

An underwater photograph showing a large school of small, silvery fish swimming in clear blue water above a dark, rocky reef. Sunlight rays are visible filtering down from the surface.

GLOBAL CHANGE ECOLOGY AND SUSTAINABILITY
a.a. 2023-2024

Conservation and Management of Marine Ecosystems
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**Main EU Directives on marine
environments**

Main international regulations and agreements

- BD EU Bird Directive (EU Parliament and Council Directive 2009/147/EC on the conservation of wild birds)
- CBD Convention of Biological Diversity
- CFP Common Fisheries Policy (EU Parliament and Council Regulation No. 1380/2013 on the Common Fisheries Policy)
- EUSAIR Union Strategy for the Adriatic and Ionian Region
- HD EU Habitat Directive (EU Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora)
- HELCOM Baltic Marine Environment Protection Commission
- MSFD EU Marine Strategy Framework Directive (EU Parliament and Council Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy)
- MSPFD EU Framework Directive on Maritime Spatial Planning (EU Parliament and Council Directive 2014/89/EC establishing a framework for maritime spatial planning)
- OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic
- WFD EU Water Framework Directive (EU Parliament and Council Directive 2000/60/EC, establishing a framework for Community action in the field of water policy)

Water Framework Directive

DIRECTIVE 2000/60/EC (D.Lgs. 152/2006)

The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which:

- (a) prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;**
- (b) promotes sustainable water use based on a long-term protection of available water resources;**
- (c) aims at enhanced protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances;**
- (d) ensures the progressive reduction of pollution of groundwater and prevents its further pollution, and**
- (e) contributes to mitigating the effects of floods and droughts**

Monitoring the status of waters every six years to achieve a good quality status

Operational monitoring: water bodies at risk or not in good status

Surveillance monitoring: water bodies

Investigative monitoring: water bodies not in good status to understand and clarify causes

Habitat Directive

Directive 92/43/EEC
D.P.R. 357/1997

The aim of this Directive shall be to contribute towards ensuring biodiversity through the conservation of natural habitats, and species of particular relevance. Report every six years. A coherent European ecological network of special areas of conservation shall be set up under the title Natura 2000. This network, composed of sites hosting the natural habitat types listed in Annex I and habitats of the species listed in Annex II, shall enable the natural habitat types and the species' habitats concerned to be maintained or, where appropriate, restored at a favourable conservation status in their natural range. The Natura 2000 network shall include the special protection areas classified by the Member States pursuant to Directive 79/409/EEC.

Marine habitats of community interest included:

Sandbanks which are slightly covered by sea water all the time

* Posidonia beds

Submerged or partly submerged sea caves

Estuaries

Mudflats and sandflats not covered by seawater at low tide

* Lagoons

Large shallow inlets and bays

Reefs

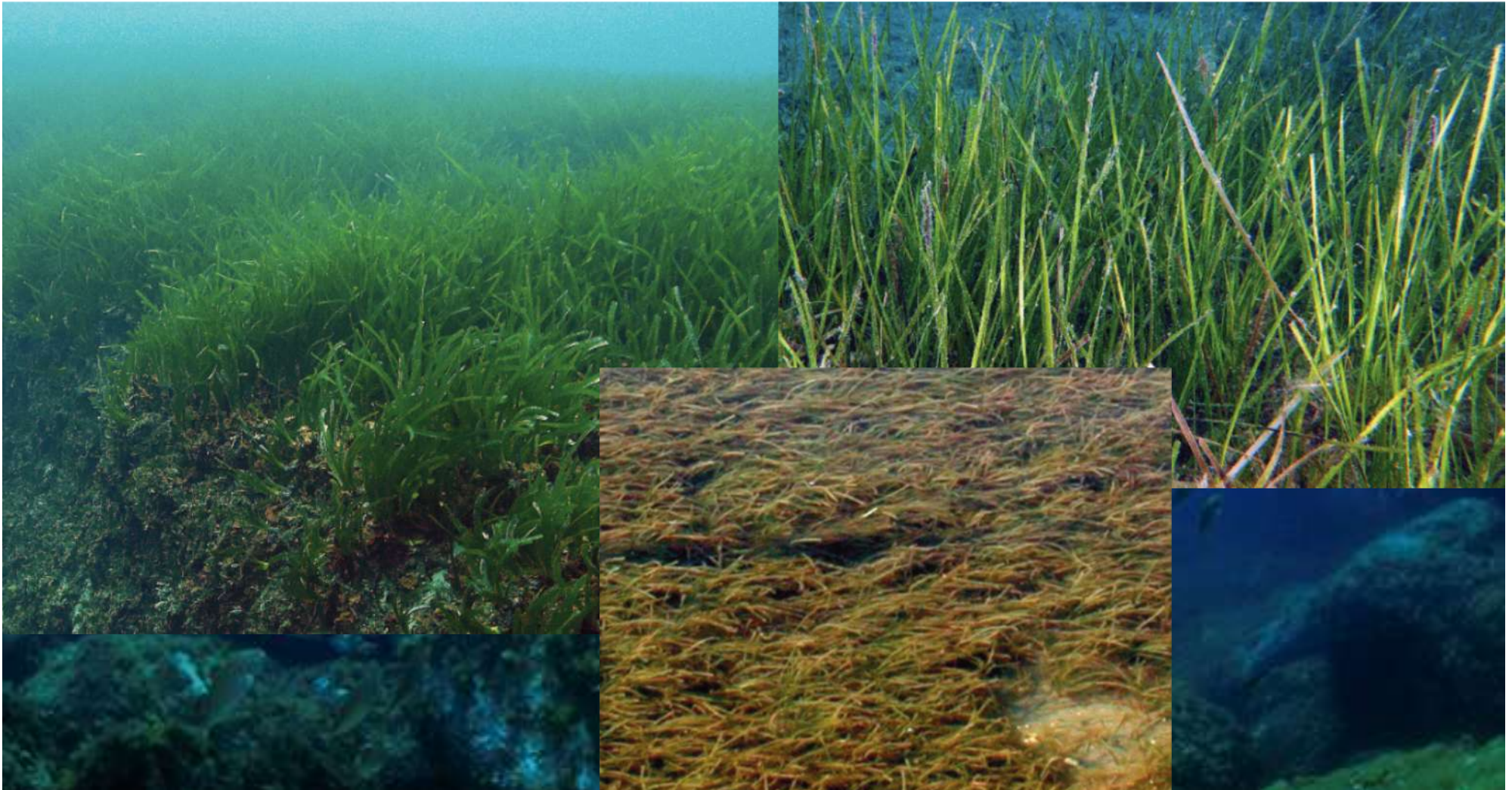
Marine 'columns' in shallow water made by leaking gases

Parham 2006

Protected or regulated species

Magnoliophyta

<i>Posidonia oceanica</i>	(Linnaeus) Delile	P2	B1
<i>Zostera marina</i>	Linnaeus	P2	B1
<i>Zostera noltii</i>	Hornemann	P2	
<i>Cymodocea nodosa</i>	(Ucria) Ascherson		B1



Protected or regulated species

Phaeophyta

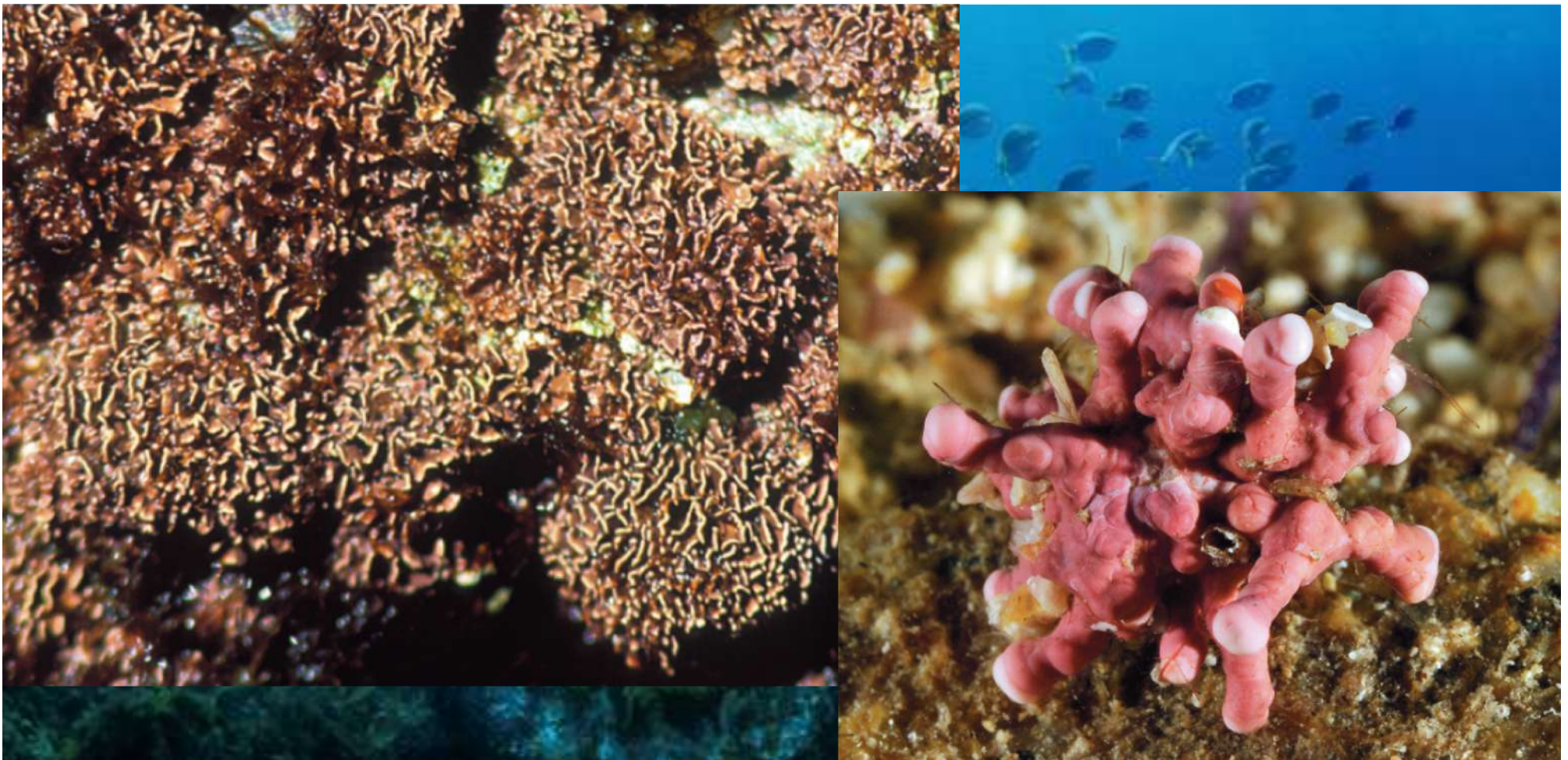
<i>Cystoseira amentacea</i> and var. <i>spicata</i>	(C.Agardh) Bory including var. <i>stricta</i> Montague (Ercegovic) Giaccone	P2	B1
<i>Cystoseira mediterranea</i>	Sauvageau	P2	B1
<i>Cystoseira sedoides</i>	(Desfontaines) C.Agardh	P2	B1
<i>Cystoseira spinosa</i>	Sauvageau including <i>C. adriatica</i> (Ercegovic) Giaccone	P2	B1
<i>Cystoseira zosteroides</i>	C. Agardh	P2	B1
<i>Laminaria rodriguezii</i>	Bornet	P2	B1
<i>Laminaria ochroleuca</i>	Pylaie		B1



Protected or regulated species


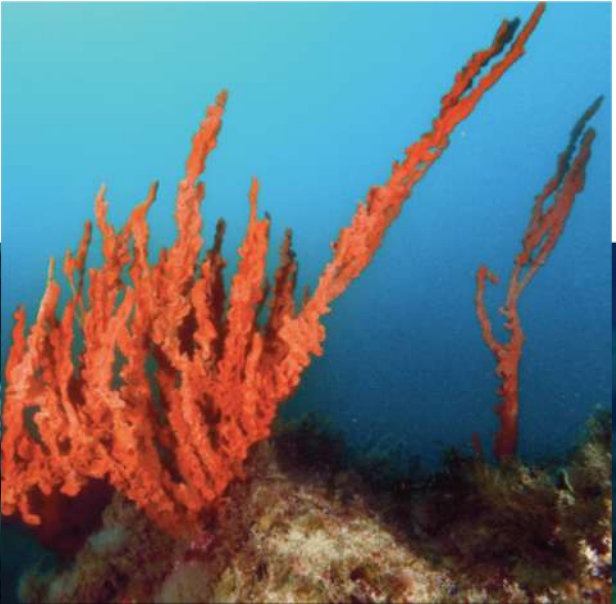
Rhodophyta

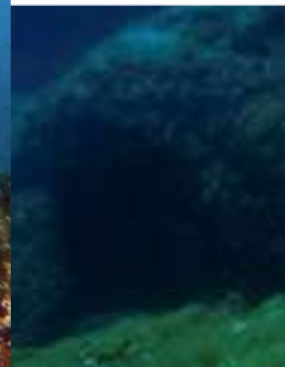
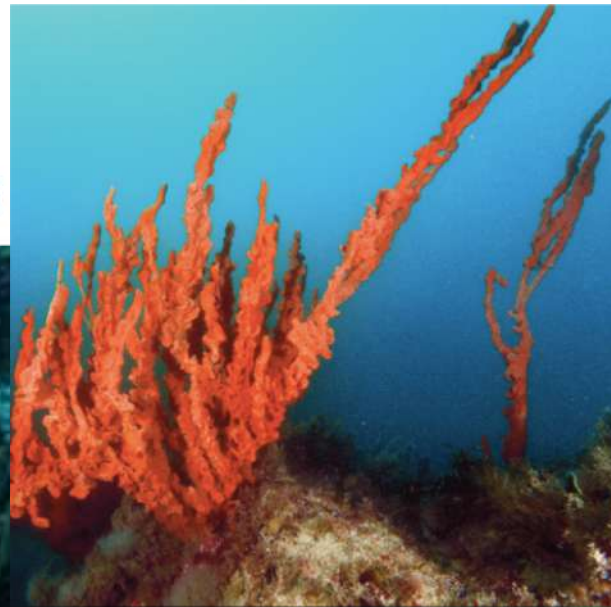
<i>Goniolithon byssoides</i>	(Lamarck) Foslie (nomenclatura non aggiornata) (3)	P2	B1
<i>Lithophyllum lichenoides</i>	Philippi (3)	P2	B1
<i>Ptilophora mediterranea</i>	(H. Huvé) Norris	P2	B1
<i>Schimmelmannia schousboei</i> (= <i>S. ornata</i>)		P2	B1



Protected or regulated species

Porifera

<i>Petrobiona massiliana</i>	Vacelet & Lévi, 1971		P2	B2
<i>Axinella polypoides</i>	Schmidt, 1862		P2	B2
<i>Axinella cannabina</i>	(Esper, 1794)		P2	
<i>Spongia agaricina</i>	Pallas, 1766		P3	B3
<i>Spongia officinalis</i>	Linnaeus, 1759		P3	B3
<i>Spongia zimocca</i>	Schmidt, 1862		P3	B3
<i>Aplysina cavernicola</i>	Vacelet, 1959		P2	B2
<i>Aplysina aerophoba</i>	Schmidt, 1862		P2	
<i>Asbestopluma hypogea (1)</i>	Vacelet and Boury-Esnault 1995		P2	
<i>Geodia cydonium</i>	(Jameson, 1811)		P2	
<i>Hippospongia communis</i>	(Lamarck, 1813)	<i>Spugna equina</i>	P3	B3
<i>Ircinia foetida</i>	(Schmidt, 1862)		P2	
<i>Ircinia pipetta</i>	(Schmidt, 1868)		P2	
<i>Tethya aurantium</i>	(Pallas, 1766)		P2	
<i>Tethya citrina</i>	Sarà e Melone, 1965		P2	



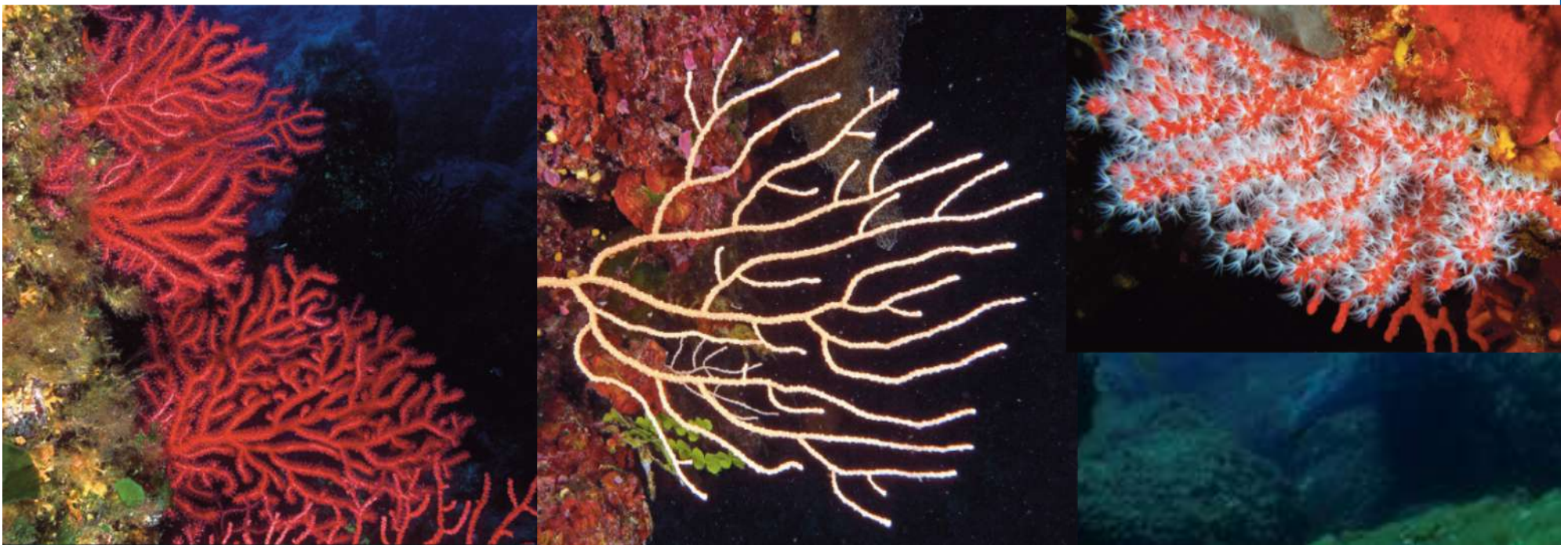
Protected or regulated species

Cnidaria

<i>Corallium rubrum</i>	(Linnaeus, 1758)	Corallo rosso	P3	B2H5
<i>Antipathes dichotoma</i>	Pallas, 1766		P3	B3CB
<i>Antipathes fragilis</i>	Gravier, 1918		P3	B3CB
<i>Antipathes subpinnata</i>	(Ellis & Solander, 1786)		P3	B3CB
<i>Astroides calycularis</i>	(Pallas, 1766)		P2	B2
<i>Gerardia savaglia</i>	(Bertoloni, 1819)		P2	B2
<i>Errina aspera</i>	(Linnaeus, 1767)		P2	

Bryozoa

<i>Hornera lichenoides</i>	(Linnaeus, 1758)		P2	
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Protected or regulated species

Mollusca

<i>Patella ferruginea</i>	Gmelin, 1791	<i>Patella ferrosa</i>
<i>Patella nigra</i> (1)	(da Costa, 1771)	
<i>Gibbula nivosa</i>	A.Adams, 1851	Trottola
<i>Dendropoma petraeum</i>	(Monterosato, 1884)	
<i>Erosaria spurca</i>	(Linnaeus, 1758)	
<i>Luria lurida</i>	(Linnaeus, 1758)	
<i>Schilderia achatidea</i>	(Gray in G.B. Sowerby II, 1837)	
<i>Zonaria pyrum</i>	(Gmelin, 1791)	
<i>Tonna galea</i>	(Linnaeus, 1758)	Elmo
<i>Ranella olearia</i>	(Linnaeus, 1758)	
<i>Charonia lampas</i>	(Linnaeus, 1758)	
<i>Charonia tritonis</i>	(Linnaeus, 1758)	Tritone lucido
<i>Mitra zonata</i>	Marryat, 1818	Mitra zonata
<i>Lithophaga lithophaga</i>	(Linnaeus, 1758)	Dattero di mare
<i>Pinna nobilis</i>	(Linnaeus, 1758)	Pinna nobile
<i>Pinna rudis</i> (= <i>pernula</i>)	Linnaeus, 1758	
<i>Pholas dactylus</i>	Linnaeus, 1758	Dattero bianco



Protected or regulated species

Crustacea

<i>Homarus gammarus</i>	(Linnaeus, 1758)	Astice	P3	B3
<i>Palinurus elephas</i>	(Fabricius, 1787)	Aragosta	P3	B3
<i>Scyllarides latus</i>	(Latreille, 1803)	Cicala grande	P3	B3H5
<i>Scyllarus arctus</i>	(Linnaeus, 1758)	Cicala di mare	P3	B3
<i>Scyllarus pygmaeus</i>	(Bate, 1888)	Cicala minore	P3	B3
<i>Maja squinado</i>	(Herbst, 1788)	Granceola	P3	B3
<i>Ocypode cursor</i>	(Linnaeus, 1758)	Granchio fantasma	P2	B2
<i>Pachylasmus giganteum</i>	(Philippi, 1836)	Pachilasma	P2	

Echinodermata

<i>Ophidiaster ophidianus</i>	(Lamarck, 1816)		P2	B2
<i>Asterina pancerii</i>	(Gasco, 1860)		P2	B2
<i>Centrostephanus longispinus</i>	(Philippi, 1845)	Riccio di mare a lunghe		
<i>Paracentrotus lividus</i>	(Lamarck, 1816)	Riccio di mare di		



Protected or regulated species

Condriichthyes

<i>Carcharodon carcharis</i>	(Linnaeus, 1758)	Squalo bianco	P2	B2
<i>Cetorhinus maximus</i>	(Gunnerus, 1765)	Squalo elefante	P2	B2
<i>Isurus oxyrinchus</i>	Rafinesque, 1810	Squalo mako	P3	B3
<i>Lamna nasus</i>	(Bonnaterre, 1788)	Smeriglio	P3	B3
<i>Prionace glauca</i>	(Linnaeus, 1758)	Verdesca	P3	B3
<i>Squatina squatina</i>	(Linnaeus, 1758)	Squadro	P3	B3
<i>Raja alba</i>	Lacépède, 1803	Razza bianca	P3	B3
<i>Mobula mobular</i>	(Bonnaterre, 1788)	Diavolo di mare	P2	B2



Protected or regulated species

Osteichthyes

<i>Acipenser naccarii</i>	Bonaparte, 1836	Storione cobice	P2	B2CBH2H4
<i>Acipenser sturio</i>	Linnaeus, 1758	Storione	P2	B2CAH2H4
[<i>Acipenser transmontanus</i>](2)	Richardson, 1836	Storione bianco		CBH5
<i>Huso huso</i>	(Linnaeus, 1758)	Storione ladano	P2	B3CBH5
<i>Alosa alosa</i>	(Linnaeus, 1758)	Alosa	P3	B3H2H5
<i>Alosa fallax</i>	(Lacépède, 1803)	Cheppia	P3	B3H2H5
<i>Aphanius fasciatus</i>	Nardo, 1827	Nono	P2	B2H2
[<i>Aphanius iberus</i>](1)	(Valenciennes, 1846)	Nono iberico	P2	
<i>Hippocampus hippocampus</i>	(Linnaeus 1758)	Cavalluccio marino	P2	CD
<i>Hippocampus ramulosus</i>	Leach, 1814	Cavalluccio marino	P2	CD
<i>Syngnathus abaster</i>	Risso, 1826	Pesce ago di Rio		B3
[<i>Cottus gobio</i>]	(Linnaeus, 1758)	Scazzone		H2



Protected or regulated species

<i>Sciaena umbra</i>	Linnaeus, 1758	Corvina	P3	B3
<i>Umbrina cirrosa</i>	(Linnaeus, 1758)	Ombrina	P3	B3
<i>Knipowitschia panizzae</i>	(Verga, 1841)	Ghiozzetto di laguna		H2
[<i>Padogobius martensi</i>]	(Günter, 1861)	Ghiozzetto padano		B3
[<i>Padogobius nigricans</i>]	(Canestrini, 1867)	Ghiozzetto di ruscello		H2
[<i>Pomatoschistus canestrini</i>]	(Ninni, 1883)	Ghiozzetto cenerino	P2	B3H2
<i>Pomatoschistus marmoratus</i>	(Risso, 1810)	Ghiozzetto marmorizzato		B2
<i>Pomatoschistus microps</i>	(Kroyer, 1838)	Ghiozzettobaltico		B2
<i>Pomatoschistus minutus</i>	(Pallas, 1770)	Ghiozzetto minuto		B2
<i>Pomatoschistus tortonesei</i>	Miller, 1968	Ghiozzetto di Tortonese	P2	
<i>Anguilla anguilla</i>	(Linnaeus, 1758)	Anguilla	P3	
<i>Epinephelus marginatus</i>	(Lowe, 1834)	Cernia bruna	P3	
<i>Thunnus thynnus</i>	(Linnaeus, 1758)	Tonno	P3	
[<i>Valencia hispanica</i>](1)	(Valenciennes, 1846)		P2	
[<i>Valencia letourneuxi</i>](1)	(Sauvage, 1880)		P2	
<i>Xiphias gladius</i>	Linnaeus, 1758	Pesce spada	P3	



Protected or regulated species

Reptilia

<i>Caretta caretta</i>	(Linnaeus, 1758)	Tartaruga marina	P2	B2CAD1H2H4
<i>Chelonia mydas</i>	(Linnaeus, 1758)	Tartaruga verde	P2	B2CADB1H4
<i>Eretmochelys imbricata</i>	(Linnaeus, 1766)	Tartaruga embricata	P2	B2CAD1H4
<i>Lepidochelys kempii</i>	(Garman, 1880)	Tartaruga bastarda	P2	B2CAD1H4
<i>Dermochelys coriacea</i>	(Vandelli, 1761)	Tartaruga liuto	P2	B2CAD1H4
<i>Trionyx triunguis</i> (1)	(Forskål, 1775)		P2	



Protected or regulated species

Aves

<i>Calonectris diomedea</i>	(Scopoli, 1769)	Berta maggiore	P2	L1A1B2
<i>Puffinus puffinus</i> <i>yelkouan</i>	(Brünnich, 1764)	Berta minore	P2	L1B2
<i>Hydrobates pelagicus</i>	(Linnaeus, 1758)	Uccello delle tempeste	P2	L1A1B2
<i>Phalacrocorax aristotelis</i> <i>desmaresti</i>	(Linnaeus, 1761)	Marangone dal ciuffo Marangone dal ciuffo ss. mediterranea	P2	L2B3 L1A1
<i>Phalacrocorax pygmeus</i>	(Pallas, 1773)	Marangone minore	P2	L1A1B2D2
<i>Pelecanus crispus</i>	Bruch, 1832	Pellicano riccio	P2	L2A1B2CAD1D2
<i>Pelecanus onocrotalus</i>	Linnaeus, 1758	Pellicano	P2	L2A1B2
<i>Phoenicopterus ruber</i>	Linnaeus, 1758	Fenicottero	P2	L2A1B2CAD2
<i>Pandion haliaetus</i>	(Linnaeus, 1758)	Falco pescatore	P2	L2A1B3CAD2
<i>Falco eleonora</i>	Géné, 1834	Falco della regina	P2	L2A1B2CAD2
<i>Numenius tenuirostris</i>	Viellot, 1817	Chiurlottello	P2	L1A1B2CAD1
<i>Larus audouinii</i>	Payraudeau, 1826	Gabbiano corso	P2	L2A1B2D1D2
<i>Sterna albifrons</i>	Pallas, 1764	Fratricello	P2	L1A1B2D2
<i>Sterna bengalensis</i>	Lesson, 1831	Sterna del Ruppel	P2	L1B3
<i>Sterna sandvicensis</i>	Latham, 1878	Beccapesci	P2	L1A1B2



Protected or regulated species

Mammalia

<i>Monachus monachus</i>	(Hermann, 1779)	Foca monaca	P2	L2B2CAD1D2H2H4
<i>Eubalaena glacialis</i>	(Müller, 1776)	Balena nera	P2	L2B2CAD1H4
<i>Balaenoptera</i>				
<i>acutorostrata</i>	Lacépède, 1804	Balenottera minore	P2	L1B2CAH4
<i>Balaenoptera musculus</i>	(Linnaeus, 1758)	Balenottera azzurra		L1B2CAD1H4
<i>Balaenoptera physalus</i>	(Linnaeus, 1758)	Balenottera comune	P2	L1B2CAH4
<i>Physeter catodon</i>				
(<i>macrocephalus</i>)	Linnaeus, 1758	Capodoglio	P2	L1B2CAH4
<i>Kogia simus</i>	(Owen, 1866)	Cogia	P2	L1B2CAH4
<i>Ziphius cavirostris</i>	Cuvier G., 1832	Zifio	P2	L1B2CAH4
<i>Tursiops truncatus</i>	(Montagu, 1821)	Tursiope	P2	L1B2CAH2H4
<i>Stenella coeruleoalba</i>	(Meyen, 1833)	Stenella striata	P2	L1B2CAH4
<i>Delphinus delphis</i>	Linnaeus, 1758	Delfino comune	P2	L1B2CAH4
<i>Grampus griseus</i>	(Cuvier G. 1812)	Delfino di Risso	P2	L1B2CAH4
<i>Pseudorca crassidens</i>	(Owen, 1846)	Pseudorca	P2	L1B2CAH4
<i>Orcinus orca</i>	(Linnaeus, 1758)	Orca	P2	L1B2CAH4
<i>Globicephala melaena</i>	(Trail, 1809)	Globicefalo	P2	L1B2CAH4
<i>Steno bredanensis</i>	(Lesson, 1828)	Steno	P2	L1B2CAH4
<i>Balaenoptera borealis</i> (1)	Lesson, 1828	Balena boreale	P2	
<i>Megaptera novaeangliae</i> (1)	(Borowski, 1781)	Megattera	P2	
<i>Mesoplodon densirostris</i> (1)	(de Blainville, 1817)	Mesoplodonte	P2	
<i>Phocoena phocoena</i> (1)	(Linnaeus, 1758)	Focena	P2	



Marine Strategy Framework Directive (MSFW)

For the MSFW (2008/CE/56) each EU country has to develop its strategy, in agreement and coordinated with all other countries in each marine region, to achieve and maintain the Good Environmental Status (GES) in 2020.

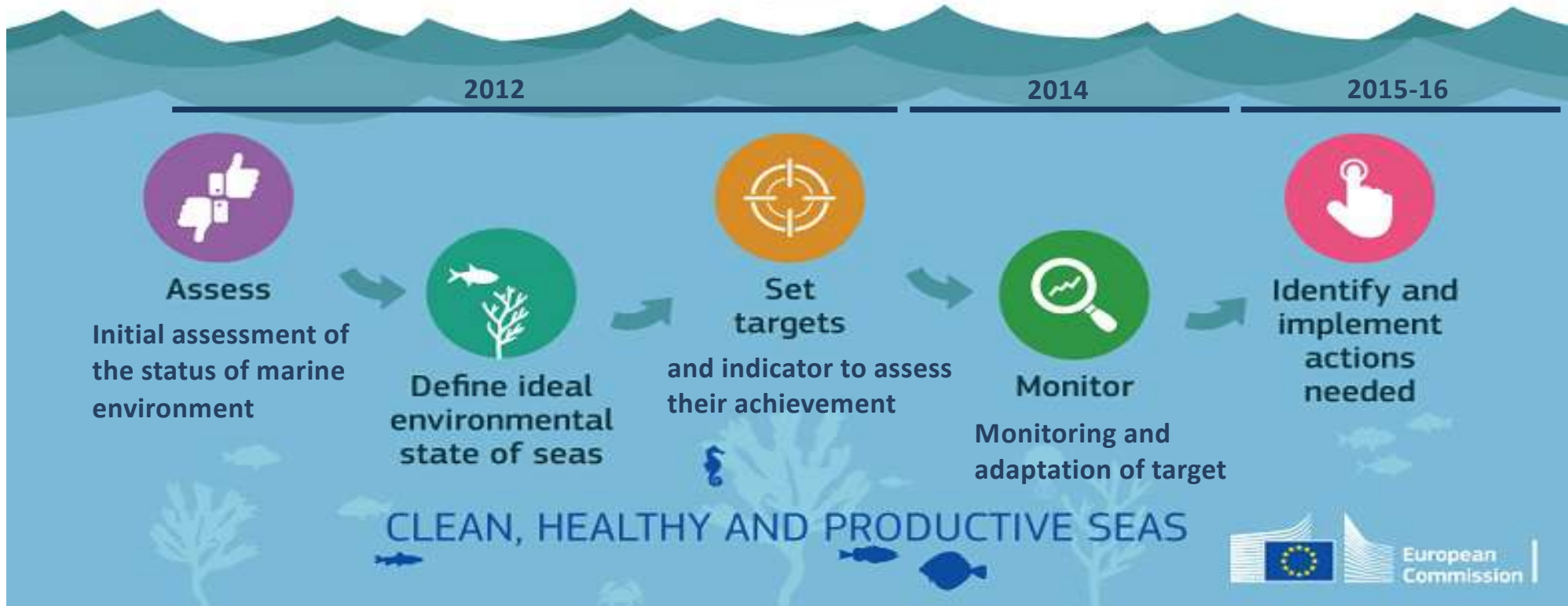
GES means that the environmental conditions of sea water are adequate to preserve diversity and functioning of seas and oceans, which are expected to be clean, healthy and productive, with a sustainable use of marine resources.

The structure, functions, and processes of marine ecosystems should work allowing their resilience. Species and habitats are protected and their persistence insured, avoiding biodiversity loss due to human activities. Physical-chemical, hydrologic, and geomorphologic features are in good conditions to sustain biodiversity and ecosystem functioning, and matter and energy inputs from human activities do not determine risks for marine biodiversity, ecosystems and environments, and for the human health and human use of resources.

In Italy, D.Lgs. n. 190/2010

Development of MSFD

How EU Member States develop marine strategies



Baltic Sea

NE Atlantic Ocean

Mediterranean Sea

Black Sea

W Mediterranean Sea

Adriatic Sea

Ionian and Central Mediterranean Sea

E Aegean Sea

Six-year cycle of reiteration of the adaptive process to maintain and or achieve GES

Initial assessment

- a) Analysis of main components and features of current environmental state in marine regions and subregions based on 11 descriptors.
- b) Analysis of main human impacts and pressures affecting marine ecosystems in the regions or subregions, their trends and potential cumulative effects
- c) Analysis of socio-economic factors and of uses of marine resources, along with environmental costs of degradation

Components

Impacts

Socio-economy



Descriptors

1. Biological diversity

2. Non-indigenous species

3. Commercially exploited species

4. Marine food webs

5. Eutrophication

6. Sea-floor integrity

7. Hydrographical conditions

8. Contaminants

9. Health issues

10. Marine litter

11. Marine energy

11 descriptors

1. Biodiversity is maintained

2. Non-indigenous species do not adversely alter the ecosystem

3. The population of commercial fish species is healthy

4. Element of food webs ensure long-term abundance and reproduction

5. Eutrophication is minimised

6. The sea floor integrity ensures functioning of the ecosystem

7. Permanent alteration of hydrographical conditions does not adversely affect the ecosystem

8. Concentrations of contaminants give no effects

9. Contaminants in seafood are below safe levels

10. Marine litter does not cause harm

11. Introduction of energy (including underwater noise) does not adversely affect the ecosystem

Indicators

1. Biodiversity

Species

Population size

Abundance or biomass

Conditions

Demography

Genetic structure

Habitats

Habitat extent

Surface

Conditions

Conditions of typical species or communities

Abundance or biomass

2. Non-indigenous species (NIS)

Abundance and conditions of NIS with a particular focus on invasive species

Trends in abundance, frequency of occurrence, and distribution of NIS

Impact of NIS on native species, habitat and ecosystems

Commercially exploited species

Fishing pressure

Fishing catches / biomass-catch ratio

Reproductive ability of stocks

Biomass of reproductive stocks – other indices

Age and size distribution

Indicators

4. Marine food webs

Proportion of top predators

Large fish predators

Abundance/distribution of trophic guilds

Trends in abundance of functionally important guilds

5. Eutrophication

Nutrient levels

Concentration of nutrient in the water column
Accumulation rates

Direct effect of nutrient overload

Chlorophyll concentration in the water column

Water turbidity due to phytoplankton

Changes in phytoplankton assemblages

Indirect effects

Dissolved oxygen and extent of depleted areas

6. Sea floor integrity

Physical damage on different substrates

Area of seabed, for each habitat, significantly affected by human activities

Indicators

7. Hydrographical conditions

Spatial attributes of permanent alterations

Surface of areas permanently altered

8. Contaminants

Concentration

Concentration of pollutants in environmental matrices

Effects

Effects of pollutants on contaminated ecosystem based on known cause-effect relationships that require monitoring

9. Human health

Level, number, and frequency of contaminants

Number of pollutants and concentration beyond safe threshold defined by law

Frequency of exceeding thresholds

Indicators

10. Marine litter

Characteristics of marine litter

Trends in the amount of litter thrown in the sea and coastline, including composition, spatial distribution, and origin, if possible

Trends in the composition and distribution of microplastics

Impact of litter on marine life

Trends in the amount and composition of litter ingested by marine organisms

11. Energy inputs

Spatial and temporal distribution of underwater sounds

Year-round proportion and distribution of anthropogenic noise in the affected areas when exceeding levels potentially harmful for marine organisms

Effects

Effects of pollutants on contaminated ecosystem based on known cause-effect relationships that require monitoring

Targets

1. Biodiversity

Species and habitat listed in the HD and other regulations maintain or achieve a good conservation status
MPAs maintain or achieve the status of SPAMI

A representative and functionally connected network of MPAs covering the 10% of Italian marine waters is implemented

4. Food webs

The status of all components is improved through the achievement of targets for D1,3,5,6 with respect to bone fish, sharks, marine mammals, reptiles, benthic and planktonic communities

5. Eutrophication

Several targets of reduction and regulation of sewage discharge
Hypoxia and anoxia are reduced

2. NIS

Early-warning systems in all large harbours
Response system of authorities in harbours and aquaculture farms activated
Import, or movements of NIS for aquaculture tracked
Knowledge of NIS impact is increased

6. Sea floor integrity

Impact of construction or deployment of structure on biogenic habitat are reduced
Abrasion is avoided on 10% of sea floor suitable for fishing exploitation
No fishing on biogenic substrates
Vessels for seabed fishing are tracked

3. Commercial species

Mortality by fishing of overexploited species is reduced by 2020
Illegal fishing practices are reduced by 2020
Recreational fishing is regulated and its impact estimated
Minimum landing size for commercially exploited sharks

7. Hydrography

Hydrographic effects of on-shore and offshore human structures existing, in construction, or projected are assessed

8. Contaminants

Level of contaminants above thresholds are reduced
Knowledge on their impact is increased
Frequency of events is reduced

Targets

9. Human health

Pollutant levels exceeding thresholds for safety in seafood from national waters are decreasing

Frequency of cases of contamination in seafood from national waters is decreasing

10. Litter

The amount of litter on coasts, seabed, and in the water column, including floating litter is decreasing

Ingested items in marine organisms is decreasing

Knowledge on the origin, composition, distribution, dispersion and impact of marine litter is increased

11. Energy

The register of underwater noise on human activity producing pulse sounds within the range of 10 Hz-10kHz is implemented

A baseline level of ambient noise (continuous sounds a low frequency) is defined