UNIVERSITY OF THE AEGEAN
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MSc Integrated Coastal Zone Management

An Overview of the Policy and Legal Framework pertaining to Deep Sea Habitats

MSc Thesis

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For zante beach and the ecosystem services

In memory of Spiros

University of the Aegean

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ABSTRACT

The deep sea is the largest and least explored biome on Earth and many difficulties are inherent to the conservation of its ecosystems. The latter have the ability to create biodiversity hotspots and therefore various countries have endorsed relevant conservation and management plans. The main objective of the present thesis has been to identify the basic International and European legal framework that functions as a multi-level tool for their protection, while additional information on their types, their characteristics and known occurrence in the marine areas around Greece is provided in order to promote the discussion on their conservation and the problems around it. Geomorphology, geology, and hydrology/hydrodynamics, other abiotic components and their temporal variability control the multi-dimensional distribution and diversity of the deep sea habitats. The Mediterranean basin has a particular character which leads to different diverse distribution patterns of deep sea habitats from those of the adjacent Atlantic Ocean, while some distinct features occur in its Eastern region.

Deep sea habitats have great ecological value as they provide for the storage of greenhouse gasses, bioremediation, contribute to biochemical cycles and enhance productivity; they also create biodiversity hotspots and support overall the health and functioning of the oceans. Hence, their identification and preservation should be pursued even more urgently under contemporary circumstances which are associated with increased threats and pressures. In the waters around Greece presently known occurrences of deep sea habitats (DSH) include certain types of chemosynthetic habitats, seamounts and biogenic habitats. However, their conservation is problematic due to their present location in the high seas. Their situation may change in the future as a result of the declaration of a Hellenic EEZ.

The first step towards their conservation has been their recognition as 'vulnerable'. Several organizations related to fisheries management (e.g., FAO, GFCM and the EU Common Fisheries Policy), have endorsed policies with the establishment of rules, restrictions and PAs. Further on, certain policies and legislation have been developed aiming directly at their protection. These include the Dark Habitats Action Plan which has been designed to apply to issues pertinent specifically to their conservation, and certain provisions of the EU Habitats Directive, as well as MSFD which urges Member States to identify the relevant habitat types, establish spatial protection measures and secure their preservation and good environmental status.

Other policies and legislation are designed to promote preservation, restoration and recovery of biodiversity in general, and the creation of representative networks of MPAs, including thus in their structure deep sea habitats as basic components of the environment. Provisions target certain categories, such as threated and rare species and habitats. Several deep sea habitats and their associated species are also rare, endemic, threatened or other and consequently benefit from such provisions, upon though, identification. These protection/conservation provisions are mostly related to the Convention of Biological Diversity, the Barcelona Convention and its SPA/BD Protocol, the EU Biodiversity framework and the EU Directives aiming at environmental protection and the sustainable allocation of uses of the maritime space. Legislation, covering many aspects of the protection of deep sea habitats exists and provides an effective conservation framework and a basis for action. Further legislative provisions specifying or adding on their conservation could be particularly helpful especially in the direction of inciting action by States. Crucial prerequisites are the cartography of the seabed, identification and habitat mapping and the regulation of the jurisdictional space according to the provisions of UNCLOS and other relevant legislation creating solutions and a basis for conservation.

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List of Acronyms

ABNJ	Areas beyond National Jurisdiction
ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area
APEIs	Areas of Particular Environmental Interest
BBNJ	Biodiversity beyond National Jurisdiction
BC	Barcelona Convention
CBD	Convention of Biological Diversity
CFP	Common Fisheries Policy
CISE	Common Information Sharing Environment
COP	Conference of the Parties
CORINE	Coordination of Information on the Environment
DHAB	Deep Hypersaline Anoxic Basin
DSF	Deep Sea Fisheries
DSH	Deep Sea Habitats
EBM	Ecosystem Based Management
EBSA	Ecologically and Biologically Significant Area
EC	European Community
EcAp	Ecosystem Approach
EEA	European Environmental Agency
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
EU	European Union
EUNIS	European Nature Information System
FAO	Food and Agriculture Organization
FRA	Fisheries Restricted Area
GES	Good Environmental Status
GFCM	General Fisheries Commission of the Mediterranean
GIS	Geographic Information System
HCMR	Hellenic Centre for Marine Research
IAS	Invasive Alien Species
ICZM	Integrated Coastal Zone Management
IMAP	Integrated Monitoring and Assessment Program
IMMA	Important Marine Mammal Area
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
ISA	International Seabed Authority
IUCN	International Union for Conservation of Nature
IUU	Illegal Unreported Unregulated
IWC	International Whaling Commission
LBS	Land Based Sources
MAP	Mediterranean Action Plan
MPA	Marine Protected Area
MSP	Maritime Spatial Planning
MSSD	Mediterranean Strategy for Sustainable Development
NOAA	National Oceanic and Atmospheric Administration

OECM	Other Effective Conservation Measure
PA	Protected Area
POM	Particulate Organic Matter
POP	Persistent Organic Pollutant
PSSA	Particularly Sensitive Sea Areas
REMPEC	Regional Marine Pollution Emergency Response Centre
SAC	Special Area of Conservation
SAI	Significant Adverse Impact
SCI	Site of Community Importance
SDGs	Sustainable Development Goals
SEA	Strategic Environmental Assessment
SPA/RAC	Specially Protected Areas Regional Activity Center
SPA	Specially Protected Area
SPAMI	Specially Protected Area of Mediterranean Importance
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Program
UNGA	United Nations General Assembly
VME	Vulnerable Marine Ecosystem
VMS	Vessel Monitoring System
VTS	Vessel Traffic Services
WGVME	Working Group on Vulnerable Marine Ecosystems

1. Introduction

The exploration of the oceans has been a challenging venture for scientists through the centuries. Our knowledge on the marine biodiversity, geodiversity, ecosystems, habitats, species and their interconnected functions still remains scant and fragmentary on various levels. This applies even more so to aphotic environments which extent to ultra-deep hadal areas. The vastness of the deep sea justifies our incomplete knowledge a reality better understood when we consider that approximately 60% of our planet is covered by waters deeper than 1000 m[1]. Deep sea ecosystems include the waters and sediments, beneath approximately 200 m depth. They represent the world's largest biome, covering more than 65% of the earth's surface and including more than 95% of the global biosphere (Danovaro et al., 2010).

These environments once considered lifeless domains, now do not cease to surprise scientists with their heterogeneity, diversity and complexity of structures and functions. Their location far from shore and in great water depths has been an obvious impediment for discoveries and research, and has further placed them in relevantly lower places in conservation priority lists due to the inherent difficulties in the application of measures and surveillance. For some nations, difficulties in research and conservation may be connected with additional problems relating to unclear jurisdictional regimes, difficulties in transboundary cooperation for conservation including the varying degree of implementation of environmental legislation[2], lack of funding and prioritization in favor of investment plans instead of conservation (Katsanevakis et al., 2015).

Nevertheless several countries have given attention to these deep sea habitats supporting scientific surveys and programs, enacting laws and taking spatial and other measures unilaterally or jointly. Impressive deep sea habitats and species such as gigantic glass sponges of hundreds and even thousands of years old, sea pens groves, coral forests and cold water coral reefs have been found in the Atlantic Ocean (NOAA, 2017) as well as in European waters (though to a lesser extent and intensity), leading to even bold conservation actions such as enforcement of closures in rich commercial fisheries grounds[3]. Many of these deep sea features hold unique or specific characteristics that make them rare or vulnerable and are considered to create biodiversity hotspots. As accessibility to the deep seas and knowledge become upgraded and enhanced due to the technological advances, attention gradually increases, while the interest on possible resources exploitation rises, creating new threats to forms of life already known or yet to be discovered. In this light, urgent and timely action on local, national, international and transboundary level for their protection, conservation and sustainable management is indispensable.

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[1] https://uicnmed.org/docs/mediterraneandeepsea.pdf ,p .14

[2] Notably Greece is a signatory of the SPA/DB Protocol to the Barcelona Convention while its ratification is still pending, bounded though for its implementation through EU ratification and set into force in 1999. Countries sharing marine space include Libya, which has not signed the above Protocol, and Turkey, which is not a signatory of UNCLOS, but has set into force the SPA/BD Protocol in 2002. Italy and Egypt have both set into force the Protocol and have ratified UNCLOS.

[3] https://www.fisheries.noaa.gov/new-england-mid-atlantic/habitat-conservation/northeast-canyons-and-seamounts-marine-national

The above scientific discoveries and research have led to the question on the existence of similar deep sea ecosystems in the deep waters around Greece. Their potential occurrence is considered high due to the great water depths of the many marine basins and troughs found in this region. The average water depth of the Greek Seas is 2500 m[4] whereas the deepest point of the Mediterranean Sea is also located in the Greek waters (about 5270 m, Ionian Sea). Inevitably several questions can be posed. If such habitat types indeed exist in the area, are they similar to those found in the Atlantic or maybe the area supports other distinct types which create hotspots of biodiversity? It is also known that the area hosts some unique geomorphology and some emblematic species; is it then possible that these ecosystems are somehow interconnected, and these deep seabed habitats are indispensable components? And if so, are these habitats under any protection/conservation scheme based on a legal framework?

The objective of this thesis has been to consider the above questions, and particularly the question of the pertaining policy and legal framework for the protection/conservation of these deep Mediterranean ecosystems. Towards this objective, a bibliographic research has been conducted mainly through electronic means, in order to collate information pertaining to the existence, types, and geographical distribution of such deep sea habitats in the Hellenic and adjacent waters, together with information on the broad characteristics of these habitat types (Section 2) and the pressures that can adversely affect them (Section 3) in order to comprehend their value and the necessity of protection (Section 3); thus further comments on their conservation status are provided along with their presentation (section 2);The results and comments are cited below in the respective sections, while some basic information on the oceanographic character of the Mediterranean, on the geomorphology of the seabed around Greece and on elements that define bathymetric distribution of deep sea habitats have been gathered and cited prior to the description of the habitat types (Section 2), as it has been considered essential for the purpose of understanding the reasons behind their occurrence or absence, and their extent and distribution in these waters.

In addition, effort was made to present policies and legislation of great significance to the protection and conservation of these deep sea habitats and these are found in Section 4. This protection framework consists of international, regional and European policies, international Conventions and Agreements, binding Recommendations, Regulations, Directives and important regional Mediterranean legislation. Some of these policies and legislation concern deep sea habitats more or less directly providing strong suggestions or immediate regulation of issues regarding their protection from the negative effects of pressures due to their vulnerability, their conservation and monitoring. That includes several UNGA Resolutions, the FAO Guidelines for the management of deep sea fisheries, SPA/RAC Dark Habitats Action Plan, BC IMAP, GFCM Recommendations, EU CFP Regulations, the EU Habitats and MSF Directives and certain provisions of UNCLOS on the management of living resources and the prevention of pollution.

Another group of policies and legislation are either of a more general nature or indirectly connected to deep sea habitats , providing for biodiversity conservation in general,

[4] https://portals.iucn.org/library/sites/library/files/documents/2004-052.pdf , p.11

transboundary cooperation platforms, pollution prevention, protection from specific pressures, risk and impact assessment, and protection of species and habitats of certain characteristics or peculiarities (e.g. threatened or rare). These are global, regional and European strategies and frameworks on sustainable development and biodiversity and their targets and goals, provisions of UNCLOS, MARPOL and BC Protocols on pollution, EIA and SEA Directives, SPA/BD Protocol, Habitats Directive, Bern Convention and the ACCOBAMS Agreement of the Bonn Convention.

Within the same policies and legislation another group of provisions, programs and actions aims at the spatial protection and conservation and thus it is analyzed under the concept of the need for coherent, representative and connected MPA networks. The establishment of MPAs in offshore waters automatically equals to the conservation of deep sea habitats, increase of PAs cover, protection of genetic and functional diversity and enhanced connectivity with the expansion beyond territorial waters. Hence their spatial protection is based on GFCM Recommendations on the establishment of FRAs, on the identification of EBSAs under the CBD according to certain criteria particularly relevant to deep sea habitats, on SPA/BD Protocol and the establishment of SPAs and SPAMIs according again to criteria of great significance for deep sea habitats, on targets and goals of biodiversity strategies on marine protected areas cover and habitats restoration, on certain provisions of UNCLOS and SPA/BD Protocol regarding transboundary cooperation for the establishment of protected areas and jointly managed zones, on the provisions of Habitats Directive for Natura 2000 network, on MSP Directive, as well as on the actions of IMO for the establishment of PSSAs through the spatial and functional connection of deep sea habitats with deep diving cetaceans, underwater noise and pollution.

Finally the division of the marine space, the rights and obligations concerning the use of resources and the protection of the marine environment, as these have been set out and regulated by the international community through UNCLOS are thoroughly described, with the intent to elaborate on who has the responsibility, obligation or right to protect the components of the marine environment and deep sea habitats in particular, according to their location.

The above categorization of policies and legislation is provided for the mere purpose of providing the causal link for their inclusion in this overview and it is not the structure that has been followed. The overview of policies and legislation begins with the first actions of the international community for their conservation and particularly their recognition as VMEs as an immediate response to the pressure from fisheries, and with the established framework and further developments for ABNJ (Section 4.1), while it continues following analysis by policy or statute of International (Sections 4.1, 4.2, 4.3), Mediterranean (Section 4.4) and European application (Sections 4.5, 4.6). Relevant commentary is provided along the way, where deemed necessary.

Finally this work discusses the progress made towards the preservation of deep water habitats, provides with some conclusions on the sufficiency of the conservation framework and some relevant recommendations.

2. Deep Sea Environments: features and habitats

2.1 Characteristics of the Eastern Mediterranean

The Mediterranean deep sea occupies almost 78% of its total marine area, harboring some of its most iconic, rare and vulnerable features and creatures. Some estimates indicate that it can host close to 3000 species versus the estimated 17000 of its entire marine environment[5]. This is a basin with high endemism rates, particular geomorphology and oceanographic character and past. The presence of these geomorphologies and habitats along with temporal variation are supporting deep sea biodiversity. Full comprehension of the geologic and oceanographic past and present of the Mediterranean environment is necessary for understanding biogeographic, ecological and evolutionary patterns of taxa, while the relevant data support predictive modelling of habitats.

The Mediterranean Sea is a semi-enclosed marginal sea of the Atlantic Ocean. At the present time the basin is relatively isolated from the Atlantic due to the shallow sill of the Strait of Gibraltar (maximum depth 280 m). A second physical barrier dividing the basin into two distinct sub regions is the shallow Sicily Channel. These geological barriers create isolation conditions. For example, the Gibraltar sill may acts as filter for deep sea benthic fauna and larvae along with the unfavorable dominant hydrological conditions of the basin (the Pseudo population hypothesis, Bouchet and Taviani., 1992)[6] whereas all the physical barriers may hinder genetic exchanges. The Western and Eastern basins show distinct characteristics, with the Eastern basin being much more tectonically active (Vanney and Gennesseaux, 1985) due to the tectonic plate collision, as well as more oligotrophic.

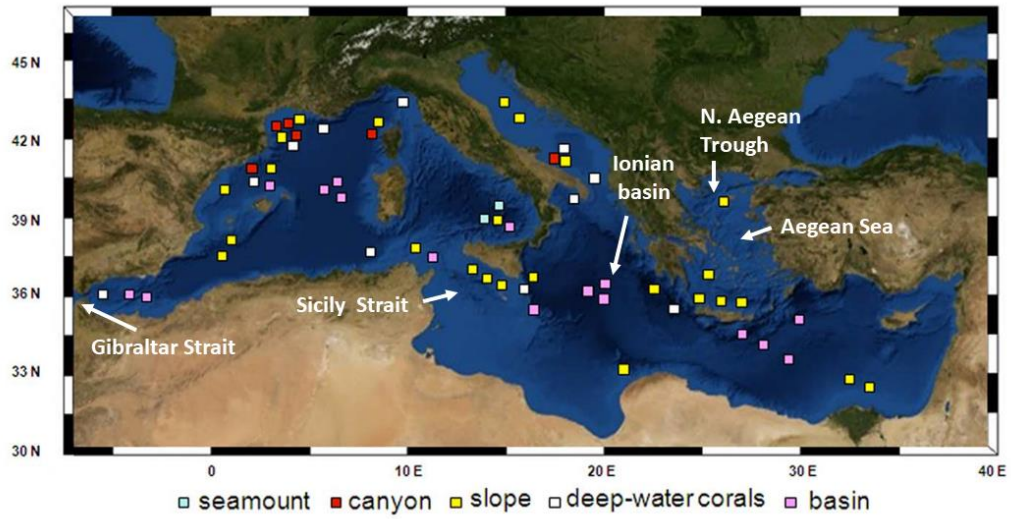

Fig.2.1 Mediterranean basins and studied deep sea environments (after Danovaro et al., 2010)

[5] https://uicnmed.org/docs/mediterraneandeepsea.pdf , p.26
[6] https://portals.iucn.org/library/sites/library/files/documents/2004-052.pdf ,p.17

The Eastern Mediterranean comprises three deep basins, the Ionian, the Aegean and the Levantine, all three showing significant differences. The Central and Eastern Ionian Sea show some of the deepest waters of the basin with average depths of 2500 m. The maximum depth (> 5200 m) of the entire basin is also located there while the average depth of the Mediterranean Sea is 1500 m. The deepest point is found off the southwestern Peloponnese within the abyssal zone of the Hellenic Trench.

The intense seismicity of the area, the existence of hydrocarbon reservoirs and other geologic factors result in some distinctive features. These particular geomorphologic structures can result in biodiversity hotspots and a highly heterogeneous sea floor which further enhances biodiversity (Danovaro et al., 2010). The geomorphologies of the basin include a narrow continental shelf and steep open slopes, submarine canyons, base of slope deposits, seamounts, cold seeps, pockmarks, mud volcanoes, deep hypersaline anoxic basins (DHABs) hydrothermal vents, bathyal and abyssal muddy plains (Danovaro et al., 2010).

The narrow continental self is a common characteristic for the entire basin with only few self-areas extending far offshore, resulting with deep water areas very close to shore, which is very crucial regarding the conservation and protection of deep sea benthic and associated pelagic species. Notably the continental self covers 30% of the Mediterranean Sea surface while the bathyal domain constitutes the 60% and the abyssal plains the 10% respectively. Along with the particular geomorphologies, abiotic elements play a decisive role in biological diversity and distribution. Deep sea temperatures are remarkably high comparing to other deep sea basins in the world and remain largely uniform after 300 m at around 13.5°-15.5 °C in the eastern basin. Salinity and oxygen levels are also high and do not follow Atlantic patterns[7].

The hydrology of the basin is crucial when it comes to the establishment of organisms. Water masses bare distinct characteristics and circulate creating currents, gyres and eddies in various depths and locations, affecting the biogeochemical fluxes. Enrichment of the deep sea floor takes place also as a result of rapid vertical transport of surface waters to great depths as they become denser due to evaporation and cooling (cascading). Additionally strong currents have been documented in submarine canyons in relation to meteorologically driven episodic events. Generally though, the trajectories of deep bottom currents are largely unknown. Hydrological conditions (both large and small scale) control the spatial distribution and establishment of the benthic fauna particularly of suspension feeders.

While at the present time the Mediterranean is a semi enclosed basin relatively isolated due to the shallow sill of Gibraltar, at the end of the Miocene epoch this corridor gradually closed and consequently the basin was cut off from the Atlantic and almost dried out. The oceanographic signature of this event known as the Messinian Salinity Crisis is thought to have been lethal for many marine species inhabiting the Mediterranean basin. Prior to that event and during the Middle-Upper Miocene the hydrological exchanges between the two areas were unrestricted through wide deep corridors and psychrospheric conditions prevailed in the basin (Taviani et al., 2005).

[7] https://uicnmed.org/docs/mediterraneandeepsea.pdf , p.20

After the salinity crisis the restoration of water exchanges with the Atlantic Ocean at the beginning of the Pliocene epoch replenished the basin with marine biota. Organisms such as cold water corals once again had the opportunity to colonize suitable regions of the Mediterranean basin. For part of the Pliocene, at least, the Mediterranean basin enjoyed quasi-oceanic psychrospheric conditions enhanced by a corridor with the Atlantic deep enough to guarantee the free access of deep-water benthos and nekton from the ocean (Taviani et al. 2005). Fossil coral taxa are documented for the late Pliocene and early Pleistocene, as well as for the last glacial period in the late Pleistocene. The hydrological conditions of the Holocene have led to an impoverishment of the rich glacial deep sea fauna, particularly of the cold steno-haline taxa, that until the last glacial Pleistocene era was very similar to the present Atlantic fauna. Since benthic deep water taxa were thriving during the last glacial periods in the basin, when the sill of Gibraltar was almost similar to present time, it could be assumed that the hydrological conditions are defining factors on such species richness, diversity and density in the Eastern Mediterranean explaining the gradual impoverishment from west to east (Bouchet and Taviani., 1992). This particular paleoecology has also been defining the number and type of endemisms of the deep Mediterranean Sea as supported by the Tethys hypothesis, considering the origin of some Mediterranean endemisms as relicts of the Messinian Salinity crisis (Pérès, 1985, IUCN)[8]. Evidently, it is inferred that geomorphology, climatic conditions, and hydrology are of the outmost importance when it comes to the existence and distribution of deep sea habitats.

2.2 Geomorphology of the Ionian and Aegean Basins

The Ionian and Aegean Sea basins of the Eastern Mediterranean bare their own outstanding geomorphological characteristics which are partly responsible for sustaining unique habitats and ecosystems. The overall Hellenic sea floor displays a complex geomorphology due to intense geodynamic processes and tectonic movements. Its most prominent features are probably the North Aegean Trench, the Volcanic Arc and the Hellenic Trench. Each separate basin hosts features of a distinct character[9]

The North Aegean shelf (Fig. 2.2) with the islands of Thasos and Samothraki on its shallow platform is dissected by the wide gulfs of Chalkidiki Peninsula and is followed by the North Aegean Trench which is developed along the trace of the Northern Anatolian Fault. Notably, this is the area with the highest biological productivity in the basin. The trench is made up by three elongated depressions separated from each other by other morphological highs. These deep large basins are southwards defined by steep slopes of tectonic origin as they meet the shallow Sporades-Limnos Plateau. Between this and the Central Aegean Plateau various small but deep basins have been formed due to tectonic activity and faulting. They represent isolated morphological depressions separated by shallow platforms of 200-400 m and are surrounded by steep slopes. Notably these are Skopelos basin (1500 m), Skyros and N. Skyros basins (800, 1000 m), Psara basin (800 m), and the southernmost basin of the group,

[8] https://portals.iucn.org/library/sites/library/files/documents/2004-052.pdf , p.17

[9] Sakellariou D & Alexandri M, Geomorphology of the Hellenic Seafloor, in: State of Hellenic Fisheries, HCMR,2007

Ikaria basin (800-1000 m). The combined characteristics of this sub basin support some prominent deep water habitats such as those formed by deep water corals[10]

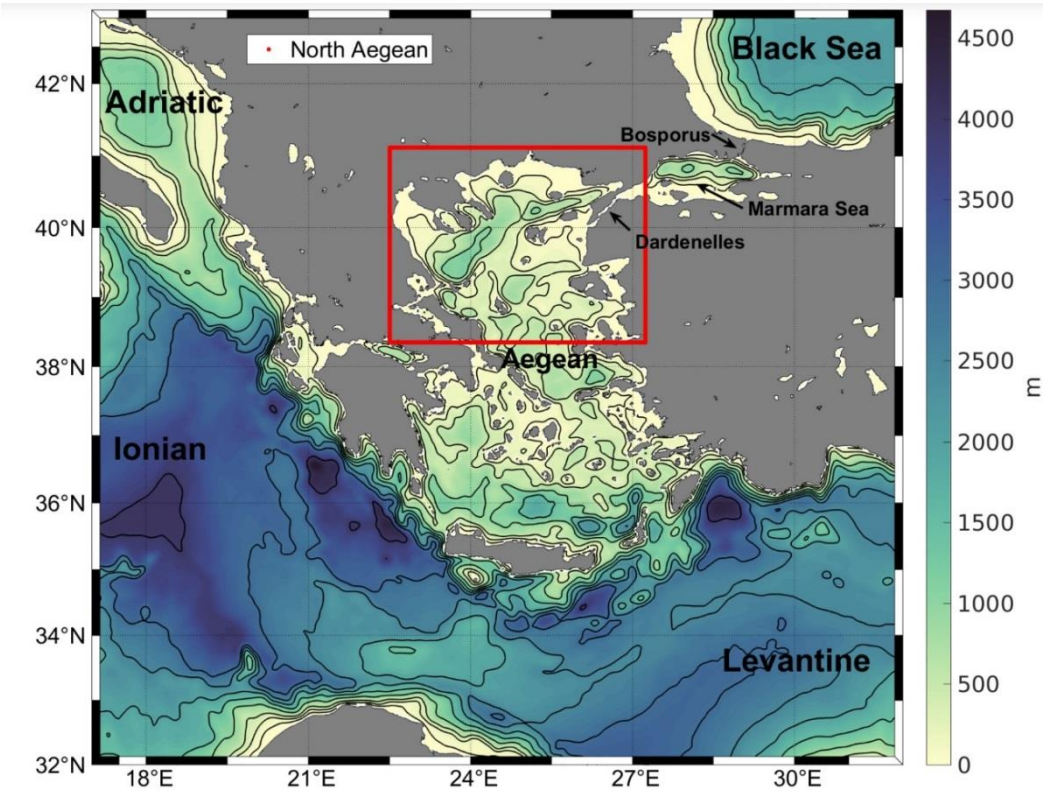

Figure 2.2 Bathymetry and geomorphology of the Aegean and Ionian basins (Mamoutos, 2022)

In the Central Aegean the dominant feature is the Central Aegean Plateau, a shallow platform of a 200 m mean depth which has a gentle morphology due to weak neo tectonic activity. Its northern limit is defined by the islands of Andros, Tinos, Mykonos Ikaria and Samos and the southern part coincides with the Volcanic Arc and the islands of Nisyros, Santorini, Milos, Poros, Aegina and various submarine volcanic centers. Deep water habitats associated with hot venting are located along the arc area (Oulas et al., 2016).

The South Aegean basin extends from the Volcanic Arc to the north to the Island Arc to the south and encompasses the area from Argolikos Gulf to the Sea of Crete and the Sea of Karpathos and harbors the greater depths of the Aegean. This area is dominated by deep elongated basins of past tectonic origin with steep faulted slopes, divided by shallow ridges (Karpathos and Irakleio basins 2500 m and 1800 m deep respectively).

In the west, the Ionian Sea is divided in two distinct regions divided by the strike-slip fault of Cephalonia. The northern part is characterized by an extensive shelf with Corfu Island on it and connected by a steep slope to a relatively flat basin. The southern part is characterized by high tectonic activity. As a result deeply eroded submarine canyons dissect the continental self and slope off the Ionian Islands and the Peloponnese and end up in small

[10] https://chm.cbd.int/database/record?documentID=204115

deep isolated basins with depths of over 4000 m, one of which hosts the deepest point of the basin. The succession of these basins along the foot of the submarine slopes constitutes the western part of the Hellenic Trench and where the deepest point of the entire basin is found. The Trench which is a result of active faulting continues eastwards, extending along the Cretan island Arc, to the islands of Karpathos and Rhodes. Herodotus, Ptolemy, Strabo and Pliny trenches form the central and eastern part of the trench. The Strabo and Pliny trenches terminate north-eastwards into the Rhodes basin, a 4000 m deep and relatively young basin within the Levantine Sea. This is a unique by many standards area hosting habitats related to hydrocarbon reservoirs; cold seeps and some of the most prominent cold water coral formations are scattered on ridges, escarpments, terraces, slopes and muddy bottoms (Mytilineou et al.,2014, Massi et al., 2018, Titschack.,2019).

2.3 Dark Habitats

The marine environment is divided into the euphotic, the mesophotic and the aphotic zones. Euphotic zone is the area where irradiance is strong enough to allow the development of sea grass. After this limit and up to the limit of presence of algae is the mesophotic or twilight zone, while at 150-200 m depth light is absent; this is upper limit of the aphotic zone extending to bathyal, abyssal and hadal depths of thousands of meters. Deep sea habitats usually occur in these depths, in the dark, and consequently are perceived as dark habitats.

Absence of light though may also occur in places not that deep and where darkness is not dictated by depth but geomorphology. Those dark habitats with poor or no light penetration also located within the euphotic zone are the underwater caves. The distribution of benthic organisms is determined by many factors besides light or its absence, notably substrate type, hydrodynamics, temperature, oxygen levels, salinity, pressure, sedimentation rates, trophic state, presence of natural chemical compounds, as well as the geographical area.

Some of the occurring or engineering species of deep sea habitats may establish themselves or appear above the limit of the aphotic zone and within the twilight zone usually in the deeper circa littoral, according to their distribution. Many of them are encountered also in coralligenous communities in the mesophotic zone, along with other bio constructors. These are considered eurybathic species with higher tolerance for instance in temperature, light or sedimentation rates and consequently they may prove more resilient to certain pressures. Zones' depth ranges vary significantly between eco-regions as these are determined by water transparency and various other physical factors affecting light penetration. In this thesis benthic dark habitats typical of the deep sea environments, are discussed generally those occurring below 150-200 m water depth. They are associated to geomorphologies and seeping phenomena, as well as biogenic benthic habitats constructed by several invertebrate engineering taxa. Certain of these geomorphologies may include parts in the euphotic zone as on the case of seamounts whose summit may reach some meters below the surface while their base lies at hundreds or thousands of meters; or on the

case of the heads of canyons. Maintaining their integrity justifies considering them wholly within the deep sea/dark habitat classification (Dark Habitats Action Plan, 2015)[11].

2.3.1 Deep water Chemosynthetic Habitats

Chemosynthetic habitats exist in many areas in the marine environment, both in shallow and deep waters. In shallow areas seeping may occur in brackish lagoons, seagrass meadows, prodeltaic organic-rich sediments and also in submarine caves with sulphur springs, at hydrothermal vents, cold seeps and seeping pockmarks in areas with high organic deposition. Fluids seepage occurs also in deep waters in geologically diverse areas linked to active and passive margin kinematics (Taviani et al., 2014). Consequently, these areas are characterized by high heterogeneity in sea bottom types, nature of seeping, types of fluids and rates of flux and further on, this heterogeneity is equally reflected in the trophic ecology of the associated communities. The above habitat areas related to fluids seepage from the sea floor (Fig.2.3) are characterized by the presence of microbial mats and chemo symbiotic organisms and are mainly cold seeps, pockmarks, mud volcanoes, brine pools and hydrothermal vents, while they are often spatially, highly associated.

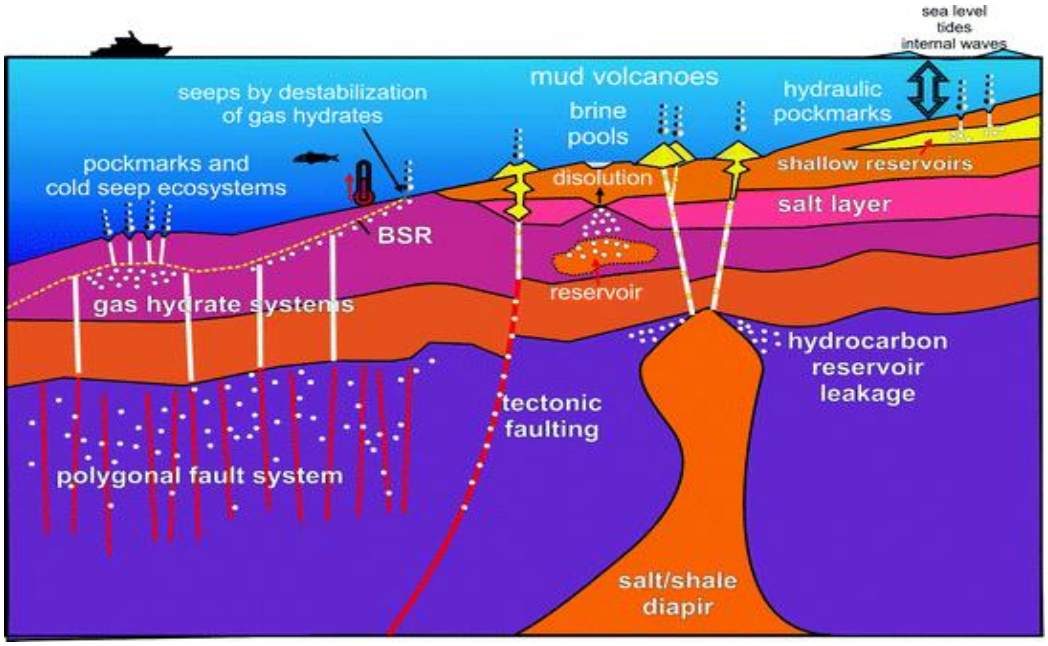

Fig.2.3 Deepwater chemosynthetic habitats (Ceramicola et al., 2017)

Cold seep habitats

Cold seeps are developed along tectonic features of the deep sea and around hydrocarbon emission pathways from the seabed. They are characterized by the upward seepage of cold fluids (Fig.2.3) enriched in methane and other chemicals such as hydrogen sulphide,

[11] https://www.rac-spa.org/meetings/nfp15/nfp_docs/wg502_06_dark_habitats_ap_eng.pdf

molecular hydrogen, ammonia, insoluble iron sulphides and elemental sulphur. Unlike the majority of their shallow counterparts, cold seeps at bathyal depths sustain specialized chemosynthetic communities. Thus, these particular environments created by geomorphologic features are dominated by bacterial mats and host unique chemosynthesis-based communities relying on specially evolved symbiotic bacteria which mainly, through sulpur oxidation or reduction and methane oxidation, supply the associated specialized fauna with organic matter.

Furthermore, the aggregations of the chemo symbiotic fauna in these areas, such as *Mytilidae, Vesicomyidae, Lucinidae, Thyasiridae* thiotrophic bivalves and several tubeworms, provide structure and habitat for different associations of benthic fauna able to cope with the elevated concentrations of chemical compounds and extremely low oxygen levels or anoxic conditions found at, and below the sediment in such environments. A large proportion of the species found in these ecosystems are endemic, with only few species commonly occurring at different sites.

In situ observations in the Eastern Mediterranean Sea have revealed the presence of aggregations of bivalves, siboglinid polychaetes (e.g. *Lamellibrachia anaximandri)*, large sponges, such as *Suberitidae* sponges (e.g. *Rhizaxinella pyrifera*) and crabs (e.g. *Chaceon mediterraneus, Calliax sp*.) and deep-sea mussels, while the ghost shrimp *Calliax* is a very characteristic species in all Mediterranean cold seeps. These environments are also known to enhance meiofaunal diversity and act as deep sea nurseries for elasmobranchs which attach their eggs to *Lamellibrachia* tubes (Taviani et al., 2014). Thus, the leakage of cold, methane and sulphur-rich fluids from the subsurface reservoirs to the sea floor at these specific sites sustains some of the richest ecosystems on the seabed with remarkable rates of endemism.

An important seeping area is the 'Olimpi' field south of Crete, an area containing seeping sites including pockmarks, mud volcanoes and brine pools at depths down to 2000 m on the Eastern Mediterranean Ridge.

Pockmark Habitats

Pockmarks are topographic depressions that occur in areas of fluid discharge and they need fine-grained sediments to form and retain their structure over longer periods of time. They originate by the expulsion of gas from over-pressured gas pockets or by the continuous hydrocarbon fluid discharge which prevents sediment deposition around the seep. The intensity of the methane flux defines the density of the sulphur oxidizing bacteria which in the abovementioned way support chemo symbiotic communities. Dominating faunal species belong to bivalves, tubeworms and ghost shrimps which burrow into the sediment, while in various locations of active pockmarks tubeworms, gastropods and cnidarians have been observed being in association (Smith et al.,2009).

Mud volcanoes

Mud volcanoes appear to be closely related with tectonic features and are linked to gas and oil reservoirs (Fig.2.3). They are created by the more or less, violent eruption or surface

extrusion of watery mud or clay accompanied by escaping methane gas, which builds a mud or clay deposit around the gas exiting site. The characteristic chemo symbiotic fauna has also been documented on these mud volcanoes, including large siboglinid tubeworm aggregations (*Siboglinidae*) and communities of thiotropic bivalves of *Solemyidae, Mytilidae, Lucinidae, Thyasiridae* and *Vesicomyidae.* Mud volcanoes are hotspots of meiofaunal benthic species with the most abundant families belonging to nematodes (*Comesomatidae, Chromadoridae, Desmodoridae, Xyalidae*) and copepods while cold-water corals may also appear in this unique biocoenosis. Other non-chemo symbiotic fauna which is abundant around seeps in the Eastern Mediterranean includes *Suberitidae* sponge *Rhizaxinella pyrifera*, decapod crustaceans and large abundances of *Echinus* species, possibly influenced by the seepage environment. In conclusion, it is evident that these three dimensional bottom mount like structures enhance the spatial heterogeneity and potentially influence the functioning of the surrounding benthic ecosystems[12].

Mud volcanoes are abundant in the Eastern Mediterranean and include the Anaximander mud volcano south of Turkey, the 'Olimpi' mud volcano field south of Crete, the Eratosthenes Seamount area south-west of Cyprus and the Nile Deep Sea Fan area amongst many. The 'Olimpi' mud volcano field is located south of Crete on the Eastern Mediterranean Ridge and is densely marked by mud volcanoes and pockmarks at depths ranging from 1700 to 2000 m. Mud volcanoes in that area include the 'Napoli', 'Milano', 'Maidstone' and 'Moscow' mud volcanoes. The 'Napoli' mud volcano which is located at a depth of 1900 m is prominent among others by the diversity of higher taxa, and in overall these mount like structures seem to host a higher diversity with respect to similar communities found in other oceans including also neo-endemic species. These are also high productivity areas due to upwelling process and characterized by the presence of highly migratory species such as cetaceans, which appear to be on the top of food chains linked to the rich and diverse benthic ecology associated to methane rich fluid seepage. These habitats are hence regarded as important feeding areas for marine mammals which execute deep foraging dives. Notably, gouge signs on mud volcanoes have been identified as traces made by Cuvier's Beaked Whale (*Ziphius cavirostris).*[13] The wider area is included in the Hellenic Trench EBSA[14] particularly due to its unique role for the life of cetaceans and hydrographic features.

Brine pools, lakes and DHABs (Deep Hypersaline Anoxic Basins)

In same locations of seepage, as described above, high concentrations of brines can be found on the ocean floor as lakes or pools (Fig.2.3). These areas often contain high concentrations of methane and sulphide and appear as pools or lakes due to the high density of the brine and slow interaction with the sea above. This is a result of their salinity values which are up to four times these of the sea water. The DHABs originate from the

[12] https://uicnmed.org/docs/mediterraneandeepsea.pdf , p.44

[13] https://portals.iucn.org/library/sites/library/files/documents/2015-043-chp.5_plates.pdf, p.29

[14] https://chm.cbd.int/database/record?documentID=204117

dissolution of ancient evaporites, as tectonic movements expose the 5-6 million year's Messinian Salinity Crisis evaporites to sea water. These environments are of the most extreme when it comes to their compatibility with life. In their anoxic environments surveys have shown the existence of large and diverse communities of Bacteria and Archaea, as well as eukaryotic meiofaunal communities with biomass values higher compering to those outside the brine pool, as well as newly documented species. Most of these brine pools are thalassohaline, meaning that the ionic ratios of their brine are nearly equal of that of the sea water. In recent surveys three unique brine pools have been discovered in the Eastern Mediterranean, as they are magnesium chloride dominated ($MgCl_2$). These are the only known athalassohaline DHABs, and on- going research has proven that their interface is dominated by microorganisms highly specialized and stratified, while more research is necessary regarding these highly extreme environments (La Como et al., 2019).

Although generally hostile, they harbor unique assemblages, adapted to withstand high salinity levels, oxygen depletion and high concentration of methane and sulphide and can be thought of as "isolated islands of evolution", due to their distinct chemical composition (Fisher et al., 2021). It is thus understood that in these environments adaptation and evolution of life is unique and of extreme interest for understanding fundamental biological processes and of life as well as potential implications for the use of biological resources. These areas and their associated habitats are truly unique and rare not only by Mediterranean standards, but global.

Several DHABs have been discovered in the Eastern Mediterranean. Very significant discoveries have been made in an area approximately 119-200 nautical miles south west of Crete and south of the Peloponnese within the Hellenic Trench, in depths ranging from 3200-3600 m. The DHABs in this area include 'Urania', 'Atalante', 'Bannock', and 'Thetis', while 'Discovery', 'Hephaestus' and 'Kryos' are athalassohaline basins. Since their extent is limited and are particularly fragile environments to mixing conditions according to their above-mentioned values immediate conservation attention is required.

Mud volcanoes and brine pool habitats

Mud volcanoes containing brine lakes and pools with hypersaline fluids are very rare and only known so far in the Gulf of Mexico and the Eastern Mediterranean. Their association possibly relates to the common pathways and driving mechanisms, as the release of fluids along the Mediterranean ridge, ranges from simple seeping of brines and gas to more energetic and explosive emissions with sediment at mud volcanoes. They are characterized by microbial (bacteria, archaea) and chemo symbiotic communities.

Mud volcanoes with brine pools are the 'Napoli' and 'Milano' mud volcanoes at the 'Olimpi' seeping mud volcano field south of Crete. Notably the 'Napoli' mud volcano is covered with shallow pools on its most active central area and appears to form a vast salt marsh where brines emitted by numerous small vents have accumulated in shallow depressions of the sea floor.[15]

[15] https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/EO081i051p00625-02

Hydrothermal Vents Chemosynthetic habitats

Similarly to seeps, vents support chemosynthetic communities and are developed in areas of volcanic activity. Hydrothermal vents constitute biogeochemical environments characterized by emission of reactive gases, dissolved elements and sharp thermal and chemical gradients (Oulas et al., 2016). In these areas the sea water circulates through the sea floor and transforms into an anoxic and sulfidic heated fluid often enriched in metals, silica, carbon dioxide, hydrogen and methane. Mediterranean hydrothermal vents are characterized by the slow escape of the liquid or gas through the porous material or through small orifices and are generally situated in relevantly shallow waters. Temperatures may reach up to 464 degrees Celsius and the microorganisms performing chemosynthesis have adapted to survive in extreme conditions of temperature, salinity, acidic pH and heavy metals. Specialized bacteria of high diversity form thick mats, convert inorganic carbon and methane into organic compounds proving food and energy for the associated fauna, such as the siboglinid tubeworms which form clusters around the vents. Many of these organisms are found both in cold seeps as in hot vents. Deep sea hydrothermal vents remain largely unexplored in the Mediterranean.

Unique hydrothermal systems exist along the Hellenic Volcanic Arc at Methana, Milos, Santorini, Nisiros and Kos islands. These unique systems include brine seeps and vents around Milos, vents in Santorini, Nisiros/Kos area and the vents around Lesvos Island. The volcanic field at Santorini extends for 20 km as a line of more than twenty submarine cones, the largest of which is Kolumbo situated at a depth of 505 m. Several chimneys and vents emitting hot fluids of temperatures ranging from 70 to 220 degrees Celsius are located in the northern part of Kolumbo. Due to the extremely low levels of pH the thriving organisms are Bacteria and nitrifying Archaea and hence the vents and the surrounding seabed have been found to be covered by well-developed prokaryotic mats (Oulas et al., 2016). This is considered a geologically, mineralogically and biologically unique place. Hydrothermal vents may also serve as natural experiments in ocean acidification due to their CO_2 emissions and the consequent local pH reduction, while progressing scientific knowledge on the biology of the associated microorganisms will reveal the potential for any biotechnological exploitation. This area is included in the wider Central Aegean EBSA[16] and is a protected area extending up to 50 km^2 under Natura 2000 network of Habitats Directive, listing as Habitat type 1180 (Submarine structures made by leaking gases)[17].

2.3.2 Deepwater habitats on raised features

Habitats associated with seamounts

Seamounts are described as sea floor elevations of at least 100 m. Similar elevations are bank rises, highs, hills, spurs and other types of elevation. These sites are recognized as highly valuable biodiversity hotspots as they often host unique communities. These are hard

[16] https://chm.cbd.int/database/record?documentID=204116

[17] https://eunis.eea.europa.eu/sites/GR4220036#tab-habitats

bottom habitats which also affect the hydrographic conditions of the area causing eddies and local upwelling, enhancing feeding conditions and productivity.

Their diverse and abundant communities affect the adjacent areas which show remarkable differences in community composition when compared to others of the typical bathyal plain. Suspension feeder species of corals and sponges are dominant on seamounts. The most important habitat-forming cnidarian taxa are Alcyonacea, Antipatharia, Pennatulacea and Scleractinia. Moreover, encrusting species of Foraminifera, Porifera (including carnivorous sponges), bryozoans, annelids, various bivalves, holothurians, asteroids, shrimps of commercial interest (*Aristaeomorpha foliacea, Aristeus antennatus* and *Plesionika martia*) and fish species are found in these environments. This rich benthic biodiversity sustains a complex pelagic and planktonic trophic net dominated by top predators such as sharks and cetaceans. Their importance is further highlighted as it has been supported that they may act as refuge for relict populations or become centers of speciation (Galil and Zibrowius, 1998, IUCN).

The Eastern Mediterranean harbors impressive seamounts including the massive Eratosthenes Seamount south of Cyprus with the highest underwater elevation in the basin. The Aegean hosts several seamounts including Aphroditi and Glavki Banks in North Aegean, south of Chalikidiki Peninsula, which is a critical cetacean habitat while communities of structure forming stony corals like *Lophelia pertusa* and *Madrepora oculata* are also present within the North Aegean Trench.[18] The importance of the site is underlined as it is part of the Northern Aegean EBSA[19].

Within the area of the Hellenic Trench, two Seamounts at the south of Crete are of major importance. Firstly, the Seamount discovered during the DANAOS project in 2007[20], is located between Ptolemy and Pliny Trenches, south -south west of Chryssi Island, approximately 12 nautical miles south of Ierapetra. Its summit is lying at 450 meters depth and in the south is dropping off to in excess of 1000 m. The area hosts active pockmarks and seeping areas, while small colonies of the gorgonian *Isidella elongata*, yellow stony coral *Dendrophyllia cornigera* and Anthipatharia species are present. Remarkable numbers of shrimp species *Plesionika* were observed as well as fish species *Chloropthalmus agassizi, Polyprion americanus, Pagellus bogaraveo, Conger conger,* particularly near large outcrops and seeps. Regarding its conservation status it is important to note that trawl marks were identified on the western flatter part, due to deep sea shrimp fisheries exercised by Italian trawlers (Smith et al., 2009). Notably these trawling activities while exercised in the high seas affect and destroy the sedentary species attached to the continental shelf.

The second seamount between the trenches is Ptolemy Seamount in the central-eastern part of the area south of Crete.[21] The site is characterized by seasonal strong upwelling and enhanced productivity and by the intense presence of cetaceans, such as Cuvier's Beaked

[18] https://www.iucn.org/content/atlas-mediterranean-seamounts-and-seamount-structures,p.11

[19] https://chm.cbd.int/database/record?documentID=204115

[20] https://portals.iucn.org/library/sites/library/files/documents/2015-043-chp.5_plates.pdf

[21] https://portals.iucn.org/library/sites/library/files/documents/2015-043-chp.5_plates.pdf

Whale (*Ziphius cavirostris)* and important populations of blue sharks (*Prionace glauca*), while it is a longline fishing ground for pelagic commercial fisheries of tuna and swordfish. Noteworthy the blue shark is a common by-catch. Both seamount areas are included within the EBSA of the Hellenic Trench[22]. According to the classification criteria, the Hellenic Trench which includes important various seeping areas as aforementioned, it is a high priority area for its uniqueness, rarity, importance for life stages of species, important for threatened and vulnerable species and biological productivity. Despite its importance very few elements are under protection in the area mainly under coastal Natura 2000 sites (6 nautical miles) while deep water features including chemo synthetic communities, seamounts, sessile vulnerable fauna, and deep diving cetaceans are not represented.

Carbonate mound habitats

Carbonate Mounds are geological elevations of various shapes, with very steep sides. They have resulted from the growth of carbonate producing organisms such as cold water corals, sponges and bryozoans, sedimentation and bio erosion processes. Their origin might be connected either with fault controlled methane seepage from deep hydrocarbon reservoirs or gas-hydrocarbon dissociation. They appear offshore in depths of 500-1100 m. Characteristic fauna includes cold water reef building corals *Lophelia pertusa* and *Madrepora oculata*, hydroids, sponges, soft corals, ascidians, calcareous tube worms, crinoids, bivalves and echiuran worms. Coral debris along with mud may also form a significant component of the seafloor substratum. Although very little research has been conducted in the Mediterranean, observations from elsewhere have revealed that these can be areas of high species diversity in the deep-sea and, therefore, of particular ecological significance[23].

2.3.3 Deepwater biogenic habitats

Cold water corals are organisms with the ability to create biogenic calcareous three dimensional frameworks which provide the ecological niches and substrate for a variety of species. They are preferentially distributed on topographic irregularities, predominantly on hard substrata, like fault escarpments, rocky outcrops, prominent terraces, submarine canyons, seamounts, carbonate mounds, on open slopes and along the edges of the continental shelf, in vents, as deep as over 3000 m and as shallow as 39 m in fjords, while others colonize various substrata including muddy flat bottoms. They establish themselves at locations where there is a continuous and regular supply of concentrated food and nutrients due to the flow of a relatively strong current and in areas of reduced mud sedimentation (Tursi et al., 2004). Therefore they depend on an energetic trophic system as they are suspension feeders same as most of their associated fauna. Most of them are highly sensitive to the abiotic variables of temperature, salinity and dissolved oxygen and survive within a certain known range according to present existing data. Other crucial characteristics are their slow growth rates and their high longevities, which makes them vulnerable to several pressures.

[22] https://chm.cbd.int/database/record?documentID=204117

[23] https://uicnmed.org/docs/mediterraneandeepsea.pdf , p.38

Cold water coral reef habitats

Within the Mediterranean waters the Scleractinian triad forming cold water coral reefs, is *Lophelia pertusa, Madrepora oculata and Desmophyllum dianthus* (Taviani et al., 2005, Tursi et al., 2004, Schembri et al., 2007). These corals create a unique biocenosis similar to its Atlantic counterpart but of a much lower biodiversity. Characteristic species that add to the structure of the framework, besides the white stony corals are the solidarity coral *Desmophyllum cristagalli*, and the annelid tube warm *Eunice norvegica.*

Associated species which live on dead branches of the framework or on coral rubble belong to species of Foraminifera, Porifera (e.g. *Poecillastra compressa, Cliona levispira, Lantrunculia insignis, Desmacella inornato, Crellastrina alecto),* of other cnidarian species, particularly antipatharian corals like *Leiopathes glaberrima,* and the solidarity scleractinian coral *Stenocyanthus vermiformis, Serpulid*ae species such as *Filograna implexa, Serpula vermicularis,* brachiopods, gastropods and molluscs including several bivalve species (e.g. *Asperarca nodulosa).*

Accompanying species found around the framework on hard or soft substrata, belong to Octocorallia, like *Callogorgia verticulata, Acanthogorgia hirsuta*, to Hexacorallia, like the relatively eurybathic yellow stony corals *Dendrophyllia cornigera* and *Dendrophyllia ramea*, decapod crustaceans like *Polycheles typhlops,* and echinoderms such as *Cidaris cidaris*. Various copepods, amphipods, isopods and decapods are attracted as they consume corals' and sponges' facultative symbionts while the zooplankton is found in higher abundances in such areas. The co-occurring species gather at the free space around the colony. These are typical bathyal species of decapod crustaceans and Osteichthyes, both of commercial interest, as well as a large diversity of Chondrichthyes.

Particularly co-occurring species are, the commercial crustaceans *Aristaeomorpha foliacea, Aristeus antennatus, Plesionika martia, Nephrops norvegicus, Parapenaeus longirostris,* the commercial fish species, *Coger coger, Lepidion lepidion, Mora moro, Helicolenus dactylopterus, Chloropthalmus agassizii, Merluccius merluccius, Pagellus bogaraveo, Polyprion americanus* and sharks such as *Galeus melastomus, Chimaera monstrosa, Etmopterus spinax, Raja oxirhynchus, Hexanchus griseus*. (Mastrototaro et al., 2002, Tursi et al.,2004, D' Onghia et al.,2012, Mytilineou et al.,2014).

It is evident why these colonies of corals have been characterized as "marine animal forests" and ecosystem engineers (NOAA, 2017). They support an ecosystem of incredible variety and density in the deep sea and usually support faunal communities of higher biomass and diversity comparing to surrounding unstructured deep sea habitats. Their structure provides spawning sites, resting and feeding areas, shelter and refuge for associated species and they may also act as faunal spreading centers to neighboring sites (Mastrototaro et al., 2002). These structures also attract ambush predators like *Helicolenus dactylopterus* and *Galeus melastomus* who prey on small shrimp (D' Onghia et al., 2012), as well as deep diving cetacean species. It has been supported that deep water coral reefs may also provide an important link between the benthos and diel vertical migrating mesopelagic fishes and the macronecton invertebrates (NOAA, 2017).

In the Eastern Mediterranean cold water coral reefs have a patchy distribution and no dense aggregations similar to those found in areas of the Western basin have been discovered yet. Often the identified individuals or colonies bare dead branches and sometimes are also patinised with Mn-Fe oxides. Coral rubble is also occurring in many sites and this particular substrata hosts diversified species aggregations comparing to those of the adjacent areas, thus still contributing to the enhancement of deep-sea local biodiversity. Also fossiled and sub fossiled corals constitute a frequent discovery in certain areas. These findings are closely related to the geomorphological past of the basin and the Messinian Salinity Crisis. In that respect the Mediterranean represents an excellent biological archive of past deep water coral growth, whose study may help understand taxonomic, biogeographic, ecological and evolutionary patterns of modern corals. These fossiled specimens also provide a valuable source of information such as by extracting climatic signals and understanding water characteristics through time (Taviani et al., 2005). In conclusion, thriving colonies of stony cold water corals seem to develop in areas with continuous and regular supply of nutrients and relatively strong cold currents (Tursi et al., 2004).

Cold water coral garden habitats

Black corals (Antipatharia) are soft corals whose skeleton grows in forms of trees, whips, fans or coils. They have a wide geographic and bathymetric distribution and are found on hard substrata like seamounts, canyons and escarpments. Black corals are species of extremely high longevities and are amongst the oldest known marine organisms. Characteristic species of Antipatharia found in assemblages are *Antipathella subpinnata, Leiopathes glaberrima, Parantipathes latrix, Antipathes dichotoma.* They can form monospecific aggregations reaching high densities, but also mixed assemblages, with other corals. Particularly *Leiopathes glaberrima* forms mixed colonies with gorgonians *Callogorgia verticillata, Bebryce mollis, Isidella elongata, Corallium rubrum,* stony corals *Desmophyllum dianthus, Madrepora oculata, Dendrophyllia cornigera, Lophelia pertusa, a*s well as sea pens*, Funiculina quandrangularis, Pennatula phosphorea and Pennatula rubra.* The forests of *L. glaberrima* have been identified as essential for the completion of life cycles of commercial fish. Notably a large number of egg capsules of spotted catsharks *Scyliorhinus canicula* have been found anchored exclusively to *L. glaberrima* colonies. Furthermore black corals play an important role in the transfer of energy and biomass from pelagic to benthic environments by recycling POM sinking from the upper photosynthetic layers while using it for their nutrition (Massi et al., 2018).

Gorgonians belong to Octocorallia of the order Alcyonacea and are also soft corals. They present a wide geographic and bathymetric distribution from the circa littoral to the bathyal zone and their assemblages can be highly diverse. Most species dominate several types of hard substrata and some can grow on coral rubble, while other gorgonians may stand some sedimentation or even develop on detritus or muddy soft bottoms. They may form monospecific isolated colonies or assemblages which may reach high densities and thus characterized as “gardens or forests”. These high density assemblages may also be formed by several gorgonian species, or in combination with antipatharians like *Leiopathes glaberrima* and *Antipathes dichotoma,* or the scleractinians *Lophelia pertusa, Madrepora oculata* and *Dendrophyllia sp.* Such gorgonian species are *Callogorgia verticilata,*

Acanthogorgia hirsuta, Swiftia pallida, Viminella flagellum, Eunicella cavolini, Eunicella verucosa, Paramuricea clavata and Corallium rubrum, the latter inhabiting shallow water caves of the littoral zone as well as bathyal rocky environments in high densities or in mixed forests. The most characteristic soft bottom gorgonian coral is the critically endangered 'bamboo' coral, *Isidella elongata,* a species almost exclusive to the Mediterranean (Gerovasileiou et al., 2019). Some gorgonians may also occur together with other Octocorallia species such as those belonging to the order of Pennatulacea (sea pens). Many of these species, like *Leiopathes glaberrima, Isidella elongata* and *Antipathes dichotoma* and their aggregations have been associated with rich epifauna and high biodiversity (Mytilineou et al., 2014), structuring habitats of similar value to those created by the stony cold water corals, and thus characterized as hotspots of biological diversity in the deep sea.

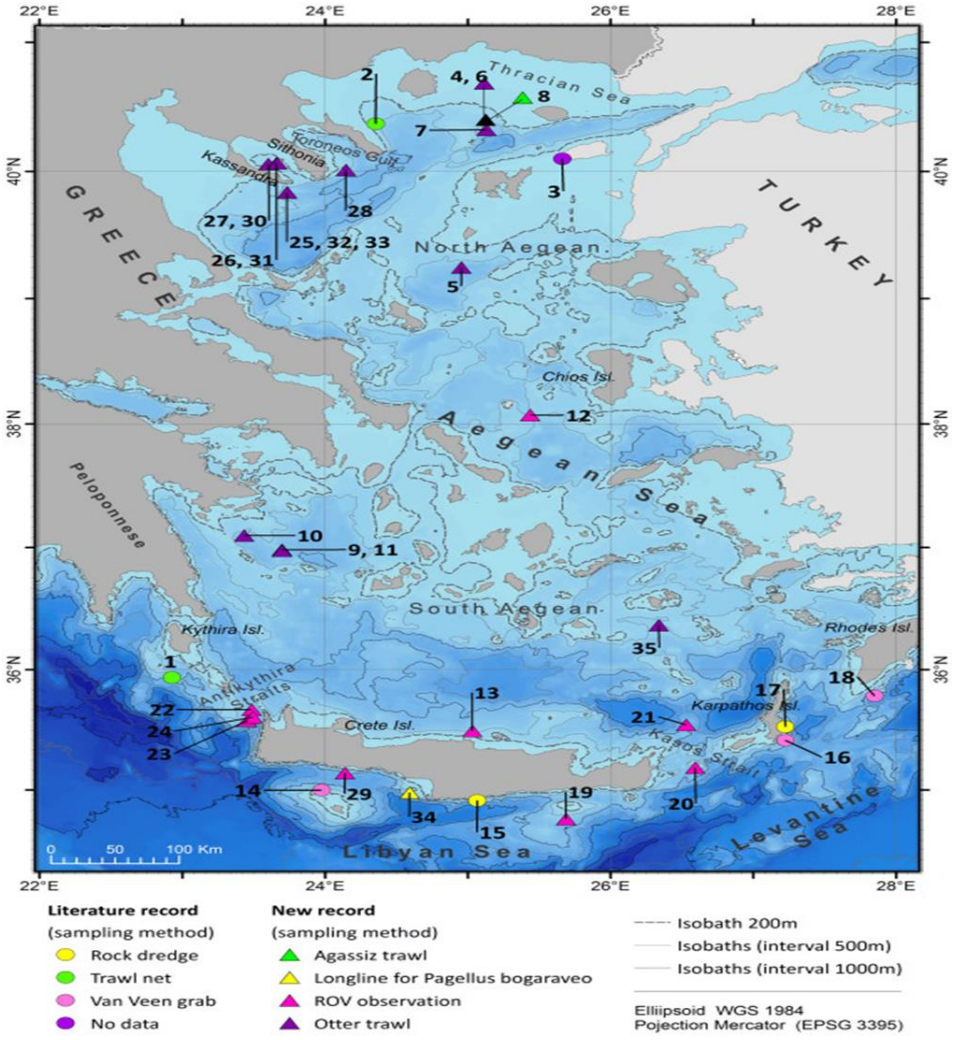

Figure 2.4 Distribution of *Isidella elongata* in Greek Seas (Gerovasileiou et al., 2019)

Sea pen grove habitats

Sea pens are Octocorallia corals of the order Pennatulacea and belong to soft bottom species. They have similarly to gorgonians a wide bathymetric distribution and are found in

sandy or muddy bottoms of the littoral to bathyal zones. Species like *Pennatula phosphorea* and *Pennatula rubra* form numerous communities on the edges of the continental shelf and on sandy-muddy patches of the upper slope as well as on bathyal bottoms and on other sea bottom irregularities with soft sediments. Similar colonies, thickets and thick groves are formed by the typical species *Funiculina quadrangularis*. Additionally these species form dense assemblages with other sea pens, gorgonians, like *Isidella elongata,* sponges and many other soft bottom species such as bryozoans.

Sponge ground habitats of Demospongiae

Deep water sponges can be found from the lower circa littoral to the bathyal zone, both in hard and soft bottoms. They can establish themselves in canyons, mounds, seeps and vents forming large aggregations and even reef like structures like the one created by *Leiodermatium pfeifferae*. Other species which form dense sponge grounds include amongst others *Poecillastra compressa, Pachastrella monolifera*, and the muddy bottom sponges *Thenea muricata*, *Rhizaxinella shikmonae, Rhizaxinella pyrifera,* while the latter can be found also in cold seeps on mud volcanoes. These sponge grounds may be monospecific or more diverse, including sponges, hydroids and gorgonians and other corals. They are equally important ecosystem engineers, since their dense aggregations are characterized by high abundances; provide habitat, refuge, spawning and nursery grounds, as well as nutrition for various organisms. Sponges, being filter feeders play an important role in carbon, nitrogen, silicate cycling (NOAA, 2017), and in enhancing local productivity and have further been recognized as key components of vulnerable marine ecosystems (indicator species, FAO)[24].

Other deep water biogenic habitats

Besides the described habitat types above many others of similar importance and structure have been documented in the deep seas. These are habitats formed by *Alcyoniidae*, sea anemones (Actinaria) and sea tubes (Ceriantharia), which may form dense aggregations on both hard and soft substrata; habitats formed by various sponges and glass sponges (Hexactinellida); and mixed habitats with corals, gorgonians and sponges. Other habitats are formed by mixed aggregations of bryozoans associated with species of cold water corals; habitats of tube worms in association with chemo symbiotic fauna or mixed with sponges, corals, bryozoans and gorgonians and habitats of mollusks, including oyster reefs as well as habitats formed by crustaceans.

2.3.4 Occurrence of deep water biogenic habitats in Ionian and Aegean waters

Commonly reported species of deep water vulnerable biogenic habitats for the Eastern Mediterranean include the gorgonian *Isidella elongata,* crinoid *Leptometra phalangium*, scleractinian corals *Caryophyllia smithii* and *Desmophyllum dianthus*, the sea-pen *Funiculina quadrangularis*, demosponge *Rhizaxinella shikmonae,* and the brachiopod *Gryphus vitreus* (Salomidi et al., 2019).

[24] https://www.fao.org/in-action/vulnerable-marine-ecosystems/vme-indicators/fr/

The western part of the Ionian Sea hosts one of the most emblematic sites of cold water coral formation, the *Lophelia* and *Madrepora* reefs off the Cape Santa Maria di Leuca (Italy), which is a VME recognized and protected amongst other measures with the establishment of a FRA under RFCM, imposing a permanent closure for bottom contact fishing gears. The eastern part of the Ionian Sea, though not that investigated, hosts some important hotspots of biodiversity formed by corals. The presence of several such species has been reported 9 nautical miles south west of Cephalonia Island within Greek territorial waters, in depths of 500-600 m along an extension of the Cephalonia ridge. In an area with some pockmarks and lithified carbonate crusts, species of Scleractinia, Alcyonacea, Antipatharia and Pennatulacea have been recovered in high abundances. These species are *Desmophyllum dianthus (*EN*), Isidella elongata (CR), Swiftia pallida, Villogorgia sp., Antipathes dichotoma, Leiopathes glaberrima (*EN*), Pennatulatea phosphorea (*VU*),* and *Funiculina quandrangularis (*VU*)*. Typical fish species, including *Helicolenus dactylopterus* and *Galeus melastomus* were recorded present and in high proximity with certain coral species indicating a possible close relationship (Mytilineou et al., 2014).

The identified components indicate the presence of habitats or mixed habitats of coral gardens, formed by stony corals, gorgonians, black corals and sea pens some of them also corresponding to VMEs indicator taxa provided by the GFCM, as it is going to be analyzed below (Section 4.1.3). Most notably the majority of the species are included in the IUCN Red List of Threatened species[25] as indicated in the parenthesis above. The area being far from shore is not covered by any Natura 2000 site and no specific conservation measures have been taken for the protection of these VMEs besides the general obligations of DSF set by the GFCM and the EU CFP. The occurrence of many of these species has been reported for the wider area of the south eastern Ionian Sea and in particular for areas around the islands of Cephalonia and Zakynthos as well as the Gulf of Kyparissia off the western coasts of the Peloponnese. Some of the identified species caught by longlines and gillnets of fishermen are *I. elongata, L. glaberrima, D. dianthus, A. dichotoma* (Mytilineou et al., 2010, Massi et al., 2018). The Eastern Ionian is a strong candidate for the establishment of a future FRA under GFCM, as it hosts vulnerable species of corals and sharks, important commercial resources (red shrimp, wreck fish, blackspot seabream), while many anthropogenic pressures have been identified[26].

Species of antipatharians and *I. elongata* and *D. cornigera* colonies have been found in the area of the Seamount between Ptolemy and Pliny Trenches within the Hellenic Trench, 12 nautical miles south of Crete, as mentioned above under the respective section for seamount habitats (Smith et al., 2009). *D. cornigera* (EN, IUCN Red List) has also been reported from another location within the Hellenic Trench, on the outer side of the South Aegean Island Arc, south of the island of Karpathos. Colonies of the same species have also been reported in the area between the North Aegean Trough and the Central Aegean Plateau, an area dominated by the alternation of shallow platforms and deep basins. These locations are Kyra Panagia (Sporades isl.), Antipsara and Lesvos, while for *D. ramea* first

[25] https://www.iucnredlist.org/
[26] https://www.fao.org/gfcm/technical-meetings/detail/en/c/885358/, p.14

record for Greek waters comes from Korinthiakos Gulf, although in 40 m depth along with other sessile fauna (Salomidi et al., 2010).

Stony corals *Madrepora oculata* and *Lophelia pertusa*, both listed endangered in IUCN Red List, have also been reported south of the island of Thasos (Vafidis et al., 1997, Salomidi et al.,2010), while along the steep slopes of the Hellenic Trench, south of the islands of Crete, Karpathos and Rhodes, several species of Scleractinia have been identified including *Caryophyllia calveri, Caryophyllia sarsiae, Dendrophyllia cornigera, Desmophyllum dianthus, Lophelia pertusa Madrepora oculata, Schizocyanthus fissilis, Stenocyanthus vermiformis, Trochocyanthus mediterraneus* (Titschack.,2019).

Besides the records from the Ionian Sea, *Isidella elongata* is a frequent species with 35 records in Eastern Mediterranean from the North Aegean and Tracian Seas to the Hellenic Trench. In same occasions these records concern multiple colonies, as in the case of Toroneos Gulf in Chalkidiki Peninsula, an area of interest for the GFCM (Section 4.1.3). Records also come from locations in the South Aegean Sea and in particular, off the Eastern Peloponnese, in Antikythira straits, north of Crete, in Kasos straits, off Astypalaia Island, off Chios Island and northeast of Skyros. Most records for *Isidella elongata,* though come from the areas of the Northern Aegean and the Hellenic Trench (Fig.2.4), while the record from Rhodes island within the Hellenic Trench, constitutes the easternmost occurrence of the species known to date (Gerovasileiou et al., 2019). A record of the black coral *L. glaberrima* has also been reported for the area south of Rhodes (Massi et al., 2018).

The abovementioned records of cold water corals have been basic elements for the identification of the North Aegean EBSA amongst its other significant features, while the Central Aegean ecoregion has not been that investigated in means of benthic deep water communities, and is mostly known for its hydrothermal vents. As in the case of the Ionian Sea, deep biogenic habitats are not under any protection scheme in the entire Aegean ecoregion and the Hellenic Trench, while the existing Natura 2000 sites are restricted to coastal zones focusing on the protection of reefs in euphotic environments, under habitat type 1170. There is an urgent need to alter this approach as these biogenic habitats constructed by the ecosystem engineering species displayed above, are of equal importance to *Posidonia oceanica* meadows which on the contrary, are largely protected through their inclusion in the sites of community importance of EU Habitats Directive (Chimienti et al., 2019).

3. Pressures and impacts on deep sea habitats

Unlike the continuous variations of the euphotic zone which is exposed to climatic fluctuations due to its proximity to the sea surface, deep sea environments are characterized by stable conditions. Consequently all organisms inhabiting these depths have evolved through time in order to cope with the particular usually extreme conditions of lack of light, temperature, salinity, pressure and specific sources and ways of nutrition. In such conditions, unique and complex trophic connections between species and habitats are created. These complex trophic webs support not only their benthic biocenosis but also demersal and pelagic species and aggregations. The interactions between the euphotic and aphotic domain are particularly strong in the Mediterranean as a result of the small size of the continental shelf and the consequent proximity. It is proximity that allows nutritive elements from the upper zones to reach the base of trophic chains and influence also the transfer of larvae.

Many faunal species adapted to these particular conditions are characterized by slow growth rates, extreme longevity and infrequent recruitment events. Such organisms are also corals and sponges, discovered specimens of which have been found to date hundreds of years old. These faunal structures once damaged or destroyed cannot be replaced or repaired. This is a process which takes decades or centuries and with the precondition of all other favorable conditions for their growth remaining unchanged.

The impact of anthropogenic activities is widely apparent and visible to marine ecosystems close to shore and within the shallower coastal waters. Gradually though, pressures and impacts of these activities are travelling and reaching the deep oceans in many ways and following various paths. Again the small size of the Mediterranean continental shelf leads to a strong interaction between land and sea regarding inputs of natural or anthropogenic origin. These natural pathways, such as canyons, become a highway for pressures and their adverse effects, particularly those deriving from pollution. The imposed threats on these habitats finally depend on their location, depth and morphology as well as to their potential uses.

A number of human activities occurring both on terrestrial and marine environment affect these ecosystems adversely. These are extraction of living and non -living resources, shipping, offshore renewable energy, tourism, urbanization and industrial development, while to the above is added the cumulative effect of climate change.

3.1 Fishing gears and extraction of living resources

Fisheries, commercial, artisanal or recreational, pose a tremendous threat to the deep sea habitats and in particular to those susceptible due to structure, morphology and interconnected functions to damage and degradation. Fishing bottom tending gears including trawls, dredges, traps, longlines and gillnets are seriously effecting the three dimensional structures of corals and sponges. While the most destructive practice of trawling is exercised on flat preferably sandy bottom areas of the continental shelf, the rest

of the fishing gears are used where trawls cannot go, notably on steep rocky canyons and slopes. These fisheries are targeting species of shrimps and lobster as well as other commercial fish species at the upper slope down to 500 m, while the deep fisheries down to 800 m depth (e.g. *P. longirostris*, *N. norvegicus, M. merluccius, C. conger, and A. antennatus, A. foliacea)*[27], [28].

The majority of the target species are closely associated with biogenic vulnerable habitats. Trawling is by far the most detrimental practice for cold water coral reefs and forests (e.g. *Isidella elongata),* as well as for sponge aggregations and has direct and indirect effects related to the physical and functional vulnerability of species and habitats. It is also probably the most studied case of interaction between a vulnerable habitat and a human activity. Direct effects include the removal and damage of organisms and consequently changes in food availability, loss of prey, by-catch of non-target species, changes and loss of habitat by alterations or complete destruction. Damaged colonies are also susceptible to colonization by other species which leads to increased mortality[29].

Notably trawling may turn prospering 'islands of biodiversity' into deserts, vanishing all forms of associated life directly or by habitat loss. The physical disturbance also causes sediment resuspension, increases bottom water turbidity, leads to alterations of the seabed morphology and causes increased sedimentation in the lower parts of canyons. These alterations and related dysfunctions may also lead to the direct loss of sensitive organisms or implications with their growth rates. Even more this practice can decrease the organic matter of the sediments, affect the nutrient re generation and alter the biochemical processes also due to the removal or changes in key functional groups such as filter feeders and bioturbators (alterations in functional biodiversity). Besides the above indirect effects, trawling leads to changes in diversity, abundance, body size, and causes alterations in the structure and functions of the benthic community in total[30]. Another major threat related to fisheries is the lost and abandoned gear, causing physical damages to vulnerable ecosystems and unintentional removal of species with ghost fishing.

Besides fisheries other activities pertaining to extraction of marine resources, may also cause damage and alterations in deep sea habitats. These are harvest related activities and possible overexploitation of target species such as red and black corals (e.g. *C. rubrum* and antipatharian species) and the extraction of biological resources for pharmaceutical uses or in cosmetics.

3.2 Extraction of non- living resources and offshore energy installations

Activities aiming at the extraction of non –living and non -renewable marine resources include oil and gas exploration and exploitation and sea bed mining. Oil and gas projects impact the seabed physically with the installations of platforms, pipelines and other

[27] C J Smith, Fisheries effects on benthic habitats (and fluxes), in: State of Hellenic Fisheries, HCMR, 2007
[28] https://uicnmed.org/docs/mediterraneandeepsea.pdf , p.59
[29] https://uicnmed.org/docs/mediterraneandeepsea.pdf , p.63
[30] In: State of Hellenic Fisheries, Chapter V, p.238, HCMR, 2007

accompanying structures, while are the source of multiple pollution, including the release of toxic substances and oil spillage. Oil pollution affects severely the status of corals and sponges while the induced noise pollution by surveys and increased traffic has impacts on associated species of deep water habitats such as marine mammals and fish, as well as on the invertebrate deep sea fauna itself. Deep sea mining targets the extraction of minerals, notably polymetallic manganese nodules found in abyssal depths, seafloor sulfides and polymetallic sulfides associated with extinct or active hydrothermal vents, cobalt manganese crusts on seamounts, and phosphorite nodules typically found between 200-400 m depth[31].

These operations lead to destruction of any habitat in the target area. Besides that, they affect extensive areas producing plumes, noise pollution and emission of toxic materials. Both oil and gas operations and seabed mining have a development potential in the Mediterranean. The first sector is already developed and many areas are fully operating while others are under the initial steps or under evaluation. Seabed mining is another threat for the region since sulfide deposits have been identified in various locations including Italian and Greek coasts. Due to the nature of the exploitation these developments will directly affect known or unknown seeping areas, pockmarks and hydrothermal vents as well as seamounts. Under the current developments for accessions of areas for deep sea oil exploitation within the Hellenic Trench and particularly in south and south west of Crete unique chemosynthetic ecosystems discovered in the wider area related to seeping at seamounts, mud volcanoes, pock marks and brine pools are under immediate threat of destruction or alteration. These areas are relatively newly discovered and scientific analysis on species and functions is far from complete. According to the scientific evaluation besides their ecological value their conservation should be guaranteed due to the tremendous scientific value they possess concerning the functions and the evolution of life on Earth (Fisher et al., 2021).

Offshore facilities for renewable energy, particularly wind energy, are also threatening deep sea habitats as they develop on the continental shelf or are anchored in deep water areas. Their development seems inevitable in order to combat climate change, although careful planning is necessary in order to avoid sensitive areas[32].

3.3 Shipping and Pollution

Shipping is a major driver of marine pollution while it further contributes to climate change. Notably the presence of clinker, the residue of burnt coal, observed on seabed basins and continental slopes coincides with shipping routes in the Mediterranean waters. Dumping is another way of pollution by ships and in particular of illegally released toxic or radioactive waste. It is known that explosives and other toxic materials have been released in the south Adriatic and north Ionian seas causing seafloor contamination (Danovaro et al., 2010). Besides the above shipping contributes to pollution caused by oil spills, maritime accidents

[31] https://www.iucn.org/sites/dev/files/import/downloads/mining_brochureprint_8june__3_.pdf
[32] Ideally within the framework of Maritime Spatial Planning (EU MSP Directive)

related to oil and ship wrecks, pollution by operational discharges and by marine litter including plastic and other accidental cargo losses as well as noise.

Pollution naturally does not originate solely from shipping, but from a wide range of human activities, if not all. Therefore forms of pollution affecting the deep sea are industrial discharges containing toxic or persistent substances, marine litter including plastics, micro-plastics and their related toxic substances which tend to accumulate in organisms. Marine litter is affecting gravelly deep environments while Mediterranean submarine canyons are particularly affected[33]. Due to their morphology and topography canyons tend to collect litter at their base or in depressions, gathering some of the highest concentrations of plastic, resulting in habitat loss amongst other impacts.

3.4 Climate change

Climate change related pressures are ocean warming, acidification and oxygen depletion. They cause erosion of marine systems resilience and increase their sensitivity to other pressures. According to IPCC, ocean warming has already affected deep sea ecosystems down to 2000 m[34]. This is particularly alarming in the case of the Mediterranean which is a basin very responsive to climate change and with average depth of 1500 m[35]. Temperature rise has severe adverse impacts on the survival and growth of cold water corals and sponges, which are organisms requiring low temperatures. Particularly stony reef forming corals are already at the limit of their thermal tolerance in the basin (e.g *Lophelia pertusa*). Furthermore, temperature rise leads to alterations in hydrodynamics, including in convection areas and to the water stratification, that further cause decreased dissolved oxygen concentration and reduce of input of organic matter to deep areas. The biochemical alterations will eventually lead to biological responses when these reach the stable conditions of the deep sea and species living within a narrow range of environmental variation. Another highly alarming condition for cold water corals and all calcifying organisms is the reduction of water PH values, caused by the high concentrations of carbon dioxide which eventually leads to corrosive conditions for their skeleton as it affects calcification[36].

The expansion of IAS in deep sea habitats is a combined pressure from the climate change temperature rise. Although at present benthic IAS do not present a serious threat to benthic species and habitats. Other threats to deep sea habitats are cable and pipeline development which have a direct impact during the laying operation as well as sand and gravel mining.

According to EEA assessments[37], among the most intense pressures in the Mediterranean appear to be the hazardous substances, by- catch by bottom touching mobile and pelagic

[33] https://uicnmed.org/docs/mediterraneandeepsea.pdf , p.58
[34] https://www.ipcc.ch/srocc/chapter/chapter-5/
[35] https://www.medqsr.org/climate-change
[36] https://uicnmed.org/docs/mediterraneandeepsea.pdf, p.71
[37] https://www.eionet.europa.eu/etcs/etc-icm/products/etc-icm-report-4-2019-multiple-pressures-and-their-combined-effects-in-europes-seas

towed gears, extraction of species by commercial fishing, anthropogenic sound and the physical disturbance and habitat loss of the seabed, while most affected ecosystem elements include fish, marine mammals, turtles, the bathyal seabed and cold water corals.

3.5. Ecosystem services and ecological value of deep sea habitats

Despite the fact that deep sea habitats are under serious threats they are yet to receive the conservation focus they deserve. Being remote, inaccessible and largely out of sight has impaired their discovery, study and conservation. Although immediate attention is needed, as they deserve to be protected in their own right due to their intrinsic value but also should be preserved for their ecosystem services. Deep sea ecosystems play a critical role in carbon sequestration and their ability to store greenhouse gases under the current climatic crisis should not be impeded or altered. The regulating role of microbial communities and their associated specialized fauna in deep sea habitats is important for sequestration and storage of methane amongst other gases, while specialized communities of microorganisms provide bioremediation through biotic and abiotic processes removing pollutants from the environment such as oil or micro-plastics as well as other waste. Various faunal species of the deep sea habitats from filter feeders to chemoautotrophic bacteria are key elements for biochemical circles (carbon, silicate, nitrogen cycles) and consequently for productivity in the oceans[38].

Besides their contribution in climate regulation and ocean health, deep sea ecosystems provide important living resources particularly commercial fisheries, as well as resources for purposes other than consumption including genetic resources, while they are also connected as seen above with gas, oil and mineral resources which find many applications and uses.

These habitats present a high ecological value as they constitute hotspots of biodiversity due to their biogenic or geomorphological structures amongst other things. They are highly diversified and act as an essential habitat for a variety of species, while contribute to the heterogeneity of the deep seas and support faunal communities often of higher biomass and diversity than the surrounding unstructured areas. In that way they present 'oasis in the desert' and function as faunal spreading centers, this being particularly important on the case of overfished surroundings (Tursi et al., 2004). Particularly for corals it has been observed that the more complex morphology results in higher species richness (Mytilineou et al., 2014), and high demersal secondary production (Schembri et al., 2007). This underlines the necessity to keep these habitats unscathed, as destroyed parts result not only to the gradual demise of the damaged organism, but to a wider impoverishment. It is known that these habitats include also endemic and rare species, as well as species whose existence, function and value is still unknown to science. Evidence to that are the unique trophic structures supported by the ecological components of seeping areas and their associated structures (pockmarks, vents, brine pools).

These habitat types as described above are proven to be of a high ecological value, and the need for their conservation could not be more demanding, particularly under the current

[38] https://uicnmed.org/docs/mediterraneandeepsea.pdf , p.55

situation of climate change and the planning of activities in areas with proven existence or possible occurrence of deep sea habitats.

The following framework for their conservation is comprised of International, Mediterranean (regional) and European policies and legislation with a focus of application in Mediterranean and EU coastal states of the region, including Greece.

4. International, European and Mediterranean Policies and Legislation for the conservation of deep sea habitats

4.1 Policies and Legislation for Vulnerable Marine Ecosystems (VMEs)

4.1.1 The United Nations General Assembly for VMEs and BBNJ

The Johannesburg Plan of Implementation, adopted at the 2002 World Summit on sustainable development[39], called for countries to "develop and facilitate the use of diverse approaches and tools, including ecosystem approach, elimination of destructive fishing practices, and establishment of MPAs consistent with the international law and based on scientific information including representative networks…" Further on, the plan highlighted the importance of maintaining the productivity and biodiversity of important and vulnerable marine ecosystems in areas beyond national jurisdiction (ABNJ).

Sequent United Nations General Assembly (UNGA) Resolutions 58/240 (2003)[40] and 59/24[41] (2004), both affirmed the need that states develop tools in order to conserve and manage vulnerable marine ecosystems (VMEs), including with the establishment of MPAs. Resolution 59/25 para.66[42] (2004) called upon states to "...take action […] including the application of precautionary approach, the interim prohibition of destroying fishing practices including bottom trawling that has adverse impacts on vulnerable marine ecosystems, including seamounts, hydrothermal vents, and cold water corals located in ABNJ until such time as appropriate conservation and management measures have been adopted in accordance with international law". Taking a step towards actively addressing the issue the UNGA established an Ad Hoc Open-ended Informal Working Group to Study Issues Relating to the Conservation and Sustainable use of Marine Biological Diversity beyond Areas of National Jurisdiction (BBNJ Working Group).

Additionally following UNGA Resolutions 61/105[43] and 64/72[44] called upon states to reduce and eliminate destructive fishing practices through the application of EIAs, implementation of area closures and other management measures to prevent significant adverse impacts (SAIs), implement encounter protocols regarding VMEs and adopt measures for long term sustainability of target and non- target deep sea species. With Resolutions 69/245 (2014)[45], 69/292 (2015)[46] and 72/249 (2017)[47] the UNGA decided to establish a preparatory committee and hold an intergovernmental conference for the adoption of an International legally binding instrument under the Law of the Sea on the conservation and sustainable use

[39] https://sustainabledevelopment.un.org/milesstones/wssd
[40] https://undocs.org/en/A/RES/58/240
[41] https://undocs.org/en/A/RES/59/24
[42] https://undocs.org/en/A/RES/59/25,
[43] https://undocs.org/A/RES/61/105,
[44] https://undocs.org/A/RES/64/72
[45] https://undocs.org/en/A/RES/69/245
[46] https://undocs.org/en/A/RES/69/292
[47] https://undocs.org/en/A/RES/72/249

of marine biological diversity in areas beyond national jurisdiction[48]. When the respective legislation is finalized and put into force, it shall provide in tandem with existing legislation and measures, provided by other international and regional instruments (CBD, FAO, SPA/RAC), a more firm and concrete protection to a variety of biological components of the high seas including deep sea habitats and vulnerable marine ecosystems. Until then, the GA urges states to integrate and improve management of risks to marine biodiversity of seamounts, cold water corals, hydrothermal vents and other certain underwater features, to take action addressing destructive practices to the above features, to identify ecologically or biologically significant areas, to strengthen conservation implementing area based management tools like MPAs, establishing representative networks and apply the best available science and precautionary approach in all processes (UNGA Resolution 76/72)[49].

4.1.2 FAO and VMEs

According to the Food and Agricultural Organization of the United Nations (FAO), VMEs are groups of species, communities or habitats that maybe vulnerable to the impact of fishing activities. The vulnerability of an ecosystem is related to the 'vulnerability of its constituent population, community or habitats'. Vulnerability maybe *physical*, associated with contact damage and *functional*, linked with the selective removal of a species and the consequent alteration of the manners the ecosystem works.

United Nations General Assembly Resolutions on Sustainable Fisheries, notably Resolutions 59/25 (2004), 61/105 (2006), 64/72 (2009), as aforementioned, were adopted, recognizing the adverse effect of fisheries to VMEs, introducing the latter term and linking their protection to the sustainable management of fisheries. Moreover, the resolutions urge States to apply the precautionary principle and the ecosystem approach for long term conservation and in accordance with the international law. Further work has been undertaken by FAO in that respect. FAO has adopted International Guidelines for the Management of Deep-sea Fisheries (DSF) in the High Seas providing details on the VMEs concept for fisheries management[50].

According to these guidelines "a marine ecosystem should be classified as vulnerable, based on the characteristics that it possesses" (para 42, FAO DSF Guidelines). Therefore categories of characteristics to be used as criteria[51] have been defined, in order to help states identify VMEs. These are, **uniqueness or rarity**: habitats with endemic, rare, threatened or endangered species in discrete areas, nurseries, feeding, breeding and spawning areas, **functional significance of the habitat** : nursery grounds or rearing areas, or areas necessary for the survival of rare, threatened or endangered marine species, **fragility**: susceptibility to degradation by anthropogenic impact, **life-history traits of component species that make recovery difficult**: slow growth rate, late age of maturity, low or unpredictable recruitment,

[48] https://www.un.org/bbnj/

[49] https://undocs.org/en/A/RES/76/72

[50] https://www.fao.org/3/i0816t/i0816t00.htm

[51] https://www.fao.org/in-action/vulnerable-marine-ecosystems/criteria/en/

long-lived, **structural complexity**: complex physical structures by abiotic and biotic features, dependent ecological processes, high diversity. For enhancing the identification process, the Annex to the above Guidelines, provides with examples of species groups, communities and habitat forming species that are documented or considered sensitive and potentially vulnerable to deep sea fisheries and may contribute to forming VMEs. These examples include certain cold water corals and hydroids particularly those forming coral reefs and gardens or forests (Scleractinia, Octocorallia, Antipatharia, *Stylasteridae*), types of sponge dominated communities, communities formed by sessile invertebrates like hydroids and bryozoans, and seep and vent communities comprised of invertebrate and microbial species which are endemic. Also provides with a second indicative identification group citing examples of topographical, hydro physical or geological features including fragile geological structures that potentially support species groups or communities mentioned above. These are amongst others, submerged edges and slopes, summits and flanks of seamounts and banks, canyons and trenches which all may host corals and sponges aggregations, hydrothermal vents which host microbial communities and endemic invertebrates, cold seeps and mud volcanoes with microbial communities and sessile invertebrates.

4.1.3 The General Fisheries Commission for the Mediterranean (GFCM) and VMEs

Conservation and management measures relating to the sustainable use of fisheries are under the competence of Regional Fisheries bodies, which guarantee the necessary intergovernmental cooperation within and beyond national jurisdiction of states. The General Fisheries Commission for the Mediterranean (GFCM) is a regional fisheries management organization established under the provisions of article XIV of the Constitution of the Food and Agriculture Organization of the United Nations. The GFCM aims to ensure conservation and sustainable use of marine living resources and along with other regional fisheries organizations has incorporated the concept of Vulnerable Marine Ecosystems in its actions and legally binding Recommendations. In regards to VMEs protection, the GFCM has implemented two types of fisheries restrictions; the Deepwater Fisheries Restriction Areas which provide a ban of use of towed dredges and trawl nets at depths over 1000 m and the Fisheries Restricted Areas (FRAs)[52] for the protection of VMEs through permanent closures for trawls and dredges (Recommendation GFCM/2006/3)[53].

Another type of Fisheries Restricted Area is the Essential Fish Habitat (EFH) which imposes temporal bans and closures in order to improve exploitation patterns and conservation of specific stocks. Nonetheless management measures are taken in order to protect identified VMEs within the EFH areas. These FRAs sites though, are minimal for effective protection, dispersed and far from being a network. A network of FRAs for VMEs should be established in the pathway of the Mediterranean water mass circulation in order to connect the different FRAs all over the basin by means of larval dispersal (Chimienti et al., 2019).

[52] https://www.fao.org/gfcm/data/maps/fras/en/

[53] https://www.fao.org/fishery/docs/DOCUMENT/gfcm/web/GFCM_Recommendations2006.pdf

The GFCM with Resolution GFCM/41/2017/4 [54] established a permanent working group for VMEs (WGVME). The WGVME adopted on its first meeting VME indicator features, habitats and taxa and identified indicator species listed in Appendix C and D of the 2017 Report[55]. Indicator features that potentially support VMEs are seamount and volcanic ridges, canyons and trenches, steep slopes, submarine reliefs, hydrothermal vents and areas of cold seeps namely pockmarks, mud volcanoes, reducing sediment, anoxic pools and methanogenetic hard bottoms. VMEs indicator habitats are cold water coral reefs, coral gardens, sea pen fields, deep sea sponge aggregations including glass sponges, tube-dwelling anemone patches, crinoid fields, oyster reefs and other giant bivalves, seep and vent communities and other dense emergent fauna. Indicator taxa include orders of anthozoans and hydrozoans, Demospongiae and Hexactinellida sponges, crinoids, several bivalves particularly those indicating chemosynthetic communities, the same for indicator annelid polychetes and amphipodes.

Taking into consideration the difficulty to acquire data on VMEs location and extent and for the purpose of avoiding the risk of SAIs on these ecosystems, the working group implementing the precautionary approach for DSF management with respect to VMEs adopted an encounter protocol in Appendix E of the report. Notably any catch of VME indicator taxa is considered an encounter and the protocol sets the obligation of fishing and scientific vessels to report such an encounter according to the established procedures. In its second meeting in 2018 the WGVME agreed that VMEs in waters shallower than 300 meters should be with adequate protection from deep sea fisheries particularly providing for areas such as tops of seamounts regardless their geographic position, parts of submarine canyons and steep slopes. Further, on the implementation of the encounter protocol in its report the working group noted that as an initial step the encounter protocol should be simply an encounter reporting procedure and in a second phase a process of management measures after the identification of appropriate thresholds (by-catch limits).

Finally, acknowledging the importance of *I. elongata* communities in Mediterranean deep sea soft bottoms, following its identification as indicator species in 2017, further suggested the establishment of spatially based management measures for the protection of the species. The report[56] includes an updated list of potential FRAs for VMEs including again (2017) the Eastern Ionian Area (Cephalonia), a site proposed by both the HCMR and IUCN, while also listed as a priority VME area Toroneos Gulf (Chalkidiki) in N. Aegean. Both areas host important communities of *I. elongata* and other coral garden habitats. Until now, in the Central and Eastern Mediterranean three sites have been identified as FRAs for VMEs protection. These are, in Italy, the *Lophelia* and *Madrepora* reefs off Cape Santa Maria di Leuca, which constitute the most significant discovery so far regarding reef habitats in the

[54] https://www.fao.org/gfcm/decisions/en/

[55] https://gfcm.sharepoint.com/EG/Report%20v2/2017/WGVME/GFCM_WGVME_2017_Report.pdf

[56] https://gfcm.sharepoint.com/EG/Report%20v2/Forms/AllItems.aspx?id=%2FEG%2FReport%20v2%2F2018%2FWGVME%2FGFCM%5FWGVME%5F2018%5FReport%2Epdf&parent=%2FEG%2FReport%20v2%2F2018%2FWGVME&p=true

eco-region, the Eratosthenes Seamount south of Cyprus, and the Nile delta seeping area in Egypt.

It is noteworthy that while the abovementioned criteria and indicators have been developed within the concept of sustainable fisheries management they also constitute a valuable contribution for further protection of deep sea habitats in relation with other damaging activities like seabed mining, or activities using the seabed, particularly regarding the EIAs processes. Additionally, the established fisheries restricted areas (FRAs) for the protection of VMEs from the adverse impacts of fisheries and the possible future ones, set a basis on which further conservation measures may be taken. Thus FRAs for sensitive habitats may form a basic element for the identification of SPAMIs under SPA/BD Protocol, also pursuantly to SPAMI criteria as it is discussed below, and further for the establishment of MPAs or MPA networks.

4.2 The Convention on Biological Diversity (CBD)

4.2.1 Strategic Plans for Biodiversity under CBD

For promoting the effective implementation of the CBD the COP10 adopted a Strategic Plan for Biodiversity for the period 2011-2020, establishing a shared vision and a strategic approach with goals and targets (20 Aichi Targets)[57]. The fundamental basis of the Strategic Plan are the three objectives of the Convention, conservation of biological diversity, sustainable use of its components and fair and equitable sharing of benefits arising out of the utilization of genetic resources. Currently an ambitious new strategic plan, the Post-2020 Global Biodiversity Framework, is being processed by the COP 15, while a first draft has been released[58].

The framework aims to address the progression of biodiversity loss and thus contribute further to the 2030 Agenda for Sustainable Development, whilst along with the synergetic effects of the SDGs move towards in achieving the 2050 vision of “Living in harmony with nature”. It is stressed that continuing “business as usual” will be detrimental for both nature and humanity and consequently the framework is built around a theory of change, requiring urgent and transformative actions to be taken as to reduce threats to biodiversity and move towards its sustainable use. In that respect it defines new goals and targets for 2030 and 2050 horizons. In the goals and milestones, set for 2050 and 2030 respectively, among others, demands an increase of 15 per cent at least, in **integrity** and **connectivity** of natural ecosystems and that the extinction risk of all species is reduced by 10 per cent at least. Building further on the 2010 Aichi targets, sets specific 2030 action targets, tailored to the current needs and trends. The importance of the application of an integrated ecosystem based spatial planning worldwide is recognized in target 1, which demands that “**all sea areas** are under **integrated biodiversity-inclusive spatial planning** addressing land and sea use change, retaining existing intact and wilderness areas”.

[57] https://www.cbd.int/sp/targets/

[58] https://www.cbd.int/doc/c/abb5/591f/2e46096d3f0330b08ce87a45/wg2020-03-03-en.pdf

The loss of natural habitats, their degradation and fragmentation are addressed in target 2, furthering the protection as it is described in Aichi target 5, where **habitat loss** rate is halved or if feasible brought to zero and **degradation and fragmentation** are significantly reduced, and demands that at **least 20 per cent of degraded marine ecosystems are under restoration,** ensuring **connectivity** among them and focusing on priority ecosystems; that being an increase of 5 per cent at least of what was ordained by Aichi target 15. As protected areas are a tool for the conservation and maintenance of biodiversity in all its aspects including diversity of species, genes and ecosystems, target 3 aims at an **MPA coverage of at least 30 per cent globally**, focusing especially on the conservation of " **areas of particular importance for biodiversity and its contributions to people through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and [which are] integrated into the wider landscapes and seascapes**". Although, no particular provision is made on how this percentage is to be distributed among "areas of particular importance" of different biogeographical classifications of the marine environment. The inclusion of diverse components and environments is necessary in order to achieve a truly ecologically representative network of MPAs which ensures the healthy functioning of the seas; otherwise the goal maybe met solely by numerical terms but not in terms of representativeness as it has been the case of Aichi target 11 (EEA)[59].

On the conservation of species, for the improvement of their conservation status and attainment of a favorable one, target 4 builds on Aichi target 12 according to which, the extinction of known threated species is prevented by 2020, and calls for effective management actions to enable the **recovery and conservation of species and the genetic diversity** of wild"[species]"including through ex situ conservation, and effectively managed human-wildlife interactions to avoid or reduce human-wildlife conflict". The need for sustainable use of biological resources is emphasized in target 5, calling for the implementation of all respective legally binding rules. Similar action in demanded in Aichi target 6, which further specifies that fisheries should not have "**significant adverse impacts on threated species and VMEs** and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits". This echoes clearly the work undertaken by FAO and the RFC for the Mediterranean as seen above and is also under the provisions of UNCLOS for the sustainable use of living resources in all waters. Another Aichi target tailored to VMEs is target 10, which calls for minimizing "the **multiple anthropogenic pressures on coral reefs and other VMEs impacted by climate change or ocean acidification**" in order to "maintain their integrity and functioning".

Both targets specifying on VMEs recognize the need to minimize all cumulative impacts from human activities, especially the most detrimental known to date, with respect to both their survival and protection when the additional pressures from climate change emerge or escalate, as well as for the preservation of the ecosystem services they provide, their contribution on carbon sequestration included. As the ability of degraded ecosystems to **contribute in carbon sequestration** is attenuated, target 8 underlines the application of ecosystem based approaches including **restoration** (Aichi target 15 & target 2 of the draft),

[59] https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/assessments/marine-protected-areas

and sets a contribution target to global mitigation efforts of a 10 $GtCO_2e$ per year. Further demands the impact of climate change on biodiversity to be minimized and that **all mitigation and adaptation efforts avoid negative impacts on biodiversity**. Relevant target to the attainment of a good environmental status (GES) of VMEs is target 7, which demands **pollution** from all sources to be reduced "to levels that are not harmful to biodiversity and ecosystem functions..", including by reducing "pesticides by at least two thirds and eliminating the discharge of plastic waste".

The importance of EIAs in biodiversity conservation is expressed in targets 14 and 15 where the spectrum of the direct recipients widens as to include businesses, intensifying in such the dire need for **EIA implementation** in order to achieve biological conservation. Therefore demands **full integration** "of biodiversity values into policies, regulations, planning, development processes, poverty reduction strategies, accounts, and assessments of environmental impacts at all levels of government and across all sectors of the economy, ensuring that all activities and financial flows are aligned with biodiversity values"; and that "all businesses (public and private, large, medium and small) assess and report on their dependencies and impacts on biodiversity, from local to global, and progressively reduce negative impacts, by at least half and increase positive impacts, reducing biodiversity-related risks to businesses and moving towards the full sustainability of extraction and production practices, sourcing and supply chains, and use and disposal". Since knowledge is a basic component of sustainability and conservation, Aichi target 19 underlines that by 2020 "knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss are improved, widely shared and transferred, and applied". Although **scientific knowledge** improves, it is far from being complete regarding species and ecosystem functions. Having that in mind CBD COP 10 underlined that "scientific uncertainty should not be used as excuse for inaction"; on the contrary the implementation of a precautionary approach is critical for conservation plans as well as EIA process.

4.2.2 The CBD and EBSAs

In article 2 of the Convention[60] a "Protected area" is defined as a "geographically defined area which is designated or regulated and managed to achieve specific conservation objectives".

The CBD is the principal global treaty identifying protected areas (PAs) as a significant tool for meeting its objectives. That derives from the preamble, as "In situ conservation of ecosystems and natural habitats is the fundamental requirement of conservation" and it is further elaborated in article 8. Thus, contracting parties are directly obliged to establish "a system of protected areas or areas where special measures need to be taken to conserve biological diversity" (article 8(a)). The article provides with an analytical enumeration of pertinent deriving obligations. Notably urges for the application of ecosystem approach in spatial planning and connectivity conservation, undertaking "environmentally sound and

[60] https://www.cbd.int/doc/legal/cbd-en.pdf

sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas". These areas may serve as core protected areas with clear conservation objectives, or either as buffer zones or ecological connectivity corridors and part of a PAs network[61] (IUCN). Additionally recognizes that PAs can be used as a tool for managing biological resources, and in that respect this applies to fisheries management within MPAs (zoning and closures within MPAs).

Although, fisheries management areas themselves, do not qualify as MPAs, since their primary purpose (extraction of biological resources) is other than the conservation of nature (IUCN). States (contracting parties) are further obligated to "develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations". In that way the recognition of a species or population as protected due to its threatened status, paves the way for the establishment of an area as protected with a legally recognized status. In articles 4 and 5, the Convention provides for the conservation and sustainable use of biological diversity in ABNJ, through the international cooperation between members states and competent international organizations "in the case of processes and activities". This obligation and concurrent right, being in accordance with the provisions of the International Law of the Sea (UNCLOS), is reiterated and further implemented at the SPA/BD Protocol to the Barcelona Convention and the creation of SPAMIs.

Further article 7(a) provides for a clear obligation of states to identify important components of biological diversity and article 8 (b) to develop guidelines for the selection, establishment and management of PAs or other effective conservation measures. In that way leaves the selection process for priority ecosystems and species as well as their management method to each state. Nonetheless, article 7(a) directly refers to Annex I, where the CBD provides with an indicative list of criteria for identification, selection and monitoring of ecosystems and habitats, species and communities, as well as genomes and genes.

As the common and shared goal of the CBD for the oceans is "to maintain, protect and conserve global marine biodiversity through conservation and protection of its components in a biogeographically representative network of ecologically coherent sites", the COP 9 (2008) of the Convention has further adopted the scientific criteria for identifying ecologically or biologically significant marine areas in need of protection, and the scientific guidance for designing representative networks of MPAs, including in open ocean waters and deep sea habitats in Annex I and Annex II of CBD COP 9 Decision XI/20[62] respectively. This decision was based on the recommendations made by the expert Workshop on Ecological Criteria and Biogeographic Classification Systems for Marine Areas in Need of Protection (Azores 2007)[63]. These particular areas of the ocean fulfilling the criteria are identified as EBSAs, ecologically or biologically significant areas. The intention of the CBD governing bodies is that the identified areas are considered also 'sensitive areas' under other instruments and that the marine and maritime uses and pollution occurring within

[61] https://portals.iucn.org/library/sites/library/files/documents/EPLP-081.pdf

[62] https://www.cbd.int/decision/cop/?id=11663

[63] https://www.cbd.int/doc/meetings/mar/ebsaws-2014-01/other/ebsaws-2014-01-azores-brochure-en.pdf

EBSAs geographical territory will be regulated within the regime applicable to each activity (shipping through IMO, fishing through FAO, sea bed mining through ISA)[64].

The COP 9 also decided to convene an expert workshop to provide scientific and technical guidance on the use and further development of biogeographical classification system and guidance on the identification of areas located beyond national jurisdiction that meet the scientific criteria (COP 9 Decision IX/20 ,para.19). In COP 10 (2010) it was further emphasized that member states should identify these significant and vulnerable marine areas in need of protection and provide with legally binding systems such as MPAs designations, other effective conservation measures (OECMs) and EIAs. With the objective to facilitate the description of EBSAs and on the request of the COP 10, a series of Regional Workshops were convened, including one for the Mediterranean region (2014). The description of EBSAs was conducted through the application of the scientific criteria as well as other compatible and complementary nationally or inter-governmentally agreed scientific criteria.

For the seven identified EBSA criteria, details and information regarding definition of criterion, the rationale, examples in different habitats and consideration for its application are provided (Annex I, Decision IX/20). These site-based criteria are: 1. **Uniqueness or rarity**: the area contains unique, rare or endemic species, populations or communities, and/or unique, rare or distinct, habitats or ecosystems; and/or unique or unusual geomorphological or oceanographic features. In this category, hydrothermal vents, seamount and pseudo-abyssal depressions are included as examples. 2. **Special importance for life-history stages of species:** these are areas required for a population to survive and thrive. Examples are areas including (i) breeding grounds, spawning areas, nursery areas, juvenile habitat or other areas important for life history stages of species; or (ii) habitats of migratory species, important for feeding, wintering or resting areas, breeding, moulting, as well as migratory routes. 3. **Importance for threatened, endangered or declining species and/or habitats:** these are areas containing habitats for the survival and recovery of endangered, threatened, declining species or areas with significant assemblages of such species. Examples of these critical habitats are identical to the above under category 2. 4. **Vulnerability, fragility, sensitivity, or slow recovery**: these are identified as areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery. Examples of vulnerable species are structure forming deep water corals, sponges, bryozoans, and k-selected species such as sharks while examples of vulnerable habitats are those that are susceptible to climate change impacts like acidification. 5. **Biological productivity**: areas containing species, populations or communities with comparatively higher natural biological productivity. For example these include upwelling areas or areas with hydrothermal vents. 6. **Biological diversity:** areas containing comparatively higher diversity of ecosystems, habitats, communities, or species, or have higher genetic diversity. These are par example the habitats of seamounts, of deep water sponge and cold water coral communities. 7. **Naturalness:** areas with a comparatively higher degree of naturalness

[64] Robert C. Beckman, Millicent McCreath, J. Ashley Roach, Zhen Sun, High Seas Governance: Gaps and Challenges, 2018, p.67

as a result of lack of or low level human-induced disturbance or degradation. In that respect the most undisturbed examples of habitats/ecosystems qualify.

During the technical process of EBSA identification in the Mediterranean, a further emerging issue would be on how to select the species to be used as reference for the above criteria; for instance according to their conservation status, if these are species threated or endangered included in Annex II of SPA/BD Protocol, or/and in IUCN's Red List, or identified as vulnerable marine species, or are indicator species or other.

Besides the criteria for the definition of EBSAs, in the same decision were included guidelines and criteria for the establishment of a representative MPA network, including the high seas and deep sea habitats (Annex II). These criteria should also be considered in the formation of a SPAMI network in the high seas, and are the following for the qualifying areas/sites: 1. areas that are identified as EBSAs according to the abovementioned criteria, 2. areas representing different biogeographical subdivisions of an ecological marine unit that reasonably reflect the full range of ecosystems (representativeness), 3. areas providing connectivity, allowing linkages of ecological processes, species habitats, gene flow and migration, notably areas encompassing characteristics such as gyres, currents, migration routes, as well as isolated sites, like seamounts, 4. areas containing replicated ecological features, where more than one site contains examples of a given feature within a biogeographic area (accounting for natural variation, uncertainty and catastrophic events), 5. sites that are adequate and viable; that being depended upon size and protection sufficiency, according to the system planning (size, shape, buffer, features persistency, threats, surrounding). Thus, the coherence of the network is achieved through the realization of representativeness, connectivity and replication. For that purpose, in Annex III four initial steps are cited as guidance for the development of a representative MPAs network. Through the selection process it is necessary to choose a classification system which reflects the scale of the application and address key ecological features within the area, separating at least two realms, pelagic and benthic.

The creation of a coherent network of MPAs in the Mediterranean requires the inclusion in the process of all developed and relevant scientific criteria and applying them in each subdivision of the basin[65]. This is necessary for achieving true representativeness and the subdivision may well be a scientifically defined ecological region/unit, according to for instance oceanographic elements, geographic peculiarities and biological and other ecological characteristics (Abdulla et al., 2014).

Subsequently we can assume that the identification of large marine areas using the EBSA criteria is followed by the implementation of the SPA/BD Protocol's SPAMIs criteria for further prioritization and selection, in order to finally specify the 'significant areas' of 'Mediterranean importance' (see below under the respective section). Within these EBSAs, networks of SPAMIs as well as other relevant legally set MPAs and their connecting elements (buffer zones, ecological corridors), may be defined, delineated and developed, according to

[65] https://www.cbd.int/doc/meetings/mar/ebsaws-2014-03/other/ebsaws-2014-03-submission-slovenia-en.pdf, p.10

criteria set for SPAMIs for areas within and beyond national jurisdiction, pursuant to the provisions of the respective Protocol and of the Law of the Sea. Additionally, the synchronous application of other scientific criteria in the EBSA identification process is useful in order to address possible peculiarities of an area. For instance, in the Mediterranean this applies to the case of the various threats posed by the intense shipping to a wide range of important marine biological components of the area, including threats related to many types of pollution (e.g. toxic substances or noise) and physical damage by ships. Aiming at the maximum effective protection and preservation of these components affected by shipping, during this identification and selection process, taking into consideration the criteria for Particularly Sensitive Sea Areas (PSSAs) developed by IMO, guarantees a higher degree on coverage and representation. These criteria are cited in the respective Guidelines for the identification and designation of Particularly Sensitive Sea Areas[66]. PSSAs are identified as areas which deserve special protection, due to their recognized ecological or socio-economic or scientific significance, and which may be vulnerable to damage by ships.

The adopted ecological criteria bare significant similarities to the EBSA criteria and are, uniqueness or rarity, critical habitats, dependency, representativeness, diversity, productivity, spawning or breeding grounds, naturalness, integrity, fragility and bio-geographic importance. It is important to note here that when an area is recognized as a PSSA, measures to control maritime activities are applied. These include strict application of MARPOL Convention regarding discharge, and equipment requirements for ships such as oil tankers, routeing measures and installation of vessel traffic services (VTS)[67]. These measures are of great significance for the protection of deep sea habitats and particularly associated threatened megafauna (sharks, cetaceans).

Other criteria which can be used in the wider process of establishing MPAs, within though, the limits of national jurisdiction of the riparian states, are those under EU Habitats Directive, for the identification and assessment of sites of community importance (SCI), regarding habitats and species of the Directive (Section 4.6.3).

4.3 The delimitation of Maritime Areas and environmental protection under UNCLOS

The United Nations Convention on the Law of the Sea (UNCLOS) [68] is the principal international legal instrument addressing all issues relating to the law of the sea by establishing an all-encompassing legal regime with a near universal acceptance of its key provisions. Thus, it sets the rules governing all activities in the oceans and the use of their resources, activities which should be executed in a manner that secures conservation of nature and particularly its protection from the adverse effects of overexploitation and pollution. At first, the Convention provides for the delineation of the marine space with firm and detailed rules and procedures, and defines the rights and obligations of the States, of

[66] https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/A24-Res.982.pdf

[67] https://www.imo.org/en/OurWork/Environment/Pages/PSSAs.aspx

[68] https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf

the Authority (ISA) and of other involved parties in each respective activity. Consequently operates as the framework and the foundation for any instrument that seeks to further define rights and obligations in the oceans. The space in the sea is divided between two basic categories; the areas within national jurisdiction and the areas beyond national jurisdiction or areas where the sovereignty or jurisdiction has not yet been defined. The subdivisions of the marine space beyond the baselines defined by the Convention within a jurisdictional concept are the territorial sea and its contiguous zone, the Exclusive Economic Zone, the Continental Shelf, the High Seas and the Area. Areas within the jurisdiction of a coastal state are its inland waters, the territorial sea, the EEZ and the continental shelf.

4.3.1 The Territorial Sea & Contiguous Zone

The territorial sea is the adjacent to the land belt of sea, that may extend to a maximum breadth of 12 nautical miles from the baselines and in which the coastal state exercises full sovereignty in its waters, seabed, subsoil and airspace over it (articles 3-5). Within this area all national, international and transposed legislation apply regarding various marine and maritime issues including the management of all resources, regulations on pollution of the marine environment and its protection and conservation. This also includes all relevant obligations established under the environmental provisions of UNCLOS (articles 192, 193, 210, 211 para. 3-4, 212). Therefore States shall take all appropriate measures (article 194) to combat pollution within their territorial waters having complete authority in enforcing legislation and imposing sanctions. The contiguous zone is part of the high seas (or EEZ) and operates as an intermediate status zone adjacent to the territorial sea, in which the coastal state may exercise control on a restrictively defined number of cases (fiscal, immigration, customs, and sanitary issues). The contiguous may not extend beyond 24 nautical miles from the baselines used for measuring the breadth of the territorial sea (article 33). Hence it does not in any case extend the territorial sea and does not provide any sovereign rights.

4.3.2 The EEZ

The need of the coastal states to include precious biological resources (fisheries) in their authority as well as certain issues related to the continental shelf, led to the establishment of the exclusive economic zone (EEZ) and its concept finds expression in article 55 of the Convention. The EEZ is an area beyond and adjacent to the territorial sea that shall not extend beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured. This area is subject to a specific regime which includes a web of rights and obligations of both coastal and other states in order to achieve a balance of uses. Consequently the coastal state which declares an EEZ, has sovereign rights for exploration and exploitation, conservation and management of all natural resources of the overlying waters to the seabed and of that and its subsoil, including the production of energy.

In this way the sovereign rights deriving from the continental shelf and applied in the EEZ for the exploration and exploitation of its natural resources provide a unified regime for the total breath of the EEZ. Parallel though to those rights the coastal State has the respective

obligations by the Convention on the conservation and protection of the living resources within its EEZ (article 61). Additionally to the above sovereign rights the Convention grants the coastal state jurisdiction for the establishment of certain installations, for marine scientific research and for the protection and preservation of the marine environment from pollution. Also includes in its provisions various other rights and duties of the coastal state relating to specific issues (article 56). All other states enjoy in the EEZ of the coastal state certain freedoms of the High Seas referred to in article 87, and are amongst others, the laying of pipelines and cables, navigation and other internationally lawful uses of the sea (article 58 and 79); those granted explicitly to the coastal state though, excluded. While exercising these freedoms the other States should respect the sovereign rights and jurisdiction of the coastal state in its EEZ and comply with rules of international law as well as national laws and regulations pursuant to the provisions of UNCLOS and to other international instruments including environmental regulations particularly related to pollution (articles 210 and 211 para. 5).

Thus, the coastal state has the right to act and take measures against a vessel navigating within its jurisdictional waters, when there is evidence that a violation resulting or likely to result in environmental damage has taken place (article 220). Also, when the existing regulations are deemed inadequate for the prevention of pollution by vessels the coastal state has the right to secure a clearly defined area of its EEZ, according to its ecological and oceanographic conditions, to the necessity of protection of its resources and the particular character of the marine traffic in that area (article 211 para. 5, 6). In this 'protected' area the coastal state may apply additional or stricter laws and regulations following a consultation through the competent organization with any other concerned state for achieving effective protection of the environment and the natural resources. Thus, a legal basis for the creation of a MPA is provided within the jurisdictional waters limiting the provided freedoms of other states. This provision also allows for the creation of a 'derivative zone' or area within the 200 nautical miles limit intended for protection and conservation. The latter describes the way several Mediterranean states employed this rule extending their jurisdiction partially, instead of proclaiming an EEZ for various reasons. These zones or areas take the form of ecological protection zones or fisheries conservation zones whereas some states established exclusive fishing zones (Section 5.5).

Additionally to the provided abovementioned freedoms of third states in the EEZ, in articles 62, 69 and 70, the Convention recognizes preferential rights to certain categories of States on the living resources (fisheries) of the EEZ of the coastal State; namely rights on the surplus of the allowable catch, when the coastal State does not have the capacity to harvest it entirely. Thus, when nationals of other States utilize the living resources of the coastal State within its EEZ they have the obligation by virtue of article 62 para.4 to comply with all measures and rules adopted in consistence with the rules of international law by the coastal State, in order to preserve these resources. Further, when the coastal State exercises its sovereign rights over its living resources and while using the best available scientific knowledge, it shall take all necessary measures for securing the maintenance of these resources through effective conservation and management measures so as they will not become over exploited and in doing so it should also consider "the effects on species

associated with or dependent upon harvested species with a view to maintaining or restoring populations of such associated or dependent species above levels at which their reproduction may become seriously threatened" (article 61 para 4.). Therefore the coastal state has the obligation to include associated species in the conservation and management measures for its living resources, in the case of deep sea fisheries, the VMEs, and in that risk and impact assessments should be carried within this framework. Further on the state should take the necessary measures for their protection and conservation, including enforcement measures particularly against IUU fishing, closures, prohibition of the use of certain gears and the establishment of MPAs. In overall the Convention demands that coastal States may exercise their rights in compliance with the established environmental policies and in accordance with their duty to protect and preserve the marine environment (article 193).

4.3.3 The Continental Shelf

In certain cases the breadth of the EEZ and that of the Continental Shelf are identical and extend up to 200 nautical miles from the baselines as described above. In this case the seabed and subsoil of both zones coincide. Article 76 provides with the legal definition of the Continental Shelf. It is important to underline here that this definition differs significantly from the equivalent geomorphological concept. According to the Convention, the Continental Shelf includes the entire continental margin, hence shelf, slope and rise (article 76 para 3). Bearing in mind the complexity and peculiarity of the subject, it provides with more than one alternative for the definition and sets rules for the establishment of the outer edge of the margin. It defines that "the continental shelf of a coastal State comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, **or** to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance".

Therefore while the statute guarantees that all countries shall have a continental shelf of at least 200 nautical miles with the establishment of the criterion of distance, which is in the best interest of countries with limited geological continental shelf (e.g. Norway, Greece and other Mediterranean states), at the same time according to the geological criterion of the continental margin, it addresses in the most favorable manner countries with long prolongations of their land territory extending beyond 200 nautical miles and for the purpose of applying their sovereignty on the maximum possible underwater seabed and subsoil. Although the latter States should establish the outer limits of their continental margin so their continental shelf is delineated (article 76 para. 2). Paragraphs 4-7 of article 76 describe the particulars of the establishment of the outer limit, according to which the continental shelf cannot exceed 350 nautical miles from the baselines or 100 nautical miles from the 2500 m isobaths, with an exemption for the submarine ridges. In cases such as these, beyond the breadth of the 200 nautical miles of the EEZ, the overlying waters to the remaining delineated continental shelf on which a State has sovereign rights, form part of

the high seas (article 78 para. 1, 2). This applies also on the case of an inexistent EEZ for the remaining 188 nautical miles of the Continental Shelf, where the territorial sea is 12 nautical miles.

Although the institution of the Continental Shelf serves historically purposes of fossil fuel and mineral exploitation, the Convention in article 77 included as objects of States sovereign rights the natural resources as a whole. Therefore it is made clear that the coastal state exercises exclusive sovereign rights over its continental shelf for the purpose of exploring and exploiting its natural resources. These resources "consist of the mineral and other non-living resources of the seabed and subsoil together with **living organisms belonging to sedentary species**, that is to say, organisms which, at the **harvestable stage**, either are immobile on or under the seabed or are unable to move except in **constant physical contact** with the seabed or the subsoil". This definition includes sessile vulnerable organisms like cold water corals and sponges and their community formations as well as other sedentary species. These sovereign rights of the coastal state to its continental shelf recognized for the specific expressed purposes of exploration and exploitation are inherent to the state which means they exist *ipso facto* and *ab initio* (article 77 para 3.) These are also exclusive rights as it is recognized in articles 77 para.2 and 81 and any interference requires a prior authorization (except for rights of other states of article 79 para.2). Finally they bare a functional character as they are destined to serve specific purposes (article 77 para. 1) and consequently national legislation does not apply directly regarding issues related to these rights but requires *expressis verbis* extension. Otherwise a separate specialized statutory regulation is necessary for the exploration and exploitation of the continental shelf[69]. While exercising their sovereign rights over the non- living resources, including minerals, and the sedentary species, states have the obligation to act pursuant to their environmental policies and in accordance with their duty to protect and preserve the marine environment (articles 192,193). They should also take measures regarding pollution according to the provisions of the Convention (articles 194, 208, 210), other international environmental legislation and enforce all harmonized measures for the Continental Shelf and its uses.

4.3.4 The High Seas

The high seas are all the parts of the sea that are not included in the exclusive economic zone, in the territorial sea or in the internal waters of any state (jurisdiction by exclusion) and hence are reserved for common use (*res communis usus*). The Convention guarantees that the high seas are open to all, listing *inter alia* the freedom of fishing, navigation, to lay submarine cables and pipelines, and of scientific research (articles 86 onwards). Although, these freedoms are subjected to environmental regulations (article 87, para.1); notably in articles 116-119, states are obliged to take appropriate measures for the conservation and management of marine living resources during fishing activities and cooperate in order to achieve the highest possible efficiency. Specifically articles 118, 123 and 197 provide the basic pillar for the protection of Mediterranean offshore waters (resources and the

[69] Ε. Ρούκουνας Διεθνές Δίκαιο ΙΙ, Το κράτος και το έδαφος-Δίκαιο της θάλασσας [International Law, State and land- the Law of the Sea], 1982, Αθήνα: εκδόσεις Σάκκουλας p.195

environment) which comprise the bulk of the marine space particularly in the eastern part. Hence Mediterranean states have the duty to conserve and manage living resources and protect the environment through regional fisheries organizations, regional sea agreements aiming at environmental protection and management, and bilateral and multilateral associations, forming joint monitoring zones for fisheries management, sanctuaries and other protected maritime areas[70].

The provision of article 61 for the EEZ, regarding protection, conservation and restoration of populations of associated or dependent species, is also repeated for offshore fishing activities in article 119 para 1(b). All states exercising their freedoms in the high seas abide to the provisions for the protection of the marine environment from all sources of pollution and should take measures against dumping, pollution from vessels and through the atmosphere (articles 210, 211 para.2 and 212). Apart from the above obligations, and beyond the freedoms of the high seas, states according to article 221 have the **right** to intervene and "*take and enforce* measures *beyond the territorial sea* proportionate to the actual or threatened damage, to protect their coastline or related interests, including fishing, from pollution or threat of pollution following upon a maritime casualty or acts relating to such a casualty, which may reasonably be expected to result in major harmful consequences". With this provision states for the paramount purpose of environmental protection may act where normally they have no sovereignty or jurisdiction to enforce measures. Besides the above provision, it is only the flag states that have the right to intervene in case of an environmental infringement by a vessel, according to their obligations and rights set in the Convention and initiate proceedings regardless the particular conditions of the event and impose adequate penalties (article 217).

4.3.5 The Area *(not applicable in the case of the Mediterranean Sea)*[71]

The same obligations apply for vessels undertaking activities in the Area. The area (the 'Area') of the seabed and subsoil beyond the limits of national jurisdiction as well as its resources are the common heritage of mankind and exploration and exploitation of which shall be carried out for the benefit of the mankind as a whole[72]. Activities in the Area regarding exploration and exploitation of mineral marine resources are regulated by the Authority (International Seabed Authority-ISA) and no state can claim any sovereign rights. For the effective protection of the marine environment relating to activities in the Area, "the Authority shall adopt appropriate rules, regulations and procedures for *inter alia*: (a) the prevention, reduction and control of pollution and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment, particular attention being paid to the need for protection from harmful effects of such activities as drilling, dredging, excavation, disposal of waste, construction and

[70] https://www.unimc.it/maremap/it/temi/risorse-biologiche/studi-del-parlamento-europeo/JurisdictionalWatersintheMediterraneanandBlackSeas.pdf , p.101

[71] Although chapters 5.3.6 & 5.3.7 are not applicable in the case of the Mediterranean, it has been considered useful to cite within the present thesis, the respective environmental provisions for a more integrated approach enabling further thought and comparisons.

[72] UNGA Resolution 25/2749 (XXV)

operation or maintenance of installations, pipelines and other devices related to such activities; (b) the protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment" (article 145). The Convention sets here the perquisites and aims for a protective framework and the foundation for further enhancement of rules for the protection of deep sea habitats and species, addressing threats of pollution, physical damage, effects on the functionality of ecosystems and related ecosystem services.

4.3.6 Particularly on Pollution Prevention and Protection of the environment

Part XII of the Convention sets detailed rules for the protection of the marine environment from pollution from various sources and urges states to take individually or jointly measures and to adopt plans for that cause (articles 194, 197). Particular attention is given to pollution from LBS, pollution caused by dumping, vessel- source pollution, from seabed activities under the jurisdiction of the states and in the Area, and pollution from or through the atmosphere. Further, includes in its provisions an obligation for risk and impact assessments relating to activities which may have adverse effects to the marine environment (articles 204, 206). Article 194 para. 5, adds a valuable input in deep sea habitats protection, stating that the measures taken **regarding pollution "shall include those necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life"**. Deductively all measures included in legislation, EIAs, plans and cooperative actions should address these particular groups separately, according to their intrinsic, or not, properties and character.

Additionally, besides all measures analyzed above for the conservation and management of living resources, special provisions are made for the protection and preservation of marine mammals in the EEZ and the high seas in relevant articles 65 and 120 and notably states are further advised to cooperate in the direction of conservation, management and study of cetaceans especially through competent international organizations (UNEP, FAO, IWC).

4.3.7 THE ISA and APEIs (not *applicable in the case of the Mediterranean Sea)*

As already mentioned above, the International Seabed Authority is responsible to take all appropriate measures with respect to activities in the Area, as to ensure the effective protection of the marine environment from harmful effects of such activities relating to exploration and exploitation of mineral resources (drilling, dredging, excavation, disposal of waste). Pursuant to the provisions of UNCLOS and the 1994 Agreement relating to the implementation of Part IX of the Convention, the Authority has adopted a Strategic Plan for 2019-2023 and a High level Action Plan, amongst others for the promotion of harmonized approaches to the protection of the marine environment and its resources in the Area, for

the implementation of environmental impact assessments, public access to environmental information and application of the precautionary principle[73].

Considering that scientific advances regarding the deep sea environments and particularly related to mining are continuously evolving, and that there is still, much space for discoveries and knowledge to be gained, the ISA as early as 1998 in its Guidelines[74] included provisions for the assessment of impacts and for the preservation of intact biota in the mining area. The areas referred to as "impact reference zones" and "preservation reference zones", are areas set aside in order to assess the impacts of the activity having a reference site and to safeguard the conservation of representative and stable biota of the seabed[75]. These preservation zones are Areas of Particular Environmental Interest (APEIs)[76] and should have species composition comparable to that of the test mining areas, they should be outside of these areas, the areas influenced by the plume and be large enough, so as not to be affected by the natural variations of local environmental conditions.

The anticipated legal instrument under UNCLOS (BBNJ) will hopefully enforce in a more decisive and explicit manner further environmental conservation of the deep sea environments including those related to minerals, such as hydrothermal vents and seamounts, deep abyssal plains and their associated fauna, as well as the sustainable use of all marine resources.

The Mediterranean 'anomaly'

Seabed mining has a development potential in the Mediterranean basin as well, since minerals including polymetallic sulphides have been discovered in some locations. Although the Mediterranean Sea is no more than 400 nautical miles wide at any given point, which means that there is no 'Area' in the basin and the seabed and subsoil are assumed to be fully under the national jurisdiction of the coastal states. As seen above the sovereign rights over the continental shelf are inherent to the state, meaning that are recognized without the need of a law enacting them, unlike the EEZ. Therefore any activities related to seabed mining in the Mediterranean Sea of the average depth of 1500 m, can only be authorized by a coastal state regarding its own continental shelf. In the region the opposite or adjacent coastal states have delimited their continental shelf with mutual agreements using the median line where necessary, or apply the 200 nautical miles rule while some continental shelf limits have not been clearly defined yet.

As cited above, the water column regime is regulated differently, and EEZs need a declaration to exist. As some Mediterranean states including Greece, have not claimed EEZs, a large part of the marine space belongs to the high seas particularly in the eastern part and in fact over a seabed and subsoil completely under national sovereign rights. Several states

[73] https://www.isa.org.jm/files/files/documents/isba24_a10-en.pdf

[74] https://www.isa.org.jm/document/isba4c4-rev1

[75] ISA Guidelines ISBA/4/C/Rev.1, Annex4, section5.6

[76] https://www.isa.org.jm/files/documents/EN/Workshops/2010/Pres/SMITH.pdf

have declared archeological protection zones or fishing zones or ecological protection zones, as a partial claim for EEZ rights (A Del Vecchio Capotosti., 2008). It is understood that if all states were to exercise their right in claiming an EEZ, as an immediate result there will be no high seas in the basin, but all waters would fall under the national jurisdiction of the states. In that regard the Mediterranean is perceived as a transitional sea towards EEZ regime and consequently this demands a more coherent approach in maritime delimitation and establishment of clear jurisdiction zones in order to achieve effective sustainable use of the marine space[77].

Further discussing the issue of conservation relating to [deep] sea mining and other activities affecting the seabed and subsoil, there is no explicit and specified obligation of equal measure like the one set in article 145 for the prevention of damage to the flora and fauna of the marine environment relating to adverse effects of drilling, dredging, and excavation at the continental shelf. Relevant seabed and subsoil fauna and habitat protection by the Convention is guaranteed only by the provisions on the adverse effects of fisheries to associated and depended species, on pollution and by the general obligation for marine conservation while taking management measures for the exploitation of sedentary species and other resources of the continental shelf (articles 61, 119, 208).

The Convention adds a valuable input regarding conservation with the introduction of the obligation for transnational cooperation and further through competent regional and international organizations. This duty forms the primary component of the legal basis for setting MPAs in ABNJ, which is furthered by the SPA/BD Protocol. Although the Convention, besides the provisions for the living resources and pollution, and those for the highly migratory species and marine mammals, does not take into account neither a large number of species and habitats nor the ecological interactions between and among species and marine ecosystems; therefore, not covering thoroughly the concept of marine biodiversity. Regarding deep sea environments protection, the Convention does not mention directly deep sea species although these are particularly sensitive to damages and perturbations caused by fishing practices and seabed operations.

4.4 Policies and Legislation for the Mediterranean (UNEP/MAP)

4.4.1 The Mediterranean Strategy for Sustainable Development (MSSD)

Major policies, strategies and plans, have been formulated for the promotion and realization of the fundamental principles and objectives of the Barcelona Convention and its seven accompanying Protocols. “The Convention for the Protection of the marine Environment and Coastal Regions of the Mediterranean” (Barcelona Convention, 1995/2004) is the principal regional, legally binding, multilateral environmental agreement, set to protect the marine environment of the Mediterranean from pollution and protect and enhance its environment

[77] https://www.rac-spa.org/nfp13/documents/02_information_documents/wg_431_inf_9_note_on_legal_framework_for%20bbnj.pdf

in general with the prospect of sustainability (article 4)[78]. The MSSD 2016-2025[79], adopted at the COP 19, envisions "a prosperous and peaceful Mediterranean region in which people enjoy a high quality of life and where sustainable development takes place within the carrying capacity of healthy ecosystems".

This is achieved through common objectives, strong involvement of all stakeholders, cooperation, solidarity, equity and participatory governance. Implementation of actions relating to the sustainable development in marine and coastal areas, achieving good environmental status (GES), as well as enhancing climate change resilience in the Mediterranean supports amongst others the UN SDGs 13 (climate action) and 14 (life below water). The application of the ecosystem approach (EcAp) to the management of human activities which may affect the Mediterranean biodiversity is recognized as most essential for achieving and maintaining a GES. Therefore, the Mediterranean Action Plan (MAP) contracting parties have adopted the Ecosystem Approach Roadmap and set the following strategic goals; "a) To protect, allow recovery and, where practicable, restore the structure and function of marine and coastal ecosystems thus also protecting biodiversity, in order to achieve and maintain good ecological status and allow for their sustainable use. b) To reduce pollution in the marine and coastal environment so as to minimize impacts on and risks to human and/or ecosystem health and/or uses of the sea and the coasts. c) To prevent, reduce and manage the vulnerability of the sea and the coasts to risks induced by human activities and natural events. Also under the vision of the Roadmap[80], of *a "healthy Mediterranean with marine and coastal ecosystems that are productive and biologically diverse for the benefit of present and future generations" a* list of 11 ecological objectives defining GES were adopted, including biodiversity, non-indigenous species, harvest of commercially exploited fish and shellfish, marine food webs, sea floor integrity, hydrography, pollution, marine litter, all of them linked in many ways to the GES of various deep sea habitats[81].

Relative projects to the application of EcAp, MSSD and the achievement of GES are currently the MedProgram, the IMAP-MPA project, EcApMEDIII, the Marine Litter MEDII Project. Notably IMAP-MPA project contributes to the achievement of GES, also through an ecologically representative and efficiently managed and monitored network of MPAs. Under the Integrated Monitoring and Assessment Program (IMAP), the first Quality Status Report has been issued based on the Ecological Objectives and Common Indicators of IMAP, with a view to assess the status of the Mediterranean in achieving GES[82]. Monitoring[83] process, deep sea habitats included, is supported by the BC classification system and the respective Reference List of Habitat Types[84].

[78] https://wedocs.unep.org/bitstream/handle/20.500.11822/35759/77ig9_inf3_bc_eng.pdf
[79] https://www.unep.org/unepmap/news/news/mediterranean-strategy-sustainable-development-mssd-2016-2025
[80] https://wedocs.unep.org/bitstream/handle/20.500.11822/7287/08ig17_10_annex5_17_06_eng.pdf
[81] https://www.unep.org/unepmap/what-we-do/ecosystem-approach
[82] https://www.medqsr.org/
[83] https://www.rac-spa.org/nfp13/documents/02_information_documents/wg_431_inf_12_eng.pdf
[84] https://www.rac-spa.org/nfp13/documents/01_working_documents/wg_431_06_eng_24_04_2017.pdf

4.4.2 The SAPBIO Action Program and Dark habitats action plan under the SPA/BD Protocol (SPA/RAC)

According to article 10 of the Barcelona Convention, "The Contracting Parties shall, individually or jointly, take all appropriate measures to protect and preserve biological diversity, rare or fragile ecosystems, as well as species of wild fauna and flora which are rare, depleted, threatened or endangered and their habitats, in the area to which this Convention applies". All issues related to marine and coastal biological diversity are regulated on a Mediterranean basis by the respective Protocol to the Convention while Programs and Plans have been further put into action for promoting conservation, restoration of habitats and species and cooperation amongst Mediterranean states.

The Strategic Action Program for the Conservation of Biological Diversity in the Mediterranean Region (SAPBIO)[85] is a strategic framework for the implementation of the Protocol concerning Specially Protected Areas and Biological Diversity (SPA/BD) to the Barcelona Convention. The program addresses a variety of issues and recognizes topics such as inventorying, mapping, monitoring biodiversity, conservation of sites, habitats and species, development of research and improvement of knowledge, development of skills, information and participation, and increasing awareness as priority action fields. A new amended strategy the Post-2020 Strategic Action Program for the Conservation of Biological Diversity and the Sustainable Management of Natural Resources in the Mediterranean Region (Post-2020 SAPBIO), in alignment with the post 2020 Global Biodiversity Framework of the CBD, and the UN SDGs, has been prepared in order to strengthen and streamline the implementation of plans and strategies already adopted in all levels of governance.

For the purpose of addressing issues concerning certain species or groups of species and their protection and conservation, the parties to the Convention have adopted a series of specialized Action Plans.

Such a particular attention is given to dark marine habitats which are scattered all over the Mediterranean, from dark caves of the littoral zone to the most aphotic environments of the deep sea. The Action Plan for the conservation of habitats and species associated with seamounts, underwater caves and canyons, aphotic hard beds and chemosynthetic phenomena in the Mediterranean Sea (**Dark Habitats Action Plan**)[86] was adopted within the framework of the Barcelona Convention in 2013 and was further amended in 2021 while also adding Annex I, Status of Implementation of the Action Plan 2015-2020[87]. Main objectives of the Action Plan are, firstly, to conserve the integrity and functionality of the habitats by preserving the main ecosystem services (carbon sink, halieutic recruitment and production, biochemical cycles) and the interest in terms of biodiversity (specific diversity, genetics), secondly to encourage the natural restoration of degraded habitats (reduce anthropogenic impacts), and last to improve the knowledge about dark habitat populations (biology, spatial distribution). In order to make progress on the set axis of **conservation, restoration and knowledge**, the plan incorporates six categories of actions which are as

[85] https://www.rac-spa.org/sapbio

[86] https://www.rac-spa.org/sites/default/files/action_plans/dark_habitats_ap.pdf

[87] https://www.rac-spa.org/meetings/nfp15/nfp_docs/wg502_06_dark_habitats_ap_eng.pdf

follows: a. Improvement and acquisition of knowledge, in order to implement an optimal management strategy by gathering of all available data, creating databases and GIS platforms, assessing knowledge and quantifying pressures.; b. Adoption of management measures in order to regulate threatening human activity and ensure long term conservation of dark habitats through the enactment of respective legislation. Specifically the respective measures should focus on identifying endangered or threated species and granting them a legally protected status (article 11 of SPA/BD Protocol), as well as making compulsory the incorporation of the assessment of impacts of human activities to dark habitats in the respective legislation. Special consideration should be given to species of VMEs, which may act as a prime layer for enhanced protection and furtherance of management measures. Hence, another management measure in that respect is the establishment of legally set MPAs or the enlargement of existing ones in order to include sites of interest for dark habitats, based on the SPAMI criteria for the identification of sites of Mediterranean importance. Besides the above criteria, the MPAs system plan should be based on the ecosystem approach and take into consideration the particular patchy distribution of these dark habitats. In that way it is possible to ensure a coherent and efficient network of MPAs which can contribute to the conservation and sustainability of the various types of dark habitats. Additionally regarding the creation of MPAs in ABNJ, SPAMIs may be set partly or wholly in the high seas after a proposal submitted by the Party or Parties concerned (article 9 SPA/BD Protocol). The adoption of other management measures is deemed essential and complementary for dark habitats, especially in the rise of threats, such as these induced by climate change (temperature rise, acidification, changes in salinity and hydrology) and other pressures impacting their status, either these habitats are part of an already existing MPA or not.; c. The Action Plan calls upon states to craft national plans for the protection of the dark habitats. Basic elements of national plans are, identification of biodiversity features and areas, identification of threats and pressures and legislative measures related to EIAs for dark habitats. The integration of the national plans for dark habitats in procedures and structures and the cooperation with other national plans is a basis for initiating their conservation; d. Establishment of monitoring plans for dark habitats using recent technological advances in order to obtain the most accurate state of conservation. In that respect transboundary cooperation and communication relating to the monitoring plans and projects is necessary for an integrated action in the basin; e. Confrontation of peculiarities and difficulties intrinsically related to dark habitats on a transboundary scale for effectively addressing the issue through the exchange of expertise acquis; f. Dissemination of information for dark habitats to decision makers, stake holders and the general public through information and awareness programs in order to achieve long term conservation.

4.4.3 SPA/BD Protocol to the Barcelona Convention and SPAMIs

The above Action Plan follows the general principals, measures, rights and obligations set by the Specially Protected Areas and Biodiversity Protocol (SPA/BD Protocol)[88], the axis of which, is also the basic triad of conservation and restoration of species and habitats and

[88] https://www.rac-spa.org/sites/default/files/protocole_aspdb/protocol_eng.pdf

knowledge, through transnational cooperation. The precautionary approach is recognized at its preamble, as an imperative and basic principle lying in the core of the statute. The Protocol acts as well, as the main tool for implementing the UN Convention on Biological Diversity in the Mediterranean region.

It directly obliges states to grant a protected status to endangered or threatened species after an identification process (article 3 para. 1(b) & article 11 para. 2, 3, 5) as well as to those included in the Annex II to the Protocol ("List of Endangered or Threatened Species")[89] according to the respective obligation set in article 12 para.1-3, and further cooperate in order to achieve protection and conservation of the above species. In acting thus, they have the explicit obligation to forbid the destruction and damage of their habitats. The revised Annex II has included several species characteristic to deep sea environments and VMEs indicator taxa. Some of them are cold water coral species of Scleractinia, Anthipatharia and Alcyonacea, which form VMEs also in the Eastern Mediterranean (e.g. *Madrepora oculata, Leiopathes glaberrima, Isidella elongata)* and other components of VMEs and associated as well as related species, such as sharks and cetaceans (e.g. *Ziphius cavirostris*).

Additionally, conservation and regulatory measures are mandated in article 12 para.4, in order to safeguard a favorable state of conservation for species of Annex III ("List of Species whose Exploitation is Regulated")[90], amongst them the coral species *Corallium rubrum,* also found in dark and deep water habitats.

For monitoring (related are the IMAP and EU MSFD) the conservation status of certain species and habitats, article 15 calls for the compilation of national inventories of areas under the jurisdiction of each state and inventories of threatened or endangered species. The above areas should contain rare or fragile ecosystems, reservoirs of biodiversity and areas important for threatened or endangered species. For the compilation of national inventories states are aided by criteria and reference lists[91] provided by the Barcelona Convention. These reference lists shall be further used in the identification of SPAMIs.

In article 3, the Protocol addresses a direct call for the creation of SPAs in sites of natural and cultural value and further in article 4, sets the objectives of the protection. In that, elements of representativeness, regression trends, and importance for endangered and threated species, scientific, aesthetic, cultural and educational interest and value, are to be taken into consideration as criteria for the establishment of specially protected areas. SPAs though, cannot be established in the high seas. For furthering cooperation on the management and conservation of natural areas as well as in the protection of threated species and their habitats within and beyond areas of national jurisdiction, the parties have set up a "List of Specially Protected Areas of Mediterranean Importance", the SPAMI List (article 8 para.1) and have defined common criteria for the choice of SPAMIs (article 16 and Annex I, "Common Criteria of Protected Marine and Coastal Areas that could be included in the SPAMI List"). The basic objective is conservation of the natural heritage of the region

[89] https://www.rac-spa.org/sites/default/files/annex/annex_2_en_20182.pdf

[90] https://www.rac-spa.org/sites/default/files/annex/annex_3_en_2013.pdf

[91] https://www.rac-spa.org/nfp13/documents/01_working_documents/wg_431_06_eng_24_04_2017.pdf

through a core network of transboundary SPAMIs. Notably their geographical distribution should be representative of the region and its biodiversity (Annex I section A.)

It is important to underline here the multiple value of article 9 (complemented by section C of Annex I) for the protection of deep sea habitats particularly on the high seas and on the case of areas where the limits of sovereignty or jurisdiction have not yet been defined. And that, since no global instrument has been adopted yet on the conservation and sustainable use of marine biological diversity in ABNJ under the auspices the UN (UNCLOS). According to article 9, SPAMIs may be established within the areas of the sovereignty or jurisdiction of a state, but also based on the solid cooperation mandate set by the provisions of UNCLOS and the present Protocol, partly or wholly on the high seas. Hence, the neighboring states have the potential through cooperation to protect a wide range of biodiversity. Also it is to the concerned neighboring states to provide the necessary legal status to the future SPAMI situated partly or wholly on the high seas or in areas with a still unclear regime (Annex I section C). States should also adopt management and protection measures and respect and implement them according also to the provisions of UNCLOS and with full respect of the states' rights deriving from its provisions particularly on maritime space claims (article 2). Transboundary SPAMIs provide for effective protection on the high seas, since the interested states can form an agreement on the enforcement of legislation and management measures. Such case is the Pelagos Sanctuary (SPAMI/MPA) and it's Agreement, where contracting parties are responsible for their nationals in areas within their jurisdiction as well as in areas of the high seas and additionally have competence for vessels flying flags also of third states on the high seas (article 14 of the Agreement)[92].

It is also noteworthy that the MPA legal status of the candidate SPAMI is a perquisite for the incorporation in the List as the inclusion itself would not produce any legal effects and no legally binding framework regulating protection and management could exist; this is achieved for transboundary SPAMIs by the collective action of states to create the legal status for the MPA. In this way offshore SPAMIs are formal MPAs and can form a transboundary MPAs network.

In order for a site to be eligible for inclusion in the List, it should fulfill at least one of the general criteria set in article 8 para.2, which are: **site of importance for conserving the components of biological diversity, site which contains ecosystems specific to Mediterranean area or habitats of endangered species and sites of special interest at the aesthetic, cultural or educational levels**. Secondly, the site should possess **regional value**, meaning the Mediterranean interest of an area/site, which is further evaluated by the following criteria: **uniqueness (unique or rare ecosystems, rare or endemic species), natural representativeness (high representative ecological processes or community or habitat types or other natural characteristics), diversity (of species, communities, habitats, ecosystems), naturalness (low human induced disturbance and degradation), presence of habitats critical to endangered, threatened or endemic species and cultural representativeness (existence of environmentally sound traditional activities integrated with nature which support the well -being of local populations).** Further the area should

[92] https://www.sanctuaire-pelagos.org/en/resources/official-documents/version-francaise/texte-de-l-accord

present **a particular value for research** in the field of natural sciences, or for activities of environmental education, or awareness or contain outstanding natural features, landscapes or seascapes. Additionally a certain number of other characteristics and factors are considered crucial for the inclusion in the network, such as the existence of serious threats, public participation and existence of opportunities for sustainable development (Annex I, section B).

4.4.4 Other relevant Protocols to the Barcelona Convention[93]

The conservation of deep sea habitats is in many ways linked with all the other Protocols of the Convention. In particular the Protocol for the Prevention and Elimination of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft or Incineration at Sea (1995), the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities (1996), the Protocol for the Protection of the Mediterranean Sea against Pollution resulting from Exploration and Exploitation of the Continental Shelf, the Seabed and its Subsoil (1994), the Protocol concerning Cooperation in Preventing Pollution from Ships and in cases of Emergency combating Pollution of the Mediterranean Sea (2002) and the Protocol for the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of the Hazardous Wastes and their Disposals (1996). These Protocols address issues of multi origin pollution, which may pose various threats to deep sea habitats and cause serious alterations.

The Dumping Protocol

On the case of disposal at sea, the MEDPOL program provides with certain procedures for the evaluation of matters considered for disposal, which fall into the exemption category to the imposed general prohibition of dumping (article 4 para. 2). Dumping permits are licensed according to the provisions of article 6 with the perquisite of the "careful consideration" of the factors set in the Annex to the Protocol. Amongst these factors are the characteristics of the dumping site including bottom characteristics, and possible effects on marine life. In cases of deposing materials on the deep sea floor, EIAs for the consequences, specified to the deep sea habitats and VMEs should be deemed necessary and be incorporated in all relating sectors.

The LBS Protocol

The LBS Protocol addresses issues of persistent organic pollutants (POPs), inputs of mercury, crude oil and marine litter amongst others. In that respect legally binding regional plans have been developed under MEDPOL for the purpose of reducing and eliminating the release of substances that are toxic, persistent and liable to accumulate, as listed in the Annex I to the Protocol. Also on the case of issuing permits, the evaluation of characteristics of the site such as hydrographic, geological, topographical conditions, dispersion characteristics, like horizontal transport and vertical mixing, the capacity of the receiving environment and detrimental effects on critical habitats and endangered species is

[93] https://www.unep.org/unepmap/who-we-are/barcelona-convention-and-protocols

obligatory according to article 6 and Annex II to the LBS Protocol. Regarding pollution originating from the land, it is important to note that it may travel through the paths of submarine canyons to very deep places even reaching abyssal plains. Since the continental shelf of the eastern basin is particularly short, and therefore land is closer to deep environments, this geomorphologic peculiarity increases threats both in frequency and intensity.

The Offshore Protocol

Offshore oil exploration unleashes a set of pressures to the marine environment including the deep sea, as its many phases may result in multiple pollution regarding the type, substances and size of events. For that the relating Protocol is analytical in its provisions for substances, activities and respective obligations. The adoption of the precautionary principle by the statute is of great significance. Thus it sets the obligation of the competent authority to refuse authorization of a plan or activity which is "likely to cause significant adverse effects" (article 4 para.2). In the same direction article 5 provides for the obligation of an EIA process, while it further focuses on protected areas and makes a provision for special precautions to be taken in the case of SPAs (article 5, Annex IV, & article 21). Hence, in the case of a drilling plan being developed within a SPA, the special measures to be taken include *inter alia*, the preparation and evaluation of EIAs and elaboration of special provisions in such areas concerning installations, prohibition of any discharge and monitoring, as well as exchange of information. In that way, the Offshore Protocol recognizes the stricter tier of protection for these sites, including deep sea habitats in SPAs and SPAMIs and legally protected areas in general, according to their conservation objective. Further, similarly to other pollution related protocols, it addresses the matter of transboundary pollution, deriving from such activities which may also adversely affect transboundary SPAMIs also on the high seas.

The Prevention and Emergency Protocol

The Prevention and Emergency Protocol addresses both the issue of prevention of pollution from vessels through undertaken common actions by states and equally their cooperation in case of a pollution incident. It adopts the precautionary and polluter pays principles and the process of EIAs. It aims to protect the marine environment and the related interests of the coastal states, which may be maritime activities including fishing, marine biodiversity, the sustainable use of marine resources, tourism related activities and the deriving values of the seascapes and the environment in general (articles 1 &3). In particular states are obligated to cooperate in all cases including recovery operations in the event of release or loss onboard of hazardous and noxious substances in packaged form (article 6) and for that purpose they should adopt measures and plans, exchange information and cooperate with REMPEC, which is the competent coordination center in cases of pollution emergencies. An important obligation of states is that they should asses individually or cooperatively the **environmental risks of the recognized routes used in maritime traffic** and shall take appropriate measures aimed at reducing the risks of accidents or environmental consequences thereof and also in conformity with rules and standards set by IMO (article 15). Relevant and supportive is the work undertaken by IMO for the protection of 'areas of

significance' with measures relating to prevention and reduction of threats to the environment from shipping, including the establishment of PSSAs.

The Hazardous Waste Protocol

The Protocol regulating transboundary movement of hazardous wastes is essential in the purpose of management of substances included in Annex I, Annex II as well as of those recognized by domestic legislation, in an environmentally sound manner (article 3). States are obliged to take measures towards the elimination of transport of hazardous wastes and further urges to collectively ban such operations (article 5). Notably movement of such wastes through the territorial sea of a state requires prior authorization. Special attention is given on the issue of illegal trafficking and measures should be in accordance with the rules defined by the UN Basel Convention (article 9). The elimination of the transboundary movement of hazardous wastes, the prevention of illegal trafficking of such matters and the unauthorized disposal of these wastes is of the highest importance to deep water environments and particularly for the high seas. Illegally disposed hazardous wastes in the high seas have detrimental effects on the seabed fauna and habitats which are located on the continental shelf of Mediterranean states and thus this practice affects their sovereign rights. It also creates historical pollution sites when in the future these waters form part of the EEZ of a coastal state. The semi enclosed nature of the Mediterranean along with its high maritime traffic through relatively difficultly controlled high seas, make apparent that the implementation and enforcement of all pollution related treaties is of high significance for the protection of deep sea environments.

The ICZM Protocol

Alongside the SPA/BD Protocol, the Integrated Coastal Zone Management (ICZM) Protocol serves as a **key means** to the implementation of the UN CBD in the region and "enhances the benefits of biodiversity and ecosystem services to all" (strategic goal D). It serves as a system plan element along with EU Maritime Spatial Planning Directive, in order to efficiently protect biodiversity, through the rational planning of activities, implementing the ecosystem approach and promoting ecosystem based management (EBM). Additionally, the Protocol ordains the uptake of measures to protect the characteristics of certain ecosystems, including marine habitats and species of high conservational value, irrespective of their classification as PAs. This beneficial provision though, includes those located solely within the territorial sea of the state. Although the various and interdependent interactions between the different ecological regimes lead to the implementation of its provisions beyond strict limits of applicability. The necessity of EIAs and transboundary EIAs (articles 19 &29) prior to authorization of plans is underlined.

4.5 European Policies

4.5.1 The EU Biodiversity Strategy for 2030

The Sustainable Development Strategy adopted in 2001, recognizes as cornerstone of sustainability the effective protection of marine biodiversity and ecosystems, while the European Green Deal further prioritizes this necessity along with the imperative to reduce marine pollution, combat climate chance and ensure sustainability of fisheries. Therefore governance measures, including implementation of rules, monitoring and follow-up mechanisms should be enforced.

The European Biodiversity Strategy[94] is a long term strategy that aims to protect nature and reverse the degradation of ecosystems for the benefit of people, climate and the planet.
The EU recognizes that the main drivers of marine diversity loss are changes in sea uses, overexploitation, climate change, pollution and invasive alien species, while the current biodiversity crisis is intrinsically linked with the climate crisis. In that, nature is seen as a vital ally in the fight against climate change through its protection and restoration. The European strategy shares the CDB ambition and vision for 2050 where all ecosystems are restored, resilient and adequately protected. For achieving that, by 2030 Europe's biodiversity should be on the path of recovery.

The adopted scheme for 2030 horizon contributes to the solidification of this aim with various initiatives under its umbrella. In order to **protect and restore nature** and so to halt biodiversity loss, the strategy recognizes that the present regulations and measures have been inadequate and efforts must be intensified. As existing MPAs are not sufficient to safeguard biodiversity, **protection** must be wider and stricter through the improvement of MPAs network in means of larger, connected coherent areas of a trans-European network. Therefore certain objectives are set. Firstly the furtherance of protection is achieved by designating new protected areas or enlarging existing Natura2000 sites, secondly by defining areas of high diversity and value or potential as strictly protected areas and thirdly by enhancing connectivity.

In accordance to the targets set by CBD post 2020 framework, the coverage of marine protected areas should increase by 19%, reaching up to 30% cover of MPAs for European seas, while areas of very high biodiversity value or potential, most vulnerable to climate should be strictly protected and covering 10% of MPAs (or the 1/3 of MPAs) by 2030, comparing with the present 1% coverage. Member States are responsible to identify, map, monitor and protect the biological elements in their territory and thus, designate new MPAs, enlarge existing ones, or implement OECMs (other effective conservation measures), either as part of Natura 2000 network or under national protection schemes. For achieving connectivity conservation and in order to create a truly coherent and resilient MPA network it is essential to set up ecological corridors, as to prevent genetic isolation, allow migration and maintain healthy ecosystems, in accordance to the mandate of the ecosystem approach.

Besides protection through MPAs and networks, recovery of ecosystems is achieved through **restoration** and in that the EU aims to develop an ambitious Nature Restoration Plan and thus improve the health of existing and future protected areas. In order to restore nature through an effective plan, it is necessary to reduce pressures on habitats and species, adopt

[94] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1590574123338&uri=CELEX:52020DC0380

a sustainable use of all ecosystems, tackle pollution and address the issue of invasive alien species amongst others.

Once more the EU underlines that although necessary legislation for restoration exists, it is not fully implemented while no national restoration plans with legally binding objectives have been developed. Therefore a basic objective of the plan is **strengthening the legal framework of restoration**. Besides the targets of the existing legal instruments the strategy announces its intention to adopt **legally binding restoration targets** which are under evaluation and assessment in order to ameliorate the process of restoring degraded ecosystems. Particular attention in restoration is given to those ecosystems with the most potential to capture and store carbon and prevent and reduce the impact of natural disasters. Within the restoration plan, **member states should** (i) raise the level of implementation of the existing legislation and (ii) ensure no deterioration in the conservation status and trends of all protected habitats and species by 2030. Also member states should (iii) take all measures in order to ameliorate the conservation status of at least the 30% of species and habitats which are currently in a non- favorable state. Another objective of the restoration plan related to marine environments is the **restoration of their GES**, in order to minimize marine biodiversity loss which is exacerbated by global warming.

The establishment of strictly protected areas is an imperative as it supports the GES and the restoration of carbon rich ecosystems and important fish spawning and nursery areas. To achieve GES, it is necessary to implement sustainable management of marine resources, have zero tolerance for illegal practices, such as IUU fishing and apply fully the EU Common Fisheries Policy (CFP), Marine Strategy Framework Directive (MSFD) and Habitats Directive. In the same direction urges for EBM through spatial planning, as to reduce the adverse impacts of fisheries and extraction amongst others, particularly in sensitive species and seabed habitats. The strategy announces the adoption of certain measures through the respective regulations aiming at limiting the use of fishing gears most harmful to the seabed biodiversity and the transition to more selective and less damaging fishing techniques which will help to eliminate or reduce the by catch of non –target species to a level allowing their full recovery and not threatening their GES. This is particularly important for vulnerable species of high longevity and low growth rates like corals and sponges, as well as k-selected organisms. Further on, fisheries management measures should be implemented within MPAs according to the respective conservation objectives.

Another restoration objective is the **reduction of pollution** as this is a key driver of biodiversity loss through the release of chemicals, hazardous waste and plastics. In that respect the union has adopted the Zero pollution Action Plan for air, water and soil, the Chemicals Strategy and the Strategy for Plastics while also in this direction works in alliance with the MSFD. A restoration major objective is the elimination or minimization of introduction and establishment of **invasive alien species** in European waters, since they are a cause of serious pressure and inflict gravely on the conservation status of many marine species. For that the implementation of IAS Regulation is of the outmost importance and with the particular aim to manage effectively established IAS and decrease the number of Red List species they threaten by 50%.

In **reducing biodiversity loss** the strategy adopts also **initiatives for change**, aiming at the adoption of a new biodiversity governance framework so to secure **implementation** of existing environmental legislation and further focuses on its enforcement. Particularly for Habitats Directive, **enforcement** will focus on completing Natura 2000 network, on the effective management of the sites, on protection provisions for species and for species and habitats with declining trends, while when necessary the legislation will be reviewed and revised in order to achieve the maximum positive effect on biodiversity. Since an important tool in biodiversity conservation is **knowledge**, the strategy recognizes the necessity of improvement of knowledge, of investment in research, innovation and knowledge exchange.

The EU recognizing the importance of regulating biodiversity issues at a global scale, works towards the implementation of the post 2020 global Biodiversity Framework under the CBD, and supports according to its Global Ocean Governance Agenda, the conclusion of a legally binding global agreement for BBNJ which must set clear global procedures for the identification, designation and effective management of ecologically representative MPAs in the high seas.

Also for the protection of habitats beyond the national jurisdiction, the EU calls for the implementation of the precautionary approach, the use of best available science and implementation of environmental impact assessment before any exploitation commences according to the European Parliament Resolution on International ocean governance (2017/2055(INI))[95].

4.5.2 The Strategy for the Adriatic and Ionian Regions (EUSAIR)[96]

Under the EU Integrated Maritime Policy which aims to provide a coherent approach to maritime issues through cross cutting policies, regional sea basin strategies are developed in order to achieve sustainable development of each region through the application of the ecosystem approach. The transboundary impacts of maritime activities across the Mediterranean basin have created the need for interstate cooperation in promoting the 'blue economy' and in addressing matters such as pollution, biodiversity loss, overfishing and coastal degradation. In the eastern basin, the EU has implemented the Strategy for the Adriatic and Ionian Region (EUSAIR) which amongst others deals with environmental quality of the marine environment. The region is known to host rare or unique habitats of high diversity, which contribute to the cultural heritage of the region. Nonetheless, there is a lack of systematic habitat mapping covering these seas.

Common threats to its ecosystems are recognized to be overfishing, habitat degradation, and incidental catch of species, invasive alien species and illegal collection of sponges, corals and bivalves. Interestingly, the coverage of offshore MPAs beyond 12 nautical miles is the lowest in all EU regions. The strategy suggests cooperative actions between the participating EU and non EU member states, in order to increase marine knowledge, necessary for the

[95] https://www.europarl.europa.eu/doceo/document/TA-8-2018-0004_EN.html

[96] https://www.adriatic-ionian.eu/wp-content/uploads/2018/04/EUSAIR-ACTION-PLAN-17-June-2014.pdf

development of a MSP and the application of MSFD in the region, actions for enhancing the network of MPAs (new sites, SPAMIs, fisheries restricted areas, Natura 2000 sites), and for the exchange of best practices between management authorities as to achieve the highest connectivity in the region amongst its objectives.

4.5.3 The Common Fisheries Policy

Common Fisheries Policy is a fundamental policy of the Union which derives from the Common Agricultural Policy. The policy sets rules for managing fisheries and for conserving fish stocks, while it aims to ensure that fishing is environmentally, economically and socially sustainable. The Union according to its exclusive competence on fisheries management issues various Regulations which are legally binding to Member States. These rules apply consequently to community vessels.

Regulation 1967/2006[97] lays down the rules and management measures on the conservation, management and sustainable exploitation of living aquatic resources in the Mediterranean and notably forbids the use of certain damaging fishing gears in MPAs.

In order to protect the marine environment in unregulated offshore areas the Council issued Regulation (EC) 734/2008[98] on the protection of vulnerable marine ecosystems in the high seas from the adverse impacts of bottom fishing gears, acting in accordance with the guidance provided by the General Assembly of the UN in Resolution 61/105. According to article 6, the use of bottom fishing gears is prohibited in areas that have not undergone an appropriate scientific assessment as to the risks of SAIs of fishing activities to VMEs. Also in article 7 it is prescribed that in the case of an unforeseen encounter with a VME the fishing vessel is obligated to relocate its activities at least 5 nautical miles from the area of the encounter (move-on rule), while it should report the encounter to the competent authorities. Violations regarding VMEs, namely fishing in unassessed areas and in areas of VME encounter, as well as VMS operation violations, are regarded as serious infringements (article 10) similar to those included in the list of Regulation EC No1447/1999. Additionally states should identify possible areas of interest and impose closures for bottom fishing gears (article 8).

In order to reduce the adverse impacts of fisheries, extraction of marine resources and pollution on sensitive species and seabed habitats, it is indispensable to implement fully the relevant EU legislation. This includes particularly Habitats and MSF Directives along with Common Fisheries Policy legislation while also apply the EBM on human activities and materialize the MSP within a framework where the first and the last are the precautionary principle, the available scientific knowledge and EIAs.

[97] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02006R1967-20190814

[98] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32008R0734

4.6 Relevant EU Directives

4.6.1 The Marine Strategy Framework Directive 2008/56/EC (MSFD)[99]

The MSFD constitutes the basic pillar of the Integrated Maritime Policy of the Union aiming to achieve sustainable development within its maritime space by means of the blue economy. It sets the framework within which the member states should work to achieve a good environmental status (GES) of the marine environment by 2020 and further attain it. Each member state is responsible for the GES of the marine environment under its sovereignty or jurisdiction according to the provisions of UNCLOS that being the waters, seabed and subsoil of its territorial sea and the EEZ when it is applicable, as well as all inland waters that are not included in regulations and measures under the Water Framework Directive (article 3 para. 1). In order to achieve the GES, states should reduce the impacts of pressures on the natural marine resources and the marine environment through the application of an EBM, the promotion of the sustainable use of the seas and the conservation of the marine ecosystem.

Hence achieving a GES is feasible through effective biodiversity conservation. This requires protection, preservation, deterioration prevention and restoration when necessary of the marine environment as well as prevention and reduction of pollution with the aim to maintain the biodiversity and provide ecologically diverse and dynamic oceans and seas which are clean, healthy, productive and fully functional (article 1 and 3 para. 5). As MPAs are a well-recognized conservation tool, are consequently a key tool for the GES, and hence the obligation of member states to designate new areas including Natura 2000 sites is underlined and further elaborated in the proposed marine strategies (article 13).

The Mediterranean is divided into sub regions for the needs of the Directive and further into subdivisions; those include the Ionian and Central Mediterranean Seas and the Aegean-Levantine Sea in the eastern basin (article 4 para. 2(b)). GES is determined at the level of each subdivision on the basis of 11 qualitative descriptors which are almost all relevant to deep sea habitats and their GES (Annex I). Hence the status of the benthic ecosystems may be deduced from assessments regarding biodiversity, non-indigenous species, commercial fish and shellfish, food webs, seafloor integrity, hydrographical conditions, contaminants, marine litter and introduction of energy including underwater noise. Particularly for descriptor 1, the biodiversity of benthic ecosystems should be maintained in terms of quality and occurrence of habitats, as well as the distribution and abundance of species, and all the above should be in line with the prevailing physiographic, geographic and climatic conditions. We should note here through, that vulnerable habitats of certain cold water corals are already at the limit of their thermic tolerance in the eastern basin and thus a slight change in prevailing conditions particularly due to climate change, may prove catastrophic for existing communities[100].

[99] Directive 2008/56/EC of the European Parliament and of the Council on establishing a framework for community action in the field of marine environmental policy
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0056

[100] https://www.ipcc.ch/srocc/
https://www.ipcc.ch/site/assets/uploads/sites/3/2019/11/03_SROCC_SPM_FINAL.pdf, p.22

In that respect the MSFD provides a further link for the observation of climate induced changes, through the alteration of the prevailing conditions[101]. Sea floor integrity is the descriptor linked most directly to the health of these habitats and should be at a level that ensures that the structure and functions of the ecosystem are safeguarded and the benthic habitats are not adversely affected by alterations. This descriptor addresses amongst other detrimental activities, trawling the number one cause of physical destruction of vulnerable habitats, as discussed also above in the respective section.

According to the mandates of the Directive (articles 5, 8-13) member states developed marine strategies during the first cycle of implementation, which included an initial assessment of their marine waters, determination of a set of characteristics for their GES based on qualitative descriptors, establishment of environmental targets and indicators to guide the progress towards the GES, implementation of monitoring for ongoing assessment, and programs of measures aiming at the GES of ecosystems. These latter measures notably "shall include spatial protection measures, contributing to coherent and representative networks of MPAs, adequately covering the diversity of the constituent ecosystems, such as special areas of conservation pursuant to the Habitats Directive [...] and the marine protected areas as agreed by the Community or Member States concerned in the framework of international or regional agreements to which they are parties". Thus the Directive recognizes and urges states to use all available protection schemes including SPAMIs for the GES of all marine ecosystems (article 13 para. 4). During the process member states should cooperate as to achieve a coherent approach within the same sub region using when necessary all regional institutional structures (articles 5 para.2 and 6 para. 1), while they should also invite non -member states which have sovereignty or jurisdiction over waters of the same sub region, to participate using all relevant international forums. Particularly they should build upon existing programs and activities developed within regional sea conventions (article 6). Certain relevant actions aiming at the GES of the marine environments of the sub regions of the Mediterranean and of it as a whole have been developed by the respective structures of the Barcelona Convention as discussed above, where under its strategy for sustainable development, 11 similar ecological objectives have been adopted and a quality status report on the state of the Mediterranean marine environment was issued in 2017[102].

The Directive provides an indicative list of features in Annex III (table 1), to assist states in the initial assessment of essential features, characteristics, environmental status and pressures as well as in the continuous assessment process of the GES (article 8). According to the list, member states are guided to identify, map and include predominant seabed habitat types, habitat types recognized by Habitats Directive or other international conventions and habitats in areas which by virtue of their characteristics, location or strategic importance merit a particular reference. This may include areas subject to intense or specific pressures or areas which merit a specific protection regime. Among the many areas that may qualify for the latter category we cannot but mention the Hellenic Trench whose vital importance is already scientifically recognized but yet to receive a legal

[101] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0259&from=EN, p.10
[102] https://www.medqsr.org/

recognition of the protection imperative by means of governance measures. The partial knowledge and lack of long term monitoring data along with other uncertainties and have been retentive factors in including widely and thoroughly deep sea ecosystems in the process as it has been made evident by the data poor descriptors for the deep sea habitats and the relevant bio-ecological elements presented in states' first reports. That included, for example, deficient data and assessments on deep water fish stocks and highly migratory fish, hydrographical conditions, contaminants and marine litter in the deep seas.

The Directive though has recognized that such programs cannot be effectively developed unless they are devised on the basis of a sound knowledge of the state of the marine environment in a particular area and thus states should prepare a framework including marine research and monitoring operations for an informed policy making and with the synchronous aid of the Community; while explicitly has expressed that states should take into account the potential for marine research associated with deep water environments along this process. To further assist the application of the descriptors the Commission adopted Decision 2017/848[103] laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardized methods for monitoring and assessment. Also with Directive 2017/845[104], Annex III of the MSFD has been further revised providing a list of elements to better link ecosystem components with anthropogenic pressures, impacts and activities, cross-referencing to the Decision regarding benthic habitat types (under Part II).

Particularly regarding deep sea habitats, criteria to assess pressures have been identified in the Decision, which include the spatial extent and distribution of physical loss or disturbance of the natural seabed, the spatial extent of each habitat type adversely affected by physical disturbance, the spatial extent of each benthic habitat type adversely affected due to permanent alteration of hydrographical conditions, while states should further cooperate in establishing threshold values for these adverse effects (Part I of the Annex to the Decision). Part II of the Annex to the Decision, considers the descriptors linked to the relevant ecosystem elements and thus includes criteria relating to descriptors 1 and 6 for the monitoring and assessment of benthic habits and ecosystems. It also provides with a table (table 2) of benthic broad habitat types (to which the revised MSFD Annex III is referred) according to EUNIS classification system. This table includes the mesophotic and aphotic environments of the circa littoral, upper and lower bathyal and abyssal zones and habitats on rock and biogenic reef, coarse sediment, mixed sediment, sand and mud, while other habitat types may be included upon agreement of the concerned states.

4.6.2 The implementation of MSFD regarding the GES of deep sea habitats

According to article 20 of the MSFD, the EU Commission has the obligation to publish an evaluation report within two years of receiving all programs of measures. The report after

[103] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1495097018132&uri=CELEX:32017D0848
[104] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1495097018132&uri=CELEX:32017L0845

the conclusion of the first implementation cycle of the Directive was issued in 2020[105]. Certain trends and facts on benthic habitats[106] and by-catch were once more substantiated for the Mediterranean. In overall biodiversity loss is not halted and seabed habitats are under significant pressure from the cumulative impacts of demersal fishing and other activities. Like that, 43% of the self and slope area and 79% of the coastal seabed are considered to be physically disturbed mainly by bottom trawling activities.

Amongst other activities that result in physical loss of benthic habitats are solid waste disposal, renewable energy production and other activities more relevant to coastal water habitats. It is further underlined that the impaired status of benthic habitats will influence species depending directly or indirectly on them including the abundance of commercially exploited species. This is also relevant to the reduction in abundance of top predators such as sharks, while cetacean populations are either in not good status or the data is deficient for assessment. There is further a link between heavily trawled areas and the decrease in the abundance of sensitive species. Particularly 40% of elasmobranchs (sharks, rays, skates) in the basin show a declining trend. By-catch of benthic and pelagic vulnerable and threatened species (such as elasmobranchs) remains a severe issue and is regarded as a main pressure in need of an urgent response. Also additional action is needed for the protection and preservation of the benthic habitats in order to obtain a GES. The deficiency of the data determined the outcomes of assessments regarding various pressures as noted above and as a result a clear picture was not obtained for deep environments on food webs, hydrographic conditions, contaminants or marine litter, although the presence of the latter is confirmed everywhere. Although not necessarily assessed for the impacts on deep sea habitats, maritime traffic is considered the main source of continuous underwater noise. Shipping intensity is highest along main shipping corridors and near ports.

Most notably the Mediterranean has the largest area of very high traffic, the 27% of the total sea area, among all regional seas. Impulsive underwater noise originates from activities such as marine research, offshore energy platforms, or construction operations and is very present in the areas of Central Mediterranean and Levantine seas. Since anthropogenic noise is expected to increase urgent measures should be taken to minimize impacts on a wide range of components, including fish, sharks, cetaceans and other associated fauna of benthic ecosystems and particularly in areas characterized as sensitive or significant by a plethora of international and regional instruments. The report concludes that overfishing, IAS, litter and cumulative impacts on highly mobile species along with climate change are the most severe stressors of the Mediterranean marine environment.

The programs of measures adopted by member states were not found to be adequate enough and did not address all pressures. Additionally the spatial protection measures of the programs are unevenly distributed across regions and across depth zones. Though, only a coherent, representative and effective network of MPAs can address substantially biodiversity loss and degradation, can sequester carbon, contribute to climate change mitigation, increase ecosystem resilience and coastal protection, trap and dilute pollutants

[105] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0259&from=EN
[106] https://water.europa.eu/marine/state-of-europe-seas/state-of-biodiversity/benthic-habitats

and provide intangible invaluable services. Therefore and in accordance with the 2030 biodiversity strategy states are advised to focus on establishing ecologically significant protected sites and networks at sub regional scale, enlarge coverage or the minimum size of protected areas, raise the proportion of strictly protected area or no take zones, enhance enforcement and control activities and implement effective management plans with tailored measures and adequate resources. Thus protected areas for deep sea habitats are urgently needed particularly in the unrepresented eastern basin, where the cover in Ionian and Aegean ecoregions is extremely low and the status of deep sea habitats is proven to be rather uncertain[107]. Besides protected areas other specific programs and measures should be implemented to maintain the GES of deep sea habitats of seamounts, corals, seeps, canyons and others. Regional cooperation currently is very significant in deep water environments and the report calls for an increase in cooperative actions and coordination of marine strategies of the states sharing marine regions in order to achieve coherent and effective approaches in addressing and reducing pressures. That is particularly significant as the regional coherence of the EU monitoring programs was considered low in the Mediterranean indicating that states should work further on harmonizing their approaches through regional instruments as well as gather necessary information from all possible sources and define common threshold values for a standardized method of assessments. The institutional structures of the Barcelona Convention form an ideal platform for the effective implementation of the Directive while other instruments, policies and legislation have a synergistic effect to its objectives, such as the RFCM, the EU CFP and many other EU Directives.

The MSFD is a basic tool for ecosystem approach implementation in all sectors and helps also to the delivery of other key commitments of international instruments. Notably, those under the CBD regarding conservation of biodiversity by means of goals, targets and protected areas, under UNCLOS regarding the obligations of states for sustainable resources management, protection of the marine environment from various sources of pollution, addressed all in detail, and the obligation for transboundary cooperation. Also contributes to the achievement of the targets of SDG 14[108], pertaining to sustainable management, protected areas, and pollution from marine litter, acidification, and impacts from unsustainable fishing practices, scientific knowledge and the implementation of international law. Also the Directive is implicitly connected to the Paris Agreement and all climate legislation and policies, since the assessment of the GES is linked to relevant climate change impacts, such as temperature rise, oxygen depletion and acidification. In that, monitoring climate change impacts, exploring climate change mitigation and application of the ecosystem-based approach to climate change adaptation in the marine environment is also feasible through the MSFD. The Directive has a cross sectoral application within the EU sphere, supporting and being supported by other environmental Directives and in particular works in the same direction with EU Habitats Directive, which aims to secure a favorable conservation status of enlisted species and habitats.

[107] https://water.europa.eu/marine/state-of-europe-seas/state-of-biodiversity/benthic-habitats
[108] https://sdg-tracker.org/oceans

4.6.3 Council Directive 92/43/EEC on the Conservation of natural Habitats of Wild Fauna and Flora (Habitats Directive)[109]

The aim of the Directive

The Directive is regarded as the cornerstone of EU nature conservation policy and is a major legally binding tool for achieving goals and targets set in biodiversity strategies adopted on both EU and international level as seen above. Its fundamental purpose is to contribute to the preservation of the European biodiversity through the conservation of natural habitats and species within its territory (article 2 para. 1). Further elaborating on the protected features, their conservation status and specifying on the means, the Directive defines that natural habitat types and species of community interest (as included in Annexes I, II, IV, V) should be maintained or restored at a favorable conservation status through the application of measures, taking also into account the economic, social and cultural requirements as well as regional and local characteristics (article 1, article 2 para. 2 and 3).

This approach enshrines spatial planning and sustainable management principles, taking into account activities and uses, parallel to the necessity of biodiversity conservation, the latter being feasible particularly through the adoption of spatial conservation measures as provided in article 3. Thus the Directive focusing on natural habitat types of community interest listed in Annex I and on species of community interest listed in Annex II, calls for the creation of a coherent network of protected areas under the title Natura 2000 (article 3 para 1). The network comprises sites (SACs) that include habitat types of Annex I and habitats of species of Annex II, have a legal status and are managed through the application of measures aiming at the favorable conservation status of the included features (articles 3 and 6).

Eligibility of sites for Natura 2000

These special areas of conservation (SACs) should be designated by member states following a two stage procedure as defined in article 4 and Annex III. Initially sites undergo an assessment of their relative importance for each habitat type and species included, with the use of respective criteria, and national lists with the proposed sites of community importance (SCIs) are compiled. For assessing the value of a site for a certain habitat type the criteria are habitat representativeness, habitat extent, naturalness and value, while additional criteria may be used, such as rarity, priority habitat or species presence, obligation of member states for including sites in proportion of the presence of habitat types and species of the Annexes I and II in their territory and contribution to the coherence of the network[110]. The second stage includes assessment of the community importance of the proposed sites in national lists using as criteria the value of the site, the geographical situation, the total area of the site, the number of habitat types and species of the respective Annexes present and the ecological value for the biogeographic region or sub region.

[109] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01992L0043-20130701

[110] https://ec.europa.eu/environment/nature/natura2000/marine/docs/marine_guidelines.pdf, p.45

Respectively the criteria for assessing the value of a site for a species of Annex II are the proportion of member state population in the site (size and density), the degree of conservation of the features of the habitat which is important for the species and restoration possibilities, the degree of isolation, i.e the contribution of the given population to genetic diversity and its fragility in the site, and value, while the same additional criteria used for habitat types may be applied. The assessment of the community importance of the site at the second stage uses the same abovementioned criteria of stage two. Noteworthy sites of community importance for aquatic species of Annex II which range over wide areas are considered only when they include a clearly identifiable area representing the physical and biological factors essential to their life and reproduction (article 4 para. 1). To identify such critical habitat areas particularly for breeding and feeding, aggregation patterns are used including continuous or regular presence, good population density, high ratio of young to adults and other biological elements indicating social life of species[111].

Area of application

The Directive applies to the European territory of the member states (article 2) according to the provisions of UNCLOS[112]. Therefore member states have the duty to apply the provisions of the Directive where they have sovereign rights or jurisdiction, that being the inland waters, territorial sea, EEZ and continental self. In these areas the states may establish SACs as parts of the EU Natura network as well as apply all measures for the favorable conservation status of all enlisted features of the Directive. Seabed habitats and sedentary species of the continental shelf are included in the provisions of the Directive regardless of the regime of the overlying waters and it is only them that are protected under Habitats Directive when the water column is not part of the jurisdictional area of the state. In that case, the protection of habitats and species of the continental self should be complemented by actions taken by the competent fisheries organizations in order to create a compatibility pattern between the two different regimes in the scope of fulfilling the community duty. Particularly for the Mediterranean, the RFCM may establish a FRA in the same site of the feature of community interest. When necessary the Community promotes actions, through appropriate international fisheries conventions, in order to protect such features in areas beyond the sovereignty or jurisdiction of its member states[113].

[111] https://ec.europa.eu/environment/nature/natura2000/marine/docs/marine_guidelines.pdf, p.51

[112] There has been a lack of certainty on the territorial scope of Community environmental legislation particularly before Maastricht Treaty (1993) which incorporated further aspects of environmental policy, allowing interpretation of Regulations and Directives into a widened scope. The provisions of Habitats Directive would automatically apply to habitats and species within the territorial waters of member states, but remained uncertain whether the same features could be protected in offshore waters i.e the EEZ, fishing or ecological zones and even the continental shelf. The scope of application finally became wider after the 1999 UK High Court Decision which accepted Greenpeace's argumentation and ruled a judgment based on the purposive and teleological interpretation of the Habitats Directive: if the Directive aims to include protection of *L. pertusa* and cetaceans, it does not make sense for obvious reasons to restrict the scope of the Habitats Directive to territorial waters only. Consequently the court ruled that the Directive applies to the UK continental shelf and to the superjacent waters up to a limit of 200nm from the baseline from which the territorial sea is measured. http://assets.wwf.org.uk/downloads/darwin_mounds.pdf
https://www.jstor.org/stable/pdf/44251672.pdf?refreqid=excelsior%3A0eb03fcf319edc72f7f2ad8c3e864c32&ab_segments=&origin=

[113] https://ec.europa.eu/environment/nature/natura2000/marine/docs/marine_guidelines.pdf

The natural habitat types and species of the Annexes

Annex I of the Habitats Directive provides with a list of natural habitat types of community interest. These are "terrestrial and aquatic areas distinguished by geographic, abiotic and biotic features, entirely natural or semi-natural that are (i) in danger of disappearance in their natural range, or (ii) have a small natural range following their regression or by reason of their intrinsically restricted area, or (iii) they present outstanding examples of typical characteristics of one or more of the nine following biogeographical regions: Alpine, Atlantic, Black Sea, Boreal, Continental, Macaronesian, Mediterranean, Pannonian and Steppic". Notably habitat types with the above characteristics may be listed in Annex I (article 1 (b), (c)). Those natural habitat types in danger of disappearance and for the conservation of which the Community has particular responsibility in view of the proportion of their natural range which falls within the territory of member states are defined as priority natural habitat types (article 1(d)).

Annexes II, IV and V include or may include species of community interest; these are species "(i) endangered or (ii) vulnerable or (iii) rare with small populations at risk either scattered thinly over an extensive range or located within restricted geographical areas, or (iv) endemic and requiring particular attention by reason of the specific nature of their habitat and/or the potential impact of their exploitation on their habitat and/or the potential impact of their exploitation on their conservation status".

Respectively priority species are endangered species for the conservation of which the community has particular responsibility in view of the proportion of their natural range which falls within the territory of its member states. They are listed exclusively in Annex II therefore are species whose conservation requires the designation of special areas of conservation which include their habitat (article 1(g) (h)). The Directive provides with the definition of the favorable conservation status for both natural habitat types and species of community interest in article 1 (e) and (i), associating it with the natural range and habitat extent, structure and functionality as well as the presence of vital components or characteristic species. Particularly for the protection of priority habitat types and priority species and their habitats, the Commission may intervene according to article 5 for the purpose of including in the national list a site of community importance containing such features. Thus as ordained in article 3 para 2, each member state shall contribute to the creation of the ecological network in proportion to the representation within its territory of the natural habitat types and the habitat of the species of Annexes I and II and designate sites as special areas of conservation.

For these areas member states according to article 6, have the obligation to establish conservation and other measures, including the adoption of management plans and they shall also take all necessary measures to preserve in a favorable conservation status the habitat types and species. In order to secure that plans or projects will not have adverse effects on the integrity of the site, they should be subject to appropriate assessment of their implications for the site. In any case if the site contains priority habitat types or species plans and projects are allowed only under strictly exceptional circumstances. For species

listed in Annex IV, article 12[114] requires member states to establish a coherent legal framework including enforcement measures, as to ensure the strict protection in their natural range, prohibiting deliberate killing, capture and disturbance, deterioration of their breeding and resting places, while states should also establish a system to monitor their incidental catch, and take respective measures to ensure that it does not have a significant negative impact on them. Species included in Annex V should be managed sustainably and states should take all necessary measures to ensure that their conservation status is maintained as favorable, including enacting spatial measures and prohibitions (article 14). The presence though of a species of the Annexes IV or V does not form a basis for the designation of a site as special area of conservation. Its natural habitat, representing the physical and biological factors essential for its life and reproduction maybe indirectly protected under the "umbrella effect" of the network, meaning through the establishment of a site for another habitat type or species whose extent or range may coincide. All habitat types and species of community interest should be under surveillance by member states which have the further obligation to report to the Commission on the outcomes of all programs and measures regarding their conservation status (articles 11 and 17).

Deep sea habitats and species in the Directive

For the protection of deep sea habitats and species, the Directive has included two non - priority habitat types in Annex I and *C. rubrum* in Annex V, while deep diving cetaceans are included in Annex IV. The list of the habitat types has been compiled based on the CORINE classification system, which has been revised to correspond to the EUNIS classification (Montefalcone et al., 2021). Habitat type "Reefs" has been included in the list under Natura code 1170. According to the Interpretation Manual of the EU habitats [115] and the provided definition, this type includes features elevated from the sea floor, whose origin may be either biogenic or geogenic, ranging from the littoral to the sublittoral zones including deep sea areas as the bathyal zone. These features are compact substrata supporting biogenic concretions and a zonation of benthic communities. The concretions may be of algae or of animals including both reef and non-reef forming species.

The Manual, according to the respective classification system, sites characteristic species forming reefs and characteristic non reef forming species particularly for several biogeographic regions, not mentioning though the eastern Mediterranean ecoregion. Characteristic species such as polychaetes, molluscs, hydroids, bryozoans, sponges and gorgonians are indicated for the entire basin including the eastern region. Classification systems are structured based on hierarchical levels, one of them being the region which is indicative of habitat occurrences (EUNIS, Barcelona Convention classifications). In that way some habitat types may have their main occurrence in a given biogeographical region, although this does not exclude the possibility of finding the same habitat type in other biogeographic regions. In fact these often isolated occurrences have a major scientific and conservation value[116]. According to the provided characteristic species and communities,

[114] https://op.europa.eu/en/publication-detail/-/publication/a17dbc76-2b51-11ec-bd8e-01aa75ed71a1/language-en/format-PDF/source-search
[115] https://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf
[116] https://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf, p.7

habitat type 1170 may include maerl reefs and coralligenous communities as well as cold water coral reefs and aggregations on hard substrata of sponges, tubeworms, bivalves, gorgonians, black corals and other species, and in general all such biogenic habitats of all classification levels on hard substrata and raised features (e.g. facies of a species). According to the manual this "habitat complex" also includes a variety of subtidal topographic features such as hydrothermal vent habitats, sea mounts, vertical rock walls, horizontal ledges, overhangs, pinnacles, gullies, ridges, sloping or flat bed rock, broken rock and boulder and cobble fields. Although some of these geomorphologic features are associated with methane and sulphide emissions and with organisms besides invertebrates which are not mentioned under this typology, i.e certain microbial communities.

Additionally the presence of several geomorphologic features, such as seamounts and hydrothermal vents, is independent from the depth zone and the substrate typology which are both used in the bionomic approach for habitats classification and hence their classification cannot be based on these solely. In fact, it is these features which are able to hold a "complex of habitats" and geo forms that cannot be treated in isolation[117]. Given the recognized important role of these particular geomorphologies in the Mediterranean, their occurrence should be provided with the description of the habitat (UNEP/MAP, Dark Habitats Action Plan, 2015). This is feasible through the integration of geomorphology and bionomy and the application of the eco-typological approach for the classification of benthic marine ecosystems. Nevertheless the Barcelona Convention (BC) classification has not provided yet with a habitat type for these geomorphologies, when the EUNIS system has included a distinct typology for "raised features of the deep seabed".

Some habitats linked with seeping are included under habitat type 1180 "Submarine structures made by leaking gases", although only if the structures are formed by carbonate crusts. Hence these structures can be sandstone slabs, pavements, and pillars, formed by aggregation of carbonate cement resulting from microbial oxidation of gas emissions, mainly methane. These formations are interspersed with gas vents that intermittently release gas. The two distinct types described under the wider category, are "bubbling reefs" associated also with 1170 habitat, and carbonate structures within "pockmarks". Bubbling reef habitats support diverse benthic communities consisting of algae and/or according to zonation, invertebrate specialists of hard substrata. According to the manual a variety of sublittoral topographic features are included in this habitat such as overhangs, vertical pillars and stratified leaf-like structures with numerous caves, while the most characteristic animal species include sponges, corals, tubeworms, gastropods and echinoderms. For the second subtype, the included pockmarks are those depressions in soft sediment seabed areas, which are formed by leaking gases and contain substantial carbonate structures. Those not formed by gases or not including substantial carbonate structures are not listed under this category.

Characteristic species include invertebrate specialists of hard substrata such as hydroids, anthozoans, ophiuroids, and gastropods while in the adjacent soft sediment the characteristic species are mostly nematodes, tubeworms and crustaceans. Although the

[117] https://www.sciencedirect.com/science/article/pii/S0141113621001434?via%3Dihub, p.5

chemosynthetic communities of archaea and bacteria found in vents and seeps, which support the invertebrate diversity are again not mentioned while no specification is provided on whether the above include cold seeps and/or hot vents. The EUNIS classification system has included the relevant corresponding type "seeps and vents in sublittoral sediments", which is a wider and more inclusive type.

It is more than evident that not only marine habitats in general are underrepresented in the Directive[118] but further the diverse and complicated structures and features of the deep seabed are not provided with clear and detailed types reflecting their basic and distinct characteristics (Katsanevakis et al., 2020). Certain particularly unique habitats such as brine pools and DHABs cannot be classified in any of the abovementioned types, while for others such as hydrothermal vents, mud volcanoes and seamounts classification seems puzzling given the preconditions and description of habitat type 1180 and the variety and complexion of the distinct habitats that certain geomorphologies may harbor (e.g. brine pools in mud volcanoes, seeps and corals on seamounts). "Reefs" habitat type besides including certain geomorphologies which should be provided in any case with separate habitat typologies protects only hard substrata invertebrate habitats with reef and non -reef forming species present in these aggregations. Thus, while the same species may be found within a protected habitat of a "reef", it is unprotected when it is found in different aggregations in muddy or sandy bottoms.

This is evident as the only corresponding category of the BC classification provided by the manual for the bathyal zone is "Biocenosis of deep sea corals present in the Mediterranean bathyal" (V.3.1)[119] and not the biocenosis on bathyal muds which also includes facies of the critically endangered *I. elongata.* Consequently there is a gap in the protection of soft bottom habitats and aggregations or in mixed substrata (e.g. coral forests) which have been recognized as equally important to reefs as they create hotspots of biodiversity. Thus, new types of habitats should be described regarding invertebrates aggregations on soft substrata, as well as regarding hydrothermal vents, cold seeps, mud volcanoes, brine pools, seamounts, canyons, and escarpments, while some of those types may fill the priority habitats criteria bearing particularly in mind the conservation status of certain cnidarian species and their known spatial extent. Modifications on classifications and inclusion of new habitat types or subtypes and variations have been made in the past following the accession of new member states in order to include characteristic habitats of certain biogeographic regions, while also to adapt to technical and scientific progress[120].

Respectively recent scientific findings and increasing knowledge on deep sea habitats in the Mediterranean and particularly in the eastern basin should be taken equally into consideration and lead to the inclusion of new descriptions in the SACs network, as to provide representation for characteristic habitats of the ecoregion. This would not only restore some balance between terrestrial and marine sites, but it would further fill a large gap in the equal representation of eastern Mediterranean deep sea features in the network

[118] Due to historical reasons related to the territorial scope of the Directive as seen above

[119] https://www.rac-spa.org/sites/default/files/doc_fsd/lchm_en.pdf

[120] https://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf,p.7

and further enhance connectivity with other ecoregions. These concerns on representativeness, connectivity and conservation also include, besides deep sea benthic habitats and their constituents (e.g. taxa of corals, sponges, bryozoans) associated faunal species such as deep sea fish species (e.g. *Polyprion americanus*) and elasmobranchs[121] (e.g *Hexanchus griseus, Carcharodon carcharias, Prionace glauca*) which are not provided with any protection[122]. The inclusion in the Annexes of more deep sea species is deemed essential[123]. Further, cetacean species are strongly connected to the deep sea habitats and are included in Annex IV of the Directive.

Deep sea ecosystems play a crucial role in their ecology and according to scientific findings cetaceans occur in self and slope areas, in submarine canyons and seamounts as well as in the open seas. Sperm whales (*Physeter macrocephalus*) occur around the self –edge preferably in high productivity areas with nutrients upwelling, indicating that these are important feeding areas, while others such as Cuvier's beaked whales (*Ziphius cavirostris*) and Fin whales (*Balaenoptera physalus*) prefer deeper waters off the continental shelf and high productivity areas[124] . These are areas essential for their life and reproduction and being as such, several sites have been identified in the eastern Mediterranean as important marine mammal areas or cetacean critical habitats[125]. These species and their critical habitats are under serious pressures resulting in habitat loss and degradation, as a consequence of human activities, pollution and climate change. The species are also impacted by overexploitation of food resources and consequent food depletion, severely affected by the intense shipping resulting in collisions and underwater noise, as well as threatened from by catch and pollution. Spatial conservation measures and specifically MPAs have been recognized as the key means to achieve biodiversity conservation and maintain GES, while other measures may be beneficial (article 2 para. 2). Habitats Directive states that the ecological network that it sets "shall enable [….] species' habitats concerned to be maintained or where appropriate restored at a favorable conservation status in their natural range", recognizing thus, that in order to secure a favorable conservation status for certain species, spatial measures should be set for the maintenance and restoration at a favorable conservation status of their habitats (article 3 para.1).

At this point the conservation status of these deep diving cetaceans according to the IUCN Red List[126] should be mentioned. Sperm whale is reported as endangered with a population up to 250 individuals, whereas fin whale as vulnerable and Cuvier's beaked whale as data deficient for the Mediterranean (but it is considered in a rather vulnerable state). The three above species are also listed as strictly protected in Appendix II of the Bern Convention[127],

[121] https://www.cbd.int/doc/meetings/mar/ebsaws-2014-03/other/ebsaws-2014-03-submission-slovenia-en.pdf, p.17. *C. carcharias* is included in Annex II of SPA/RAC Protocol and Appendix II of the Bern Convention

[122] https://www.rac-spa.org/sites/default/files/symposium/proc_1_dark_habitats_final.pdf, p.67

[123] Also in the Bern Convention as Appendix III includes *Antipathes* sp. and *Corallium rubrum*

[124] https://uicnmed.org/docs/mediterraneandeepsea.pdf p.54

[125] https://www.marinemammalhabitat.org/portfolio-item/ionian-archipelago
https://marinemammalhabitat.org/immas/imma-eatlas
http://accobams.org/conservations-action/protected-areas
http://www.pelagosinstitute.gr/gr/prostasia/prostatevomenes_perioches.html

[126] Setting conservation priorities includes the assessment of extinction risk. These species are also included in Annex II SPA/BD Protocol

[127] https://www.coe.int/en/web/conventions/full-list?module=treaty-detail&treatynum=104

which furthermore in article 4 para.1 calls for states to take all appropriate and necessary legislative and administrative measures to ensure the conservation of the habitats of those species as well as the conservation of endangered natural habitats. Hence Bern Convention has already recognized the necessity to conserve those species' habitats with a variety of measures connecting their conservation with that of their habitat. The spatial protection obligation is intensified in paragraph 3 of the article according to which states should give special attention to the protection of areas that are of importance for migratory species (areas important for life stages and feeding) and are appropriately situated in relation to migration routes; in that they are bound to cooperate when species range extends into their territory (articles 4 and 10).

The need to create networks of MPAs that include sites of high representativeness (spatial extent and number of habitat types present/species and habitats persistence), the strong connection between these species and deep sea benthic habitats (canyons, slopes, seamounts, vents, cold water coral reefs with particular regard to their ecological and functional value), the consequent correlation and partial or complete overlapping of sites of deep sea habitat types and of those of cetaceans habitats, as well as the 3-dimentional space necessary for the protection of the latter species (multi realm species), (meaning the bathymetric range from the sea bottom to the slopes and back to the open waters and the sea surface) may lead to the following suggestions.

At first, there are reasons enough indicating the need to amend the Annexes of species, according to contemporary data and scientific findings, particularly including deep sea species which are absent from the list (e.g. cold water corals, sponges) and upgrading to Annex II cetacean species which are emblematic features of the region. In that way their presence will justify the inclusion of marine areas into the Natura network even if these areas are limited to the jurisdictional waters of member states. The combination of designated special areas of conservation for benthic deep sea habitats and habitats of deep diving cetaceans shall create protected areas of increased connectivity and effectiveness covering dimensions and functions; they may be interdependent and shall complement each other in many ways according to conservation objectives and measures and most likely adding to the preservation of the functionality of the ecosystem particularly if we consider their ecological roles. Notwithstanding their spatial extent being limited to EU waters these areas may form a core protection element providing representativeness and higher connectivity within ecoregions[128],[129]. Additionally they might prove as a very important contribution in deep sea marine protected areas cover according also to global and European biodiversity conservations targets. Thus, the network would be more representative regarding ecoregions, depth zones and species, ensuring adequate coverage of biodiversity.

Only a decisive contribution in MPA cover will help significantly to halt biodiversity loss, and these areas can also be seen as the basis for furthering protection in ABNJ through SPAMIs or FRAs. In conclusion, listing additional marine habitat types and adapting the Annexes to

[128] Based on species distances between protected areas https://ec.europa.eu/jrc/en/news/new-indicator-connectivity-protected-areas

[129] This also contributes to the wider Emerald Network of the Bern Convention.

strengthen them with regard to marine habitats and species and their conservation status, would also provide the necessary legal basis for inciting member states into extending their marine network[130]. The selection process of sites should be conducted according to systematic conservation planning to ensure the desired qualities of the network and ideally within the framework of maritime spatial planning.

4.6.4 Directive 2014/89/EU on establishing a framework for Maritime Spatial Planning (MSP Directive)[131]

The basic aim of the Directive is the implementation by member states of a maritime spatial planning with the adoption of respective plans regulating uses in their jurisdictional waters including the seabed and the subsoil (article 2 para. 1 and article 3 point (4)). Maritime spatial planning is a cross-cutting policy tool of the Integrated Maritime Policy addressing the rapidly increasing demand for maritime space, aiming at the sustainable development and sustainable sea uses through a coordinated, integrated and transboundary ecosystem based approach. Within an integrated spatial planning the sea is regarded as a consistent whole and the issues arising from its uses are interrelated and demand uniform approach.

At the basis of sustainable spatial planning regarding already existing activities and the allocation of new maritime uses, lay the precautionary and ecosystem approaches which aim to safeguard that the GES and the capacity of the ecosystem to respond to changes are not compromised. The Directive sets the framework and the basic aspects to be taken into consideration by member states when establishing their MSP (article 5 para.3 and article 6). In doing so they shall have due regard to the particularities of the marine region (article 4 para.5), they shall take into account land –sea interactions (article 4 para.2) contributing as such amongst others to the functionality and connectivity of protected areas, they shall consider economic, social and environmental aspects (article 5 para.1), and also the interactions, pressures and impacts of existing or intended activities (article 4 para.5); whilst taking into account their cumulative effects and climate change are of the outmost importance for marine conservation.

Maritime spatial plans “shall aim to contribute to the sustainable development of energy sectors at sea, of maritime transport and of the fisheries and aquaculture and to the preservation, protection and improvement of the environment including resilience to climate change impacts” (article 5 para. 2). It is evident that while MSP considers all activities operating in marine space, giving priority to the future allocation of maritime uses which promote blue growth and do not affect ocean health when are sustainably managed, would be preferred and most beneficial (Katsanevakis et al,. 2020). Successful prioritization of areas for protection and restoration and blue growth uses within the ecosystem approach is essential to achieve a true balance in seas and oceans. In that regard MSP can be an effective framework for the establishment of networks of MPAs. Being part of the MSP

[130] https://ec.europa.eu/environment/nature/natura2000/marine/docs/marine_guidelines.pdf , p.14
[131] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0089
Directive 2014/89/EU of the European Parliament and of the Council establishing a framework for Maritime Spatial Planning

process of the allocation of marine uses, marine spatial prioritization of protected areas can be effective and contribute to a coherent and representative network of MPAs when conducted under a systematic conservation planning.

The system plan can be regarded as a support tool that provides the framework for selection and management of protected areas ensuring connectivity, adequacy, representativeness and efficiency of MPA networks (Katsanevakis et al., 2020). It incorporates criteria and stages for selection and all aspects and objectives to be considered such as for instance pressures from human activities, related costs and climate change within a hierarchical structure while the use of decision support tools (e.g. Marxan) has been proven helpful. As the sea is regarded as a consistent whole and its uses are addressed uniformly, MSP is truly effective through the necessary transboundary cooperation of states. This is a key element of marine conservation as it provides with the necessary consistency in planning and management of shared marine regions. Member states bordering marine waters shall cooperate through Regional Sea Conventions, in the case of the Mediterranean through the Barcelona Convention while using as platforms regional basin strategies, such as the Strategy for the Adriatic and Ionian macro-region, may prove even more directly effective (article 11). Member states shall also cooperate in the same context with third states sharing marine waters using all international forums and regional institutional cooperation (article 12). Although transboundary cooperation of neighboring states regarding vital space and resources may hide serious difficulties, disputes and even conflicts impeding any design and planning (Katsanevakis et al., 2015). MSP is conducted with the use of best available data, which includes in particular marine physical data and data collected in accordance with EU legislation pertinent to the themes of the planning and the utilization of all tools, platforms, and instruments provided by the EU policies and programs (articles 10 and 8).

For the conservation of deep sea habitats effective MSP is based firstly on informed benthic cartography. Habitat mapping and classification systems are important to quantify the extent of key habitats, identify their status and trends for developing effective restoration initiatives and predict their spatial distribution through habitat suitability modelling (Montefalcone et al., 2021). The relevant EU platform providing multi- layer open access data including on benthic habitats, supporting effective MSP and systematic conservation planning is EMODNET (European Marine Observation and Data Network)[132].

Additionally geophysical and oceanographic data, hydrographic conditions and relevant mapping support the process of spatial prioritization of protected areas and particularly those acting as refugia, accounting for the rapidly increasing impacts of climate change. These are areas where climate change impacts are minimal such as upwelling areas of cooler waters. Subsequently networks of MPAs to be truly effective need to consider the rapid and cumulative impacts of climate change including climate change refugia as areas of highest priority; while it has further been supported that these areas should be regarded as a criterion for the identification of EBSAS (Katsanevakis et al., 2020). Within the eastern Mediterranean ecoregion several areas that host certain hydrographic and geomorphologic features may qualify as refugia, if we consider the upwelling areas and great depths of the

[132] https://emodnet.ec.europa.eu/en/seabed-habitats

region (e.g. Hellenic Trench, Rhodes Gyre). Hence prioritizing certain deep water habitats and including them in MPA networks makes marine conservation more efficient regarding climate change, an aspect that should not be ignored in the MSP process.

The Directive aims to contribute to the sustainable development of maritime activities that as seen above pose tremendous pressures and can affect the state of deep water ecosystems. These are particularly the energy sector, maritime transport and fisheries and within MSP their selection, prioritization and allocation is connected to the prospect of sustainability.

Sustainability here includes both a qualitative and a spatial element and consequently the compatibility and hierarchy of activities should be examined regarding climate change, resources management, conservation and the general state of the environment. Thus activities should be scanned on the basis of sustainability regarding climate change as to the type of activities for selection, for example prioritization of renewables instead of hydrocarbons; on the basis of sustainability regarding exploitation of non -renewable resources and of relatively renewable when not collapsed by overexploitation, such as those included in the fisheries sector (e.g. mining or deep sea fisheries); and on the basis of sustainability regarding marine conservation and ocean health, prioritizing MPAs establishment instead of fisheries or mining (areas reserved for conservation). In an era where climate change actions are becoming increasingly intense, MSP should be regarded as the ultimate tool to protect biodiversity and particularly deep sea habitats that are located in areas prospected for energy production.

Activities supporting green energy such as renewables and seabed mining for minerals necessary for electric power mobility, are often planned to develop in areas of great depths (e.g. offshore wind energy) and can seriously affect the functions of deep sea ecosystems. Proper allocation should ensure first the conservation of the significant areas with the establishment of networks of protected sites; hence giving priority to conservation over green energy activities, whilst it should be further guaranteed that such projects will not adversely impact biodiversity under the urgency of climate crisis and the demand for clear energy[133], not forgetting that certain ecosystems including of the deep sea are important allies in climate change mitigation (e.g. carbon sequestration, biochemical cycles). Impact assessment process is absolutely necessary before the establishment of activities aiming at climate change restraint and mitigation, as to predict effects on biodiversity and the deep sea habitats, taking particularly into consideration the cumulative pressures and the detrimental impacts of climate change on their status. Participation of the public and of stakeholders also in the process of MSP (article 9) is crucial in order to gather important information, achieve maximum compliance and long term conservation.

[133] EU Directive 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable resources https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

4.6.5 SEA and EIA Directives[134]

SEA Directive

SEA Directive transposes the Protocol on Strategic Environmental Assessment to the UNECE Convention on Environmental Impact Assessment in a transboundary context[135]. Its ulterior aim is, similarly to other environmental union legislation the promotion of sustainable development; in that it sets as tool, the assessment of environmental impacts of certain plans and programs, in order to achieve a high level of environmental protection (article 1). The assessment procedure ensures that significant negative effects will be taken promptly into account and will be decisive on the authorization and its preconditions (article 4 para 1).

The plans and programs as described in articles 2(a) and 3 para. 1, are those prepared by a public authority, setting the framework for future development consent of projects (which may require an EIA according to the respective provisions) and additionally, are likely to have significant environmental effects. Public plans and programs shall undergo a screening procedure with the use of criteria provided in Annex II on their possible significant environmental effects and then, if found to have such effects, they shall further be subject to an assessment process (article 3 para. 4 and 5). The assessment process is determined as mandatory by the Directive for public plans on specific sectors, including energy and fisheries which largely affect deep sea habitats, as well as in the case of plans and programs within protected areas of Natura 2000 network, pursuantly to articles 6 and 7 of Habitats Directive (article 3 para 2(a) and (b)).

The environmental report of the assessment shall identify, describe and evaluate "the likely significant effects on the environment" of the plan or program and "reasonable alternatives taking into account the objectives and the geographical scope of the plan or program" (article 5 para. 1). It shall include all reasonably necessary information and compulsorily the information of Annex I taking into account current knowledge and assessment methods, while it should be of a sufficient quality as to meet the requirements of the Directive (articles 5 para. 2 and 12 para.2). The requirements of Annex I include amongst others information on the evolution of related aspects of the state of the environment, the environmental characteristics of the areas likely to be affected, issues regarding conservation objectives in and outside protected areas, the likely significant effects on several aspects of the environment including biodiversity and the climate, suggested measures to prevent, offset and reduce those effects as well as monitoring measures.

[134] Directive 2001/42/EC of the European Parliament and of the Council on the assessment of the effects of certain plans and programs to the environment, Directive 2011/92/EU of the European Parliament and of the Council on the assessment of the effects of certain public and private projects on the environment, Directive 2014/52/EU of the European Parliament and of the Council amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment
https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32001L0042
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0052
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011L0092

[135] Espoo Convention 1991/1997 and Kyiv Protocol 2003/2010
https://unece.org/environment-policy/environmental-assessment

Monitoring the effects is initiated after a plan has been approved and adopted in order to, amongst others, identify at an early stage unforeseen adverse effects and to be able to undertake appropriate remedial action (article 10). Most notably the effects that should be identified and analyzed include also secondary, cumulative, synergistic, short, medium and long term, permanent and temporary, positive and negative effects.

The Directive includes public participation and consultation (article 6) as well as transboundary consultation when a plan or program is likely to have significant effects on the environment of another member state (article 7), while the systems operating within the EU for EIAs should make sure that adequate transboundary consultation has been conducted.

Upon taking a decision on the plan or project the respective environmental authorities should also issue a statement summarizing how the environmental considerations have been integrated into the plan or program, how the environmental report and the consultation results have been taken into account and the reason for choosing the plan or program in the light of other reasonable alternatives (article 9 (b)).

The assessment of cumulative effects regarding deep water ecosystems is particularly important not only in general terms in view of sustainability and true preservation of the components of the environment, but also due to the uncertainty and lack of complete knowledge on their characteristics and functions. As such, the probable lack of scientific certainty and evidence on the causal relevance between pressures and impacts for a certain component deriving from a certain activity is remediated and further underpinned by the precautionary approach instead of weakening the environmental protection. Thus assessments under a cumulative effects and a "species –by species" approach is indispensable while assessment processes should be integrated within a wider framework of risk reduction and management[136].

EIA Directive

Respectively the EIA Directive applies to a wide range of defined public and private projects which are developed within the framework of the above plans and programs and are likely to have significant environmental effects (in Annexes I and II of EIA Directive). Member states shall ensure that projects likely to have such effects are made subject to consent through an EIA process and in that they should establish thresholds and criteria to be used in screening procedures.

For projects of Annex I the EIA is mandatory, while those of Annex II require case by case examination or screening based on thresholds set by member states, while the criteria of Annex III should be taken into account (article 4). These criteria include *inter alia* the possible cumulation with other projects, the environmental sensitivity of geographical areas likely to be affected, the regenerative capacity of natural resources, the type and characteristics of potential impacts including cumulative and transboundary effects. Projects of Annex I include amongst others the installation of certain pipelines for gas and oil and

[136]The Sendai Framework for Disaster Risk Reduction
https://www.undrr.org/implementing-sendai-framework/what-sendai-framework

extraction projects (hydrocarbons) over certain thresholds, while projects in need of evaluation over their possible significant effects include extraction of minerals by dredging, deep drilling, and installations for the production of energy.

The EIA report by the developer shall identify, describe and assess the direct and indirect effects on several factors including biodiversity, protected areas and species of EU legislation, water and climate and the effects on the interactions of all considered aspects accounting for the functionality and the services of the ecosystem (article 3 para. 1). The Directive provides for the participation and information of the public by the developer and the competent authorities and the necessary transboundary consultation throughout the process (articles 6, 7 and 9). The participation of the public is particularly highlighted and deemed essential by the Directive in the decision making process for activities with possible significant negative environmental effects, pursuantly to the Aarhus Convention[137] which aims to protect the right to live in an environment which is adequate for personal health and well -being.

4.7 Other relevant legislation

Also, several other statutes are connected with the conservation of deep sea habitats and species, mostly conventions on the protection of biodiversity and on pollution. These are important IMO Conventions, namely the International Convention for the Prevention of Pollution from Ships (MARPOL)[138], which recognizes the Mediterranean Sea as a 'special area'[139], in which special mandatory methods are applied for the prevention of pollution according to its Annexes[140]; the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention)[141], which provides for the prohibition of dumping most notably in cases where "there is no conclusive evidence to prove a causal relation between inputs and their effects"; and the International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC)[142], providing for the cooperation of states in cases pollution or threat of pollution, and for the obligation of ships and offshore units to report incidents of pollution deriving from oil, hazardous and noxious substances. Other Conventions related to pollution are, the UN Basel Convention on the control of transboundary movement of hazardous wastes and their disposal[143], aiming at the reduction of shipping and dumping of dangerous wastes across borders and the environmentally sound manner of their disposal; and the UN Stockholm Convention on

[137] https://unece.org/environment-4

[138] http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention

[139] https://www.imo.org/en/OurWork/Environment/Pages/Special-Areas-Marpol.aspx

[140] Annex I: Regulations for the Prevention of Pollution by Oil, Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk, Annex III: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form, Annex IV: Prevention of Pollution by Sewage from Ships, Annex V: Prevention of Pollution by Garbage from Ships and Annex VI: Prevention of Air Pollution from Ships.

[141] http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/Convention-on-the-Prevention-of-Marine-Pollution-by-Dumping-of-Wastes-and-Other-Matter.aspx & its London Protocol.

[142] http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-on-Oil-Pollution-Preparedness,-Response-and-Co-operation-(OPRC).aspx & its Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances (OPRC-HNS Protocol).

[143] http://www.basel.int/

persistent organic pollutants[144], which addresses particularly industrial chemicals, toxic pesticides and by-products that remain intact in the environment for long periods, become widely distributed geographically and tend to accumulate in living organisms.

Relevant biodiversity conservation legislation includes the Convention on the conservation of European wildlife and natural habitats (Bern Convention) of the Council of Europe, which has been partly examined above in relation with Habitats Directive, the UN Bonn Convention on the conservation of migratory species of wild animals[145], and the respective Agreement on the conservation of cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area[146]. The latter requires that states implement a detailed conservation plan for cetaceans, including legislation banning the deliberate capture of cetaceans; measures to minimize their incidental capture and the creation of protected zones. Further work has been undertaken in this direction in cooperation with IMO and IWC[147], for the application of routeing measures and establishment of PSSAs as also examined above. These actions are significant for the protection of cetaceans, and indirectly for the preservation of deep sea ecosystems' health. Additionally, the UN Convention on International trade in endangered species of wild fauna and flora (CITES), includes certain species in its Annexes that can be adversely affected by trade, and aims at their protection trough quotas or outright bans, to ensure their survival. Notably Annex II includes all Scleractinia and Antipatharia species and *C.carcharias*, while Annex I (species threatened with extinction) includes *B. physalus* and *P. macrocephalus.*

Climate change is a major driver of pressures on deep sea species, affected by temperature and salinity changes, and the increase of carbon input. Consequently all climate-related agreements and legislation are pertinent. These include the UN Framework Convention on Climate Change[148] and the Paris Agreement, aiming at the stabilization of greenhouse gas emissions at such levels, as to prevent anthropogenic effects on the climate, and limiting global warming to less than 2°C and further trying to limit temperature rise to 1.5 °C. Respectively the EU has transposed into legally binding targets the ambitious Green Deal goals to become climate neutral by 2050, and to reduce greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels, by adopting the European Climate Law[149].

Since effective conservation planning and monitoring, and transboundary cooperation in environmental matters is immediately depended upon the supply of utilizable data, the EU has adopted INSPIRE Directive[150], aiming at the harmonization of spatial data infrastructures. To ensure that these are compatible and usable in a Community and transboundary context, the Directive requires further the adoption of common implementing rules in a number of specific areas through binding Commission Decisions or Regulations. Relevant to information

[144] http://www.pops.int/
[145] https://www.cms.int/
[146] https://accobams.org/
[147] https://iwc.int/home
[148] https://unfccc.int/
[149] https://ec.europa.eu/clima/eu-action/european-green-deal/european-climate-law_el
[150] Directive 2007/2/EC establishing an Infrastructure for Spatial Information in the European Community https://inspire.ec.europa.eu/inspire-directive/2

sharing and data harmonization is the EU CISE initiative[151], which aims to make European and national maritime surveillance systems interoperable, enabling all concerned authorities to exchange information in an automatic and secure way. It covers several sectors including safety and security of maritime transport, fisheries control, marine pollution preparedness and response, protection of marine environment and general law enforcement.

All the above policies and legislation contribute to the UN SDG 14 "Conserve and sustainably use the oceans, sea and marine resources for sustainable development"[152], and to several of its targets; partially to UN SDG 13[153] "Take urgent action to combat climate change and its impacts" and in particular, considering the role of several deep sea habitats in climate change mitigation through amongst others carbon sequestration, target 13.2; 'integrate climate change measures into national policies, strategies and planning'. The relevant targets of goal 14 are as follows; target 4.1 by 2025, 'prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution'; target 14.2 [by 2020], 'sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans'; target 14.3 'minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels'; target 14.4 [by 2020], 'effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics'; target 14.5 [by 2020] 'conserve at *least* 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information', target 14.6 [by 2020], 'prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation'; target 14.a 'increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries' and target 14.c 'enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want'.

[151] https://ec.europa.eu/oceans-and-fisheries/ocean/blue-economy/other-sectors/common-information-sharing-environment-cise_el
[152] https://sdgs.un.org/goals/goal14
[153] https://sdgs.un.org/goals/goal13

5. Discussion, Conclusions and Recommendations

Within the present thesis, effort was made to present as adequately as possible, basic types of deep sea benthic habitats of the Eastern Mediterranean region, and describe their characteristics and several other elements and facts, that make them unique, vulnerable and worthy of notice and immediate protection. The broad habitat types occur with several variations in the structure and species associations, diversity, persistence and extent, in many regions of the world's oceans including the Mediterranean Sea, where its eastern ecoregion is substantially different in many ways. Hence the focus has been on the identification of those peculiarities in an area until recently very little explored, with particular attention directed in the Hellenic territorial and adjacent waters, where the latter one day may comprise the state's EEZ.

For better understanding the reasons related to these habitats occurrence, it has been considered useful to lay out first, some relevant basic facts and information on the geology, bathymetry and hydro morphology of the wider Mediterranean basin and of the sub basins in the Hellenic waters. The morphology of the seabed in the Ionian and the Aegean Seas has functioned as a canvas consisting of depressions, steep slopes, canyons, faults, mounts, plateaus and other features of the seabed-scape, on which the scientific findings may be placed.

Deep environments globally have been the last to be explored. They are out of sight, generally far from the coast and challenging for exploration and monitoring due to their extreme conditions that require state of the art technological equipment. Despite the on-going research there are still many gaps in our knowledge on their occurrence, functions and ecosystem services, as well as lack of sufficient scientific evidence on how the natural and anthropogenic pressures may impact them. Nonetheless, progress has been made in various levels from important habitat sites discoveries to their functionality in various areas of the world's oceans including the eastern Mediterranean.

While in the past the very existence of these habitats had been quite uncertain in the eastern basin including in Greek waters, particularly the last decade, intensified scientific research carried out both within EU funded projects such as MEDITS[154], CoralFISH[155], DEEPEASTMED[156], and programs and surveys by the international scientific community, proved that not only these habitats exist, but some of them are also unique. These surveys revealed spatial distribution, information on aggregations and assemblages and furthered the knowledge on the status of some vulnerable habitats and species, such as corals, the latter being greatly affected by trawling activities of fishing fleets operating on the Hellenic continental shelf.

Conservation status has been assessed for the Mediterranean populations of these deep sea species by the IUCN, classifying several as critically endangered, endangered, and vulnerable with decreasing trends (IUCN Red List), whilst the SPA/BD Protocol to the Barcelona

[154] https://www.sibm.it/SITO%20MEDITS/principaleprogramme.htm
[155] https://imbriw.hcmr.gr/coralfish/
[156] https://imbriw.hcmr.gr/deepeastmed/

Convention has included several coral, sponge, cetacean and elasmobranch taxa in its Annex II- List of threatened species, demanding maximum protection. Since their existence, occurrence, status and value are now known they can no longer be ignored. Spatial conservation measures, monitoring their status and environmental impact assessments are required, together with additional effective measures for their long term preservation.

This work reviewed the existing international, regional and European policies aiming particularly to their protection and preservation, as well as policy frameworks which include them as essential biodiversity components, and the respective legislation which sets specific obligations for the bounded states towards their conservation.

The following conclusions point out up taken and demanded actions for the deep sea habitats identification, protection and monitoring, legal gaps and inadequacies and further recommendations for their protection in the Hellenic and adjacent waters.

5.1 A recognized vulnerability

The interest of the international community for deep sea habitats protection, grew gradually, and basically evolved from the need for and principle of the sustainable use of fisheries. The initial concern had been on the depletion of living resources, both of pelagic and deep sea fisheries; though the destruction of deep sea habitats resulted also from the intense and multi gear fisheries and thus, was finally regarded as an integral part of fisheries management. Instruments such as UNCLOS and CBD had already set the basic guidelines for the equitable and sustainable use of resources, and the protection of the marine environment, while further action mostly by the UN, including the Agenda 21, the Millennium Development Goals and the Johannesburg Declaration complemented the structure incorporating the principles of integrated, ecosystem and precautionary approaches for the protection of the marine environment and particularly the prevention of its degradation (Spijkers and Jevglevskaja, 2013), including consequently deep sea ecosystems.

The first important step towards the protection of deep sea habitats has been the identification of certain features, habitats and species as vulnerable. This is particularly significant as they have been recognized as features which are rather sensitive to pressures and bare distinct and particular characteristics. By granting them the “vulnerable” title we single them out, recognizing a direct need for action and indirectly consent to a quasi-priority status. Actions taken accounting for their vulnerability, aim initially at their protection from the adverse effects of fisheries and thus the competent authorities have set legally binding rules for their protection both in jurisdictional waters and the high seas.

These binding rules include prohibitions on the use of damaging gears, area closures, move-on rules and reporting obligations of encounter protocols, processes against IUU fishing and other infringements, obligations for environmental and risk assessments regarding these features, and the establishment of FRAs. Fleets operating within the Mediterranean Sea and

European community vessels should abide to the respective Recommendations and Regulations, as well as to national laws when and where applicable.

Further, states are provided with the criteria, examples, indicator features, habitats and taxa for the purpose of identifying VMEs within their jurisdictional waters and are further urged to apply management measures, including spatial protection measures using the best available data and knowledge, the precautionary approach and an ecosystem based management towards sustainability. In that, they should further engage to improve surveillance and monitoring of activities in the areas of their jurisdiction applying all available technological means including the use of national military intelligence systems, cooperate with other states and develop partnerships with NGOs[157] (Katsanevakis et al., 2015).

5.2 The Biodiversity Frameworks

Biodiversity frameworks of international, regional and European scale recognize that the loss of biodiversity is progressing instead of being halted, and that the measures taken have been inadequate. Biodiversity crisis is linked to the climate crisis and these two are equally important in their consequences. Furthermore, nature can be considered as a vital ally in climate change mitigation efforts. Increased attention and priority are given to the protection, restoration and conservation of nature in order to maintain integrity, functionality and connectivity, combating extinction, habitat loss, degradation and fragmentation, while particular priority is recognized to habitats capable in contributing to climate change mitigation efforts, e.g. carbon sequestration.

Further ambitious targets have been adopted, recognizing the need for larger MPAs which are more representative and the need for a greater number of strictly protected sites. Although these targets for MPAs cover are general, and do not distribute the percentage to the different depth zones, but simply refer to the matter indirectly, demanding representativeness and leaving states to decide. This though, has already been proven very unsuccessful, since, while the percentage cover has even been exceeded in the past, representativeness still, has not been achieved, and particularly, deep sea habitats remain largely outside of MPAs cover.

It is quite evident, that goals can be truly achieved or get close to be, only through legally binding rules. The paradigm of the existing framework of measures regarding climate change should serve as an example. Under the extreme urgency member states to comply with measures, the EU recently adopted the European Climate Law[158], which transforms into legally binding rules important goals and targets of climate policies on reducing greenhouse gas emissions. The possibility for the adoption of a similar EU Regulation aiming at the achievement of the necessary objectives on biodiversity is slightly emerging from the announcement of the Union's intent to adopt legally binding restoration targets, and from

[157] https://www.togetherforthemed.org/success-stories/fish-make-a-comeback-in-the-mpa-of-gyaros-mpa-16.html
[158] https://ec.europa.eu/clima/eu-action/european-green-deal/european-climate-law_el

the urgent nature of the enforcement measures declared by the EU strategy. These enforcement measures concern the implementation of conservation legislation and its necessary review, enforcement measures on the completion of Natura 2000 network and its effective management, as well as enforcement of protection provisions for species, and species and habitats with declining trends.

Stricter biodiversity conservation rules with specific binding targets and the explicit obligation of states to include deep sea habitats in spatial conservation and monitoring measures will be most beneficial and will render MPAs true representativeness, and contribute to the preservation of their functionality and that of the wider ocean. Further, protection and restoration, through legally binding targets, of ecosystems which have been degraded by human activities, including several deep sea habitats, can contribute effectively to climate change mitigation.

5.3 A legal basis for protection

While these deep sea habitats have deservedly been recognized as vulnerable, the legal basis for this identification and protection had already been set by UNCLOS. Despite that the Convention does not mention deep sea habitats directly, has provided for their inclusion in fisheries management plans, for their protection through EIAs and risk assessments within the framework of activities that might have adverse effects on them, in both jurisdictional waters and the high seas, the latter accomplished through transboundary cooperation of states and competent organizations. Also provides for the protection, sustainable harvest and management of certain coral species which are included in the respective Annexes of European, regional and international legislation (Habitats Directive, Bern Convention, SPA/BD Protocol and CITES Convention[159]). As deep sea species are found on the seabed and to the extent they are considered to fall within the sedentary definition, they should be protected by the coastal state, regardless of the regime of the overlying waters, as an integral part of their exclusive sovereign right deriving from its continental shelf.

Thus, in the same manner a coastal state safeguards its considered precious resources, for example hydrocarbons, and concedes their exploitation with agreements to third parties, it should also take appropriate actions for the preservation of the sedentary species, regardless any exploitation objectives, exercising universally the respective rights and not by selection. Either way the state has the duty to protect environmental components particularly when these are regarded rare, fragile, threatened or endangered and should not allow illegal practices over its continental shelf in the same manner that it should not allow illegal drillings.

Additionally this obligation for the protection of endangered and threatened species is underpinned by the SPA/BD Protocol to the Barcelona Convention, which requires endangered and threatened species to be identified and granted a legally protected status. This status is recognized already by the Protocol for certain deep sea coral species,

[159] https://cites.org/eng/disc/text.php

cetaceans and sharks, which are assessed as currently endangered or threatened, and consequently states are obliged to take further conservation measures within their area of jurisdiction or cooperate for that purpose with other states.

The EU Habitats Directive provides with two basic habitat types of community interest aiming at the protection of reef habitats and habitats related to bubbling reefs and pockmarks with leaking gases and carbonate crusts, types which also apply in deep waters.

Summarizing, some framework for the protection of deep sea habitats, is provided for all marine zones, in various ways, accounting also for the adverse effects from human activities whether this is fisheries or extraction, including measures and actions demanded solely by the coastal state or in cooperation with other states to promote sustainable use and protection of the marine environment. Particularly for jurisdictional waters, the coastal EU member states are provided with an effective legal tool for setting up MPAs under Natura 2000 network and for taking measures for the favorable conservation status of habitats and species. Until Habitats Directive is amended accordingly to keep up with current knowledge and scientific findings, including effectively and thoroughly significant deep sea habitats and species in need of urgent protection, sufficient knowledge exists not only justifying, but demanding the uptake of conservation measures (Chimienti et al., 2019, Salomidi et al, 2019), and monitoring as it further required by the provisions of MSFD.

5.4 Monitoring within a habitat based management framework

It has been UNCLOS to recognize first with a legally binding obligation the need for monitoring marine ecosystems, even if this is limited to aspects of pollution (article 204). Nonetheless pollution is one of the most severe and sometimes difficultly detectable pressures experienced by the ecosystems of the deep sea. The obligation includes monitoring of risks and effects of pollution on all factors of the marine environment, and the deployment of monitoring measures in order to keep under surveillance the effects of any activities states permit or engage in, the above bearing partial similarities with impact assessment Directives, IMAP and MSFD.

Reducing the pressures on marine resources is recognized as the way to achieve GES, hence safeguarding preservation and functionality of marine ecosystems, while a valuable tool for that is the "unit" of a protected site in which monitoring, assessment and application of measures may take place in an effective manner. Further, precise and accurate identification, quantification and mapping of pressures in the marine environment allows for targeted and thus adequate and effective measures (Katsanevakis et al., 2020).

Evidently the indispensable element for a habitat based management is the identification and mapping of the marine components, including the habitat types of a particular area, or within the jurisdictional waters of a state, or of a region, as well as the respective species and their range. Ideally identification, mapping and inventorying are followed by the application of measures and continuous monitoring and assessment of the status of the relevant habitats and species. Notwithstanding that MSFD provided with reference lists for

the initial identification of features and pressures, benthic broad habitat types that included types of deep sea habitats, corresponding to the EUNIS classification system, and indicative lists of pressures for monitoring and continuous assessment, including the physical loss and disturbance of the seabed, as well as criteria for monitoring and assessment e.g. the extent of loss and of the adverse effects resulting from anthropogenic pressures, many states including Greece, have not included in their strategies deep sea habitats thoroughly or not at all.

And that, despite the fact that many deep sea habitats in Hellenic waters could fill the selection criteria for monitoring and assessment and the available data and knowledge although by far not complete, are enough for initiating some conservation effort. The Greek program of measures[160] is restricted to euphotic benthic environments focusing on mapping maerl habitats and imposing prohibitions for the use of trawls and dredges, while it gives some relevant attention to the conservation of cetaceans and mentions the Hellenic Trench as an area of interest without though declaring any particular intention for adopting spatial measures. Spatial protection measures though should be included in the programs of measures "contributing to coherent and representative networks of marine protected areas, adequately covering the diversity of the constituent ecosystems, such as special areas of conservation pursuant to the Habitats Directive, […] and marine protected areas as agreed by the Community or Member States concerned in the framework of international or regional agreements to which they are parties".

In the same direction on the conservation of deep sea habitats, Dark Habitats Action Plan of the Barcelona Convention calls for the adoption of national plans for the protection of dark habitats, and for the establishment of monitoring plans to assess their status; while SPA/BD Protocol requires states to compile inventories of habitats and species which are rare, fragile, threatened or endangered, properties characterizing several deep sea features, and while establishing MPAs to take into consideration the patchy distribution of dark habitats. Within these plans states should identify and monitor features, with the assistance of the reference lists that are provided, threats and pressures, establish legislative provisions and integrate dark habitats conservation into other policies.

The above support MSFD process, as well as regional assessments carried out by the BC IMAP. States, either EU members and/or parties to the BC are not left alone in this process of identification and monitoring. They are aided to conduct surveys and scientific programs funded by the EU and other schemes and use cooperation platforms with other states and competent organizations for the exchange of knowledge and scientific data. In cases where there is lack of biodiversity data for habitat mapping and habitat distribution models, the use of geomorphological, physical and chemical oceanographic features as surrogates has become a common practice (Katsanevakis et al., 2015). Thus, "the geomorphology of the seabed is a good predictor of biological assemblage's composition and percentage cover of key taxa living in deep sea biomes. Regions of the seabed with complex sedimentology,

[160] https://ypen.gov.gr/wp-content/uploads/2021/10/%CE%A5%CE%91-%CE%A0%CE%A1%CE%9F%CE%93%CE%A1%CE%91%CE%9C%CE%9C%CE%91%CE%A4%CE%A9%CE%9D-%CE%9C%CE%95%CE%A4%CE%A1%CE%A9%CE%9D-1.pdf

unusual high temperatures and structural features are considered as areas of high diversity" (Anderson et al., 2011, Katsanevakis et al., 2015).

There is an urgent need for the identification of deep sea vulnerable habitats and the establishment of spatial measures for monitoring, conservation and where possible restoration, in view of the impact of trawling activities, including IUU fishing, continuing also in the present time; in view of the intensification of fishing pressure, owing to the relocation of fisheries from depleted coastal areas to deeper environments, which are rather sensitive, collapse easier and hardly recover; and in view of the increasing cumulative pressures of climate change, as some of these habitats are known to be rather sensitive to environmental changes. Their identification and conservation will definitely demand effort, increased responsibilities and funding capitals but in return, it will offset the costs with gains in natural capital and services, transform networks of protected areas, support climate change mitigation effort, promote other sectors of the economy and will definitely contribute towards the consolidation of the sovereignty or jurisdiction of the state in the perception of the neighboring countries.

5.5 A multiple basis approach for spatial conservation and management

On several occasions deep sea habitats occur close to shore, within territorial waters mostly due to the particular geomorphology of the region, similarly to the case of the Natura 2000 Kolumbo site in the Aegean, the proposed FRA in southeastern Ionian Sea, the area of interest (VME) in Toroneos Gulf in Chalkidiki peninsula, and several other areas examined above. Greece has established a territorial sea of 6 nautical miles,[161] while recently extended it in 12 nautical miles in the Ionian region,[162] including thus, several vulnerable ecosystems particularly sensitive to fishing activities. Within its territorial waters the state has the duty and legal obligation to identify and protect habitats and species of community interest, vulnerable, threatened, endangered, and rare, and of several other characteristics and enhance the European ecological network or other MPA networks, also with the inclusion of strictly protected sites. Despite that the subsumption under protection regimes of such areas in the territorial waters for deep sea habitats is a significant step it cannot be regarded as sufficient. The marine space demands a coherent and ecosystem based approach, allowing for effective systematic conservation planning in order to protect habitats and species whose occurrence and range extends beyond territorial waters.

This becomes even more complicated on the case of the Mediterranean and Greece in particular, where parts of present high seas form its future EEZ. In that, the natural -and future national- wealth, including living resources, habitats and species are difficult to be preserved and are exposed to potentially irreversible damages; this should have been considered as against the interests of the State requiring adequate responses.

A basic restraining factor for extending protection through appropriate actions, ideally within an EEZ, has been the geopolitical situation of the area, characterized by disputes and

[161] M.L 230/1936 (FEK A' 450) and article 139 of Code of Public International Law
[162] P.D 107/2020 (FEK 258/A/2020) and L.4767/2021 (FEK 9/A/2021)

conflicts over the still unresolved jurisdictional state of several marine regions, particularly in the Aegean. This though cannot be the reason for complete inaction, as proven by other Mediterranean examples in resolving their problems with intermediate solutions. Extending the territorial sea and declaring an EEZ in areas where agreements can be reached with opposite and adjacent states (e.g. Ionian Sea) is critical for many reasons including conservation, and should be further addressed under the concept of blue growth and MSP. As for effective systematic conservation planning within a MSP framework, this finds its ideal application within the administrative unit of the EEZ (Katsanevakis et al., 2015).

Similarly to many Mediterranean states, Greece could apply the provisions of UNCLOS (article 211 para. 6, 118 ,119, 122, 123 and 197) and the EC recommendation (2003)[163], for the establishment of ecological and fisheries protection zones through transnational agreements, or cooperative actions for the establishment of joint management and protection zones (Katsanevakis et al., 2015). Relevant, particularly for the Greek territorial waters of 6 nautical miles, is CFP Regulation 1380/2013[164], which in article 20 provides for the creation of fisheries and ecological zones restricted to 12 nautical miles from the baselines. The abovementioned derivative zones can be seen as the means to achieve efficient preservation of resources and protection of the marine environment, and thus constitute only a partial implementation of EEZ rights. Italy for example has established several such zones for "the protection and prevention of all types of marine pollution, for the protection of marine mammals and biodiversity" (Del Vecchio Capotosti, 2008). An application of this approach through respective national legislation could particularly take into account areas recognized for their significance, notably the EBSAs (e.g. Hellenic Trench). Establishing a derivative zone containing wholly or partly the Hellenic Trench EBSA and IMMA (providing for the establishment of routeing measures as well), would truly attribute to the area the character of an "area of interest".

In the absence of actions resulting in extension of jurisdiction over adjacent areas to the territorial sea, the spatial protection of deep sea habitats in the "high seas" can be accomplished with the establishment of SPAMIs based on the transboundary cooperation provisions of UNCLOS and SPA/BD Protocol. This cooperation is particularly significant to develop within ecoregions, using available platforms and mechanisms in order to achieve better representation of species, genetic and functional diversity (Katsanevakis et al., 2015).

We should note here that cooperating initially within a small spatial scale is important for the possibility of successful outcomes for various reasons, and keeping particularly in mind the transitional jurisdictional regime of the Mediterranean waters. Thus, states which share regions in which their future EEZs will be established in due time, should perceive it as in their particular interest and their increased responsibility to cooperate and preserve resources and the environment, under the broad perception of a "joined jurisdictional space". Additionally, an enhanced FRAs network has also the potential to fortify the coherence of protected sites, and provide at least, initiation of conservation of deep sea vulnerable habitats through the respective actions of international organizations and states.

[163] https://ec.europa.eu/commission/presscorner/detail/en/IP_03_1610
[164] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02013R1380-20190814

We can no longer regard issues pertaining to the exercise of rights, the public interest and the geopolitical standing of the state in an one sided manner, moving thus forwards to the exploitation of resources of the continental shelf, and on the other hand ignore other established rights and obligations, as well as the particular responsibility for the protection and preservation of the marine environment in areas of present and future national jurisdiction, always pursuantly to the provisions of the Law of the Sea.

Consequently the protection of deep sea habitats is inseparably connected to the national interests of the Greek state, its legal claims in the marine space and in that, it should be the first to initiate conservation action for multiple reasons.

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ANNEX: SUMMARY TABLES OF POLICY AND LEGISLATION

A.1 Summary Table of main International Policy instruments and mechanisms relevant to DSH Conservation		
Policy/Plan (date)	**Objective**	**Aspects of relevance to deep sea habitat conservation**
FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas (FAO DSF Guidelines, 2009)[165]	Provide recommendations on governance frameworks and management of deep-sea fisheries with the aim to ensure long-term conservation and sustainable use of marine living resources in the deep sea and to prevent significant adverse impacts on vulnerable marine ecosystems (VMEs).	Deep sea ecosystems are physically and functionally vulnerable to deep sea fisheries as a result to their characteristics. The Guidelines provide with certain criteria for the identification of VMEs aiming at the conservation of target and non-target species as well as affected habitats.
Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets[166]	The purpose of the Strategic Plan for Biodiversity 2011-2020 is to promote effective implementation of the CBD through a strategic approach, comprising a shared vision, a mission, and strategic goals and targets ("the Aichi Biodiversity Targets") that will inspire broad-based action by all Parties and stakeholders.	The Plan aims to ensure that pressures on biodiversity are reduced, ecosystems are restored, biological resources are sustainably used and benefits arising out of utilization of genetic resources are shared in a fair and equitable manner; adequate financial resources are provided, capacities are enhanced, biodiversity issues and values mainstreamed, appropriate policies are effectively implemented, and decision-making is based on sound science and the precautionary approach. Deep sea is the largest biome on Earth and its ecosystems and habitats are under significant pressures. These ecosystems provide significant services, are essential for ocean health and further contribute to climate change mitigation. Several Aichi targets are directly or indirectly connected with their conservation.
The post-2020 Global Biodiversity Framework and the 2050 Goals and 2030 Milestones[167]	Biodiversity, and the benefits it provides, is fundamental to human well-being and a healthy planet. Despite ongoing efforts, biodiversity is deteriorating worldwide and this decline is projected to continue or worsen under business-as-usual scenarios. The post-2020 global biodiversity framework builds on the Strategic Plan for Biodiversity 2011-2020 and sets out an ambitious plan to implement broad-based action to bring about a transformation in society's	Further builds on Aichi Targets demanding integrity, restoration and connectivity of ecosystems, the sustainable use of resources, larger and ecologically representative MPAs and well connected networks. Recognizes the significant contribution of biodiversity to climate change mitigation and further demands that all mitigation and adaptation efforts avoid negative impacts on biodiversity. Deep sea ecosystems are affected not only by climate change but also by plans relative to its halt hile they provide significant services in regulating the climate.

[165] https://www.fao.org/documents/card/en/c/b02fc35e-a0c4-545a-86fb-4fc340e13b52
[166] https://www.cbd.int/kb/record/decision/12268
[167] https://www.cbd.int/doc/c/abb5/591f/2e46096d3f0330b08ce87a45/wg2020-03-03-en.pdf

	relationship with biodiversity.	
The Mediterranean Strategy for Sustainable Development (MSSD) 2016-2025[168]	The strategy provides a framework for securing a sustainable future for the Mediterranean region consistent with the SDGs. It aims to harmonize the interactions between socio-economic and environmental goals, adapt international commitments to regional conditions, guide national strategies for sustainable development and stimulate regional cooperation between stakeholders in the implementation of sustainable development.	Aims at the sustainable development of marine areas and of the blue economy, addresses climate change as a priority issue and improves governance in support of sustainable development.
Strategic Action Program for the Conservation of Biological Diversity in the Mediterranean Region (SAPBIO)[169] **and the Post-2020 SAPBIO**	It is a concerted strategy to further the implementation of the SPA/BD Protocol.	The program addresses a variety of issues and recognizes topics such as inventorying, mapping, monitoring biodiversity, conservation of sites, habitats and species, development of research and improvement of knowledge, development of skills, information and participation, and increasing awareness as priority action fields.
The Action Plan for the conservation of habitats and species associated with seamounts, underwater caves and canyons, aphotic hard beds and chemosynthetic phenomena in the Mediterranean Sea Dark Habitats Action Plan[170] **(2013/2021)**	Aims at the conservation of the integrity and functionality of habitats by preserving the main ecosystem services and interest in terms of biodiversity, to encourage the natural restoration of degraded habitats and to improve the knowledge about dark habitat populations.	Calls for specific actions for the conservation of deep sea habitats.

[168] https://www.unep.org/unepmap/news/news/mediterranean-strategy-sustainable-development-mssd-2016-2025
[169] https://www.rac-spa.org/sapbio
[170] https://www.rac-spa.org/sites/default/files/action_plans/dark_habitats_ap.pdf

A.2 Summary Table of the main EU Policy instruments and mechanisms relevant to DSH Conservation		
Policy/Plan (date)	**Objective**	**Aspects of relevance to deep sea habitat conservation**
The EU Biodiversity Strategy for 2030[171] (2020)	It is a long term strategy that aims to protect nature and reverse the degradation of ecosystems for the benefit of people, climate and the planet and sets as a goal that by 2030 European biodiversity should be on the path of recovery. The Strategy recognizes that the main drivers of marine diversity loss are changes in sea uses, overexploitation, climate change, pollution and invasive alien species, while the current biodiversity crisis is intrinsically linked with the climate crisis.	Sets specific initiatives for the recovery of biodiversity through protection and restoration actions. Recognizes the need for larger areas, areas of strict protection and higher representativeness and connectivity. It focuses on the identification, mapping, monitoring and protecting biological elements, on their GES implementing sustainable management of marine resources, the restoration of carbon rich ecosystems and of important fish spawning and nursery areas. It sets also initiatives for change, aiming at the implementation and enforcement of environmental legislation.
The Strategy for the Adriatic and Ionian Regions (EUSAIR)[172] (2014)	It is a regional sea basin strategy under the Integrated Maritime Policy which promotes the development of blue economy. It is based on transboundary cooperation, addressing matters such as biodiversity loss, overfishing, the environmental quality of the marine environment and coastal degradation others deals with environmental quality of the marine environment.	Common threats to the ecosystems of the region are recognized to be overfishing, habitat degradation, and incidental catch of species, invasive alien species and illegal collection of sponges, corals and bivalves. Deep sea habitats are impacted by also by transboundary pollution. The Strategy provides with a cooperation platform for EU and non EU states, significant for biodiversity conservation, monitoring actions, support and exchange of knowledge.
EU Common Fisheries Policy[173] (2013)	It is a fundamental policy of the Union which sets rules for managing fisheries and for conserving fish stocks, while it aims to ensure that fishing is environmentally, economically and socially sustainable.	The EU has an exclusive competence on fisheries management and issues legally binding Regulations including for the sustainable use of marine resources, the use and prohibition of certain gears and the protection of vulnerable marine ecosystems.

[171] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1590574123338&uri=CELEX:52020DC0380
[172] https://www.adriatic-ionian.eu/wp-content/uploads/2018/04/EUSAIR-ACTION-PLAN-17-June-2014.pdf
[173] https://ec.europa.eu/oceans-and-fisheries/policy/common-fisheries-policy-cfp_el

A.3 Summary Table of relevant International Conventions Key: CP, Contracting Party				
International Convention	Objectives	In force	CPs	Aspects of relevance to deep sea habitats conservation
Convention on Biological Diversity (CBD) 1992[174]	Cconservation of biological diversity, sustainable use of its components and fair and equitable sharing of benefits arising out of the utilization of genetic resources	29/12/1993	196 (including the EU)	The CBD establishes a global legal regime for the conservation of biological diversity; CPs shall develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations; identify important components of biological diversity; establish a system of protected areas or areas with special measures; develop guidelines for the selection, establishment and management of PAs. The Convention provides with an indicative list of criteria for identification, selection and monitoring of ecosystems, habitats, species and communities, as well as genomes and genes.
The United Nations Convention on the Law of the Sea (UNCLOS)[175]	The Convention is the principal international legal instrument addressing all issues relating to the law of the sea. Provides for the delineation of the maritime space and for the relevant rights and obligations of CPs.	16/11/1994	168 (including the EU)	The Convention of the Law of the Sea provides for the delineation of the maritime space in zones and regulates the related rights, obligations, freedoms and duties of states. Sets rules for the sustainable use of resources in areas of the jurisdiction of CPs and in ABNJ, for the prevention of pollution and for transboundary cooperation for the above purposes. Provides for environmental risk and impact assessment and monitoring, for the protection of deep sea habitats and species which are impacted by fisheries, pollution and for those that are rare threatened and endangered; for the creation of jointly managed and protection zones in the high seas and ecological areas in the EEZ.
Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean 1995[176]	Promotion of environmental protection in the Mediterranean	09/07/2004	22 (including the EU)	The Barcelona Convention (as amended in 1995), one of the European Regional Sea Conventions, is a key instrument for the protection of the Mediterranean deep sea environment. CP commit, shall *inter alia*, individually or jointly, take all appropriate measures to protect and preserve biological diversity, rare or fragile ecosystems, as well as species of wild fauna and flora which are rare, depleted, threatened or endangered and their habitats, in the area to which this Convention applies.

[174] https://www.cbd.int/doc/legal/cbd-en.pdf

[175] https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf

[176] https://wedocs.unep.org/bitstream/handle/20.500.11822/35759/77ig9_inf3_bc_eng.pdf

Specially Protected Areas and Biodiversity Protocol (SPA/BD Protocol)[177]	The Protocol is the Mediterranean's main tool for implementing CBD regarding in situ sustainable management of coastal and marine biodiversity	12/12/1999	22 (including the EU)	Aims at the conservation of species and the creation of SPAs and SPAMIs; protects species that are threatened, endangered, endemic or rare, and their critical habitats, habitats typical to the Mediterranean and habitats that are in danger of disappearance; provides for transboundary cooperation in establishment of SPAMIS in ABNJ and for exchange of knowledge amongst others. CPs shall identify the above species and habitats, compile inventories, protect and monitor their status and establish conservation measures.

[177] https://www.rac-spa.org/sites/default/files/protocole_aspdb/protocol_eng.pdf

A.4 Summary table of the main relevant EU Directives			
EU legislation	**Objective**	**Date**	**Comments: Relevancy to coastal flood resilience**
Directive 2008/56/EC on establishing a framework for community action in the field of marine environmental policy (MSFD)[178]	The MSFD constitutes the basic pillar of the Integrated Maritime Policy of the Union and sets the framework within which the Member States should work to achieve a good environmental status (GES) of the marine environment by 2020 and further attain it. Further aims to reduce pressures on the marine environment through the application of an EBM, the promotion of the sustainable use of the seas and the conservation of the marine ecosystem. For the assessment and monitoring of the GES the Directive sets 11 qualitative descriptors based on which Member States take further measures including spatial protection measures.	11/07/2014	Almost all 11 qualitative descriptors are pertinent to the GES of deep sea habitats and ecosystems, but particularly descriptors 1 and 6 (biodiversity and sea floor integrity) are used by the Directive for the assessment and monitoring of the GES of benthic deep sea habitats. Member States shall identify, map and monitor habitats and species and develop marine strategies for the purposes of the Directive; Member States are provided with indicative lists of features, criteria and methodological standards for identification, initial assessment of status, assessment of pressures and with detailed benthic broad habitat types for their identification and selection for monitoring.
Directive 92/43/EEC on the conservation of natural habitats and wild fauna and flora (Habitats)[179]	The Directive is the cornerstone of EU nature conservation policy and is the major legally binding tool for achieving goals and targets set in biodiversity strategies. Its fundamental purpose is to contribute to the preservation of the European biodiversity through the conservation of natural habitat types and species of community interest as listed in the Directive particularly through the maintenance of a favorable conservation status.	22/07/1992	Establishes the EU wide Natura 2000 ecological network of protected areas (Special Areas of Conservation-SACs) composed of sites hosting listed natural habitats/species in order to safeguard their favourable conservation status also providing for the obligation of appropriate assessment for the implications of plans within SACs; The Directive aims also at the favourable conservation status of all the other species which are not included in the spatial protection network with certain obligations of Member States; Annex I includes two habitat types of community interest also found in deep water areas and certain species associated with deep sea ecosystems; Member States shall identify and include those habitat types and species in the ecological network in their territory as well as establish measures for their protection.

[178] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0056
[179] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31992L0043

Directive 2014/89/EU on establishing a framework for Maritime Spatial Planning (MSP)[180]	Maritime spatial planning is a cross-cutting policy tool of the Integrated Maritime Policy addressing the rapidly increasing demand for maritime space, aiming at the sustainable development and sustainable sea uses through a coordinated, integrated and transboundary ecosystem based approach.	23/07/2014	Aims at an ecosystem based, marine areas prioritization for conservation and allocation of sea uses; selection of areas for protection based on a systematic conservation planning within MSP, results in representativeness and adequate cover regarding deep sea habitats; the selection of uses promoting blue growth and the allocation of uses affecting deep sea habitats in a sustainable manner promotes their preservation.
Directive 2001/41/EC on the assessment of the effects of certain plans and programs to the environment[181]	The Directive demands the assessment of environmental impacts of certain plans and programs prepared by a public authority which set the framework for future development consent of projects and are likely to have significant negative effects, in order to achieve a high level of environmental protection.	21/07/2001	Plans and programs undergo screening procedure for their negative effects to the environment according to certain criteria while the assessment process is determined as mandatory by the Directive for public plans on specific sectors, including energy and fisheries which largely affect deep sea habitats, as well as in the case of plans and programs within protected areas of Natura 2000 network. The environmental report should include evaluation of possible significant effects on biodiversity amongst many, shall take into consideration the characteristics of the area, the cumulative effects, prevention and monitoring measures and provide with reasonable alternatives.
Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment [182]	The Directive covers a wide range of defined public and private projects which should be subject to an assessment prior to their authorization.	15/05/2014	Certain projects affecting deep sea habitats are subjected to a previous mandatory assessment while others should undergo screening procedure first according to thresholds set by Member States; the EIA report by the developer shall identify, describe and assess the direct and indirect effects on several factors including biodiversity, protected areas and species of EU legislation, water and climate and the effects on the interactions of all considered aspects accounting for the functionality and the services of the ecosystem.

[180] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0089
[181] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32001L0042
[182] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0052