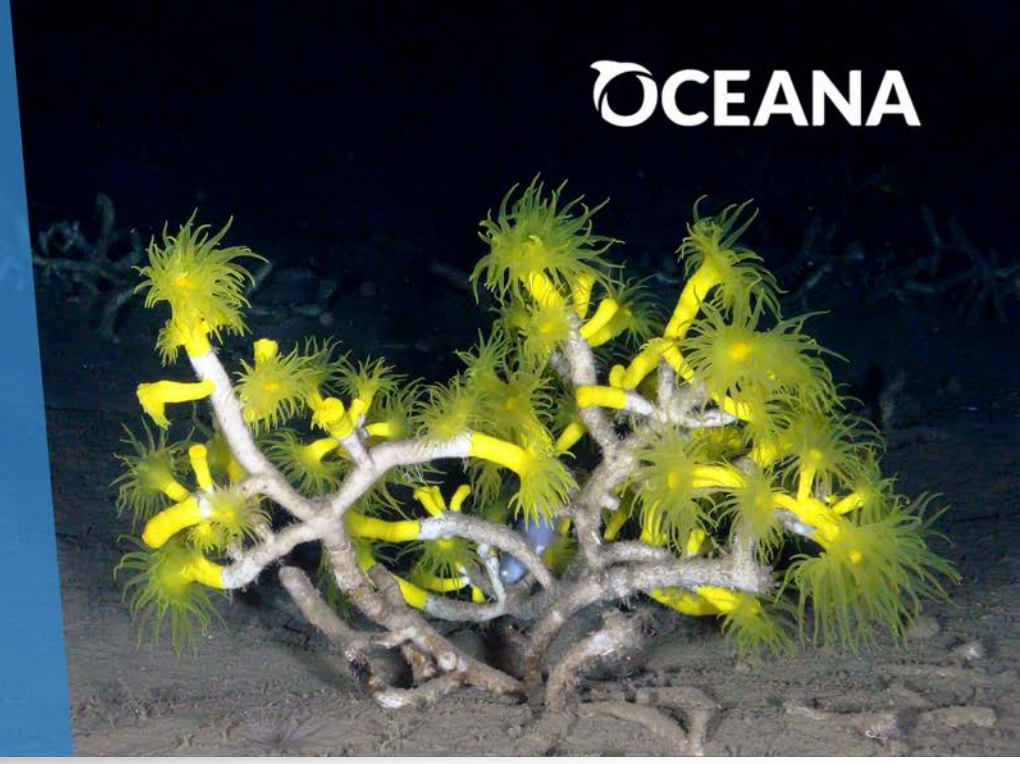
EXTENDING THE DEEP-SEA BOTTOM FISHING BAN IN THE MEDITERRANEAN SEA



October 2023

THE MEDITERRANEAN DEEP SEA IS CRITICAL FOR CLIMATE AND BIODIVERSITY

The ocean is the largest planetary carbon sink. It stores equivalent amounts of carbon to terrestrial ecosystems and removes around one-third of CO_2 emitted by human activity.[1] Healthy marine ecosystems capture and lock in carbon, acting as a nature-based solution to the climate crisis. Deepwater marine sediments and soft bottoms are considered a critical reservoir for long-term carbon storage, which can strongly influence the oceanic sink of atmospheric CO_2.[2,3] Moreover, these deep-sea sediments host vulnerable marine ecosystems (VMEs) such as coral and sponge aggregations, which are regarded as hotspots of biodiversity, and may play a key role in deep-sea ecological dynamics and carbon cycling.[4,5]

However, marine ecosystems are generally not healthy and in the Mediterranean Sea, the situation is particularly grave. According to the report *State of the Environment and Development in the Mediterranean*, the region "is affected by climate change at a pace well above the global average, in particular by more rapid warming of the ambient air and sea surface in all seasons" and it has "one of the world's highest ecological deficits"[i] with noted human-induced declines in marine ecosystems and biodiversity.[6] Overfishing has been identified as a major driver of environmental degradation.[7] In particular, bottom trawling is recognised as the most widespread and harmful anthropogenic activity affecting the seabed, and can cause wide-scale damage to benthic communities (including VMEs) through direct physical contact and indirect impacts such as sediment resuspension.[8]

In 2005, the GFCM prohibited the use of towed dredges and trawl nets at depths beyond 1000 m,[9] with the objective of curbing stock declines and improving the sustainability of fisheries exploitation. One year later, another GFCM Recommendation was adopted to establish the first three Fisheries Restricted Areas (FRAs) with the sole purpose of protecting deep-sea habitats.[10] These were followed by other FRAs such as Jabuka/Pomo Pit,[11] which was established in 2017 with the aim of integrating environmental concerns in fisheries management. Even so, the total area adopted to protect deep-sea ecosystems from fisheries impacts is quite limited, despite increased knowledge about the major role the deep ocean plays in both ecosystem functioning and climate change mitigation.

The triple crises of climate change, biodiversity loss, and environmental degradation have driven increased political commitments in the countries surrounding the Mediterranean (e.g., the Paris Agreement (UNCCC COP 21), 2030 Climate Target Plan, MedFish4Ever Declaration, GFCM 2030 Strategy), and delivering on these commitments requires stronger conservation efforts. Increased protection of the Mediterranean deep sea can contribute to these objectives and help to transition fisheries to greater sustainability.

[i] An ecological deficit occurs when the ecological footprint of a population (generated by the use of resources, production of waste, etc.) exceeds the capacity of the local ecosystems to sustain it.

IMPACTS OF TRAWLING ON DEEP-SEA ECOSYSTEMS

Deep-sea ecosystems are under increasing threat from human activities such as industrial fisheries, notably bottom trawling.[12] The physical destruction of seafloor communities caused by trawling can lead to a decrease in biological production, changes in biodiversity, and the disappearance of vulnerable species,[13] due to slow growth rates associated with deep-sea species.[14] There are strong indications that the development of bottom-trawl fisheries has been the cause of population declines in sharks, rays, and chimaeras in the Mediterranean Sea, which are particularly vulnerable to overfishing due to their life history characteristics (i.e., longevity, slow growth, and low fecundity).[15] According to the IUCN Red List, the Mediterranean basin is a key hotspot of extinction risk for those species, and some endangered deep-water sharks (e.g., *Squatina spp.*, *Etmopterus spinax*, *Hexanchus griseus*), rays (e.g., *Leucoraja melitensis*, *Raja radula*), and chimaeras (e.g., *Chimaera monstrosa*) are threatened as a result of being captured as bycatch in deep-sea fisheries.[16]

It is well known that deepwater fisheries in the Mediterranean usually target shrimps, notably giant red shrimp (*Aristaeomorpha foliacea*) and blue and red shrimp (*Aristeus antennatus*), using trawl gears. Although both species are found at depths of down to several thousand metres, they are normally fished in waters shallower than 800 m,[17] due to fleet capacity and the species' behaviour.[18] According to the last GFCM Scientific Advisory Committee (SAC) assessment – and noting that some of the GSAs[ii] were not assessed in 2023 – both species are currently considered in overexploitation in all but one GSA (Table 1).[19] To remediate the problem, the GFCM adopted management plans for these species in the Strait of Sicily, the Levant Sea, and the Ionian Sea.

Table 1. Deep-sea shrimp stock status according to the latest GFCM SAC assessment. The fisheries reference point used (F_{ref}) is equivalent to $F_{0.1}$.

SPECIES	GSA	2023 SAC ASSESSMENT	
		QUANTITATIVE STATUS (F/F_{REF})	STOCK STATUS (EXPLOITATION AND BIOMASS LEVEL)
Aristeus antennatus	1	0.92	Sustainable exploitation
	2	1.51	In overexploitation
	5	4.45	In overexploitation
	6	4.91	In overexploitation, with relatively low biomass
	18-19-20	4.43	In overexploitation
Aristaeomorpha foliacea	9-10-11.1-11.2	1.8	Biomass above reference point and in overexploitation
	18-19-20	2.25	In overexploitation

In 2018, the Food and Agriculture Organization of the United Nations (FAO) identified the Mediterranean Sea as the world's most overexploited area.[20] Since that time, stocks have remained at unsustainable levels; the latest SAC advice in 2023 found that 73% of assessed stocks were fished outside biologically sustainable levels. According to the FAO, high rates of overfishing will negatively impact the capacity of Mediterranean fish stocks to cope with climate change impacts, and demersal species will suffer regional impacts associated with expected changes in primary production, thermohaline circulation, and harsher winter weather.[21] The GFCM recommends adaptive spatial planning (e.g., area-based measures) that increases the resilience of stocks and thus their capacity for recovery or stabilisation during unfavourable climatic periods.[22]

[ii] Geographic Sub-Area

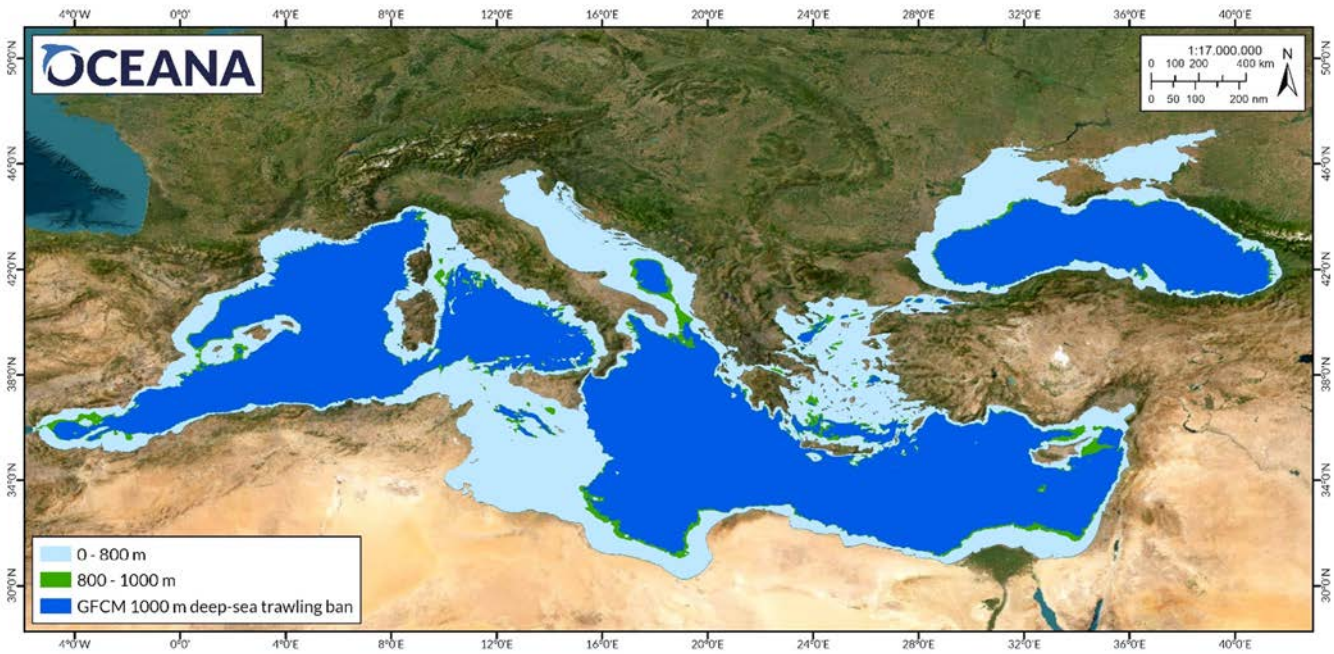
The protection of VMEs is another important element of Mediterranean deep-sea fisheries management. They are usually framework-forming habitats that comprise unique biodiversity hotspots, acting as feeding, spawning, or nursery areas, and therefore play an important role in stock health and recovery.[23] For those reasons, VMEs have been subject to protection globally for more than 20 years, and in the Mediterranean Sea, they are protected under international agreements like the UNEP/MAP Barcelona Convention, and various GFCM decisions.[24] In some other regions, specific prohibitions on towed bottom gear have been adopted for the protection of VMEs, such as in EU waters of the Northeast Atlantic Ocean below 800 m depth.[25] Deep-sea bottom trawling frequently overlaps with areas where VMEs occur, notably those formed by threatened species such as black corals or cold-water corals[26] whose distribution ranges also extend to waters deeper than 800 m. For instance, populations of Critically Endangered bamboo coral (*Isidella elongata*), a near-endemic species to the Mediterranean Sea that lives mostly beyond 500 m depth, decreased by 80% in the last century due to the impact of trawling activity on its grounds.[27]

» CHANGING THE DEPTH LIMIT OF THE GFCM 1000 METRE BAN ON TOWED BOTTOM GEARS

At the 2019 meeting of the GFCM Working Group of Marine Protected Areas (WGMPA), scientists proposed an extension of the 1000 m deep-sea ban on the use of bottom trawls and dredges, to encompass all waters below 600 m depth.[15] The proposal was framed under the EU-funded IDEM project (Implementation of the MSFD to the Deep Mediterranean Sea)[28] and was based on expert advice on better protection of deep-sea ecosystems from overfishing, with a focus on VME protection. At that time, the WGMPA was reluctant to endorse the proposal due to potential economic impacts on fleets operating between 400 and 800 m depth. In 2022, the Scientific Advisory Committee on Fisheries (SAC) advised implementing a roadmap that would allow for an initial assessment of the potential impacts of changing the depth limit of the current 1000 m ban. It also recommended analysing the overlap between VMEs and the deep-water red shrimp fishery in the central-eastern Mediterranean, to provide information about fishing activities below 600 m depth. Such information was provided by organisms like the Mediterranean Advisory Council (MEDAC), which indicated that the average depth of red shrimp catches was between 640 m and 780 m, and that this fishery would therefore be strongly affected if the ban were extended to include all waters deeper than 600 m.[29] Following this, in 2023 the SAC proposed four pilot studies (one per Mediterranean sub-region) to obtain data on socio-economic aspects of a possible extension of the current ban on towed bottom gears, to instead include waters deeper than 800 m.

With this extension, the cessation of bottom trawling and dredging in the 800-1000 m depth range of the Mediterranean Sea (not including the Black Sea) would result in an additional 109 380 km^2 (7.5%) of deep-sea area protected from bottom-fishing to the 1 461 037 km^2 covered by the current 1000 m ban (Figure 1).

Figure 1. Mediterranean Sea by depth ranges of 0-800 m, 800-1000 m, and greater than 1000 m.



CURRENT BOTTOM FISHING ACTIVITY BETWEEN 800-1000 M DEPTH

According to the GFCM Authorized Vessel List (AVL), there are 4573 vessels fishing with towed bottom-contacting gears in the Mediterranean (GSAs 1 to 27)[30] (considering those vessels listed as only using bottom trawls and dredges: OTB, OTT, TB, TBB, DRB, and TX). Those vessels that operate in the deep sea and target mostly shrimps and other demersal species are often the largest vessels within the fleet: 12-24 m length overall (LOA) and greater than 24 m LOA.[31]

To assess the potential impact of extending the current bottom fishing ban in the Mediterranean to include all waters below 800 m depth, Oceana analysed apparent fishing effort by bottom trawlers and dredgers during 2022 in the 800-1000 m depth range. We did this using Global Fishing Watch (GFW) data[32] from the GFCM area, which were cross-checked with the European Fleet Register and the GFCM Authorized Vessel List.[iii] The following results emerged from our analysis:

235 vessels[iv,v] with bottom trawls as their sole listed fishing gear were identified as operating in the 800-1000 m depth range, for a total of 13 451 fishing hours (0.5% of the total hours of apparent fishing with towed gears in the Mediterranean in 2022). No dredgers were found to be fishing within the 800-1000 m depth range.

5,1%

These trawlers represented 5.1% of the total Mediterranean trawling and dredging fleet, and were flagged predominantly to Italy, Spain, and Turkey, with a smaller number of vessels from Tunisia, Greece, Malta, France, and Cyprus (listed in decreasing order by number of vessels).

75%

75% of the apparent fishing activity in the 800-1000 m depth range was carried out by just 57 bottom trawlers, of which 43 were registered in Spain, 11 in Italy, one in France, one in Malta and one in Cyprus.

Only 24 vessels (10.2%) spent 10% or more of their total apparent fishing hours operating in the 800-1000 m depth range. Of the remaining 89.8% of vessels, 43.8% spent less than 1% of their apparent fishing activity in this depth range.

Apparent fishing activity in waters deeper than 800 m seemed to occur mostly in the northern region of the Mediterranean.[v] This activity was particularly dense in Western Mediterranean GSAs, with more concentrated areas in Spanish waters (especially in the Alboran Sea), south of Sardinia, and north and southwest of Sicily, as well as in the area around Greece, the eastern basin off Antalya (Turkey), and Southwestern Cyprus (see red-yellow areas in Figure 2).

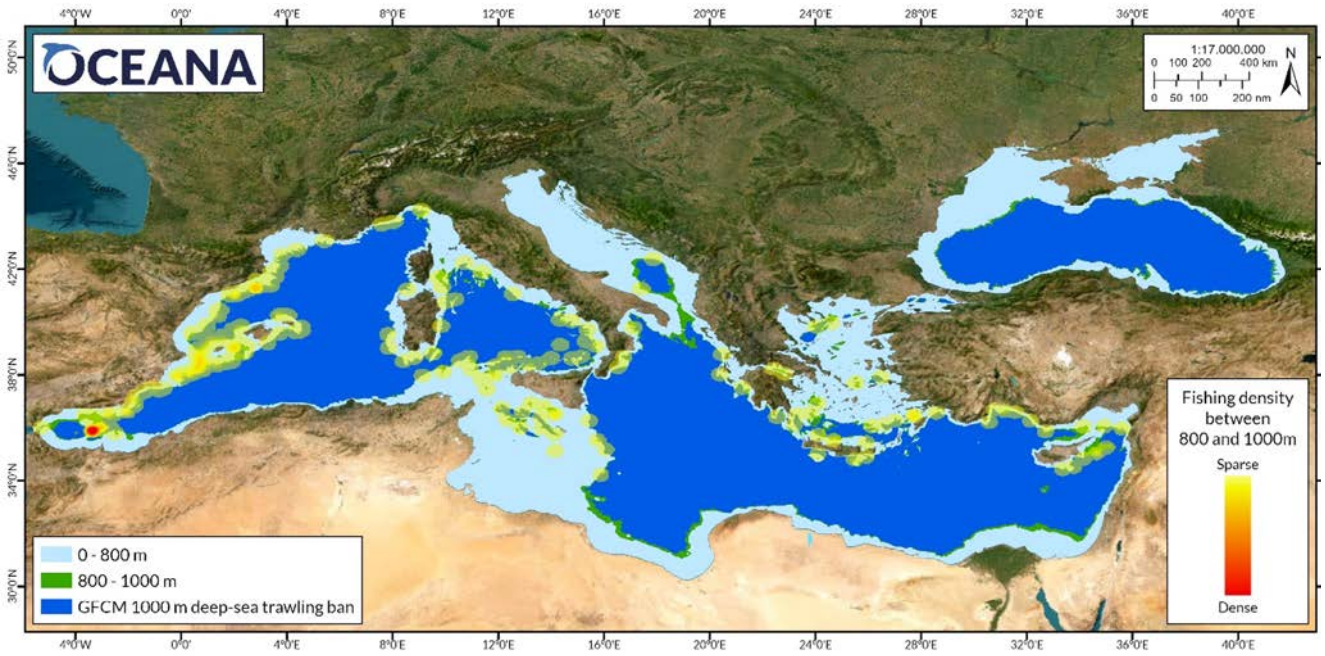
[iii] Vessels were excluded if their gear types could not be verified on the EFR or AVL.

[iv] Vessels were only included if they had at least 1 hour of apparent fishing activity in the 800-1000 m depth range during 2022.

[v] Oceana took a conservative approach, considering only vessels registered in the GFCM Authorized Vessel List or the European Fleet Register as using only bottom trawls and/or dredges. However, this approach was likely to underestimate actual levels of fishing, given that it excluded any bottom-trawling or dredging vessels that also included non-trawling gears among their registered gear-types. Using a less conservative approach that included all vessels identified as "trawling" by the GFW algorithm (excluding any vessels that were listed as mid-water trawlers on the AVL or the EFR), the number of vessels fishing in the 800-1000 m depth range increased to 327, with a total of 16 893 hours of apparent trawling.

[v] This finding may have been biased by the lack of AIS requirements and thus AIS data for vessels from some Northern African countries in Global Fishing Watch.

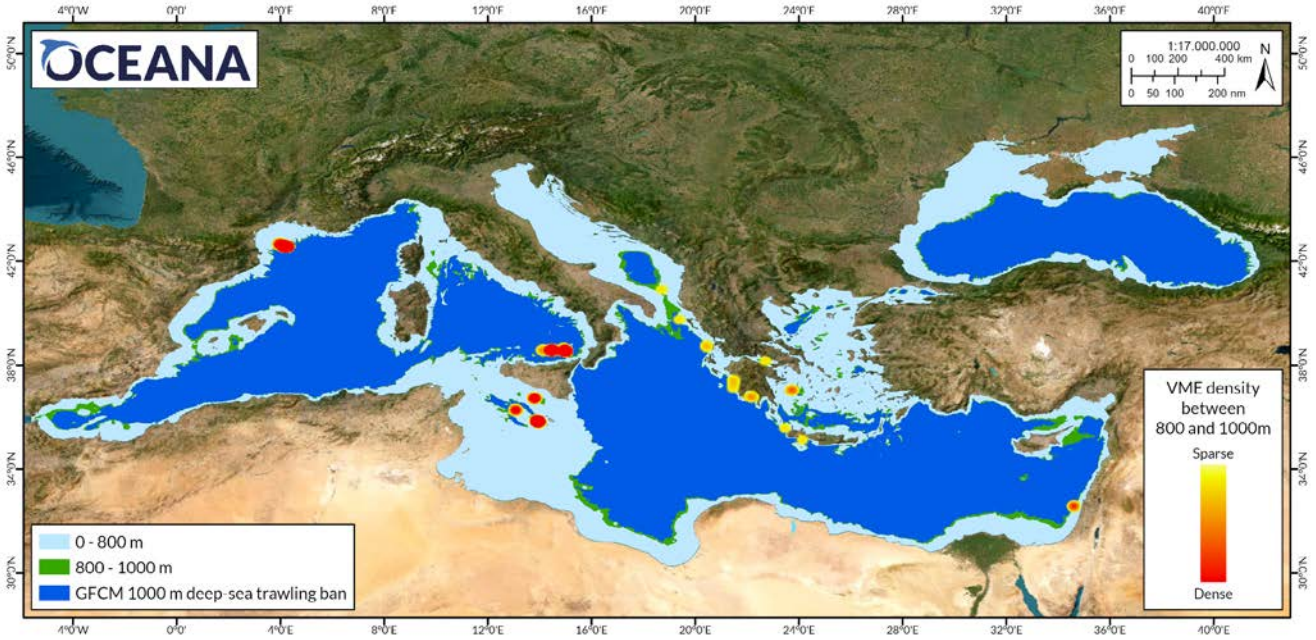
Figure 2. Density of apparent bottom trawling activity between 800 and 1000 m depth. (Source: Oceana using GFW data).



INTERACTION BETWEEN BOTTOM TRAWLING ACTIVITY AND VMES

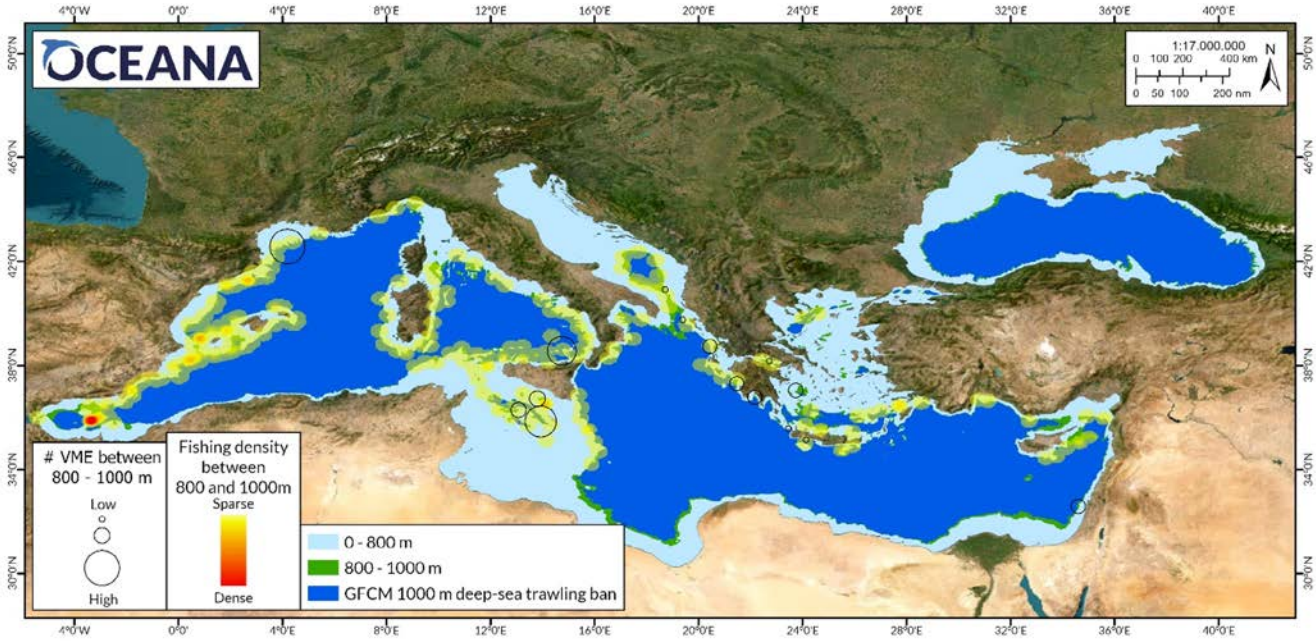
While the Mediterranean deep sea is still relatively unknown in terms of habitat and species distributions, knowledge on this topic has improved since the adoption of the deep-sea bottom fishing ban and the first FRAs. In fact, a GFCM database has been created that compiles voluntary records of around 20 500 VMEs found across the GFCM area. Of those records, 394 are located between 800 and 1000 m depth. They are mostly concentrated to the north and southwest of Sicily and in the Gulf of Lion, with lower densities in waters around Greece, the southern Adriatic Sea, and off Israel (Figure 3). The low number of recorded VMEs in the database is likely to reflect a lack of available information for deep-sea areas, probably due to the relative lack of research in deeper waters.

Figure 3. Distribution and density of VMEs between 800-1000 m depth. (Source: GFCM VME database).



By combining the information shown in Figures 2 and 3, Oceana determined that all the locations in the GFCM VME database with higher reported densities of VMEs between 800 and 1000 m were also areas where bottom-trawl fishing is potentially occurring – increasing the risk of interactions and the threat that they pose to VMEs. These areas were the Gulf of Lion, and waters to the north and southwest of Sicily, around Greece, in the southern Adriatic, and off Israel (see circled areas in Figure 4).

Figure 4. Areas of overlap between apparent bottom trawling activity in 2022 and recorded VMEs. (Source: Oceana using GFW data and the GFCM VME database).



In order to have a closer look at these potential areas of interaction, a few areas have been identified to showcase examples where apparent bottom trawling overlaps with zones where VMEs have been described in the GFCM VME database. These examples are shown in Figures 5, 6, and 7, where the green areas represent the presence of VMEs extracted from the GFCM VME database, and the yellow-to-red shading represents bottom trawling intensity extracted from GFW:

Figure 5. Example of potential overlap between apparent bottom trawling and VMEs in the Western Mediterranean: Gulf of Lion. (Source: Oceana using GFW data and the GFCM VME database).

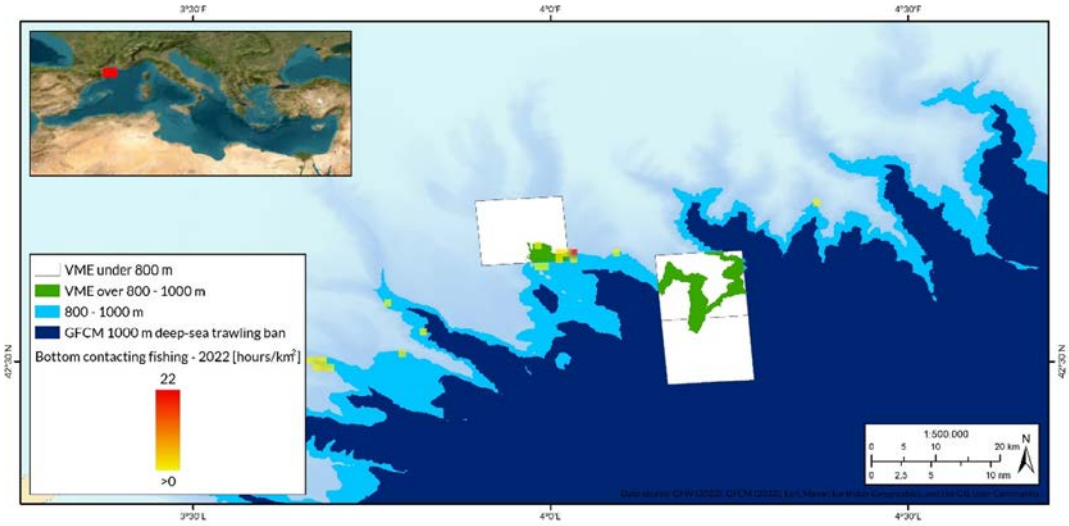


Figure 6. Example of potential overlap between apparent bottom trawling and VMEs in the Central Mediterranean: Strait of Sicily. (Source: Oceana using GFW data and the GFCM VME database).

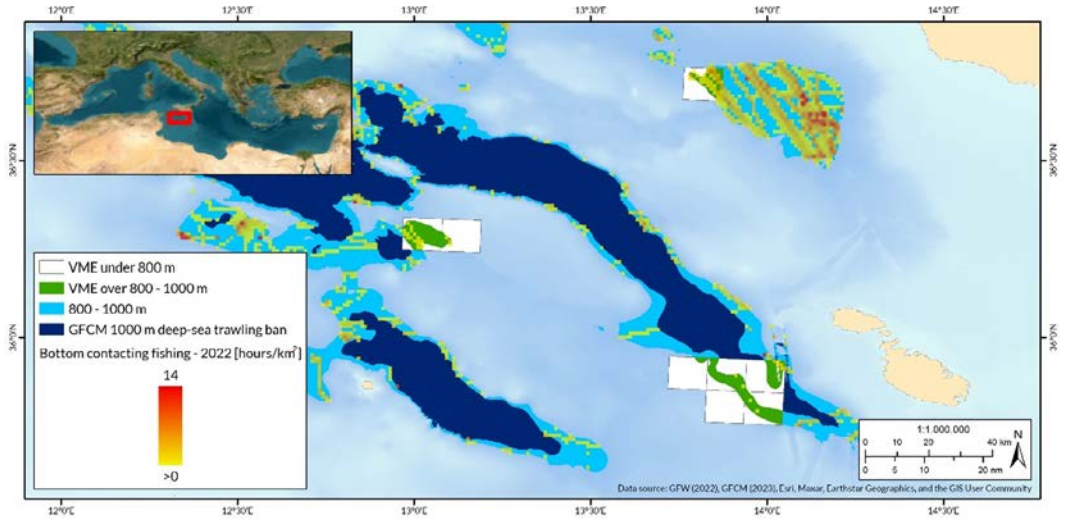
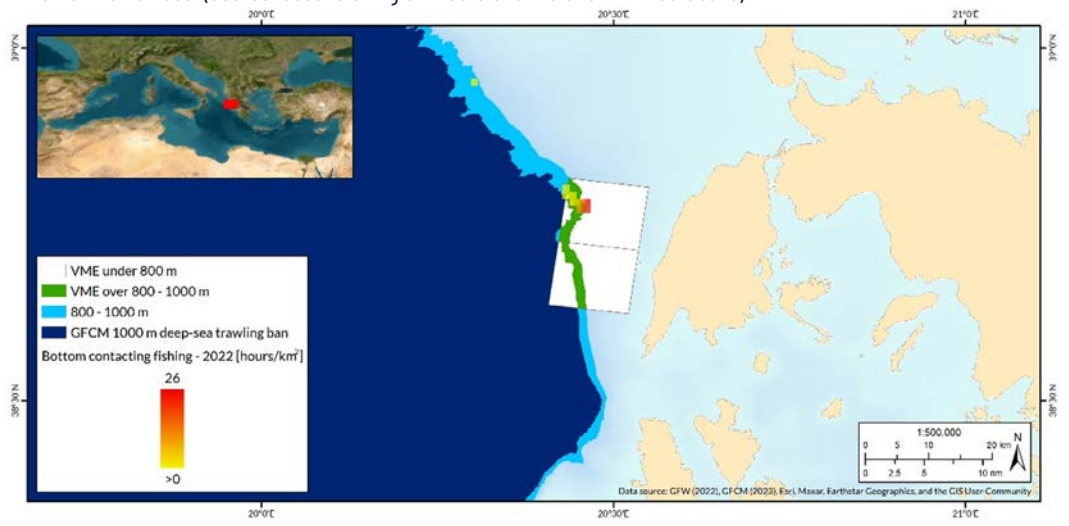


Figure 7. Example of potential overlap between apparent bottom trawling and VMEs in the Eastern Mediterranean: Eastern Ionian Sea. (Source: Oceana using GFW data and the GFCM VME database).



CONCLUSIONS

The extension of the existing GFCM deep-sea fishing ban to include waters below 800 m depth would result in multiple benefits, for fisheries management, for the wider Mediterranean Sea environment, and for climate resilience. Not only would this measure support the application of the precautionary approach in one of the most overfished seas in the world, but protecting deep-sea ecosystems would also contribute to meeting the GFCM's ambitious 2030 targets on biodiversity and climate action. Oceana would like to particularly stress the following points:

IMPROVING DEEP-SEA FISHERIES:

Protecting the area between 800 and 1000 m depth could directly alleviate fishing pressure on certain overfished stocks, such as deep-sea shrimps in the Western Mediterranean, and help recover them to sustainable levels by contributing to the reduction of fishing mortality that has been repeatedly called for by the GFCM SAC.

The main fishing grounds for deep-sea shrimps would be affected in a limited way, as they are generally located above 800 m depth.

The socioeconomic impacts of the measure should be taken into account, but seem to be limited to only 24 vessels (0.5% of the entire Mediterranean trawling fleet) that operate regularly in the area proposed for protection.

The measure would create a level playing field for EU fishers, by applying coherent rules on deep-sea bottom-fishing depth limits in the Northeast Atlantic Ocean (which already has an 800 m limit on bottom trawling), and the Mediterranean Sea.

SUPPORTING ECOSYSTEM-BASED MANAGEMENT AND CLIMATE ACTION:

Extending the GFCM deep-sea fishing ban would help to implement an ecosystem-based approach to fisheries management, by protecting VMEs, deep-sea species, and wider ecosystem functions, specifically by:

Increasing the protection of threatened deep-sea species (e.g., deep-sea sharks) and of VMEs that provide essential fish habitats for commercial and non-commercial species.

Supporting carbon sequestration in the deep ocean by avoiding disturbance of the seabed from bottom fishing, facilitating the overall climate resilience of the Mediterranean Sea.

Strengthening the implementation of important GFCM decisions such as the *Resolution to protect VMEs formed by coral species*,[26] multiannual management plans for shrimps in the Central and the Eastern Mediterranean,[33,34,35,] and the GFCM 2030 Strategy.

OCEANA STRONGLY SUPPORTS THE PROCESS TO REVISE THE DEPTH LIMIT OF THE DEEP-SEA FISHING BAN IN GFCM, FROM 1000 M TO 800 M, TO FURTHER LIMIT IMPACTS OF FISHING ON FRAGILE DEEP-SEA ECOSYSTEMS AND TO IMPROVE THE SUSTAINABILITY OF OVEREXPLOITED MEDITERRANEAN FISHERIES.

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[31] GFCM. (2022). *The State of Mediterranean and Black Sea Fisheries 2022*. FAO. https://doi.org/10.4060/cc3370en.

[32] Global Fishing Watch, a provider of open data for use in this article, is an international nonprofit organization dedicated to advancing ocean governance through increased transparency of human activity at sea. The views and opinions expressed in this article are those of the authors, which are not connected with or sponsored, endorsed or granted official status by Global Fishing Watch. By creating and publicly sharing map visualizations, data and analysis tools, Global Fishing Watch aims to enable scientific research and transform the way our ocean is managed. Global Fishing Watch's public data was used in the production of this publication.

Global Fishing Watch uses data about a vessel's identity, type, location, speed, direction and more that is broadcast using the Automatic Identification System (AIS) and collected via satellites and terrestrial receivers. AIS was developed for safety/collision-avoidance. Global Fishing Watch analyzes AIS data collected from vessels that its research has identified as known or possible commercial fishing vessels, and applies a fishing presence algorithm to determine "apparent fishing activity" based on changes in vessel speed and direction. The algorithm classifies each AIS broadcast data point for these vessels as either apparently fishing or not fishing and shows the former on the Global Fishing Watch fishing activity heat map. AIS data as broadcast may vary in completeness, accuracy and quality. Also, data collection by satellite or terrestrial receivers may introduce errors through missing or inaccurate data. Global Fishing Watch's fishing presence algorithm is a best effort mathematically to identify "apparent fishing activity." As a result, it is possible that some fishing activity is not identified as such by Global Fishing Watch; conversely, Global Fishing Watch may show apparent fishing activity where fishing is not actually taking place. For these reasons, Global Fishing Watch qualifies designations of vessel fishing activity, including synonyms of the term "fishing activity," such as "fishing" or "fishing effort," as "apparent," rather than certain. Any/all Global Fishing Watch information about "apparent fishing activity" should be considered an estimate and must be relied upon solely at your own risk. Global Fishing Watch is taking steps to make sure fishing activity designations are as accurate as possible. Global Fishing Watch fishing presence algorithms are developed and tested using actual fishing event data collected by observers, combined with expert analysis of vessel movement data resulting in the manual classification of thousands of known fishing events. Global Fishing Watch also collaborates extensively with academic researchers through its research program to share fishing activity classification data and automated classification techniques.

In this analysis, bottom towed fishing gear refers to both bottom trawlers and dredges. Bottom towed fishing gear for this analysis was matched to EU registries where bottom gear information is included. If all the possible gear types for the registered vessel were bottom towed fishing gear, then it was included in this portion of the analysis. This matching process is external to GFW. GFW data cannot distinguish between mid-water and bottom-trawling gear.

[33] Recommendation GFCM/43/2019/6 on management measures for sustainable trawl fisheries targeting giant red shrimp and blue and red shrimp in the Strait of Sicily (geographical subareas 12, 13, 14, 15 and 16).

[34] Recommendation GFCM/42/2018/4 on a multiannual management plan for sustainable trawl fisheries targeting giant red shrimp and blue and red shrimp in the Ionian Sea (geographical subareas 19, 20 and 21).

[35] Recommendation GFCM/42/2018/3 on a multiannual management plan for sustainable trawl fisheries targeting giant red shrimp and blue and red shrimp in the Levant Sea (geographical subareas 24, 25, 26 and 27).

[36] Resolution GFCM/44/2021/12 on a GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea.

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Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Co-funded by The Wishful Squid, a donor-advised fund of Fondation Philanthrophia.