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TÜRKIYE
CONSERVATION OF MEDITERRANEAN MARINE AND COASTAL BIODIVERSITY BY 2030 AND BEYOND

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CONSERVATION OF MEDITERRANEAN MARINE AND COASTAL BIODIVERSITY BY 2030 AND BEYOND

Ecological Status, Pressures, Impacts, their Drivers and Priority Response Fields

POST-2020 SAPBIO

Strategic Action Programme
for the **Conservation** of **Biodiversity**
and **Sustainable Management**
of **Natural Resources**
in the **Mediterranean Region**

United Nations Environment Programme
Mediterranean Action Plan
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List of Acronyms

CBD	Convention on Biodiversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DEÜ-DBTE	Dokuz Eylül University – Institute of Marine Sciences and Technology
EICAT	Environmental Impact Classification of Alien Taxa
EKAD	Ecological Research Association
EPASA	Environmental Protection Agency for Special Areas
EU	European Union
EUNIS	European Nature Information System
FAO	Food and Agriculture Organization of the United Nations
GDNCNP	General Directorate of Nature Conservation and National Parks (of MoAF)
GDPNA	General Directorate for Protection of Natural Assets (of MoEU)
IUCN	International Union for Conservation of Nature
IUU	Illegal, unreported and unregulated
MAP	Mediterranean Action Plan
MCPA	Marine and Coastal Protected Area
MoEU	Ministry of Environment and Urbanisation
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
NAP	Nature Park
NGO	Non Governmental Organization
NP	National Park
ODTÜ-SAT-AFAG	Middle East Technical University, Underwater Society, Mediterranean Monk Seal Research Group
SEPA	Special Environmental Protection Areas
SLR	Sea level rise
SNR	Strict Nature Reserve
SPA/BD	Specially Protected Area/Biological Diversity
SST	Sea surface temperature
TUBITAK	The Scientific and Technological Research Council of Türkiye
TUIK	Turkish Statistical Institute
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
VME	Vulnerable Marine Ecosystem
WR	Wildlife refuge
YÖK	Council of Higher Education

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Executive Summary

The zoogeographic position of Türkiye constitutes an important site for terrestrial, fresh water and marine biodiversity. Its encirclement by three seas have resulted in a unique marine biota, since Türkiye is the only Mediterranean country that have coasts on the Black Sea, Aegean Sea and Levant Sea, which all have different oceanographical characteristics.

Mediterranean Sea is typically an oligotrophic ecosystem in terms of trophic status, depending on the nutrient and Chl-a concentrations. However, water column biological communities are poorly studied in Türkiye, in which available information concerning phytoplankton and zooplankton species is mainly composed of sporadic investigations. When it comes to the macroorganisms, the same problem is faced. About 6,000 marine species have been reported from coasts of Türkiye. When the total known marine biodiversity of the Mediterranean is taken into consideration (about 17,000 species), our current knowledge on marine biota of Türkiye is extremely limited. The recently published checklists made a great contribution to Turkish marine flora and fauna, but the inventories are still far from being complete. Some of the invertebrate groups, such as Annelids, Arthropods and Molluscs are well studied, but very little information is found about the biodiversity, distribution patternes and faunal compositions for small groups, such as, Xenacoelomorpha, Myxozoa, Tardigrada, Echiura.

It is accepted that the human activities on earth lead to severe habitat destruction and loss of biodiversity. Protection of species strictly requires the protection of their habitats. Thus, deep knowledge on habitats is as crucial as the knowledge on taxonomy for proper conservation and management issues.

Both Aegean and Levantine coastline bear diverse environmental characteristics. The Turkish Mediterranean coastline includes typical marine and coastal Mediterranean habitats, but also some habitats unique to eastern Mediterranean. Except few studies conducted on seagrass species, and a preliminary mapping study, we do not have any specific information about the distribution, depth range, faunal and floral compositions of the marine habitats found on the Mediterranean coasts of Türkiye. Without knowing the habitats, it is not possible to figure out properly the pressures and their impacts on the biota.

The Turkish marine fauna comprises endemics, cosmopolitan species, Atlanto-Mediterranean, Tropical Atlantic and Indo-Pacific/Red Sea originated species. The industrial fishery activities carried out along Mediterranean coasts of Türkiye are mostly dependent on schooling pelagic species, while only a few demersal fish are represented by high capture production values. Information on abundance, spatial distribution and population dynamics (age, growth, mortality, etc.) of pelagic stocks through the area are

either largely missing and/or outdated. Marine capture production is highly influenced by fluctuating demersal and pelagic stocks. Only a few pelagic species show biomass levels below biologically sustainable levels, whereas rest of the demersal stocks are heavily overfished and drastic decreases in annual production is observed.

Mediterranean Sea is one of the world's immensely affected ecosystems by alien species and Türkiye is located within the core area of alien taxa. Alien species have potential to become invasive and may have substantial effects on the ecosystems they have been introduced, including extinctions or displacement of native species, modification of habitats, change of the community structure, altered food web dynamics, negatively affecting human health and causing economic losses. The alien puffer fish *Lagocephalus sceleratus* causes a considerable financial loss of over 2 million Euros per year. However, alien fish and crustacean species dominate the fisheries market on the Eastern Levantine coasts, contributing to local fisheries and provide positive socio-economical income, but on the other hand, creating a conflict between conservational and economical issues. Although the coasts of Türkiye, mainly the Levantine coasts, are highly invaded by alien species, there is no clear strategy for the management of alien species. While conducting projects against alien species on one hand, the economically valued ones are protected by law, having seasonal prohibition or size limits, on the other hand.

A total of 18 Marine and Coastal Protected Areas are located on the Mediterranean coasts of Türkiye, covering a total area about 1,900km2, with more than 1,400km2 marine component, which is quite impressive. However, only 4 out of 12 Special Environment Protection Area have a declared management plan.

Climate warming is a serious threat to the marine and coastal biodiversity, which also have physical consequences (i.e. sea level rise) affecting global human populations. The worldwide observable effects include loss of sea ice, shifts in ranges of biota, accelerated sea level rise and more intense heat waves. There is enough of evidence that the damage caused by climate change will increase over time and concrete measures have to be taken.

As summarized above, there are multiple pressures on marine and coastal biodiversity, whose cumulative effects often cause dramatic ecosystem responses. Despite of growing number of scientific research conducted to date, we still don't have not enough knowledge for understanding the synergistic influence of pressures and impacts on marine and coastal biodiversity of the Turkish coastline. There is a comprehensive legislation on nature conservation and fisheries in Türkiye. However, there is no legal text specifically for the protection of species or habitats. The problems in practice are tried to be overcome with the rules in different regulations implemented by different institutions, which create conflicts of authority between them.

The problems we face can be solved by improving our knowledge on the Mediterranean habitats and the biota living in them. Although there is quite information on the marine and coastal biodiversity, there is lack of clear national strategy to inventory marine and coastal biodiversity, lack of knowledge on marine habitats, lack of monitoring programmes for biodiversity in marine protected areas. This lack of knowledge can only be overcomed by multidiciplinary collective long term studies and monitoring programmes, which requires high amount of funding.

Promotion of training and capacity building among governmental bodies and academics highly recommended, especially in: monitoring, planning, multidisciplinary co-operation, training of specialists on multidisciplinary/multinational project management. Pressures and their impacts on biodiversity in protected areas should be determined and ecosystem based integrated management plans should be implemented as soon as possible..

1.

Reference documents and information consulted

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1.1. Documents provided by SPA/RAC and its international consultants

1.2. National documents and publications identified and available

All the documents used in preparation of the present draft are cited in the report where appropriate and given in alphabetical order in the References Section. Besides those, the documents listed below were also used in preparation of this report.

- Capacity Building on Marine Strategy Framework Directive in Türkiye, Final Report on Initial Assessment of Turkish Mediterranean Sea Waters, Ministry of Environment and Urbanization, 2 February 2018, Ankara, 369 pp.
- Katağan, T., Tokaç, A., Beşiktepe, Ş., Öztürk, B. (Eds.) (2015). The Aegean Sea Marine Biodiversity, Fisheries, Conservation and Governance. Turkish Marine Research Foundation (TUDAV), Publication No: 41, Istanbul, Türkiye.
- Turan, C., Salihoğlu, B., Özgür Özbek, E., Öztürk, B. (Eds.) (2016). The Turkish Part of the Mediterranean Sea; Marine Biodiversity, Fisheries, Conservation and Governance. Turkish Marine Research Foundation (TUDAV), Publication No: 43, Istanbul, Türkiye.
- National Climate Change Action Plan of Republic of Türkiye, 2011-2023. The Ministry of Environment and Urbanization, General Directorate of Environmental Management, July 2011, 177 pp.
- UN Convention on Biological Diversity, Sixth National Report. Ministry of Agriculture and Forestry, General Directorate of Nature Conservation and National Parks, November 2019, 59 pp.

1.3. Other documents identified

The documents listed below are also considered during the preparation of this draft report.

- SPA/RAC–UN Environment/MAP. (2019): Updated Classification of Benthic Marine Habitat Types for the Mediterranean Region. Tunis: 23pp.
- UNEP-MAP-RAC/SPA. (2010). Fisheries conservation and vulnerable ecosystems in the Mediterranean open seas, including the deep seas. By de Juan, S. and Lleonart, J. Ed. RAC/SPA, Tunis: 103pp.

1.4. Quality and comprehensiveness of available information documents

There is broad information in the literature concerning the biota of the Turkish Mediterranean coasts. All are available, comprehensive and based on solid data. Recent reviews are helpful for understanding the current status. However, due to continuously incoming alien species and the changes in the oceanographical characteristics, the literature should be updated in a shorter time.

Türkiye has a fairly comprehensive legislation on nature conservation and fisheries. All the related documents are publicly available.

2.

Marine and coastal ecosystem status

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Located in the eastern Mediterranean, Türkiye's Mediterranean coast is divided into two parts, The Aegean coast and the Levantine coast. The Turkish coasts of the Aegean Sea extend from the Greek border in the north to the Gulf of Fethiye (Mugla) in the south. The coastline from Gulf of Fethiye to the Syrian border in the east is the Levantine Sea coastline. Both seas have different physical and chemical characteristics, resulting in a diverse biota on the Mediterranean coast of Türkiye. Together with the waters of the Black Sea poured into the Aegean via Çanakkale Strait (Dardanelles), several major rivers such as Meriç, Bakırçay, Gediz, Büyük Menderes and Küçük Menderes create nutrient rich environments on the Turkish Aegean coasts. The presense of numerous submarine thermal springs located on the fault lines also help in formation of biodiversity hot spots. The Levantine Sea is more oligotrophic compared to the Aegean Sea. However, high number of alien species introduced via Suez Canal generate an exceptional ecosytem dominated by the aliens.

2.1. Biological characteristics

2.1.1. Description of water column biological communities

Phytoplankton

By the very low cell abundance and the high number of species observed, the Mediterranean Sea is typically an oligotrophic ecosystem in terms of trophic status, depending on the nutrient and Chl-*a* concentrations. Primary production rates are on average three times lower in the eastern than in the north-western basin (Turley, 1999). Daily primary production in the Aegean Sea ranges between 38.88 and 81.36 mg C m^{-2} day^{-1}, in southern and northern basin, respectively (Ignatiades *et al.,* 2002), while higher values are observed in İskenderun Bay, northeast Levant (140 - 250 mg C m^{-2} day^{-1}, reaching to 640 mg C m^{-2} day^{-1} during spring blooms) (Yılmaz *et al.,* 1992).

Water column biological communities are poorly studied in Türkiye, in which available information is mainly composed of sporadic investigations. The most comprehensive checklist of phytoplankton of Turkish Seas include a total of 492 species (Koray, 2001), but the study is merely a presentation of species list and their distribution in seas surrounding Türkiye were not presented in detail. Our existing knowledge on phytoplankton diversity is therefore mostly based on Koray *et al.,* (2000), who carried out field works between 1995 and 1998 at İzmir Bay (Aegean Sea) and İskenderun Bay (north-east Levant Sea) (Table 1). Phytoplankton studies in Turkish Aegean waters were reviewed by Türkoğlu (2015).

The species composition in Edremit Bay (northern Aegean Sea) mostly consisted of dinoflagellates (53.7%) which were followed by diatoms (43.9%). Dinophyceae had the highest cell number in July (1,100 cell/l) and Bacillariophyceae in April (2,280 cell/l),

Table 1

Phytoplankton species diversity in Aegean and Levant Seas (based on Koray et al., 2000).

Group	Genera		Species		Forma-Variety		Taxa	
	Aegean	Levant	Aegean	Levant	Aegean	Levant	Aegean	Levant
Cyanophyceae	1	1	0	0	0	0	1	0
Dinophyceae	20	17	103	80	30	27	133	107
Prymnesiophyceae	2	0	2	0	0	0	2	0
Dictyochophyceae	2	1	2	1	2	0	4	1
Bacillariophyceae	37	37	94	79	8	8	102	87
Prasinophyceae	1	1	1	1	0	0	1	1
Total	*63*	*57*	*202*	*161*	*40*	*35*	*243*	*196*

while Chl-*a* ranged between 0.10 – 1.68 µg/l (Ağlaç and Balkıs, 2014). According to the trophic scaling for the Aegean Sea based on Chl-*a* concentrations (Ignatiades, 2005), the categories "open oligotrophic" < "offshore mesotrophic" < "inshore eutrophic" waters were defined for Chl-*a* as 0.5< (0.5–1.0) <1.0 µg/L. That simply underlines the highly dynamic nature of phytoplankton assemblages, so the same study area can show drastic seasonal fluctuations in terms of trophic status. In another study carried out in Datça peninsula (southern Aegean Sea), Taş (2014) determined that Diatoms were the most diverse algal group with 71 (53.7%) taxa, followed by dinoflagellates with 60 taxa (45.4%). The highest number of phytoplankton cells reached 5,400 cells/l, and Chl-*a* values were between 0.19 and 0.68 µg/l.

In comparison to the Aegean Sea, significantly different results were achieved during surveys conducted throughout the northern Levant shores. Polat and Perçin Piner (2002a) found phytoplankton biomass (in terms of Chl-a) in Iskenderun Bay ranging from 0.05 to 2.7 µg/l; abundance was lowest in summer (264 cell/l) and highest in spring (12,725 cells/l), in which diatoms were the dominant group (66%) followed by dinoflagellates (31%). Through the Mersin shores, surface chlorophyll-a concentrations varied seasonally between 0.01-7.73 in coastal waters (depth <30 m) as the offshore concentrations varied in the range 0.01-0.91 µg/l during the period of 2009-2011, indicating about 10-fold decrease in the oligotrophic open waters (Yücel *et al.,* 2017). Extreme oligotrophy was determined at Babadıllimanı Bight, where surface phytoplankton abundance was as low as 336 cells/l (August), with Chl-a concentrations ranging from 0.1 - 0.87 µg/l (Polat and Perçin Piner, 2002b).

Information on phytoplankton cells grazed by microzooplankton is quite scarce and limited to a single study conducted in the central part of the Aegean Sea. Phytoplankton growth and microzooplankton grazing was investigated in Homa Lagoon by Kutlu (2012), who found that microzooplankton (mainly composed of dinoflagellates, tintinnid ciliates and nauplii) consumed 45% of microalgal production throughout the year, suggesting that the low grazing was one of the factors contributing to the development of the spring bloom. Microzooplankton grazing increased with temperature and grazing rate reached maximum levels in spring and summer.

Zooplankton

Until now, zooplankton species diversity in Türkiye has not been meticulously reviewed and certainly requires more efforts to fill the gap. EICAT copepods are the best studied group of mesozooplankton (200 µm-2 mm) due to their abundance and ecological importance in the marine ecosystems.

The zooplanktonic communities of the Aegean Sea are dominated by copepods, except for some coastal areas during summer and early autumn when cladocerans are dominant, usually constituting 70 - 80% of the total number of zooplanktonic organisms. The basin wide zooplankton assemblages differ significantly and Aker (2015) have listed the most important copepod species according to regions as follows: a) Coastal and open waters of the North Aegean Sea: *Acartia* (*Acartiura*) *clausi* Giesbrecht, 1889, *Paracalanus parvus* (Claus, 1863), *Centropages typicus* Krøyer, 1849, *Temora stylifera* (Dana, 1849), *Clausocalanus arcuicornis* (Dana, 1849), b) Turkish coastal waters of middle Aegean Sea: *P. parvus* (Claus, 1863), *C. furcatus* (Brady, 1883), *C. typicus* Krøyer, 1849, *T.stylifera* (Dana, 1849), *A.*(*Acartiura*) *clausi* Giesbrecht, 1889, c) Coastal and open waters of South Aegean Sea: *C. arcuicornis* (Dana, 1849), *C. furcatus* (Brady, 1883), *C. paululus* Farran, 1926, *O. plumifera* Baird, 1843, *O. similis* Claus, 1866. Abundance of total zooplankton in the northern Aegean Sea (Gökçeada Island) was estimated between 4,966 – 8,290 ind.m^{-3} (autumn and spring, respectively), in which *A.clausi* dominated in all seasons (Tarkan, 2000). Cladoceran abundance was also determined in a few studies, showing distinct variations. *Penilia avirostris* reached an abundance of 3,172 ind.m^{-3} during summer in İzmir Bay (Aker and Özel, 2006), while a maximum of 317 ind.m^{-3} of *Pleopis polyphemoides* was observed in Güllük Bay (Killi and Sagdic, 2018).

Zooplankton research conducted in Northern Levantine Basin have mostly focused on the spatial and temporal variations of Copepoda species in the Iskenderun and Mersin Bays, where over 200 planktonic copepod species have been reported (Uysal *et al.,* 2002; Terbıyık-Kurt and Yılmaz-Zenginer, 2016). Vertical distribution of main zooplanktonic groups varied temporally and spatially in the Northeastern Mediterranean Sea, for example Copepoda and Siphonophora are generally abundant at 0-50 m layer of Antalya Bay during spring (Terbıyık *et al.,* 2010), while Copepoda is followed by Appendicularia, Cladocera, Thecosomata, Hydrozoa and Chaetognatha in the same depth layer in Cilician basin (Terbıyık-Kurt and Yılmaz-Zenginer, 2016).

When compared to offshore habitats, zooplankton abundance is always higher in coastal regions (Table 2). Wide continental shelf areas, such as Göksu delta, İskenderun and Mersin Bays are seasonally exposed to varying intensities of anthropogenic and terrestrial influences, thus dynamic zooplankton assemblages exist (Terbıyık-Kurt and Yılmaz-Zenginer, 2016).

Table 2.

Abundance (ind m-3) and biomass (mg m-3) values of zooplankton at Turkish coasts.

Locality	Abundance (ind m^{-3})	Biomass (mg m^{-3})	Reference
Iskenderun Bay (coastal)	522 – 12,931	3.14 - 21.72	Terbıyık-Kurt and Yılmaz-Zenginer (2016)
Iskenderun Bay (offshore)	521 – 5,443	3.31 - 8.99	Terbıyık-Kurt and Yılmaz-Zenginer (2016)
Mersin Bay (coastal)	4,968	22	Zenginer-Yılmaz and Beşiktepe (2010)
Mersin Bay (offshore)	603	3	Zenginer-Yılmaz and Beşiktepe (2010)
Mersin Bay	215 - ,2220	4 - 22	Uysal and Shmeleva (2012)
Cilician basin	977 – 2,972	4.78 - 10.1	Uysal *et al.,* 2008, cited in Terbıyık-Kurt and Yılmaz-Zenginer (2016)
Antalya Bay (spring)	72.28 - 757.55	2.2 - 18.1	Terbıyık *et al.,* (2010)
Antalya Bay (autumn)	99.54 - 492.52	0.98 - 4.67	Terbıyık *et al.,* (2010)

2.1.2. Information on invertebrate bottom fauna, macro-algae and angiosperms including species composition, biomass and annual/seasonal variability

Macroalgae

Major contributions for algal flora were made after 1950s. A comprehensive checklist was given by Taşkın (2015). A total of 430 taxa (Phaeophyceae: 111 taxa; Rhodophyta: 238 taxa; Chlorophyta: 81 taxa) from the Aegean Sea and a total of 382 taxa (Phaeophyceae: 80; Rhodophyta: 222; Chlorophyta: 82) from Levantine coastline. The algal checklist of the Turkish Mediterranean coasts reported by Okudan *et al.,* (2016) included 435 taxa (Rhodophyta: 256 taxa; Ochrophyta: 86 taxa; Chlorophyta: 93 taxa).

Photophilic and sciophilous macroalgal vegetation in the midlittoral zone in the Aegean coasts of Türkiye is represented by *Cystoseira barbata, C. corniculata*, *C. crinita*, *C. foeniculacea, Ectocarpus spp.*, *Jania rubens, Laurencia obtusa, Ganonema farinosum, Ceramium spp.*, *Polysiphonia spp.*, *Phymatolithon lenormandii*, *Ulva spp.*, and *Cladophora* spp, where as, it is represented by *Cystoseira compressa, C. spinosa, Dictyota spp.*, *Halopteris scoparia*, *Padina pavonica*, *Peyssonnelia spp.*, *Gracilaria bursa-pastoris, Nitophyllum punctatum*, *Botryocladia spp.*, *Grateloupia filicina*, *Caulerpa cylindracea*, *Codium bursa*, *Halimeda tuna, Flabellia petiolata,* and *Valonia spp.*

Productive and diverse coralligenous habitats are common in the Aegean Sea. *Lithophyllum stictaeforme*, *Mesophyllum alternans*, *M. expansum*, and *Peyssonnelia polymorpha* are abundant. Due to the karstic limestone structures along the Antalya coasts limestone algae *Amphiroa beauvoisii*, *A. cryptarthrodia*, *A. rigida*, *Haliptilon roseum*, *H. squamatum*, *H. virgatum*, *Jania longifurca*, *J. rubens*, *Lithophyllum cystoseirae*, *L. incrustans*, *Mesophyllum expansum*, *M. lichenoides* communities form a dense mat on the hard substrate, reaching almost 100% coverage locally.

Seagrasses

Five seagrass (Magnoliophyta) species are found along the Aegean coasts of Türkiye, *Posidonia oceanica, Cymodocea nodosa, Zostera marina, Zostera noltii and Halophila stipulacea*. The first two are the most abundant ones and found almost all along the Aegean coastline. Meadows of both species are found at very shallow depths and dense *Posidonia oceanica* meadows were down to 40 m around Datça Peninsula (Okuş *et al.,* 2007), whereas, *Cymodocea nodosa* seldomly observed below 30 m. *Zostera spp.* meadows are rare, but form dense beds on sandy or muddy bottoms in sheltered bays, brackish coastal lagoons and at river mouths, in 0.2 - 5 m depth range (Çınar *et al.,* 1998). A study on phenological parameters of *Posidonia oceanica* meadows in 17 stations showed that the shoot densities were classified as supranormal (8 stations), normal (7 stations) and abnormal (2 stations), indicating healthy environmental conditions in majority of the stations (Dural *et al.,* 2012).

Posidonia oceanica, Cymodocea nodosa, Zostera marina and Halophila stipulacea were found on Levantine coast. However, the dominant species of the Aegean Sea, *Posidonia oceanica*, is replaced by *Cymodocea nodosa* at shallow depths and by *Halophila stipulacea* below 20 m. Dense meadows of *Posidonia oceanica* are still found on the eastern boundary of the Levantine coast between Fethiye (Mugla) and Kaş (Antalya), but it is very rare on the east of Kaş. The easternmost limit is found to be 36 09' N 33 26' E (Gücü and Gücü, 2002). The limiting factor is suggested to be the combination of light penetration and high water temperature (Çelebi *et al.,* 2007).

The seagrass meadows were mapped only in few recent studies. One of the earliest study was conducted in Foça SEPA in 2005. *Posidonia oceanica* meadows all along the SEPA was mapped and the total coverage area was found to be 6.7 km^2 (Akçalı *et al.,* 2019a). Okuş *et al.,* (2007) investigated 73 stations in Datça-Bozburun Peninsula SEPA and found that the SEPA includes healthy *Posidonia oceanica*, *Cymodocea nodosa* and *Halophila stipulacea* meadows, covering 41.2 km^2, 4.3 km^2 and 2.8 km^2, respectively. In the scope of the project "Determination Work on Marine Biodiversity at Ayvalık Adaları Nature Park" the distribution patterns and the coverage of Phanerogams were determined (Yokeş and Demir, 2013). *Posidonia oceanica* was observed at 21 stations, with a coverage rate of up to 60 percent in both the 0-5 m and the 5-50 m zones. *Cymodocea nodosa* was observed at 14 stations and was usually found at shallower depths than *Posidonia oceanica*. Yet, at some stations its coverage rate reached 90 %. The Indo-Pacific originated *Halophila stipulacea* was not prevalent within the borders of the nature park. Its coverage rate was between 1-2 % locally.

Seagrass meadows in Ölüdeniz region (Kaş-Kekova SEPA) was mapped between 0-50 m depth range (Akçalı *et al.,* 2019a). Solitaire, as well as mixed meadows of *Posidonia oceanica, Cymodocea nodosa, Zostera marina* and *Halophila stipulacea* were found. The total area covered by *Posidonia oceanica*;1.047 km^2; *Cymodocea nodosa*: 0.718 km^2; *Zostera marina*: 0.344 km^2; *Halophila stipulacea*: 1.375 km^2; *Cymodocea nodosa* with *Zostera marina*: 0.146 km^2. *Posidonia oceanica, Cymodocea nodosa* and *Halophila stipulacea* meadows in Kaş-Kekova SEPA (outside Ölüdeniz region) were mapped and followed between 2002-2018 (Yokeş *et al.,* 2019). Unfortunately, a drastic decline both in the number and coverage of *Cymodocea nodosa* meadows were observed in the last 4

years. 15 out of 22 *Cymodocea* patches were completely vanished. Extensive grazing by abnormally expanded *Chelonia mydas* population in the SEPA suggested to be the main cause of this degradation.

A long term monitoring study was conducted on *Posidonia oceanica* meadow in Yıldız Bay, Gökçeada (North Aegean Sea) between 2008-2016 (Guresen *et al.,* 2019). It was found that the lower limit of the seagrass has regressed by 3.21±1.1 m. According to the Posidonia Biotic Index values, the status of the meadows has declined from "Good" to "Moderate" status in 8 years. Plagiotrophic rhizomes were observed in front of the lower limit in 2008; however dead mat of *Posidonia oceanica* was found at the lower limit with >50% coverage in 2016. There fore the type was changed from 'progressive' to 'sparse limit'.

Yücel-Gier *et al.,* (2019) mapped *Posidonia oceanica* meadows in Gülbahçe Bay (Gulf of İzmir) by combining Worldview-2 satellite image, high-resolution sub-bottom profiler and digital side scan sonar data. Total area of the *Posidonia* meadows was measured as 1,393 ha, nearly 25% of the entire bay.

A major contribution to the mapping of *Posidonia* meadows came from Duman *et al.,* (2019). They used a combination of acoustic technology and video recordings to interpret, geomorphological, oceanographic, and sedimentological data. The methodology showed high discrimination capacity between different structures, making appropriate and easy way to map seabed. In their study, they collected data for a total 1,600 km^2 coastal area down to 50 m water depth in Edremit, Çandarlı, Gülbahçe, Ildır, Güllük and Gökova Bays.

All in all, a total of 14 486.20 ha of *P. oceanica* coverage was reported in 16 studies until 2019. However, this figure seems to be remarkably underestimated. It is therefore determined that the mapping of *Posidonia* seagrass beds in Türkiye has not yet provided exploitable information and data for marine spatial planning and still remains as an urgent task (Akçalı *et al.*, 2019b).

Porifera

The knowledge on the sponge fauna of the Turkish coasts is poor when compared to that of the other parts of the Mediterranean. A total of 50 sponge species were reported from İzmir Bay by Sarıtaş (1972, 1973, 1974) and Yazıcı (1978) reported 15 species from Gökçeada (northern Aegean Sea). Several sponge species were also reported from the Aegean Sea in some faunistic and ecological studies (e.g. Geldiay and Kocataş, 1972; Erguven *et al.,* 1988; Kocak *et al.,* 1999; Topaloğlu, 2001). Evcen and Çınar (2012) studied the sponge species from the Levantine coast of Türkiye and provided a checklist of sponges. The checklist was updated by Topaloğlu and Evcen (2014), in which, a list of 112 sponge species, 82 species from Aegean coasts and 51 species from Levantine coasts of Türkiye were given.

Cnidaria

The literature on cnidaria along the Turkish Mediterranean coastline is limited. Most of the studies were conducted in the Sea of Marmara. Çınar *et al.,* (2014b) listed 121 species from Aegean coasts and 58 species from Levantine coast, with a total of 136 species from the Mediterranean coasts of Türkiye.

According to the Barcelona and Bern Conventions, *Savalia savaglia* is recognized as an endangered or threatened species. In the national legislation fisheries of *Corallium rubrum* and *Savalia savaglia* are prohibited along the coasts of Türkiye. *Savalia savaglia* is known to occur in the North Aegean Sea (Çınar *et al.*, 2014b). Although *Corallium rubrum* has been found at the depths of the North Aegean Sea (Chintiroglou *et al.,* 1989; Vafidis *et al.,* 1994) and Kastellorizon Island (Zibrowius, 1979). Living colonies of *Corallium rubrum* were observed at 50m depth off Gökçeada (North Aegean Sea) and fragments of dead colonies were found in three laocations on the Levantine coast of Türkiye (Çınar *et al.,* 2018).

Annelida

The faunistic analysis of marine annelids in Türkiye started as early as mid 1800s. Only few studies concerning annelids were published until 1950s.The first report to investigate the diversity of the marine fauna of Türkiye was made in the frame work of the project "Database of Fauna of Türkiye" in 1998 and a total of 375 annelid species were reported (Kocataş *et al.,* 2000). Since then, many new records and new species have been encountered on the coast of Türkiye.

The most comprehensive checklist on Annelids was published by Çınar et al, 2014a and 650 species (559 species from Aegean Sea and 459 species from Levantine coasts) were reported from Mediterranean coasts of Türkiye. The Mediterranean coasts of Türkiye were the type locality of 16 polychaete species: *Hermodice nigrolineata*, *Syllis ergeni, Trypanosyllis sanmartini*, *Leonnates aylaoberi*, *Marphysa cinari*, *Lumbrineris geldiayi*, *Prionospio anatolica*, *Prionospio ergeni*, *Prionospio maciolekae*, *Levinsenia demiri*, *Levinsenia kosswigi*, *Levinsenia materi*, *Levinsenia tribranchiata*, *Flabelliderma cinari*, *Semiodera cinari* and *Stylarioides grubei*.

Most of the Annelid species characterize high dynamic littoral environment with soft substrate. There are also parasites (such as, members of Piscicolidae family) and pelagic species (such as members of the Tomopteridae, Typhloscolecidae, Lopadorhynchidae families) (Çınar *et al*., 2014a). Some species such as *Aricidea pseudoarticulata*, *Aricidea suecica meridionalis*, *Cirrophorus furcatus* and *Paradoneis lyra* seem to be tolerant to organic pollution, occurring abundantly in the polluted soft substratum. However, *Aricidea claudiae, Aricidea simonae* and *Levinsenia demiri* were found to occur in unpolluted regions (Erdoğan *et al.,* 2016).

Arthropoda

The first taxonomic studies on arthropod species along the Turkish coasts began in the 18th century. During the first half of the 20th century several researchers made contributions to the understanding of the diversity of marine arthropods. However, in the second half of the 20th century, there has been a significant increase in the number of scientific studies on arthropods along the coasts of Türkiye (literature reviewed in Bakır *et al.,* 2014). More than 300 papers regarding marine arthropods have been published from the region, but the most completed checklist was published by Bakır *et al.,* (2014), including a total of 1,424 arthropod species from the Mediterranean coasts of Türkiye (1,056 species from the Aegean coasts and 849 from Levantine coasts). But, researchers made more additions afterwards, [e.g. Öktener *et al.,* 2018 (*Ceratothoa oxyrrhynchaena*); Deval and Froglia,

2016 (*Funchalia villosa, Plesionika acanthonotus*, *Plesionika gigliolii, Monodaeus couchii*); Özcan *et al.,* 2019 (*Mesopodopsis slabberi),* Ozgen *et al.,* 2019 *(Caprella tavolarensis*, *Eriopisella ruffoi*, *Iphimedia vicina*, *Astacilla mediterranea*, *Apseudopsis minimus* and *Macropodia deflexa*) Gönülal *et al.,* 2016 (*Sicyonia lancifer*)].

Mollusca

Over the last two centuries, the molluscan fauna of the coasts of Türkiye have been extensively studied. The number of molluscan studies increased in early 1900s but the major contribution was made in the last decades. Studies on alien mollusc fauna also made a considerable input to the species lists.

The specimens of *Hinemoa cylindrica*, previously reported from the Levantine coast of Türkiye, were re-described as *Oscilla galilae* by Bogi *et al.,* (2012). There is a similar status to the specimens of *Murchisonella columna* that originated along the Levantine coast, which have been re-described as a new species (*Murchisonella mediterranea*) by Peñas and Rolán (2013), and it was found to be unrelated to the Red Sea species *Murchisonella columna*. The Mediterranean coasts of Türkiye were the type locality of several gastropod species, such as *Eleutheromenia carinata, Alvania bozcaadensis, Alvania campanii, Alvania datchaensis*, *Alvania marmarisensis*, *Trivia levantina* and *Odetta zekiergeni*.

Several checklists on special groups were published, Yokeş, 2009 (Opisthobranchia); Albayrak, 2001 (Bivalvia); Salman *et al.,* 2002 (Cephalopoda); Öztürk and Çevik, 2000 (all marine molluscs). The most comprehensive checklist was included a total of 1,000 species from the Mediterranean coasts of Türkiye (825 species from the Aegean coasts and 807 from Levantine coasts) (Öztürk *et al.,* 2014).

Most of these mollusc species inhabit the littoral biotopes at depths up to 100 m and most of the species inhabit both soft and hard substrata. However, there are also parasite living (Pyramidellidae and Eulimidae) or pelagic species (Pteropoda, Cephalopoda).

Bryozoa

The first study on marine bryozoan fauna of the Turkish Aegean coasts was given by Forbes (1844), but a considerable input to the bryozoan fauna could not be made until 1970s. Ünsal (1975) published the description and illustration of the bryozoan species collected in the Aegean Sea. *Hornera lichenoides,* which is listed in Annex II of the SPA/BD protocol of the Barcelona Convention, was reported from the Aegean coasts (Ünsal, 1975). *Cleidochasmidra canakkalense* was described as a new species (Ünsal and d'Hondt, 1978–1979). Considerable contributions to the Bryozoan fauna of the Levantine coasts were made by Nicoletti *et al.* (1995) and Chimenz *et al.* (1997), *Retevirgula akdenizae* (type locality: Datca) was described. Both spatial and temporal aspects of fouling communities in different marinas located on the Aegean coast were investigated by Kocak *et al.* (1999) and Kocak (2008).

A complete checklist of Bryozoans from the Turkish coastline was given by Koçak and Aydın Önen (2014). In which, 139 species were reported from the Aegean Sea and 66 species from the Levantine coasts, giving a total of 158 species from the Mediterranean coasts of Türkiye. Ulman *et al.,* (2017) reported four alien species: *Amathia verticillata*, *Hippopodina* sp. A, *Parasmittina egyptiaca* and *Watersipora arcuata* from various marinas along the Aegean and Levantine coasts. Another alien species, *Bugulina fulva* was recorded by Koçak and Bakkal (2019) in Marmaris.

Other invertebrate groups

Not all the invertebrate groups were extensively studied along the Turkish Mediterranean coastline. A series of checklists were published in 2014. The number of species listed for Mediterranean coasts of Türkiye are given in Table 3. However, more new records, especially of alien species, were reported all along the Turkish Mediterranean coasts. Thus, these checklists should be updated.

Protected species

The invertebrate species listed in Annex II of the SPA/BD protocol of the Barcelona Convention: *Cymodocea nodosa, Posidonia oceanica, Zostera marina, Zostera noltii, Gymnogongrus crenulatus, Lithophyllum byssoides, Tenarea tortuosa, Titanoderma trochanter, Cystoseira spp.*, *Sargassum acinarium, Sargassum hornschuchii, Aplysina spp.*, *Axinella cannabina, Axinella polypoides, Sarcotragus foetidus, Tethya spp.*, *Savalia savaglia, Cladocora caespitosa, Corallium rubrum, Hornera lichenoides, Charonia tritonis variegata, Dendropoma petraeum, Erosaria spurca, Lithophaga lithophaga, Luria lurida, Pholas dactylus, Pinna nobilis, Ranella olearia, Tonna galea, Zonaria pyrum, Ocypode cursor, Asterina pancerii, Centrostephanus longispinus and Ophidiaster ophidianus* and the invertebrate species listed in Annex III: *Hippospongia communis, Spongia (Spongia) officinalis officinalis, Corallium rubrum, Paracentrotus lividus, Homarus gammarus, Maja squinado, Palinurus elephas, Scyllarides latus, Scyllarus arctus* and *Scyllarus pygmaeus* were reported from the Mediterranean coasts of Türkiye.

Table 3.

Number of invertebrate species reported from the Mediterranean coasts of Türkiye. Med: Mediterranean coasts of Türkiye, encompassing the Aegean Sea and the Levantine Sea.

	All species			Alien species			
Invertebrate groups	Aegean Sea	Levantine Sea	Med	Aegean Sea	Levantine Sea	Med	Reference
Porifera	82	51	112				Topaloğlu and Evcen, 2014
Cnidaria	121	58	136	9	7	15	Çınar et al., 2014a
Ctenophora	4	3	5	1	1	1	Çınar et al., 2014a
Platyhelminthes	76	7	82				Çınar, 2014
Nematoda	8	3	11				Çınar, 2014
Acanthocephala	3	1	4				Çınar, 2014
Nemertea	7	11	13				Çınar, 2014
Annelida	559	459	650	29	56	66	Çınar et al., 2014b

Invertebrate groups	All species Aegean Sea	Levantine Sea	Med	Alien species Aegean Sea	Levantine Sea	Med	Reference
Echiura	1	1	1				Çınar, 2014
Phoronida	4	3	4				Çınar, 2014
Chaetognatha	3	10	10		1	1	Çınar, 2014
Sipuncula	17	18	21	3	4	4	Açık, 2014
Arthropoda	1056	849	1424	33	61	78	Bakır et al., 2014
Mollusca	825	807	1000	37	111	114	Öztürk et al., 2014
Bryozoa	139	66	158	3	2	4	Koçak and Aydın Önen, 2014
Echinodermata	76	51	81	2	4	5	Öztoprak et al., 2014
Chordata	40	36	52	2	4	4	Çınar, 2014
TOTAL	**3021**	**2434**	**3764**	**119**	**251**	**292**	

2.1.3 Information on vertebrates other than fish

Turtles

Caretta caretta, *Chelonia mydas*, and *Dermochelys coriacea* are the marine reptiles reported from the Mediterranean coasts of Türkiye. The latter species does not nest in the Mediterranean and those individuals uncommonly encountered are suggested to be of Atlantic origin (IUCN, 2012). All 3 sea turtles are distributed along the Mediterranean coasts of Türkiye, however, *C. caretta* and *C. mydas* are dependent on their nesting sites along the Levantine coasts (Türkozan and Kaska, 2010).

Regarding the number of nesting sites, Türkiye is one of the most important countries for the sea turtle populations in the Mediterranean. The shoreline from Tarsus to İskenderun was denoted as the important nesting site for *Caretta caretta* by Carus (1893) and Gruvel (1931). Major contributions to the ecology of turtles were made after 1970s. Most of the nesting sites along the Levantine shores of Türkiye were extensively examined (Hathaway, 1972; Başoğlu, 1973; Geldiay, 1984). More recent studies revealed the presence of 25 sea turtle nesting sites, spread over a total of 289 km of coastline from Samandağ in the east to Ekincik Bay in the west (Türkozan and Kaska, 2010).

For the last 30 years marine turtles and nests were monitored in five SEPAs (Fethiye-Göcek, Belek, Göksu Deltası, Köyceğiz-Dalyan and Patara) between May and October under the framework of the '*Action Plan for the Conservation of Mediterranean Marine Turtle*' by MoEU in collaboration with universities and NGOs.

In the framework of a monitoring programme, *Caretta caretta* and *Chelonia mydas* populations in Kaş-Kekova SEPA were monitored between 2002-2018 (Yokeş *et al.*, 2019).

Expansions in population sizes were observed in both species. The number of sightings of *Caretta caretta* doubled in 2014 and decreased back to normal in 2016. *Chelonia mydas* was seldomly observed in the SEPA until 2015. After then, the population size increased to an unexpected level and groups of 5-10 individuals grazing at the same site became a common observation in certain locations in the SEPA. Number of individuals observed increased from 2/day (in 2014) to 22/day (in 2018). The increase in population sizes were suggested to be the result of successful conservation programmes conducted in the nesting sites all along the Levantine coasts of Türkiye.

Seabirds

The zoogeographic position of Türkiye constitutes an important site for seabirds in terms of breeding, passage, and wintering. In recent years, studies on seabirds in Türkiye were accelerated because of the increase in the activities of the NGOs and bird-watching groups organized at universities or established as independent clubs throughout the country. Besides, increasing number of amateur photographers and NGOs for nature photography provide extensive temporal and spatial data on the distribution of birds of Türkiye. However, scientific studies on seabirds still needs to be increased to fill the gap of knowledge on the distribution, population, ecology and conservation of the species.

A checklist of seabirds was recently published, but still needs to be updated (Güçlüsoy *et al.*, 2014). A total of 41 species were reported from the Mediterranean coasts of Türkiye (Aegean Sea: 36 species; Levantine Sea: 39 species). *Calonectris diomedea, Puffinus yelkouan, Hydrobates pelagicus, Pelecanus crispus, Pelecanus onocrotalus, Microcarbo pygmeus, Phalacrocorax aristotelis, Chroicocephalus genei, Ichthyaetus audouinii, Ichthyaetus melanocephalus, Larus armenicus, Gelochelidon nilotica*, *Hydroprogne caspia*, *Thalasseus bengalensis*, *Thalasseus sandvicensis*, *Sternula albifrons* are listed in Annex II of the SPA/BD protocol of the Barcelona Convention.

Cetaceans

Ten Cetacean species were reported from Mediterranean coasts of Türkiye; *Phocoena phocoena relicta, Delphinus delphis, Tursiops truncatus, Stenella coeruleoalba, Grampus griseus, Ziphius cavirostris, Physeter macrocephalus, Pseudorca crassidens, Balaenoptera physalus, Balaenoptera acutorostrata* (Güçlüsoy *et al.*, 2014). All of these species are listed in Annex II of the SPA/BD protocol of the Barcelona Convention. In addition to these ten species, Indian Ocean humpback dolphins (*Sousa plumbea*) were first time observed at two occasions on 3 February and 25 April 2016 on Turkish coastal waters of the Northeast Mediterranean (Özbilgin *et al.* 2018).

The studies on the cetaceans in the Aegean Sea are very limited and most of the knowledge were collected by sporadic sightings (*e.g.* Güçlüsoy, 2008) and by studying stranded animals (e.g. Güçlüsoy *et al.*, 2004). By using both opportunistic platforms and photo ID, Alan *et al.* (2015) estimated the population size of bottlenose dolphins as 143 (%95CI: 111-159) for 2013 and 132 (%95CI: 109-158) for 2014 individuals, and photo-identified (Alan *et al.* 2017) 11 *T. truncatus* individualsin the outer part of the İzmir Bay. Alan *et al.* (2018) also conducted cetacean monitoring surveys biannually for three years in the southern part of Çandarlı bay. And confirmed a low encounter rate of small delphinids in the bay

as 1.7567 sightings per100 km.Genetic studies revealed that the two individuals of *P. phocoena relicta* sampled in the northern and southern Aegean Sea coast of Türkiye carry two different haplotypes which were found in the Black Sea in earlier studies, supporting the idea that harbor porpoises from the Black Sea are dispersing into the Aegean Sea (Tonay *et al.,* 2012 and 2014)

Besides, a preliminary genetic study performed on a stranded Risso's dolphin showed that the stranded individual in the Aegean Sea had genetic profile very close to Western Pacific individuals (Sönmez *et al.,* 2012).

Monachus monachus

The Mediterranean monk seal, *Monachus monachus* is one of the rarest and most threatened species in the Mediterranean. The species is protected by several conventions, Bonn (Appendix I and II), Bern (Appendix II), CITES (Appendix I), Barcelona (Fourth protocol species), and Biodiversity (Eligible species) conventions and European Community's Habitats Directive (Annex II and Annex IV). Türkiye is among the very few countries still providing a shelter to the species.

In late 1970s, the population of *Monachus monachus* on the Mediterranean coasts of Türkiye was estimated to be composed of 35 individuals. Further studies helped to figure out the actual size of the population, however, no accurate information could be obtained concerning the population size. Berkes *et al.,* (1979) estimated 90 seals living along the entire Aegean coasts in the late 1970s. Öztürk (1998), however, estimated that this number had dropped down to 28 within twenty years. According to survey based on sighting data gathered from local fishermen and expeditions, Güçlüsoy *et al.,* (2004) made a better approximate estimation as minimum of 104 individuals for the entire Turkish coasts (Black Sea: 2-3; Sea of Marmara: ≥1; North Aegean Sea: 35; South Aegean Sea: ≥28; Levantine Sea: ≥37). According to their data the sightings were concentrated on four regions in the Aegean Sea: 1) Gökçeada to Baba Cape, 2) Foça to Karaburun, 3) Çeşme to Kuşadası-Dilek peninsula, 4) Bodrum.

Berkes *et al.,* (1979) estimated the Levantine population composed of 35 individuals. Öztürk (1994). identified 11 seals in 1987 - 1994 surveys. A colony which still retained reproductive ability was found on the west coast of Mersin (Gucu *et al.,* 2004). Resting and breeding caves used by the seals were discovered. The area was set aside for conservation in 1997 and "No take-zone" was declared in the sea and on the land, encompassing the caves and the foraging areas. Follow up studies conducted after the conservation remedies were enforced revealed that the colony was composed of 24 individuals. A significant increase was observed in the breeding success and the size of the colony was increased from 24 to 30 after the protection measures set (Gucu and Ok, 2006). Small segregated breeding populations of seals were also found inhabiting the rocky coasts at Turkish/Syrian border and around Antalya. As of year 2008, a total of 50 individuals were believed to survive in four populations on the northeastern Mediterranean shores.

The literature on the population size, distribution and ecology of the monk seal populations along the coasts of Türkiye is unfortunately outdated and must be updated as soon as possible for the sake of conservation of this iconic species.

In the framework of 'The Action Plan for the Management of Mediterranean Monk Seal', several projects were conducted in Foça SEPA (Kıraç and Güçlüsoy, 2008).

2.1.4 Inventory of the temporal occurrence, abundance and spatial distribution of non-indigenous, including invasive, species

Mediterranean Sea is invaded by many alien marine organisms of either Atlantic or Indo-Pacific origin and this invasion is an ongoing process, each year new alien species are being recorded in the Levantine basin. A total of 154 alien species were known from the Turkish coasts before 1990. However, the new additions greatly increased after 1990 and 247 alien species were added to the list between 1990-2011, with an increment of 160%.

The first detailed analysis of this invasion phenomenon was done by Çınar *et al.,* (2005) and a list of 263 species belonging to 11 systematic groups were given for all Turkish coasts (Black Sea: 20 species; Sea of Marmara: 48 species; Aegean Sea: 98 species and Levantine Sea: 202). The Suez Canal found to be the primary vector for species introductions in the Eastern Mediterranean. Six years later, Çınar *et al.* (2011) published an updated review of the list, reporting 400 alien species belonging 14 systematic groups (Black Sea: 20 species; Sea of Marmara: 69 species; Aegean Sea: 165 species and Levantine Sea: 330). It was found that the 76% of total number of species have become established in the area, while 15% were classified as casual, 6% as questionable (6%) and 3% as cryptogenic.

Checklists of marine macrofauna of the Turkish coasts were published in a series of papers (see Çınar and Bilecenoglu, 2014), in which a total of 292 alien species from Mediterranean coast of Türkiye was reported (Aegean Sea: 199; Levantine Sea: 251). These checklists do not cover all the alien species recorded on the coasts of Türkiye, since they do not include all the groups, such as macroflora and Foraminifera. 37 taxa of alien macroflora, (Aegean Sea: 20 taxa; Levantine Sea: 21 taxa) were reported by Taşkın *et al.,* (2018a and 2018b). Extensive studies on recent benthic foraminifera revealed the presence of 99 alien species (Black Sea: 1 species; Sea of Marmara: 38 species; Aegean Sea: 50 species; Levantine Sea: 48 species), 36 of which were not included in Çınar *et al.,* (2011) (Meriç *et al.,* 2015, 2016a, 2016b; 2017). Besides, many more alien recordings, range expansions reported in the last ten years (e.g. Çiftçi *et al.,* 2017; Gökoğlu *et al.,* 2016; Stamouli *et al.,* 2017; Ulman *et al.,* 2017; Yokeş, 2015; Yokeş *et al.,* 2018). Thus, the alien lists of nearly all groups are outdated.

2.1.5 Information on species of commercial interest for fishing (fish, mollusk and shellfish):

Fish

In a zoogeographical sense, the Turkish marine ichthyofauna comprises endemics, cosmopolitan species, Atlanto-Mediterranean, Tropical Atlantic and Indo-Pacific/Red Sea originated species. Comprehensive reviews have revealed the presence of over 500 marine fish along Türkiye's coasts, of which 449 occur in Aegean Sea and 441 in Levant Sea (Bilecenoglu *et al.,* 2014). At least 1/3 of the fish fauna are exploited as food, although

many of them bearing only limited and/or local commercial interest. The minimum size allowed for fisheries and the closed fisheries period for selected species is regulated according to the fisheries notifications (renewed in every four years) announced by the Turkish Ministry of Agriculture and Forestry, General Directorate of Fisheries and Aquaculture.

Similar to most parts of the Mediterranean Sea, Turkish marine fisheries along the eastern Mediterranean (FAO fishing areas 3.1. Aegean Sea and 3.2. Levant Sea) can be grouped under three main categories, namely the small scale, trawl and purse seine fishery. Small-scale fishery is an important commercial and traditional activity for contribution to the livelihoods of local community, in which passive gears such as gill-nets, entangling nets, longlines and traps are frequently used (Tosunoglu and Güçlüsoy, 2019). The Turkish small-scale fishing fleet consists of nearly 13,000 vessels (57% registered to Black Sea and Sea of Marmara), representing over 90% of the commercial fleet in terms of number of vessels (Ünal and Ulman, 2020). Trawlers and purse-seiners can be considered as industrial vessels and according to the most recent fishery statistics, there are 240 bottom trawlers (63 in Aegean and 177 in Levant Seas) and 90 purse-seiners (55 in Aegean and 35 in Levant Seas) (TUIK, 2019).

The industrial fishery activities carried out along the Aegean and Levant seas are mostly dependent on schooling pelagic species (such as anchovy, pilchards, chub mackerel, etc.), while only a few demersal fish are represented by high capture production values (Table 4). Information on abundance, spatial distribution and population dynamics (age, growth, mortality, etc.) of pelagic stocks through the area are either largely missing and/or outdated. Available mortality data reveals that majority of the existing demersal fish stocks are overfished, with exploitation rates well over the optimum sustainable level (Table 5).

The official fishery notifications include a list of species strictly banned for fishing, which is regularly being updated. During the last decade, the list has significantly been extended. According to the recent restrictions in charge (fishery notification no. 5/1 and 5/2, valid until 2024), it is prohibited to capture the following cartilaginous shark and ray species: *Carcharhinus plumbeus*, *C. longimanus* (not existing in Türkiye), *C. falciformis*, *Cetorhinus maximus*, *Galeorhinus galeus*, *Prionace glauca*, *Alopias superciliosus*, *A. vulpinus*, *Isurus oxyrinchus*, *Oxynotus centrina*, *Sphyrna zygaena* (possibly locally extinct in the wild), *Lamna nasus*, *Squalus acanthias*, *Squatina oculata*, *Sq. squatina*, *Sq. aculeata*, *Rhinobatos rhnibatos*, *R.cemiculus*, *Raja clavata*, *Mobula mobular*, and *M. japanica*. Among ray finned fishes, fishery of all sturgeon fishes (*Acipenser spp.* and *Huso huso*), short-snouted seahorse (*Hippocampus hippocampus*) and dusky grouper (*Epinephelus marginatus*) is prohibited.

The artisanal fisheries in Türkiye targets at least 40 fish and invertebrate species (Table 6). Since the official fishery statistics do not break down capture production data into various fishing gears, amount of fishery production originated from small scale fisheries is not fully known. Anyhow, *Mullus spp.* (red/striped mullet), *Epinephelus spp.* (groupers), Sparids (*Diplodus spp.*, *Pagrus spp.*, *Pagellus spp.*, *Dentex spp.*, *Sparus aurata* etc.), Siganids (dusky/marbled spinefoot) and brushtooth lizardfish (*Saurida lessepsianus*) are among the most fished species at Aegean and Levant Sea coasts.

Table 4.

Capture fish production of main commercial species (TUIK, 2019)

Aegean Sea		Levant Sea	
Species	Production (tonnes/year; 2019)	Species	Production (tonnes/year; 2019)
1. Anchovy	12,141	1. Pilchards	3,656
2. Pilchards	10,683	2. Tunas	1,771
3. Bogue	2,595	3. Red mullet	875
4. Chub Mackerel	1,693	4. Sea breams	635
5. Horse mackerels	1,373	5. Chub mackerel	569
6. Shads	1,372	6. Horse mackerels	443
7. Grey mullets	1,349	7. Grey mullets	354
8. European hake	1,143	8. Atlantic bonito	332
9. Red mullet/Surmulet	1,133	9. Soles	258
10. Atlantic bonito	423	10. Gilt-head bream	207

Table 5.

Population characteristics of selected commercial fish stocks (AS: Aegean Sea, LS: Levant Sea; exploitation rates over 0.5 denotes overfishing).

Species	Locality	Length Range	Age	Exploitation Rate	Reference
Engraulis encrasicolus	AS	6.2 - 14.0	I - III	-	Uçkun et al., 2005
Trachurus trachurus	AS	10.0 - 13.9	I - IV	-	Erdogan et al., 2016
Scomber japonicus	AS	12.5 - 27.2	I - IV	-	Bayhan, 2007
Sardinella aurita	AS	13.0 - 21.4	I - III	-	Mater et al., 2003
Sardina pilchardus	AS	8.7 - 14.3	I - III	0.38	Erdogan et al., 2010
Sardina pilchardus	AS	9.3 - 14.3	I - IV	-	Karakayis and Togulga, 2000
Boops boops	AS	11.3 – 27.9	I - V	-	Kara and Bayhan, 2015
Mullus barbatus	AS	5.0 - 23.0	I - V	0.72	Özbilgin et al., 2004
Mullus barbatus	LS	6.9 - 15.7	I - V	0.67	Çiçek, 2015
Mullus surmuletus	AS	6.6 - 22.6	I - VI	-	Uçkun İlhan et al., 2009
Merluccius merluccius	AS	13.6 - 43.5	I - VII	-	Uçkun et al., 2006
Merluccius merluccius	AS	5.9 - 44.4	-	0.74	Gurbet et al., 2013
Merluccius merluccius	LS	8.8 – 21.8	I - IV	0.88	Çiçek and Avsar, 2010
Solea solea	LS	8.8 - 22.2	I - VIII	0.62	Türkmen, 2003
Solea solea	AS	19.1 - 42.1	I - IX	-	Cerim and Ates, 2020

Molluscs: Among the coasts of Türkiye, the highest number of molluscan species was recorded from the Aegean Sea (825 species), followed by the Levantine Sea (807 species) (Öztürk *et al.*, 2014). The eastern Mediterranean commercial fishery is mostly concentrated on cephalopods (octopus, squid and cuttlefish), whose annual production during 2019 was 1828 tonnes (Table 7). The Mediterranean Sea mussel (*Mytilus galloprovincialis*) seems to be the most widely consumed molluscan species in Türkiye, whose capture fishery is mainly carried out in Black Sea and Sea of Marmara.

Some species such as *Rapana venosa* (Rapa whelk), *Chamelea gallina* (striped venus clam), *Ruditapes decussatus* (grooved carpet shell) and *Venus verrucosa* (warty venus), obtained from natural habitats by fishing, have been mostly exported to different European and Asian countries (Öztürk *et al.*, 2015).

There are fishery restrictions for some molluscan species such as *Pinna nobilis*, *Cerithium vulgatum*, *Haliothis tuberculata* and all members of the family Lamellaridae, whose collection are prohibited along the entire coasts of Türkiye.

Crustaceans: *Penaeus semisulcatus*, *P. japonicus*, *P. kerathurus*, *Metapenaeus monoceros*, *M. stebbingi*, *Parapenaeus longirostris* and *Melicertus hathor* are among the most common captured species at the eastern Mediterranean coasts. Prawns are not only fished by bottom trawlers, but also by trammel nets and there is a constant demand for their exploitation in the market. In terms of annual capture production rates (tonnes/year), crustaceans are the mostly fished invertebrates along the Aegean and Levant seas.

Table 6.

Target species captured by different fishing gears in southern Aegean Sea (Ünal et al., 2019)

Type of fishing gear	Target species
Red mullet bottom-set gillnet	Red mullet, twaite shad, chub mackerel, yellowmouth barracuda, brushtooth lizardfish, pandora
Pink dentex bottom-set gillnet	Red porgy
Bottom-set gillnet	Sardine, goldband goatfish, yellowmouth barracuda, horse mackerel, chub mackerel
Bottom-set gillnet	Grey mullet, horse mackerel, saddled sea bream, chub mackerel, barracuda, bonito, garfish
Atlantic bonito bottom-set gillnet	Bonito, little tuny, pompano
Red mullet trammel net	Red mullet, goldband goatfish, striped red mullet, chub mackerel, sardine, brushtooth lizard fish, tub gurnard, European hake, grey mullet, horse mackerel
Trammel net	Red mullet, rabbitfish, salema, dentex, pandora, randall sea bream, bluetooth lizardfish, bonito, twaite shad, pompano, bogue, two-banded sea bream, barracuda, scorpionfish, annular sea bream, striped red mullet, goldband goatfish
"Voli" trammel net	Grey mullet, rabbitfish, saddled sea bream, two-banded sea bream, barracuda, chub mackerel, horse mackerel, white grouper, red mullet, bonito, greater amberjack, leerfish
Common dentex trammel net	Dentex, white grouper, octopus, cuttlefish, squid, greater amberjack, red porgy, two-banded sea bream, tub gurnard, spiny lobster
Common sole trammel net	Sole
Combined bottom-set net	Dentex, pandora, gilthead sea bream, white grouper, brushtooth lizardfish
Thin longline	Pandora, two-banded sea bream
Middle longline	Comb grouper, dentex, red porgy
Thick longline	Goldblotch grouper, dentex, red porgy

Table 7.

Commercially exploited mollusc and arthropods in eastern Mediterranean fisheries of Türkiye (TUIK, 2019).

Species	Aegean Sea (tonnes/year; 2019)	Levant Sea (tonnes/year; 2019)	Total (tonnes/year; 2019)
Octopus	287.3	5.1	292.4
Squid	435.4	182.3	617.7
Cuttlefish	346.5	573.2	919.7
Prawns	2,209	1,158	3,367
Blue crab		4.7	4.7
Lobsters	2.7	0.1	2.8

2.2. Main Habitat types

Because of the diverse environmental characteristics, the marine and coastal area of the Turkish Mediterranean coastline contains not only the typical marine and coastal Mediterranean habitats, but also some habitats unique to eastern Mediterranean (Figure 1-4). Studies concerning marine habitat typing are very limited for Mediterranean coasts of Türkiye. Except the mapping studies of seagrass meadows mentioned in Section 2.1.2, there are only two studies, in which local habitat types are defined and mapped (Aslan *et al.*, 2018; SPA/RAC–UN Environment/MAP, 2020). Although there is quite a lot of information on the biota, there is lack of information on the mapping, abundance, coverage and health status of the coastal and marine habitats on the Turkish Mediterranean coasts.

Regarding SPA/RAC-UN Environment/MAP 2019 Updated Classification of Benthic Marine Habitat Types for the Mediterranean Region, the most known habitat types found along the Turkish Mediterranean coastline are given below.

Seagrass meadows

Posidonia oceanica meadows are abundant all along the Aegean coasts, from the shore down to 40 m. Majority of the meadows are healthy and reproductive. *Posidonia* meadows are very limited on the Levantine coasts. Dense and healthy beds are found around Kalkan and Kaş (Antalya), but it becomes rare and form smaller patches towards the east of Antalya.

Cymodocea nodosa beds are usually found in confined bays and coves at shallower depths compared to *Posidona oceanica*. But it can also be found down to 30 m. It is widely distributed all along the Mediterranean coasts of Türkiye. It is the dominant seagrass species on the Levantine coasts.

Halophila stipulacea is an alien species, which is widely distributed on the Mediterranean coasts of Türkiye. However, it is much more abundant in the Southern Aegean Sea and is

the dominant Phanerogam in the Levant Sea. Although it can be found at shallow depths, it is more common and form dense mats below 10 m.

Zostera spp. have a limited distribution on the Mediterranean coasts of Türkiye. They are found in confined places, lagoons and river mouths. But they occupy large areas and are dense enough to form facies by themselves.

Cystoseira facies

dix sept different *Cystoseira* taxa were reported from the Mediterranean coasts of Türkiye. *Cystoseira* forests occur on the Aegean and western Levantine coasts. They form dense facies which may go from 0 to 30 m of depth.

Caves

Türkiye may be considered as a country rich in caves, due to the abundance of soluble rocks, such as limestone, marble, dolomite, travertine, gypsum and halite. The Taurus Mountains running parallel to shore all along the Levantine coasts create high and steep cliffs the shore, which go down to tens or sometimes more than hundred meters of depth in the sea. The karstic structure resulted in formations of caves at the shore, as well as at various depths in the sea. Coasts of Mersin, Antalya, Muğla, İzmir and Çanakkale includes many marine caves, which can be classified in different habitat types according to depths and the amount of penetrating light.

Very few preliminary biodiversity studies have been conducted in submarine caves along the Mediterranean coasts of Türkiye. Taşkın and Akçalı (2019) reported 79 taxa of marine benthic macroalgae, 58 of wich were belonging to red algae (Rhodophyta), 12 were green algae (Chlorophyta) and 9 were brown algae. Macrozoobenthic invertebrates were investigated in three submarine caves along the coasts of Izmir and Aydın and 104 species belonging to 10 taxonomic groups were recorded (Çınar *et al*., 2019). 32 fish species were reported by Bilecenoğlu (2019) from six submarine caves along the Aegean coasts. 72 species were observed in submarine caves in Gökçeada and Bozcaada (North Aegean Sea) by Özalp (2019). Anthropogenic impact on cave habitat was investigated by Öztürk *et al.* (2019) in caves on the southwestern coast of Türkiye.

Facies with Alcyonacea

Eunicella singularis, *Eunicella cavolinii*, *Paramuricea clavata* communities are found in North Aegean Sea. *Eunicella spp.* are very common below 20 m on rocky reefs in Saros Bay, Gokçeada and Bozcaada. Dense gorgonian communities were reported in Ayvalık Nature Park (Yokeş and Demir, 2013).

Lagoons

There are 15 lagoons found on the Mediterranean coasts of Türkiye. Two of them are under protection as SEPA (Göksu Delta SEPA and Köyceğiz-Dalyan SEPA), two of them are national park (Büyük Menderes Delta National Park, Yumurtalık Lagoon National Park) and one of them very recently gained the natural protected site status (Akyatan Lagoon).

2.3 Singular habitats in the country

It was shown that, the two alien herbivorous Siganid fish species, *Siganus luridus* and *Siganus rivulatus* are responsible for the barren formation in the Eastern Mediterranean (Sala *et al.,* 2011). Continuous grazing on the rocky surface results in depletion of algal communities, leaving behind a habitat composed of bare rocks with extremely low biomass. This type of habitat is very common all along the Levantine coasts of Türkiye. But it is not classified neither in 'SPA/RAC-UN Environment/MAP 2019 Updated Classification of Benthic Marine Habitat Types for the Mediterranean Region', nor in EUNIS classification.

2.4 Transboundary issues

Mediterranean coasts of Türkiye host many migratory or vagrant species, such as fishes, sea turtles, seabirds and cetaceans. Effective management of these species requires international cooperations. The stocks of some of the migratory pelagic fish species such as swordfish, bluefin tuna, bonito, and bluefish are shared by Türkiye and Greece (Öztürk *et al*., 2002). The Mediterranean monk seal has a small population surviving among the Aegean islands and islets. The distribution patterns of the individuals encompase both Turkish and Greek waters (Öztürk 1998). Long-term satellite tracking of Green turtle (*Chelonia mydas*) revealed that the individuals are highly mobile and can travel all along the Eastern Mediterranean coastline (Godley et al., 2002).

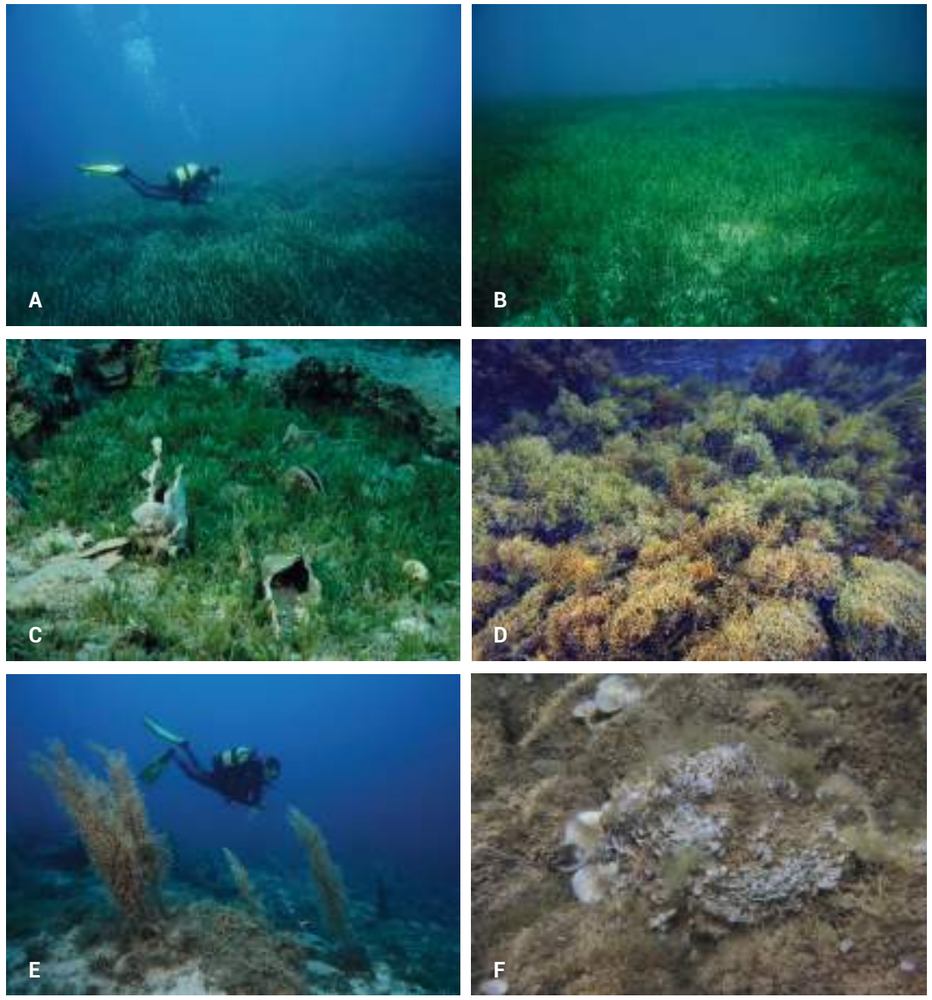

Figure 1.

Common habitat types found on the Turkish Mediterranean coasts that are associated with macrophytes. A) Posidonia oceanica meadows; B) Cymodocea nodosa meadows; C) Halophila stipulacea beds; D) Cystoseira spp. communities; E) Sargassum acinarium communities; F) Brown and/or green algae mixed communities.Photo credits: A, B, C, E, F: Hasan Yokeş; D: Murat Bilecenoğlu.

Figure 2.

Habitats associated or formed by the alien species, that are common in the Eastern Mediterranean. A) Caulerpa cylindracea; B) Caulerpa taxifolia var. distichophylla; C) Sand forming alien foraminifera Amphistegina lobifera; D) An Octopus vulgaris juvenile hiding in its burrow made by alive Amphisorus hemprichi individuals; E) Cerithium scabdridum dominating benthic communities; F) Strombus persicus dominating soft substrate. Foto credits: A, B: Hasan Yokeş; C, D, E, F: M. Baki Yokeş.

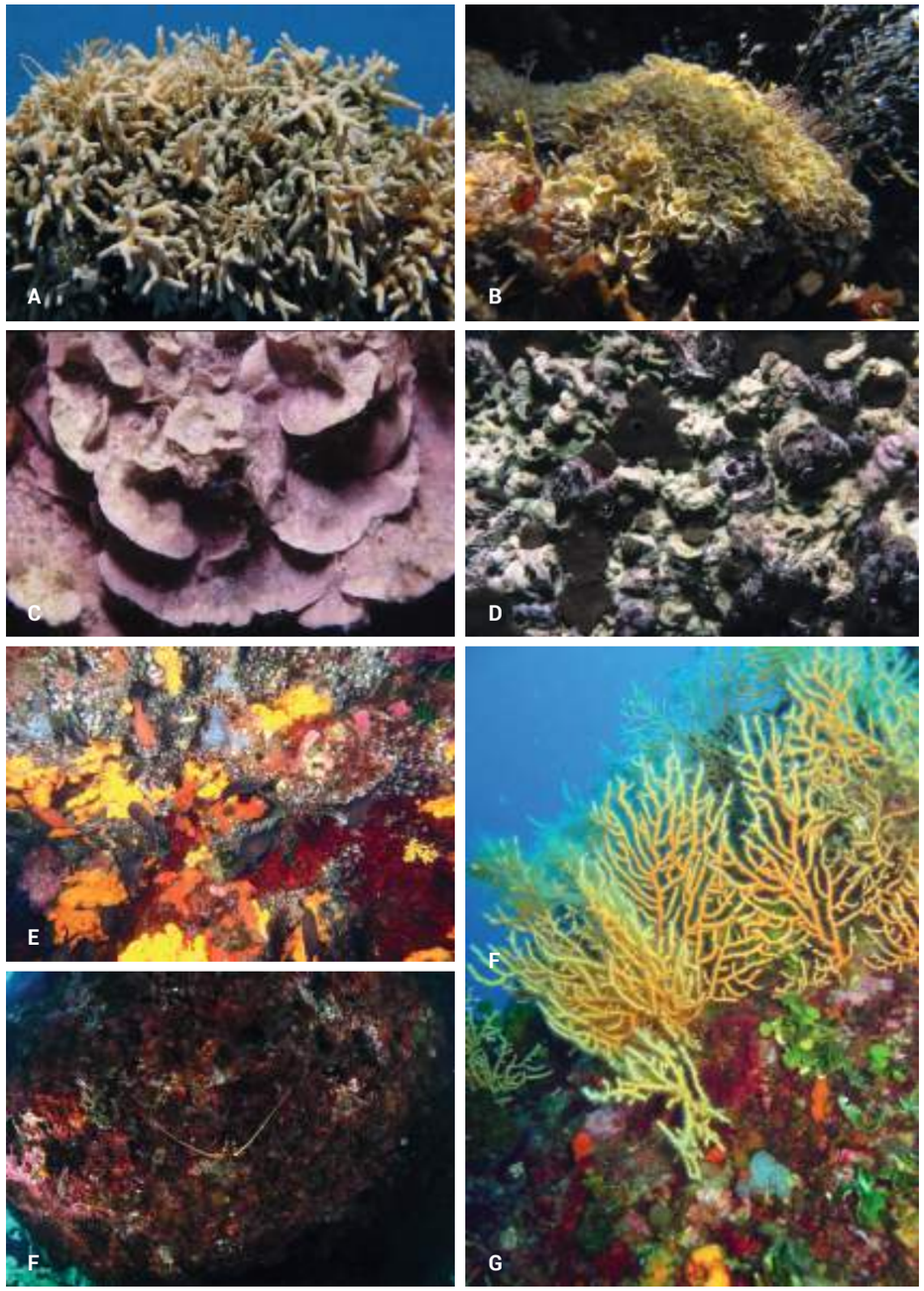

Figure 3.

Reef building or coralligenous habitats. A) Titanoderma trochanter associated; B) Tenarea tortuosa associated; C) Dendropoma spp associated.; D) Mesophyllum spp associated; E) Sponge and Scleactinia mixed habitats; F) Peyssonnelia spp. dominating habitats; G) Alcyonacea associated habitats. Photo credits: A, B: Emine Şükran Okudan; C, D, G: M. Baki Yokeş; E, F: Murat Bilecenoğlu.

Figure 4

A) Sand; B) Peble; C) Coble; D) Anemonia viridis associated hard bottoms. E) Barrens of the Eastern Mediterranean; F) Low productive hard bottoms of the Eastern Mediterranean with very limited algae content. Photo credits: A, B, C, E: Murat Bilecenoğlu; D: Noyan Yılmaz; F: Hasan Yokeş.

Majority of the alien species are introduced to the Eastern Mediterranean via Suez Canal and distributed counter clockwise following the surface currents. Thus, any protective measures taken to inhibit alien invasion cannot be succesfull unless all the eastern Mediterranean countries work together, since the surrounding countries will continue to be a source for the alien species, even if we can manage to eradicate it locally. The alien invasion phemenon does not only require collaboration of the Eastern Mediterranean countries, since there are many alien species that invade the Western Mediterranean first, then spread eastwards. So the alien invasion is the common problem of all the Mediterranean countries. Movement of biota is not only the transboundary issue. Gönülal

et al., (2016) found that eight percent of litter colected off Gökçeada was of foreign in origin coming from Greece and Bulgaria. Marine litter, as well as other physical and chemical polutants also follows the surface currents in the Eastern Mediterranean.

2.5. Identification of the country's marine and coastal biodiversity gaps needed for scientifically sound based conservation

The main gaps identified for the conservation and management of marine and coastal biodiversity of Turkish Mediterranean Sea are as follows:

- Although there is quite information on the marine and coastal biodiversity, there is no clear national strategy to inventory marine and coastal biodiversity.
- Insufficient monitoring programmes for biodiversity in MCPAs.
- Insufficient inventories of marine and coastal habitats.
- Insufficient information on deep sea and high seas habitats.
- Lack of taxonomic experts for some invertebrate groups.
- Insufficient number of multidisciplinary scientific research.
- Insufficient number of multinational scientific research.
- Insufficient monitoring programmes for alien species.
- Insufficient strategy for the management of alien species.
- Only small number of MCPAs have management plans.
- Insufficient implementation of the existing management plans of MCPAs.

3.

Pressures and impacts

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There are multiple pressures on marine and coastal biodiversity, whose cumulative effects often cause dramatic ecosystem responses. Despite of growing number of scientific research conducted to date, understanding the synergistic influence of pressures and impacts on marine and coastal biodiversity of the Turkish coastline is generally difficult to interpret. According to Bazairi *et al.,* (2010), ecosystem approach can be used not only to better understand and undertake the relations and cumulative effect between pressures and impacts, but also the direct/indirect ecosystem consequences and the cascade effects.

3.1. Biological disturbance

The biological disturbance is described below based on non-indigenous (including invasive) species, impact of fisheries and aquaculture on target and non-target species and habitats, and microbial pathogens.

3.1.1. Non-indigenous and invasive species

The worldwide vectors for alien marine species are diverse and can be listed under 15 broad categories, including prominent factors such as commercial shipping activities, canals, aquaculture and fisheries, drilling platforms and the aquarium industry (Bax *et al.,* 2003). Mediterranean Sea is one of the world's immensely affected ecosystems by alien species and the influx of tropical originated species is doubtless the most remarkable bio-geographical phenomenon of today. Due to its proximity to the Suez Canal (which is the main vector of origin for several species) and dense maritime traffic, Türkiye is located within the core area of alien taxa.

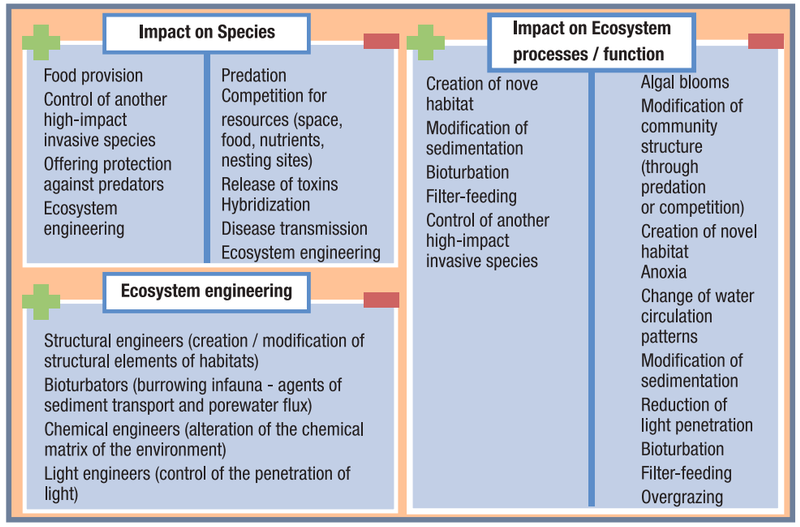

Figure 5.
Main mechanisms through which alien species impact biodiversity (green cross: positive impacts; red minus sign: negative impacts) (from Katsanevakis et al., 2014)

In marine ecosystems, several alien taxa have a potential to become invasive and may have substantial effects on the ecosystems they have been introduced, including extinctions or displacement of native species, modification of habitats, change of the community structure, altered food web dynamics and ecosystem processes, impede the provision of ecosystem services, negatively impacting human health and causing economic losses (Figure 5, Katsanevakis *et al.,* 2014). Based on wealth of studies carried out today throughout the eastern Mediterranean basin, no native species extinctions were reported, but sudden and drastic changes in the local faunal and floral compositions have regularly been observed. No matter which taxa is being introduced to the Mediterranean Sea, each of them alters the food web dynamics to varying degrees. Although there is common negative approach to all alien and invasive species, several of them contributes to local fisheries and provide positive socio-economical income. For example, great majority of the shrimps captured at the northern Levant are of Indo-Pacific origin (i.e. *Marsupenaeus japonicus, Penaeus semisulcatus*), while rabbitfishes (*Siganus spp.*) are one of the main catch of artisanal fisheries. It is noteworthy that current research is mostly focused on records of new alien taxa introductions and bioecological studies are often neglected, which hinders the better understanding of the impact of tropical taxa on ecosystems.

3.1.1.1. Coasts and wetlands

Information on the presence of terrestrial non-indigenous and invasive taxa with potential negative impacts on the coastal ecosystems is quite limited in Türkiye. Existing data focuses on compilations of checklists while no risk assessment was hitherto made.

The free floating aquatic macrophyte *Eichhornia crassipes*, which is native to the Amazon basin, was first recorded in Türkiye from Asi (Orontes) river (Hatay) (Uremis *et al.,* 2014). This perennial species can adapt itself to a wide range of habitats and possess high reproductive characteristics, so may cause serious environmental problems. The remnants of water hyacinth flow from Asi River after rains, move to the dunes of Samandağ beach to create organic-matter pollution, and pose risks to young green sea turtles (*Chelonia mydas*) preventing them getting to the sea after hatching.

The mat forming *Carpobrotus* species have been introduced in most parts of the world and they are widely naturalized on many coastal habitats outside their native range. Due to its tolerance to stress factors such as salinity, drought and excess of light, *Carpobrotus spp*. is a pioneer of disturbed sites and coastal areas including cliffs and sand dune systems, ultimately affecting patterns of native species diversity (Campoy *et al.,* 2018). Two species, *Carpobrotus acinaciformis* and *C.edulis*, have been recorded as naturalized aliens in Türkiye (Uludağ *et al.,* 2017), but their impacts on the ecosystems has not yet been studied.

Besides of the positive socio-economic usage, the habitat transforming *Eucalyptus camaldulensis* is also known for its negative impacts on coastal biodiversity and habitats. Being introduced during the late 19th century in Türkiye, plantations of *Eucalyptus camaldulensis* along the Mediterranean coasts resulted with soil drought and degradation of sands and wetlands in the country (Atasoy and Çorbacı, 2018). It also enhances soil erosion, suppresses undergrowth, depletes soil nutrients and allopathically affects nearby agricultural crop (Bayle, 2019).

Acacia saligna is considered to be one of the most widely planted species across Europe for multiple purposes (reforestation, ornamental use, dune stabilization, etc.). The species is widespread throughout the Turkish Mediterranean Sea coastline and regarded as a naturalized alien species (Uludağ *et al.,* 2017). Research have shown that *A.saligna* modify soil characteristics by increasing the levels of total nitrogen and of organic matter, favoring the development of nitrophilous species and even the removal of Acacia aids in secondary invasion of alien weedy grasses (Yelenik *et al.,* 2004).

3.1.1.2. Coastal water

Concerning the eastern Mediterranean ecosystem, there are several cases of negative impacts of invasive taxa on local biodiversity, mostly through predator-prey relationships and niche overlap. Many alien species are commercially exploited, while some others have drastic effects on local fisheries. Impacts of toxic and venomous species are also well documented.

Alien species have become very important components of benthic and pelagic communities in Iskenderun Bay. A bottom trawl haul in August 2009 (30 m depth) near Yumurtalık (Adana, northeastern Levant) revealed that 92% of the number of specimens and 89% of total biomass belonged to Lessepsian species (Çınar *et al.,* 2011). *Rhopilema nomadica* (58% of total biomass), *Charybdis longicollis* (17%), *Penaeus semisulcatus* (5%) and *Equulites klunzingeri* (4%) comprised the majority of biomass (84%) in the area. The most abundant species in the catch were *C. longicollis* (63% of total specimens) and *E. klunzingeri* (20%).

Saurida lessepsianus has been known from the Turkish coastline since 1956 (as *S.undosquamis*, Ben-Tuvia, 1966), which became one of the most commercially important fish species since then. The population is most abundant at the northeastern Levant shores (i.e. İskenderun Bay), gradually decreasing westwards towards Gökova Bay (southern Aegean Sea). Ecological impact of *S.lessepsianus* is both on other commercial bony fishes on which it preys and on native species (such *Synodus saurus* - lizardfish) which it competes for space. Stomach content analyses clearly showed that the species heavily preys on Clupeids (mostly *Sardinella aurita*) and anchovy (*Engraulis encrasicolus*) (Özyurt *et al.,* 2017), thus exerting negative impact on the local commercial native fish stocks.

The two veteran invasive alien rabbit fish species, *Siganus rivulatus* and *S.luridus*, have a widespread distribution along the shallow algae covered rocks and seagrass beds of the northern Levant and southern Aegean Sea coasts of Türkiye. Although these species have venom glands associated with their spines, the venom is not life threatening and envenomation occur only if the fish is handled incorrectly. Their flesh is tasty, thus constituting one of the major catch of artisanal fishers. By forming schools of up to thousands of individuals, these herbivorous species constantly graze on coastal algae, sometimes causing local extinctions of algae and forming barrens (Sala *et al.,* 2011). In addition, they also compete with two native herbivorous fish (*Sparisoma cretense* - parrotfish and *Sarpa salpa* - salema), locally outnumbering them.

There are some cases in which an introduced taxa swiftly takes part in the commercial fisheries. Significant examples include the Randalls threadfin bream (*Nemipterus randalli*)

and Red Sea goatfish (*Parupeneus forsskali*), both of which reached to southern Aegean coasts in a very short time interval and now regularly appearing in the local fish markets at prices ranging 5 – 8 Euros. The increase in abundance of Red Sea goatfish is so immense that, it can be observed almost in every scuba dive at the northern Levant shores, usually in association with small schools of *Siganus spp.* (Figure 6).

The silvercheeked toadfish (*Lagocephalus sceleratus*) is probably the most nuisance invasive species throughout the Mediterranean Sea, which pose great risk to human health (due to the highly potent tetrodotoxin in its flesh) and also to the small scale fisheries. Cases of poisonings have been quite frequent, despite the Turkish government has banned fisheries, landing and marketing of the species since 2008. The species has powerful jaws that easily cuts bottom longlines and hooks, resulting with a financial loss of over 2 million Euros per year (Ünal *et al.,* 2015). An extreme case has recently been reported, where a traumatic finger amputation of a child occurred (Sümen and Bilecenoglu, 2019).

Figure 6.
Parupeneus forsskali, a recently introduced alien fish, is now very common along the Turkish coastline (Photograph: Kaş, Antalya, M. Bilecenoglu).

Rhopilema nomadica, the nomadic jellyfish, is considered a serious threat to human health, touristic activities and fisheries (Figure 7). Its massive swarms have been reported along the coastline between Antalya and Adana, where 815 hospitalized cases were recorded during summer of 2009 (Öztürk and Isinibilir, 2010). The painful stings generally leave whip like marks on the body, though no fatalities have been reported yet. When found in large abundance, bottom trawlers experience net clogging and inability to sort the fish catch. The other alien invertebrates that pose risks to human health are *Phyllorhiza punctata*, *Cassiopea andromeda*, *Macrorhynchia philippina* (Hydrozoa), *Eurythoe complanata* (Polychaeta) and *Diadema setosum* (Echinoidea). The latter species is of special concern, which rapidly invaded the northern Levant and southern Aegean Sea shores, even inhabiting depths below 1 m. The very long spines of *D.setosum* can easily penetrate the human skin and release a mild venom causing acute pain. Injuries are quite common especially during the high tourism season, but not reported by any means to date.

Figure 7.
Rhopilema nomadica, observed at Kaş-Kekova SEPA (Photo: Hasan Yokeş)

The recent invasion of devil firefish (*Pterois miles*) is also of special concern, since it also have quickly invaded a remarkable long coastline (from İskenderun Bay to central Aegean Sea, with signs of northwards expansion) just within few years after its first introduction to Türkiye. Infamous for its voracious feeding habits on coastal fish species and crustaceans, its spines are also associated with a potent venom that may cause serious injuries (Figure 8). Some restaurants have recently included the species within their menu, which may help with controlling the existing *P.miles* population through artisanal fisheries.

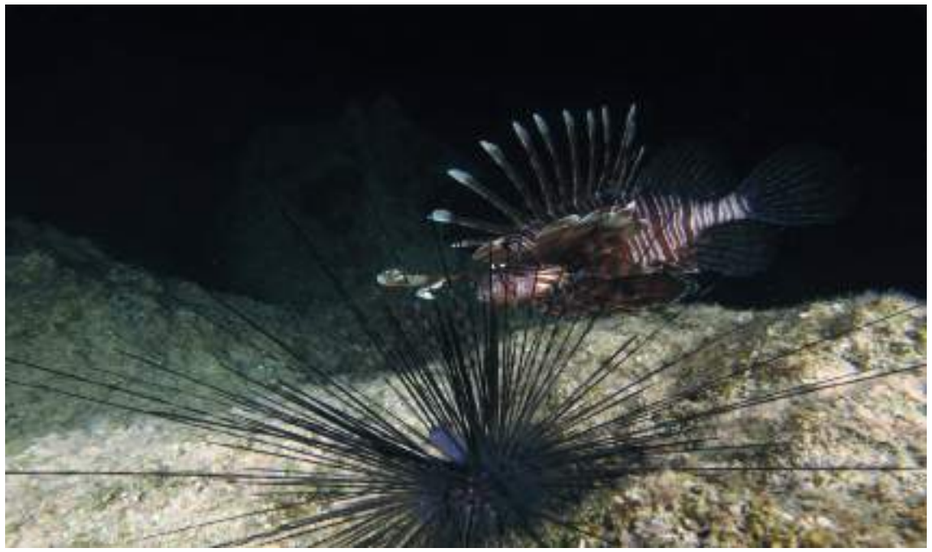

Figure 8.
Two nuisance invasive species together in the same frame; *Diadema setosum* at the front, and *Pterois miles* at the back (Photo: M.Bilecenoglu)

3.1.1.3. High seas

Since majority of the alien and invasive taxa have distributions restricted to the shallow coasts, much of the research effort have been spent on them and general information on the situation in high seas remained largely unknown. Anyhow, there are few cases of

competitive displacement that modified bathymetric ranges of native fish species. The native *Mullus barbatus* (red mullet) and *Merluccius merluccius* (hake) were displaced together to cooler and deeper waters by their respective Indo-Pacific originated competitors, *Upeneus moluccensis* and *Saurida undosquamis* (Por, 1978).

3.1.2. Impact of fisheries and aquaculture on target and non-target species and habitats

Based on FAO's long-term monitoring of assessed marine fish stocks, the state of world's marine fishery resources has continued to decline. The proportion of fish stocks that are within biologically sustainable levels decreased from 90% in 1974 to 65.8% in 2017, with 59.6% classified as being maximally sustainably fished stocks and 6.2% underfished stocks. In 2017, among FAO's Major Fishing Areas, the Mediterranean and Black Sea had the highest percentage (62.5%) of stocks fished at unsustainable levels (FAO, 2020).

According to fishery statistics of Türkiye in 2017, total fishery production was about 628,000 tonnes, comprising marine capture (51%), inland capture (5%) and aquaculture (44%) (Figure 9). The total estimate of national fishing vessels was 17,497 (73% under 5 GT) and the total number of marine fishers was 31,842. An additional 10,500 people were engaged in aquaculture sector.

Considering the Mediterranean coasts of Türkiye, marine capture production is highly influenced by fluctuating demersal and pelagic stocks. When the average production between 2000 and 2017 (Aegean Sea) is taken into account, only a few pelagic species (sardines, anchovy, bogue and Atlantic mackerel) show biomass levels below biologically sustainable levels, whereas rest of the demersal stocks are heavily overfished and drastic decreases in annual production is observed (Table 8). Both demersal and pelagic stocks of the region in general have experienced high fishing mortality rates. Important commercial stocks of hake (*Merluccius merluccius*) and European bass (*Dicentrarchus labrax*) show particularly high fishing pressure, together with many stocks of bluefish (*Pomatomus saltatrix*), grey mullets (Mugilidae), Atlantic Bonito (*Sarda sarda*) and leerfish (*Lichia amia*). The drastic decline of shark catch should also be noted, which is a significant indicator of fishing down marine food webs phenomenon.

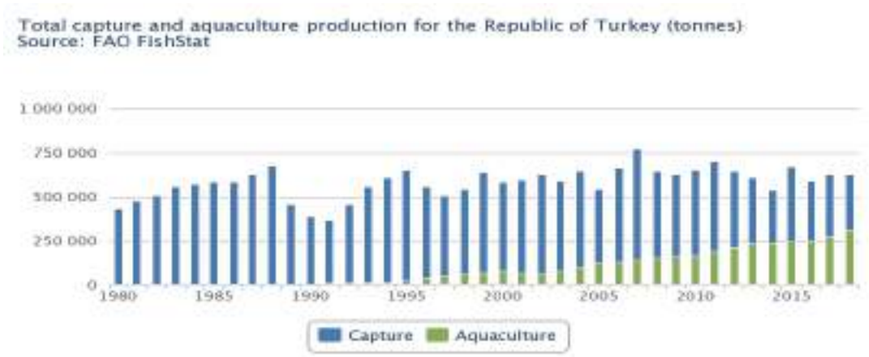

Figure 9.
Total capture and aquaculture production for the Republic of Türkiye (tonnes) (source: FAO FishStat)

The illegal, unreported and unregulated (IUU) fishing is a serious problem of the world fisheries, which undermine the conservation and management efforts in capture fisheries. It is a broad term that captures a wide variety of fishing activity, found in all types and dimensions of fisheries occurring both on the high seas and in areas within national jurisdiction.

According to FAO (2001), illegal fishing refers to activities: i) conducted by national or foreign vessels in waters under the jurisdiction of a State, without the permission of that State, or in contravention of its laws and regulations; ii) conducted by vessels flying the flag of States that are parties to a relevant regional fisheries management organization but operate in contravention of the conservation and management measures adopted by that organization and by which the States are bound, or relevant provisions of the applicable international law; or iii) in violation of national laws or international obligations, including those undertaken by cooperating States to a

Table 8.
Change in fishery production of the Aegean Sea (Türkiye)

Species	Production (2017, tonnes)	Mean Production (2000 - 2017)	% Change
Clupeids	14,025.2	9,942.1	+ 41.1
Anchovy	15,837.6	9,301.0	+ 70.3
Grey mullets	1,028.9	2,775.7	- 62.9
Bogue	2,856.0	1,898.9	+ 50.4
Chub mackerel	1,124.6	1,208.0	- 6.9
Hake	889.7	1,163.6	- 23.5
Atlantic horse mackerel	796.8	1,019.4	- 21.8
Twaite shad	939.1	1,007.7	- 6.8
Mediterranean horse mackerel	856.2	858.5	- 0.3
Atlantic bonito	523.7	782.8	- 33.1
Bluefish	142.6	687.3	- 79.3
Red mullet	442.5	533.3	- 17.0
Gilthead seabream	362.9	421.1	- 13.8
Striped mullet	501.5	420.3	+ 19.3
Bullet tuna	339.2	528.2	- 35.8
European bass	105.8	362.0	- 70.8
Little tunny	321.6	419.0	- 23.2
Porgies	388.7	262.3	+ 48.2
Atlantic mackerel	339.2	253.0	+ 34.1
Annular seabream	61.7	210.3	- 70.7
Salema	122.7	207.5	- 40.9
Blotched picarel	79.2	192.7	- 58.9
Sharks	9.6	114.0	- 91.6
Leerfish	43.0	113.0	- 61.9

relevant regional fisheries management organization. Unreported fishing refers to fishing activities: i) which have not been reported, or have been misreported, to the relevant national authority, in contravention of national laws and regulations; or ii) undertaken in the area of competence of a relevant regional fisheries management organization which have not been reported or have been misreported, in contravention of the reporting procedures of that organization. Unregulated fishing refers to fishing activities: i) in the area of application of a relevant regional fisheries management organization that are conducted by vessels without nationality, or by those flying the flag of a State not party to that organization, or by a fishing entity, in a manner that is not consistent with or contravenes the conservation and management measures of that organization; or ii) in areas or for fish stocks in relation to which there are no applicable conservation or management measures and where such fishing activities are conducted in a manner inconsistent with State responsibilities for the conservation of living marine resources under international law.

The most common IUU fishing activities in Türkiye are violation of minimum catch size (frequently observed for bluefish, Atlantic bonito, whiting, etc.), usage of illegal fishing gear (use of beach seines or spearfishing at night; both of which are banned in Türkiye) and opposition to fishing season. Main illegal fishing gear observed in inspection and control practices is mono and multi-monofilament fishing net which has been banned since 2011. Average size of fishing boats engaged in IUU fisheries is usually below 12 m (Öztürk, 2015). The quite harmful dynamite fishing is also practiced along the northern Levant, and it is possible to observe several locals and fishermen with missing extremities due to abrupt explosion.

Bycatch and discards threat sustainable fisheries by inflicting unnecessary mortalities, where the magnitude of annual discards in global marine capture fisheries was estimated to be 9.1 million tonnes, which represent 10.8% of the annual average catch of 2010-2014 (Pérez Roda *et al.,* 2019). A rough Mediterranean-wide estimate of discards was around 230,000 t, corresponding to 18.6% (13.3–26.8%) of the produced catch (Tsagarakis *et al.,* 2014). Bottom trawling is probably the most important activity that causes highest discard ratios. In a recent study carried out in Iskenderun Bay, 77,994 individuals belonging to 97 fish species were obtained in 32 hauls, 69 (n=54,119) of them were determined as discard (Yemişken *et al.,* 2014). Great majority of the alien and invasive taxa were totally discarded regardless of their sizes (for example all alien Apogonids, all Tetraodontids, *Equulites klunzingeri*, *Oxyrichthys petersi*, *Cynoglossus sinusarabici*, etc.), together with high discard rate of endangered chondrichtyans such as *Gymnura altavela*. In general, purse-seines, trammel-nets and gillnets are generally characterized by low bycatch and discards rates (Tsagarakis *et al.,* 2014).

Recreational fishing activities are mainly associated to gears such as angling, handline and spearing, which can threaten juveniles of coastal fish species such as *Diplodus sargus*, *Sparus aurata*, *Dentex dentex*. The negative impacts of spearfishing in Türkiye is clearly seen especially for the dusky grouper (*Epinephelus marginatus*), whose stocks are at the verge of collapse, despite of annual fishery ban of the species.

Regarding the aquaculture sector, the direct effects of over-fishing is observed at bluefin tuna farms (currently located at İzmir and Alanya), since tunas required for farming are collected from the nature and stocked in these cages to be fattened for a period of 6 - 8 months. Harvesting of these wild tuna populations represent a huge pressure that may induce a collapse of existing stocks. Aquaculture facilities are also known for the increase in organic content under the cages (due to excessive pellet usage), which deteriorates the environment, negatively influences seagrass beds and change demersal invertebrate species composition.

3.1.3. Microbial pathogens

There is a considerable rate of increase in mucilage events in the Mediterranean Sea, which seems to be linked to climate-driven sea surface warming. Analysis of historical reports indicated that the frequency of the mucilage has increased almost exponentially in the last two decades (Danovaro *et al.,* 2009). Mucilage is made of exopolymeric compounds with highly colloidal properties that are released by marine organisms through different processes (Danovaro *et al.,* 2009). During the mucilage events, not only the seawater become unsuitable for bathing, but also the artisanal fishermen are negatively impacted due to clogging of fish nets. The phenomenon is frequently observed in Türkiye but was subjected to a few number of research.

The ongoing mass mortality event is the most widespread threat to the endemic *Pinna nobilis* throughout the Mediterranean Sea, in which 100% of mortality rates were reported from various localities. The first histological examinations revealed the presence of a haplosporidan-like parasite within the digestive gland of affected pen shells and the parasite was later described as a new species, *Haplosporidium pinnae* (Kersting *et al.,* 2019). The pathogen has recently been observed in Türkiye, causing drastic mortalities (ranging from 85 to 99%) of the endangered Pinna population (Özalp and Kersting, 2020).

In the Aegean Sea, phenomena of massive necrosis were observed in three sedentary benthic organisms: *Cladocora caespitosa* (Hexacorallia), *Eunicella singularis* (Octocorallia) and *Aplysina aerophoba* (Porifera) (Skoufas, 2003). The same observations were also made in Türkiye, but the findings remained unpublished. Especially the sponge diseases are frequently encountered along the Turkish coasts, but the causative pathogens were not scientifically examined to date. Most influenced sponge species is probably *Aplysina aerophoba*, probably suffering from black patch disease. According to Luter and Webster (2017), microbial profiling of healthy and black patch-affected sponges revealed multiple sequences that were only present in diseased *A. aerophoba*, including a Deltaproteobacteria with similarity to a strain implicated in coral black band disease. Garrabou *et al.,* (2019) have recently analyzed 196 scientific papers for the mass mortality events occurred in the Mediterranean Sea and extracted information regarding 676 events between 1979 and 2017. These events encompassed 93 species from nine taxonomic groups, as follows in order of importance: Cnidaria, Porifera, Bryozoa, Bivalvia, Chordata (Ascidiacea), Rhodophyta, Annelida, Chlorophyta, Echinodermata. The associated inventory included only three entries for Türkiye, in which mass mortalities of *Spongia officinalis*, *Hippospongia communis* and *Sarcotragus spinosulus* was reported from Bodrum, based on observations dating back to 1986.

3.2. Vulnerable marine ecosystems

Marine ecosystems are classified as VMEs (vulnerable marine ecosystems) according to a set of characteristics as defined by FAO (2009); i) uniqueness or rarity, ii) functional significance of the habitat, iii) fragility, iv) life-history traits of component species that make recovery difficult, and v) structural complexity. As an initial step towards developing a Mediterranean list of VME indicator species, Oceana (2016) proposed a list of VME habitat types (associated with their indicator species), including cold-water coral reefs, hard and soft bottom coral gardens, deep-sea sponge aggregations, sea pen fields, tube-dwelling anemone patches, mud- and sand-emergent fauna, bryozoan patches, molluscs, annelids and crustaceans. Since the above mentioned ecosystems are frequently associated with a diverse biota, they provide habitat for specific assemblages and special interest should be given for their management and conservation. None of the habitats has yet been evaluated according the proposed VME characteristics in Türkiye, but at least two protected areas will doubtless meet the outlined criteria (Ayvalık Islands Nature Park, famous for its unique coral assemblages and Finike Seamount SEPA).

3.3. Emerging issues such as climatic change effects and open sea including deep-sea ecosystem concerns

Climate warming is a serious threat to the marine and coastal biodiversity, which also have physical consequences (i.e. sea level rise) affecting global human populations. The worldwide observable effects include loss of sea ice, shifts in ranges of biota, accelerated sea level rise and more intense heat waves. There is enough evidence that the damage caused by climate change will increase over time and concrete measures have to be taken.

Climate change related events have become more frequent in the Mediterranean Sea and their biological impacts have densely been studied. Several reports indicate northwards shifts of marine taxa due to increase sea water temperatures, enormous impact of the intrusion of Red Sea and Indo-Pacific originated species, increased mass mortality events, emergence of pathogens and modifications of ecosystem functioning. Information related to above mentioned topics were already given in the context of this report.

Gücel and Sakallı (2018) have investigated the sea surface temperature (SST) change in the Gulf of Iskenderun over the period of 1982-2015 using remote sensed data, where the SST change was about 1.5°C in the study period. Similar results were repeatedly reported also by various authors. As for the other physical consequences of climate change, approximately 1 mm/year of sea level rise (SLR) was estimated for the Mediterranean Sea (UNEP-MAP-RAC/SPA, 2008), which will likely to have considerable effects on the coastal ecosystems in short term. There are no global-scale assessments of the impacts of SLR on coastal regions that provide national-scale estimates for Türkiye (Gosling *et al.,* 2011). However, a number of national scale studies suggest that Türkiye could experience appreciable coastal impacts from SLR. Most parts of the Turkish coast appears to experience sea-level changes within the generally accepted range of sea-level rise (1-2 mm/yr) and no significant acceleration in the rate of SLR has been detected during the last century (Karaca and Nicholls, 2008). According to Kuleli *et al.,* (2009), SLR along the Turkish coast is not likely to be as significant as in some other parts of the world, but there could be local vulnerability due to topography and subsidence. The population in Türkiye at risk to SLR is around 428,000 along the Mediterranean coast and 208,000 along the Aegean coast (Kuleli *et al.,* 2009).

Many strategy documents (Agricultural Strategy, Energy Efficiency Strategy, etc.), long-term policy programs (Rural Development Program, etc.) and action plans (National Action Plan to Combat Desertification, Biodiversity Strategy and Action Plan, Waste Management Action Plan, Waste Water Treatment Action Plan, etc.) that were prepared in Türkiye in recent years mostly without explicitly mentioning climate change, include measures regarding the mitigation of emissions as well as adaptation to climate change. Legislation directly related with the adaptation to climate change include over 20 laws and regulations (see National Climate Change Action Plan of Republic of Türkiye, 2011-2023).

Our knowledge on deep-sea biota is very limited. The workshop concerning the deep-sea ecosystems of the national waters included deep-sea sponges, corals, bivalves, cephalopods, echinoderms, malacostraca and fish species, as well as, deep-sea fisheries (Gönülal *et al*., 2017). Macrozoobenthic invertebrate fauna of two high seas banks (Johnston Bank and Sinaya Bank) in the North Aegean Sea were investigated by Topaloğlu *et al.,* (2010). With its coralligenous habitats, Johnston Bank (51 taxa) was found to be more diversified when compared to the Sinaya Bank (17 taxa) with mud-sand substrate. Algal composition of the maërl beds of the Johnston Bank revealed the presence of six coralligenous algae: *Lithophyllum racemus, Lithophyllum stictaeforme, Lithothamnion corallioides, Lithothamnion minervae, Neogoniolithon sp.* and *Spongites sp.* (Aktan, 2012).

Since research effort is mostly concentrated on coastal waters, in which anthropogenic disturbance is much more elevated, few data exist on the effects of human activities on the alteration of ecosystems in the open sea, including the deep-sea. Thus any possible biological disturbance on deep-sea ecosystem remains unknown. Whether the maritime traffic pose any risk to this fragile environment is also yet to be examined

4.

Current response measures

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4.1. Marine protected areas and other area based conservation measures

A total of 18 Marine and Coastal Protected Areas (MCPA), including 12 Special Environmental Protection Areas (SEPA), 2 National Parks (NP), 1 Nature Park (NAP) and 1 Strict Nature Reserve (SNR) are located on the Mediterranean coasts of Türkiye (Figure 10 and 11). Besides these MCPAs, there are also 3 more coastal protected areas (1 NP, 1 SEPA and 1 Wildlife Refuge (WR) which do not have marine component. The physical properties of the MCPAs are given in Table 9.

Table 9.

The foundation years, IUCN categories and some metrics of MCPAs on Turkish Mediterranean coasts. NTZ: No-take zone (Güçlüsoy, 2015 and 2016).

MCPA	Foundation year	IUCN Category	Coastal length (km)	Total area coverage (ha)	Marine area coverage (km2)	No of NTZs as core zone
Gulf of Saros SEPA	2010	IV	62	73,021	538.34	0
Ayalık Adaları NAP	1995	II	110	17,950	142.00	0
Foça SEPA	1990	IV	28	7,144	51.78	0
Karaburun-Ildır Bay SEPA	2019	IV	181.7	94,656	510.64	1
Dilek Peninsula - Büyük Menderes Delta NP	1966	II	*	27,598	*	1
Gökova SEPA	1988	IV	193	109,279	817.76	6
Datça-Bozburun SEPA	1990	IV	417	144,389	736.63	4
Marmaris NP	1996	II	*	29,206	*	1
Köyceğiz Dalyan SEPA	1988	IV	46	46,146	40.84	0
Fethiye-Göcek SEPA	1988	IV	195.71	80,537.30	340.11	2
Patara SEPA	1990	IV	22.87	19,710.60	49.94	0
Kaş-Kekova SEPA	1990	IV	80.55	25,783.68	165.91	5
Finike Seamount SEPA	2013	IV	0	1,124,173	11,228.85	0
Beydağları Coastal NP	1972	II	~91	31,018	0	0
Belek SEPA	1990	IV	19	14,168	24.26	0
Göksu Delta SEPA	1990	IV	35.16	22,850.11	80.78	0
Akyatan WR	2005	IV	~21	15,291.10	0	0
Yumurtalık Lagoon SNR	1994	Ia	~33	16,979.94	*	1

*Information will be provided by the MoAF.

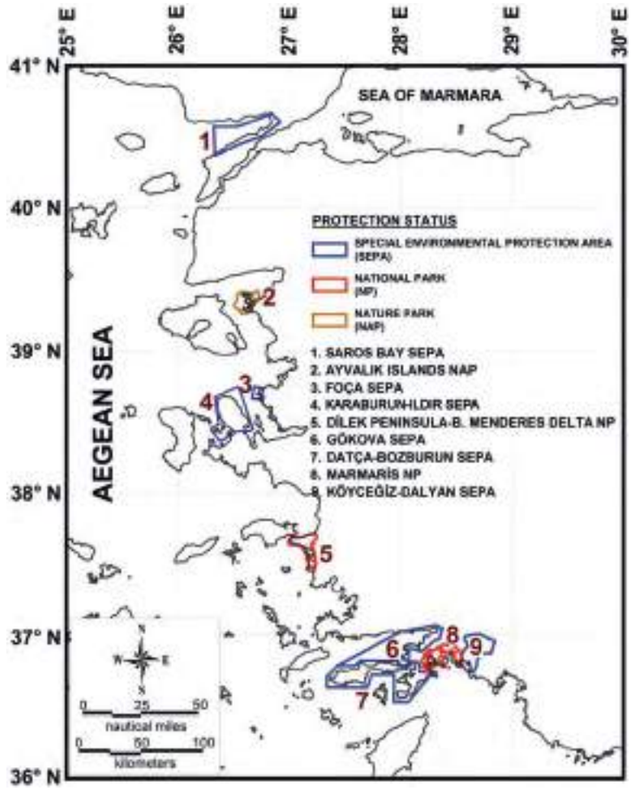

Figure 10.
MCPAs of the Turkish Aegean coasts (Modified from Güçlüsoy, 2015)

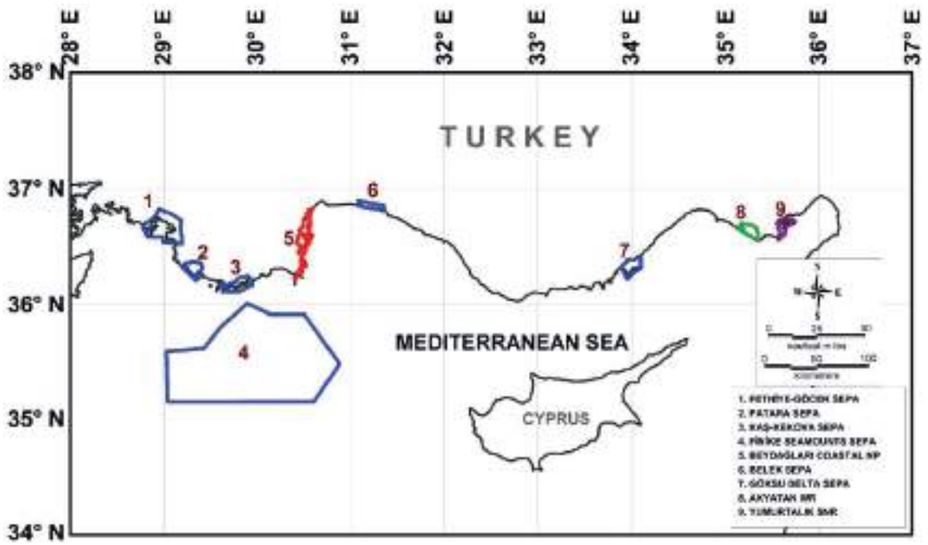

Figure 11.
MCPAs of the Turkish Levantine coasts (Güçlüsoy, 2016)

Gulf of Saros SEPA

Gulf of Saros and surrounding coastal area was declared as SEPA in 2010. It covers 53.834 ha marine area as SEPA. In the framework of marine species inventory project a total of 550 species (Macrophytes: 207; Invertebrates: 233; Pisces: 108; Cetaceans: 2) were recorded in the SEPA (MoEU, 2014).


Photo : GDPNA

Ayvalık Adaları NAP

Ayvalık Adaları was declared as "Nature Park" in 1995. The NAP included 22 islands. In a marine biodiversity research, a total of 671 species belonging to Polychaeta (198 species), Mollusca (169 species), Pisces (76 species), and Crustacea (69 species) were determined. Besides, 37 macrophytes were reported (Yokeş and Demir, 2013). Fan coral (Gorgonacea, Anthozoa) reefs were found to be the most impressive and important habitat in the NAP. Three species of fan corals were identified: *Eunicella cavolini, Eunicella singularis* and *Paramuricea clavata.* In addition, healthy colonies of the stony coral *Cladocora caespitosa* was observed in the NAP. The total annual value of the marine and coastal ecosystem services in Ayvalık Adaları NAP was estimated to be around US$ 43 million per year (Bann and Başak, 2013a)


Photo : GDNCN

Foça SEPA

It was established in 1990. In 1997 its borders were extended. The ancient town "Phocaea" received its name after the settlers "saw a seal coming to dry land" (Johnson and Lavigne, 1999). Today, the name of the town is Foça, meaning seal, is one of the main habitats

for the Mediterranean monk seal (*Monachus monachus*). Species conservation actions started in Foça right after the establishment of the National Monk Seal Committee in 1991 (Güçlüsoy and Savaş, 2003). Last published research by Kıraç and Güçlüsoy (2008) estimated that there were only 3 individuals of this critically endangered species live between 2004 and 2007.

In the baseline biodiversity inventory studies for both in marine (DEÜ-DBTE, 2008) and terrestrial (EKAD, 2013) terrains revealed 168 marine and 548 terrestrial (291 plant- 257 animal) organisms were identified. Total annual value of Foça SEPA's marine and coastal ecosystem was estimated to be around US$ 37 million per year (Bann and Başak (2011a).


Photo : Murat Bilecenoğlu

Karaburun-Ildır Bay SEPA

Karaburun-Ildır SEPA was established in 2019 due to existence important terrestrial floral and faunal species. Numerous endemic, endangered and medicinal terrestrial plants were reported. The Karaburun peninsula was inhabited by caracal and Eurasian otter. The peninsula is also used by Mediterranean monk seal population. Marine biodiversity of the SEPA is currently unknown.


Photo : GDPNA

Dilek Peninsula - Büyük Menderes Delta NP

Dilek Peninsula was declared as a NP in 1966, then the borders were extended to circumscribe Büyük Menderes Delta in 1994 (Kılıçaslan *et al.,* 2011) Since it includes an important wetland numerous plants belonging to 95 families, and 42 reptiles, 256 birds (among which 70 are breeding) and 28 mammal species (Kılıçaslan *et al.,* 2011). Unfortunately, very limited data I available concerning the marine biota. A monk seal survey was conducted in 1988 by ODTÜ-SAT-AFAG. This NP mainly managed for daily recreational use such as swimming and bathing, picnicking facilities and tracking routes (Kılıçaslan *et al.,* 2011).


Photo : GDNCNP

Gökova SEPA

Gökova SEPA was founded in 1990, and it was extended to its present borders in 2010 It was declared as a SEPA due to the presence of sweet gum forest *Liquidambar orientalis*) and to protect natural assets (*e.g.,* Kadın and Akçapınar streams). (EPASA, 2011). It is one of the most studied MCPAs in Türkiye. Eleven marine and coastal projects on such as marine species inventory, fisheries, and management plan preparation were carried out between 2000 and 2012 (Kıraç *et al.,* 2012). Prior to extension of this SEPA, in their comprehensive study in the zone between supralittoral and 55 m depth Okuş *et al.,* (2006) inventoried 723 macroscopic species comprising 79 flora and 644 fauna taxa. Among these species, 34 of them were under protection by Bern and/or Barcelona Conventions and national Fisheries Circular. In addition, 101 phytoplankton, 110 zooplankton and 26 alien species were identified. Boncuk cove of Gökova SEPA is also known one of the three nursery sites for Sandbar shark *(Carcharhinus plumbeus)* in the Mediterranean Sea and species area use is monitored irregularly (*e.g.* Bilecenoğlu, 2008). The total marine and coastal ecosystem services and the total annual value of these services was estimated to be around US$ 31.2 million per year (Bann and Başak (2011b)

Datça-Bozburun SEPA

Datça and Bozburun as SEPA was entered into force in 1990. Huit cent sept (807) marine species were recorded in a biodiversity research conducted between 2002-2004 (Okuş *et al.,* 2007). Mollusca was found to be the most diverse group (187 species), which was followed by fishes (184 species) and algae (139 species). 35 of the species reported were listed in Bern and Barcelona Convention's lists and national legislation such as Fisheries Law/Circular. Bann and Başak (2013b) estimated the total annual value of the SEPA's marine and coastal ecosystem to be around US$ 38.2 million per year

Photo : GDPNA

Marmaris NP

Marmaris NP was established in 1996. It includes important archaeological sites. Until today no programmatic marine studies were conducted in this NP, main interest was on forest assets of the area (Kaynaş and Gürkan, 2005).

Photo : GDNCNP

Köyceğiz - Dalyan SEPA

Köyceğiz - Dalyan SEPA declared in 1988. Until now, its borders werechanged twice; in 1990 and and in 2000). It was declared as a SEPA to protect natural and historical assets of the region (EPASA, 2011). It is a good example for a complex SEPA, since it includes lake, lagoon, marine and forest ecosystems. The famous 4.7 km long Dalyan beach is one of the most significant reproductive sites for loggerhead sea turtles (*Caretta caretta*) and it contributes 12%. of overall nesting efforts of *Caretta caretta* in Türkiye Nile soft shell turtles *Trionyx triguis* also uses the beach for nesting. Ekincik beach is, which is located within the SEPA constitutes the northern most nesting site for *Caretta caretta* (Türkozan and Kaska, 2010).

A total of 288 species (160 faunal and 122 floral) were reported. 17 of these species were red list species and 10 of them were alien species (Bizsel *et al.,* 2010). Bann and Başak (2013c) estimated the total annual value of the SEPA's marine and coastal ecosystem to be around US$ 51.2 million per year.

Photo : Murat Bilecenoğlu

Fethiye-Göcek SEPA

It was founded in 1988 and the borders were modified in 2006 and in 2014 (EPASA, 2011). The SEPA includes natural and historical assets. Fethiye Beach is one of the important nesting and breeding sites for *Caretta caretta* (Türkozan and Kaska, 2010). Also there are forests of the endemic species sweet gum *Liquidambar orientalis* (EPASA 2011). It is is one of the most studied MCPAs in Türkiye. In a comprehensive biodiversity study 1,545 marine species belonging to 24 taxonomic groups were observed DERINSU (2009). The most represented taxonomical groups were Polychaeta (n=347), Mollusca (n=288) and Crustacea (n=264). 40 of them were under protection and 93 were alien.

Photo : Murat Bilecenoğlu

Although the 31 % of the SEPA covered by rocky reef systems, a very low fish biomass was reported (Sala *et al.,* 2012). Southwest of this SEPA coinciding with the Rhodes Basin is one of the most important Sperm whale encountered areas (Öztürk *et al.,* 2013). In addition, beaked whales and Risso's dolphins strandings were also reported for this SEPA (Öztürk *et al.,* 2011). Bann and Başak (2013d) estimated the SEPA's coastal ecosystem services value to be around US$ 210 million per year. It is a highly touristic region. The sea turtle nests count and water quality monitoring programmes continue since 1993 and 2006 respectively.

Patara SEPA

Patara SEPA was established in 1990 to protect natural and historical assets. It includes a 1st degree archaeological site (EPASA, 2011). Patara SEPA has one of the important coastal dune areas that are used for touristic recreational activities (Avcı *et al.,* 2015). It also includes an important nesting area for Caretta caretta (Türkozan and Kaska 2010; Olgun *et al.,* 2016). The sea turtle nests count and water quality monitoring programmes continue since 1989 and 2006 respectively


Photo : Murat Bilecenoğlu

Finike Seamounts SEPA

Prior to its establishment, the area was proposed as a High Seas MPA by Öztürk (2009) and later as the first SPAMI of Türkiye (Öztürk *et al.* 2012). It was declared as the first marine region without any land component as SEPA in 2013, due to its unique deep sea habitats including having mud volcanoes and methane cold seeps (Öztürk *et al.,* 2015). This SEPA engulfs Finike-Anaximander Seamount complex located between the Hellenic and Cyprus arcs (Öztürk *et al.,* 2015). The depths of the seamounts are Anaxagoras: peak depth 920-930 m and base depth 1,510-1,520 m; Anaximander-Finike: peak depth 1,110-1,120 m and base depth 2,000-2,010 m; Anaximenes: peak depth 690-700 m and base depth 1,500-1,510 m.

Several biodiversity researches were conducted in the area, revealing chemosynthetic communities dominated by small sized bivalves, Siboglinid tubeworms (Lamellabrachia sp.), amphipods, brachyuran crabs, echinoid sea urchins, galatheid squat lobsters (Olu-Le Roy *et al.,* 2004) ; Öztürk *et al.,* 2015). Huit (8) fish, 4 deep-sea shrimps and 1 cephalapod species were also sampled from this SEPA (Öztürk *et al.,* 2010). The density distribution of the swordfish during peak spawning period suggested that the major spawning area located near this SEPA (Tserpes *et al.,* 2008). The SEPA also constitutes an important sites for deep diving marine mammals such as, Cuvier's beaked whales (*Ziphius carvirostris*) and sperm whales (*Physeter macrocephalus*) (Woodside *et al.,* 2006; Öztürk *et al.,* 2013).

Kaş-Kekova SEPA

On of the most important marine archeological site Kekova was declared as a SEPA in 1990. In 2006, the borders were extended westwards to Kaş according to the findings of a biodiversity research and the name of the SEPA changed to Kaş-Kekova SEPA.


Photo : Hasan Yokeş

During a marine vessel carrying capacity assessment conducted in 2010, a total of 191 macrozoan species and 60 macrophyte species were identified in the Ölüdeniz region of the SEPA (Akçalı *et al.,* 2013). In a comprehensive biodiversity research conducted in the SEPA (outside of the Ölüdeniz region), 1152 marine species were identified. 79 marine species were monitored between 2002-2018 within the SEPA and a recovery was observed in the populations of some Epinephelinae and Sparidae species after 7 notake zones were set in 2012 (Yokeş *et al.,* 2019).

Beydağları Coastal NP

Beydağları Coastal NP was established in 1972 because its natural and historical assets. The NP does not any marine part. The ancient Phaselis City is located in this NP. Being in the center of a highly touristic region resulted in loss of nearly 50% of its origial size since it was established. Çıralı beach is one of nesting area for *Caretta caretta* located in this NP. There are numerous caves on the coast of the NP and the nearby islands (Üçadalar), where monk seals were sighted and captured with camera traps (Güçlüsoy *et al.,* 2008; Gücü *et al.,* 2009. Cuvier's beaked whales (*Ziphius carvirostris*) were also reported off the coast of this NP (Baş *et al.,* 2016).


Photo : GDNCNP

Belek SEPA

Belek SEPA was established in 1990. It is located on the coast but does not include any marine part. The coastal dunes, turtle nesting beaches and floral diversity are considered to be the main important assets for protection. However, Belek SEPA's coastal dune areas are used for Touristic activities and golf courses (Avcı *et al.,* 2015). The SEPA has a diverse avifauna with 213 species reported (EPASA 2011). It includes a total of 29.3 km long beach, which is one of the most important nesting grounds for Caretta caretta. The beach is also used by *Chelonia mydas* (Türkozan and Kaska, 2010).


Photo : GDPNA

Göksu Delta SEPA

Göksu Delta was declared as SEPA in 1990. The boundaries was modified once in 2006. The beaches are used by *Caretta caretta* and *Chelonia mydas* for nesting. The Nile turtle *Trionyx triunguis* can also be observed in the delta. The SEPA also includes a Ramsar wetland and important site for the migratory birds. (EPASA 2011; Türkozan and Kaska 2010; Avcı *et al.,* 2015).


Photo : GDPNA

Akyatan Wildlife Refuge (WR)

Akyatan lagoon was as the Water Birds and Black Francolin Protection and Reproduction Field in 1986 under the Hunting Code (No. 3167). The status of the lagoon was changed to WR in 2005. It is also listed as a Ramsar area and declared as 1st degree natural protection area. Akyatan WR does not have a marine part. The sand dune area between the lagoon and the shore is a major green turtle nesting site. A total of 1,335 nests of *C. mydas* and 21 *C. caretta* were recorded between 2006 and 2011.

Yumurtalık Lagoon SNR

Yumurtalık Lagoon was declared as 1st degree natural protection area in 1993, a year later, its status was changed to SNR. The area is also designated as one of the Ramsar sites in 2005 (Erdem and Saraç, 2007). The area includes breeding grounds for *Chelonia mydas* (Türkozan and Kaska 2010; Yılmaz *et al.,* 2015). A total of 186 genera and 234 species of plants were reported, 223 of which were natural and 3 of the were endemic. (Altınözlü 2004). The area is one of the few locations of the Aleppo pine *Pinus halepensis* is found (Yılmaz, 1998). Managing Yumurtalık and Akyatan areas with an integrated model as a Specially Protected Areas of Mediterranean Importance (SPAMI) was proposed Yılmaz *et al.,* (2003).


Photo : GDNCNP

4.2. Legal and institutional frameworks governing the conservation and sustainable use of marine and coastal biodiversity

4.2.1. Major authorized institutions

Many institutions and organizations are authorized for nature protection in Türkiye. Unfortunately, there is a conflict of authority between these institutions. Major authorized institutions and relevant legislation are explained below.

Ministry of Agriculture and Forestry

The duties of the Ministry of Agriculture and Forestry are regulated in Articles 410-440 of the Presidential Decree No. 1 published in the Official Gazette No. 30474 dated 10/7/2018. Two General Directorates have powers within the scope of environmental protection. One of them is General Directorate of Fisheries and Aquaculture and the other is the General Directorate of Nature Conservation and National Parks. In the clause (c) of the 1st paragraph of 416 article where the duties of the General Directorate of Fisheries and Fisheries are regulated; "To protect fisheries and aquaculture resources, to determine conservation, production and aquaculture areas and to take measures to protect these areas from damages" and to "To develop fisheries and aquaculture production resources and to increase productivity, to carry out control and inspections" The General Directorate mentioned within the scope of its duties.

The duties of the General Directorate of Nature Conservation and National Parks are defined in Article 420. In the subparagraph (e) of paragraph 1 of this Article, the task of "taking measures for the protection of plant and animal species and areas protected by international conventions and cooperating with the relevant organizations" is regulated. In the subparagraph (g) of the same paragraph, the duties of "carrying out works and procedures related to the conservation and improvement of plant and animal species genetic resources in relation to its field of duty" are regulated.

Ministry of Environment and Urbanization

It is the general competent ministry for the protection of biological diversity and prevention of environmental pollution Its duties regarding the issue are regulated in Articles 97-126 of Presidential Decree No. 1. Two general directorates, the General Directorate of Environmental Management and the General Directorate of Protection of Natural Assets, are in charge of these issues. Under the General Directorate of Environmental Management, there is a Department that is authorized for the protection of the seas. The duties of the aforementioned Department are as follows;

1 _ In order to use, protect, prevent or eliminate pollution of sea and coastal waters; To determine goals, principles and policies, to prepare action plans for pollution removal and control, to determine the procedures and principles, to ensure their implementation,

2 _ To monitor national and international developments regarding the prevention and protection of the pollution of the sea and coastal waters and its environment, to carry out negotiations, to evaluate, to carry out and make studies for determining and implementing policies and strategies on the subject, to fulfill the duties of national focal point before relevant international organizations,

3 _ Determining and implementing the procedures, principles and measures for the elimination and control of pollutants and pollution in order to ensure the conservation of sea waters, to prevent marine pollution with an integrated and ecosystem-oriented approach, and to establish the good marine environment,

4 _ To determine the targets, principles and policies for preventing that marine pollution caused by ships on the Turkish seas, to identify the principles and procedures for the removal and control of pollution, making efforts to implement, to create a decision support system, to prepare action plans to prepare,

5 _ To prepare the marine environment national and regional environmental management strategy and action plans within this scope,

6 _ Considering the ecological structures of sea and coastal waters, to make quality classification in line with the principles of conservation-use, to determine the pressures on these areas, to create a program of measures to achieve the determined environmental quality targets, to develop technologies, to draw risk maps, to ensure their implementation, To determine the procedures and principles to control the discharges made, to establish a monitoring policy and strategy,

7 _ Determining policies, strategies, procedures and principles regarding the management of coastal waters, prevention of pollution within the river basin management plans,

8 _ To determine the procedures and principles for emergency response and compensation for damages in case of pollution of the marine environment with oil and other harmful substances, to be prepared, to take the necessary measures to increase the response and combat capacity, to have them taken; In this context, to make emergency response plans, restoration and rehabilitation plans and management plans of the wastes generated as a result of accidents,

9 _ To determine the procedures and principles regarding the dredging activities to be carried out in coastal areas and sea waters and also procedures and principles for discarding the dredging materials formed as a result of these dredging activities, to carry out the necessary studies,

10 _ To determine the procedures and principles for environmental management of activities that may pose a pollution risk in marine and coastal waters, especially aquaculture, oil exploration and the salvage of sunken ships, to reveal the effects of such activities on the marine environment, to have risk analysis done, to identify risky areas, do the necessary work,

11 _ To protect and prevent the pollution of water used for swimming and recreation,

12 _ To determine the standards of wastewater discharges to be made into sea and coastal waters, design principles and criteria for sea discharge and deep-sea discharge, to carry out approval procedures,

13 _ To prepare strategic action plans for marine litter, determining, implementing, enforcing the procedures and principles,

14 _ To make researches and projects for the protection and improvement of sea and coastal waters,

15 _ To perform the duties assigned by the General Manager.

Ministry of Transport and Infrastructure

Its duties regarding the issue are among the articles 474-502 of the Presidential Decree numbered 1. The duties of the General Directorate of Maritime Affairs are regulated in the 478th article of the aforementioned decree. It is the Ministry responsible for the implementation of the Ship Ballast Water Management Contract.

4.2.2. National laws and regulations

Türkiye has a fairly comprehensive legislation on nature conservation and fisheries. However, there is no legal text specifically for the protection of species or habitats, and the problems in practice are tried to be overcome with the rules in different regulations.

Environmental Law No. 2872

Its purpose is to protect the environment, which is the common asset of all living things, in line with the principles of sustainable environment and sustainable development. The following paragraphs of the Article 9 titled "Protection of the environment" constitute the

main basis for environmental protection. In the paragraph (a) of the article; "It is essential to protect the biodiversity that constitutes the natural environment and the ecosystem that contains this diversity. The principles of conservation and use of biological diversity are determined by taking the opinions of local governments, universities, non-governmental organizations and other relevant organizations ". In the paragraph (f) of the same article; With the provision "It is essential to protect those endangered or vulnerable and rare plant and animal species in terms of ensuring the sustainability of biological diversity, it is forbidden to be trafficked in violation of the legislation" in subparagraph (h); "It is essential that the sea, underground and surface water resources and aquaculture production areas of the country are used regarding protection measures and should be protected against pollution.

Coastal Law No. 3621

The Coastal Law has been regulated in order to determine the principles of protection and use for public benefit, taking into account the natural and cultural characteristics of the sea, natural and artificial lakes and streams coasts and the coastal strips that are under the influence of these places and are their continuation.

Fisheries Law No. 138023

The Fisheries Law regulates the protection, production and control of the fishery products defined as "plants and animals found in seas and inland waters and their eggs". This Law is executed by the Ministry of Agriculture and Forestry. General justification of the law ahs been determined as; "Sustainable management of fishery products and protection of biodiversity and habitats in water, conservation of natural species in water resources, regulation of fisheries activities aimed at preventing the spread of invasive and alien species in our resources, smuggling fisheries abroad and preventing their introduction into the country alive".

Fisheries Regulation

This Regulation has been prepared on the basis of the Fisheries Law No. 1380 in order to protect the fisheries stocks and economically benefit from the aquaculture resources. It regulates fisheries license permits, hunting for sportive purposes, changing locations of the natural resources, using explosives and harmful substances in hunting, harmful and pollutant substances that are prohibited to be released into fisheries production areas, the qualification, conditions and use of vehicles, commercial and amateur fishing, trawling, fishery products produced incidentally, fishery health, manufacture of products and semi-finished products from fisheries, marketing of fishery products, principles, prohibitions, restrictions, matters related to liability, measure, control and inspection.

Communiqués regulating commercial and amateur fishing

Based on the Fisheries Law and the Fisheries Regulation, two communiqués regulating commercial and amateur fishing published every four years by the Ministry of Agriculture and Forestry. The lists of prohibited species, size and weight limits, as well as maps of the notake zones are given in these communiqués. The contents of the communiqués is rearranged every 4 years.

Aquaculture Regulation

The purpose of the regulation; To ensure efficient use of the water resources potential of our country, to ensure sustainability in aquaculture, to protect the environment and to supply quality / safe food, the planned investments in aquaculture and effective control during production.

Regulation on the Conservation and Sustainable Use of Fisheries Genetic Resources

The purpose of the regulation is identification of genetic resources living in inland water and marine environment in Türkiye, conservation and sustainable use of the resources, make policies and infrastructure to regulate the related procedures and principles.

Regulation on Registration of Fisheries Genetic Resources

The purpose of the regulation is to control the procedures and principles regarding the registration of genetic resources living in inland waters and marine environment of Türkiye.

Wetlands Regulation

The regulation aims, Türkiye's territorial boundaries and continental shelf located within the protection of wetlands, management and development to determine the principles of cooperation and coordination between official institutions and organizations in this regard.

Regulation on the Implementation of the Convention on the International Trade of Endangered Wild Animal and Plant Species

The purpose of the regulation is to regulate the procedures and principles for controlling international trade in coordination with relevant institutions and organizations in order to ensure the sustainable use of animal and plant species covered by the Convention on International Trade of Endangered Wild Animal and Plant Species (CITES).

In addition to the above mentioned ones, there are other laws and regulations which indirectly related to sustainable use of natural resources and create a healthy environment, such as, "Aquaculture Regulation", "Law on the Principles of Emergency Response and Compensation for Damages in Pollution of the Marine Environment by Oil and Other Hazardous Substances", "Regulation on Control of Pollution Caused by Hazardous Substances in Water and Its Environment", "Regulation on Water Pollution Control", Regulation on Receiving Waste from Ships and Control of Waste".

4.3.3. International agreements

Türkiye, acts as a bridge for the passage of species between the continents, includes diverse geological, geographical and climatic characteristics, resulting in a rich biodiversity. Türkiye is a party to the international conventions on the protection of nature listed below and has rights and obligations arising from these agreements. The international

- United Nations Convention on Biological Diversity
- Biodiversity Targets (Aichi Targets)
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity
- International Convention for the Control and Management of Ships' Ballast Water and Sediments (2004)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat
- Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats)
- Barcelona Convention (Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean)
- (Bucharest Convention) Convention Convention on the Protection of the Black Sea Against Pollution

Türkiye has adopted national biodiversity targets or equivalent commitments in line with the Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets. The National Biodiversity Coordination Council is established for effective implementation of Convention. The newly developed National Biodiversity and Action Plan is directly aiming realization of Aichi Targets.

5.

Assessment of marine and coastal status and pressures and impacts on the marine and coastal biodiversity

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5.1. Marine and coastal status and pressures relevant for national marine and coastal areas

Eutrophication

Ministry of Environment and Urbanization has been conducting pollution and quality monitoring studies in all seas of Türkiye since the 2000s under the Regional Sea Conventions signed by Türkiye (Barcelona and Bucharest Conventions) and national and international legislation. Since 2011, the marine monitoring studies have been carried out on the basis of ecosystem-based management approach under the "Turkish National Integrated Marine Pollution Monitoring Program". It is a huge monitoring program covering all the seas of Türkiye with a large monitoring network and besides covering most of the pollution and quality components of IMAP and MSFD it includes advanced level monitoring components like online monitoring, satellite monitoring acitivities etc. in pilot areas. The subject of this report biodiversity and alien spiecies monitoring components are also involved by means of phytoplankton, zooplankton, macrozoobenthos, seagrass, fish and macroalgea. In detail the national monitoring program is implemented for 3 year periods and the 2020-2022 period has begun. In Aegean Sea and in Levant Sea the biodiversity surveys are conducted in totally 51 phytoplankton stations (2 times a year), 27 zooplankton stations (2 times a year), 3 seagrass monitoring areas (2 times a year) and 31 macrozoobenthos stations (once every three years), 38 fish trawl areas (once every three years), 36 macroflora areas (once every three years). So both the species concerned gathered from trawl surveys, scuba diving surveys, plankton net samples and sediment grab samples are analyzed during the surveys, if there are alien and invasive species they are determined, evaluated -if possible according to indexes- and reported. However the surveys are conducted in limited scales in means of areas so biodiversity monitoring acitivities in more larger areas are required.

According to the Water Framework Directive, ecological status of coastal waters are assessed with three biological quality elements (phytoplankton, zoobenthos and macro algae) and in five quality classes (high/good/moderate/poor/bad). Eutrophication was monitored by indicators like nutrient levels and their temporal changes, dissolved oxygen levels at the bottom and/or intermediate layer depths and their temporal changes, chlorophyll-a levels in euphotic water column, light penetration, prevalence and distribution of opportunistic macroalgae are monitored at the seafloor and in the water column. Results of the most recent surveys (conducted between 2014 and 2016) were recently published (Aegean Sea Summary Report, 2017 – Aegean Sea; Tuğrul *et al.*, 2017 – northern Levant). Only a single locality (inner part of İzmir Bay) showed "bad" status throughout the Aegean Sea. Meriç river mouth, central and outer part of İzmir Bay and Güllük Bay had "moderate" qualities, while rest of the coasts were ecologically either good or very good. As for the northern Levant, ecological quality was determined as moderate/poor only in Mersin Bay and rest of the coasts were good/very good.

Most of the coasts are negatively affected by the discharge of untreated waste into marine environments, which has long been an important problem for Türkiye. Advanced treatment of wastewater, removing nitrogen and phosphorus after dissolving solid waste, is necessary for discharging wastewater into marine environments. Some improvements were made especially during the last decade and the numbers of wastewater treatment centers have significantly increased (Table 10).

Table 10.

Wastewater indicators for Turkish municipalities (2008 – 2018) (source Turkish Statistical Institute)

	Years					
	2008	2010	2012	2014	2016	2018
Number of municipalities	3,225	2,950	2,950	1,396	1,397	1,399
Municipalities with wastewater treatment centers	236	326	460	604	881	991
Natural treatment centers	17	35	89	118	199	206
Physical treatment centers	29	39	57	49	55	55
Biological treatment centers	158	199	244	345	492	527
Advanced treatment centers	32	53	70	92	135	203

In İzmir and Mersin Bays where eutrophication reaches crucial levels, the food web structure shows alterations in favor of small planktivorous pelagics (especially Clupeids), while demersal fish species (red mullets, annular sea bream, etc.) dramatically disappear. It is worth to mention that the wastewater treatment plant in İzmir Bay was completed during 2002 and a decrease in nitrogen has been observed immediately after, but phosphate concentrations have not changed since and the plant has been ineffective regarding this subject (Sunlu *et al.,* 2010).

Estuaries in particular have served as major repositories for the disposal of industrial and municipal wastes, sewage sludge, and dredged material (Kennish, 1994). Contaminants associated with these wastes have impacted biotic communities and sensitive habitat areas. A significant percentage of the population's livelihood is from agriculture in Türkiye, in which the use of fertilizers and agrochemicals is a common practice. Relevant wastes are carried by the streams, rivers, drainage canals and even underground waters into the lagoons and estuaries, often causing negative ecological impacts.

Marine Litter

Marine litter is an environmental, economic, health and aesthetic problem, which has been an issue of concern in the Mediterranean since 1970s. Any persistent manufactured or processed solid material which is discarded, disposed of, or abandoned in the marine and coastal environment are defined as marine litter (UNEP/MAP, 2011). The problem is prominent at densely populated and multi-use regions where agricultural, touristic, fishing and industrial activities co-dominate, such as the Cilician basin of Türkiye. Aydın *et al.,* (2016) sampled coastal macro-litter on 13 beaches following MSFD guidelines, who found the average litter density as 0.92 items/m^2; plastic items constituted more than 80% of the dominant material type. Gönülal *et al.,* (2016) collected marine litter from supralittoral zone and subtidal areas between 50-450 m depth on Gökçeada (North Aegean Sea) coasts. On the beaches, the litter density was found to be varied from 0.1 to 22.1 items per 100 m^2. Plastic materials dominated the composition of waste materials (59%) followed by soft plastic, nylon (11.5%). Only 12 items were collected in subtidal areas, and the number of debris ranged from 0 to 1.6 items km^{-2}.Cerim *et al*., (2014) investigated the litter compositon in four bays (Gulf of Kuşadası, Gulf of Güllük, Gulf of Gökova and Marmaris) in eastern Aegean Sea and found out that plastic material comprised the biggest group (48%) and it is followed by metal (25%), glass (12%), others (12%) and wooden (3%). Regional litter densities were also calculated for regions as 1692.0 item/km2 for Marmaris, 796.0 item/km2 for Gulf of Güllük, 175.0 item/km2 for Gulf of Kuşadası, and 58.0 item/km2 for Gulf of Gökova. Plastic materials accumulation in relation to their sources were also determined by bottom trawling in fishery grounds of Iskenderun Bay down to a depth of 50 (Yılmaz *et al.,* 2002). 510 plastic material weighing 15,583 g were reported, majority of which were transported via the counter clockwise surface currents. Existence of such material at benthic habitats can be lethal for many invertebrates and monitoring studies are required. Turkish National Integrated Marine Pollution Monitoring Program involves marine monitoring activities according to MSFD and IMAP descriptors since 2014. Both micro litter and macro litter surveys has been hold but they are in pilot scales. Therefore detailed and more frequent monitoring studies are required.

Occurrence of microplastics in the gastrointestinal tracts of some edible fish species were investigated by Gündoğdu *et al.,* (2020). The number of microplastics detected was 2.5/fish for leaping mullet, 1.1/fish for red mullet, 0.6/fish for sand steenbras, and 0.4/fish for Mediterranean horse mackerel and surmullet. Polypropylene (26%) was the most frequently detected polymer, foloowed by polyethylene (21.9%), polyethylene terephthalate/polyester (8.2%), and cellulose (7.5%).

Only a single survey was conducted as MPAs (Gökova Bay), where the average number of items were much lower (0.16 items/m^2) (Vlachogianni, 2019). As for the microplastic pollution level in the Levant coast of Türkiye, results (0.376 item/m^2) were similar to the other regions of the Mediterranean Sea (Gündoğdu and Çevik, 2017).

Climate Change and Thermophilic Species

Global warming is facilitating the poleward range expansion of plant and animal species. The Mediterranean Sea is not only suffering from the impacts of alien species, but also the latitudinal shifts of native taxa may lead to currently unexpected ecological changes. Northward advance of thermophilic native fishes in the Mediterranean has received an increasing interest over the last few decades. This phenomenon is known as meridionalization, indicating the shift of taxa (mostly fish) towards colder sectors of the Mediterranean Sea primarily as a result of seawater warming (Azzurro *et al.,* 2011). For example, northern Aegean Sea now holds several thermophilic species, which were previously absent from the region. The distributional shifts are not the only problem, because biological characteristics of several fish species (for example reproduction seasons) have also changed in relation to increased sea water temperatures.

5.2. Critical impacts and effects on marine and coastal biodiversity

Lagoons

Several lagoons of Türkiye have lost their fishery production importance due to their ineffective management. According to Tosunoglu *et al.,* (2015), the threats are brought

by urbanization (pollution, tourism, etc.), decreasing or extinction of freshwater input, being unable to apply sustainable lagoon activities (valliculture and other aquaculture activities), right to prior use and intensive agricultural activities, being unable to apply improvement activities due to conservation status (shallowing of both straits and lagoon areas), not applying the rule related to weirs mentioned in communicated to regulate fisheries, being unable to obey the fishing regulations related the lagoons according to Fishing Notification, over fishing around the adjacent seas and being unable to compete with aquaculture. The above mentioned factors may lead a decrease (or even end) in the production level of coastal lagoons.

Posidonia meadows

The most significant pressures on seagrass beds (*Posidonia oceanica*) in Türkiye are pollution, water turbidity (including mucilage events), coastal modifications and wild anchoring. The latter factor is of special concern, since mechanical damage caused by boat anchoring is likely to increase parallel to the growing coastal traffic. Anchoring with conventional mooring chains scrub the substrate and damages *Posidonia* meadows by tearing leaves and rhizomes, in which the emptied space is immediately filled with invasive alien species, such as *Caulerpa cylindiracea*. Conserving seagrass meadows is equivalent to the conservation of all coastal fish assemblages and invertebrate diversity.

Coralligenous habitats

Although there is no complete agreement between researchers on the definition of coralligenous, Ballesteros (2003) defines it as a hard bottom of biogenic origin mainly produced by the accumulation of calcareous encrusting algae growing in dim light conditions. In terms of biodiversity, these habitats are typical Mediterranean Sea hotspots, housing thousands of fauna and flora species. Coralligenous grounds have insufficiently been examined in Türkiye and mapping studies are urgently needed. As an important part of this habitat, coral communities are observed especially in the Ayvalık Island National Park (northern Aegean). Three species of fan corals (Gorgonacea, Anthozoa) exist (*Eunicella cavolini*, *Eunicella singularis* and *Paramuricea clavata*), also colonies of the stony coral *Cladocora caespitosa* are prevalent in the region. The relevant coral habitat has previously faced with extinction, due to the purse-seiners fishing at that critical area, leaving their nets right above the endangered colonies.

Deep waters

Bottom trawling has severe impacts on the sea bottom, including stock impoverishment, alterations to the sea-bottom morphology, sediment resuspension, increased bottom-water turbidity, altered organic matter content, damage and death of benthic biodiversity. Benthic assemblages in deep waters are often extremely vulnerable to physical disturbance and their recovery from the impacts of trawling will likely take a long time (IUCN, 2019). Impact of bottom trawlers to deep-sea fishing grounds in Türkiye is practically unknown, although several fishing grounds have long been exploited to capture Norway lobster, giant red shrimp, hake, angler fish, etc. As part of conservation activities, Türkiye has recently announced Finike Seamounts as Special Environmental Protection Area, but several more sensitive areas are needed to be assessed as such.

6.

Assessment of national priority needs and response actions

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6.1. Needs

- Comprehensive studies on the diversity of data-poor marine taxa (Porifera, Cnidaria, Myxozoa etc.). Organization of pre-training programmes for citizens and involvement of citizen scientists to conservation and biodiversity studies.
- Long term monitoring studies on priority species, such as sea turtles, Mediterranean monk seal, dolphins and coral beds.
- Monitoring of sea grass beds, including detailed analysis of their spatial distribution.
- Fish stock assessments especially for overexploited commercial resources (bluefish, Atlantic bonito, *Scomber spp*., anchovy, turbot etc.).
- Biological and ecological research on cartilaginous fish.
- Improving fishery statistics.
- Special emphasize on the monitoring of spatial distribution, abundance trends and biological traits of endangered marine taxa.
- Increasing the number of marine protected areas, synchronously with their improved management. Establishment of management structures is also vital. All of which will facilitate the required SPAMI establishments.
- Creation of a National History Museum, which will include reference collections of native, alien, endangered and vulnerable taxa.
- In depth monitoring of anthropogenic pressures on the environment.
- Biological characteristics of all marine invasive species should be studied (age, growth, feeding habits, reproduction, impacts on local food web).
- Training activities by expert biologists and ecologists should be organized regularly specifically for official staffs of relevant Ministries (Ministries of Agriculture and Forestry, Environment and Urbanization, etc.).
- Assessment of potential impact of global warming and rise in sea level on the coastal and marine biodiversity.
- Assessment of potential impact of threats (pollution, overfishing, alien species introduction, habitat destruction, illegal/unreported/unregulated fishing) to the coastal and marine biodiversity.
- Compiling and regular updating of alien species of Turkish coasts, associated with searchable online databases freely open to public. Setting up a national committee (or work groups of experts) responsible for regularly updating and revising the national inventories is essential.

- Organize coordinated campaigns focusing on specific regional biodiversity issues.

- Encourage integrated studies targeting the entire ecosystem, including ecological aspects, trophic networks and ecosystem functioning.

- Detailed mapping of marine and coastal species, habitats and biocenoses, especially species and habitats that are of conservation interest for Türkiye and the Mediterranean, using available protocols.

- Exchange, cooperation and coordination between national experts, laboratories and organizations should be facilitated.

6.2. Urgent actions proposed

- The marine biodiversity of Türkiye includes several wildlife taxa owing to the geological history of the region, yet, existing studies carried out so far are sporadic and confined to subregions or to a specific range of organisms. The first attempt to compile Türkiye's marine animal diversity is quite recent and some 5,000 species are listed (see Çınar and Bilecenoglu, 2014), whereas algal diversity is presented by the comprehensive review by Taşkın (2019). The species diversity rapidly changes due to physicochemical (such as shifts of thermophilic taxa to northern latitudes, due to climate change) and human mediated factors (such as introduction of alien organisms), so it should be meticulously monitored in the region.

- Complete checklist of species associated with seagrass meadows (*Posidonia oceanica*, *Cymodocea nodosa*, *Zostera marina*, *Halophila stipulacea*), marine bioconstructions (*Lithophyllum byssoides*, vermetid platforms, *Cladocora caespitosa* etc.), coralligenous communities, marine caves and deep bottoms (for example Finike seamounts) should be compiled. Long-term monitoring programmes should be established in order to define the temporal variability of abundance, biomass, and other assemblage variables within sensitive habitats, as proposed by UNEP-MAP-RAC/SPA (2003).

- There is certainly a great need of taxonomical studies to reveal current and changing conditions of the aquatic realm, but the number of taxonomists is scarce in Türkiye and existing capacity should be improved by target training and regional exchange.

- In order to better understand the food web dynamics, there is a need to expand ecological studies on phytoplankton, zooplankton, phytobenthos and zoobenthos, to further reveal their role as a link between lower and higher trophic levels.

- National Action Plans for the conservation and management of specific species or groups of species should be prepared.

- Level of climate change and marine and coastal biodiversity issues should urgently be upgraded in national policies and appropriate funds should be allocated.
- Risk status and threats impacting on endangered species should be assessed.

- Evaluation of the magnitude and effect of the interactions between fisheries (both industrial and artisanal) and marine species populations (monk seal, sea turtles, cetaceans, etc.)

- Organize thematic workshops (on biodiversity, stock assessment, habitat mapping, etc.) to elaborate standardized regional monitoring programmes.

- A special action must be addressed to improving statistics of recreational fishery data (fleets, composition, abundance and size of catch). The current fishery statistics of Türkiye give only information on the total catch for a certain species that are sometimes incorrect, for example, records of octopus catch from the Black Sea were given, although no cephalopods inhabit this region. Discrimination between annual productions of industrial and small scale fisheries will help to monitor the impact.

7.

Funding problems and opportunities

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7.1. Regular national sources, potential co-financing for international funding

The main funding body in Türkiye is TUBITAK (The Scientific and Research Council of Türkiye), aiming to support potential researchers and projects about various funding opportunities up to a period of 3 years. Academic Research Funding Program Directorate (ARDEB) of TUBITAK supports research projects proposed by public agencies, private companies, and universities. For academic research and development (R&D), both research for generating new information or solving technological problems in compliance with scientific basis and short term R&D projects with small budgets are supported. Researchers to join international projects that are executed by multiple researchers and corporations from different countries are also supported. Any project submitted to TUBITAK is reviewed by a group of panelists and only those achieving appropriate scores are eligible for support.

7.2. Other sources (private, public, partnership)

The Ministry of Environment and Urbanization and The Ministry of Agriculture and Forestry supply small scale funds for biodiversity researches in marine protected areas. Private or public funds in Türkiye are very small scaled and are not common source for potential researchers. Thus, they can be neglected.

7.3. International funds, projects, programmes, national eligibility for international programmes/funds (e.g. green funds) identified.

The main sources of funding come mainly from the EU via its framework programmes on the environment and biodiversity, the Global Environment Facility (GEF), the UN Environment Programme (UNEP), the UN Development Programme (UNDP), and the Regional Activity Centre for Specially Protected Areas (RAC/SPA). Some international NGOs (such as WWF-Türkiye) irregularly allocate sources for marine and coastal biodiversity.

8.

Conclusions and recommendations

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8.1. Conclusions

The Convention on Biological Diversity (CBD) (Rio de Janeiro, 1992) agreed that anthropogenic activities are leading to mass destruction of terrestrial and marine habitats world-wide. Thus, the conservation of the habitats is a must because of ethical and economical reasons, and also for human survival. But having a deep biological knowledge is vital for appropriate conservation and management of the habitats, in particular, species. Because of this, taxonomical inventories, distribution patterns, as well as the ecology of the species and the habitats are unquestionably required for conservation of the nature. Besides being in connection with Europe, Middle East, Central Asia and Africa, its encirclement by three seas have resulted in a high terrestrial, fresh water, and marine biodiversity in Türkiye. Biologists, naturalists, and conservationists have been attracted by this remarkable wildlife. However, our current knowledge on marine biota of Türkiye is extremely limited and infrequent when compared to terrestrial ecosystems.

Annotated checklists of the marine life of Türkiye have been published recently, including about 6,000 marine species, which made great contributions to our knowledge on Turkish marine biota. But still, the inventories are far from being complete. The diversity, distribution patterns, faunal compositions are well studied for large groups, such as, Annelida, Arthropoda and Mollusca, Pisces, but there are very little data about some groups, such as Xenacoelomorpha, Acanthocephala, Myxozoa, Tardigrada, Cephalorhyncha, Echiura. Besides, the biodiversity has an ongoing modification due to increasing number of alien species. There is a big gap of knowledge concerning the distribution and ecology of the marine habitats found along the Turkish coastline. There is lack of knowledge on the deep sea and high sea habitats and biodiversity.

There is a comprehensive legislation on nature conservation and fisheries in Türkiye. However, there is no legal text specifically for the protection of species or habitats, and the problems in practice are tried to be overcome with the rules in different regulations implemented by different institutions, which create conflicts of authority between them. The total area of MCPAs is about 1,900km^2, with more than 1,400km^2 marine component, which is quite impressive. However, of the 12 SEPAs, only 4 have declared management plan.

Although the coasts of Türkiye, mainly the Levantine coasts, are highly invaded by alien species, there is no clear strategy for the management of alien species. While conducting projects against alien species on one hand, the economically valued ones are protected by law, having seasonal prohibition or size limits, on the other hand. It was documented that a single species, *Lagocephalus sceleratus*, causes a considerable financial loss of over 2 million Euros per year.However, alien fish and crustacean species dominate the fisheries market on the Eastern Levantine coasts, creating a conflict between conservational and economical issues.

All the problems stated above can be solved by improving our knowledge on the Mediterranean habitats and the biota living in them. This lack of knowledge can only be overcome by multidiciplinary collective long term studies and monitoring programmes, which requires high amount of funding.

8.2. Recommendations.

Taking into account the analysis made in this document, the following recommendations can be made

- Knowledge on marine and coastal biodiversity should be improved. Besides the taxonomical studies, the number of multidisciplinary projects on ecosystem scale should be increased. More attention should be given to the less studied groups and habitat types. More data should be produced on the biology, ecology and genetics of the species, interactions between the components of the communities and habitats.

- Specific researches, in particular on habitat mapping, habitat ecology, integrated coastal management, biology and ecology of alien species.

- Specific attention should be given to deep ecosystems, scientific studies on deep water ecology, conservation and sustainable management of deep water fisheries should be promoted.

- Training and capacity building should be promoted, especially in: monitoring, planning, multidisciplinary co-operation, training of specialists, not only on taxonomy, but also on multidisciplinary/multinational project management.

- Like the "Turkish National Integrated Marine Pollution Monitoring Program" being implemented for almost ten years, monitoring programs on marine biodiversity and habitat integrity should be implemented, at least in the MCPAs.

- Finally, pressures and their impacts on biodiversity in MCPAs should be determined, ecosystem based integrated management plans should be created in accordance to the scientific data and should be implemented as soon as possible for all MCPAs.

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SPA/RAC WORKING AREAS

*SPA/ RAC, the UNEP/ MAP **Specially Protected Areas Regional Activity Centre**, was created in 1985 to assist the Contracting Parties to the Barcelona Convention (21 Mediterranean contries and the European Union) in implementing the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol).*

POST-2020 SAPBIO

Strategic Action Programme for the **Conservation** of **Biodiversity** and **Sustainable Management** of **Natural Resources** in the **Mediterranean Region**

SPAMI

Specially Protected Areas of **Mediterranean Importance**

Marine turtles

Cetaceans

Specially Protected Areas

Monitoring

Mediterranean Monk Seal

Cartilaginous fishes
(Chondrichtyans)

Coralligenous and other calcareous bio-concretions

Marine vegetation

Marine and coastal bird species

Listed in Annex II of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean

Dark Habitats

Habitats and species associated with seamounts, underwater caves and canyons, aphotic hard beds and chemo-synthetic phenomena

Species introduction and invasive species

POST-2020

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