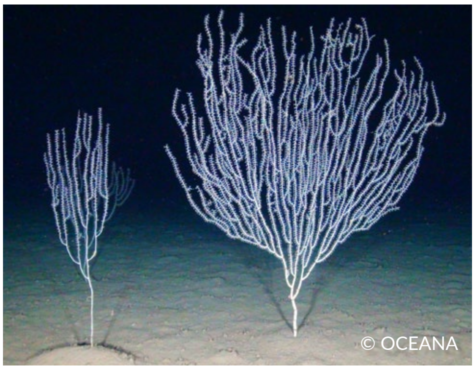
Extending the limit on deep-sea bottom fishing in the Mediterranean to preserve vulnerable habitats

October 2024

1. THE IMPORTANCE OF THE DEEP-SEA FOR BIODIVERSITY AND CLIMATE CHANGE MITIGATION

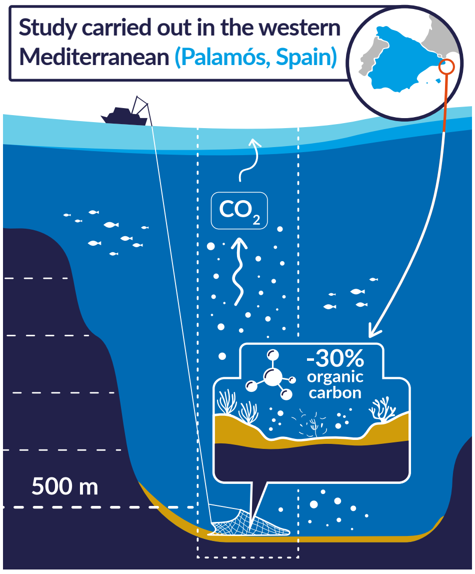
Deep-sea habitats are formed by geographical features (e.g. submarine canyons, reefs, and seamounts) that host a large variety of ecosystems that are biodiversity hotspots, and may play a key role in deep-sea ecological dynamics and carbon cycling.[1,2] Many of these ecosystems act as essential fish habitats (EFHs), supporting essential life stages of a large number of commercial species, and/or are vulnerable marine ecosystems (VMEs). This is the case of forests formed by black corals *Leiopathes glaberrima*, which create tree-like structures that provide shelter, spawning grounds, and feeding opportunities for various species ranging from small invertebrates to large predators like the Mediterranean mora (*Mora moro*) and deep-sea sharks (e.g. gulper shark (*Centrophorus granulosus*) and velvet belly lanternshark (*Etmopterus spinax*)).[3]



Like black corals, most species that form EFHs and VMEs are extremely sensitive to physical disturbance, which puts deep-sea ecosystems at high risk of damage from human activities such as bottom trawling.[4] Bottom trawling is recognised as the most widespread and harmful anthropogenic activity affecting the seabed globally.[5,6] In the Mediterranean Sea, one clear example of its impacts is the dramatic reduction of species such as bamboo coral (*Isidella elongata*), a near-endemic species that lives mostly below 500 m depth; its population decreased by 80% in the last century due to the impact of trawling activity.[7]

The largest carbon reservoir on Earth

The ocean plays a vital role in climate change mitigation. As the largest planetary carbon sink, it absorbs around 25% of CO_2 emitted by human activity.[8] Features like marine sediments and soft bottoms, which are widely distributed in deeper areas, are considered critical reservoirs for long-term carbon storage.[9,10] Bottom trawling can reduce ocean climate resilience, by directly disturbing carbon stored in seabed sediments, which is then resuspended into the water column.[11] Once resuspended, sedimentary carbon can be converted to CO_2, which is likely to increase ocean acidification and reduce the capacity of the ocean to absorb atmospheric CO_2.[12] A study carried out in the western Mediterranean region of Palamós (Catalonia) found 30% less organic carbon in deep-sea (500 m) sediment that was continuously bottom trawled for shrimp, compared to sediment where bottom trawling had been banned for two months.[13]



A refuge against ocean warming and heatwaves

Deep-sea habitats can serve as **climate refugia** for marine species.[14,15,16] As shallower waters get increasingly warmer, some species migrate towards cooler, deeper areas,[17] including to avoid marine heatwaves.[18] Heatwaves have become more frequent and intense over the past decade, especially in the relatively small, semi-enclosed Mediterranean, affecting vast areas and a large number of species and occasionally evolving into mass mortality events.[19,20] Deep-sea species tend to be adapted to a largely stable environment and therefore may be relatively vulnerable to such drastic environmental changes.[21]

At the same time as climate change drives species towards deeper waters, fishing has also been shifting progressively deeper. Globally, the average depth of fishing increased from 200 m to 1000 m between 1950 to 2004.[22] This trend is likely due to not only rising water temperatures, but also technological advances and the depletion of shallower fish stocks. One such example from the Mediterranean Sea is that of the commercial fleet in the Catalan Sea, which has exploited the blue and red shrimp (*Aristeus antennatus*) for over six decades and is now fishing at average depths of between 550 m and approximately 900 m.[19] As stated during the last General Fisheries Commission for the Mediterranean (GFCM) Scientific Advisory Committee session, stock assessments of *A. antennatus* and other deep-sea shrimps show that they are overexploited in most GSAs.[23] Similarly, the shift of bottom trawl fleets towards deep waters may drive declines in Mediterranean populations of sharks, rays, and chimaeras, as has been observed for velvet belly lanternshark (*E. spinax*) and longnosed skate (*Dipturus oxyrinchus*) in northern Spain[24] and the Strait of Sicily.[25] These species are particularly vulnerable to overfishing due to their life history characteristics (i.e. long lifespans, slow growth, and low fecundity).[26] Evidence also shows that deeper areas of the Mediterranean Sea host a higher diversity of cartilaginous fish species (chondrichthyans), potentially related to the higher fishing effort exerted in the continental shelf.[27]

Steps taken by the GFCM to date to protect vulnerable deep-sea ecosystems

In 2005, the GFCM prohibited the use of towed dredges and trawl nets at depths beyond 1000 m, with the objective of curbing stock declines and improving the sustainability of fisheries exploitation.[28] Since that time, the total area adopted to protect deep-sea ecosystems from fisheries impacts has barely increased. It remains very similar to almost 20 years ago, despite increased knowledge about the critical role the deep sea plays in ecosystem functioning and in climate change mitigation.

At the 2019 meeting of the GFCM Working Group of Marine Protected Areas (WGMPA), scientists proposed to extend the 1000 m deep-sea trawling ban to encompass all waters below 600 m depth.[29] In 2022, the GFCM SAC recommended, as a first step, to analyse the overlap between VMEs and deep-water fisheries in the central-eastern Mediterranean. This evaluation was intended to provide information about fishing activities below 600 m depth,[30] to facilitate an initial assessment of the potential impacts of changing the 1000 m depth limit. Following this, in 2023 the GFCM adopted a resolution to conduct four regional pilot projects to assess the environmental and socioeconomic impacts of a possible extension of the current 1000 m depth limit of the trawling ban to 800 m.[31] The results from the pilot projects will be presented to the GFCM in 2025, and the SAC is then expected to formulate scientific advice accordingly.

THE 800 - 1000 M DEPTH RANGE OF THE MEDITERRANEAN SEA ALONE (WITHOUT THE BLACK SEA) REPRESENTS A SURFACE AREA OF APPROXIMATELY 100 000 KM^2 OF DEEP SEA.

Similar prohibitions on bottom trawling below 800 m are already in place in some areas. In 2016, the EU prohibited fishing with bottom-contacting gears below 800 m depth in North-East Atlantic waters, to minimise negative impacts on the marine ecosystem.[32] In 2024, Spain, Italy and France established 800 m limits on bottom trawling in their national waters in the Western Mediterranean.[33,34,35]

2. ESTIMATING FISHING ACTIVITY BETWEEN 600 AND 1000 M DEPTH

To assess the extent of bottom-contact fishing activity in the Mediterranean Sea at depths of between 600 m and 1000 m, Oceana conducted a comprehensive analysis using Automatic Identification System (AIS) data.[a] These data were obtained from Global Fishing Watch (GFW),[36] and then cross-referenced against the European Fleet Register and the GFCM Authorized Vessel List (AVL)[b] to ensure identify those vessels using bottom-contacting gears.[c]

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The results indicate a low level of fishing activity below 800 m depth. According to the GFCM Authorized Vessel List (AVL),[37] 3423 vessels in the Mediterranean (in GSAs 1 to 27) are equipped with bottom-contacting gears. Those vessels are often the largest vessels within the fleet, measuring 12-24 m length overall (LOA) and greater than 24 m LOA.[38] Based on the AIS data for 2023, a limited fraction (3.5%) of the Mediterranean bottom trawling fleet appears to operate under 800 m,[d] and most of those vessels that do appear to fish below 800 m (80%) carried out less than the 10% of their total apparent fishing activity beyond this depth. Because Mediterranean trawl fleets are expanding towards deeper fishing grounds,[13] a trend that is likely to continue, it is of greatest importance to act to **freeze the spatial footprint** of deep-sea trawl fisheries to precautionary depths, to prevent adverse impacts on deep-sea VMEs, carbon-rich ecosystems, and sensitive species.

3. ESTIMATING POTENTIAL INTERACTIONS BETWEEN BOTTOM-CONTACT FISHING AND DEEP-SEA HABITATS

While the Mediterranean deep sea is still relatively unknown in terms of habitat and species distributions and interactions,[39] knowledge has greatly improved since 2005. One example is the GFCM database on sensitive benthic habitats and species,[40] which compiles voluntary records of around 20 500 VMEs found across the GFCM area. Using this database, Oceana gathered the best available information on the distribution of VMEs in the Mediterranean Sea. Oceana combined these data with EFH distribution maps from Mediterranean Sensitive Habitats (MEDISEH),[41] a European project that reviewed and mapped all available data (including historical data) on nurseries and spawning grounds of certain demersal species.[e] As an example, the project mapped EFH for important commercial species like European hake (*Merluccius merluccius*), a species identified as the most overexploited in the Mediterranean according to the 2024 GFCM SAC stock assessment.[23]

To assess the potential ecological impacts of extending the current deep-sea bottom trawling ban, Oceana combined the data on apparent fishing effort by bottom trawlers in 2023 (see *Estimating fishing activity between 600 and 1000 m depth*, above) with data on VMEs and EFHs, for two different depth scenarios: 600-1000 m and 800-1000 m. The potential spatial overlap between apparent bottom fishing and the presence of VMEs and/or EFHs for the two depth scenarios was then analysed.

[a] The use of AIS systems is not mandated by all Mediterranean countries, and as a result, the data may not provide a comprehensive representation of vessels from all nations in the region.

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

[c] Vessels listed as only using bottom trawls and dredges (fishing gear codes: OTB, OTT, TB, TBB, DRB, and TX) were considered for this analysis.

[d] Vessels with fewer than 20 hours of apparent fishing activity in 2023 were not included in the analysis.

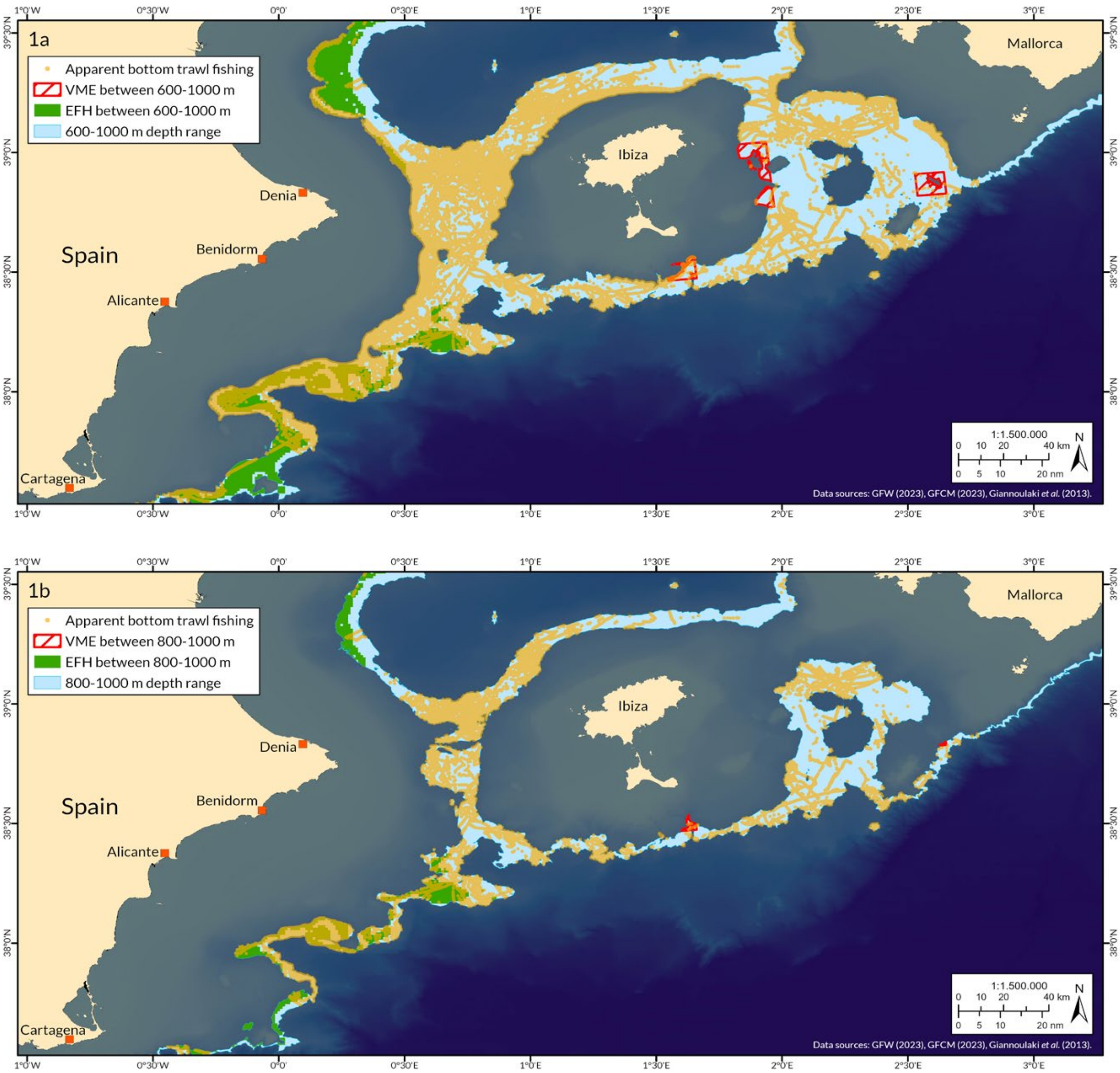
[e] The species included were: *Aristaeomorpha foliacea*, *Aristeus antennatus*, *Eledone cirrosa*, *Galeus melastomus*, *Illex coindetii*, *Merluccius merluccius*, *Mullus barbatus*, *Mullus surmuletus*, *Nephrops norvegicus*, *Pagellus erythrinus*, *Parapenaeus longirostris*, and *Raja clavata*.

To visualise our results, Oceana created an online interactive tool[f] on the Global Fishing Watch platform, which can be found at the following link: [Protecting Mediterranean depths: Interactive tool for assessing bottom trawling impacts].

Two examples of the results of these analyses are presented below. They illustrate the potential interactions of bottom fishing activity with VMEs and/or EFHs in Spain, in the waters off the coast of Alicante and in the Mallorca Channel (Figure 1), and in Italy, in the northern Strait of Sicily (Figure 2). For each example, the apparent fishing activity and presence of VMEs/EFHs are presented for two depth ranges: 600-1000 m and 800-1000 m, highlighting areas where VMEs and EFHs may be at risk from bottom trawling.

In the Alicante-Mallorca Channel area, approximately 20% of the apparent bottom fishing hours in the 600-1000 m depth range occurred in areas where VMEs and/or EFHs may occur, while this overlap was approximately 6% in the 800-1000 m depth range. In the northern Strait of Sicily, nearly 90% of apparent bottom fishing hours in the 600-1000 m depth range were from areas where VMEs and/or EFHs occur, versus around 20% in the 800-1000 m depth range.

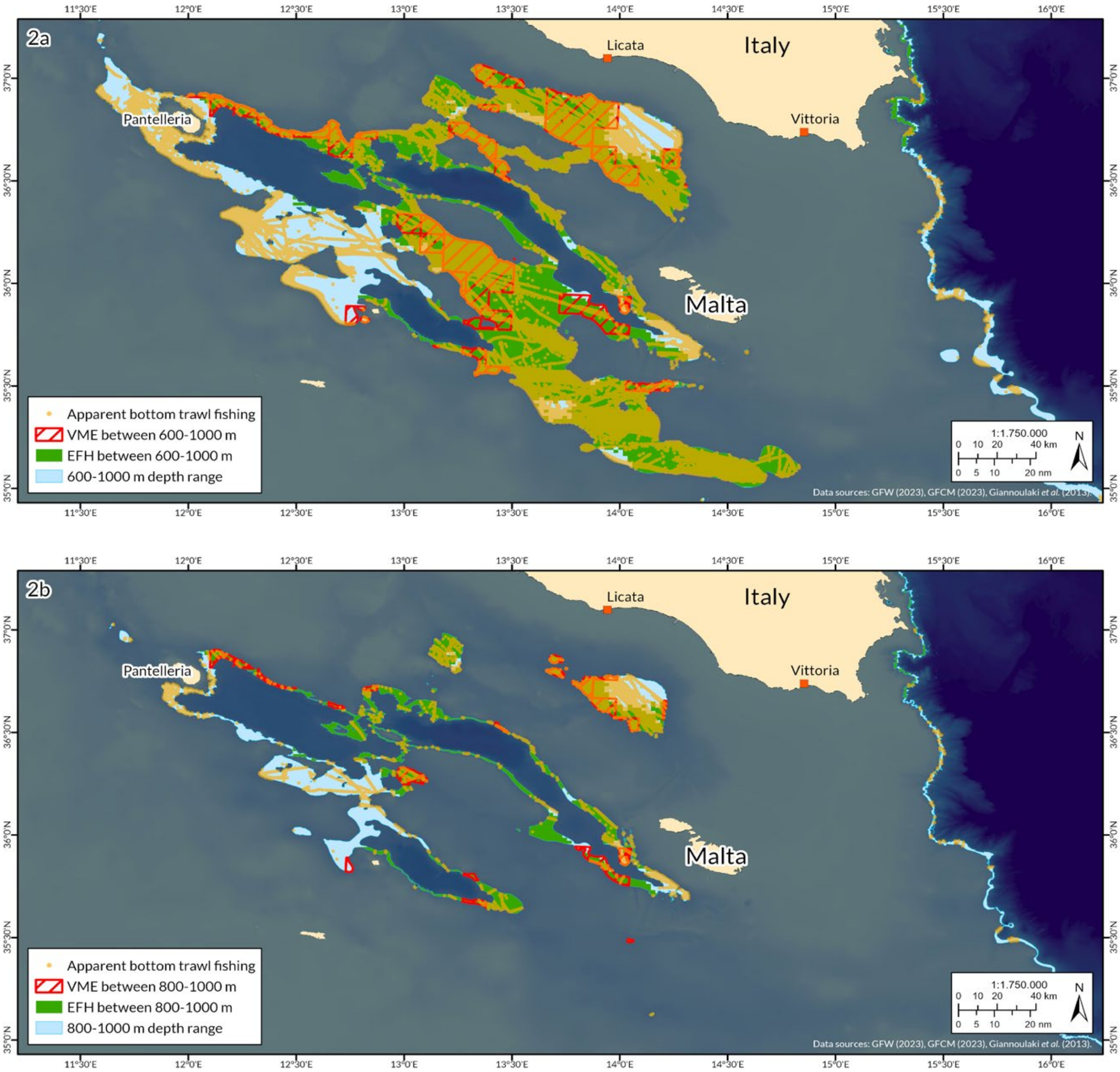
***Figure 1**. Potential overlap between apparent bottom trawling activity, EFHs, and VMEs in the area off Alicante and the Mallorca Channel between 600 m and 1000 m depth (a) and between 800 m and 1000 m depth (b) (Source: Oceana analysis using data from GFW, MEDISEH, and the GFCM database on sensitive benthic habitats and species).[42]*



[f] The tool is designed to assist users (primarily representatives of GFCM member countries or individuals involved in GFCM regional pilot projects) in assessing the potential environmental impacts of an extension of the current 1000 m bottom-contact fishing ban. By interacting with the available options in the workspace, users can explore different scenarios of apparent bottom-contact fishing activity (at depths of between 600-1000 m, 700-1000 m, and 800-1000 m) and evaluate the potential interactions this activity may have with areas where VMEs and EFHs are likely to occur.

These examples reflect the broader situation in the Mediterranean, where about 60% of apparent bottom-contact fishing hours in the 600-1000 m depth range take place in areas where VMEs and/or EFHs are likely to be present. In the 800-1000 m depth range, approximately 45% of apparent bottom-contact fishing hours may overlap with these critical habitats. This indicates substantial bottom-fishing activity occurring in seabed areas that are recognised as ecologically important and in need of protection. The issue is particularly pronounced in the 600-1000 m depth range, where the percentage of overlap between apparent bottom fishing and vulnerable habitats is higher compared to the 800-1000 m range. This difference may reflect a combination of lower bottom fishing activity at greater depths and the relatively limited availability of ecological records from deeper areas. It should also be noted that, in general, information on VMEs/EFHs is not comprehensive, and so even at shallower depths, sensitive habitats or ecosystems may exist in areas where no such records are available and where bottom trawling is taking place.

Figure 2. Potential overlap between apparent bottom trawling activity, EFHs, and VMEs in the Strait of Sicily between 600 and 1000 m (a) and between 800 and 1000 m (b) (Source: Oceana analysis using data from GFW, MEDISEH, and the GFCM database on sensitive benthic habitats and species).[38]



4. OCEANA'S RECOMMENDATIONS

Oceana strongly supports the GFCM process to extend the 1000 m deep-sea trawling ban to include shallower waters and, as such, further reduce the impacts of fishing on deep-sea ecosystems and species, improve the sustainability of overexploited Mediterranean deep-sea stocks, and strengthen the carbon storage capacity of the deep ocean. Extending the limit would support the objectives of the GFCM 2030 strategy,[43] and provide a much-needed precautionary approach to managing fisheries in relation to climate change. The need for climate-smart fisheries management in the Mediterranean Sea is especially urgent, considering that the Mediterranean Sea is the second most overfished sea in the world and a region that is warming faster that the global average.[44]

AS THE GFCM CONTINUES ITS WORK TO ASSESS THE POTENTIAL FOR REVISING THE DEPTH LIMIT OF THE DEEP-SEA TRAWLING BAN, OCEANA STRESSES THE NEED TO CONSIDER THE FOLLOWING:

Protecting the area below at least 800 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 called for repeatedly by the GFCM SAC.

Extending protection to shallower waters (e.g. below 600 m) should be considered in specific priority areas: where certain target species could benefit, or where VMEs/EFHs may be present and at potential risk from interaction with bottom fishing activities.

While **potential socioeconomic impacts** should be taken into account, they **appear to be limited**, as only 3.5% of the entire Mediterranean trawling fleet operates regularly or occasionally below 800 m depth.

Precautionary management is necessary to prevent the expansion of Mediterranean trawl fleets towards deeper fishing grounds, and to ensure that deep-sea habitats can continue to provide key ecosystem benefits, such as acting as climate refugia.

Protecting deep-sea carbon-rich ecosystems from bottom-fishing impacts would support carbon sequestration in the deep ocean, and facilitate the overall climate resilience of the Mediterranean Sea.

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36 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 document 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.

37 FAO. (2024, September). GFCM Fleet Register. https://www.fao.org/gfcm/data/fleet/register

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

39 IUCN. (2019). Thematic report – Conservation overview of Mediterranean deep-sea biodiversity: A strategic assessment. IUCN. https://uicnmed.org/docs/mediterraneandeepsea.pdf

40 FAO. (2024). *GFCM database on sensitive benthic habitats and species*. FAO. https://www.fao.org/gfcm/data/maps/sbhs/en/

41 Giannoulaki, M., Belluscio, A., Colloca, F., Fraschetti, S., Scardi, M., Smith, C., Panayotidis, P., Valavanis, V., & Spedicato, M. T. (Eds.). (2013). *Mediterranean Sensitive Habitats (MEDISEH): Final project report*. Hellenic Centre for Marine Research. https://imbriw.hcmr.gr/wp-content/uploads/2013/12/MEDISEH-final-report-reduced.pdf

42 VME data were generated from the GFCM Vulnerable Marine Ecosystem database. Based on those point data, 10 km x 10 km GFCM grid cells where VMEs have been recorded were identified. For EFHs, the data shown represent the potential presence of species documented from the MEDISEH project. Apparent bottom trawling activity is from Oceana analyses of AIS data from GFW, cross-checked with the EFR and GFCM AVL databases. Vessels were only included if the EFR and/or AVL indicated that they were only using bottom-contact fishing gear at the time when the fishing activity was carried out, according to GFW.

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

44 OBSERVER: Record-Breaking marine heatwaves in the Mediterranean and safeguarding marine ecosystems. (2023, 3 August). *Copernicus*. https://www.copernicus.eu/en/news/news/observer-record-breaking-marine-heatwaves-mediterranean-and-safeguarding-marine

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