaging fishing practices in the Mediterranean Sea, since they are generally practiced in deeper waters than trawling, very shallow areas or in untrawlable zones that are good habitats for different anthozoan species (gorgonians, black corals, cold water corals, etc.). These gears have a high probability of coral by-catch, as already documented for other areas (Edinger *et al.* 2007; Lumsden *et al.* 2007; Mytilineou *et al.* 2014).

Recent ROV (Remote Operated Vehicle) and manned submersible surveys provide evidence that fishing impact is a

Box 2. The bamboo coral *Isidella elongata*

The case study of *Isidella elongata* is one of the most representative of the entire Red List for Mediterranean anthozoans. *I. elongata* is a very charismatic species for the Mediterranean Sea and its uniqueness relies not only on its peculiar biological and ecological features but also on the huge impact that the populations of this species have suffered, virtually unnoticed, in the last decades due to the impact of unselective fisheries.

Isidella elongata is a near-endemic species of the Mediterranean Sea and is the only bamboo coral species known for this basin, although a recent study indicates the presence of two new species of the genus *Acanella*, previously considered as *Isidella elongata* (Heestand Saucier and France 2016). *Isidella elongata* is among the most long-lived gorgonian species of the Mediterranean basin and it is known to form extended forests on soft bottoms. This candelabrum-shaped species was known to inhabit the bathyal muds from 200 to 1,200 m depth, with vast meadows especially deeper than 500 m depth, in the whole western basin including some areas in the eastern Ionian Sea.

Nowadays the species is considered Critically Endangered since a decline of the population of around 80% in the last 100 years has been inferred, mainly on the basis of by-catch data. The latter suggest a dramatic effect of trawling activity on the majority of the known *Isidella* grounds of the Mediterranean Sea in a period ranging from the beginning of intensive, industrial fishing activities (around the 1960s) to the present, and concentrated on the bathyal plains. Probably under the socio-economic pressures of trawlers and also because the ecological importance of this species was not clear back then, no action has ever been made to preserve these populations. Highly disturbed populations have been detected in French, Italian and Catalan trawling grounds where the extinction rate has been proven to be very rapid under the current fishing pressure (Cartes *et al*. 2013).

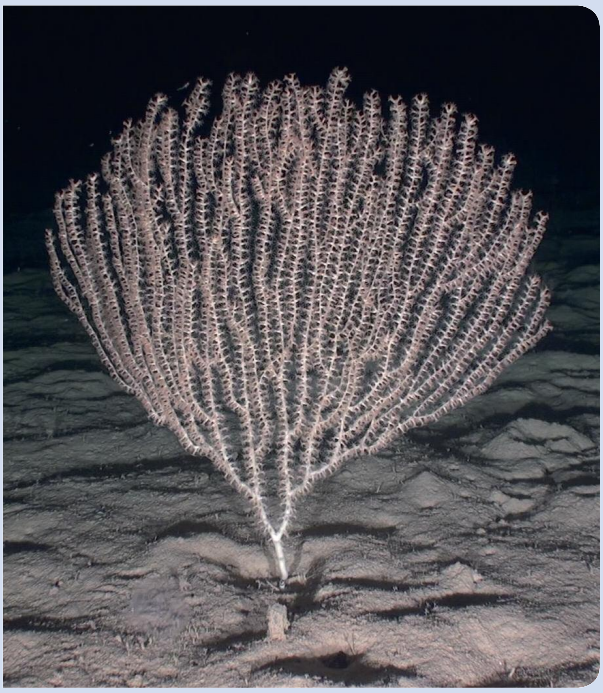
In addition to the trawling impact, recent evidences obtained from experimental fishing surveys with bottom longlines have shown that *I. elongata* represents a common coral by-catch also for artisanal fisheries due to its abundance and catchability, due to by its tree-like morphology (Mytilineau *et al*. 2014).

Pollution and litter dumping on *I. elongata* facies are other important threats. Mineral extraction, together with trawling activities, favour high silting levels.

At present the dense bathyal fields of this species may be considered almost extirpated in the Mediterranean Sea, and their occurrence is limited to the shallowest or deepest ranges of their distribution: shallow water refuges of muddy bottoms naturally protected from trawling activities or grounds where trawling is forbidden, for example on slope grounds below 1,000 m depth. The recovery ability of this species is very low, due to its slow growth rates, low dispersal ability, and a very long life span. The damage to these coral gardens is accompanied by a great biodiversity loss in consideration of all the species, benthic, pelagic or demersal, that gravitate around the communities formed by this species.

Compact mud facies with *Isidella elongata* are among the Vulnerable Marine Ecosystems (VMEs) so far recognized by the international scientific community; until now they have only been included in the Marine Protected Area of the Gulf of Lion.

A major management plan for the surviving populations is urgently needed to preserve this species in the Mediterranean Sea. Long-term restrictions on fishing activities at critical sites are essential not only in the areas hosting the colonies but also in wide portions of the nearby seafloor to enable the recovery of the populations and their expansion. In this regard, a network of protected sites or fisheries restricted areas at off-shore bathyal muddy areas (for example over red shrimp bathyal fishing grounds) hosting *Isidella elongata* facies is required. In addition, a scientific and communication action plan should be implemented both to cover important knowledge gaps on the reproduction, genetics, growth and dispersal of this species and to enhance the conservation efforts and awareness of indirect and direct deep sea users.



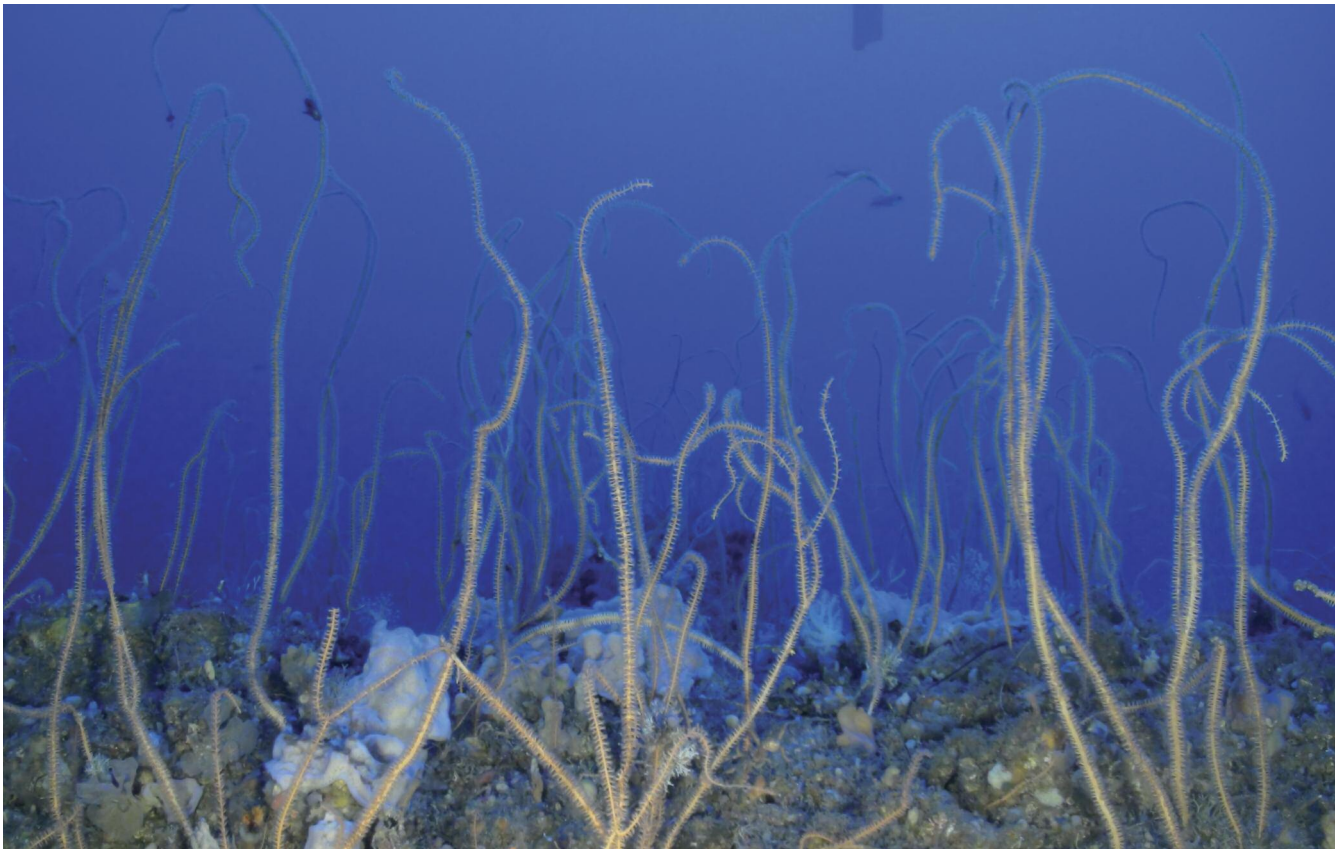
Isidella elongata in Menorca channel, Balearic Islands, Spain. © OCEANA.

major concern for Mediterranean hard-bottom communities (Bo *et al*. 2013, 2014; Orejas *et al*. 2009; Angiolillo *et al*. 2015). Tree-like anthozoans represent a major component of the longline fishing by-catch, but almost no quantitative studies are available for the Mediterranean. Experimental longline seabream fishing carried out between 500-600 m depth in the eastern Ionian Sea demonstrated that corals occurred in 72% of the long lines and most of the colonies were caught entire and alive, while others showed already signs of damage (Mytilineou *et al*. 2014). Bamboo corals were found highly abundant in the coral by-catch together with black corals with an estimation of 130 live colonies of bamboo corals caught per fisherman per year. Moreover, coral by-catch was dependent on the hook size, being higher with smaller hooks.

The impact on anthozoans seems to be related to the morphology, size and skeletal characteristics of each species (Bo *et al*. 2013, 2014). Furthermore, for species with a small distribution range such as *Ellisella paraplexauroides* (Box 5), the effects of fishing can cause the death of a large number of colonies in a short time and directly increase the risk of population collapse (Maldonado *et al*. 2013). Damaged colonies are also more susceptible to the colonization of encrusting organisms that can slowly kill the coral (Bavestrello *et al.* 1997).

Ghost fishing by abandoned or discarded small-scale gears is another issue of potential importance in the Mediterranean basin. Anchor lines, ropes connecting lobster pots, gill nets placed across gorgonian populations and lost monofilament lines may cause tissue abrasion or detachment of the whole coral colonies (Bavestrello *et al*. 1997; Tsounis *et al.* 2012). Ghost fishing litter has been showed to directly impact benthic organisms, primarily gorgonians (*P. clavata, E. cavolini, C. verticillata, C. rubrum*, etc.), black corals (*Antipathella subpinnata, Antipathes dichotoma* and *Leiopathes glaberrima*) and sponges in the Tyrrhenian Sea, Campania, Sicily and Sardinia (Bo *et al*. 2013, 2014; Angiolillo *et al*. 2015).

In addition, direct harvest of anthozoans such as the historic black coral fisheries and intensive harvesting (legal and illegal) for the Red Coral, *Corallium rubrum,* still continue along the Mediterranean coast. The impact of this direct fishing is driving significant shifts in the size structure of shallow Red Coral populations and there is increased exploitation of Red Corals living below 100 m (Box 6). Other gorgonian species such as *Savalia savaglia* have been collected as souvenirs or ornaments and jewellery in the past (Cerrano *et al.* 2015) and this practice probably continues. The use of *Dendrophyllia cornigera* and *D. ramea* for ornamental purposes is also widely distributed in the Mediterranean as well as in the Atlantic. In the case of other species, such as *Anemonia viridis* (= *A. sulcata*), harvesting for consumption also occurs in Spain, the south coast of Italy, Sardinia and Greece; however, official capture data are absent from most locations.



Rocky area with the gorgonian *Viminella flagellum* in the Alboran Sea. © Universidad de Málaga/INDEMARESAlboran.

Box 3. The reefbuilder *Cladocora caespitosa*

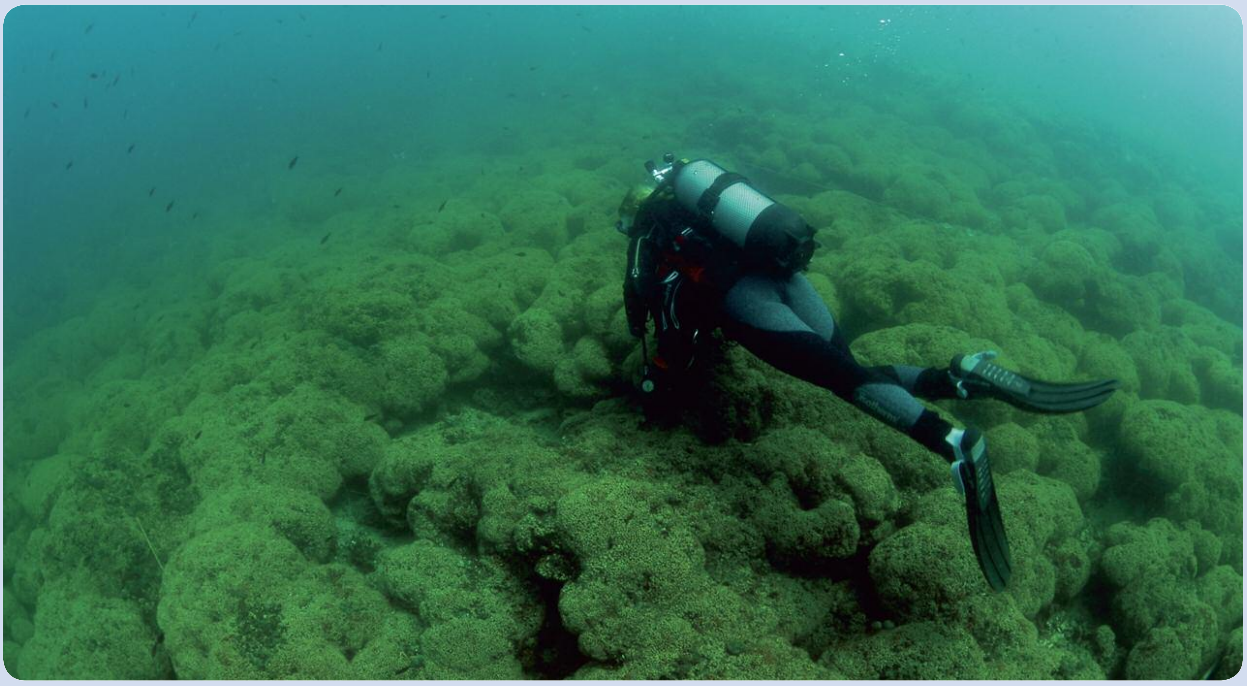
The near-endemic reefbuilder *Cladocora caespitosa* is known to have thrived in Mediterranean waters for at least 3 million years. However, the large reefs built by this coral in the ancient Mediterranean Sea have long disappeared, giving place to rare, relict banks in a few locations. Besides these extraordinary sites, the species occurs mostly in the form of small dispersed colonies along the Mediterranean coast.

The largest and best developed populations and reefs known to date are located in the Mljet National Park (Croatia, Adriatic Sea; Kružić and Benkovic 2008), Columbretes Islands Marine Reserve (Spain, NW Mediterranean; Kersting and Linares 2012) and in Kotor Bay in Montenegro (RAC/SPA, 2014). When abundant, *Cladocora caespitosa* is an ecosystem engineer and plays a main role in the biodiversity and structure of the communities.

This species has been notably affected by sea warming during the last 15 years and some populations of *C. caespitosa* have been unprecedentedly impacted. While the mass mortality event described after the summer of 1999 affected *C. caespitosa* in some sites, the abnormally hot summer of 2003 triggered high mortality rates over a wide geographical range, including the exceptional populations in Columbretes and Mljet. Worryingly, successive warming-related mortalities of different intensity kept on impacting *C. caespitosa* along the levantine and western basins (Kersting *et al*. 2013, Kružić *et al.* 2014, Jiménez *et al*. 2014). The recurrent mortalities represented population losses of up to 50-80% in some sites like the Columbretes Islands and colonies were affected by necrosis.

Moreover, the habitat of *C. caespitosa* is being increasingly invaded by several invasive algal species such as *Caulerpa cylindracea* and *Lophocladia lallemandii* (Kružić *et al*. 2008, Kersting *et al*. 2014). Even though there is no evidence of lethal effects caused by the algal invasion on the adult coral colonies, impacts on other stages of *C. caespitosa* life cycle (e.g., recruitment) are happening and synergies with other stressors like warming are very likely. Other impacts derived from eutrophication, industrial and sewage discharges, fishing activities and coastal development have been reported to cause major *C. caespitosa* declines in some areas like the eastern Adriatic Sea.

Cladocora caespitosa is a slow-growing, long-lived species with extremely slow dynamics and reduced recovery potential. Its low recruitment rates will hardly balance the recurrent warming-related mortalities that are affecting its populations, thus worryingly exposing it to the increasing global change impacts and other coastal pressures on this species in the Mediterranean basin. Considering its life traits and the decline in many of its populations, *Cladocora caespitosa* has been listed as Endangered. It is of great importance to protect and preserve *C. caespitosa* populations and its reef habitats from additional impacts to favor its overall health and resilience. Essential information on the distribution, health status and population traits is still lacking in many Mediterranean areas and the implementation of networking monitoring programmes is highly needed to assess the long-term responses to global change.



Reef of *Cladocora caespitosa* at Mljet National Park, Croatia. © Petar Kružić.

4.2. Climate change and severe weather

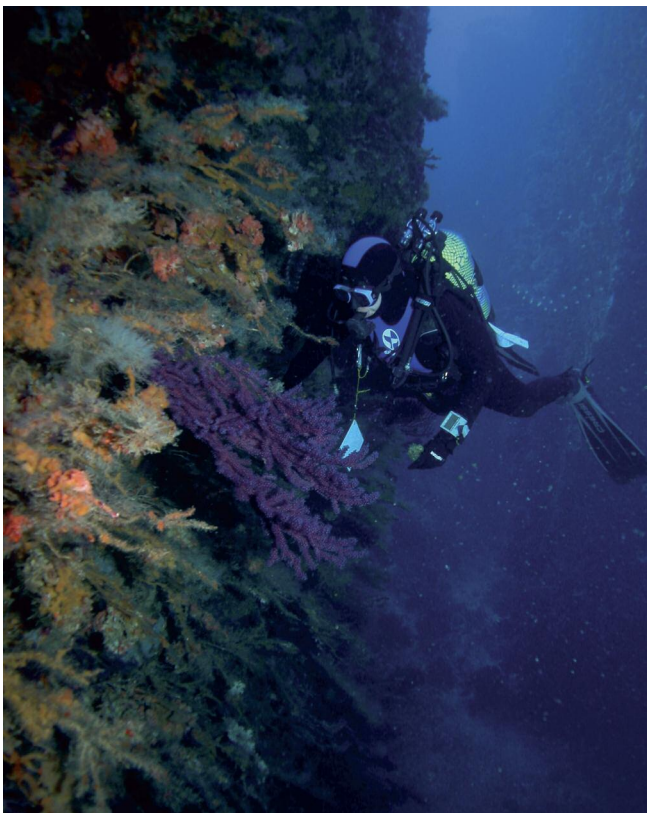
The effects of climate change, including ocean acidification, are specially marked in the Mediterranean Sea, as it is considered a climate change hotspot, being especially vulnerable to the increased sea surface temperature (SST) caused by greenhouse gas emissions (Diffenbaugh and Giorgi 2012; IPCC 2013; Lionello *et al*. 2014).

At present, it is known that climate change including increasing seawater temperatures, severe weather (storm surges, ocean wind generated waves) and sea level rise can affect and it is already affecting many Mediterranean marine species. The mean maximum summer seawater temperature of the Mediterranean Sea has risen by around 1 °C over the last three decades and there has been an increase in the frequency and intensity of marine heat waves (references within Lionello *et al*. 2014).

Mediterranean anthozoans, particularly calcifying corals and gorgonian species from the infralittoral are reported to be very vulnerable to climate change. Mass mortality events linked to seawater warming and summer heat waves mostly affect shallow populations in less than 40 m depth. These mass mortality events have been observed and studied mostly in the Western Mediterranean but also reported in other regions (e.g. Garrabou *et al.* 2009, Cerrano *et al*. 2000; Kipson *et al.* 2015).

Continued surface seawater warming (+2,5°C on average predicted for SST by the end of the 21st century using A1B[1] and CMIP5[2] ensemble mean scenarios; Lionello *et al*. 2012; Shaltout and Omstedt 2014) as well as the enhancement of the water column stratification and the lengthening of summer conditions, is likely to cause further mass mortalities of habitat-forming anthozoans as well as affect the early life stages of a wide range of species. In addition, increasing temperatures may also contribute to higher frequencies of disease outbreaks as warm-water microbial pathogens are expected to spread (Vezzulli *et al*. 2010, Crisci *et al*. 2011). Changes in key physiological parameters (calcification, respiration and ammonium excretion) due to the increased seawater temperature and acidification in combination with light intensity and/or nutrient imbalance may further reduce the productivity of coral symbiosis and cause mass necrosis or bleaching events.

Moreover, the impact of climate change with the rising temperatures may be a further trigger increasing the distribution and abundance of some warm-water affinity species, such as the endemic soft coral *Maasella edwardsi* or the orange coral *Astroides calycularis* (Bianchi 2007; Ozalp and Ates 2015). It may also affect the current distribution of the infra-littoral stony coral *Oculina patagonica* (Orejas *et al.* 2011; Rodolfo-Metalpa *et al*. 2014) or cold-water anthozoans, as shown in the different responses documented in aquarium experiments for example for the scleractinians *Lophelia pertusa, Madrepora oculata, Desmophyllun dianthus* and *Dendrophyllia cornigera*. The effects of climate change in deep waters have not been fully evaluated yet. Signs of deep Red Coral mass mortalities apparently not related to climate changes have also been recently detected in the Salerno Gulf, Italy (Bavestrello *et al*. 2014b).

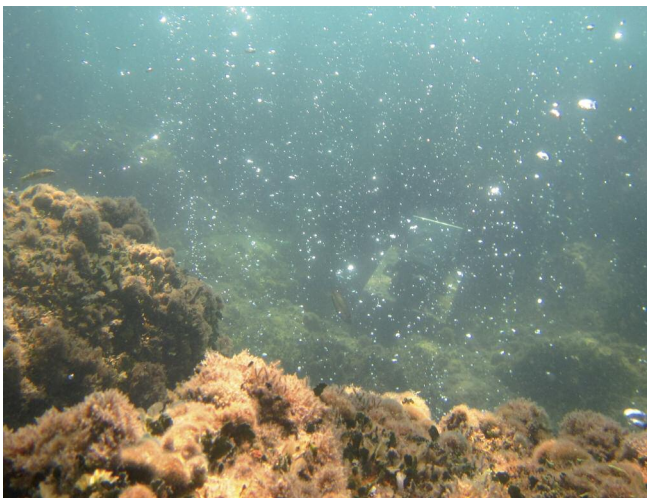


Paramuricea clavata population heavily affected by recurrent, warming-related mortalities (Columbretes Islands, Spain). © Diego Kersting.

Mediterranean acidification is already detectable (Meier *et al*. 2014; Howes *et al.* 2015), and combined with the rapid warming may result in extensive mortality and decreased calcification rates for carbonate-forming anthozoans (corals and gorgonians) (Fantazzini *et al.* 2015). Over the next fifty years, various estimates forecast a pH decrease of 0.07-0.13 units corresponding to a decreasing rate of 0.002 ±0.001 pH units per year (Geri *et al.* 2014). Even small changes in surface water CO_2 concentrations could impact calcifying species as they are strongly sensitive to a decrease in calcium carbonate which they need to maintain rigid skeletons. Mediterranean deep water corals grow slowly and calcification in aragonite-limited waters could make them especially vulnerable to ocean acidification (McCulloch *et al.* 2012; Movilla *et al.* 2014b).

[1] A1B scenario based on - A balanced emphasis on all energy sources. IPCC's assessment report.

[2] Coupled Model Intercomparison Project Phase 5 - World Climate Research Programme.



Natural CO_2 emissions from vents in Ischia island, Italy. © Mar Otero.

Slower growth rates of gorgonians (*Eunicella* spp., *Paramuricea clavata*, etc.) may also detrimentally affect major bioconstruction coralligenous reefs and likewise directly affect the crustose calcifying coralline algae that form important habitats in the Mediterranean coast, supporting fisheries and attracting recreational tourism (Ponti *et al.* 2014).

Currently, however, very little data is published on observed impacts to Mediterranean anthozoans, particularly on the acclimation of calcification in the natural environment. Species with fast generation times that are able to mature and reproduce quickly will be more able to adapt to the rapid environmental change as a result of climate impacts.

Overall, the outlined disturbances may not act in isolation, and their synergistic effects need to be considered. The future evolution

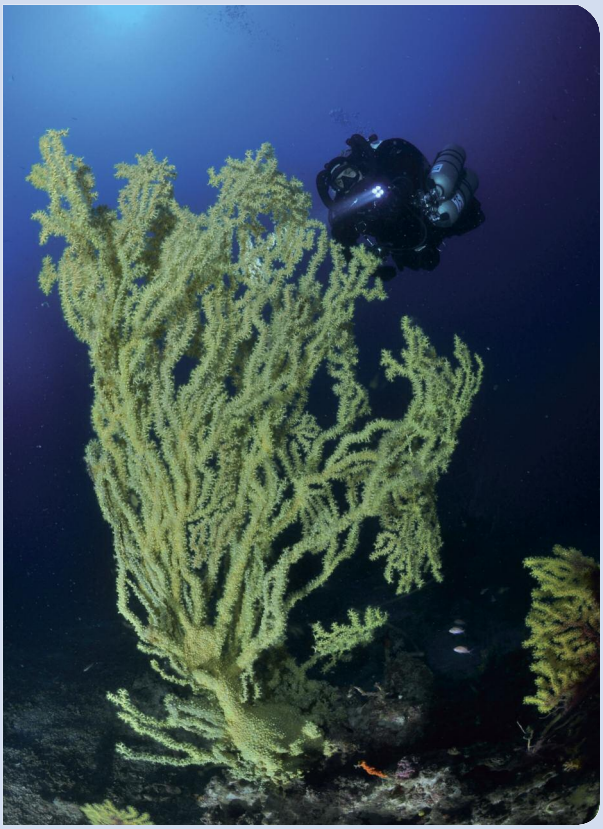
Box 4. The gold coral *Savalia savaglia*

The gold coral *Savalia savaglia* is a species native to the Mediterranean Sea. Owing to its rarity, its biological peculiarities, and the ongoing impacts, the species has been listed in Annex II of the SPA/BD Protocol of the Barcelona Convention and in Annex II of the Bern Convention.

It is unique in its biology and ecology, with colonies that can be more than 2 m high with a 30 cm basal diameter. It grows as a parasite on living colonies of gorgonians. After a larva settles on a gorgonian, it starts growing by vegetative propagation at a fast rate (about 10 cm per year) until the overgrown octocoral dies a few years later. After this phase, *S. savaglia* secretes hard proteinaceous endoskeleton rich in hystidine. From this moment, the gold coral activates seasonal sexual reproduction, and its presence, if undisturbed, will affect the surrounding benthic assemblage for hundreds of years, enhancing biodiversity.

The occurrence of centenarian specimens of *S. savaglia* in benthic assemblages can be considered an indicator of quite undisturbed communities. Until a few years ago, this species was believed to be present sporadically in the Mediterranean Sea, with just a few scattered colonies, but recent discoveries have changed this view, showing its extensive bathymetric range (15-700 m). Four hot spot areas with high densities of the gold coral are known today in the Mediterranean: at 70 m depth in the Italian MPA of Portofino and at Punta Manara in the Ligurian Sea, along the western coast of Apulia (Italy), with the presence of the biggest (likely oldest) colonies ever reported for the Mediterranean Sea, and a shallow population in the Bay of Kotor, Montenegro (Giusti *et al.* 2015).

The species is vulnerable to illegal collection by scuba divers, and in the past 40 years was intensively collected. Its morphology also facilitates the entanglement of nets and fishing lines in their branches and its rigidity increases its potential fragmentation and destruction. Awareness campaigns are needed to avoid the destruction of this unique natural heritage, especially at local level, where these populations are recorded.



Savalia savaglia. Large colony from the Ionian Sea. © Portofino Divers.

of sea level in the Mediterranean is uncertain and severe storm events are expected to increase in both intensity and frequency in parts of the Mediterranean coast like the coasts of Sicily and along both the Ionian and Aegean sectors of the Greek coast (Lionello *et al*. 2016). The immediate effect of these storms in near coastal shallow areas could affect the populations of different benthic communities, including gorgonian forests (Teixido *et al.* 2013; Gili *et al.* 2014).

4.3. Human intrusions and disturbance

Despite the economic benefits of tourism, excess diving activity can ultimately have a detrimental effect on gorgonian populations and some Mediterranean corals. Colonies can be damaged or removed by the impact of fins, hands and other diving equipment in areas of intense diving activity. This threat is more likely to affect shallower populations (down to the limit of recreational diving at 40 m depth). Few studies have been carried out to demonstrate the extent of this impact, although these effects have been well documented in some Mediterranean MPAs, where due to the increase in diving activity gorgonians and other species such as the endemic orange coral *Astroides calycularis* have been impacted (Coma *et al*. 2004; Di Franco *et al.* 2009; Ocaña *et al*. 2015 and references within).

Unintentional activities such as bottom cleaning to improve bathers' access, trampling, and probably changes in water quality due to sunblock products are other examples of important impacts on threatened species that affect the anemone *Paranemonia vouliagmeniensis* (see Box 1), an endemic species of the Lake Vouliagmeni in Greece.

4.4. Pollution, blooms and urban development

The decline in water quality in coastal marine environments, and expanding coastal urbanization with the associated discharge of improperly treated seawage, have direct effects on the Mediterranean shallow water communities. Negative impacts resulting from eutrophication have been described in

Box 5. The rare *Ellisella paraplexauroides*

Ellisella paraplexauroides is among the largest colonial invertebrates of the Mediterranean Sea. It also has an unusual restricted and uneven distribution, with isolated and extremely sparse colonies in a few sites in the Alboran Sea, Algeria and Tunisia, and in the Strait of Sicily, and an exceptionally dense and rich population around the Natura 2000 site on Chafarinas Islands (Alboran Sea). Its particular distribution has been interpreted as how the species adapted to the climatic changes that took place during the Pleistocene until present.

Around the Chafarinas Islands, the abundance of colonies makes a seascape that is unique in the Mediterranean Sea and that is considered of exceptional value.

Today this gorgonian is considered Vulnerable in the Mediterranean basin, since its populations, mostly concentrated around these few sites, have suffered a drastic decline over recent decades. This decline is believed to be related to the impact of unregulated and illegal fisheries, particularly the use of benthic gillnets, trawling gear, and longlines. Other threats like pollution or the alteration of river run-off increasing the delivery of nutrients, especially of silicates, have also impacted the species and the associated benthic communities.

The basic knowledge of the biology of this species, together with its low recovery capacity in the face of pressures, indicates there is an urgent need for an adequate management plan that covers its restricted distribution range.

Ellisella paraplexauroides in Chafarinas Islands.
© OCEANA/Juan Cuetos.

some *Cladocora caespitosa* populations, including those on the largest coral banks at Mljet, Croatia (Kružić and Požar-Domac 2007). The northern Adriatic Sea, for example, has been historically subjected to phosphorus and nitrogen loading originating from agriculture, industries and sewage funneled into the Sea by the Po River (Graneli *et al*. 1999).

Blooms of mucilaginous aggregates caused by the proliferation of several phytoplankton species have considerably increased in frequency in different parts of the north-western Mediterranean Sea, around Sicily and particularly in the northern Adriatic Sea. They form dense mats settling on the sea bottom that sometimes completely cover entire benthic communities, such as gorgonian forests (e.g. *Paramuricea clavata, Eunicella cavolini, Eunicella singularis*; Mistri and Ceccherelli, 1996; Giuliani *et al*. 2005) and cause lesions and necrosis to the colonies due to the prolonged anoxic conditions.

Near-shore species, such as the golden anemone *Condylactis aurantiaca* or the gorgonian *Leptogorgia sarmentosa* are exposed to increasing coastal disturbances and anthropogenic activities (such as dredging, land clearing, municipal and agricultural discharge, construction, and coastal development) which can alter water chemistry and increase turbidity and sedimentation (Airoldi 2003). The Cassidaigne canyon (France) receives massive disposal of bauxite residues expelled by an aluminium company inland, resulting in deep gorgonians (*Acanthogorgia hirsuta*) being smothered with the red mud residue and showing clear signs of tissue necrosis and patches of mud deposits (Fabri *et al*. 2014).

Recent studies also showed that deep rocky environments of the Tyrrhenian Sea with high relative abundance of debris (mainly lines and nets, plastic items), have a heavy impact (covering and abrasion action) on gorgonians (*P. clavata, E. cavolini, C. verticillata,*), Red Coral (*Corallium rubrum)*, antipatharians (*Antipathella subpinnata, Antipathes dichotoma* and *Leiopathes glaberrima*), and other invertebrates (Bo *et al*. 2014; Angiolillo *et al*. 2015).

4.5. Energy production and mining

Corals are likely to be greatly impacted by sediment plumes generated during mining extraction activities. Exposure to suspended sediments can mechanically damage corals by smothering and clogging their tissues, and can also contain toxic substances that affect coral physiological processes.

Sea floor drilling activities as part of oil exploration or mining, and the deployment of submarine cables and pipelines, threaten the integrity of deep benthic communities such as those where *Antipathella subpinnata, Antipathes dichotoma, Isidella elongata, Desmophyllum dianthus, Parantipahes larix* or *Leiopathes glaberrima* might occur.

Other species, such as those in cold water coral frameworks are likely to be also subjected to physical disturbance due to drilling and mining activities, anchorage and positioning of offshore structures on the seabed, impacting cold water coral framework. Studies from north Atlantic cold water coral populations (Larsson and Purser 2011) highlighted how the turnover of sediments and drill cuttings can smother coral tissues until it compromises the survival of polyps.

Marine mining, however, is at an exploratory stage in the Mediterranean Sea, although potential future explotation of sulphide deposits has been identified along the Italian and Greek coastlines[3]. The development of technologies allowing cost-effective extraction and transport of minerals still needs to be further developed, as well as our understanding of the impacts that these activities will have on anthozoans and the marine communities around them.

Offshore oil and gas exploration contracts have been rapidly increasing in the last few years in the Mediterranean, to meet energy demands. This demand has been forecasted to enhance the growth of these sectors a further 60% in the case of offshore oil production and by five-fold in the case of offshore gas production, from 2010 to 2030 (Piante and Ody 2015). The impacts of the installation of these structures or any accidental activities that might occur during their operation have not been quantified.

4.6. Invasive and other problematic species

The invasion of coastal ecosystems by non-native species is widely recognized as one of the major threats to marine biodiversity. The Mediterranean Sea is a marine hot-spot for non-indigenous species, hosting almost 1,000 exotic species, of which 128 are macrophytes (Zenetos *et al*. 2010).

Invasive exotic species and particularly invasive algae are spreading over the entire Mediterranean coastline, however little information is available on the effects of exotic species' invasions on native flora and fauna, and specifically on anthozoans. Several invasive macroalgal species, such as *Caulerpa cylindracea, Lophocladia lallemandii, Womersleyella setacea* and *Acrothamion preissii,* have overlapped their distribution with those of Mediterranean structural anthozoans along wide geographical and depth ranges (Kružić *et al.* 2008, Cebrian *et al*. 2012, Linares *et al*. 2012, Kersting *et al*. 2014).

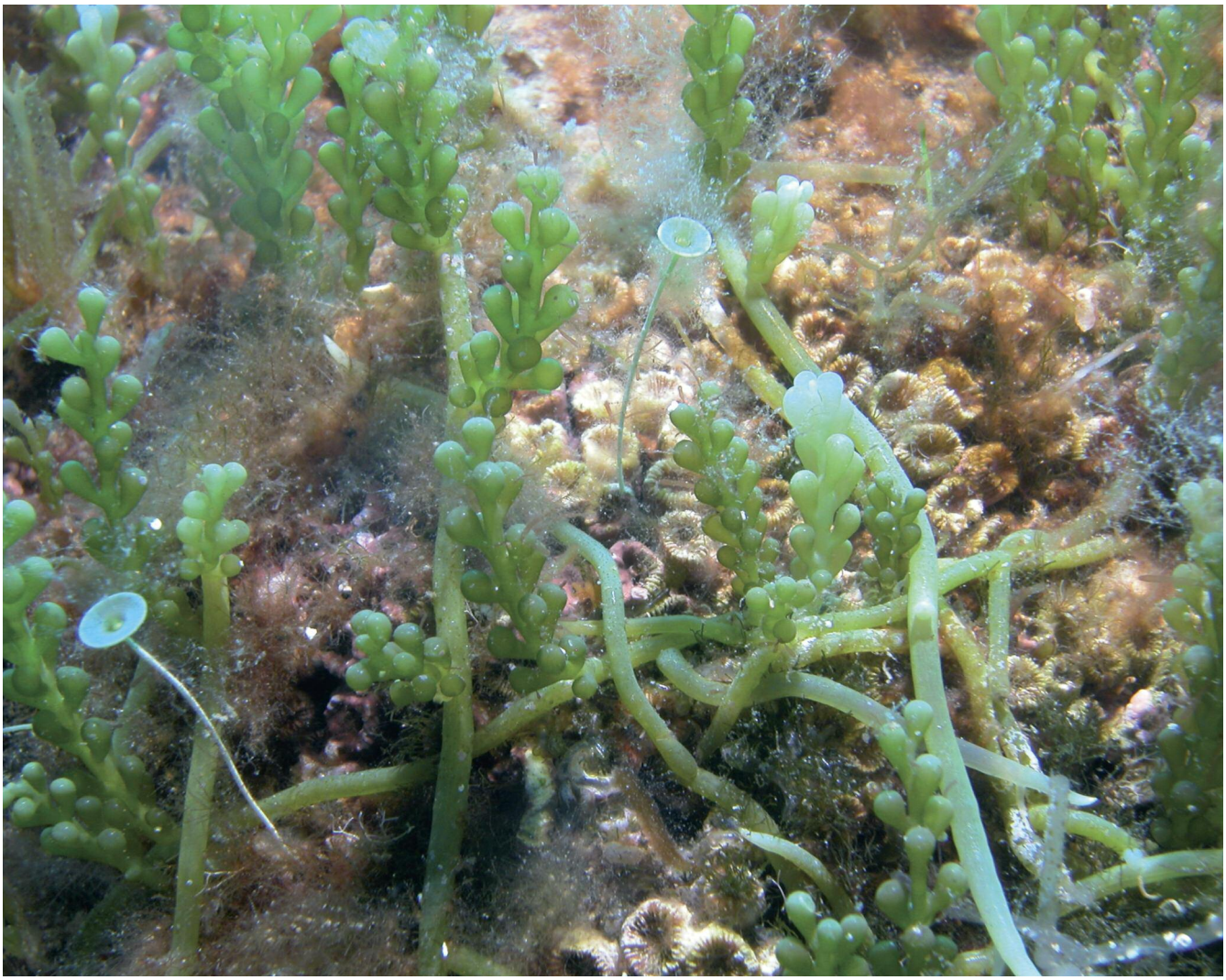
[3] European Commission, in press. Scoping study on a conceptual approach for addressing green growth potential for the marine economies. Reference within Piante and Ody 2015.

Experimental studies have reported negative effects of invasive algae overgrowth on gorgonians dwelling in coralligenous assemblages. Juveniles of the Red and White Gorgonians, *Paramuricea clavata* and *Eunicella singularis*, have been observed to be impacted by overgrowth of the invasive algae *C. cylindracea*, *W. setacea* and *A. preissii*, increasing their mortality rates and decreasing significantly their biomass, which in turn affects their long-term viability (Linares *et al*. 2012). Furthermore, the thick and persistent turf cover displayed by some of these algal species, seriously reduces larval settlement and recruitment, as found for the White Gorgonian *E. singularis* (Cebrian *et al.* 2012, Linares *et al*. 2012).

Exotic algae are also spreading over the few scleractian coral reefs in the Mediterranean Sea. *Caulerpa cylindracea* is already present over the largest *Cladocora caespitosa* reef known in the Mediterranean, in Mljet National Park (Croatia; Kružić *et al*. 2008) and both *C. cylindracea* and *L. lallemandii* are spreading over the great extension occupied by *C. caespitosa* colonies and reefs in the Columbretes Islands Marine Reserve (Spain; Kersting *et al*. 2014). Recent studies have shown the existence of defence mechanisms in this coral that reduced *C. cylindracea* overgrowth (Kersting *et al*. 2014). However, negative effects on recruitment can be expected as in some locations most of the suitable substrata for larval settlement is occupied by invasive algae during the reproduction period of this coral.

Recruitment and juvenile coral survival play crucial roles in the recovery of impacted populations and invasive algae may affect these early life stages. It has to be noted that a reduction in recruitment could seriously jeopardize the persistence of many anthozoan populations already impacted by warming-related mass mortalities and other pressures. In addition, invasive algae overgrowth on these anthozoan species may synergistically interact with other wide extended impacts, such as sea warming.

There is an important lack of information on the overall extent of the effects of invasive species on anthozoan species and knowledge on this issue is highly needed to assess their health status and potential impacts, taking into account the increasing trend of biological invasions.



Caulerpa cylindracea invasive algae growing on dead *C. caespitosa* colonies. © Diego Kersting.

Chapter 5. Recommendations for priority conservation measures

5.1. Enhancing anthozoan threatened species policies

5.1.1. The development of national legal frameworks to ensure effective species conservation

A range of national policies from different Mediterranean countries have potential relevance for anthozoans and for the conservation and management of key sites and habitats where these species are found.

Many countries have recently revised or are revising their environmental legislation. Nonetheless, specific protection for anthozoan species is not widely included by Mediterranean countries with the exception of Croatia, Greece, Turkey, Spain and Malta, that have enacted legislation for the protection of marine biodiversity which includes some anthozoan species[4] (Appendix 3). Thus, it will be relevant for all Mediterranean states to update their legislation for the protection of biodiversity and add to it all the threatened species, to adapt it to the evolution of anthozoans vulnerability to current threats.

To enhance conservation success, endemic threatened anthozoan species (Table 5) distributed in the territory of a Mediterranean state should be subject to national conservation measures. For example, the anemone *Paranemonia vouliagmeniensis* and the sea pen *Crassophyllum thessalonicae* are unusual threatened endemics that occur only in Greece. However, neither of them are included in the Presidential Decree 67/1981 for the protection of native flora and wildlife.

Many coastal and marine development projects along the Mediterranean coasts have been undertaken even when the environmental impact assessments conducted in the area don't address avoiding and mitigating impacts on threatened marine species. The general lack of enforcement of mitigation measures in the marine environment, poor integration between different coastal laws and management plans, as well as the limited quality of species impact assessments, also affect the effectiveness of protected species laws and regulations. Threatened species laws still need to be strengthened and be fully implemented in all Mediterranean countries.

Additionally, the establishment of a comprehensive, adequate and representative regional and national network of marine areas,

[4] Croatia: Ordinance on strictly protected species 2013 (Official Gazette 144/13).

Greece: Presidential Decree 67/1981: protection of native flora and wildlife.

Spain: Royal Decree 139/2011, 4th February. Development of List of Wildlife Species under Regime for Special Protection and the Spanish Catalogue of Threatened Species.

National Law 42/2007, 13 December of Natural Heritage and Biodiversity (Annex VI).

Decree, 9 June 1999 for the inclusion in the Spanish Catalogue of Threaten Species certain species of cetaceans, marine invertebrates and flora, changing the category or excluding other species (Annex I).

Malta: Environment and Development Planning Act (Cap. 504) - Flora, Fauna and Natural Habitats (Amendment) Regulations, 2013, L.N.322 of 2013, 14th October, 2013.

Turkey: Fisheries Regulation No. 22223, Art. 6. (1995). Implemented by: Notification No. 2012/65 regulating commercial fisheries and Notification No. 2012/66 regulating non-commercial fisheries.

specifically protected by law is an effective way of protecting and conserving threatened species and ecosystems. Policy-based actions through the creation of Mediterranean Marine Protected Areas (MPA) or the expansion of existing ones can help to preserve anthozoan species and populations. For instance, the marine reserve[5] of Tombant des Spélugues in Monaco was designated to protect a coralligenous habitat which includes the populations of two anthozoan species: *Corallium rubrum* and *Eunicella cavolini*. Other Mediterranean MPAs also host populations of threatened anthozoans, although the level of protection and its enforcement within these MPAs may vary. Moreover, some countries have enacted specific laws to protect anthozoans species within their protected area networks. This is for example the case of Egypt with the Law No 102 of 1983 for Nature Protectorates[6]. Its conservation objective, to be applied to all protected areas, specifies that "*damaging or removing any living organisms or natural features and resources, such as shells, corals, rocks, or soil for any purpose*" is forbidden within the national protected areas system.

The inclusion of conserving threatened anthozoan species within the objectives and management plans of MPAs could be further underlined in other areas to reinforce their conservation. However, some endangered anthozoans might be extremely poorly represented in the nation's protected area system. Hence, the designation of sites as MPAs where rich, unique or unusual communities of anthozoans develop could foster a better conservation for them at the national and at Mediterranean level.

Summarizing, it is relevant that countries conduct surveys and evaluations of anthozoan populations and their conservation status in their existing protected areas, assess the effectiveness of legislation on threatened species outside the MPA system and identify new key sites for their conservation. Based on these assessments, areas of critical habitats (and Key Biodiversity Areas) could be added to the existing protected areas and specific regulations be developed. As climate change is one of the main threats to corals and gorgonians, the identification of critical areas should further consider the future climate change scenarios predicted by the IPCC (for example, the need to establish habitat corridors, climate refugia, or suitable habitat types within the likely future distribution of a species) and contribute to minimize the multiple anthropogenic pressures (CBD Aïchi target nº 10).

5.1.2. Increase effective implementation through international instruments

International global and regional conventions and agreements can guide trans-boundary and national policies and legislation of the Mediterranean countries and offer harmonized and coordinated approaches to monitor, assess and address conservation strategies for marine species.

Among them, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) aims to *'ensure that international trade in specimens of wild animals and plants does not threaten their survival'*[7]. It aims to prevent species from becoming extinct as a result of international trade.

According to article II of the Convention, Appendix I contains species threatened with extinction and that are or may be affected by trade. The species under this Appendix *'must be subject to particularly strict regulation in order not to endanger further their survival and must only be authorized in exceptional circumstances'*[8].

Appendix II includes '*all species which although not necessarily now threatened with extinction may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilization incompatible with their survival*' and *'other species which must be subject to regulation in order that trade in specimens of certain species referred to in sub-paragraph (a) of this paragraph may be brought under effective control'*[9].

Appendix III includes *'all species which any Party identifies as being subject to regulation within its jurisdiction for the purpose of preventing or restricting exploitation, and as needing the co-operation of other Parties in the control of trade'.*

The commercial international trade is therefore regulated by export and import permits on the species included through these Appendices.

In the Mediterranean Sea, CITES has been ratified by all States and plays a role in the protection of Mediterranean anthozoans (Appendix 4). Currently, seven of the 17 threatened species are included in Appendix II of the CITES[10], such as the stony corals (order Scleractinia: *Lophelia pertusa, Madrepora oculata*) and black corals (Species of the order Antipatharia such as *Leiopathes glaberrima*), strengthening the cooperation between

[5] Marine Reserve of the "Tombant des Spélugues", Ordinance 2d of July 1908 modified by Ordinance nº 8.681 19th August 1986.

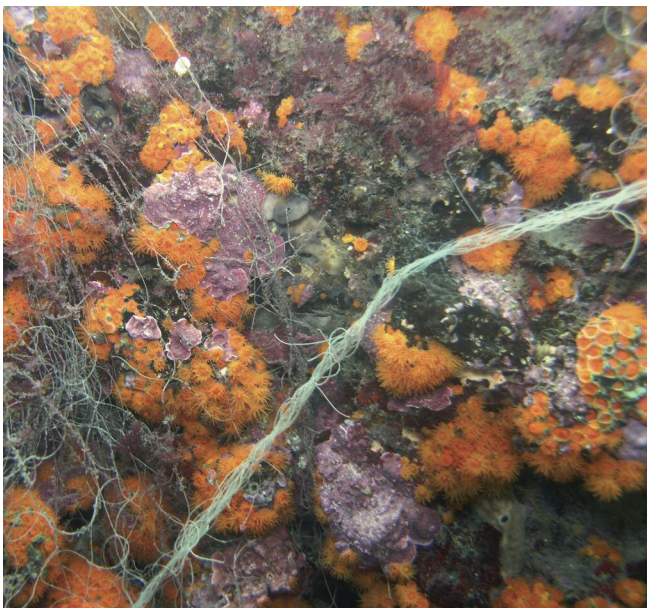
[6] See Appendix 3.

[7] https://cites.org/eng/disc/what.php

[8] Article II, Fundamental principles, Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973.

[9] *Ibidem*.

[10] See Appendix 4.



Remains of gillnets fishing gear in the orange coral *Astroides calycularis*. © Alejandro Terrón-Sigler (Project sosredes.org, Asociación Hombre y Territorio).

Mediterranean countries concerning their trade and regulations. The inclusion in Appendix I or II of the CITES list of the endangered Red Coral C*orallium rubrum* is however needed to protect it, as current measures are not enough to ensure its survival and the conservation of the marine habitats it supports. Other anthozoan species that could be subject to an illegal trade (e.g. *Savalia savaglia, Ellisella paraplexauroides*) should be proposed for being listed in the CITES Appendices (I, II or III, depending on the impact of trade in the particular species).

Under the Protocol concerning Specially Protected Areas and Biological Diversity (*Protocol SPA/BD*)[11] of the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean[12] (**Barcelona Convention**), Annex II lists the endangered or threatened species in the Mediterranean Sea, and Annex III those species whose exploitation is regulated in the Mediterranean basin.

Only five of the 17 threatened anthozoan species are presently granted protection under Annex II and the Red Coral is included in Annex III (Appendix 4). Increasing the legal protection by fostering contracting parties to renew the amendment process and adding these species into Annex II is urgently needed, particularly for the Critically Endangered *Isidella elongata* and other currently threatened anthozoan species which are excluded.

Contracting Parties to the Barcelona Convention need to adhere to the Protocol SPA/BD; some States, such as Greece or Israel still have not ratified this highly relevant legal instrument in the Mediterranean context. Moreover, there is a gap in the national legislations for the protection of anthozoans, as few Mediterranean states have adopted legal measures following the agreements under the Conference of parties of the Barcelona Convention. Hence, considering that almost all of the Mediterranean countries have ratified the Protocol SPA/BD, if it is efficiently translated and enforced at the national level, the Protocol could strengthen the protection of threatened anthozoans by filling the gaps that remain in the national legislation of Mediterranean States. Moreover, the two Action Plans of the SPA/BD protocol could further drive trans-boundary activities and a common framework to enhance the conservation of some of these species. These are the Action Plan for the conservation of habitats and species associated with seamounts, underwater caves and canyons, aphotic hard beds and chemo-synthetic phenomena in the Mediterranean Sea (Dark Habitats Action Plan), and the Action Plan for the conservation of the coralligenous and other calcareous bio-concretions in the Mediterranean Sea. Both of them propose a series of initial measures to conserve habitats and their species.

Another regional Convention established in the framework of the Council of Europe, the Convention on the conservation of European wildlife and natural habitats (**Bern Convention**[13]), is formed by mostly members of the Council of Europe, four African countries[14] and other non-Council members. Within this Convention, Appendix I is a list of strictly protected flora species, Appendix II lists the strictly protected fauna species, Appendix III lists the protected fauna species and Appendix IV concerns the prohibited means and methods of killing, capture and other forms of exploitation.

Currently, the Convention contains nine species of anthozoans (Appendices II and III), a smaller number compared to the Protocol SPA/BD of the Barcelona Convention. However, as it has been ratified by many non-Mediterranean and Mediterranean countries (except Algeria, Lebanon, Egypt and Israel), it could serve as a relevant legal instrument for the protection of threatened species including those found in the Atlantic, Black Sea and Mediterranean Seas. Therefore, the Appendices should be considered for amendment in order to include the currently threatened Mediterranean species. Moreover, ratification of the Convention by Mediterranean states should be encouraged, by those countries that still are not Contracting Parties to the Convention.

[11] Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean, Barcelona, 1995.

[12] Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, 1976, Barcelona.

[13] Convention on the Conservation of European Wildlife and Natural Habitats, Bern, 1979.

[14] Two are from North-Africa, Morocco and Tunisia.

5.1.3. Include species and habitats of principal importance in the European Union legislation

In the European Union legislation, two legal instruments contain legal provisions relevant for the protection of anthozoans species: the European Union Wildlife Trade Regulations and the Habitats Directive (Appendix 4).

The European Union Wildlife Trade Regulations were established to implement the provisions of the CITES, taking into account the European Single Market policy and the absence of systematic border controls within the EU. The Council regulation 338/97 of 9 December 1996 on the protection of species of wild fauna and flora by regulating trade therein[15] is part of this set of trade regulations. Hence, all anthozoan species present in Annex B of the EU Council regulation are therefore the same as the ones in CITES Appendix II, and are subject to the same level of protection and trade regulation measures.

Furthermore, the European Union has developed a network of protected areas, the Natura 2000 Network. This network is based on Council Directive 92/43 of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) and Directive 79/409/CEE on the conservation of wild birds[16] (Birds Directive). The Habitats Directive designates in its Annex I the list of natural habitat types of community interest whose conservation requires the designation of Special Areas of Conservation (SACs). Annex II, on the other hand, establishes a list of animal and plant species of community interest whose conservation requires the designation of SACs. Furthermore, two additional annexes include species protection measures: Annex IV is a list of animal and plant species of community interest in need of strict protection, and Annex V lists animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures.

According to this Directive and in order to build a coherent and representative Natura 2000 network, European countries must designate sites that might host several habitats as defined by the Interpretation Manual of the European Union, as well as maintain their good conservation status. 'Reefs' (habitat type EU 1170) are included in Annex I, and according to the Interpretation Manual, reef habitats[17] can be considered those formed by different anthozoan species such as facies and forests of gorgonians and black corals (*Eunicella* spp., *P. clavata, E. paraplexauroides, Leptogorgia* spp.), *Isidella elongata* and *Callogorgia verticillata* gardens, facies of Red Corals (*Corallium rubrum*), *Cladocora caespitosa* reefs, *Astroides calycularis* facies, banks of *Dendrophyllia cornigera* and *D. ramea* banks, or white corals banks of *Madrepora oculata* and *Lophelia pertusa*.

The inclusion of 'Reef' habitats in the Mediterranean as a '*Priority habitat type*' in the EU Habitats Directive (92/43/EEC) should be regarded as a conservation priority for EU Mediterranean countries to enable the creation of SACs including anthozoan hotspots in the Mediterranean Sea, monitor habitats and species, and ensure their conservation or restoration to a favorable conservation status. Furthermore, the present annexes of the Directive should be revised to include the threatened anthozoans in the IUCN Red List in Annexes II, IV and V (depending on the protection needed by the species).

5.2. Addressing the interaction of threatened species with fisheries

By-catch

Several anthozoan species are threatened by commercial fisheries that capture them as by-catch (see Boxes 2 and 5). Indeed, trawling and dredging fishing gear have large impacts on the populations of anthozoans and biodiversity hotspots (e.g. Bongiorni *et al*. 2010; D'Onghia *et al*. 2016). By-catch of anthozoans is also recorded with the use of professional trammel nets, gillnets and longlines and it is particularly relevant on structuring species thriving both on hard and soft bottoms.

The General Fisheries Commission for the Mediterranean (GFCM), as a Regional Fisheries Management Organization (RFMO) of FAO, has developed several recommendations and regulations with measures to protect sensitive habitats and anthozoans (Appendix 4).

Among them, of relevance for deep sea anthozoans, the GFCM Recommendation 29/2005 on the management of certain fisheries exploiting demersal and deep water species[18] prohibits the use of *'towed dredges and trawl nets fisheries at depths beyond 1000 m of depth'*. Moreover, few Fisheries Restricted Areas (FRA) have been designated in the Mediterranean in order to protect shallow and deep sea sensitive habitats[19] and the recovery of certain fisheries stocks (Recommendation GFCM/30/2006/3). Considering this, towed dredges and bottom trawl nets are

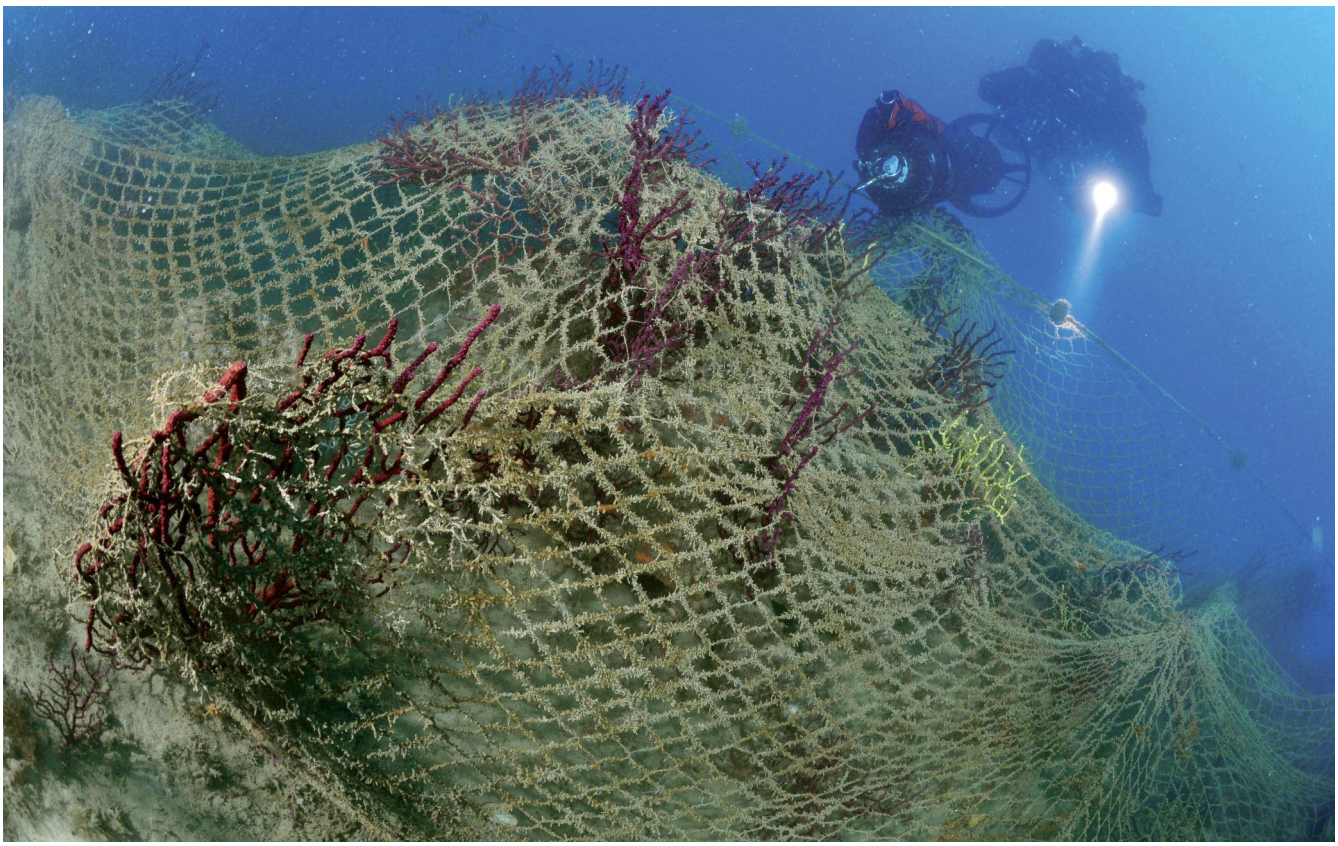
[15] COUNCIL REGULATION (EC) No 338/97 of 9 December 1996 on the protection of species of wild fauna and flora by regulating trade therein.

[16] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (this is the codified version of Directive 79/409/EEC as amended).

[17] http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

[18] REC.CM-GFCM/29/2005/1 Management of certain fisheries exploiting demersal and deep-water species.

[19] REC.CM-GFCM/30/2006/3 Establishment of fisheries restricted areas in order to protect the deep sea sensitive habitats.



Ghost fishing nets entangled in a gorgonian forest. © Bruno Borelli, Portofino Divers.

prohibited in designated FRA sites like the '*Lophelia* reef of Capo Santa Maria di Leuca' and 'Eratosthenes Seamount'. These areas contain rich populations of scleractinian corals, rare deep water sponges, zoanthids and antipatharians, among other rich and vulnerable biodiversity.

Further implementation and adoption of measures for the protection of VMEs following United Nations General Assembly (UNGA) Resolutions 59/25, 61/105 and 64/72 and enforcement of the regulations at the present sites designated as FRAs will be important to protect threatened deep-sea anthozoan species in the coming future.

For EU Mediterranean countries, the Common Fisheries Policy (CFP) is the main policy framework and instrument for managing European fishing, together with the national policy of each Member State. This policy, with the Habitat Directive and the Marine Strategy Framework Directive, also gives Member States the chance to play an active role in designing fisheries conservation measures and is currently developing a new framework proposal for technical conservation measures that goes in line with other GFCM recommendations. Within the context of the current proposal for regulation of the European Parliament and Council, measures to mitigate the impacts of fishing gears on sensitive species or closed areas to protect sensitive habitats (e.g. cold water coral reefs) are included [20].

Target fisheries of anthozoan species

The Red Coral, *Corallium rubrum* (Box 6), is one of the most valuable coral species, exploited for one thousand years to produce jewels, talismans and artistic objects. Its long history of intensive commercial harvesting has resulted in a well-documented decline of its stocks throughout the Mediterranean Sea, becoming especially apparent during the last two decades (Tsounis *et al*. 2007). Due to this, several Mediterranean countries such as France, Algeria, Greece, Italy, Morocco, Spain and, Tunisia, have developed national legislation to regulate Red Coral fishing[21] in their territorial waters or adopted the regulations by GFCM. During the 1980s, at least 25 locations supported the harvest of *Corallium rubrum*, while today the only known official and commercially viable beds are found along the African coast in Tunisia, in Greece, in the Bonifacio Strait off western Sardinia, Italy, and off Costa Brava and Mallorca, Spain (Tsounis *et al*. 2007). Exploitation of new areas is believed to occur in the short-term also off Morocco, Algeria and

[20] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the conservation of fishery resources and the protection of marine ecosystems through technical measures. COM(2016) 134 final.

[21] See Appendix 3.

probably Libya, with harvest in deeper water habitats (Cau *et al.* 2015). Countries such as Albania[22] and Turkey[23] have banned this activity, due also to the fact that coral divers were impacting other species of commercial interest[24].

Corallium rubrum harvesting has been regulated only at the national level until recently, often in separate and uncoordinated ways in the different Mediterranean countries. As such, for example in Corsica, the French Ministerial order of 6 July 2006 regulated Red Coral fishing through the Corsican Prefect, the responsible institution to deliver fishing authorizations. Similarly, in Morocco, the Decree nº 2-04-26[25] of 2005 established that Red Coral fishermen should have a specific fishing license which needed to be delivered by the competent administrative authority. The same type of measure exists in Italy since 1979 by the Regional Law of 5 July[26], providing that Red Coral fishing shall be exercised by professional fishermen in possession of a regional authorization.

Today, most of the Mediterranean states, following the GFCM Recommendations in 2011 and 2012, have adopted the binding recommendations, imposing minimum size and depth limits to harvest Red Corals (Recommendations GFCM/35/2011/2 and GFCM/36/2012/1). Furthermore, given the progressive impoverishment of shallow populations, some countries or regions have adopted stricter regulations than those originally imposed by the GFCM (i.e. Sardinia) while the adoption of a Regional Management Plan by the GFCM Secretariat is under development.

Following the GFCM Recommendation 35/2011[27], coral harvesting using the Saint Andrews' Cross and other coral dredges that existed since ancient times are currently banned, and the only gear permitted for harvesting is a hammer by scuba divers. This recommendation also prohibits the exploitation of Red Coral populations at depth less than 50 m[28] and restricted the use of remotely operated vehicles (ROVs) for scientific purposes and first identification of harvest areas in zones under national jurisdiction until 2015. Until December 2017, the use of ROVs for Red Coral observation and prospection operations is no longer allowed unless justified by scientific advice.

Since the implementation of this set of recommendations in different countries, SCUBA diving to harvest coral has proved to be a less destructive harvesting technique than those previously used. Nonetheless, it has also allowed the exploitation of corals along vertical slopes, under overhangs, near cave entrances and in crevices where coral dredges cannot operate (Rossi *et al.* 2008). Today, coral divers in France, Italy, Tunisia and Spain typically descend to depths of 30 to 100 m on air, but depletion of shallow resources is forcing more divers into deeper waters (up to 140 m) using mixed gases (Bruckner 2009).

The present GFCM adopted measures means that Mediterranean Red Coral fishers need to record and report to national authorities their daily catches and fishing effort by area and depths. This information should be submitted yearly to the GFCM Secretariat for the consideration and advice of the Scientific Advisory Committee (SAC). Moreover, GFCM Recommendation 36/2012 on further measures for the exploitation of Red Coral in the GFCM area[29] regulates that Red Coral fisheries need to have a legal minimum size for colonies to be harvested, with a minimum basal diameter of at least 7 mm at the trunk. It also regulates that landing is only allowed in a limited number of ports and that the lists of designated ports should be communicated to the GFCM Secretariat for monitoring.

Following these, some countries and the EU[30] have implemented different regulations and legislative procedures to regulate further this type of fishery. For example in the Atlantic side of Morocco, the Ministerial order nº 2776-14[31] restricts Red Coral fishing to 400 kg per year and the Decree nº2-04-26 regulates the landing ports according to the Red Coral fishing permits. Red coral harvest is not presently allowed in the Mediterranean side of Morocco. Similarly, in Spain, Royal Decree 629/2013[32] adapting the last GFCM Recommendations established more requirements for fishing, with a system of licensing and control programmes, an authorization procedure for extraction and sale, the reduction of the annual total weight of the catch, the establishment of a minimum size, a tolerance margin for the size restriction and a new logbook to record Red Coral fishing data.

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22 Law No. 7908, dated on 05. 04.1995 ON FISHERY AND AQUACULTURE, prohibits at the article 22 the fishing of corals and sponges.

23 Notification No. 2012/66 regulating non-commercial fisheries. - 18 August 2012, article 10 and Notification No. 2012/65 regulating commercial fisheries. - 18 August 2012, article 16.

24 Bussoletti, E., D. Cottingham, A. Bruckner, G. Roberts, and R. Sandulli (editors). 2010. *Proceedings of the International Workshop on Red Coral Science, Management, and Trade: Lessons from the Mediterranean*. NOAA Technical Memorandum CRCP-13, Silver Spring, MD 233 pp. p. 119.

25 Decree n° 2-04-26 of 6 hija 1425 (17th January 2005) fixing the conditions and modalities of red coral fishing.

26 Legge Regionale 5 luglio 1979, n. 59 Regolamentazione della pesca del corallo.

27 REC.CM-GFCM/35/2011/2 On the exploitation of red coral in the GFCM Competence Area.

28 "...until scientific studies, as validated by GFCM-SAC, indicate otherwise". REC.CM-GFCM/35/2011/2 On the exploitation of red coral in the GFCM Competence Area, paragraph 13.

29 REC.CM-GFCM/36/2012/1 On further measures for the exploitation of red coral in the GFCM Competence Area. Spain has a derogation to allow fishing above 50 m.

30 Regulation (EU) 2015/2102 of the European Parliament and of the Council of 28 October 2015 amending Regulation (EU) No 1343/2011 on certain provisions for fishing in the GFCM (General Fisheries Commission for the Mediterranean) Agreement area.

31 Ministerial order nº 2776-14, 24th July 2014, regulating red coral fishing in the maritime zone situated between Cap Spartel and Larache.

32 Royal Decree 629/2013, 2 August to regulate red coral fishing, sales and proceedings to get authorizations for fishing licences.

Box 6. The Red Coral *Corallium rubrum*

The emblematic Red Coral *Corallium rubrum* is a colonial species from the Mediterranean Sea and neighbouring Atlantic rocky shores (up to the Cabo Verde Archipelago), living between 5 to more than 800 m depth, although most populations are found between 30 and 150 m depth. It is commonly found in hard substrate ecosystems of prime ecological importance, such as the coralligenous assemblages on steep walls, sublittoral caves, small cavities, and overhangs. Often, it coexists with a rich fauna of benthic invertebrates, such as other anthozoan species (gorgonians and hard corals), sponges, as well as calcareous algae (e.g. Ballesteros 2006; Costantini *et al*. 2010). Research has shown that the Mediterranean Red Coral can live more than 100 years and its slow recruitment and growth rate (colonies grow in diameter about 0.25 mm per year, with a higher growth in the early stages of life) hightlight the slow recovery times of disturbed populations (Marschal *et al.* 2004).

Today, the Red Coral *Corallium rubrum* is considered one of the nine most precious corals harvested for jewelry in the world. Harvest guidelines, quotas and a ban on the use of dredges have been implemented by different Mediterranean countries to regulate the fisheries (see *Target fisheries of anthozoan species* section). Despite these efforts, the long intensive harvesting (legal and illegal) of the corals, besides other human-induced threats acting at local and subregional scales, such as habitat destruction (trawling, anchoring), sedimentation, pollution, too frequent recreational diving, and more recently, mass mortality events linked to the current warming trend reported for the Mediterranean, are and have been affecting the populations.

Recent Mediterranean studies have echoed the vulnerability of these corals (e.g. Bavestrello *et al*. 2014a; Garrabou *et al*. 2009; Harmelin, 2004). A decrease in catch landings of 60% during the last thirty years, combined with the observed local depletions and extinctions, imply an estimated decline that almost certainly exceeds 30% over the past 30 years (one generation). As threats are ongoing, the species is listed as Endangered, considering its past and future decline may well exceed 50% unless the threats are addressed.

The enforcement of current regulations on fisheries and monitoring across Mediterranean countries to reduce poaching and produce accure stock assessments, setting up new sanctuaries for Red Coral populations across its main areas and depths of distribution, as well as evaluating and implementing restoration programmes based on transplants for shallow populations, will allow better conservation and a more sustainable use of this coral resource.

Corallium rubrum at Medes MPA, Catalan coast, Spain. © OCEANA/Juan Cuetos.

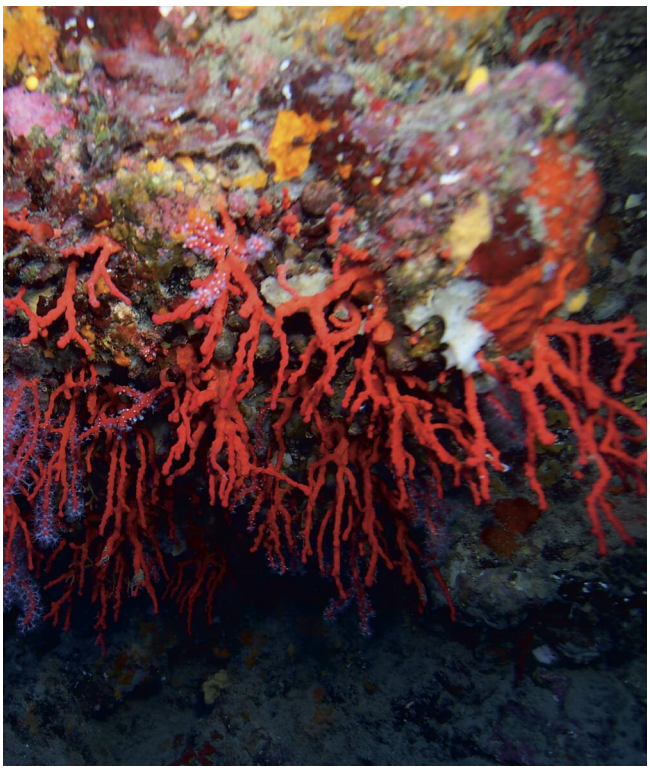
In Greece, Presidential Decree 174/1994[33] and the Ministry Decision 240102/1995 following Greek Law 1740/1987 imposed a general framework for the exploitation of Red Coral stocks and the use of a rotating harvesting system in Greek waters since 1994. With a maximum of 10 licenses given each year, the harvesting system covers five large fishing geographical zones and stipulates that each area should be harvested for a maximum of 5 years, on a rotational basis, followed by a 20-year closure period. The same system has been implemented in Algeria by the Decree of 26 August 2015, fixing terms and conditions for Red Coral fishing with a new decree will establish the opening of the fishing in 2017.

The discovery of new fishing grounds for the exploitation of Red Corals is also regulated in some countries. In Italy, for example, Regional Law of 14 July 1965[34] provides in its article 16 that the "discoverer" of new coral fishing grounds has the exclusive right to exploit the area for the duration of two fishing seasons and further exploitation by others without authorization could be penalized (article 28 of the same law).

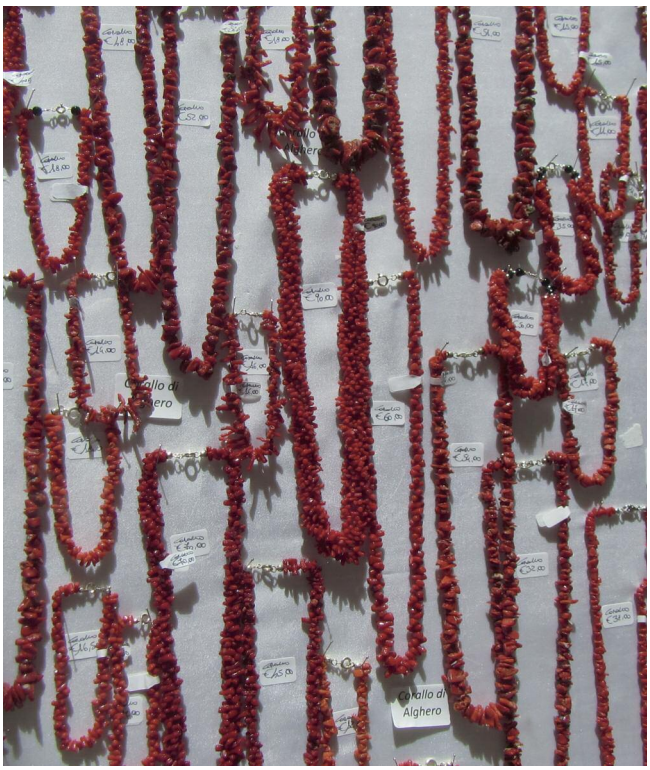
Despite all these regulations, the increased reports of illegal fishing (e.g. Dounas *et al.* 2010; Tsounis *et al*. 2006; Rossi and Gili 2007; Santangelo *et al*. 2014) and the endangered status of *C. rubrum,* highlight the vulnerability of this species to fishing and the need to revise its present management in the

[33] Greek Presidential Decree 174/1994, 24th October 1994.

[34] L 14/07/1965 Num.963 / Legge 14 luglio 1965, n. 963 (in Gazz. Uff., 14 agosto, n. 203). - Disciplina della pesca marittima.



Red coral *Corallium rubrum*. © Oscar Ocaña.



Mediterranean Red Coral Jewelry. © Mar Otero.

Mediterranean Sea. Furthermore, the management implications of a shift in the size/age structure on reproduction and recruitment of Red Coral populations (e.g. Bramanti *et al.* 2014), the increases in harvesting of smaller-sized colonies, including undersized corals, for the manufacture of jewelry from reconstituted coral, the removal of entire colonies including the bases (reducing the possibility of regeneration) and the progressive expansion into deeper areas, have been previously highlighted. All of these indicate that current measures should be reexamined and adjusted based on new information on the biology and population dynamics of the species and the present status of the populations.

An assessment to evaluate the current stock, real status of the fisheries at the countries and the feasibility of management measures for controlling illegal exploitation with the assessment of the *Corallium rubrum* trade in the Mediterranean states would help to better outline a sustainable trade, and set the most realistic target to preserve this species. Further implementation by all countries of GFCM Recommendations concerning the regulation of Red Coral fishing, most importantly measures to combat illegal, unreported and unregulated fishing activities together with the adoption of a Regional Adaptation Management Plan[35] that covers the above aspects, are necessary to ensure the sustainability of these fisheries and that their survival is not threatened by the continued harvesting of the populations.

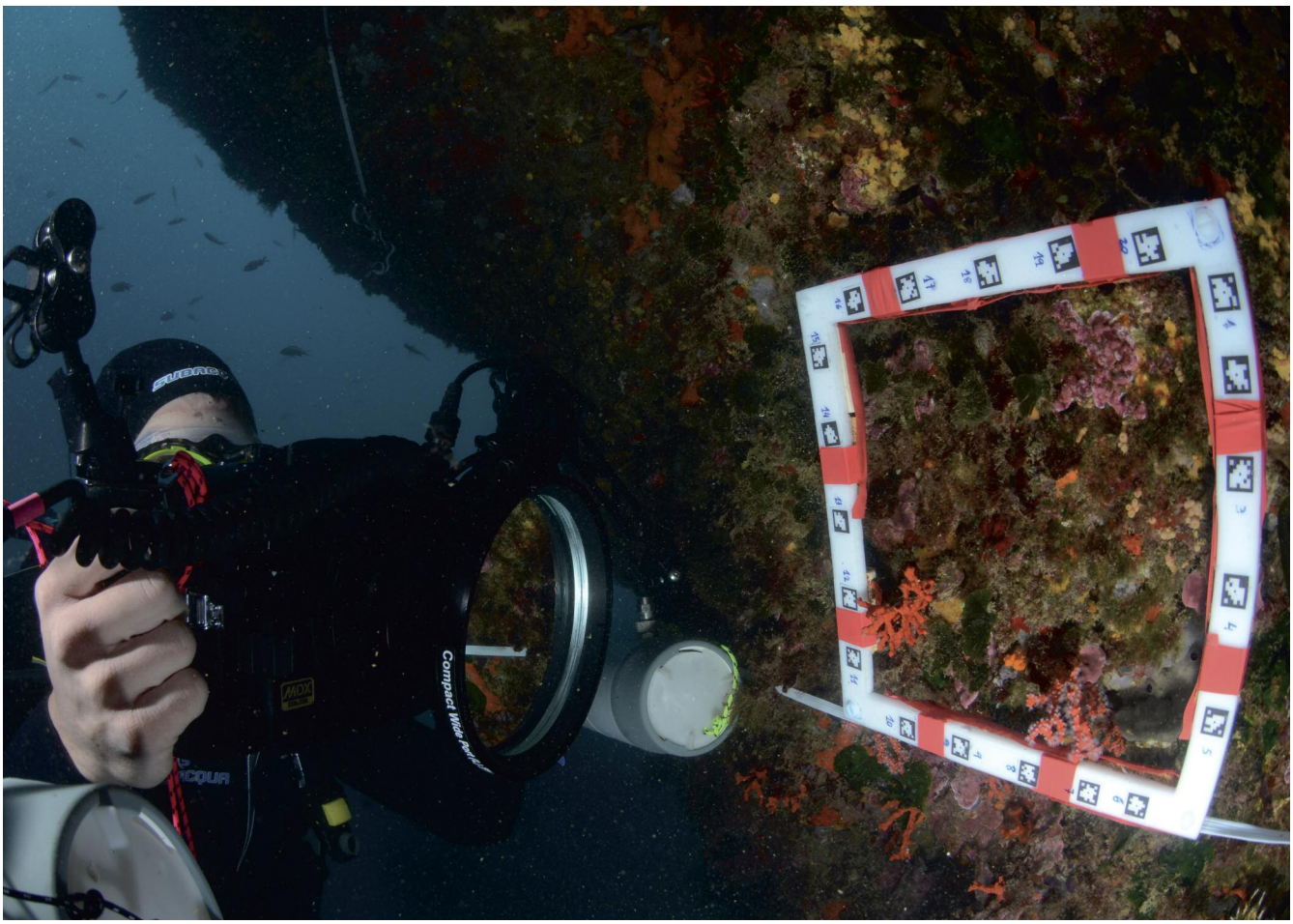
Other harvested species

As previously mentioned, small scale harvesting of sea anemones *Anemonia viridis* exist in some areas such as Sardinia and Trieste (Italy), Marseille (France), Andalucia region (Spain) and Pagasitikos Gulf (Greece). In Andalucia, this coastal fishery and trade is regulated by regional decrees and an ordinance[36] that establish the capture limits (e.g. 12 kg/day/person), days and fishing schedule, periods of closure, marketing of catches, mode and gear of capture, licences and monitoring programmes. It will be important to assess the importance of this fishery in other Mediterranean regions and if necessary, establish suitable regulations to maintain a sustainable fishery in line with the conservation of the species.

Currently, it is also known that other anthozoans such as the golden coral *Savaglia savaglia,* the red gorgonian *Paramuricea clavata, Ellisella paraplexauroides*, or some black corals are targeted by unregulated and illegal (IUU) fishing activities (e.g. Giusti *et al.* 2015; Maldonado *et al.* 2013; Deidun *et al.* 2015). However, there is no information on the extent of these practices at country level, and more efforts are needed to assess and enforce, if necessary, measures to prevent, deter and eliminate the fishing of these protected species.

[35] http://www.fao.org/3/a-i5646b.pdf

[36] Order of July 15, 1993, as amended by 25 March 2003. Resolution 30th November 2006 for license periods.



Monitoring benthic marine communities with photo quadrats. © Joaquim Garrabou.

5.3 Improving monitoring

Much of the information known today about anthozoans is available from relatively small sites such as MPAs and sporadic studies of benthos with short-term research projects. Comprehensive distribution maps for many species are still lacking and frequently reports only record presence/absence data and scarce or no information on trends and conservation status. This lack of information, together with reduced available funding and the high costs of marine field work, make regular monitoring programmes in many Mediterranean regions difficult to support and implement.

Monitoring programmes for anthozoans (threatened, endemic or structural species particularly) need to be established in all countries, to determine population trends and improve the accuracy of red listing in future years. Such monitoring programmes would also help to better predict threatened species trajectories and the effectiveness of conservation interventions under future climate change scenarios.

Citizen science initiatives based on volunteer divers could be useful to acquire data on the distribution of anthozoans and their habitats in coastal areas. Data are already being collected through several initiatives across the Mediterranean Sea, gathering precious information on the distribution of species and their threats.

Within the Barcelona Convention, the new Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP)[37] aims to assess the status of the Mediterranean Sea and coast, as a basis for further and/or strengthened measures. In its initial phase (2016-2019), the existing national monitoring and assessment programmes of each Mediterranean country will be integrated, in line with the IMAP structure and principles and based on some basic common indicators. Among the common and candidate indicators agreed upon, which are at the core of IMAP, there are several that will provide good information to follow anthozoan population development and conservation status (named *habitats' distribution ranges, condition of the*

[37] **UNEP**(DEPI)/MED IG.22/28. Athens, 2016.

habitat's typical species and communities, by-catch of vulnerable and non-target species, non-indigenous species, litter and pollution).

The IMAP programme will be further supported for other ongoing policies, particularly the GFCM Mid-term Strategy and the EU's Integrated Maritime Policy for the conservation and management of the marine environment with the **Marine Strategy Framework Directive (MSFD 2008/56/EC)** that aims to achieve Good Environmental Status (GES) of marine waters by 2020. Member States are required to implement the MSFD by developing a Marine strategy with assessment, monitoring programmes and programmes of measures for achieving the GES of the marine environment.

In view of the present results on the vulnerability of Mediterranean anthozoans, it will be important that these programmes develop appropriate long term monitoring projects to obtain baseline population abundance information on the species and their ecological communities, as well as on their biotic and abiotic factors. This will allow monitoring population trends, which is especially relevant in the current context of global change impact, and will support adaptive management and conservation actions.

5.4 Prioritize research and gaps in knowledge

More research on the distribution, biology and ecology of different anthozoan species is necessary to guarantee their conservation, particularly Data Deficient species. Field research should be carried out along the whole basin and this is particularly needed for the southern and levantine basin, where there is a lack of information for many groups and the main ecosystems where they thrive. On deep circalittoral, slope and bathyal environments, it is important to improve the knowledge on the population dynamics and reproduction traits of cold-water corals, sea pens, black corals and bamboo corals to develop management and conservation plans for the Mediterranean context. For sea pen (pennatulacean) communities, research needs to be developed on community and habitat description (species characterization, geographical distribution), impacts and by-catch of fisheries and population dynamic studies in order to assess the resilience of populations to natural or human-induced changes.

More information is required on the geographical and bathymetric distribution of gorgonians and other anthozoans, demographic characteristics, health status and population trends at the Mediterranean scale, and over the whole bathymetric range where threatened and Data Deficient species are present. The responses to global change, including the potential for acclimatization (phenotypic response) and/or adaptation (genotypic response) of different species is mostly unknown, although some research has been initiated in the last few years to understand some of these aspects. Studies *in situ* and in aquaria should also focus on the ecological linkages between seawater quality and the effects of other environmental parameters on vital biological processes, such as feeding, growth and connectivity among populations.

Anthozoans are a complex taxonomic group, particularly in terms of relationships between suborders and families, and more research on the taxonomy of some groups and species are required (e.g. anemones, stoloniferans, black corals, zoanthids and ceriantharians). Taxonomy provides the key to understand the origin and historical evolution of species and resolve nomenclatural disputes that once settled will allow future assessment of species for protection. Given the above, it should be noted that recently, taxonomic rearrangement of some Mediterranean anthozoan species such as *Isidella elongata* or *Lophelia pertusa* has been suggested and further integrative studies combining molecular, developmental biology and ecological environmental studies are required to test the potential conspecificity or dissimilarity of findings. The new records of anthozoans in shallow habitats from certain areas of the eastern Mediterranean Sea such as the Sea of Marmara or the coast of Lebanon also demonstrate the historical lack of biological exploration and taxonomic studies in some areas of the Mediterranean Sea.

Establishing underwater observatories in several particular places (e.g. MPAs) may help deliver some of the required information to understand the evolution and trends of species populations at relatively low cost. The ecological significance of some of these species as spawning grounds for invertebrates, refuge and feeding areas for fish and other species is large, but assessments and studies to understand and justify these relationships are few.

Given the current and potential threats in the Mediterranean and the limited knowledge on the response by anthozoans, more efforts are also necessary to understand how these processes and pressures can affect the populations.

5.5. Recovery mechanisms and critical areas. Management strategies

Species close to extinction require special efforts to increase their chances of survival. As climate change and ocean acidification erode the resilience and increase the vulnerability of anthozoans, successful adaptive management will also become more challenging. Reduction of local threats is of primary importance to increase their resilience with programmes to monitor the recovery capacity of damaged populations. Also, the management of threatened anthozoan species can involve improved management of critical areas such as refuge sites, and the translocation of some species.

Transplantation and relocation have been used as a tool to mitigate local impacts on tropical and subtropical corals (mostly

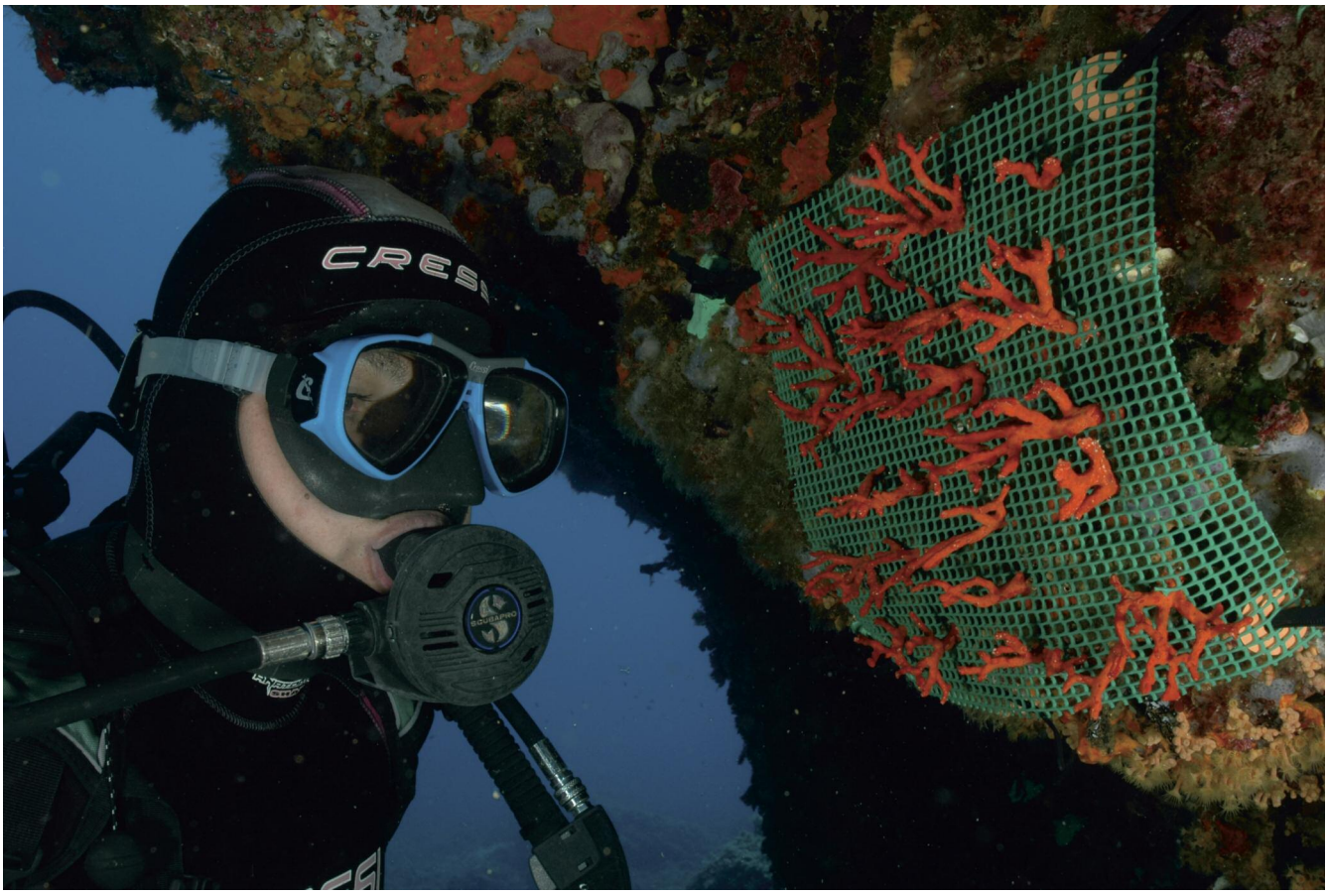
reef forming species) as well as in an attempt to establish new areas for tourist activities worldwide (e.g. Thornton *et al*. 2000). For shallow water species, they can be used as possible and feasible mitigation measures in case no other options and alternatives are available and in the events where the appropriate techniques, methodologies and results are well demonstrated.

Until now, few experimental and pilot studies have been carried out on transplantation of anthozoans with living colony fragments of Mediterranean species from degraded areas. Initial results suggest the feasibility of such restoration measures to enhance recovery of the vulnerable *Paramuricea clavata* at the local scale (Linares *et al*. 2008). Other species such as the orange coral *Astroides calycularis*, have shown mixed results; sometimes with limited success due to unsuitable transplant sites and excessive algae growing (Ocaña *et al*. 2009) or to collection by recreational scuba divers (Zibrowius 1995), others with more encouraging outcomes (Terrón-Sigler *et al*. 2011).

However, further experiments and studies are still needed to evaluate the potential success of similar methodologies in the transplantation of Mediterranean anthozoans and assess if these strategies are cost-effective to boost the size and long-term viability of wild populations. Bearing in mind the slow growth and limited effective dispersal of many Mediterranean anthozoans, conservation plans should be defined at the local and regional scale to facilitate recovery, and, if species do not rely on self-recruitment, allow gene flow from other populations in the region.

Hard and soft corals, gorgonians, black corals, sea pens and anemones can create complex habitats by providing shelter and food for a diverse and productive community. Different studies in the Mediterranean Sea and elsewhere have demonstrated how combined threats may disturb these communities but very heterogeneously among sites (e.g. Sini *et al*. 2015; Fabri *et al*. 2014; Garrabou *et al*. 2009; Coma *et al*. 2004). Areas with natural resilience, such as reserves and MPAs, that are well-managed may have the potential to act as refuges and be particularly important for the persistence and the recovery of the structural species and their associated organisms.

As climate change advances and makes existing threats more severe, other critical sites and/or deeper depths will be important to maintain viable populations of threatened species to enable adaptation. It will be crucial to also identify and protect these new refuge sites and MPAs can provide the most secure option for saving such important habitats. The involvement of different local stakeholders on these initial steps of identification, particularly fishermen, can allow for better information exchange and create a better understanding and responsibility to develop appropriate management measures.



Experimental restoration of red coral in Medes MPA, Spain. © Joaquim Garrabou.

Chapter 6. Conservation status of key Mediterranean habitats dominated by anthozoan species

6.1. Mediterranean gorgonian forests

As previously explained, gorgonian forests are subjected to cumulative threats such as overfishing, habitat destruction, warming and invasive species. The slow dynamics displayed by gorgonians make them especially vulnerable when faced with increasing disturbances.

The Vulnerable *Paramuricea clavata* has been one of the species most severely affected during mass mortality events associated with the sea warming trend reported in the Mediterranean (Cerrano *et al*. 2000; Garrabou *et al*. 2009), that greatly affected its distribution, demography, and reproduction (e.g. Linares *et al*. 2005, Arizmendi-Mejía *et al*. 2015). In addition, communities dominated by gorgonians are suffering from the invasion of introduced species such as the filamentous red alga *Womersleyella setacea* and the green alga *Caulerpa cylindracea*. Invasive algae can significantly affect the viability of juvenile colonies of *P. clavata*, implying that the long-term viability of shallow Red Gorgonian populations may be jeopardized in the future, especially in the case of populations already impacted by mass mortalities associated with climate warming (Cebrián *et al*. 2012).

Among local stressors, recreational scuba diving is one of the main potential threats for this species because of the beauty of sites where Red Gorgonian populations thrive. In the small Medes Island MPA (Spain, NW Mediterranean), one of the areas with the highest diving activity in the Mediterranean (approx.. 60,000 dives per year), the increase of diving activity has shown a direct impact, with a three-fold increase in mortality rates of gorgonians (Coma *et al*. 2004).

Although *Paramuricea clavata* and other species such as *E. singularis* and *E. cavolini* are common species widely distributed in the Mediterranean Sea, the increasing threats are severely affecting their populations. As a consequence of these global and local stressors, several shallow gorgonian gardens, especially in the Western Mediterranean Sea, have showed large declines during the last decade. This highlights the vulnerable status of the Red Gorgonian species and the risk for other gorgonian

Life in a Mediterranean gorgonian forest. © Frhojdysz | Dreamstime.com.

species as well as the need of management actions to ensure the gorgonians viability in the face of global change.

Similarly, bamboo coral forests seem to thrive only in certain areas and the loss of these unique habitats comes accompanied by a great ecosystemic and biodiversity loss of pelagic or demersal species that gravitate around these habitats.

6.2. Sea pen dominated communities

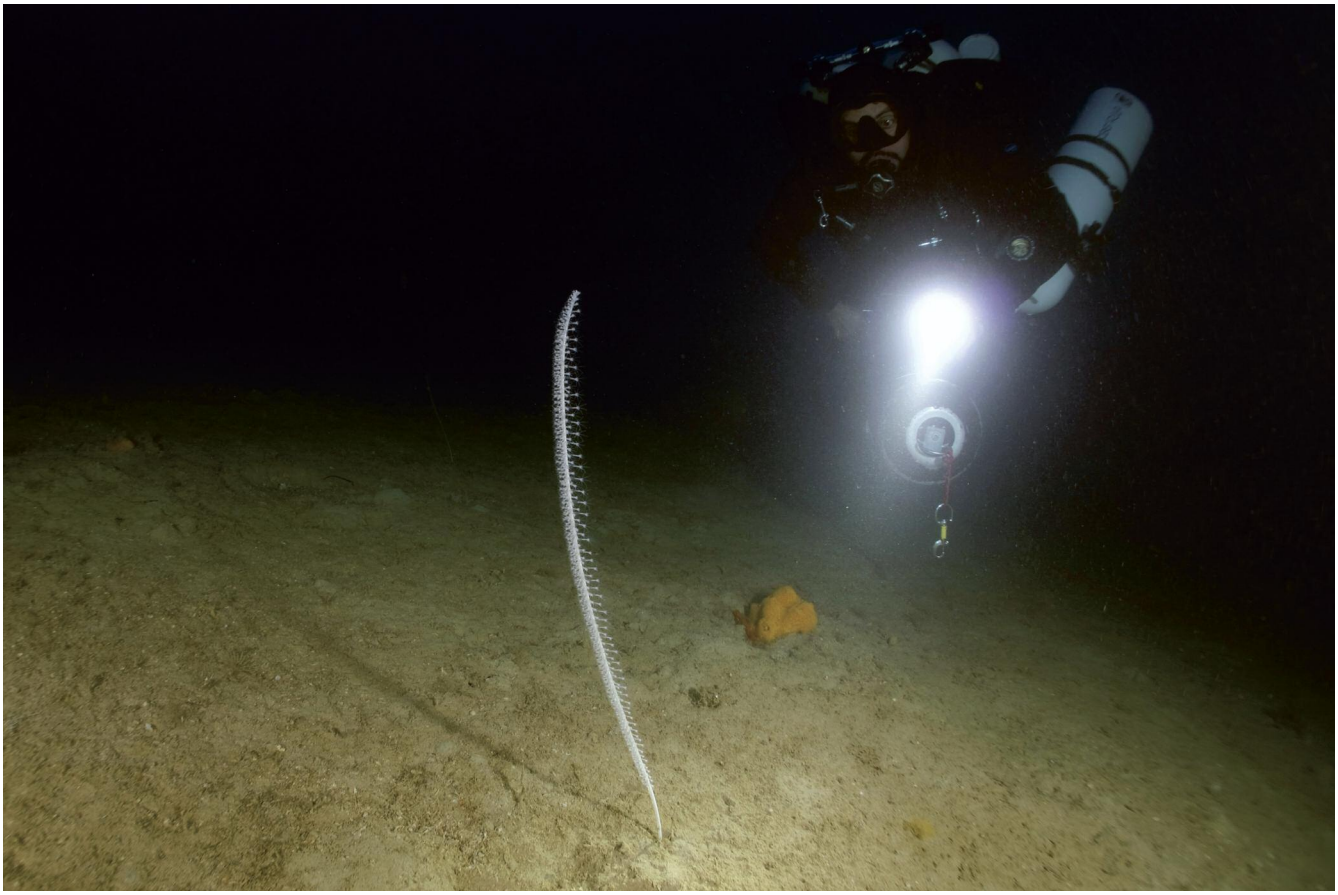
Due to their distribution on muddy and sandy bottoms, and also occasionally on cobbles and rhodolith beds, these species are especially vulnerable to human activities. Many of the most destructive anthropogenic activities, including trawl fishing, oil drilling, sand extraction, waste dumping, etc., occur on and over the beds where they live.

These habitats are considered key sites of aggregation for biodiversity, also supporting a high abundance of species of commercial interest. For example, the tall sea pen (*F. quadrangularis*) beds are considered Essential and Sensitive Habitats (Essential Fish Habitats, EFH) by the General Fisheries Commission for the Mediterranean (GFCM) and the European Commission, due to their fragility and importance for commercial species of crustaceans, such as the Norway Lobster (*Nephrops norvegicus*) and the deep-sea Rose Shrimp (*Parapenaeus longirostris*). The Barcelona Convention includes *Pennatula* beds as unique formations of Conservation Interest under the "Dark Habitats" Mediterranean Action Plan.

The impacts of human activities, particularly the increase in fishing practices over bottoms with pennatulaceans, have provoked sharp declines in several species. It is inferred that *F. quadrangularis*, *P. phosphorea*, *P. rubra* and *P. spinosum* populations in the Mediterranean Sea have decreased by around 40% in the last 20 years and it is expected that this trend will continue in the future.

It is necessary to develop protection plans to avoid the continued degradation and loss of sea pen aggregations, and of the biodiversity that they host. These measures would also imply benefits for Mediterranean commercial fisheries, by protecting Essential Habitats for crustaceans and fishes that spend part of their life cycle in these valuable habitats.

The creation of Marine Protected Areas in the sites where the densest aggregations of sea pens occur, the inclusion of these species in the annexes of the Specially Protected Areas and Biological Diversity in the Mediterranean SP/BD Protocol, together with their recognition as Vulnerable Marine Habitats within the GFCM, will help to stop their decreasing trend and the loss of these important species and communities.



Funiculina quadrangularis in Giannutri Island, Punta Secca, 104 m depth. © Simone Nicoli.

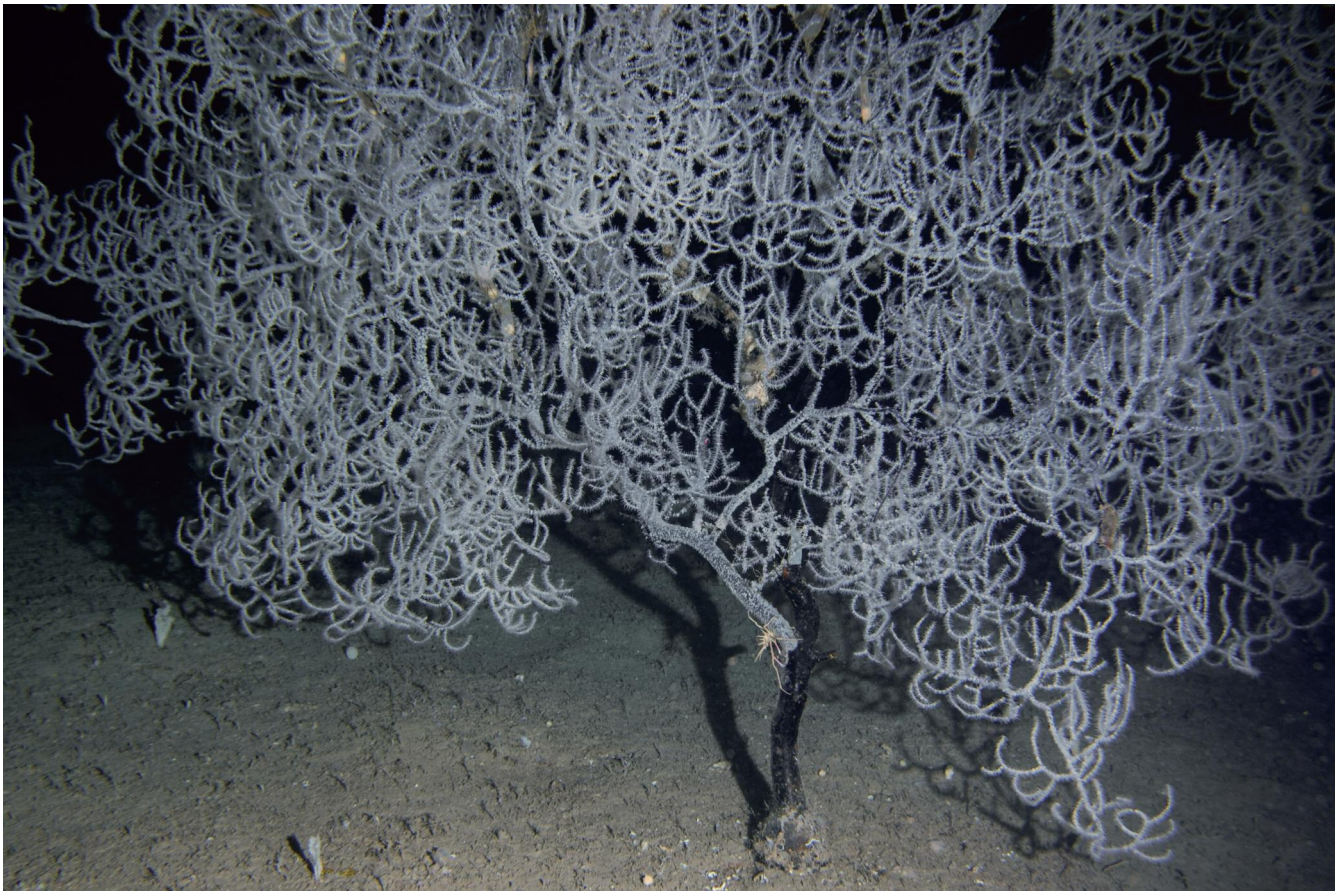
6.3. Mediterranean black coral gardens

The use of ROVs is rapidly reducing the knowledge gap on the distribution of deep Mediterranean black coral species and we know today that black corals are far more common than was thought in the past. ROV exploration is however also proving that the structure and distribution of the existing assemblages may represent a reduction in their original natural abundance. Numerous anthropogenic threats have been recognized for the Mediterranean antipatharian fauna, but the effects of fishing (direct and indirect) are probably the most important. Bottom longlining is generally practiced in untrawlable rocky areas that are good habitats for black corals. These species, due to their tendency to form dense aggregations, to their size and their tree-like morphology, have an increased catchability. In addition, specimens may also be damaged *in situ* by fishing. The most significant impact on the colonies is mechanical damage, their entanglement and the resuspension of nearby soft sediments which may choke them over time. Damaged colonies are also more susceptible to the colonization of epibiont organisms that slowly increase their mortality (Bo *et al*. 2014, 2015).

The available information from fisheries by-catch as well as the ROV observations have informed the decision to list *A. subpinnata*, *A. dichotoma* and *P. larix* as Near Threatened species due to an inferred population reduction of about 20%. Contributing factors include the current distribution of the subpopulations, their current health status, the observed decline in the habitat quality, the biological factors enhancing their catchability and reduced recovery ability, as well as the continuous existing fishing pressure on deep hard grounds. A more severe situation has been inferred for *L. glaberrima*, listed as Endangered due to a decline in the population of about 50% over 100 years due to the millennial life span of this species.

Other pressures to black corals include direct harvesting for jewelry, particularly well documented historically in France, Cyprus, Croatia, Morocco and especially Malta in the 1980s (Deidun *et al*. 2010). Further, deep mass mortality events are known to occur, but are not well known. Other pressures such as sea floor drilling for oil exploration or future mining can and will threaten the integrity of these deep benthic communities.

There is an urgent need for basin-scale management measures focused on the protection of the black coral assemblages as well as a communication plan targeting fishermen and ultimate users to explain the importance of these marine communities. Further actions need to focus on a comprehensive census of the distribution of the deep populations in the Mediterranean basin, increase the knowledge on the biological and ecological characteristics of these species, and identify and designate MPAs with strict fishing restrictions in order to conserve black coral populations.



Leiopathes glaberrima from Carloforte shoal (Sardinia, Italy). © Marzia Bo (UNIGE) & Simonepietro Canese (ISPRA).

6.4. Mediterranean cold water coral reefs and frameworks

Mediterranean cold water coral reefs and frameworks constitute one of the most vulnerable marine ecosystems. Their current distribution, limited to some special areas where they find suitable environmental conditions but also locations which are under anthropogenic impact, demand protection and an adequate management of activities in these areas where they develop.

The available information regarding the current status of the Mediterranean deep water coral populations of *Lophelia pertusa* and *Madrepora oculata* indicate a 40-50% decline over the last 50-60 years, mostly due to bottom trawling, although other fisheries practices such as benthic longline and gill net gears used at the submarine canyons represent additional threats (Orejas *et al.* 2009). Climate change, ocean acidification and fishing impacts, together with their slow growth rates, clearly indicate that damage to these communities would have dramatic consequences for the ecosystem and recovery will take a long time (or may even be irreversible) for these deep water communities.

Several investigations based on aquarium experiments have been published on the potential effects of ocean acidification in cold water coral species in the Mediterranean, and responses seem to be species specific and also highly dependent on the exposure regime (e.g. Maier *et al.* 2013 and references therein, Carreiro-Silva *et al*. 2014, Movilla *et al*. 2014a,b, Rodolfo-Metalpa *et al*. 2015). These studies suggest some degree of acclimation to changes in carbonate chemistry and the long term effects of ocean acidification, but also different types and degrees of impacts on calcification and respiration rates and effects on the skeletal structure that could result in weakening or additional mechanical damage to the reef frameworks.

Given this uncertainty, the precautionary declaration of protection areas and adoption of good management measures should be implemented and replicated at different locations in the Mediterranean to protect these ecosystems.

Additional scientific studies are also essential if we are to understand better the ecology of deep sea corals and their communities to use this information as a tool to legislate and manage the marine environment in a sustainable manner.

Dendrophyllia cornigera off Malaga coast, Spain. © OCEANA.

Chapter 7. Conclusions and recommendations

This report presents the first comprehensive regional IUCN Red List assessment of the anthozoan fauna of the Mediterranean region, with 17 (12.6 %) out of 136 species considered to be threatened. Of these, 1 is Critically Endangered (0.7% of the total), 9 are Endangered (6.7%), and 7 are Vulnerable (5.2%).

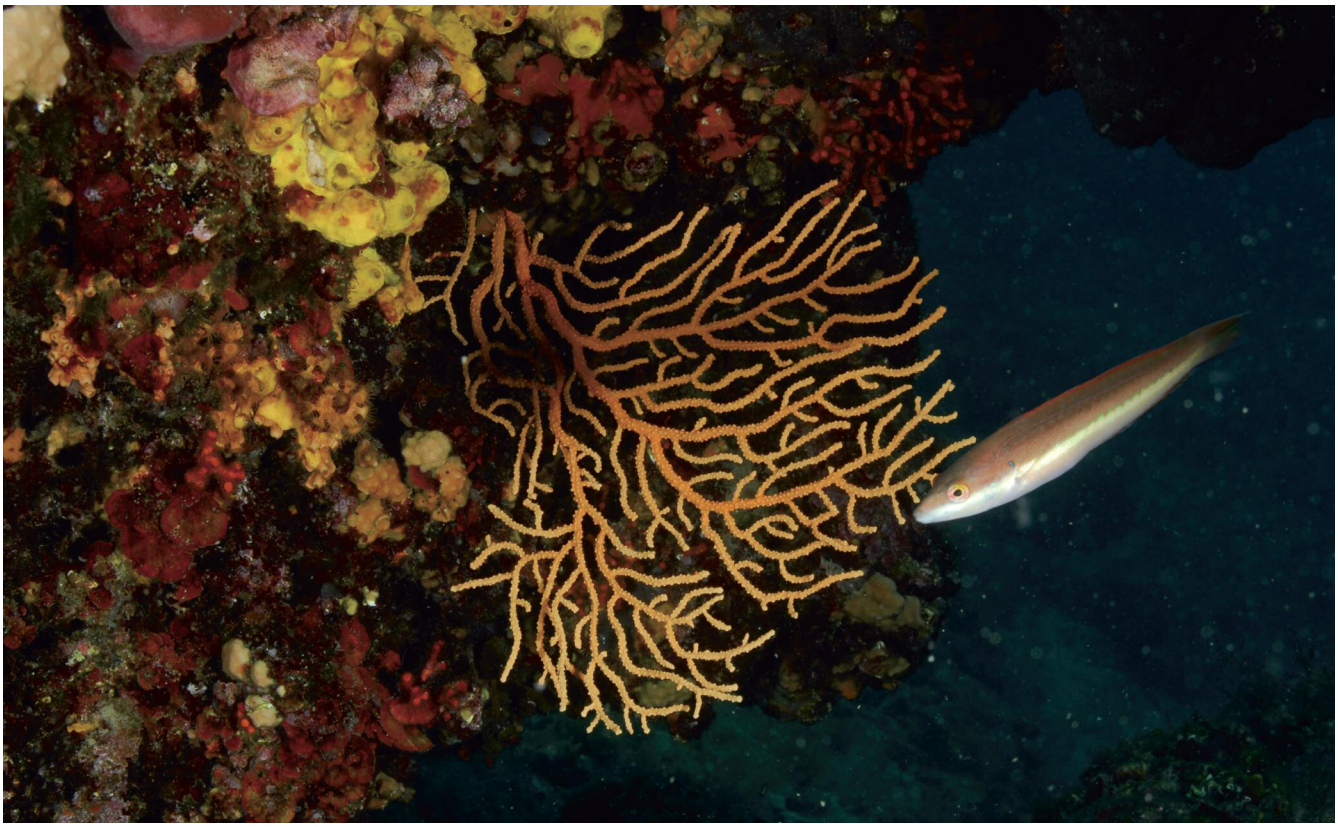
Due to insufficient knowledge and information, 69 (51%) of the assessed species are listed as being Data Deficient in the Mediterranean region. Ten species (7.4%) were listed as Near Threatened, and 40 (29%) were listed as Least Concern.

Increased funding and research attention thus needs to be directed towards both the 17 Threatened species and the 69 Data Deficient species, and particularly the 19 endemic species that are Data Deficient species. More research and survey efforts are need in the south of the Mediterranean including the Levantine Sea, North Africa and deeper waters to fill the data gaps. In particular, more research and survey efforts are needed in the south of the Mediterranean including the Levantine Sea, North Africa and deeper waters.

This is particularly important when there are apparent threats yet virtually no available data on population sizes or biological parameters.

In addition, not all taxonomic groups from the different regions in the Mediterranean have been well investigated and currently undescribed species are expected to be discovered in coming years. Assessing the recently recognized species (Appendix 2) and revising the list of threatened species regularly with the new information available will help to improve management programmes and further identify those areas which require priority conservation action.

Overall, fishing impacts and the increase of seawater temperatures are considered to be the largest threats to anthozoans in the Mediterranean region, in one way or another potentially affecting most or possibly almost all of the species present there. Globally, the conditions for calcified corals and gorgonians are predicted to get worse over the coming century with more frequent and severe mass mortality events expected due to increasing seawater



The gorgonian *Eunicella cavolini* in the Adriatic Sea. © Petar Kružić.

temperature anomalies and a reduction in the rate of calcification brought on by rising temperatures and ocean acidification. The indirect and direct synergic effects of these threats, combined with other local pressures, will further contribute to the loss of populations and habitats formed by these species and their associated biota.

To address all these challenges, coordinated efforts at country level to improve the resilience of local species and their recovery capacity, besides other efforts by the international community to reduce carbon emissions are crucial. In particular, the following are needed:

- Develop adequate national legal frameworks and other instruments to ensure effective protection of threatened species at the local level. This should include building ecologically representative Marine Protected Area (MPA) networks that provide adequate protection to threatened anthozoans with adaptive management programmes that facilitate setting priorities overtime and monitor results;
- Include Mediterranean threatened species within the relevant national and regional legislation and policies;
- Identify valuable and vulnerable marine sites and develop measures (e.g. spatial closures or fishing gear selectivity tools) to protect them from major impacts. This is particularly relevant to species that are fragile and long-lived species with infrequent recruitment.
- Increase knowledge of fishing intensity to fully assess the impact of trawling and other fisheries on different species and assess possible conservation measures.
- Reduce coral and gorgonian by-catch by decreasing mechanical disturbances.
- Revise the present management for Red Coral exploitation and adopt a Regional Adaptation Management Plan by all Mediterranean countries to ensure the recovery of shallow populations and the survival of the species. This plan should also increase the efforts to reduce the illegal harvesting of this and other anthozoan species.
- Establish long term monitoring programmes for endemic or near endemic threatened species that help to design and implement conservation actions at local and regional levels.
- Conduct basic biological research for Data Deficient species as well as clarify the validity of not assessed species.
- Ensure the strong regional cooperation between experts continues, and the capacity in countries where information is scarce increases (particularly North Africa and Levantine Sea area), so that the work carried out to produce the first evaluation of the conservation status of native Mediterranean anthozoans can be updated as new information becomes available.

The hermit crab *Pagurus bernhardus* and the anemone *Calliactis parasitica* in the Mediterranean Sea. © Leonardix | Dreamstime.com.

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Cladocora caespitosa in the Dardanelles (Çanakkale Strait-Turkey). © Bariş Özalp. In some areas around the Dardanelles Strait, this species with *Polycyathus muellerae*, *Phyllangia mouchezii* and *Madracis pharensis* formed particular facies among rocky substrates and on *Polychaete* mounds. (Özalp and Alparslan, 2016).

Mediterranean coralligenous assemblages. © Joaquim Garrabou.

Appendix 1. Summary of regional IUCN Red List status of Mediterranean native anthozoans

Order	Family	Species	Authority	IUCN Red List Category at the Mediterranean level	IUCN Red List criteria	Mediterranean endemic
ACTINARIA	ACTINIIDAE	*Actinia cari*	Delle Chiaje, 1825	DD		endemic
ACTINARIA	ACTINIIDAE	*Actinia equina*	(Linnaeus, 1758)	LC		
ACTINARIA	ACTINIIDAE	*Actinia striata*	(Rizzi, 1907)	DD		endemic
ACTINARIA	ACTINIIDAE	*Anemonia viridis*	(Forsskål, 1775)	LC		
ACTINARIA	ACTINIIDAE	*Aulactinia verrucosa*	(Pennant, 1777)	LC		
ACTINARIA	ACTINIIDAE	*Bunodactis rubripunctata*	(Grube, 1840)	LC		
ACTINARIA	ACTINIIDAE	*Condylactis aurantiaca*	(Delle Chiaje, 1825)	LC		endemic
ACTINARIA	ACTINIIDAE	*Cribrinopsis crassa*	(Andres, 1884)	LC		endemic
ACTINARIA	ACTINIIDAE	*Paranemonia cinerea*	(Contarini, 1884)	DD		endemic
ACTINARIA	ACTINIIDAE	*Paranemonia vouliagmeniensis*	Doumenc, England & Chintiroglou, 1987	EN	B1ab(iii)+2ab(iii)	endemic
ACTINARIA	AIPTASIIDAE	*Aiptasia diaphana*	(Rapp, 1829)	LC		
ACTINARIA	AIPTASIIDAE	*Aiptasia mutabilis*	(Gravenhorts, 1831)	LC		
ACTINARIA	AIPTASIIDAE	*Aiptasiogeton pellucidus*	(Holland, 1848)	LC		
ACTINARIA	ALICIIDAE	*Alicia mirabilis*	Johnson, 1861	LC		
ACTINARIA	ANDRESIIDAE	*Andresia parthenopea*	(Andres, 1884)	DD		
ACTINARIA	BOLOCEROIDIDAE	*Bunodeopsis strumosa*	Andres, 1881	DD		
ACTINARIA	CONDYLANTHIDAE	*Segonzactis hartogi*	Dimitris & Chariton, 2002	DD		endemic
ACTINARIA	HALCAMPOIDIDAE	*Halcampoides purpureus*	(Studer, 1878)	DD		
ACTINARIA	HALOCLAVIDAE	*Anemonactis mazeli*	(Jourdan, 1880)	DD		
ACTINARIA	HORMATHIIDAE	*Actinauge richardi*	(Marion, 1882)	DD		
ACTINARIA	HORMATHIIDAE	*Adamsia palliata*	(Fabricius, 1779)	DD		
ACTINARIA	HORMATHIIDAE	*Amphianthus dohrnii*	(Koch, 1878)	DD		
ACTINARIA	HORMATHIIDAE	*Calliactis parasitica*	(Couch, 1838)	LC		
ACTINARIA	HORMATHIIDAE	*Hormathia alba*	(Andrès, 1880)	DD		
ACTINARIA	HORMATHIIDAE	*Hormathia coronata*	(Gosse, 1858)	LC		

Appendix 1. cont'd, Summary of regional IUCN Red List status of Mediterranean native anthozoans

Order	Family	Species	Authority	IUCN Red List Category at the Mediterranean level	IUCN Red List criteria	Mediterranean endemic
ACTINARIA	HORMATHIIDAE	*Paractinia striata (Paractinauge paxi)*	(Risso, 1826)	DD		endemic
ACTINARIA	ISOPHELLIIDAE	*Telmatactis forskalii*	(Ehrenberg, 1834)	DD		
ACTINARIA	PHYMANTHIDAE	*Phymanthus pulcher*	Andres, 1883	DD		endemic
ACTINARIA	SAGARTIIDAE	*Actinothoe sphyrodeta*	(Gosse, 1858)	DD		
ACTINARIA	SAGARTIIDAE	*Cereus pedunculatus*	(Pennat, 1777)	LC		
ACTINARIA	SAGARTIIDAE	*Sagartia elegans*	(Dalyell, 1848)	LC		
ACTINARIA	SAGARTIIDAE	*Sagartiogeton entellae*	Schmidt, 1972	DD		
ACTINARIA	SAGARTIIDAE	*Sagartiogeton undatus*	(Müller, 1788)	DD		
ALCYONACEA	ACANTHOGORGIIDAE	*Acanthogorgia armata*	Verrill, 1878	DD		
ALCYONACEA	ACANTHOGORGIIDAE	*Acanthogorgia hirsuta*	Gray, 1857	LC		
ALCYONACEA	ALCYONIIDAE	*Alcyonium acaule*	Marion, 1878	LC		
ALCYONACEA	ALCYONIIDAE	*Alcyonium coralloides*	(Pallas, 1766)	LC		
ALCYONACEA	ALCYONIIDAE	*Alcyonium palmatum*	Pallas, 1766	LC		
ALCYONACEA	CLAVULARIIDAE	*Rolandia coralloides*	de Lacaze Duthiers, 1900	LC		
ALCYONACEA	CLAVULARIIDAE	*Sarcodictyon catenatum*	Forbes, 1847	LC		
ALCYONACEA	CLAVULARIIDAE	*Scleranthelia microsclera*	Lopez, Ocaña & Garcia, 1995	DD		
ALCYONACEA	CLAVULARIIDAE	*Scleranthelia rugosa*	(Pourtalès, 1867)	DD		
ALCYONACEA	CORALLIIDAE	*Corallium rubrum*	(Linnaeus, 1758)	EN	A4abd	
ALCYONACEA	CORNULARIIDAE	*Cervera atlantica*	(Johnson, 1861)	DD		
ALCYONACEA	CORNULARIIDAE	*Clavularia carpediem*	Weinberg, 1986	DD		endemic
ALCYONACEA	CORNULARIIDAE	*Clavularia crassa*	(Milne-Edwards, 1846)	LC		endemic
ALCYONACEA	CORNULARIIDAE	*Clavularia marioni*	von Koch, 1891	DD		
ALCYONACEA	CORNULARIIDAE	*Cornularia cornucopiae*	(Pallas,1766)	LC		
ALCYONACEA	ELLISELLIDAE	*Ellisella paraplexauroides*	(Stiasny, 1936)	VU	A4ad; C2a(i); D1	
ALCYONACEA	ELLISELLIDAE	*Viminella flagellum*	(Johnson, 1843)	NT		
ALCYONACEA	GORGONIIDAE	*Leptogorgia lusitanica*	(Stiasny 1937)	LC		
ALCYONACEA	GORGONIIDAE	*Leptogorgia sarmentosa*	(Esper, 1789)	LC		
ALCYONACEA	ISIDIDAE	*Isidella elongata*	(Esper, 1788)	CR	A2bc+4bc	
ALCYONACEA	PARALCYONIIDAE	*Maasella edwardsi*	(Lacaze-Duthiers, 1888)	DD		endemic

Appendix 1. cont'd, Summary of regional IUCN Red List status of Mediterranean native anthozoans

Order	Family	Species	Authority	IUCN Red List Category at the Mediterranean level	IUCN Red List criteria	Mediterranean endemic
ALCYONACEA	PARALCYONIIDAE	*Paralcyonium spinulosum*	(Delle Chiaje, 1822)	LC		
ALCYONACEA	PLEXAURIDAE	*Bebryce mollis*	Philippi, 1842	DD		
ALCYONACEA	PLEXAURIDAE	*Eunicella cavolini*	(von Koch, 1887)	NT		
ALCYONACEA	PLEXAURIDAE	*Eunicella filiformis*	(Studer, 1879)	NT	A3d	
ALCYONACEA	PLEXAURIDAE	*Eunicella gazella*	Studer, 1878	DD		
ALCYONACEA	PLEXAURIDAE	*Eunicella labiata*	Thomson, 1927	DD		
ALCYONACEA	PLEXAURIDAE	*Eunicella singularis*	(Esper, 1791)	NT		
ALCYONACEA	PLEXAURIDAE	*Eunicella verrucosa*	(Pallas, 1766)	NT		
ALCYONACEA	PLEXAURIDAE	*Muriceides lepida*	(Carpine & Grasshoff, 1975)	DD		
ALCYONACEA	PLEXAURIDAE	*Paramuricea clavata*	(Risso, 1826)	VU	A4ace	
ALCYONACEA	PLEXAURIDAE	*Paramuricea macrospina*	(von Koch, 1882)	DD		endemic
ALCYONACEA	PLEXAURIDAE	*Placogorgia coronata*	Carpine & Grasshoff, 1975	DD		
ALCYONACEA	PLEXAURIDAE	*Placogorgia massiliensis*	Carpine & Grasshoff, 1975	DD		
ALCYONACEA	PLEXAURIDAE	*Spinimuricea klavereni*	(Carpine & Grasshoff, 1975)	DD		endemic
ALCYONACEA	PLEXAURIDAE	*Swiftia pallida*	Madsen, 1970	DD		
ALCYONACEA	PLEXAURIDAE	*Villogorgia bebrycoides*	(von Koch, 1887)	DD		
ALCYONACEA	PRIMNOIDAE	*Callogorgia verticillata*	(Pallas, 1766)	NT		
ANTIPATHARIA	ANTIPATHIDAE	*Antipathes dichotoma*	Pallas, 1766	NT		
ANTIPATHARIA	LEIOPATHIDAE	*Leiopathes glaberrima*	(Esper, 1788)	EN	A4c	
ANTIPATHARIA	MYRIOPATHIDAE	*Antipathella subpinnata*	Ellis & Solander, 1786	NT		
ANTIPATHARIA	MYRIOPATHIDAE	*Antipathella wollastoni*	(Gray, 1857)	DD		
ANTIPATHARIA	SCHIZOPATHIDAE	*Parantipathes larix*	(Esper, 1788)	NT		
CERIANTHARIA	ARACHNACTIDAE	*Arachnanthus oligopodus*	(Cerfontaine, 1891)	DD		endemic
CERIANTHARIA	CERIANTHIDAE	*Cerianthus membranaceus*	(Spallanzani, 1784)	LC		
CERIANTHARIA	CERIANTHIDAE	*Pachycerianthus solitarius*	(Rapp, 1829)	DD		
CORALLIMORPHARIA	CORALLIMORPHIDAE	*Corynactis viridis*	Allman, 1846	LC		
PENNATULACEA	FUNICULINIDAE	*Funiculina quadrangularis*	(Pallas, 1766)	VU	A2ab+4ab	

Appendix 1. cont'd, Summary of regional IUCN Red List status of Mediterranean native anthozoans

Order	Family	Species	Authority	IUCN Red List Category at the Mediterranean level	IUCN Red List criteria	Mediterranean endemic
PENNATULACEA	KOPHOBELEMNIDAE	*Kophobelemnon stelliferum*	(Müller, 1776)	LC		
PENNATULACEA	PENNATULIDAE	*Crassophyllum thessalonicae*	Vafidis & Koukouras, 1991	EN	B1ab(ii,iii)+ 2ab(ii,iii)	endemic
PENNATULACEA	PENNATULIDAE	*Pennatula aculeata*	Danielssen, 1860	DD		
PENNATULACEA	PENNATULIDAE	*Pennatula phosphorea*	Linnaeus, 1758	VU	A2c+4c	
PENNATULACEA	PENNATULIDAE	*Pennatula rubra*	(Ellis, 1764)	VU	A2c+4c	
PENNATULACEA	PENNATULIDAE	*Pteroeides spinosum*	(Ellis, 1764)	VU	A2c+4c	
PENNATULACEA	VERETILLIDAE	*Cavernularia pusilla*	(Philippi, 1835)	DD		
PENNATULACEA	VERETILLIDAE	*Veretillum cynomorium*	(Pallas, 1766)	LC		
PENNATULACEA	VIRGULARIIDAE	*Virgularia mirabilis*	(Müller, 1776)	LC		
SCLERACTINIA	ASTROCOENIIDAE	*Madracis pharensis*	De Angelis, 1908	DD		
SCLERACTINIA	CARYOPHYLLIIDAE	*Caryophyllia calveri*	Duncan, 1873	DD		
SCLERACTINIA	CARYOPHYLLIIDAE	*Caryophyllia cyathus*	(Ellis & Solander, 1786)	DD		
SCLERACTINIA	CARYOPHYLLIIDAE	*Caryophyllia inornata*	(Duncan, 1878)	LC		
SCLERACTINIA	CARYOPHYLLIIDAE	*Caryophyllia smithii*	Stokes & Broderip, 1828	LC		
SCLERACTINIA	CARYOPHYLLIIDAE	*Ceratotrochus magnaghii*	Cecchini, 1914	DD		endemic
SCLERACTINIA	CARYOPHYLLIIDAE	*Coenocyathus anthophyllites*	Milne-Edwards & Haime, 1848	DD		
SCLERACTINIA	CARYOPHYLLIIDAE	*Coenocyathus cylindricus*	Milne-Edwards & Haime, 1848	DD		
SCLERACTINIA	CARYOPHYLLIIDAE	*Desmophyllum dianthus*	(Esper, 1794)	EN	A2d+4d	
SCLERACTINIA	CARYOPHYLLIIDAE	*Hoplangia durotrix*	Gosse, 1860	DD		
SCLERACTINIA	CARYOPHYLLIIDAE	*Lophelia pertusa*	(Linnaeus, 1758)	EN	A2d+4d	
SCLERACTINIA	CARYOPHYLLIIDAE	*Paracyathus pulchellus*	(Philippi, 1842)	DD		
SCLERACTINIA	CARYOPHYLLIIDAE	*Phyllangia americana mouchezii*	(Lacaze-Duthiers, 1897)	DD		
SCLERACTINIA	CARYOPHYLLIIDAE	*Polycyathus muellerae*	(Abel, 1959)	LC		
SCLERACTINIA	CARYOPHYLLIIDAE	*Pourtalosmilia anthophyllites*	(Ellis & Solander, 1786)	DD		
SCLERACTINIA	CARYOPHYLLIIDAE	*Thalamophyllia gasti*	(Döderlain, 1913)	DD		
SCLERACTINIA	DENDROPHYLLIIDAE	*Astroides calycularis*	Milne-Edwards & Haime, 1848	LC		

Appendix 1. cont'd, Summary of regional IUCN Red List status of Mediterranean native anthozoans

Order	Family	Species	Authority	IUCN Red List Category at the Mediterranean level	IUCN Red List criteria	Mediterranean endemic
SCLERACTINIA	DENDROPHYLLIIDAE	*Balanophyllia europaea*	(Pallas, 1766)	LC		
SCLERACTINIA	DENDROPHYLLIIDAE	*Balanophyllia regia*	(Risso, 1826)	DD		
SCLERACTINIA	DENDROPHYLLIIDAE	*Cladopsammia rolandi*	Gosse, 1860	DD		endemic
SCLERACTINIA	DENDROPHYLLIIDAE	*Dendrophyllia cornigera*	Lacaze-Duthiers, 1897	EN	A2d+4d	
SCLERACTINIA	DENDROPHYLLIIDAE	*Dendrophyllia ramea*	(Lamark, 1816)	VU	A4a	
SCLERACTINIA	DENDROPHYLLIIDAE	*Leptopsammia pruvoti*	(Linnaeus, 1758)	LC		
SCLERACTINIA	incertae sedis	*Cladocora caespitosa*	(Linnaeus, 1767)	EN		
SCLERACTINIA	incertae sedis	*Cladocora debilis*	Milne-Edwards & Haime, 1849	DD		
SCLERACTINIA	FLABELLIDAE	*Javania cailleti*		DD		
SCLERACTINIA	FLABELLIDAE	*Monomyces pygmaea*	(Risso, 1826)	LC		
SCLERACTINIA	GUYNIIDAE	*Guynia annulata*	Duncan, 1872	DD		
SCLERACTINIA	GUYNIIDAE	*Stenocyathus vermiformis*	(Pourtalès, 1868)	DD		
SCLERACTINIA	OCULINIDAE	*Madrepora oculata*	Lacaze-Duthiers, 1897	EN	A2d+4d	
SCLERACTINIA	OCULINIDAE	*Oculina patagonica*	Linnaeus, 1758	LC		
SCLERACTINIA	TURBINOLIIDAE	*Sphenotrochus andrewianus*	Milne Edwards & Haime, 1848	DD		
ZOANTHARIA	EPIZOANTHIDAE	*Epizoanthus arenaceus*	(Heller, 1868)	LC		
ZOANTHARIA	EPIZOANTHIDAE	*Epizoanthus frenzeli*	Delle Chiaje,1823	DD		endemic
ZOANTHARIA	EPIZOANTHIDAE	*Epizoanthus incrustatus*	Düben & Koren, 1847	DD		
ZOANTHARIA	EPIZOANTHIDAE	*Epizoanthus mediterraneus*		DD		endemic
ZOANTHARIA	EPIZOANTHIDAE	*Epizoanthus paguricola*	Roule, 1900	DD		endemic
ZOANTHARIA	EPIZOANTHIDAE	*Epizoanthus paxii*	Abel, 1955	DD		endemic
ZOANTHARIA	EPIZOANTHIDAE	*Epizoanthus steueri*	Pax, 1937	DD		endemic
ZOANTHARIA	EPIZOANTHIDAE	*Epizoanthus tergestinus*	Pax, 1937	DD		endemic
ZOANTHARIA	EPIZOANTHIDAE	*Epizoanthus univittatus*	Lorenz, 1860	DD		endemic
ZOANTHARIA	EPIZOANTHIDAE	*Epizoanthus vagus*	Herberts, 1972	DD		endemic
ZOANTHARIA	EPIZOANTHIDAE	*Epizoanthus vatovai*	Pax & Lochter, 1935	DD		
ZOANTHARIA	PARAZOANTHIDAE	*Parazoanthus anguicomus*	(Norman, 1868)	DD		
ZOANTHARIA	PARAZOANTHIDAE	*Parazoanthus axinellae*	(Schmidt, 1862)	LC		
ZOANTHARIA	PARAZOANTHIDAE	*Savalia savaglia*	(Bertoloni, 1819)	NT		

Appendix 2. List of taxa not included in the Mediterranean regional Red List assessment*

Order	Family	Species	Reason
ACTINARIA	SAGARTIIDAE	*Kadophellia bathyalis*	unconfirmed taxonomic status
ACTINARIA	ACTINIIDAE	*Actinia atrimaculata*	unconfirmed taxonomy
ACTINARIA	ACTINIIDAE	*Actinia cleopatrae*	Lessepsian species
ACTINARIA	ACTINIIDAE	*Actinia crystallina*	unconfirmed taxonomy
ACTINARIA	ACTINIIDAE	*Actinia depressa*	unconfirmed taxonomy
ACTINARIA	ACTINIIDAE	*Actinia fragacea*	Mediterranean records unconfirmed
ACTINARIA	ACTINIIDAE	*Actinia judaica*	unconfirmed taxonomy
ACTINARIA	ACTINIIDAE	*Actinia phaeochira*	unconfirmed taxonomy
ACTINARIA	ACTINIIDAE	*Actinia rubra*	unconfirmed taxonomy
ACTINARIA	ACTINIIDAE	*Actinia rubripunctata*	unconfirmed taxonomy
ACTINARIA	ACTINIIDAE	*Actinia zebra*	unconfirmed taxonomy
ACTINARIA	ACTINIIDAE	*Anemonia cereus*	unconfirmed taxonomy
ACTINARIA	ACTINIIDAE	*Anemonia melanaster*	Mediterranean records unconfirmed
ACTINARIA	ACTINIIDAE	*Anemonia sulcata*	unconfirmed taxonomy
ACTINARIA	ACTINIIDAE	*Anthopleura ballii*	Species status recently confirmed
ACTINARIA	ACTINIIDAE	*Anthopleura thallia*	Mediterranean records unconfirmed
ACTINARIA	ACTINIIDAE	*Bunodactis glandulosa*	unconfirmed taxonomy
ACTINARIA	ACTINOSTOLIDAE	*Paranthus chromatoderus*	unconfirmed taxonomy
ACTINARIA	ACTINOSTOLIDAE	*Paranthus rugosus*	unconfirmed taxonomy
ACTINARIA	AIPTASIIDAE	*Aiptasia carnea*	unconfirmed taxonomy
ACTINARIA	AIPTASIIDAE	*Aiptasia couchii*	Species status recently confirmed
ACTINARIA	AIPTASIIDAE	*Aiptasia saxicola*	unconfirmed taxonomy
ACTINARIA	ALICIIDAE	*Alicia costae*	unconfirmed taxonomy
ACTINARIA	CAPNEIDAE	*Aureliania heterocera*	unconfirmed taxonomy
ACTINARIA	CONDYLANTHIDAE	*Segonzactis platypus*	Mediterranean records unconfirmed
ACTINARIA	DIADUMENIDAE	*Diadumene cincta*	Lessepsian species
ACTINARIA	DIADUMENIDAE	*Diadumene lineata*	Non Mediterranean native
ACTINARIA	EDWARDSIIDAE	*Edwardsia beautempsii*	Mediterranean records unconfirmed
ACTINARIA	EDWARDSIIDAE	*Edwardsia claparedii*	Mediterranean records unconfirmed
ACTINARIA	EDWARDSIIDAE	*Edwardsia timida*	Mediterranean records unconfirmed
ACTINARIA	EDWARDSIIDAE	*Edwardsiella carnea*	Mediterranean records unconfirmed
ACTINARIA	EDWARDSIIDAE	*Edwardsiella janthina*	Mediterranean records unconfirmed
ACTINARIA	EDWARDSIIDAE	*Scolanthus callimorphus*	Mediterranean records unconfirmed

* Species marked in green correspond to taxa of recently confirmed species status.

Appendix 2. cont'd, List of taxa not included in the Mediterranean regional Red List assessment

Order	Family	Species	Reason
ACTINARIA	EDWARDSIIDAE	*Synhalcampella oustromovi*	Mediterranean records unconfirmed
ACTINARIA	GONACTINIIDAE	*Gonactinia prolifera*	Mediterranean records unconfirmed
ACTINARIA	GONACTINIIDAE	*Protanthea simplex*	Mediterranean records unconfirmed
ACTINARIA	HALCAMPOIDIDAE	*Halcampella endromitata*	unconfirmed taxonomy
ACTINARIA	HALOCLAVIDAE	*Mesacmaea mitchellii*	unconfirmed taxonomy
ACTINARIA	HALOCLAVIDAE	*Mesacmaea stellata*	unconfirmed taxonomy
ACTINARIA	HALOCLAVIDAE	*Peachia cylindrica*	Species status recently confirmed
ACTINARIA	HALOCLAVIDAE	*Peachia hastata*	Mediterranean records unconfirmed
ACTINARIA	HORMATHIIDAE	*Adamsia carciniopados*	Species status recently confirmed
ACTINARIA	HORMATHIIDAE	*Adamsia rondeletii*	unconfirmed taxonomy
ACTINARIA	HORMATHIIDAE	*Hormathia digitata*	unconfirmed taxonomy
ACTINARIA	HORMATHIIDAE	*Hormathia nodosa*	Mediterranean records unconfirmed
ACTINARIA	HORMATHIIDAE	*Paracalliactis lacazei*	unconfirmed taxonomy
ACTINARIA	HORMATHIIDAE	*Paracalliactis robusta*	unconfirmed taxonomy
ACTINARIA	ISOPHELLIIDAE	*Telmatactis cricoides*	Species status recently confirmed
ACTINARIA	ISOPHELLIIDAE	*Telmatactis solidago*	Species status recently confirmed
ACTINARIA	METRIDIIDAE	*Metridium senile*	Mediterranean records unconfirmed
ACTINARIA	SAGARTIIDAE	*Actinothoe clavata*	Mediterranean records unconfirmed
ACTINARIA	SAGARTIIDAE	*Octophellia timida*	unconfirmed taxonomy
ACTINARIA	SAGARTIIDAE	*Sagartia troglodytes*	Mediterranean records unconfirmed
ALCYONACEA	CLAVULARIIDAE	*Telestula septentrionalis*	Mediterranean records unconfirmed
ALCYONACEA	DENDROBRACHIIDAE	*Dendrobrachia bonsai*	Species status recently confirmed
ALCYONACEA	GORGONIIDAE	*Filigorgia guineensis*	Mediterranean records unconfirmed
ALCYONACEA	GORGONIIDAE	*Leptogorgia viminalis*	unconfirmed taxonomy
ALCYONACEA	ISIDIDAE	*Acanella arbuscula*	Species status recently confirmed
ALCYONACEA	MELITHAEIDAE	*Acabaria erythraea*	Lessepsian species
ALCYONACEA	NIDALIIDAE	*Chironephtya mediterranea*	Species status recently confirmed
ALCYONACEA	NIDALIIDAE	*Nidalia studeri*	Species status recently confirmed
ALCYONACEA	PLEXAURIDAE	*Spinimuricea atlantica*	Mediterranean records unconfirmed
ANTIPATHARIA	ANTIPATHIDAE	*Antipathes fragilis*	unconfirmed taxonomy
CORALLIMORPHARIA	CORALLIMORPHIDAE	*Corynactis mediterranea*	unconfirmed taxonomy
CORALLIMORPHARIA	SIDERACTINIDAE	*Sideractis glacialis*	Species status recently confirmed
PENICILLARIA	ARACHNACTIDAE	*Arachnactis albida*	Mediterranean records unconfirmed
PENICILLARIA	ARACHNACTIDAE	*Isarachnanthus maderensis*	Mediterranean records unconfirmed
PENNATULACEA	PROTOPTILIDAE	*Protoptilum carpenteri*	Species status recently confirmed
SCLERACTINIA		*Oulastrea crispata*	Species status recently confirmed
SCLERACTINIA	DENDROPHYLLIIDAE	*Balanophyllia cellulosa*	Mediterranean records unconfirmed
ANTIPATHARIA	SCHIZOPATHIDAE	*Bathypathes patula*	Mediterranean records unconfirmed
SCLERACTINIA	DENDROPHYLLIIDAE	*Dendrophyllia laboreli*	Species status recently confirmed
SPIRULARIA	BOTRUCNIDIFERIDAE	*Cerianthula mediterranea*	unconfirmed taxonomy
SPIRULARIA	CERIANTHIDAE	*Cerianthus lloydii*	Mediterranean records unconfirmed
SPIRULARIA	CERIANTHIDAE	*Pachycerianthus dohrni*	unconfirmed taxonomy
ZOANTHARIA	ZOANTHIDAE	*Zoanthus lobatus*	Mediterranean records unconfirmed

Appendix 3. Specific national laws of Mediterranean countries for the protection of anthozoans or regulation of fishing (2017)

	1. Laws on the Regulation of anthozoan fishing		2. Laws for the protection of species		3. Laws on Protected areas		Other laws	
Country	Name of the law	Name of the species or group	Name of the law	Name of the species	Name of the law	Name of the Species/Group of species	Name of the law	Name of the Species/Group
Albania	Law No. 7908, dated on 05. 04.1995 ON FISHERY AND AQUACULTURE	Prohibition to fish corals and sponges (general term)						
Algeria	Decree 26th August 2015 and Order of 3 Rabie El Aouel 1437 corresponding to 13 January 2016 fixing terms and conditions for the exercise of red coral fishing (opening areas, divers, modalities*)	*Corallium rubrum*						
Croatia	Law on Marine Fisheries (Official Gazette 81/2013) - forbidding collection of *Corallium rubrum* and other corals through small scale coastal or sport/recreational fishing.	*Corallium rubrum and all other corals*	Ordinance on strictly protected species 2013 (Official Gazette 144/13)	*Diadumene lineata* *Corallium rubrum*** *Eunicella verrucosa* *Paramuricea macrospina* *Antipathes dichotoma* *Leiopathes glaberrima*				

* A new decree for coral exploitation is under development to open the fishing in Algeria in 2017-2018.

** Although *Corallium rubrum* is listed as strictly protected species in Croatia, harvesting concessions are issued by Croatian Ministry of Agriculture (Fisheries Directorate). In total 11 such concession have been issued allowing harvest of 200 kg per year and concession.

Appendix 3. cont'd, Specific national laws of Mediterranean countries for the protection of anthozoans or regulation of fishing (2017)

	1. Laws on the Regulation of anthozoan fishing		2. Laws for the protection of species		3. Laws on Protected areas		Other laws	
Country	Name of the law	Name of the species or group	Name of the law	Name of the species	Name of the law	Name of the Species/Group of species	Name of the law	Name of the Species/Group
Croatia *(cont.)*	In addition the Law prescribes fines for keeping onboard St. Andrew's cross or similar fishing gear for collection of the red coral, all other corals and organisms similar to corals.			*Antipathella subpinnata* *Pachycerianthus multiplicatus* *Astroides calycularis* *Dendrophyllia ramea* *Savalia savaglia*				
Cyprus	Number 153 (I) 2003 Law providing protection and management of Nature and Wildlife. ΠΑΡΑΡΤΗΜΑ IV [Αρθρα 2, 24, 25, 42] ΕΙΔΗ ΖΩΩΝ ΚΑΙ ΦΥΤΩΝ ΚΟΙΝΟΤΙΚΟΥ ΕΝΔΙΑΦΕΡΟΝΤΟΣ ΤΩΝ ΟΠΟΙΩΝ Η ΑΠΟΣΠΑΣΗ ΑΠΟ ΤΟ ΦΥΣΙΚΟ ΤΟΥΣ ΠΕΡΙΒΑΛΛΟΝ ΚΑΙ Η ΕΚΜΕΤΑΛΛΕΥΣΗ ΕΙΝΑΙ ΔΥΝΑΤΟΝ ΝΑ ΡΥΘΜΙΖΟΝΤΑΙ ΜΕ ΔΙΑΧΕΙΡΙΣΤΙΚΑ ΜΕΤΡΑ	*Corallium rubrum*						
Egypt					Law No 102 of 1983 for Nature Protectorates	all of the corals situated in Mediterranean Egyptian MPAs		

Appendix 3. cont'd, Specific national laws of Mediterranean countries for the protection of anthozoans or regulation of fishing (2017)

	1. Laws on the Regulation of anthozoan fishing		2. Laws for the protection of species		3. Laws on Protected areas		Other laws	
Country	Name of the law	Name of the species or group	Name of the law	Name of the species	Name of the law	Name of the Species/Group of species	Name of the law	Name of the Species/Group
France	Ministerial order 6th July 2006	*Corallium rubrum*					LOI n° 2016-1087 du 8 août 2016 pour la reconquête de la biodiversité, de la nature et des paysages (Article 113)	Ban of dredging activities on coral reefs*
Greece	Law No. 1740 (1987) on the development and protection of coral formations, aquaculture and fish breeding areas.	*Corallium rubrum*	Presidential Decree 67/1981: protection of native flora and wildlife	*Corallium rubrum*				
	Presidential Decree 174/1994.							
	Ministry Decision: 240102/1995: exploitation of red coral.							
	Law 30 March 1998: exploitation of red coral.							
Israel							Proclamation (Protected Natural Assets), 5765-2005	Coelenterata (including corals)
Italy	Legge 14 luglio 1965, n. 963 (in Gazz. Uff., 14 agosto, n. 203). - Disciplina della pesca marittima. (Maritime Fishing Regulation).	*Corallium rubrum*						

* particular relevant for french overseas territories.

Appendix 3. cont'd, Specific national laws of Mediterranean countries for the protection of anthozoans or regulation of fishing (2017)

	1. Laws on the Regulation of anthozoan fishing		2. Laws for the protection of species		3. Laws on Protected areas		Other laws	
Country	Name of the law	Name of the species or group	Name of the law	Name of the species	Name of the law	Name of the Species/Group of species	Name of the law	Name of the Species/Group
Italy *(cont.)*	Presidential Decree 2d October 1968 n°1639 : implements the Maritime Fishing Regulation (National law 14th July 1965).	*Corallium rubrum*						
	Legge Regionale 5 luglio 1979, n. 59 Regolamentazione della pesca del corallo.							
	Legge Regionale 30 maggio 1989, n. 23 Modifiche alla legge regionale 5 luglio 1979, n. 59, concernente "Regolamentazione della pesca del corallo".							
	DECRETO N. 585 GAB/DecA/27 del 24.04.2013: Oggetto: L.R. 5 .7.1979, n. 59. - Art. 4, Disposizioni sulla pesca del corallo per l'anno 2013 nelle acque territoriali prospicienti il territorio della Regione Autonoma della Sardegna.							
	DECRETO N. 1203/DecA/82 del 08.08.2012: Disposizioni							

Appendix 3. cont'd, Specific national laws of Mediterranean countries for the protection of anthozoans or regulation of fishing (2017)

	1. Laws on the Regulation of anthozoan fishing		2. Laws for the protection of species		3. Laws on Protected areas		Other laws	
Country	Name of the law	Name of the species or group	Name of the law	Name of the species	Name of the law	Name of the Species/Group of species	Name of the law	Name of the Species/Group
Italy *(cont.)*	di attuazione del Decreto dell'Assessore dell'agricoltura e riforma agro-pastorale n. 761/GAB/DecA/42 del 21.05.2012 e ss.mm.ii.: linee guida per garantire il rispetto della normativa in materia di tracciabilità del corallo rosso prelevato nelle acque territoriali prospicienti il territorio della Regione Autonoma della Sardegna ai sensi della Delibera n. 16/24 del 18.04.2012.	*Corallium rubrum*						
Lebanon								
Malta			Environment and Development Planning Act (Cap. 504) - Flora, Fauna and Natural Habitats (Amendment) Regulations, 2013, L.N.322 of 2013, 14th October, 2013.	*Antipathes dichotoma* *Astroides calycularis* *Cladocora caespitosa* *Corallium rubrum* *Savalia savaglia* *Errina aspera*				
Morocco	Décret n° 2-04-26 du 6 hija 1425 (17 janvier 2005) fixant les conditions et les modalités de pêche du corail.	*Corallium rubrum*						

Appendix 3. cont'd, Specific national laws of Mediterranean countries for the protection of anthozoans or regulation of fishing (2017)

	1. Laws on the Regulation of anthozoan fishing		2. Laws for the protection of species		3. Laws on Protected areas		Other laws	
Country	Name of the law	Name of the species or group	Name of the law	Name of the species	Name of the law	Name of the Species/Group of species	Name of the law	Name of the Species/Group
Morocco *(cont.)*	Order of the Minister of Agriculture, Rural Development and Fisheries No 1954-05 of 6 Ramadan 1426 (10 October 2005) on the temporary ban on coral fishing in certain maritime areas of the Mediterranean.	*Corallium rubrum*						
	Order of the Minister of Agriculture and fisheries No. 2409-10 of 7 Ramadan 1431 (18 August 2010) concerning the temporary ban of red coral fishing in certain maritime areas of the Mediterranean Sea.							
Monaco					Sovereign Order of 29 August 1986 (reserve declaration). Réserve du tombant coralligène des Spélugues.	*Corallium rubrum*		
Montenegro			Decision of the protection of rare and endangered species 7th December 2006.	*Madrepora oculata* *Cladocora caespitosa* *Antipathella subpinnata*		*Eunicella cavolini*		

Appendix 3. cont'd, Specific national laws of Mediterranean countries for the protection of anthozoans or regulation of fishing (2017)

	1. Laws on the Regulation of anthozoan fishing		2. Laws for the protection of species		3. Laws on Protected areas		Other laws	
Country	Name of the law	Name of the species or group	Name of the law	Name of the species	Name of the law	Name of the Species/Group of species	Name of the law	Name of the Species/Group
Montenegro *(cont.)*				*Corallium rubrum* *Eunicella cavolini* *Eunicela stricta* *Savalia savaglia*				
Slovenia					Decree on the Strunjan Landscape Park (Uredba o Krajinskem parku Strunjan Uradni list RS, št. 107/04, 114/04 – popr., 83/06, 71/08, 77/10, 46/14 - ZON-C); Ordinance on the proclamation of natural monuments in the municipality of Piran (Odloka o razglasitvi posameznih naravnih spomenikov in spomenikov oblikovane narave v Občini Piran, Primorske novice, Uradne objave, 5/90)	*Cladocora caespitosa*		

Appendix 3. cont'd, Specific national laws of Mediterranean countries for the protection of anthozoans or regulation of fishing (2017)

	1. Laws on the Regulation of anthozoan fishing		2. Laws for the protection of species		3. Laws on Protected areas		Other laws	
Country	Name of the law	Name of the species or group	Name of the law	Name of the species	Name of the law	Name of the Species/Group of species	Name of the law	Name of the Species/Group
Spain	Royal decree 12121/1984, 8 June, to regulate red coral fishing.	*Corallium rubrum*	Order AAA/1351/2016, 29 July to modify the annex to the Royal decree 139/2011, 4 February. Species included in the list of wild species specially protected and included in the Spanish Catalogue of threatened species.	*Astroides calycularis* *Errina aspera* *Savalia savaglia*				
	Royal decree 10 October, on types of penalties for red coral fishing activities.							
	Royal decree 2223/1985, 23 October, to complement R. Decree 2090/1984, 10 October, on types of penalties for red coral fishing activities.							
	Royal Decree 629/2013, 2nd August, on fishing red coral, first sale and license procedures for fishing.							
	Regional Catalan Decree 54-2015 (DOGC núm. 6606, de 17 de abril de 2014)							

Appendix 3. cont'd, Specific national laws of Mediterranean countries for the protection of anthozoans or regulation of fishing (2017)

	1. Laws on the Regulation of anthozoan fishing		2. Laws for the protection of species		3. Laws on Protected areas		Other laws	
Country	Name of the law	Name of the species or group	Name of the law	Name of the species	Name of the law	Name of the Species/Group of species	Name of the law	Name of the Species/Group
Spain *(cont.)*	for extraction of red coral on Catalan waters. Updated on 2017 to reduce catches and 2018 to stop all extraction over 10 years.		Decision IG.21/6 on the amendments to Annexes II and III of the Protocol on especially protected areas and biodiversity in the Mediterranean. April 27, 2015.	*Astroides calycularis* *Errina aspera* *Savalia savaglia* *Antipathella subpinnata* *Antipathes dichotoma* *Antipathes fragilis* *Leiopathes glaberrima* *Parantipathes larix* *Callogorgia verticillata* *Cladocora caespitosa* *Cladocora debilis* *Ellisella paraplexauroides* *Lophelia pertusa* *Madrepora oculata*				
Tunisia	Decision 29/08/1974 regulating red coral fishing. Decision 23/03/1981 regulating red coral fishing. Decision 26/02/1982 regulating red coral fishing.	*Corallium rubrum*						

Appendix 3. cont'd, Specific national laws of Mediterranean countries for the protection of anthozoans or regulation of fishing (2017)

	1. Laws on the Regulation of anthozoan fishing		2. Laws for the protection of species		3. Laws on Protected areas		Other laws	
Country	Name of the law	Name of the species or group	Name of the law	Name of the species	Name of the law	Name of the Species/Group of species	Name of the law	Name of the Species/Group
Tunisia *(cont.)*	Decision 08/04/1982 regulating red coral fishing.	*Corallium rubrum*						
	Decision 14/04/1983 regulating red coral fishing.							
Turkey	Notification No. 2012/65 regulating commercial fisheries. - 18 August 2012.	*Corallium rubrum*						
		Gerardia savaglia						
	Notification No. 2012/66 regulating non commercial fisheries*. - 18 August 2012.	*Corallium rubrum*						
		Gerardia savaglia						

* E.g.: recreational fishing, sport fishing, etc...

Appendix 4. Anthozoan species listed on international annexes and regulations

(CITES, Protocol SPA/BD of Barcelona Convention, Bern Convention, GFCM and EU Habitats Directive and Regulation Trade of wild fauna and flora species)

	IUCN Category	International Legal Instrument	Regional Legal Intrument			European Legal Instrument	
Species		CITES (a)	Protocol SPA/BD (b)	Bern Convention (c)	GFCM Recommendations (d)	EU Habitats Directive (e)	EU Regulation Trade wild fauna and flora species (f)
Isidella elongata	CR						
Desmophyllum dianthus	EN	II					B
Lophelia pertusa	EN	II	II				B
Corallium rubrum	EN		III	III	REC.CM-GFCM/36/2012/1 On further measures for the exploitation of red coral in the GFCM area. REC.CM-GFCM/35/2011/2 On the exploitation of red coral in the GFCM Competence Area.	V	
Dendrophyllia cornigera	EN	II					B
Cladocora caespitosa	EN	II	II				B
Leiopathes glaberrima	EN	II	II	III			B
Madrepora oculata	EN	II	II				B
Paranemonia vouliagmeniensis	EN						
Crassophyllum thessalonicae	EN						
Dendrophyllia ramea	VU	II					B
Ellisella paraplexauroides	VU		II				

(a) Ratified by all Mediterranean States. Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled.
(b) Ratified by all Mediterranean States (except Greece, Israel, Bosnia and Libya). Annex II lists species that are endangered or threatened and Annex II lists species whose exploitation is regulated.
(c) Ratified by all Mediterranean States of the study, except Algeria, Egypt, Israel, Lebanon. Appendix II – Strictly protected fauna species. Appendix III – Protected fauna species.
(d) Must be implemented in all Contracting Parties of the GFCM in the Mediterranean.
(e) Council Directive 92/43/EEC. Must be implemented in all European States of the Mediterranean. Annex I lists different marine European habitats, including one Habitat type (1170 Reefs) which might concern several species of anthozoans.
Annex V species whose taking from the wild can be restricted by European law.
(f) Must be implemented in all European States of the Mediterranean according to Regulation (EC) No 338/97, Annex B.

Appendix 4. cont'd, Anthozoan species listed on international annexes and regulations (CITES, Protocol SPA/BD of Barcelona Convention, Bern Convention, GFCM and EU Habitats Directive and Regulation Trade of wild fauna and flora species)

	IUCN Category	International Legal Instrument	Regional Legal Intrument			European Legal Instrument	
Species		CITES (a)	Protocol SPA/BD (b)	Bern Convention (c)	GFCM Recommendations (d)	EU Habitats Directive (e)	EU Regulation Trade wild fauna and flora species (f)
Funiculina quadrangularis	VU						
Pennatula rubra	VU						
Pennatula phosphorea	VU						
Pteroeides spinosum	VU						
Paramuricea clavata	VU						
Antipathes dichotoma	NT	II	II	III			B
Antipathella subpinnata	NT	II	II	III			B
Callogorgia verticillata	NT		II				
Parantipathes larix	NT	II	II				B
Savalia Savaglia	NT		II	II			
Caryophyllia smithii	LC	II					B
Caryophyllia inornata	LC	II					B
Polycyathus muellerae	LC	II					B
Astroides calycularis	LC	II	II	II			B
Balanophyllia europaea	LC	II					B
Leptopsammia pruvoti	LC	II					B
Madracis pharensis	DD	II					B
Phyllangia americana mouchezii	DD	II					B
Caryophyllia calveri	DD	II					B
Pourtalosmilia anthophyllites	DD	II					B
Caryophyllia cyathus	DD	II					B
Coenocyathus cylindricus	DD	II					B
Coenocyathus anthophyllites	DD	II					B
Hoplangia durotrix	DD	II					B
Paracyathus pulchellus	DD	II					B
Thalamophyllia gasti	DD	II					B
Ceratotrochus magnaghii	DD	II					B
Balanophyllia regia	DD	II					B
Cladopsammia rolandi	DD	II					B
Antipathella wollastoni	DD	II	II	III			B
Cladocora debilis	DD	II	II				B
*Antipathes fragilis**		II	II	III			B

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