University of Trieste: GLOBAL CHANGE ECOLOGY a.a. 2019-2020

BIODIVERSITY AND ECOSYSTEM FUNCTIONING

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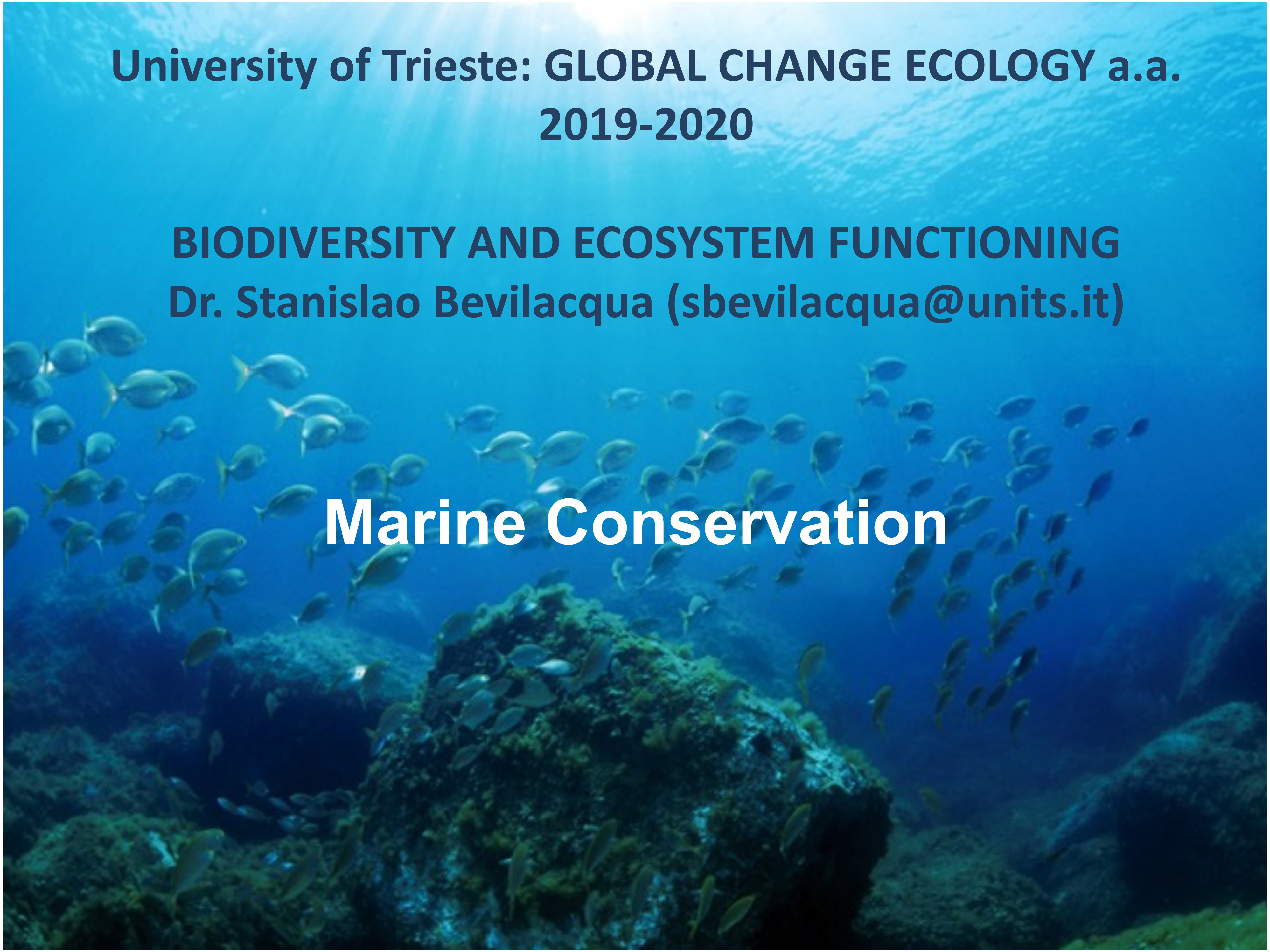
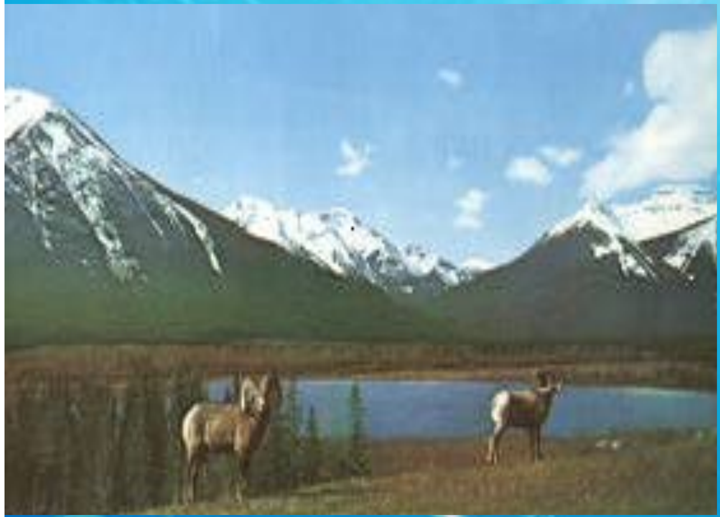
Marine Conservation



Conservation on land



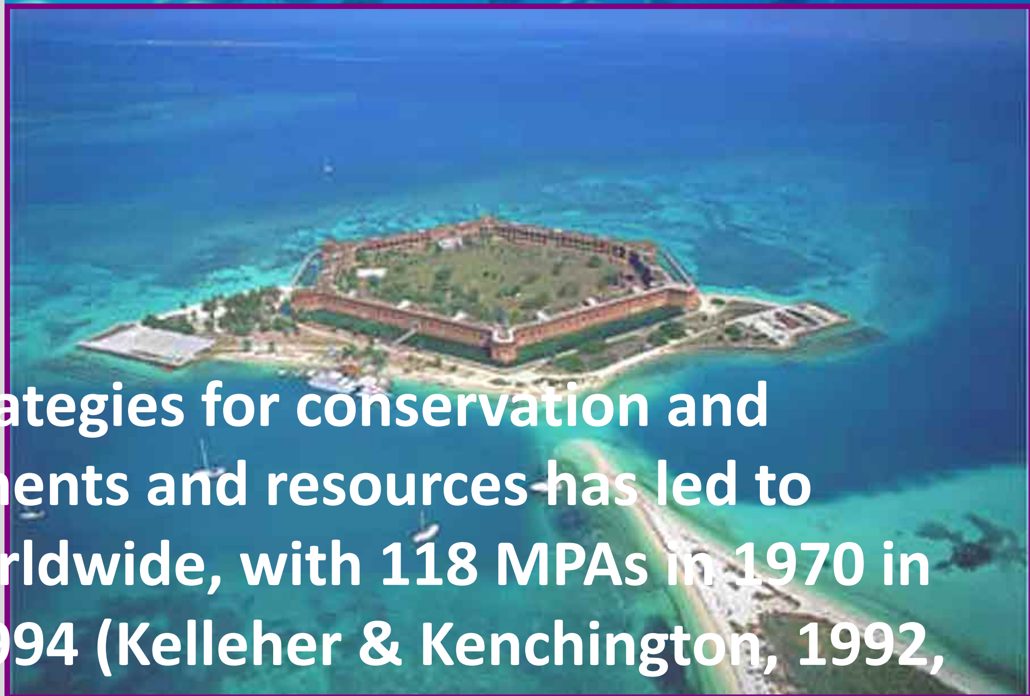
First protected forests in India more than 2000 years ago (Talbot, 1984);

In Europe (England, Italy, etc.) between XVII and XIX centuries several protected areas were established with the aim of protecting natural resources, but indeed they were hunting reserve only for rich people;

In 1872, the Yellowstone National Park was established as a “place where natural beauty is preserved for the whole society” (Wright, 1996).

Marine conservation

The implementation of Marine Protected Areas (MPAs) is relatively recent: the first MPA was probably the Fort Jefferson National Monument created in Florida in 1935 (Gubbay, 1995).



In 1950s the need for suitable strategies for conservation and management of marine environments and resources has led to increase the number of MPAs worldwide, with 118 MPAs in 1970 in 27 countries and 1306 MPAs in 1994 (Kelleher & Kenchington, 1992, Kelleher *et al.*, 1995)

Key differences between terrestrial and marine ecosystems (1)

Feature	Terrestrial ecosystems	Marine ecosystems
Environmental		
Prevalence of aquatic medium	less	greater
Dimensions of species distribution	two-dimensional	three-dimensional
Scale of chemical and material transport	smaller	greater
"Openness" of local environment (i.e., rates of import and export)	less	greater
Ecological		
Phyletic diversity (α and β)	less	greater
Life-history traits		
Per capita fecundity of invertebrates and small vertebrates	lower	higher
Per capita fecundity of mammals	low	low
Difference in dispersal between life stages	less	greater
Importance of pollination syndromes	great	minimal
Rate of response to environmental variability	lower	faster
Sensitivity to large-scale environmental variability	lower	higher
Population structure		
Spatial scale of propagule transport	smaller	greater
Spatial structure of populations	less open	more open
Reliance on external sources of recruitment	lower	higher
Likelihood of local self replenishment	high	low
Sensitivity to habitat fragmentation	greater	less
Sensitivity to smaller scale perturbations	greater	less
Temporal response to large-scale events	slower (centuries)	higher (decades)

(Carr et al., 2003)

Key differences between terrestrial and marine environments (2)

Trophic		
Lateral transport of energy	low (few planktivores)	high (many planktivores)
Turnover of primary producers	slow (many perennials)	high (few perennials)
Reliance of carnivores on external input of prey	lower	higher
Prey populations influenced by external input of predators	lower	higher
Pronounced ontogenetic shifts of vertebrates	rare	very common
Genetic		
Effective population size	smaller	larger
Spatial scale of gene flow	smaller	larger
Interpopulation genetic diversity	higher	lower
Types and relative importance of contemporary human threats		
Habitat destruction	widespread	spatially focused (e.g., estuaries, coral reefs)
Loss of biogenic habitat structure	widespread (e.g., deforestation)	spatially focused (e.g., estuaries, coral reefs)
Trophic levels threatened or exploited	lower (primary producers)	higher (predators)
Degree of domestication	higher	lower

(Carr et al., 2003)

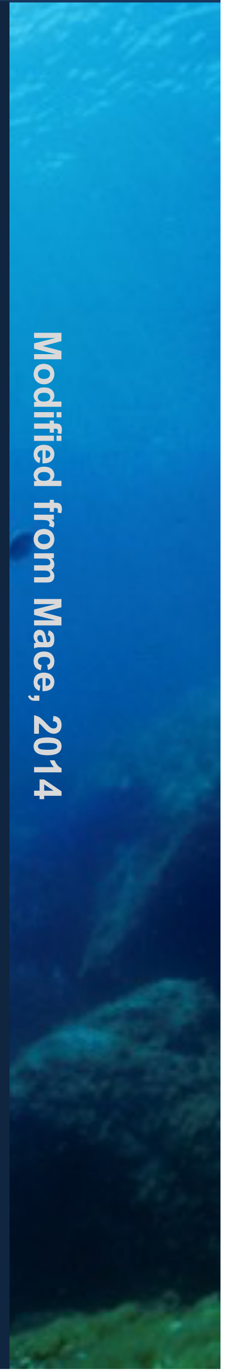
Implications for differences in conservation strategies and reserve networks

Feature	Terrestrial ecosystems	Marine ecosystems
Reserve objectives		
Spatial focus for protection	within reserves	within and outside reserves
Emphasis on propagule export	little	great
State of knowledge		
Taxonomic identification	good	poor
Patterns of species distribution and abundance	good	poor to moderate
Geographic patterns of marine ecosystem diversity	good	poor
Design criteria		
Movement (connectivity) corridors		
Importance of connectivity	less	greater
Type	primarily habitat based	primarily current based
Importance of habitat corridors	greater	lower
Human managed	great	little
Constancy/predictability	high	low
Protection of nonreserve populations	less critical	very critical
Reserve size		
Sufficient for local replenishment (single reserve)	smaller	larger
Habitat diversity necessary for resource requirements	smaller	larger
Reserve location		
Sensitivity to biogeographic transitions	less	greater
Importance of import–export processes (i.e., winds, currents)	less	great

(Carr et al., 2003)

Historical evolution of conservation purposes

Rough timeline	Framing of conservation	Key ideas	Science underpinning
1960 1970		Species Wilderness Protected areas	Species, habitats and wildlife ecology
1980 1990		Extinction, threats and threatened species Habitat loss Pollution Overexploitation	Population biology, natural resource management
2000 2005		Ecosystems Ecosystem approach Ecosystem services Economic values	Ecosystem functions, environmental economics
2010		Environmental change Resilience Adaptability Socioecological systems	Interdisciplinary, social and ecological sciences



Contribution of ecological theories to marine conservation

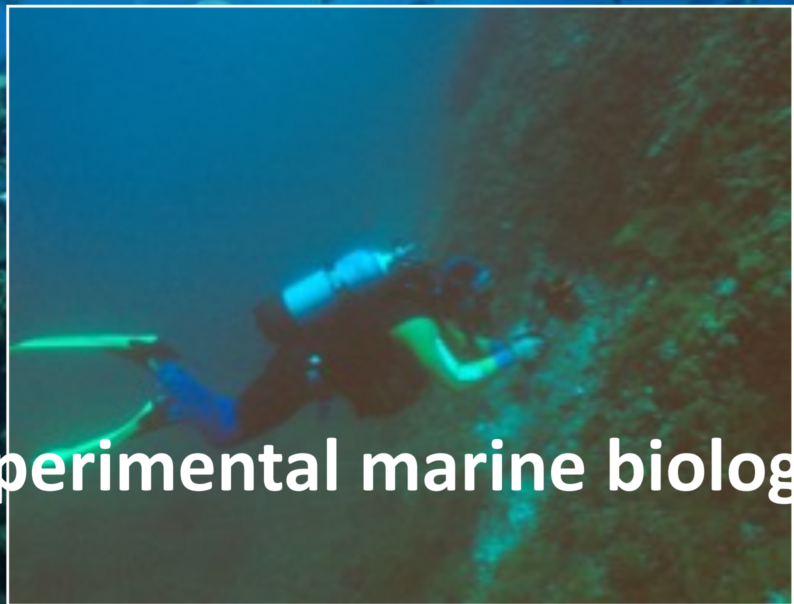
Theory of island's biogeography

(MPAs can be seen as 'islands' of reduced human influence within a 'sea' subject to several human pressures; the larger the more speciose, high isolation - low diversity)

Supply side ecology

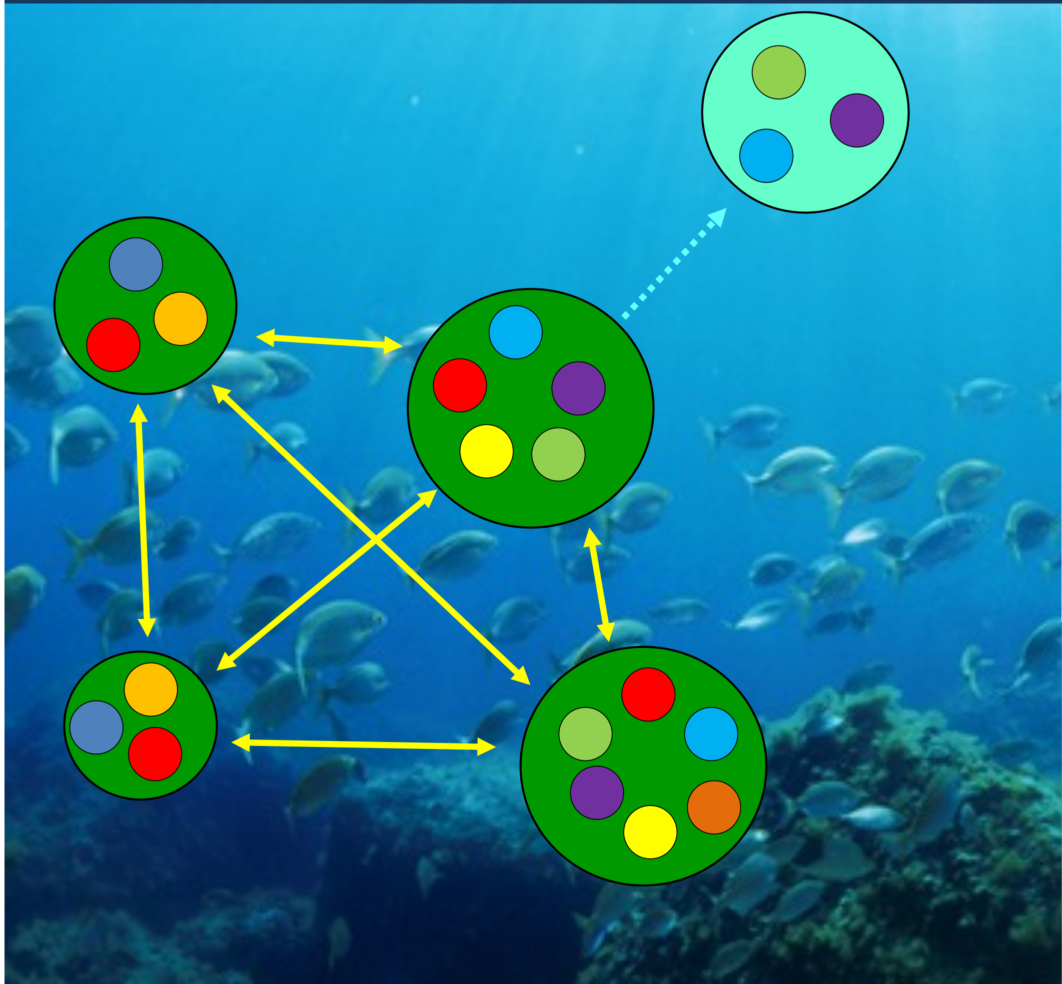
Metapopulation theory

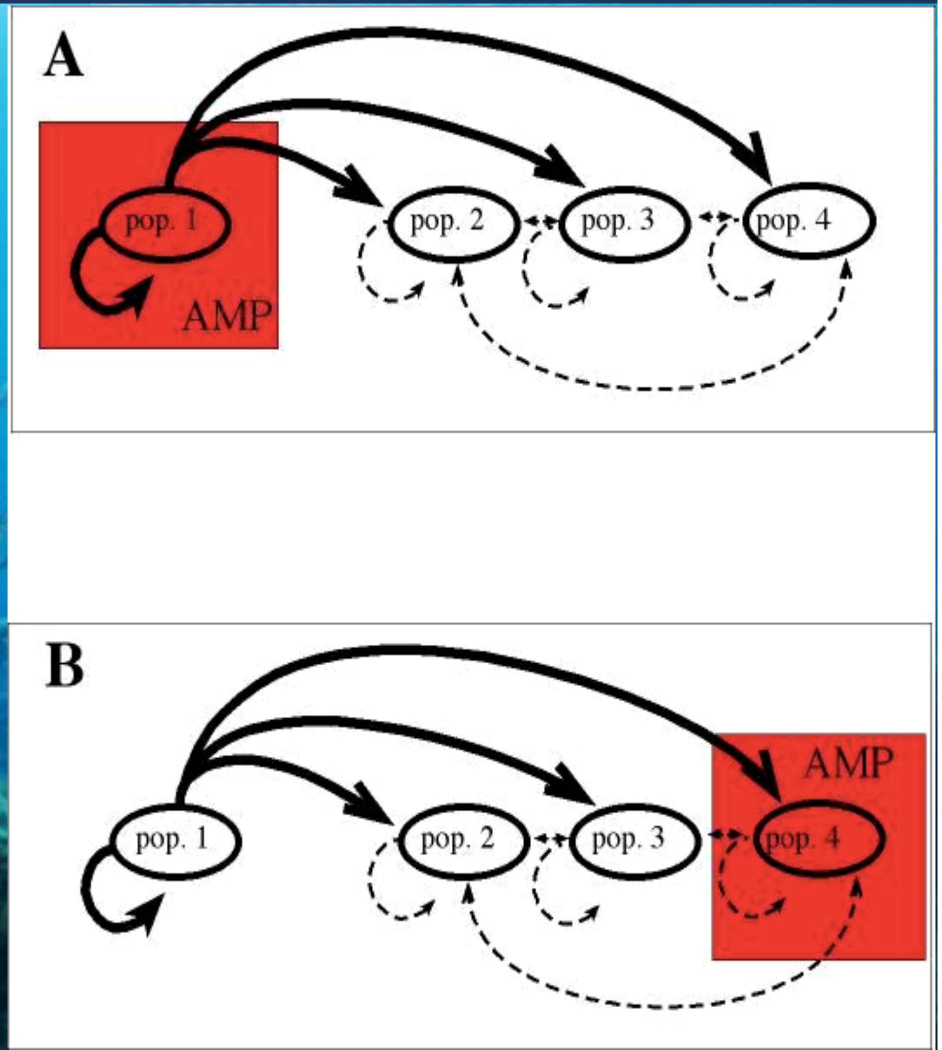
Patch dynamic



Great contribution of experimental marine biology and ecology

Supply side ecology, metapopulations, and metacommunities





Sinks and sources
The importance of life cycles and life histories
Inter-habitat harmonization

SLOSS controversy

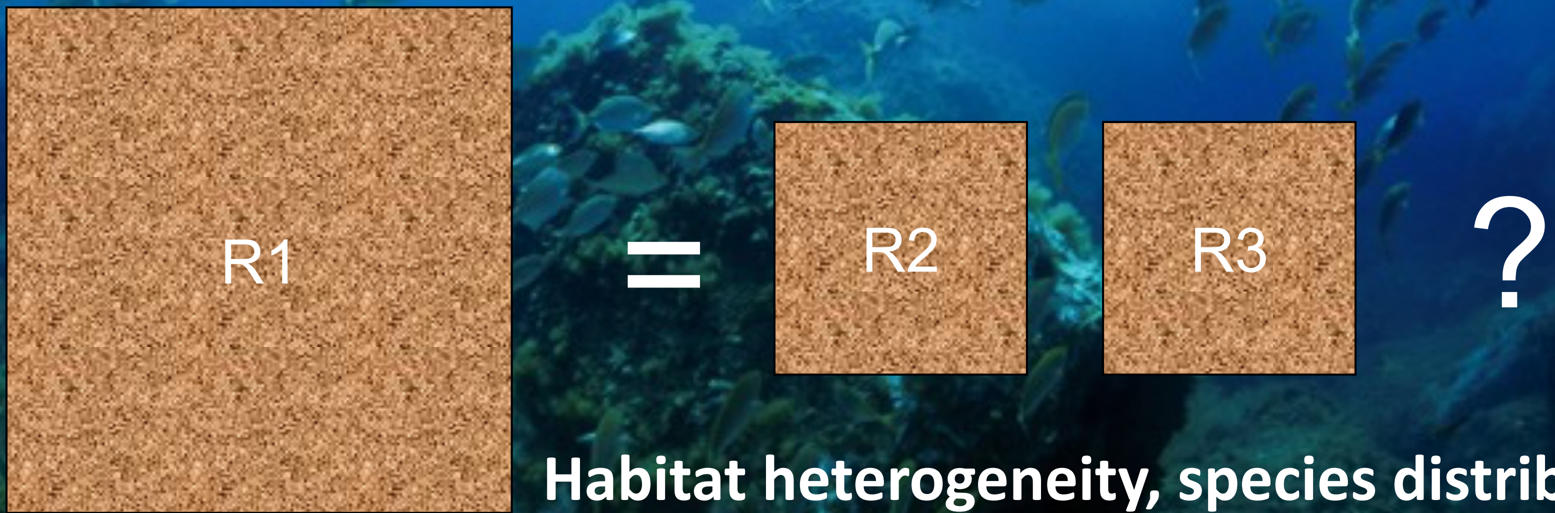
IBT raised concerns about the opportunity to implement single large or several small reserves

Large areas allow protecting more species than smaller ones. However…Large areas are expensive in terms of management and enforcement. They are politically difficult to propose and sustain

Large areas have higher probability to create social and economic conflicts. They are also more difficult to monitor

Uncertainty on the result of conservation in terms of amount of species protected…

$S_{R1} \leq (S_{R2}+S_{R3})$



Habitat heterogeneity, species distribution

A question of size

Pelagos Sanctuary (SPAMI)
Year of institution: 1999
Surface: about 90,000 km^2
Countries: Italy, France, Monaco

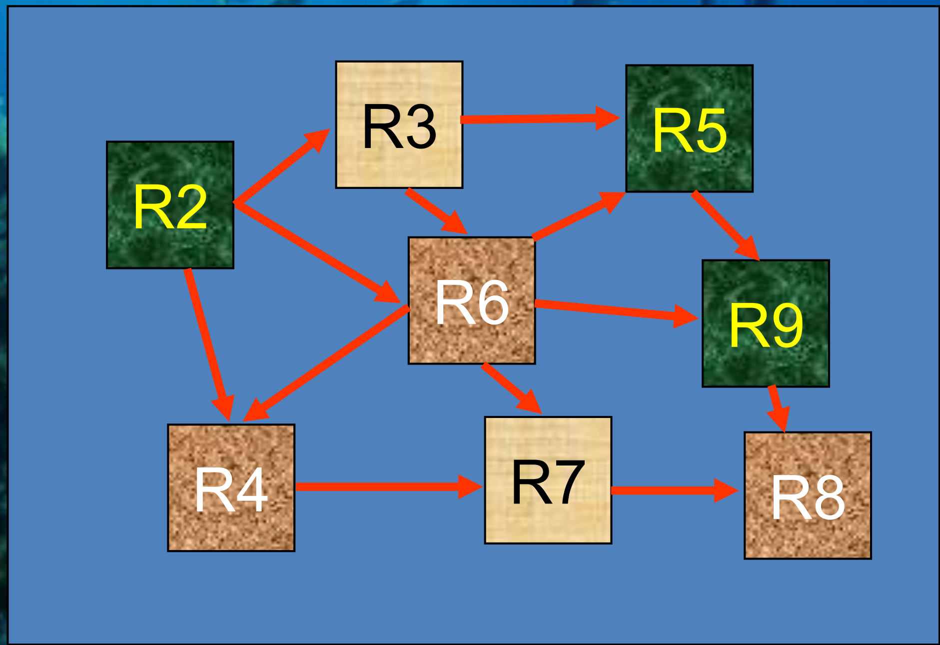
Large reserve for large animals or animals requiring a large surface for movements and foraging

A question of size: distribution

The largest marine park in the Mediterranean Sea is the National Marine Park of Sporadi, in the Aegean Sea. Created in 1992, it is devoted to protection of *Monachus monachus*, the Mediterranean monk seal

Small reserves could increase chance in the face of perturbations

Several small interspersed reserves could provide insurance against perturbations (e.g., catastrophic disturbance or demographic events), with recolonization provided by undisturbed sites, or including higher habitat diversification with respect to larger ones and therefore more species



Should We Protect the Strong or the Weak?

If the conservation objective was to maximize the chance of having at least 1 healthy site, then the best strategy was protection of the site at lowest risk. On the other hand, if the goal was to maximize the expected number of healthy sites, the optimal strategy was more complex. If protected sites were likely to spend a significant amount of time in a degraded state, then it was best to protect low-risk sites. Alternatively, if most areas were generally healthy then it was best to protect sites at higher risk. (Game et al., 2008)

Alternative strategies have been proposed, for instance, to protect areas proportional to the risk of pertubation event to increase insurance that catastrophic events will not affect the core of reserves. (Allison et al., 2003)

Notwithstanding, large reserves…

Should….

1 – decrease competition and predation pressure from neighbouring species, with border populations more exposed than those in the centre of the reserve;

2 – provide a better spatial match with the *home-range* of large carnivorous species;

3 – include a larger range of environments to allow persistence of different species populations in the long term;

4 – include different subpopulations and, as a consequence, higher intra-specific genetic diversity;

5 – better respond to external disturbace through a buffer effect

Conservation purposes

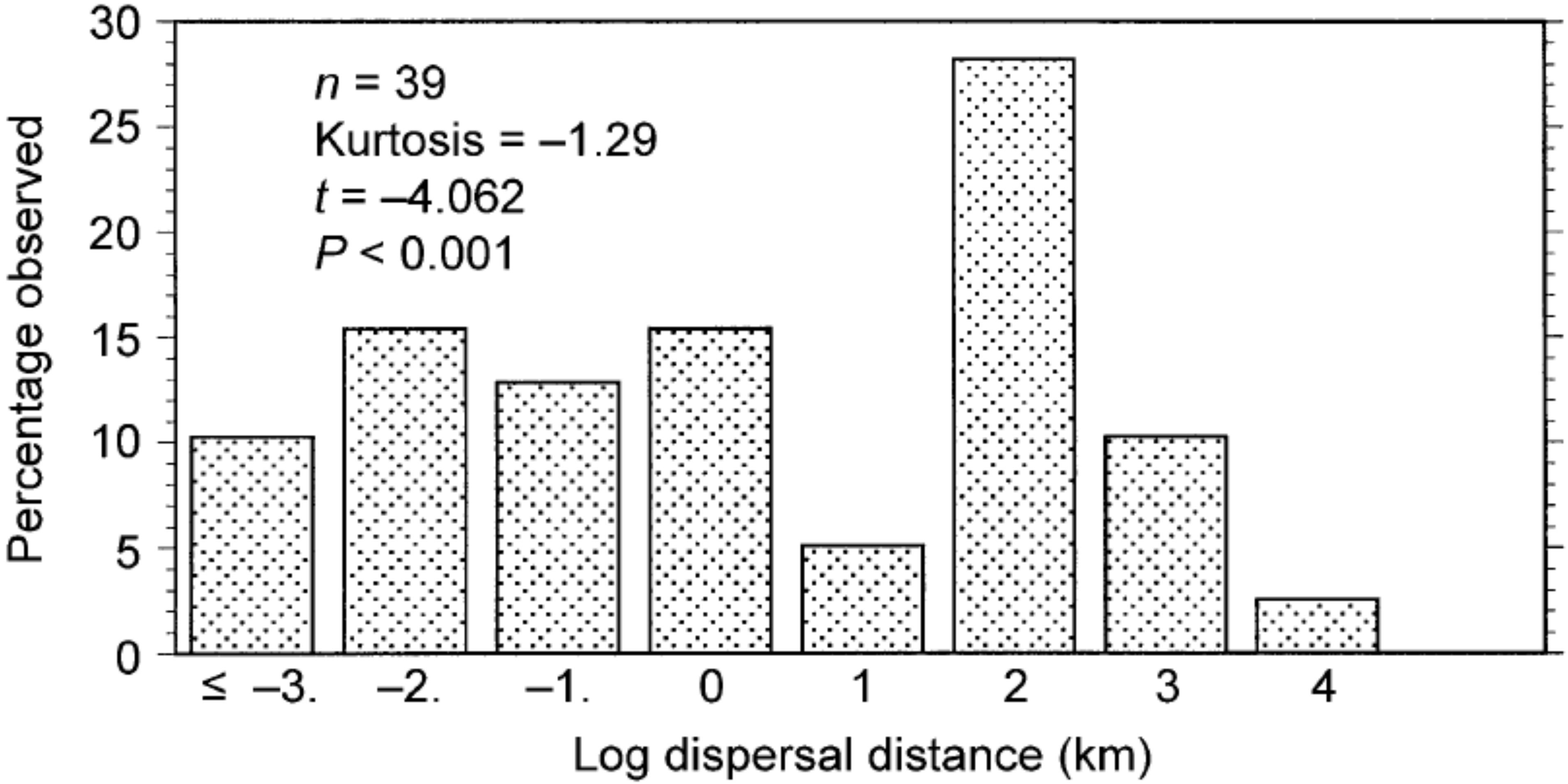
- → Increase or maintain species diversity
- → Protect vulnerable species
- → Protect areas of high endemism or biodiversity hotspots
- → Protect biological uniqueness
- → Protect commercial species (nursery areas, shelter areas, genetic diversity), increasing their abundance (and/or biomass)
- → Protect priority habitats
- → Education, research, aesthetic and cultural

Often multipurpose MPAs

Networks to increase complementarity, or connectivity

Restoration purposes

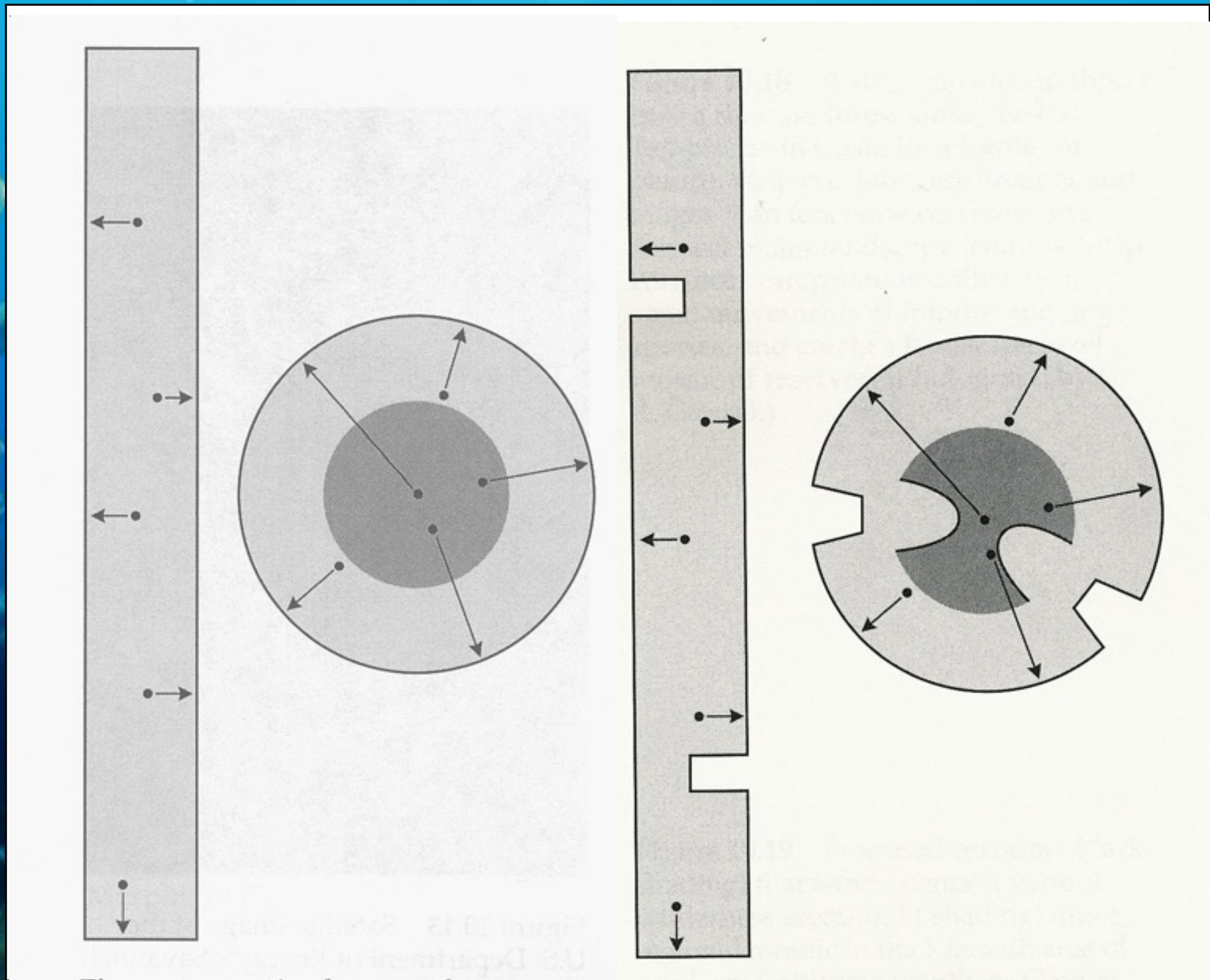
Environmental context: spacing



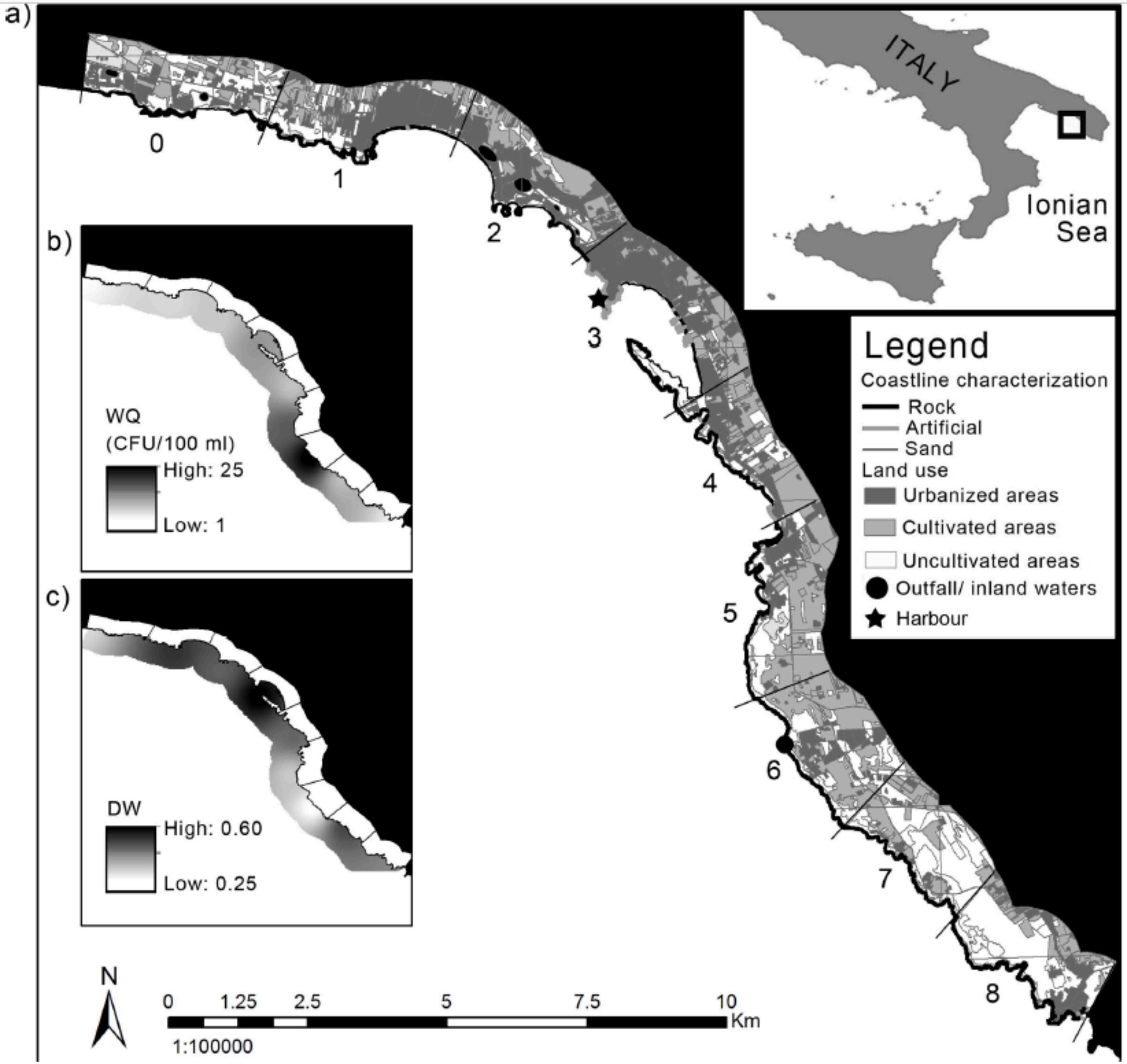
1) Bimodal trend in dispersal strategies, one short distance and long distance.
2) Reserves with diameter of 4-5 km, 10-20 km apart are wide enough to retain propagules of short-distance dispersers and far enough to allow long-distance dispersers to be captured. However, limited range of organisms. Habitat continuity.
Shank et al., 2003

Environmental context

Low area/perimeter ratio could increase exposure of central populations to external influence



Environmental context

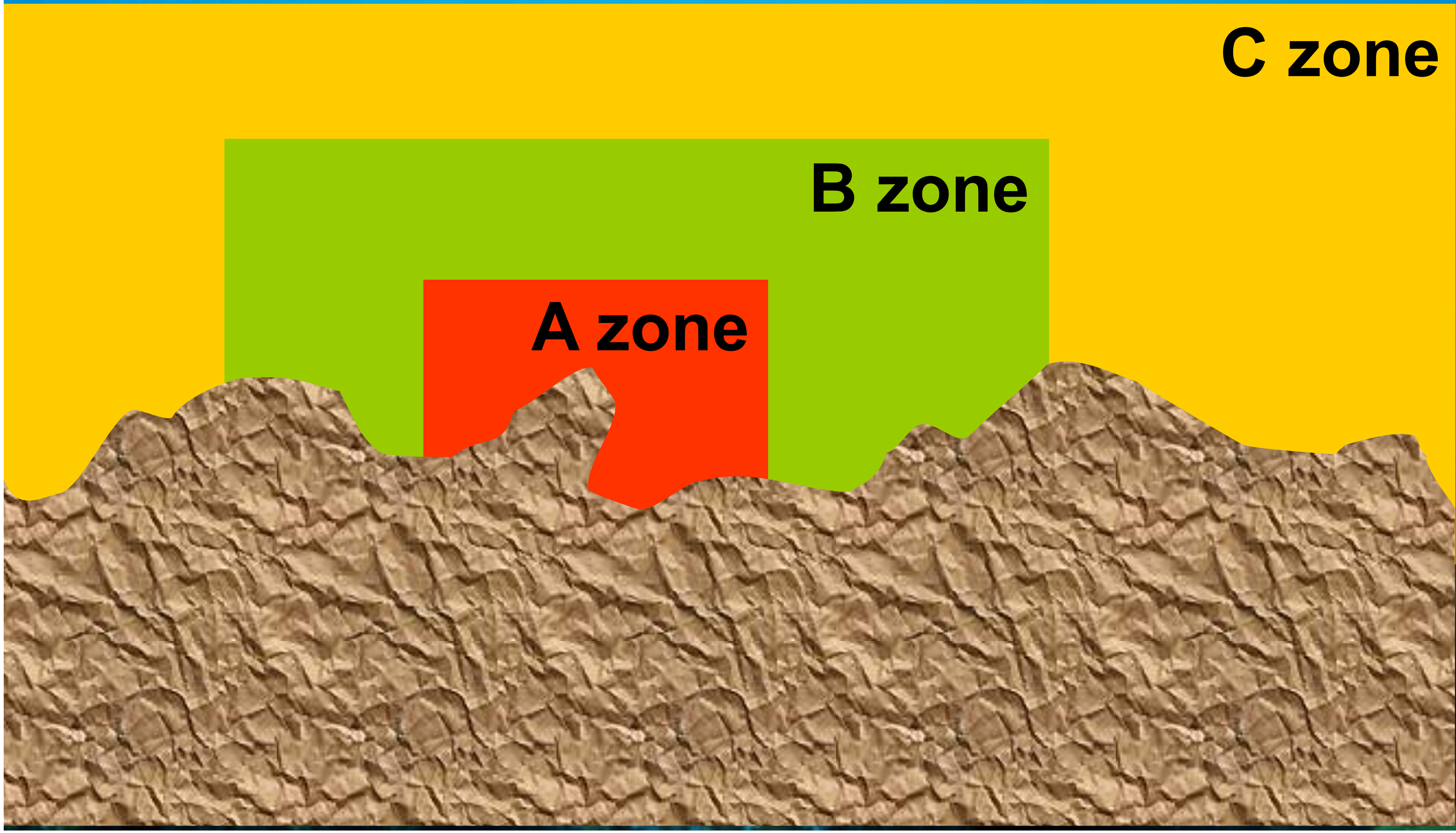


Guarnieri et al., 2016

High level of anthropization could increase exposure of protected populations and communities to human pressures or impacts

Zonation

Management of MPAs relies, as first, on zonation. This allow to delimit different areas at different protection regimes in order to fulfil conservation purposes and reduce conflicts with neighbouring human populations and influence of human activities



Zonation

A Zone (*no-take, no access*): full protection.
The core of the MPA, all human activities are forbidden, except those authorized concerning scientific research and control.

B Zone (*partial protecton*)
Local fishery with not-impacting gears (selective fishing) could be authorized. Bathing, SCUBA diving frequentation (limited or controlled), entrance, and authorized boating can be allowed.

C Zona (*buffer area*): general protection
Same as B zone, plus anchoring (but within limited specific areas), recreational fishing (but not spearfishing) could be allowed

Summary: factors to take into account

Protection purpose(s) (seascape, communities/ecosystems, target species)

Geographic position, size, shape

Connectivity of protected species or communities (network)

Size of protected populations

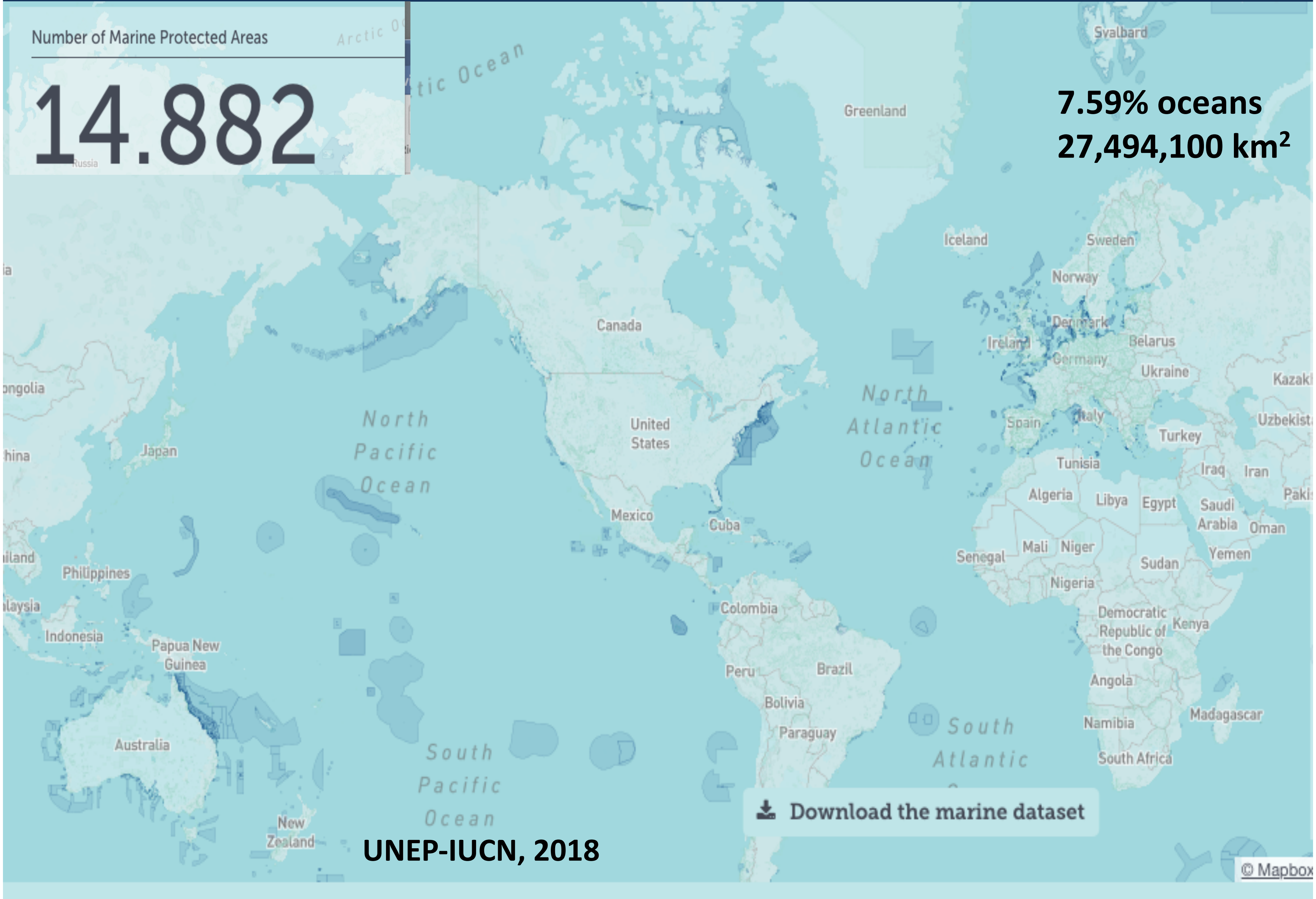
Ecological process with the MPA

Human threats from neighbouring areas

Socio-economic and cultural context (reduce conflicts and increasing compliance)

Governance and environmental policy

Marine conservation at global scale



7.59% oceans
27,494,100 km^2

UNEP-IUCN, 2018

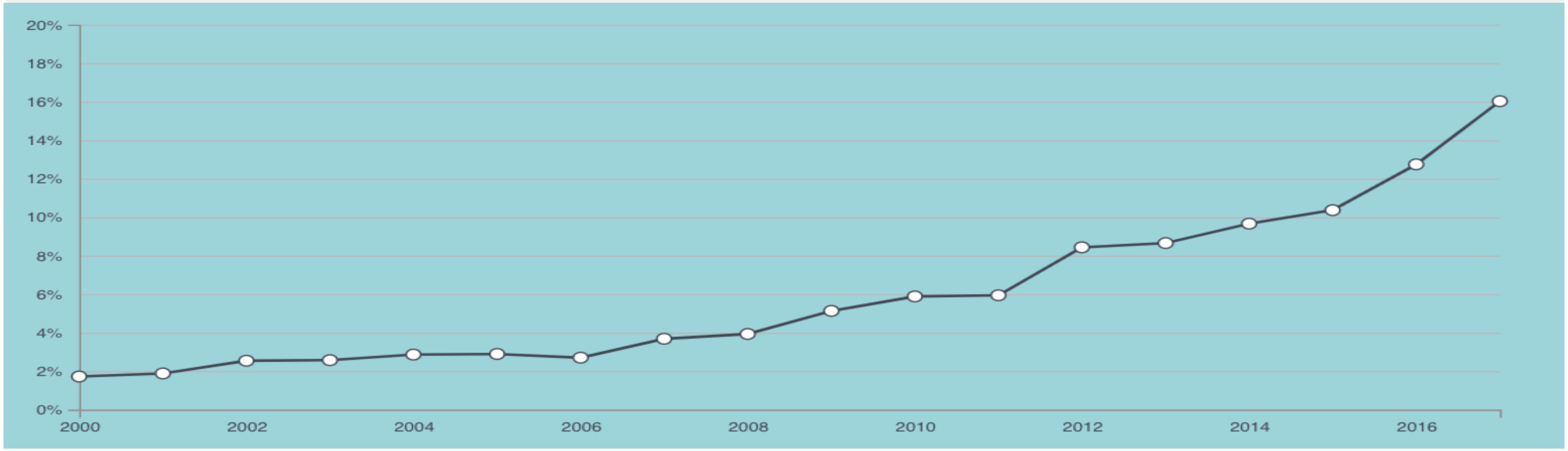
Marine conservation at global scale

The Global Ocean

National waters 39%

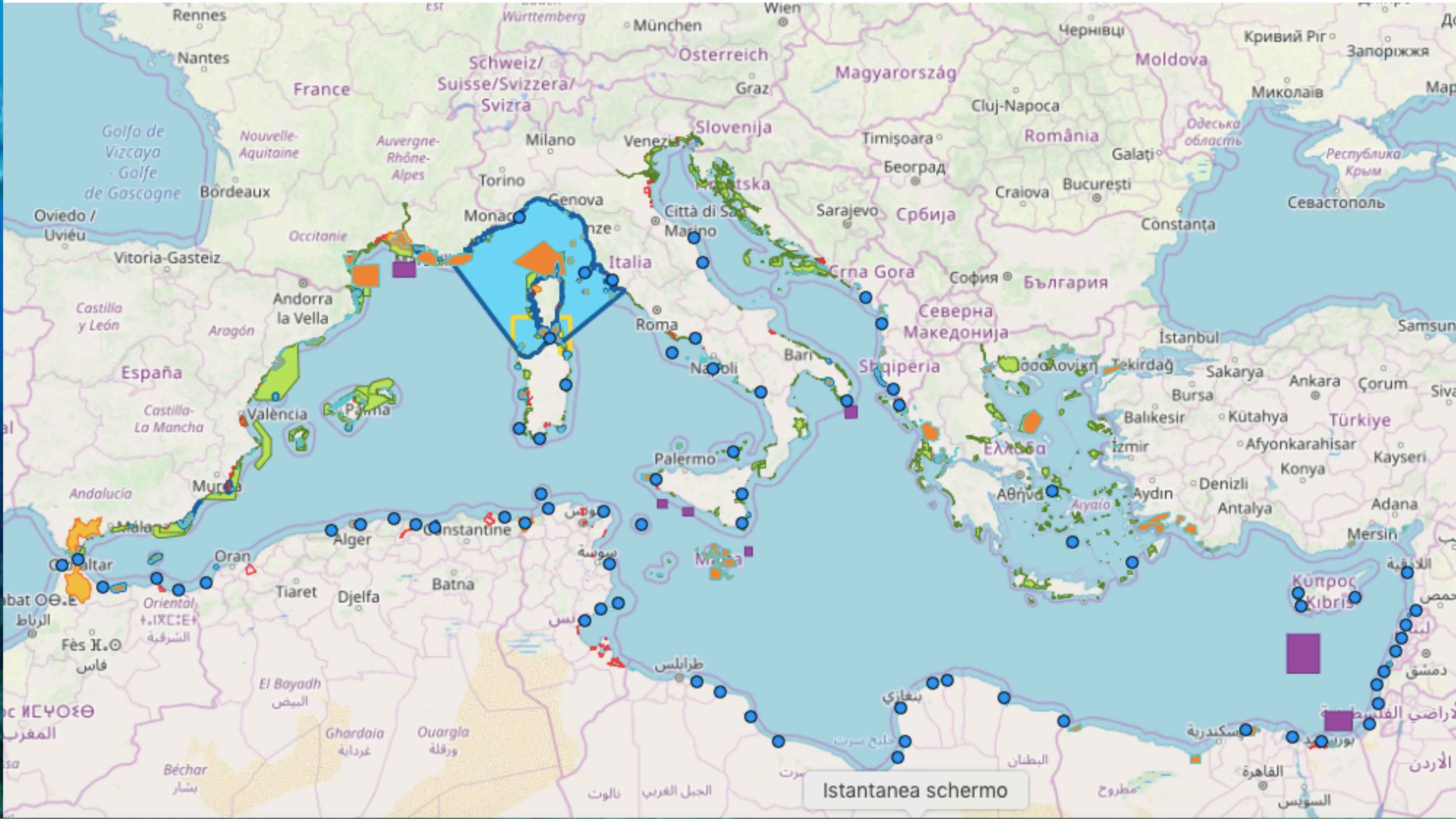
High Seas 61%

Protected Area coverage of national waters	Protected Area coverage of the high seas
17,7% ($24.875.947 km^2$)	1,18% ($2.618.153 km^2$)



The Mediterranean Sea

This is a simple visualisation of MAPAMED, a more advanced visualisation will be part of our new web site soon.
Be patient, it is a bit long to download the first time.
Nov. 2017 release - If you need access to the dataset please contact reda.neveu@medpan.org



The Mediterranean Sea

There are 1,231 MPAs and OECMs in the Mediterranean covering 179,798 km^2 which places a surface of 7.14% under a legal designation

Over 72.77% of the surface covered is located in the Western Mediterranean, 90.05% of the total surface covered by MPAs and OECMs are found in EU waters.

9.79% of European waters are covered mostly due to the Natura 2000 at sea network which rarely affords strict restrictive measures.

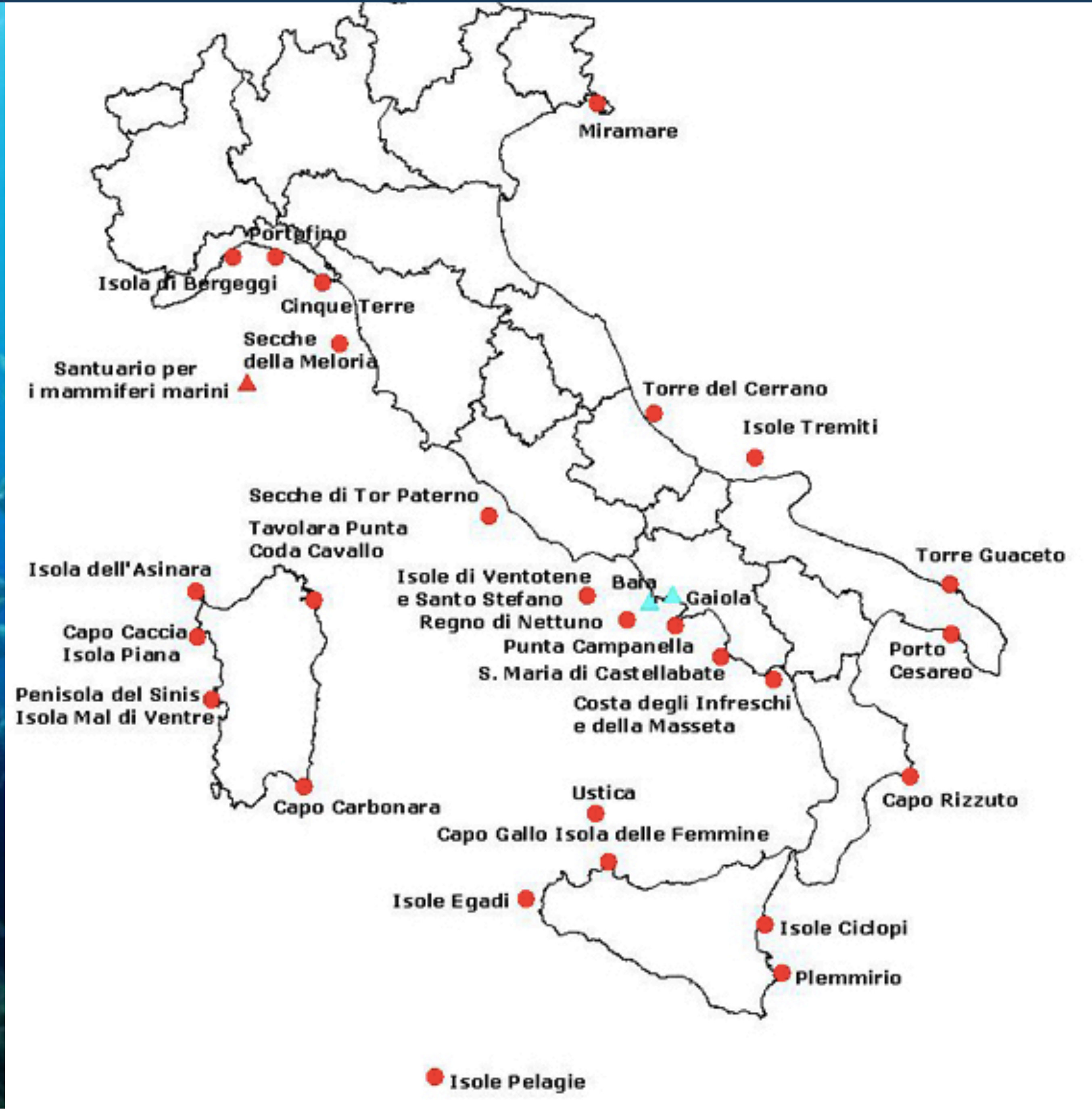
Mostly shallow waters

39.77% of *Posidonia* meadows and 32.78% of Mediterranean coralligenous communities are covered.

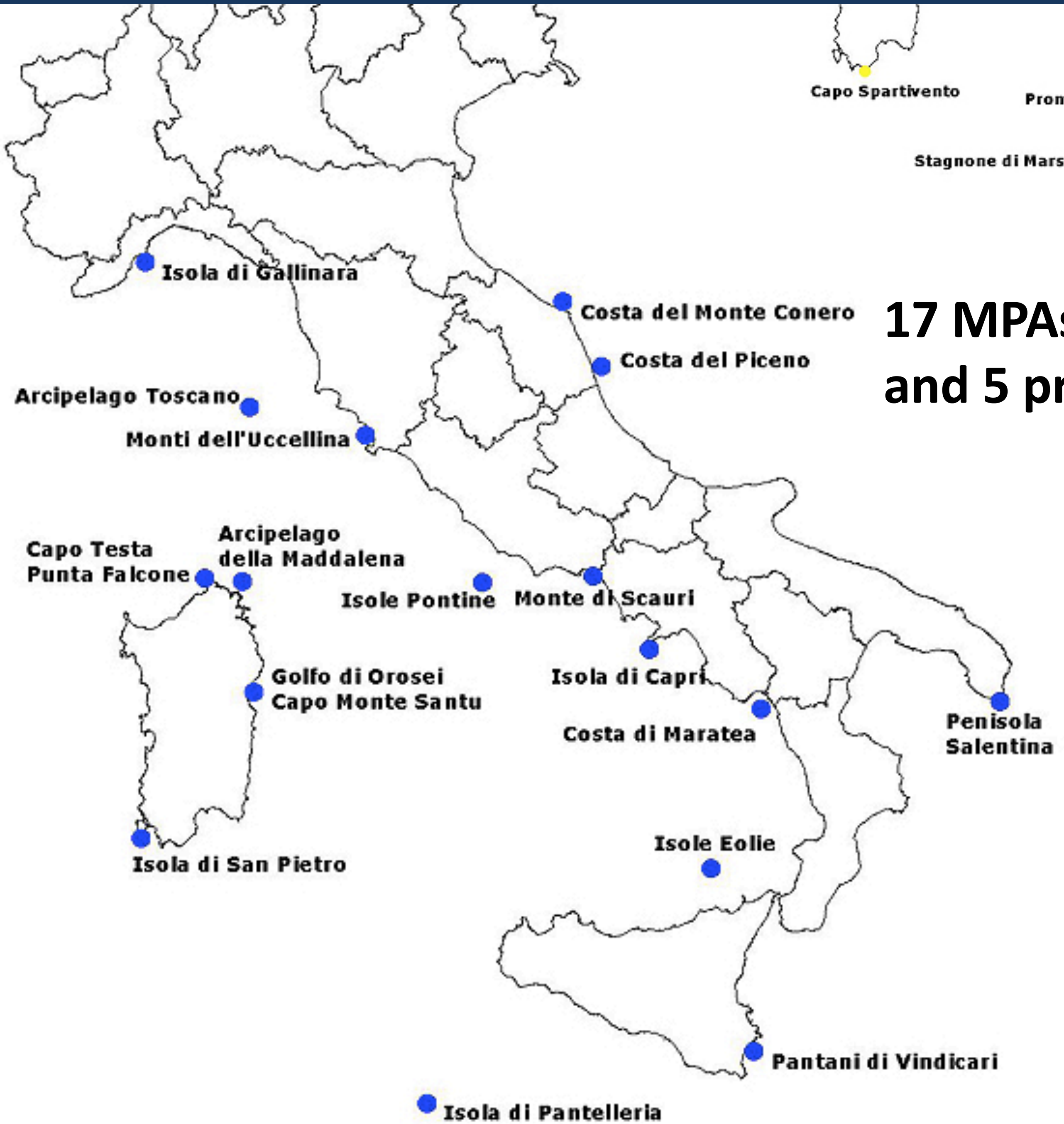
65.05% of MPAs of national designations have a marine surface of less than 50 km^2 (77.17% of all MPAs and OECMs), 69 nationally designated sites have a marine area smaller than 10 km^2 and 46 are larger than 100 km^2.

78% of nationally designated MPAs are over 10 years old, which is considered the minimum age for an MPA to reach a certain maturity (even though the time required for an MPA to be effective varies greatly from one area to another) and 46 sites are over 20 years old.

The Italian coasts: implemented



The Italian coasts: next designation



17 MPAs for next designation and 5 projected

Designation and implementation

Al fine dell'istituzione di un'area marina protetta, un tratto di mare deve innanzitutto essere individuato per legge quale "area marina di reperimento".

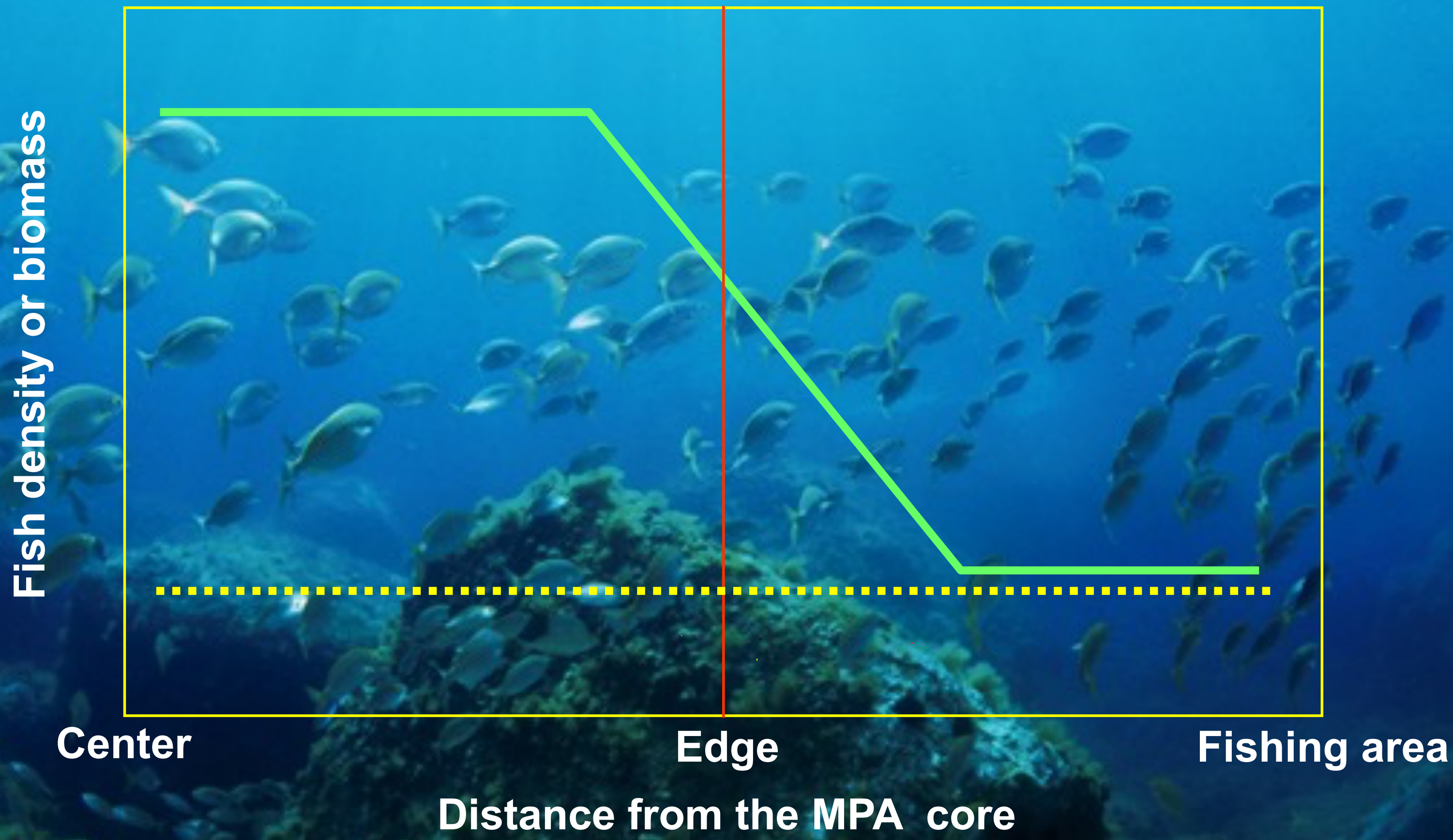
Una volta avviato l'iter istruttorio all'area marina di reperimento, questa viene considerata come area marina protetta di prossima istituzione. Le aree marine protette sono istituite con un Decreto del Ministro dell'ambiente che contiene la denominazione e la delimitazione dell'area, gli obiettivi e la disciplina di tutela a cui è finalizzata la protezione.

Per l'effettiva istituzione di un'area marina protetta occorre innanzitutto disporre di un aggiornato quadro di conoscenze sull'ambiente naturale d'interesse, oltre ai dati necessari sulle attività socio-economiche che si svolgono nell'area.

La gestione delle aree marine protette è affidata ad enti pubblici, istituzioni scientifiche o associazioni ambientaliste riconosciute, anche consorziati tra di loro. L'affidamento avviene con decreto del Ministro dell'ambiente, sentiti la regione e gli enti locali territorialmente interessati.

Sheltering

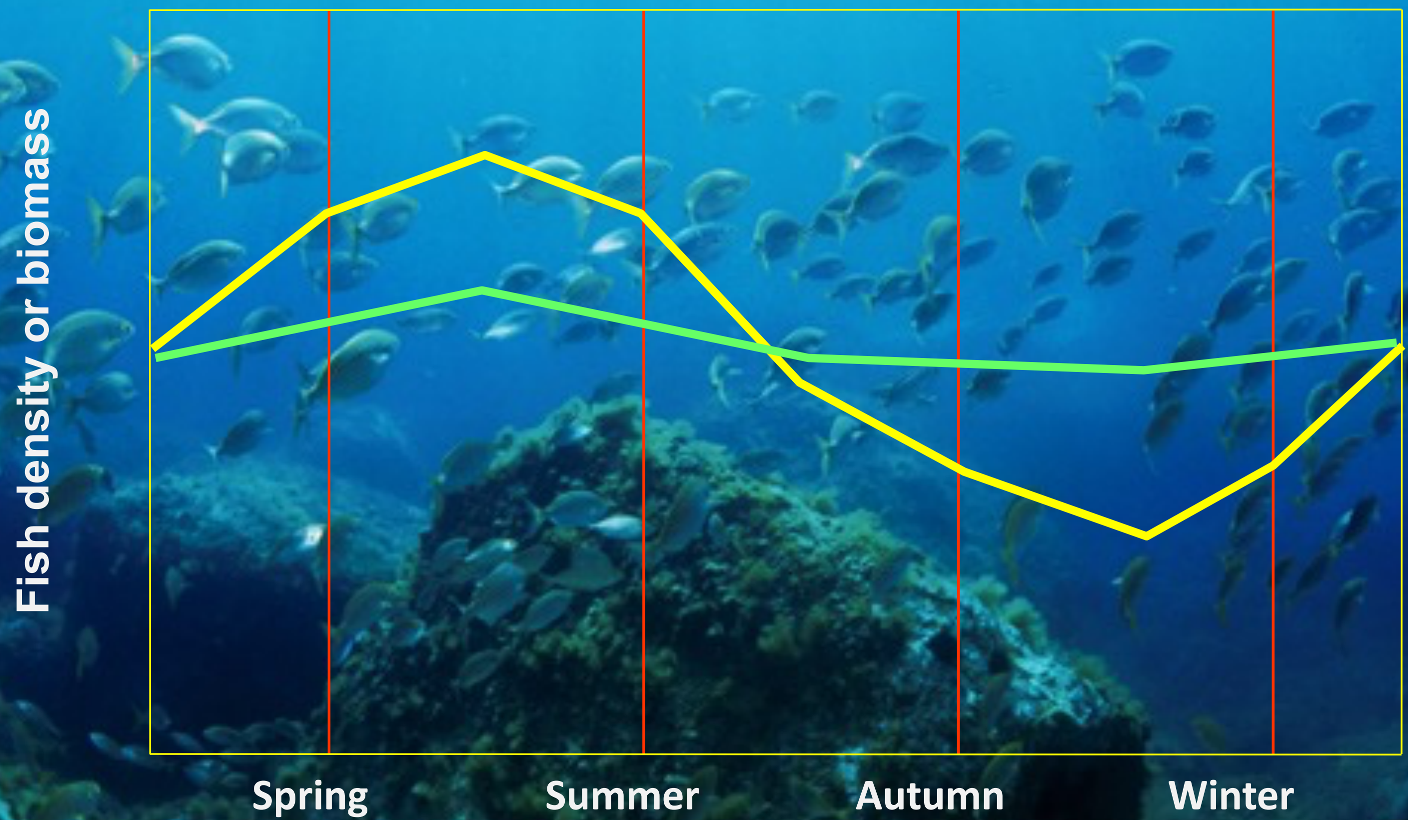
This occurs when one or more target species increase their abundance, size or biomass within the protected areas with respect to fished areas.



Spillover

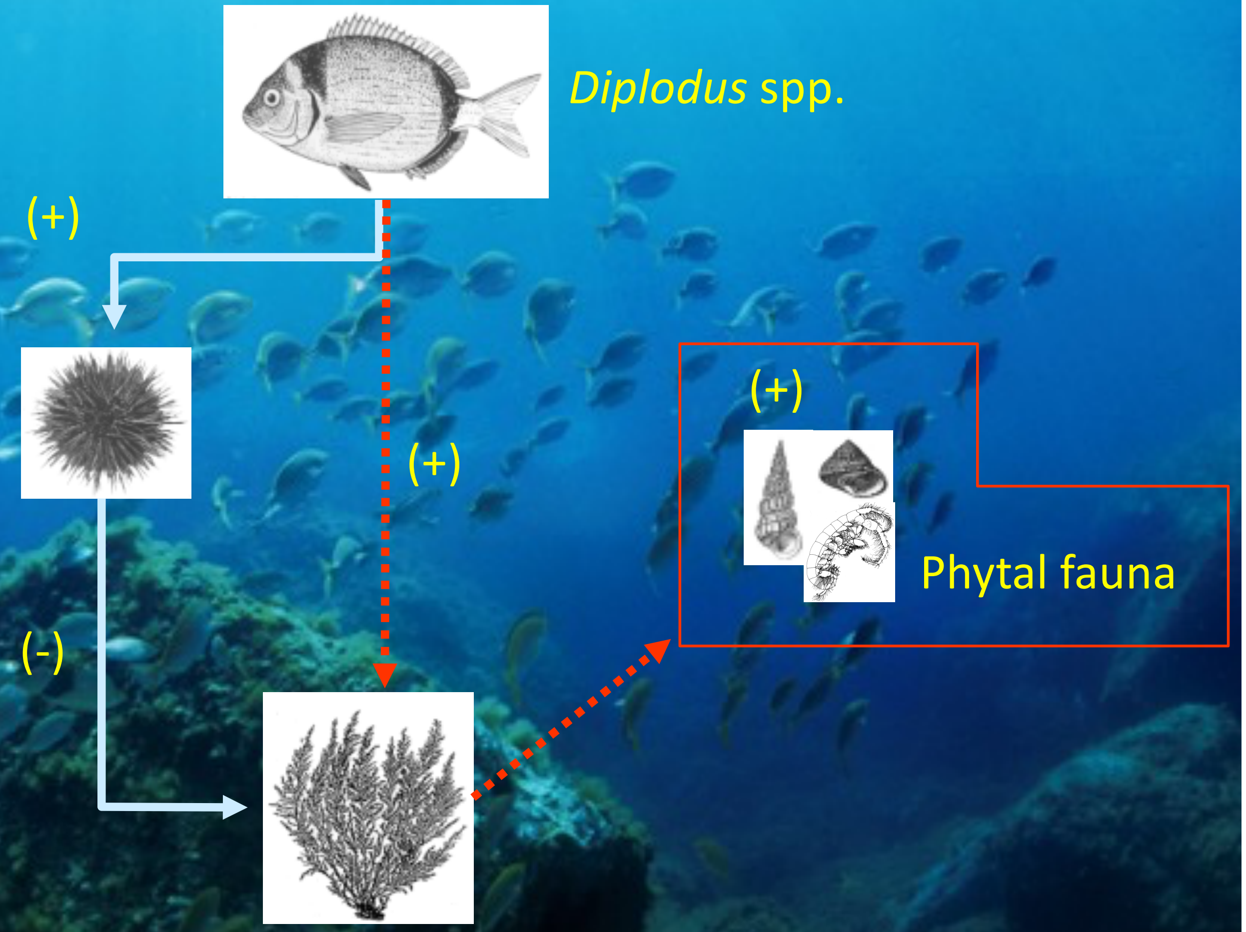
Buffering

This occurs when one or more target species exibit less steep seasonal and/or interannual fluctuations within the protected area. Complex causes…reduction of post-recruitment mortality, increase of larval mortality (high density of predators)



Cascading effects

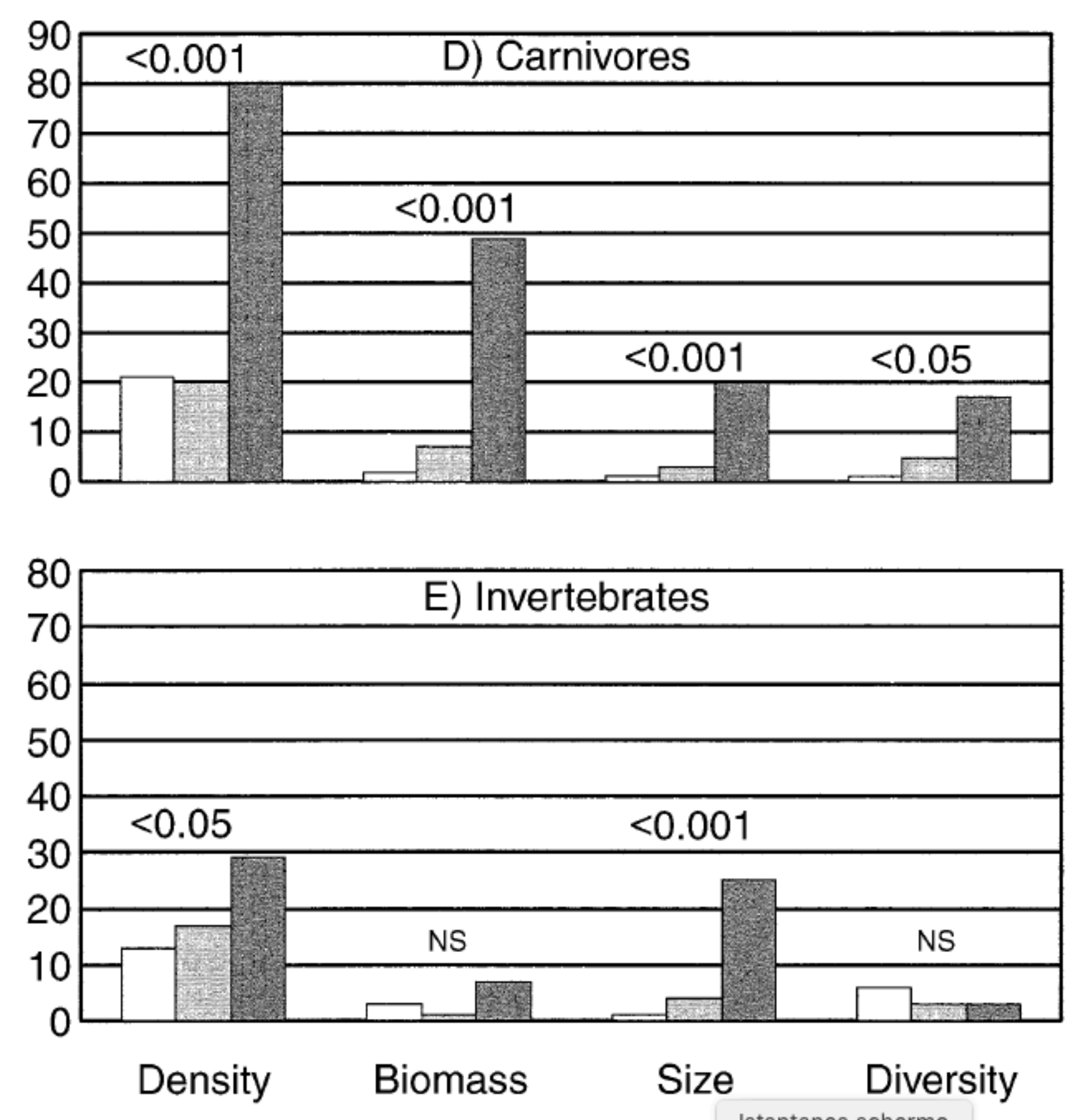
This occur when one or more target species have specific ecological role in stucturing marine communities. Protection, by increasing the abundance of this species allow them maintaning their role in controlling lower trophic levels, triggering cascading effects.



So, a predator population, enhanced by protection, could control their prey population, which in turn has an effect on basal component of food webs.

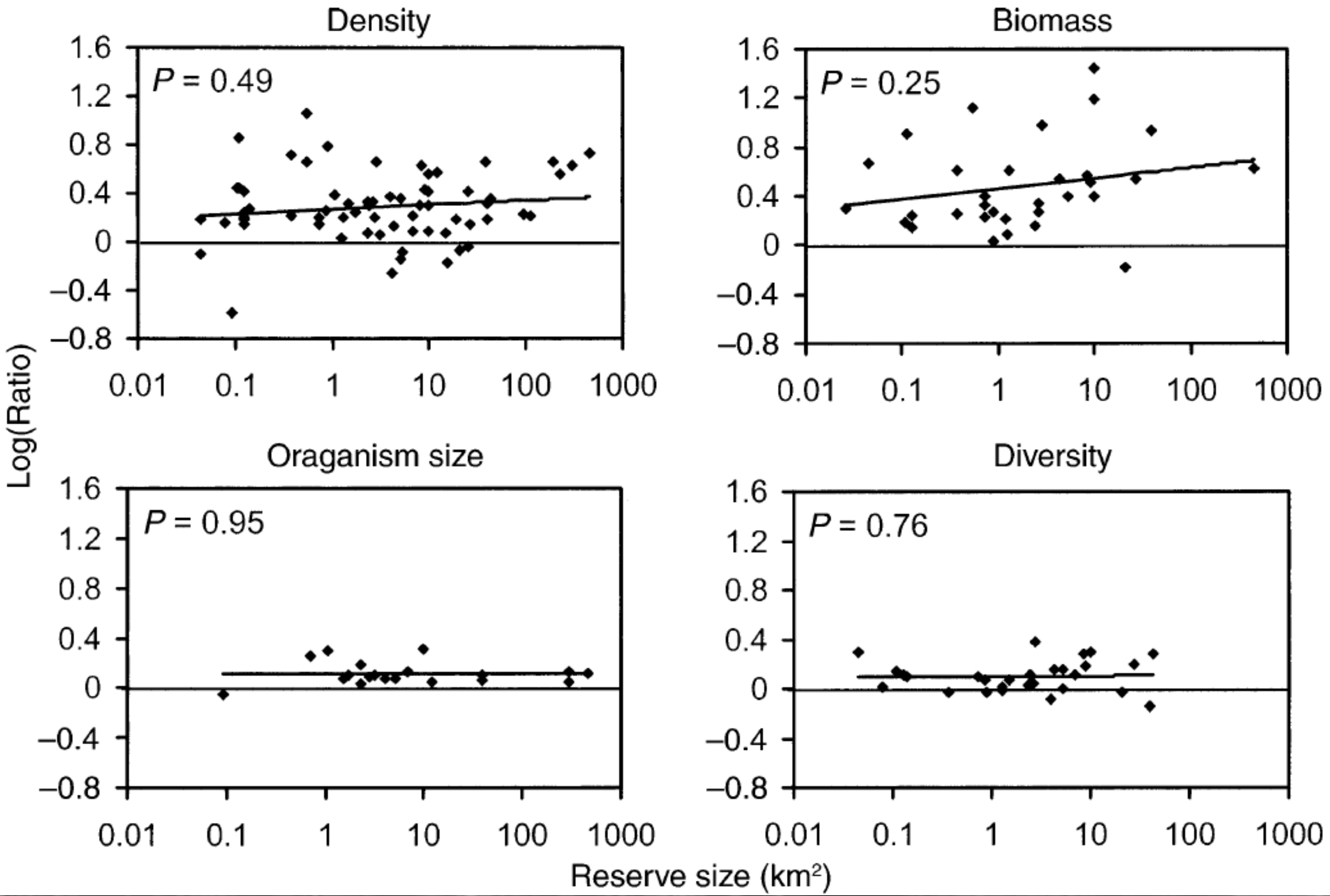
Sala et al., 1998
Guidetti, 2006

Comparing effects between fish and invertebrates

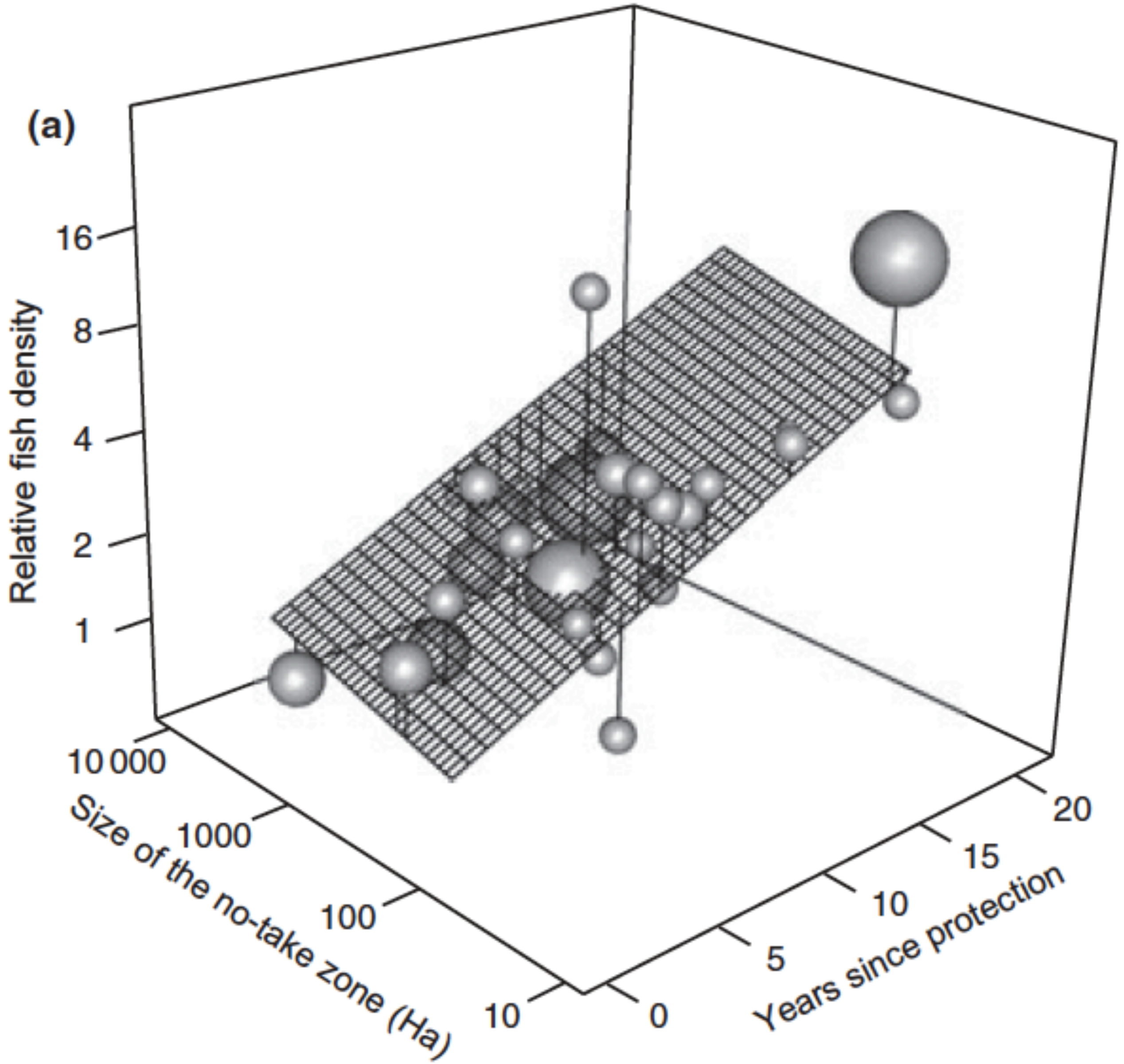


Halpern, 2003
89 MPAs.
Density, size, biomans and diversity of fish fauna were signifcantly higher within than outside the reserve. Benthic invertebrates, however, showed significant difference only for density and size

Relationship with reserve size

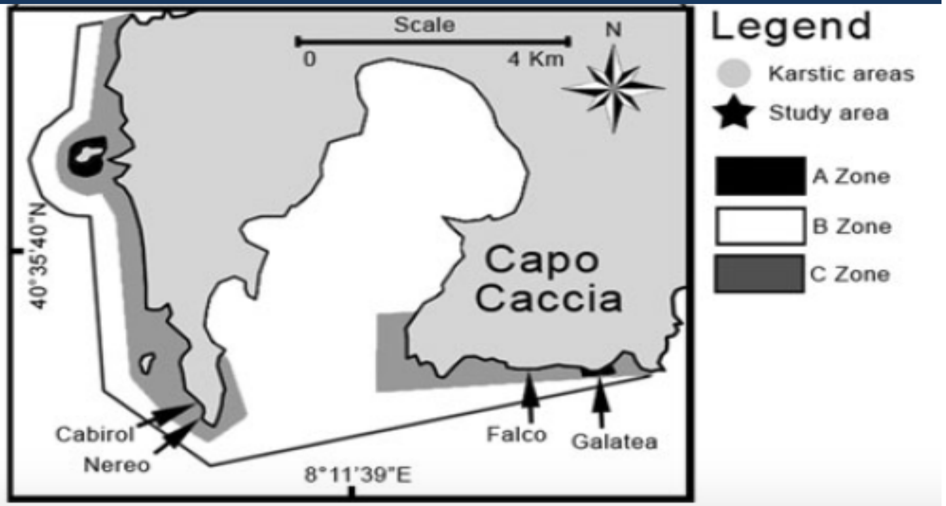


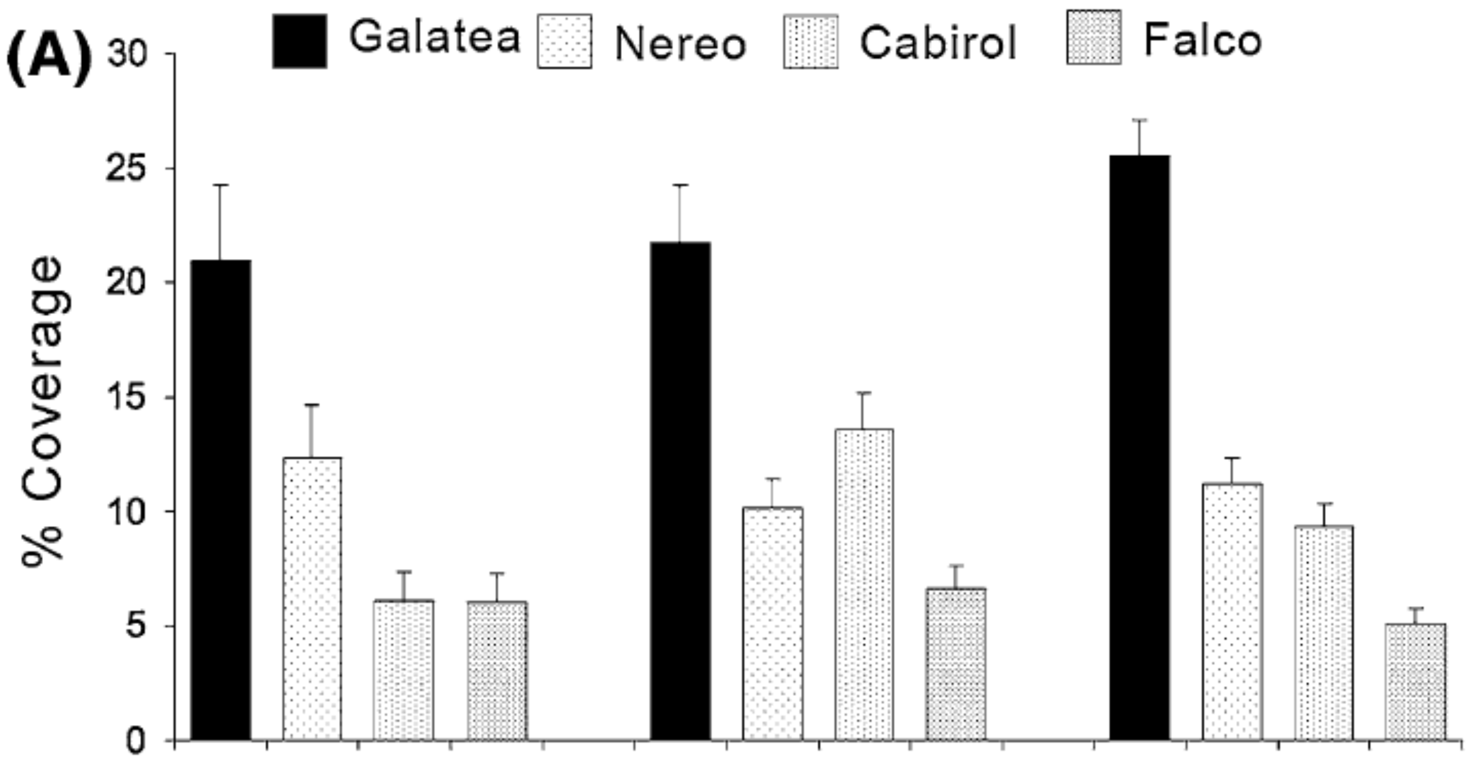
Size again…



Using 58 datasets from 19 European marine reserves, they showed that reserve size and age do matter: Increasing the size of the no-take zone increases the density of commercial fishes within the reserve compared with outside. Moreover, positive effects of marine reserve on commercial fish species and species richness are linked to the time elapsed since the establishment of the protection scheme. (Claudet et al, 2008)

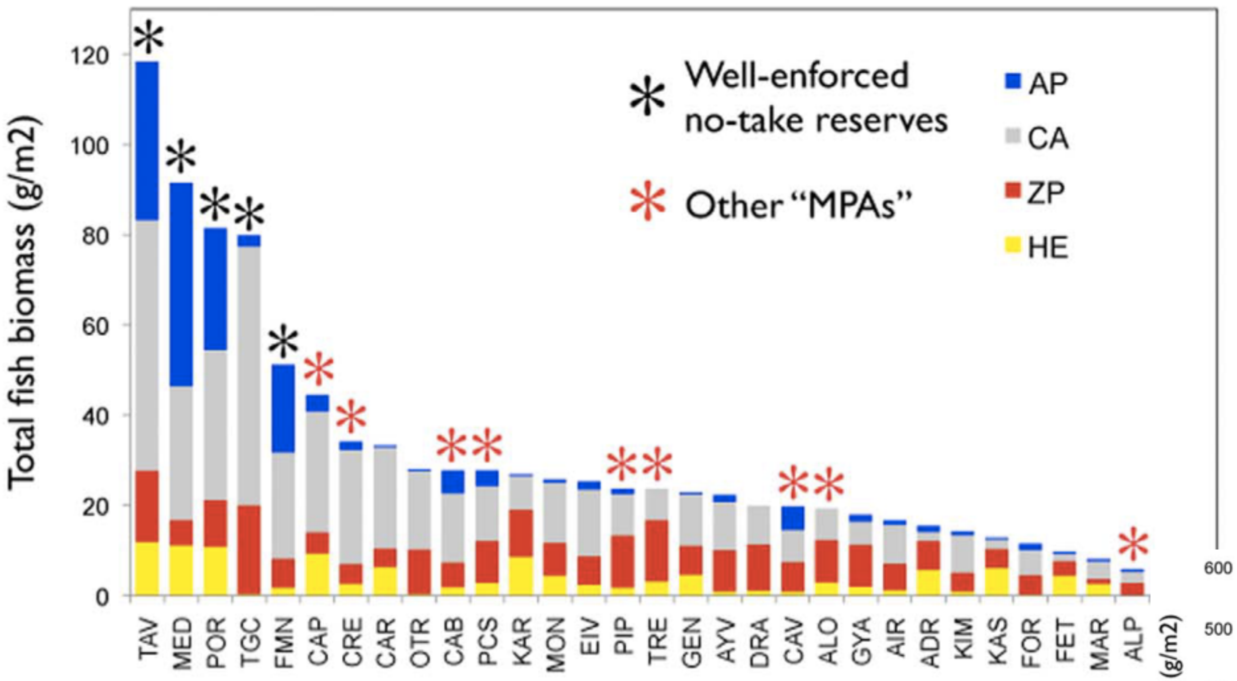
Effects on benthos



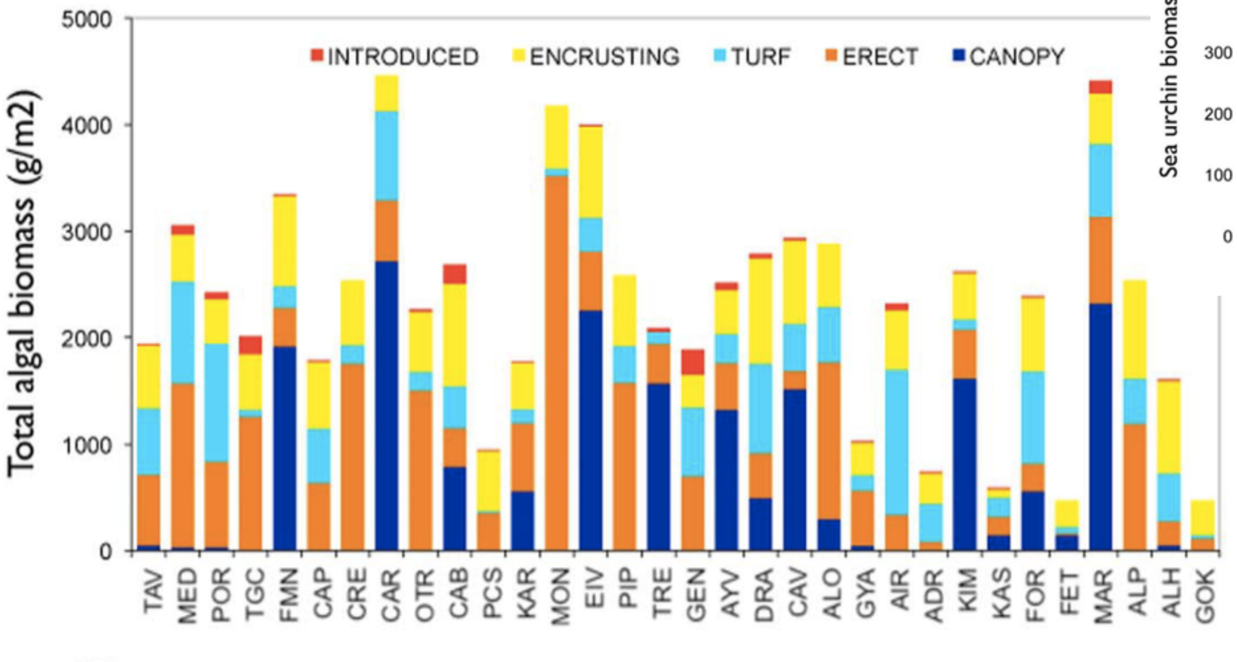


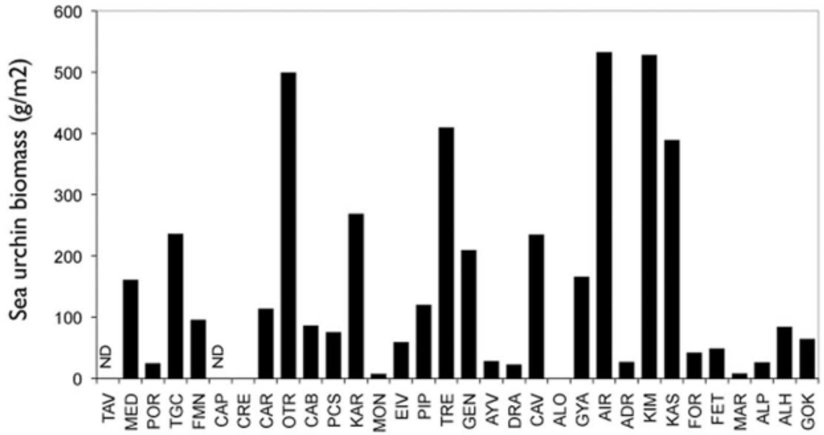
Diving frequentation in submarine caves. Effects on Benthic invertebrates. (Guarnieri et al., 2012)

Mediterranean MPAs – subtidal rocky reefs



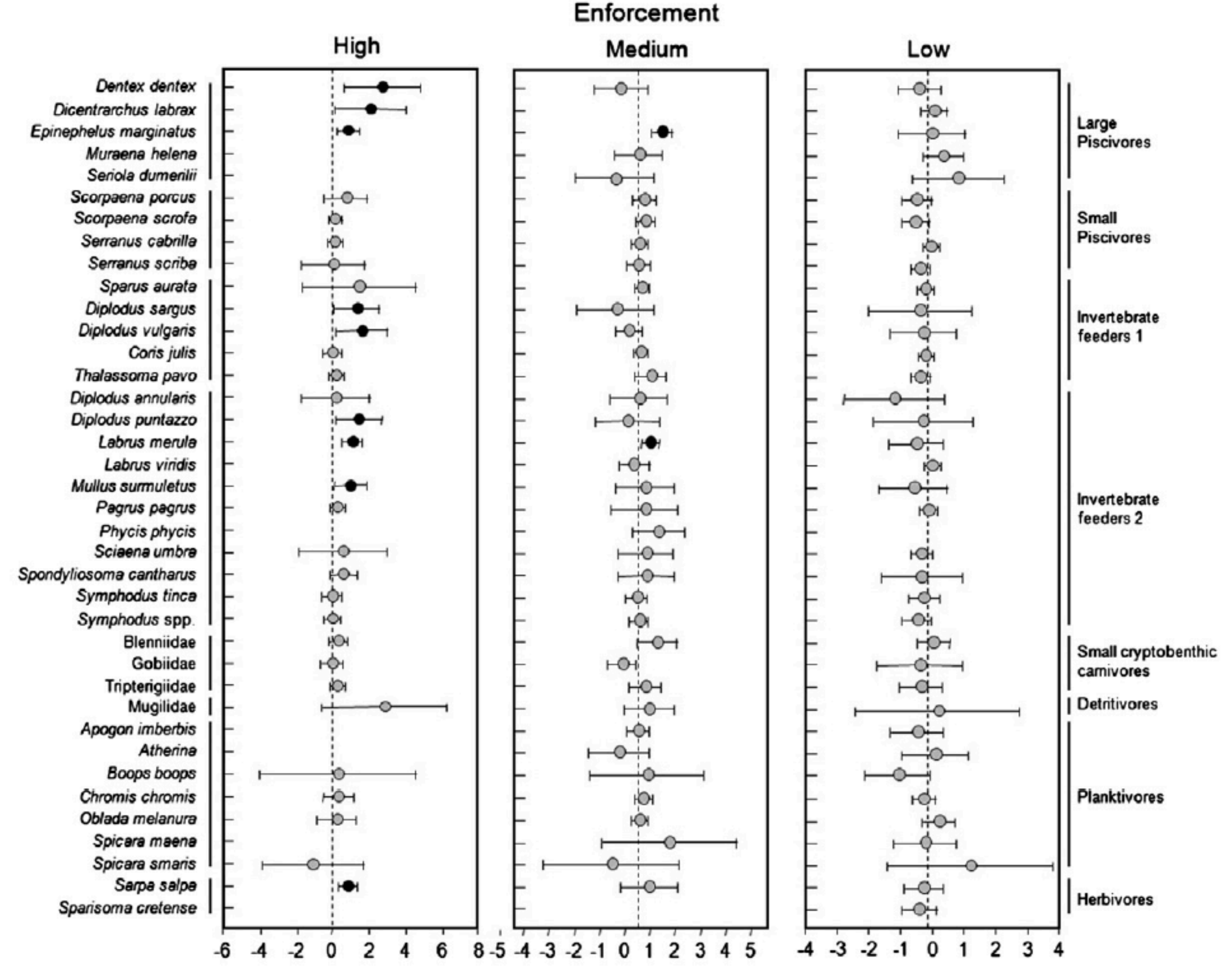
Fish biomass is significnaly higher in well-enforced MPAs. Also, macroalgal stands (erect and canopy-forming species strongly varied, but were not related to protection. (Sala et al., 2012)





However, macroalgal stands were associaoted to low herbivore (sea urchins) pressure.

The role of enforcement



Issues

Effective protection require three main points:

1) as first, MPAs should be sited to fulfil well-defined conservation purposes. This in turn will guide positioning and subsequent conservation strategies. The aims of MPAs should take into account connectivity, population dynamics, diversity distribution and, last but not least, the context to reduce socio-economic conflicts and external human pressures.

2) effective protection cannot fall outside considerations of geopolitical and large scale governance constraints, resources availability to maintain governace of reserves, and therefore enforcement, to avoid creation of ‘paper reserves’

3) adaptive management is unavoidable; habitats distribution could change, zonation could require refinements, and monitoring is mandatory to detect changes and implement actions, modifying strategies, or simple to insure that conservation target are being achieved

(Airamè et al., 2003)

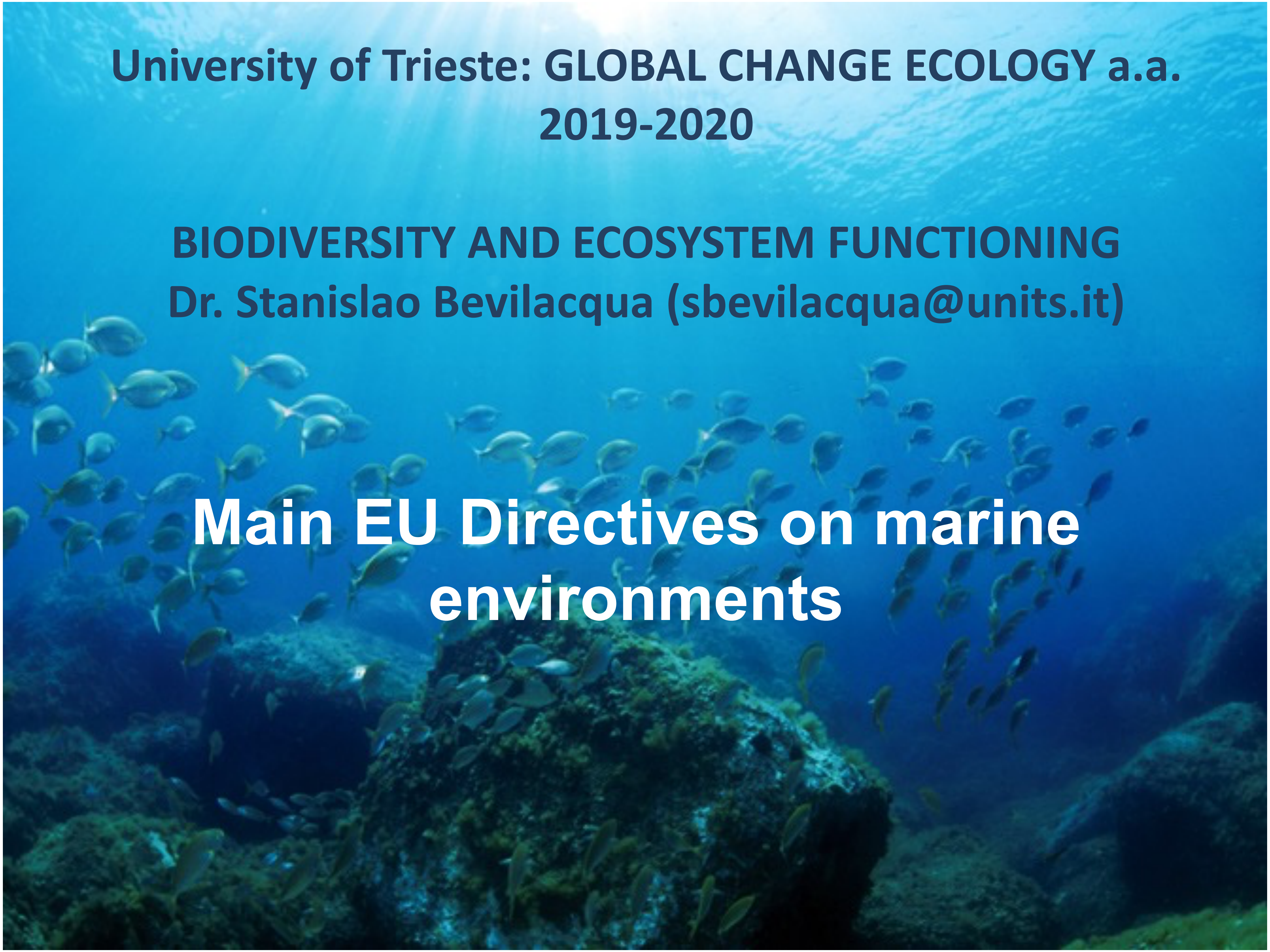
Necessary but not sufficient…

Research is demonstrating that marine reserves are powerful management and conservation tools, but they are not a panacea;

They cannot alleviate all problems, such as pollution, climate change, or overfishing, that originate outside reserve boundaries. Marine reserves are thus emerging as a powerful tool, but one that should be complemented by other approaches.

The answer to the question, ''how much is enough'' is the holy grail of conservation in both marine and terrestrial ecosystems. The goal of marine reserves is to ensure the persistence of the full range of marine biodiversity—from gene pools to populations, to species and whole ecosystems—and the full functioning of the ecosystem in providing goods and services for present and future generations. Because there will always be opportunity costs to conservation, there is a limit to how much we can conserve.

(Lubchenco, 2003)



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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 theirwater 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 andlosses 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 ofthis 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.

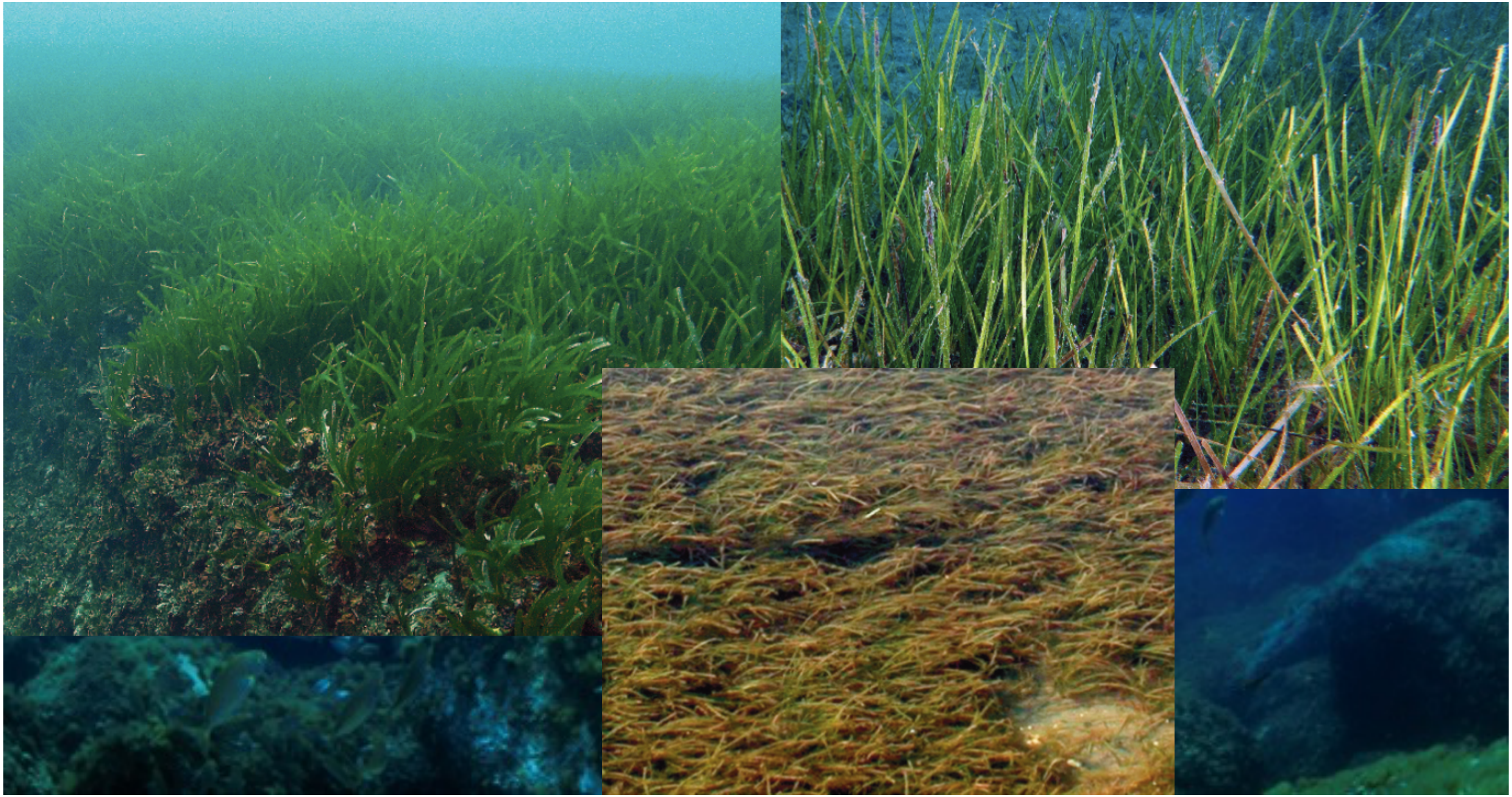
Marine habitats of community interest included:

Sandbanks which are slightly covered by sea water all the time
* Posidonia beds
Estuaries
Mudflats and sandflats not covered by seawater at low tide
*Lagoons
Large shallow inlets and bays
Reefs
Submerged or partly submerged sea caves
Marine 'columns' in shallow water made by leaking gases

Palmer et al 2006

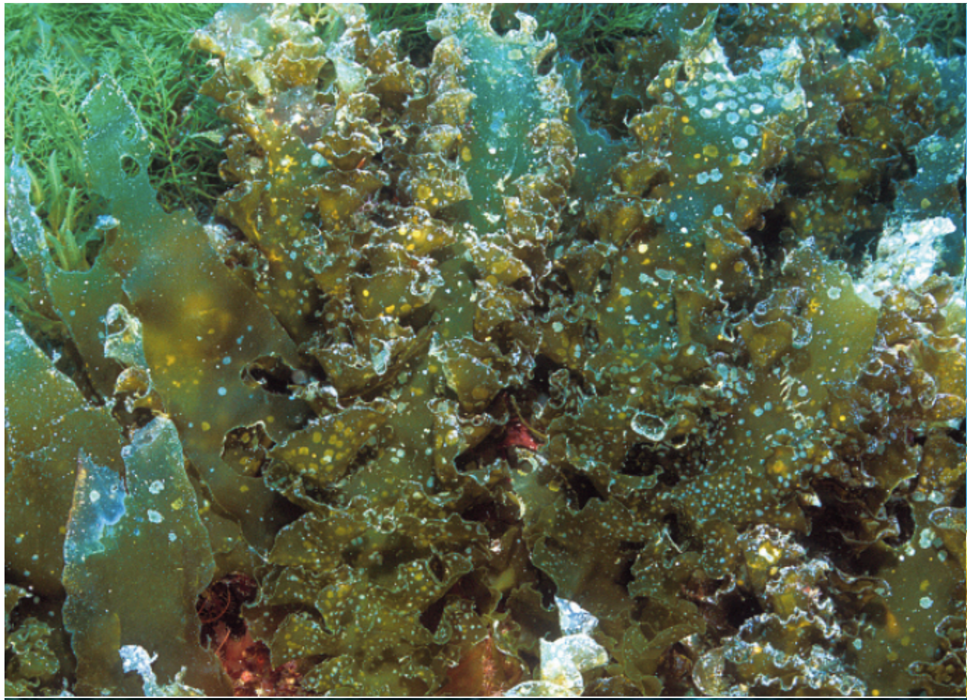
Protected or regulated species

Magnoliophyta			
Posidonia oceanica	(Linnaeus) Delile	P2	B1
Zostera marina	Linnaeus	P2	B1
Zostera noltii	Hornemann	P2	
Cymodocea nodosa	(Ucria) Ascherson		B1



Protected or regulated species

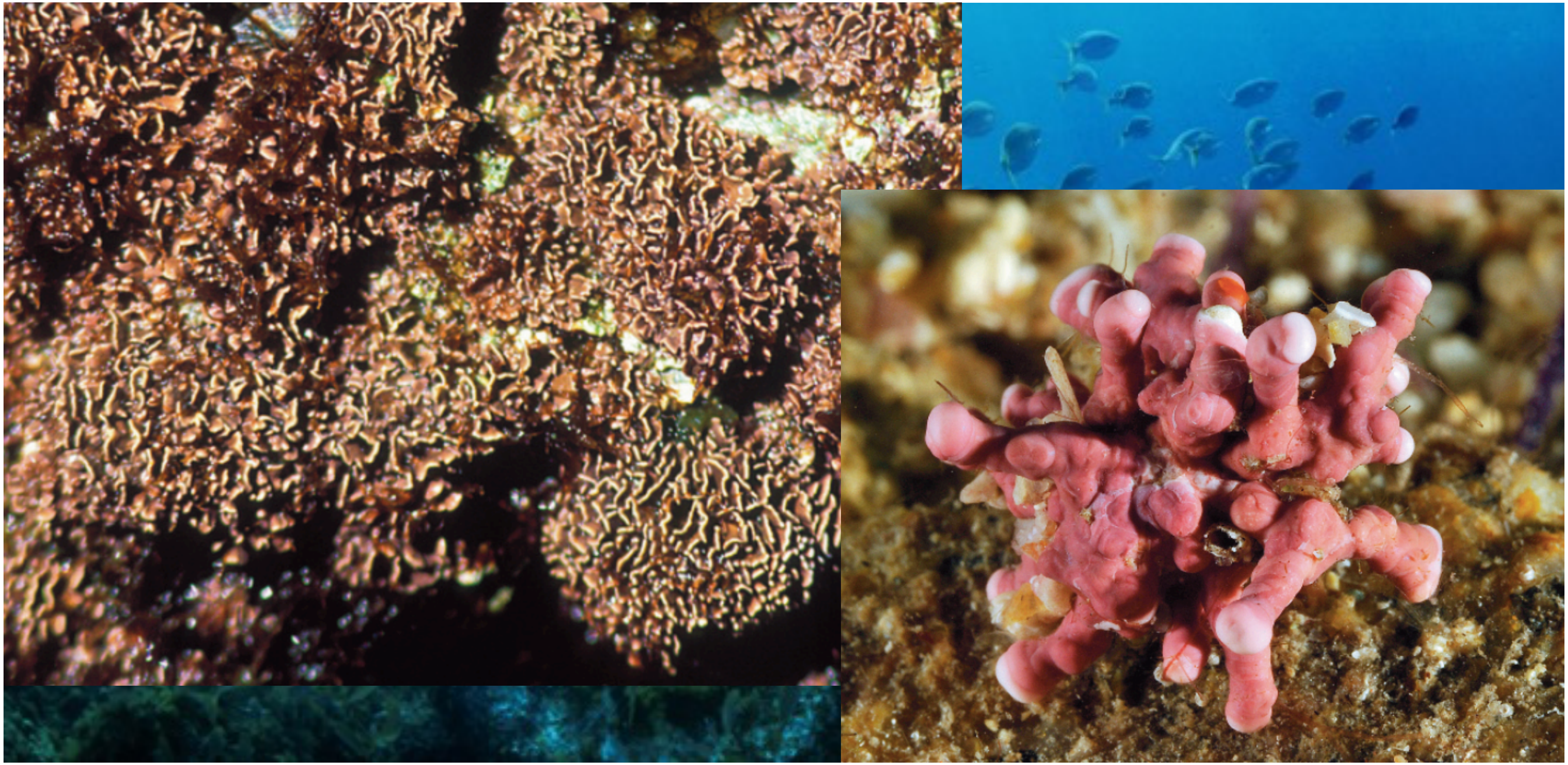
Phaeophyta			
Cystoseira amentacea and var. *spicata*	(C.Agardh) Bory including var. *stricta* Montague (Ercegovic) Giaccone	P2	B1
Cystoseira mediterranea	Sauvageau	P2	B1
Cystoseira sedoides	(Desfontaines) C.Agardh	P2	B1
Cystoseira spinosa	Sauvageau including *C. adriatica* (Ercegovic) Giaccone	P2	B1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



Protected or regulated species

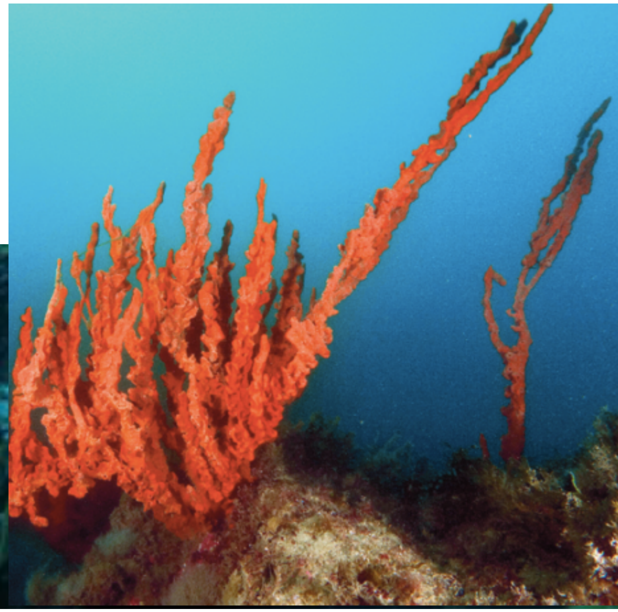
Rhodophyta

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



Protected or regulated species

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



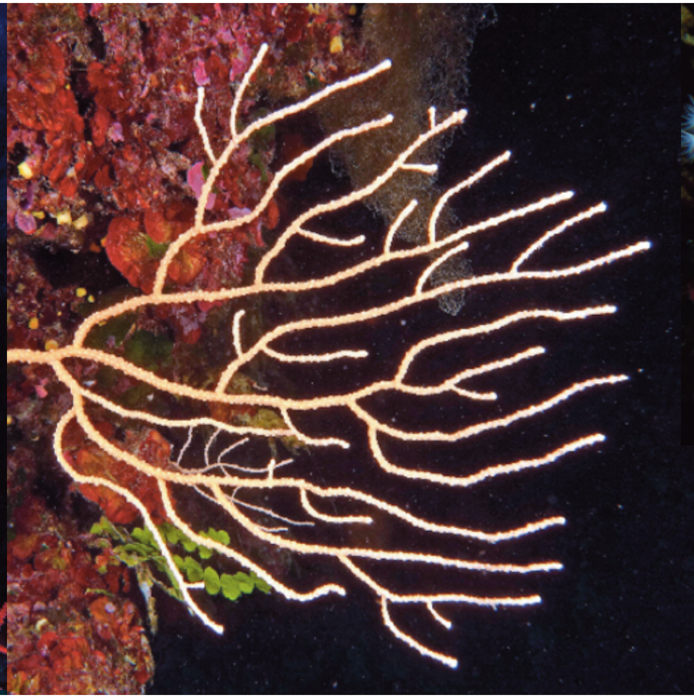
Protected or regulated species

Cnidaria

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

Bryozoa

Hornera lichenoides	(Linnaeus, 1758)		P2	

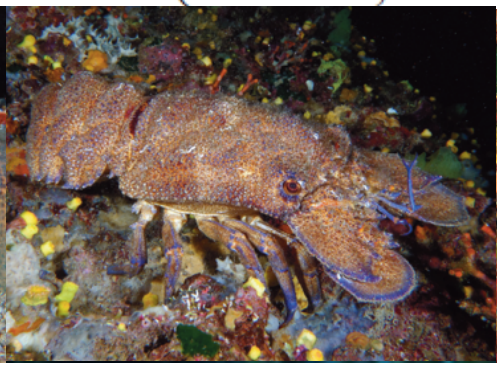
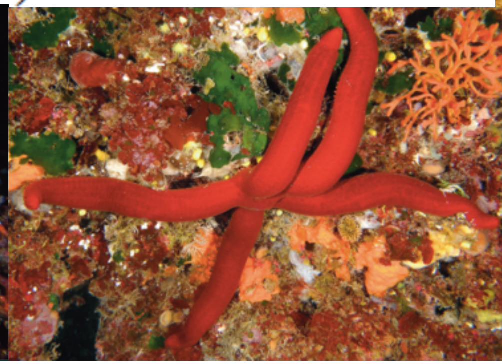
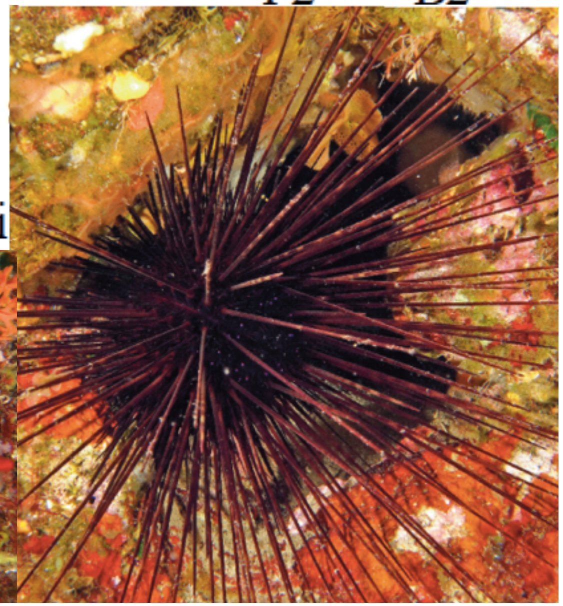



Protected or regulated species

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

Protected or regulated species

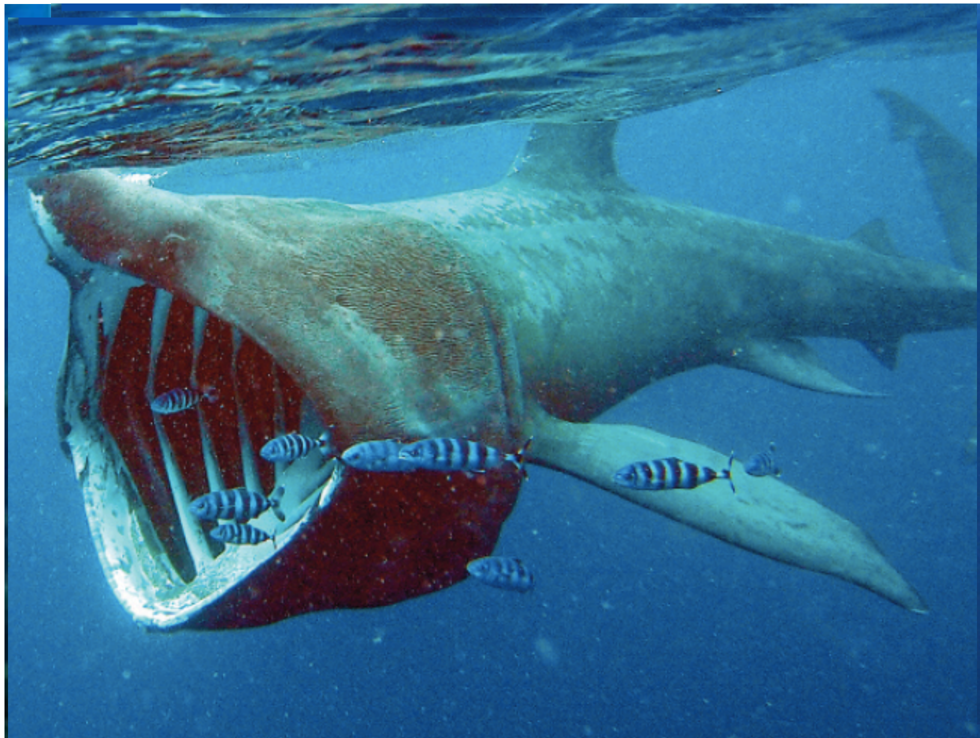
Crustacea				
Homarus gammarus	(Linnaeus, 1758)	Astice	P3	B3
Palinurus elephas	(Fabricius, 1787)	Aragosta	P3	B3
Scyllarides latus	(Latreille, 1803)	Cicala grande	P3	B3H5
Scyllarus arctus	(Linnaeus, 1758)	Cicala di mare	P3	B3
Scyllarus pygmaeus	(Bate, 1888)	Cicala minore	P3	B3
Maja squinado	(Herbst, 1788)	Granceola	P3	B3
Ocypode cursor	(Linnaeus, 1758)	Granchio fantasma	P2	B2
Pachylasmus giganteum	(Philippi, 1836)	Pachilasma	P2	
Echinodermata				
Ophidiaster ophidianus	(Lamarck, 1816)		P2	B2
Asterina pancerii	(Gasco, 1860)		P2	B2
Centrostephanus longispinus	(Philippi, 1845)	Riccio di mare a lunghe		
Paracentrotus lividus	(Lamarck, 1816)	Riccio di mare di		

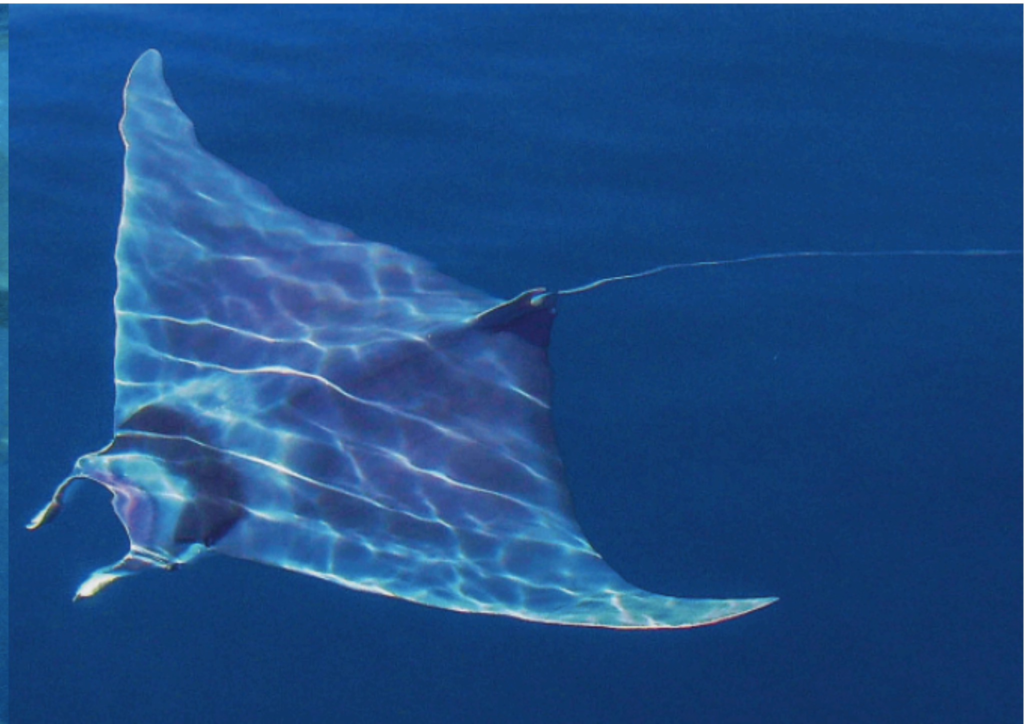





Protected or regulated species

Condrichthyes

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

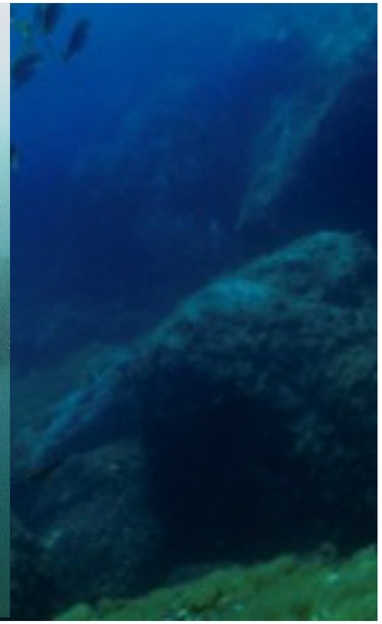




Protected or regulated species

Osteichthyes

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

Protected or regulated species

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



Protected or regulated species

Reptilia

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

Protected or regulated species

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

Protected or regulated species

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

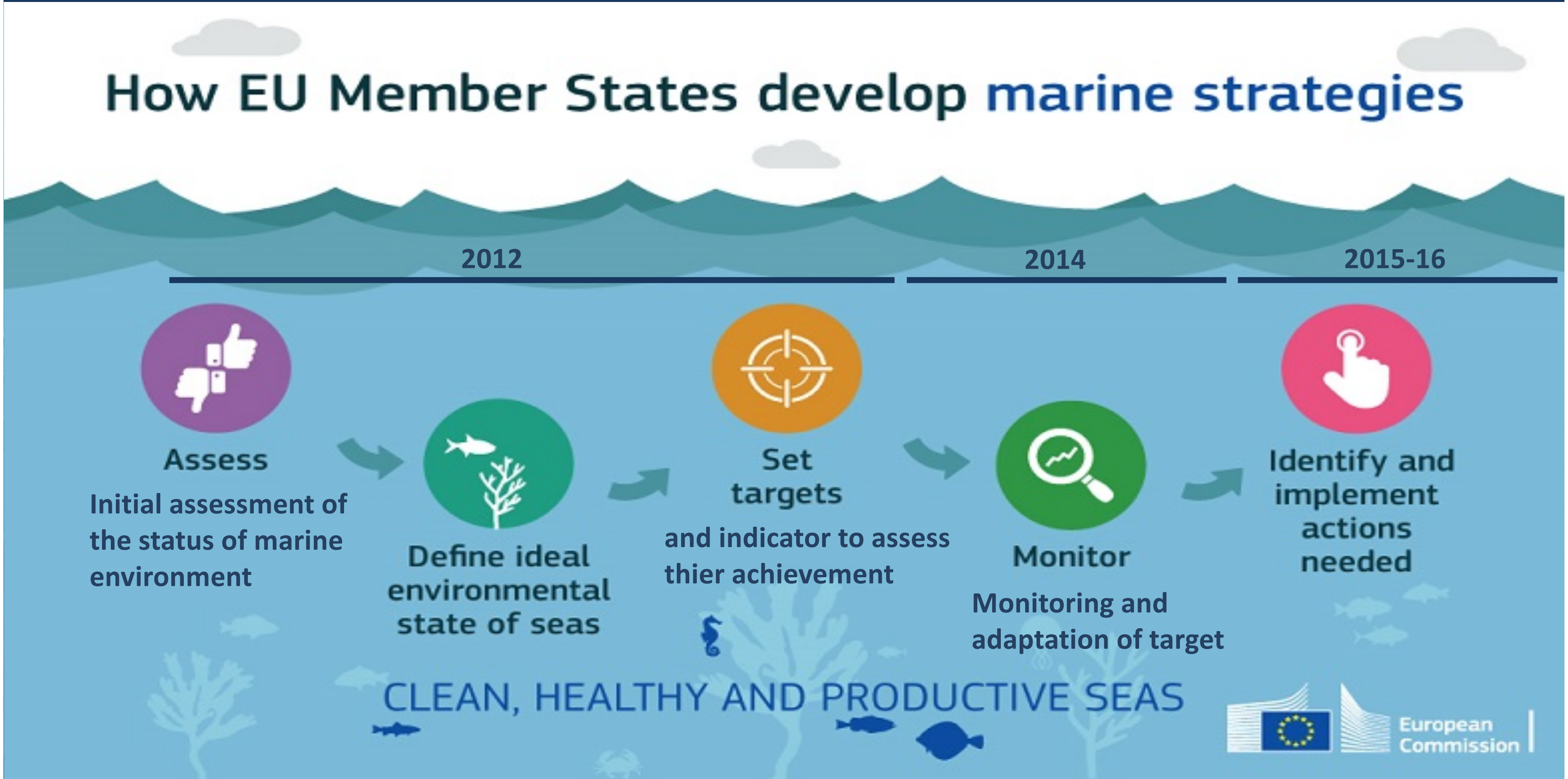
GES means that the environmental conditions of sea water are adequate to preserve diversity and functioning of seas and oceans, which are expected to be clean, healthy and productive, with a sustainable use of marine resources.

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

Palmer et al 2006

Development of MSFD



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

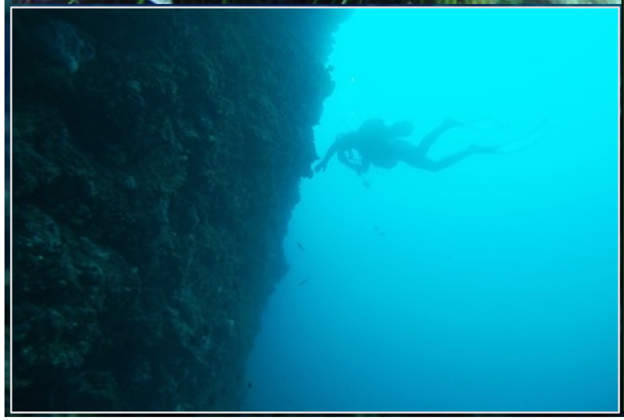
Baltic Sea
NE Atlantic Ocean
Mediterranean Sea
Black Sea

- W Mediterranean Sea
- Adriatic Sea
- Ionian and Central Mediterranean Sea
- E Aegean Sea

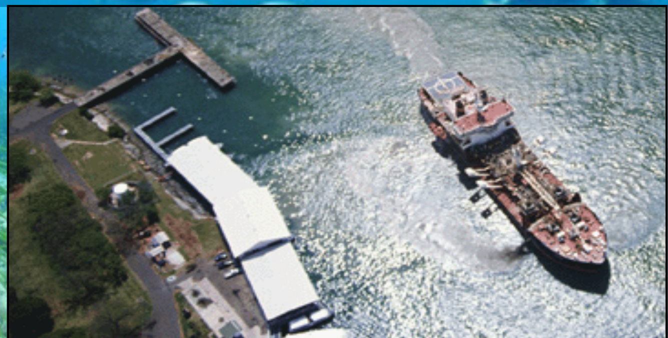
Initial assessment

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 hydrolographical 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 Acculmulatin 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 alterated

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 definide 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 distributin 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 proportio 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

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

2. 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

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 communites

5. Eutrophication

Several targets of reduction and regulation of sewage discharge

Hypoxia and anoxia are reduced

6. Sea floor integrity

Impact of construction or deployement 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

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 (continuos sounds a low frequency) is defined