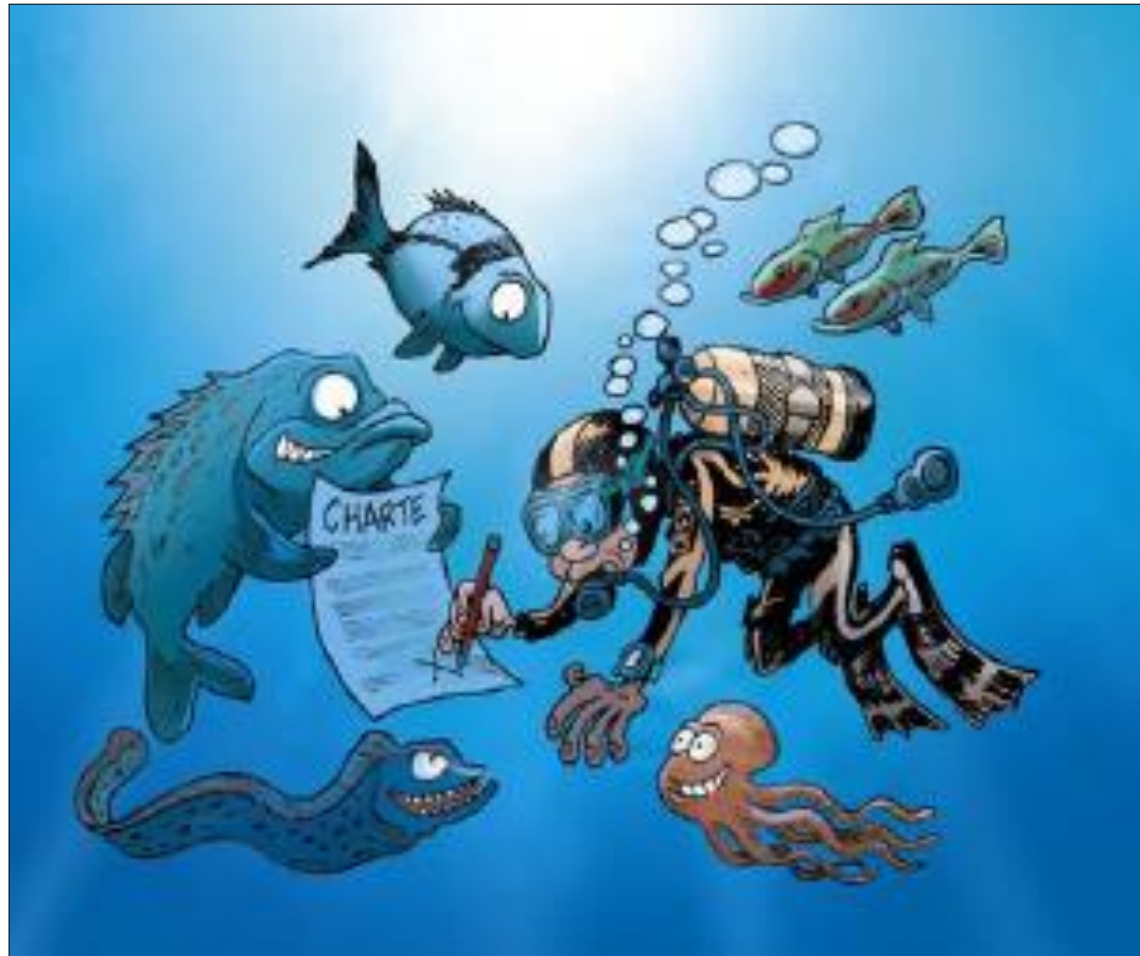




Biological Conservation & Marine Protected Areas (MPAs)

Marine Protected Areas as TOOLS for Biological Conservation & Sustainable Development



What is a Marine Protected Area (MPA)

Definition

~ **IUCN Definition 2008**: A Protected Area is

- a **clearly defined geographical space**, recognized, dedicated and managed, to achieve the **long term conservation of**

- ✓ **nature**
- ✓ **associated ecosystem services**
- ✓ **cultural values**

~ **PISCO 2016**: Marine Protected Areas (MPAs) are places in the sea designed to protect marine species and ecosystems, while sometimes allowing for sustainable uses of marine resources within their boundaries.



What is a Marine Protected Area (MPA)

What is a MARINE PROTECTED AREA ?

A Marine Protected Area is an area of sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.

– IUCN, the World Conservation Union

Seas and oceans the world over are at risk, and under severe threat from the actions of mankind. Marine Protected Areas are designated for the protection of the marine environment and the life that it supports, so as to ensure that future generations can enjoy the full benefits of the marine environment in all its glory.

Marine Protected Areas do not exclude access to humans – they encourage the sensible use of marine resources and ensure that the activities that take place are not harmful to the area.

... is an area of sea especially dedicated to the protection and maintenance of biological diversity, and natural and associated cultural resources through legal or other effective means (IUCN)...

Types of Marine Protected Areas (MPAs)

Many types of MPAs: e.g. National Parks, Wildlife Refuges, Archeological sites (Shipwrecks & Marine Antiquities), NATURA 2000 sites (Reefs, Seagrass beds - *Posidonia* meadows, Tidal lagoons and mudflats, Saltmarshes & Mangroves, Underwater areas on the coast, Seabed in deep waters, Open waters - the water column)

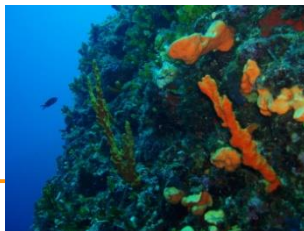
But overall these belong to **three main** categories:

Partially Protected Areas

- **Lightly protected:** most extractive activities are allowed
- **Strongly protected:** some uses are prohibited but some extractive activities are allowed and regulated.
- **Temporarily protected:** extractive activities during some time of the year.

Fully Protected Areas: no extractive activities allowed.

Multiple-use Areas: use of zones with different protection levels.



Types of Marine Protected Areas (MPAs)

Marine Reserves – No-take Areas

• A special type of **Marine Protected Area** **fully protected** from activities that remove animals and plants or alter habitats, except as needed for scientific monitoring”

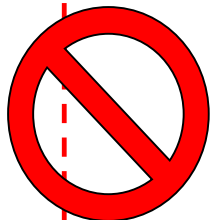
• **Fully Protected:**

- all extractive and destructive activities are forbidden
- removal of plants or animals is forbidden
- only scientific monitoring allowed



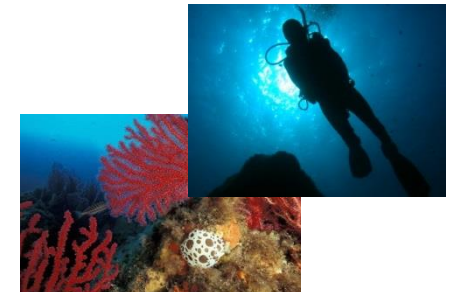
• **Prohibited activities** include

- Fishing
- Aquaculture
- Dredging
- Mining



• **Activities usually allowed or regulated**

- Swimming
- Boating
- Scuba diving





The purpose of Marine Protected Areas (MPAs)

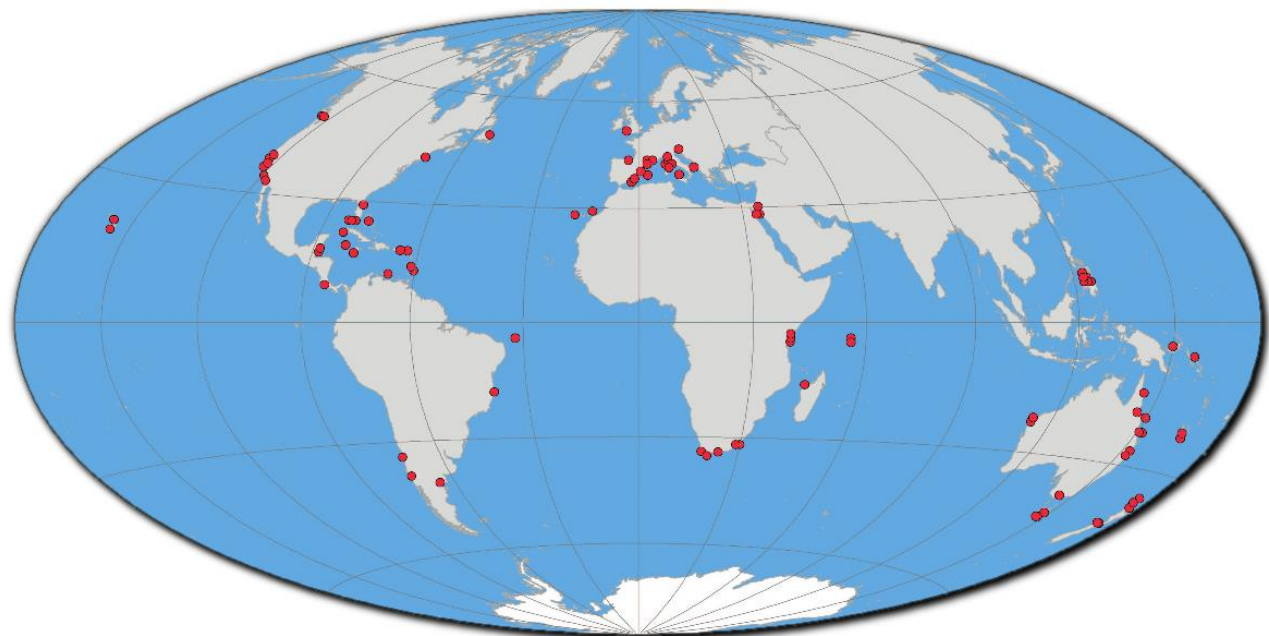
MPA aims to Several ecological and socio-economic goals including:

- Conservation** of Marine Biodiversity
- Protection of threatened**, rare or endangered **species** and populations
- Protection of commercially** / economically **important species**
- Preservation of habitats** that are critical for the survival and/or lifecycles of species, including
- Fisheries management** (reduce fishing pressure, replenish fish-stocks, protect critical stages of species lifecycles, reduce by-catch, reduce competition among fishers)
- Sustainable Economic** development & Tourism
- Education & public awareness** (schools, universities, general public, stakeholders)
- Research** purposes – provide natural laboratories and reference sites (e.g. transplantation of corals, effects of climate change)

Now-days MPAs Facts & Figures - WORLDWIDE

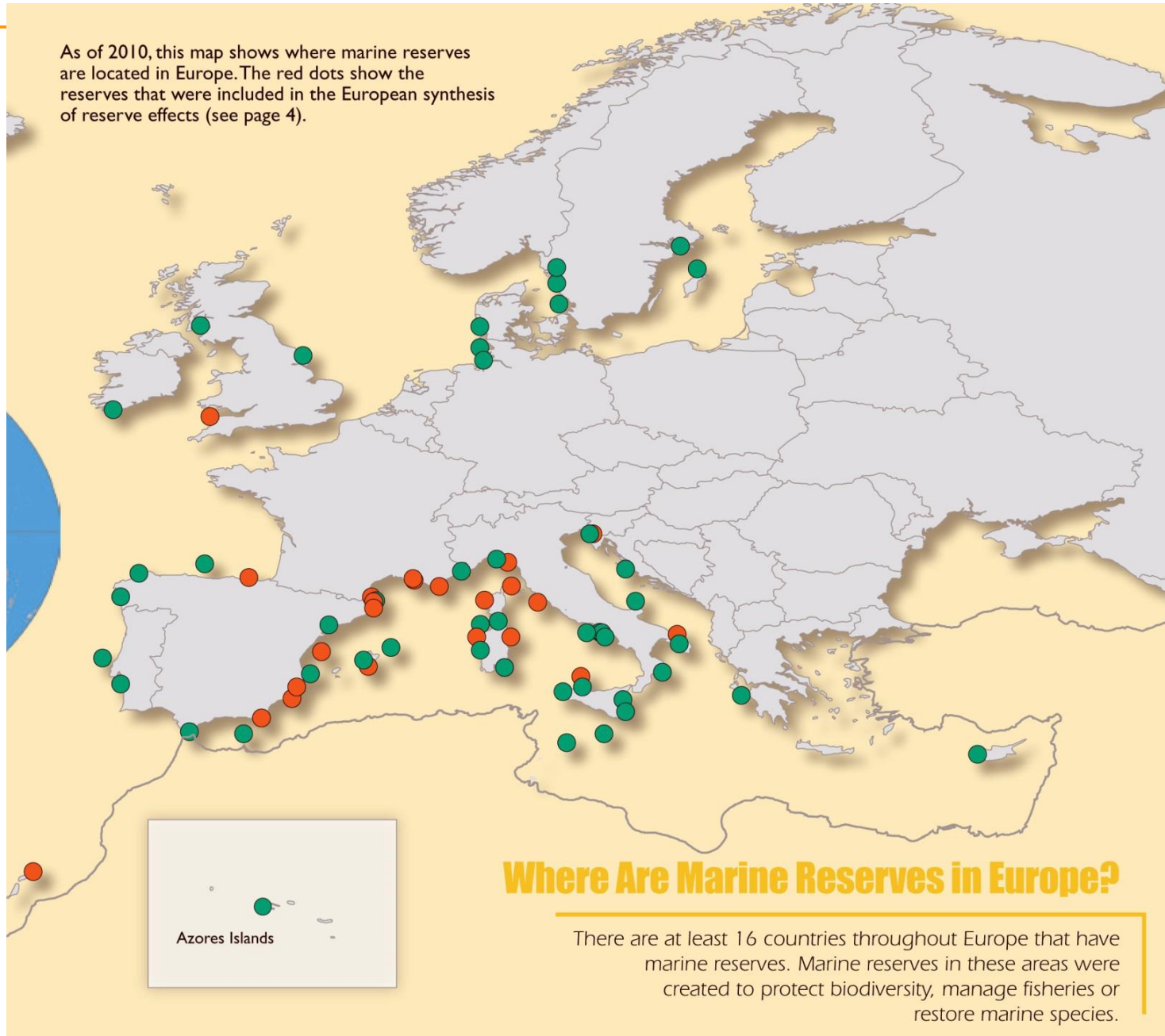
- In **2015** at least **11.300 MPAs** existed worldwide, covering **3.7%** of the ocean.
- But only a **small number** of them were **Marine Reserves** = only **1.4%** of the global seas receive complete and permanent.
- **Next goal = ?**
protect at least 10% of the oceans and seas through the establishment of MPAs **by 2020!**
(Convention on Biological Diversity - IUCN)

- The difference between **Marine Reserves** versus **partially protected** areas is significant. Why ?
- because **full protection** provides **more benefits** than lower level of protection.

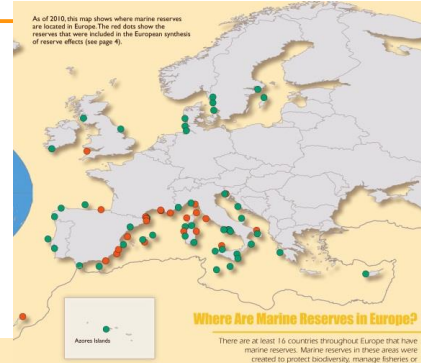


Now-days MPAs Facts & Figures - EUROPE

As of 2010, this map shows where marine reserves are located in Europe. The red dots show the reserves that were included in the European synthesis of reserve effects (see page 4).



Now-days MPAs Facts & Figures - EUROPE



Marine Reserve Facts

- **Of the 74 European marine reserves, only 18 occur outside of the Mediterranean Sea and the Azores and Canary Islands.**
- **Most European reserves are quite small. Half of the reserves in Europe cover less than 1.8 square kilometres.**
- **A survey of 15 Italian marine reserves found that only 3 had adequate enforcement.**

Legal Framework

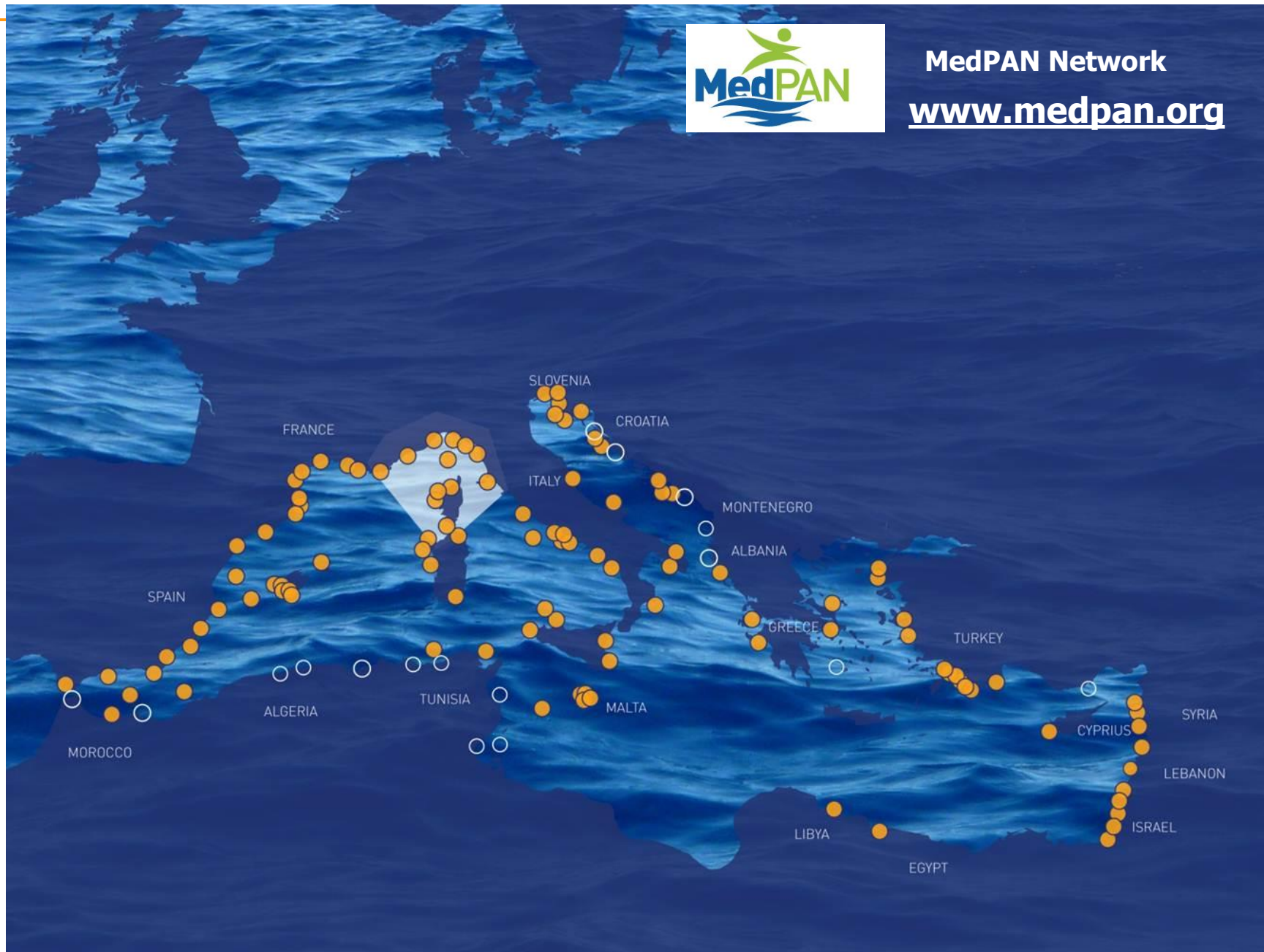
The main legal obligations to designate MPAs in the EU are provided by the Marine Strategy Framework Directive (MSFD) and the Habitats and Birds Directives. Although these do not explicitly require marine reserves, they do require that *coherent networks* of designated sites help achieve *good environmental status* by 2020. These networks will protect habitats and species. Legal obligations such as EU policies, regional seas conventions and the Convention on Biological Diversity, in combination with the best available science, offer an opportunity to further marine conservation throughout Europe.

Croatia
Cyprus
Denmark
England
France
Germany
Greece
Ireland
Italy
Malta
Monaco
Portugal
Scotland
Slovenia
Spain
Sweden

References: 2, 3, 4, 5, 6, 7, 8, 52



Now-days MPAs Facts & Figures - MEDITERRANEAN





Now-days MPAs Facts & Figures - MEDITERRANEAN



MedPAN Network

www.medpan.org

Members





Now-days MPAs Facts & Figures - MEDITERRANEAN



MedPAN Network

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Status of MPAs in the Mediterranean Sea (2008)

The current Mediterranean MPA system is not representative or coherent

Management in Mediterranean MPAs needs to be more effective

CBD target of protection of 10% is not likely to be achieved in the Mediterranean

- Only 3,8% of the Mediterranean Sea is under protection
- Without Pelagos: 0,4%
- No-take areas: 0,01%

- Mostly coastal; only Pelagos in High-Sea
- 73.4% of MPA on the northern shoreline
- No MPA on Gulf of Syrte
- Distance between MPA don't ensure ecological connections

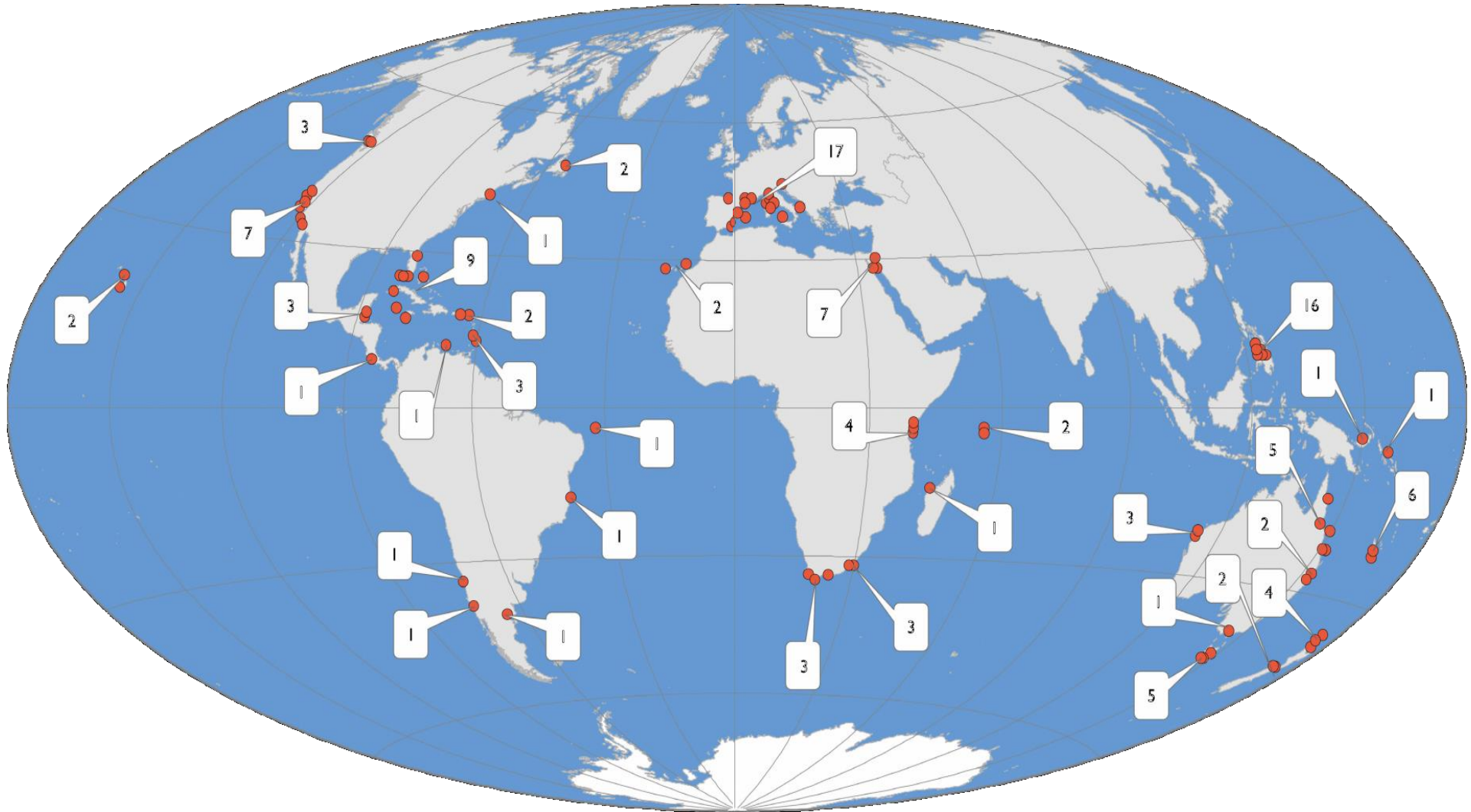
- 42% of MPA only have a management plan
- 80% of MPA do not have enough human and material means in order to implement management measures

Challenges : improve

1. Ecological coherence and representativity of MPA network
2. Management efficiency of existing MPAs

Ecological benefits of Marine Protected Areas (MPAs)

Study in 124 Marine Reserves Worldwide



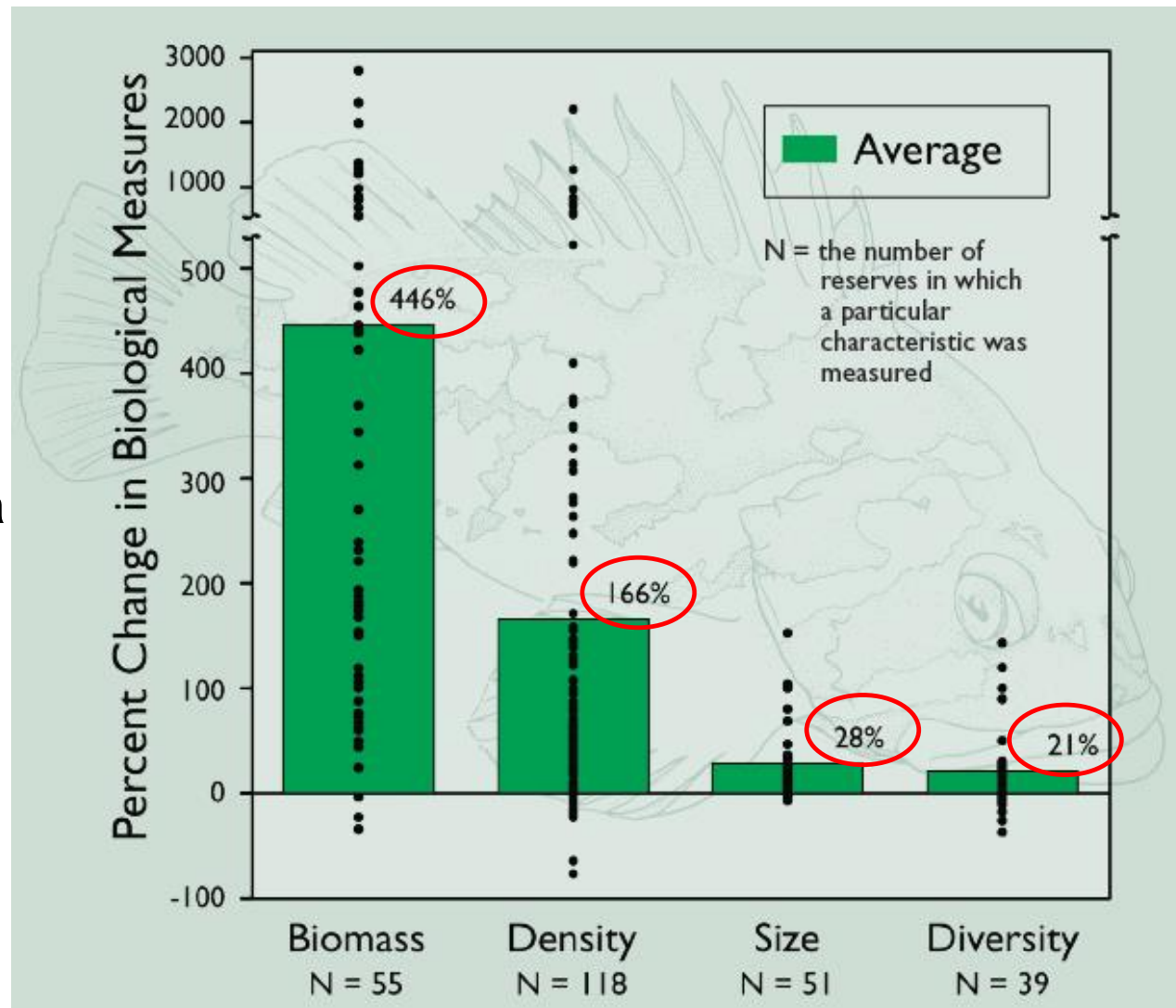
Lester et al. 2009 Biological effects within no-take marine reserves: a global synthesis. MEPS 384: 33-46

Ecological benefits of Marine Protected Areas (MPAs)

A main goal of MPAs is to: **Protect the abundance and diversity of marine life** - Lester et al. (2009) showed that **Fully Protected** and **well enforced Marine Reserves** accomplish this goal.

Marine fish, invertebrates & macroalgae show an average increase in MPAs.

- Biomass** – total weight of animals and plants
- Density** – number of plants or animals within a given area
- Size** – body size of animals
- Diversity** – number of species



Ecological benefits of Marine Protected Areas (MPAs)

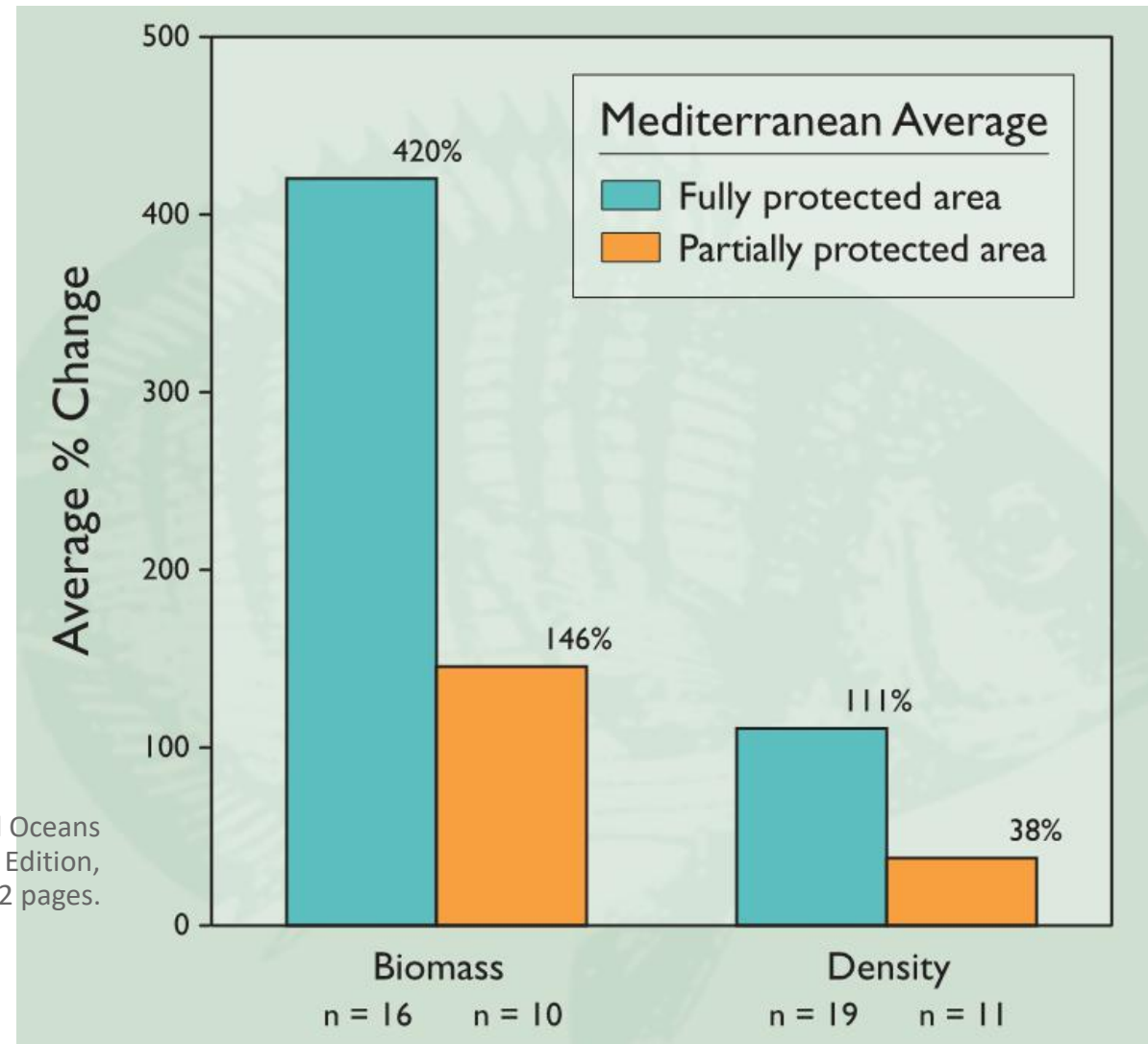
In addition ...

A new review of 24 MPAs in the Mediterranean Sea showed similar results (Giakoumi et al. 2017) - Both fully and partially protected areas had more and larger fish than areas outside MPAs (i.e. Unprotected Areas).

But

- ❑ the response of fish species was **greater** in **Fully Protected Areas** than in adjacent **Partially Protected Areas**.

Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) 2017. The Science of Marine Reserves (3rd Edition, Europe). 22 pages.



Ecological benefits of Marine Protected Areas (MPAs)

Increase in body size

Why is this important?

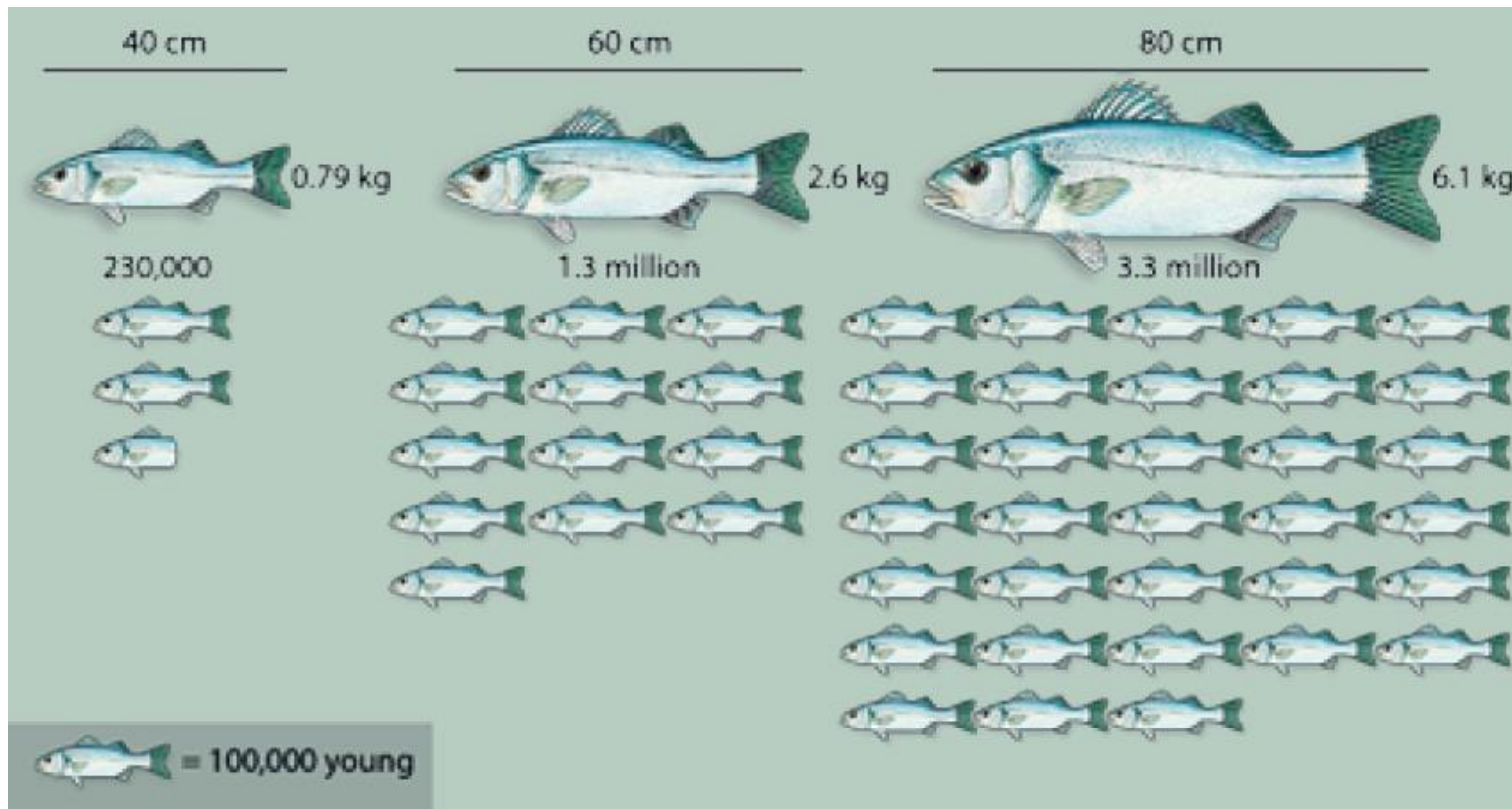
Bigger Fish = more off-springs (απόγονοι)

BOFFFF hypothesis - Berkeley et al. (2004):

Big old fat fecund female fish

(Μεγάλα ηλικιωμένα γόνιμα θηλυκά ψάρια):

- Produce more larvae,
- Have longer time periods,
- Have more chances of survival



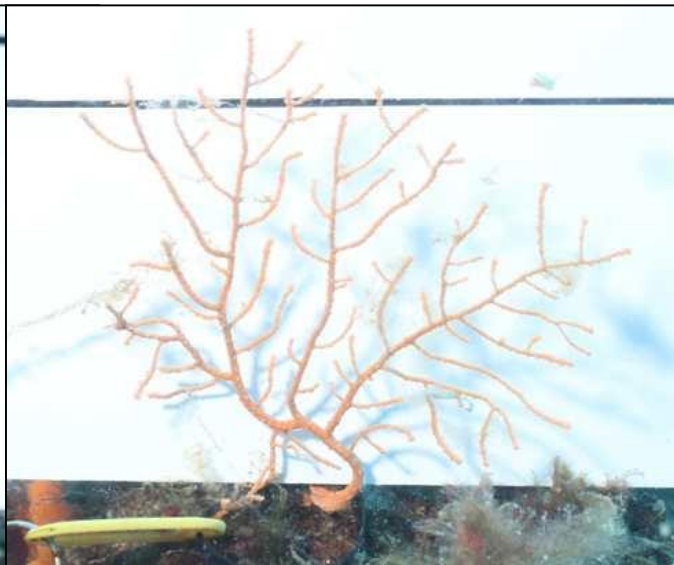
Ecological benefits of Marine Protected Areas (MPAs)

Increase in body size

Why is this important?

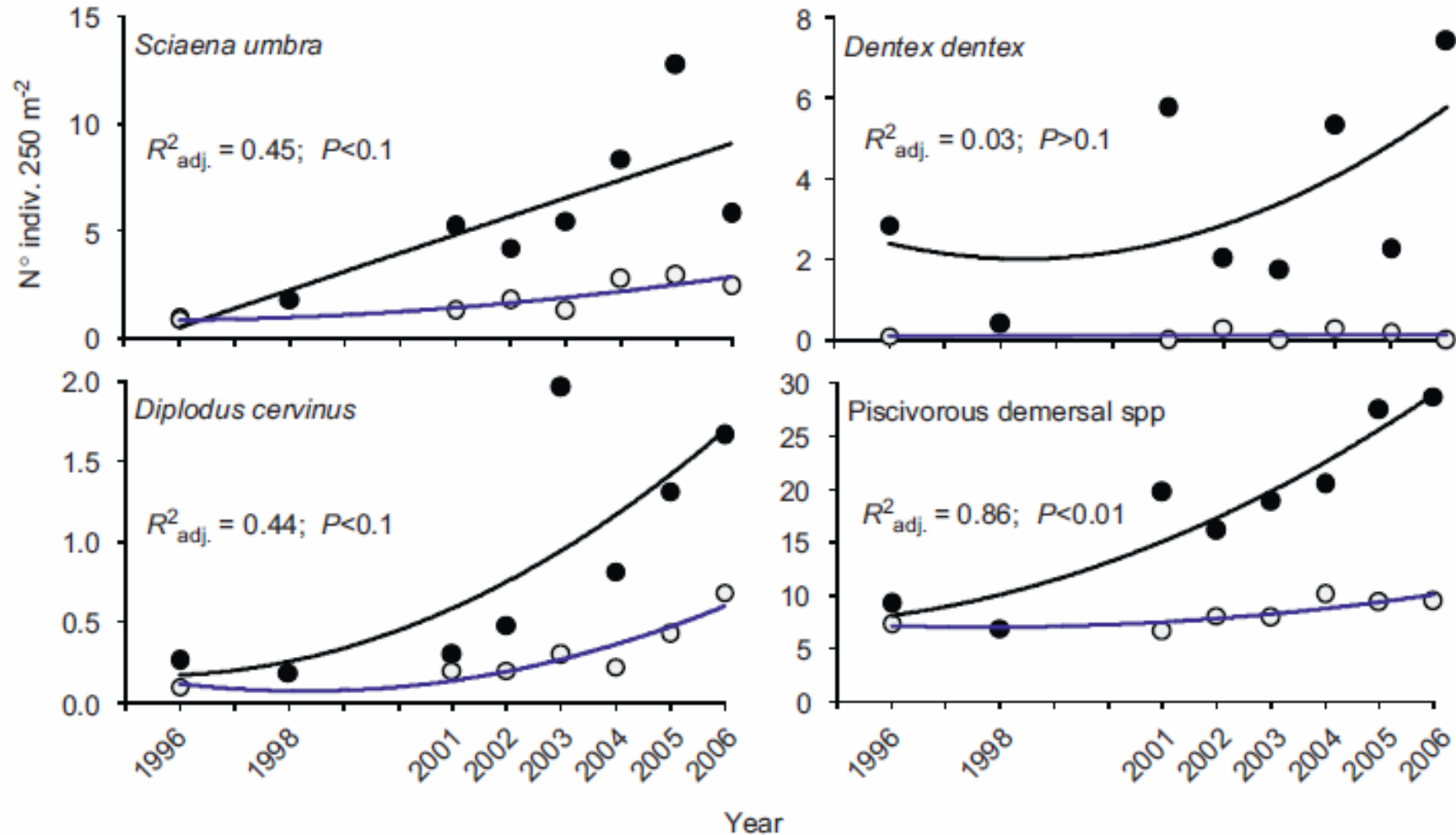
The same is also **true for many invertebrate** species, e.g. the yellow gorgonian *Eunicella cavolini*

Bigger Invertebrate = more off-springs (απόγονοι)



Ecological benefits of Marine Protected Areas (MPAs)

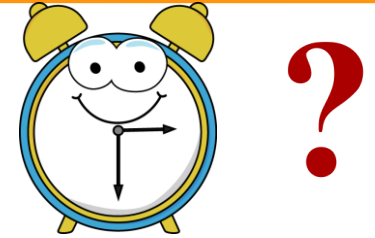
But what do you observe here?



Population density of Fish inside (●) and outside (○) the **Capo de Palos MPA** in Spain. Protection Actions started in 1995. Source: García-Charton et al. 2008.



Ecological benefits of Marine Protected Areas (MPAs)



How much time is needed for Population & Ecosystem recovery?

It depends on:

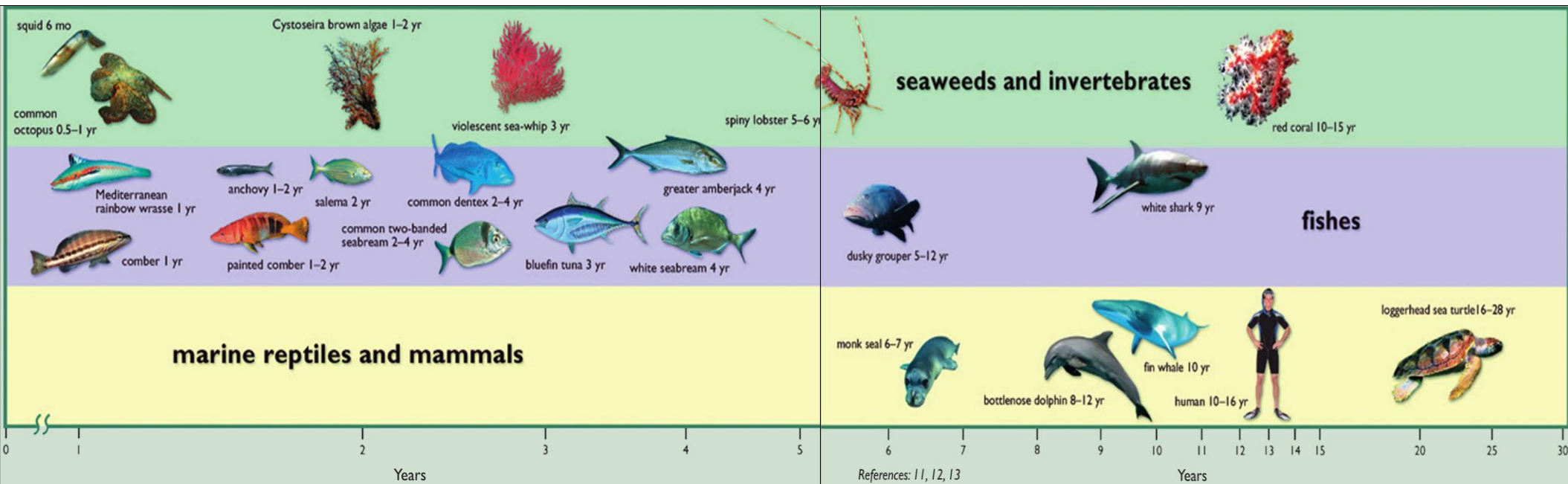
- a) a species **life cycle**, growth and maturity rate,
- b) a species **fishing status**,
- c) **species interactions**,
- d) **state of the communities**,
- e) **state of the environment**,
- f) existence of other **stressors** (e.g. climate change, regional pollution)

Ecological benefits of MPAs – Effect of species life cycle, growth & maturity

• Effect of a species life cycle, growth & maturity

Different species have variable responses according to their **Life cycle**

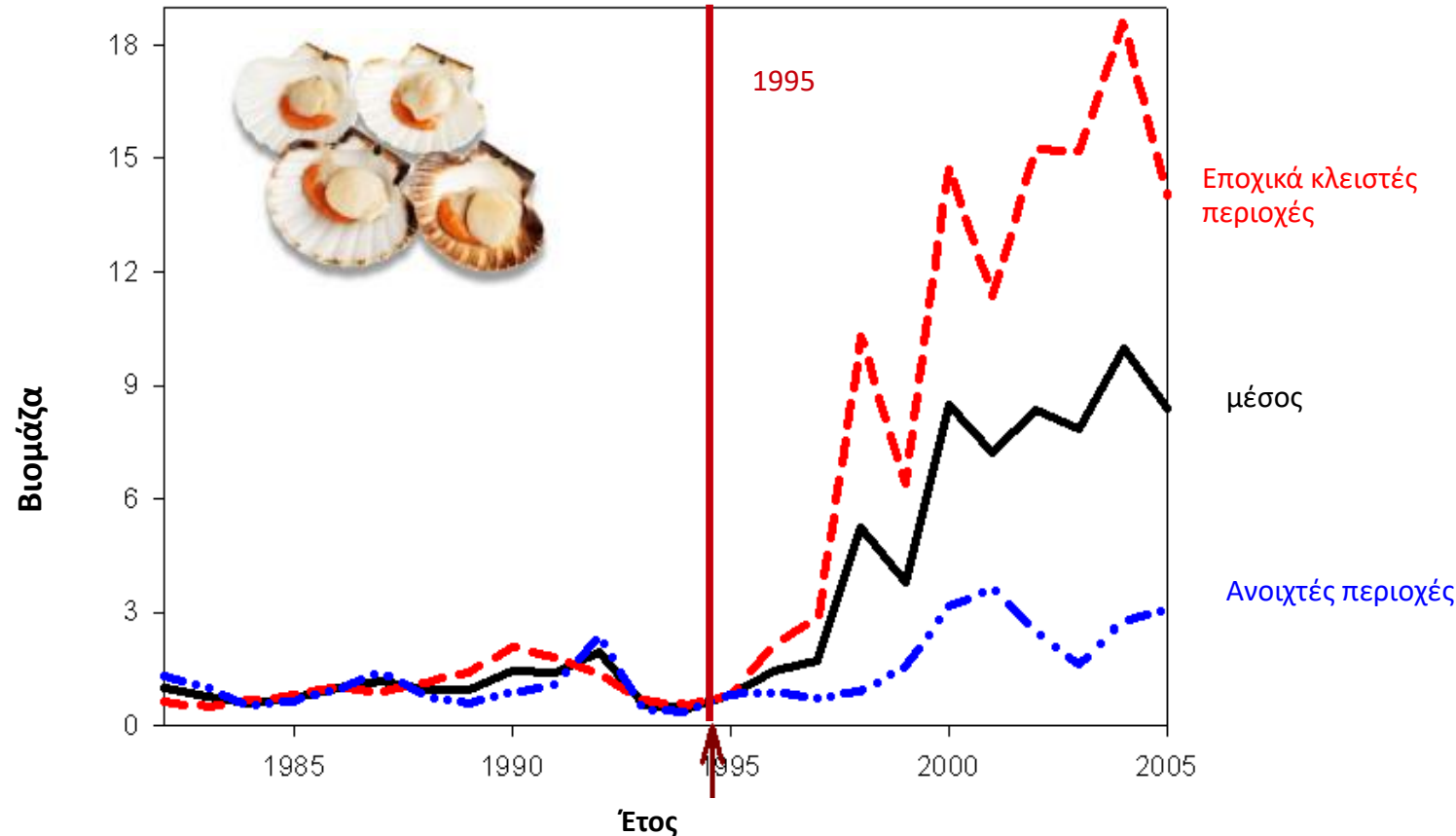
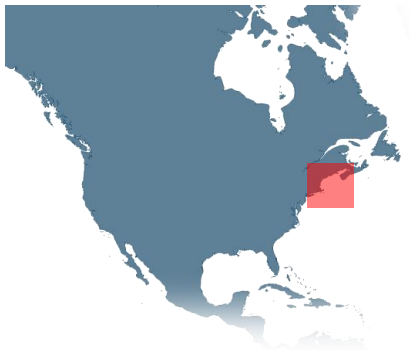
- ❑ Species that **grow** and reach sexual maturity **relatively fast** (1- 4 years): e.g. Scallops (*Pecten* spp.), Squids (*Loligo* spp.), Seabreams (*Diplodus vulgaris*)
- ❑ Species that **grow slow** and need a long time to reach sexual maturity (several years to decades): e.g. Groupers (*Epinephelus* spp.), Cod (*Gadus* spp.), Lobsters (Palinuridae, Homaridae), Sea Reptiles - Turtles, Marine Mammals



Ecological benefits of MPAs – Effect of species life cycle, growth & maturity

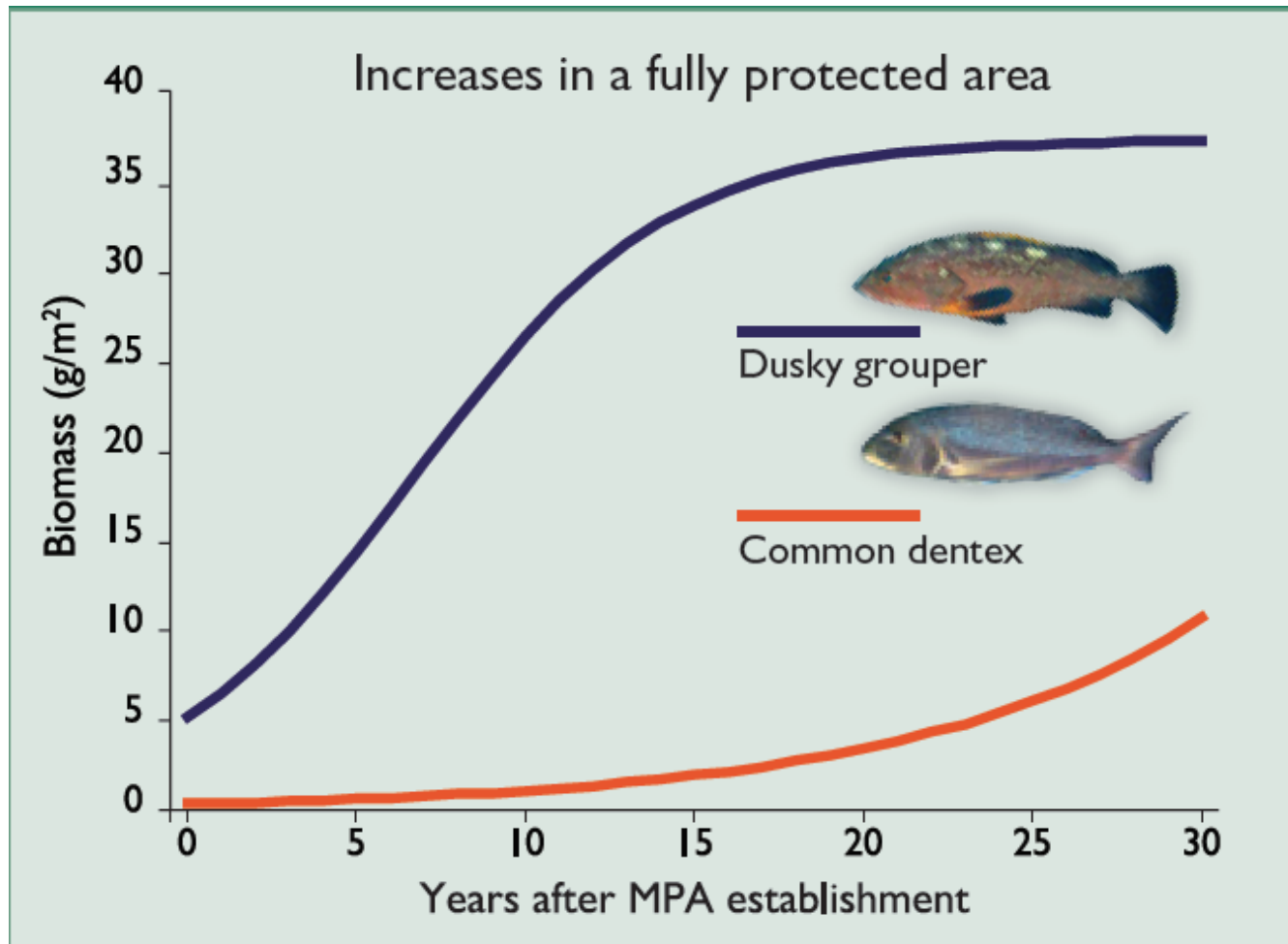
Example 1: George's Bank **Scallops** (*Placopecten magellanicus*)

After several years of overexploitation, in 1994 **seasonal area closures** led to a dramatic **increase** in the **density** and **biomass** of scallops within only a few years.



Ecological benefits of MPAs – Effect of species life cycle, growth & maturity

Example 2: Medes Islands, Spain - *Epinephelus marginatus* versus *Dentex dentex*



- The biomass of *E. marginatus* increased for **15 years** and stabilized about 20 years after protection.

- The biomass of *D. dentex* increased **more slowly**, but continuously, and is **still increasing** 30 years after protection.



- Long term protection is needed for full ecosystem recovery.

Ecological benefits of MPAs – Effect of Fishing status & Species Interactions

• Effect of Fishing Status & Species Interactions

- A worldwide analysis has revealed that:
 - ~ **61% of fish species** were **more abundant inside** Marine Reserves than outside
 - ~ **39% of fish species** decline following protection.
- Some species increase, some decrease, and some stay the same in abundance within an MPA. **Can you imagine Why?**

- ❑ **Species interactions:** Prey species will increase in the absence of their predators, and will decrease when they re-appear due to protection.
- ❑ **Fishing status:** Species subject to fishing in Unprotected areas tend to increase in Fully Protected MPAs.

- ~ **Example 1:** a decline of **juvenile Lobsters** in Medes Islands MPA, Spain (Diaz et al., 2005).

- ~ **Why?** ✓ **Increase of predators** that feed upon juveniles.



Ecological benefits of MPAs – Effect of Fishing status & Species Interactions

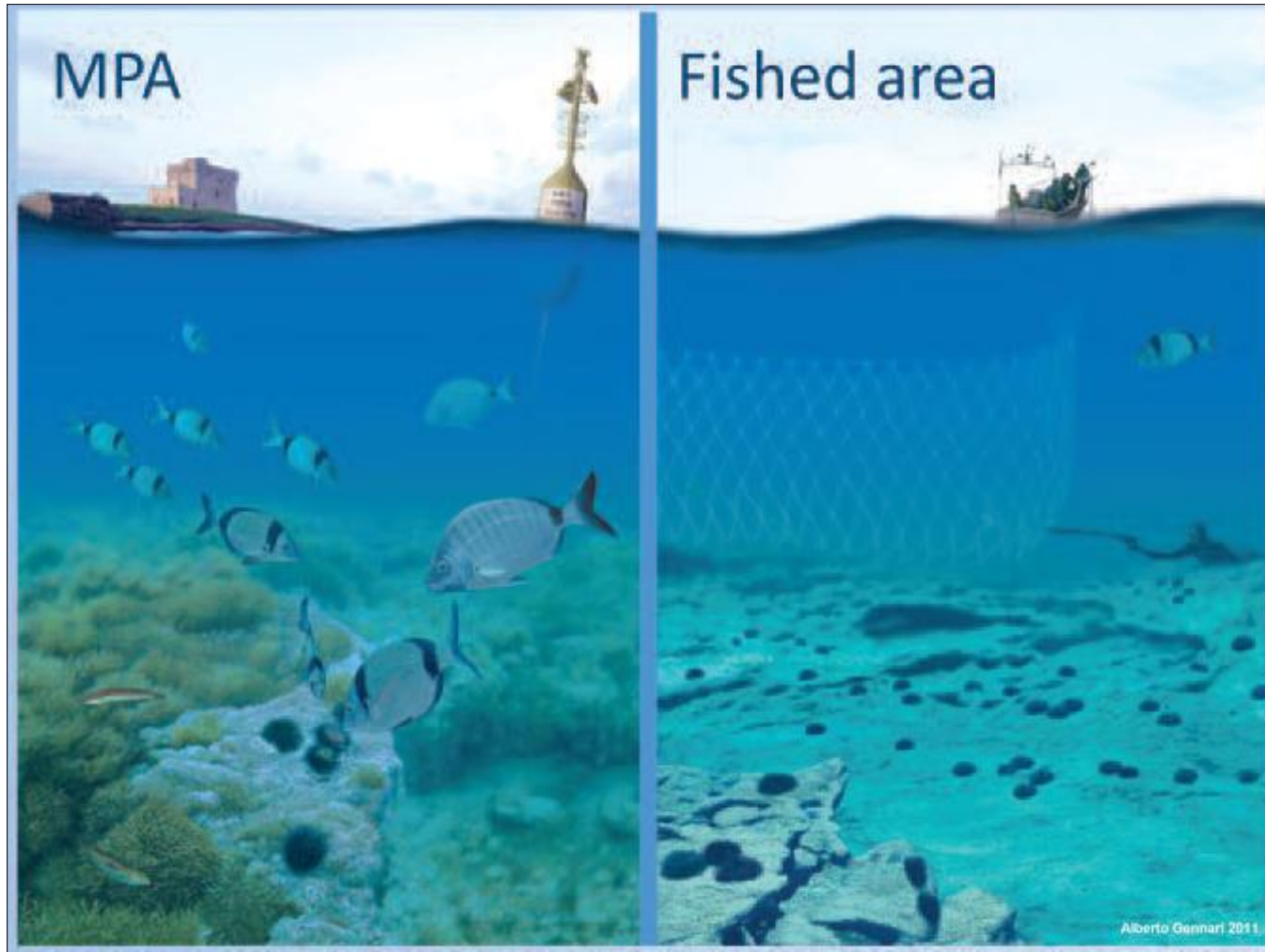
- ❑ **Example 2:** a study in New Zealand, showed that **Lobster abundance** was **higher in Marine Reserves** than in multi-purpose MPAs. **Why?**
 - ✓ Recreational fisheries were allowed in multi-purpose MPAs. This kept population numbers low.

- ❑ **Example 3:** a review of Marine Reserves in New Zealand, Australia, USA, Kenya, Philippines showed that **Fish species targeted by fishing** generally **responded within 5 years of Protection**. **Unfished species** took an average of **13 years to respond**. **Why?**
 - ✓ Unfished species were not responding to the absence of fishing but to changing abundances of other species (i.e. **species interactions**)



Ecological benefits of MPAs – Previous State of the Ecosystem

- **Effect of the Previous State of the Ecosystem**



Ecosystem restoration is possible but it needs a **long time** for **all ecosystem components** to respond.

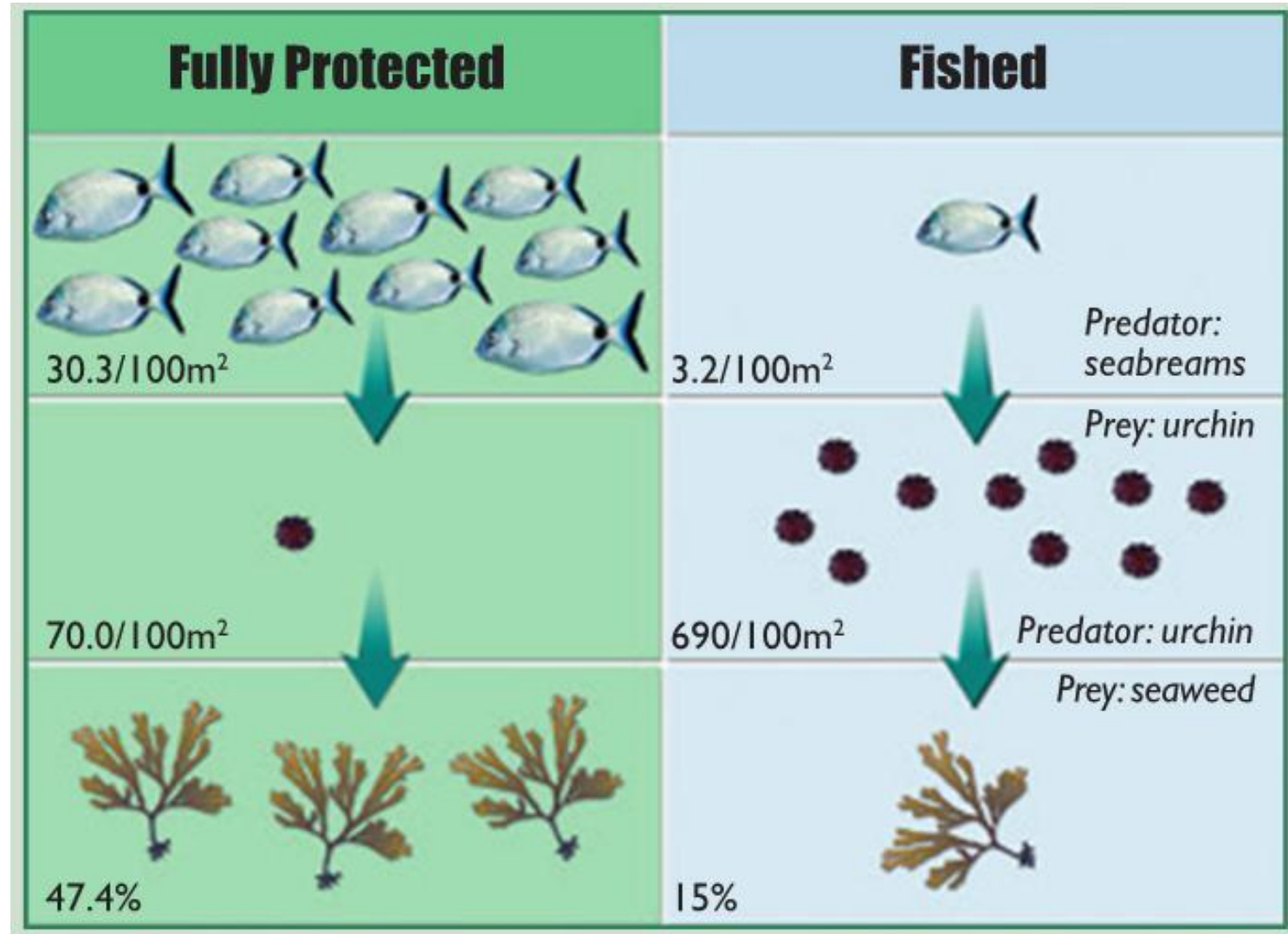
Ecological benefits of MPAs – Previous State of the Ecosystem

□ Example 1: Torre Guaceto (ITALY) Marine Reserve

Commonly fished sea-breams (e.g. *Diplodus sargus*) became **2-10 times** more abundant in the Marine Reserve, after **10 years of protection**.

Seabreams ate sea urchins, which became **10 time less** abundant.

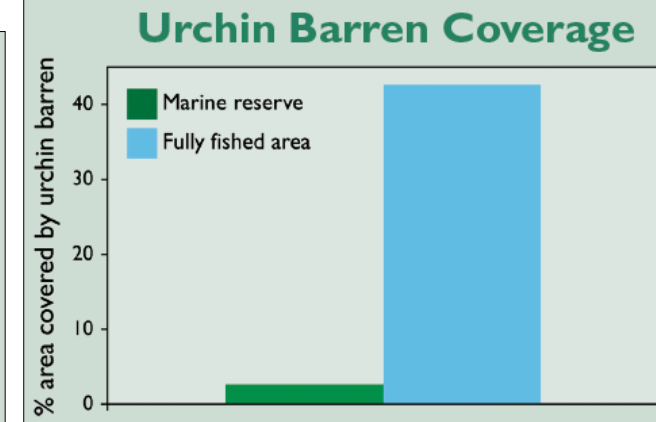
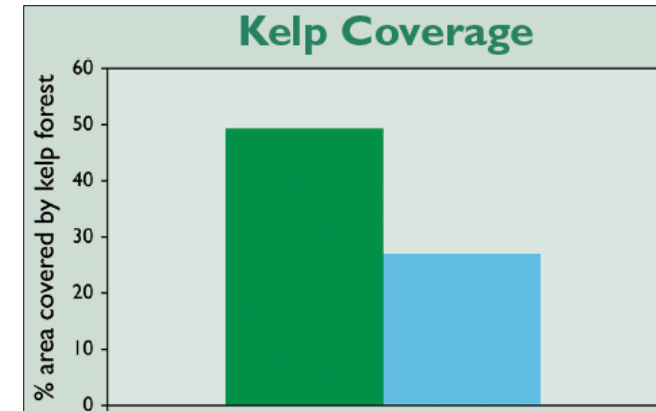
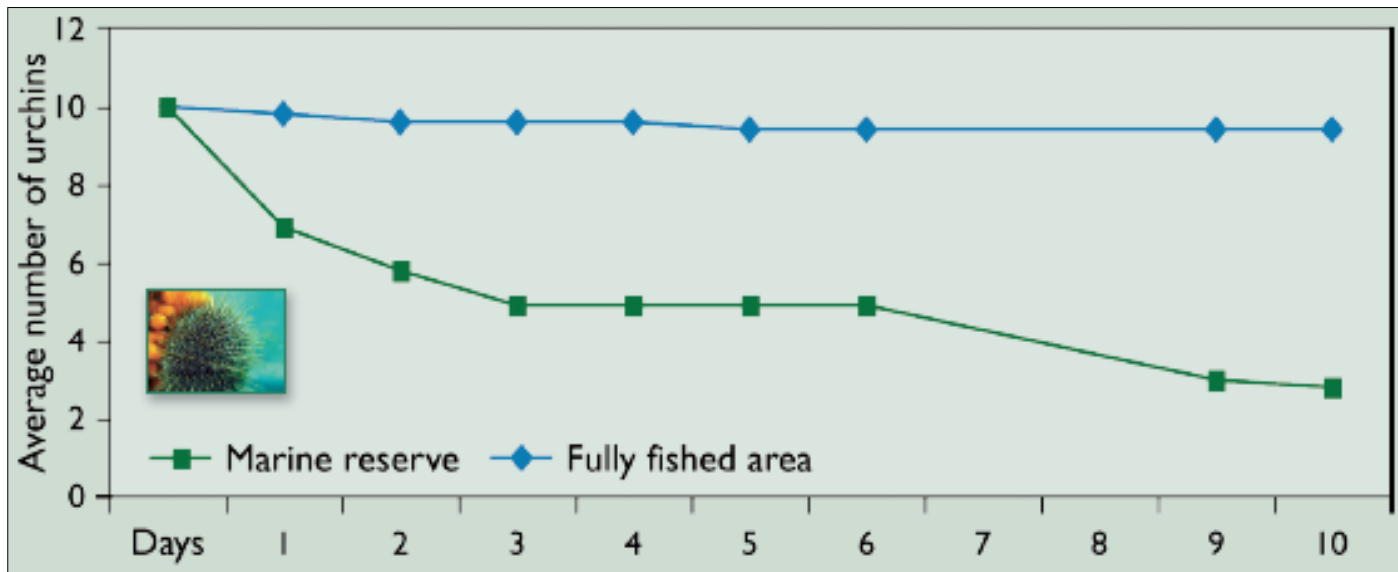
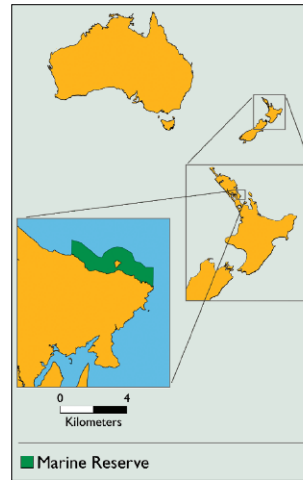
With less sea urchins, **macroalgal communities** showed a **3 times** cover increase.



Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) 2017. The Science of Marine Reserves (3rd Edition, Europe). 22 pages.

Ecological benefits of MPAs – Previous State of the Ecosystem

Example 2: Leigh Marine Reserve, New Zealand



Shears NT, Babcock RC, 2002. Marine reserves demonstrate top-down control of community structure on temperate reefs. *Oecologia* 132:131–142

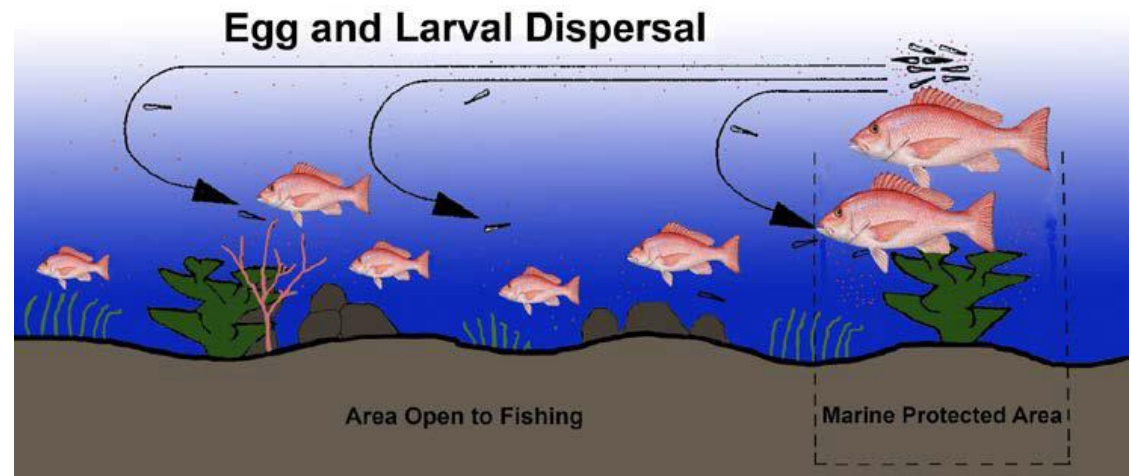
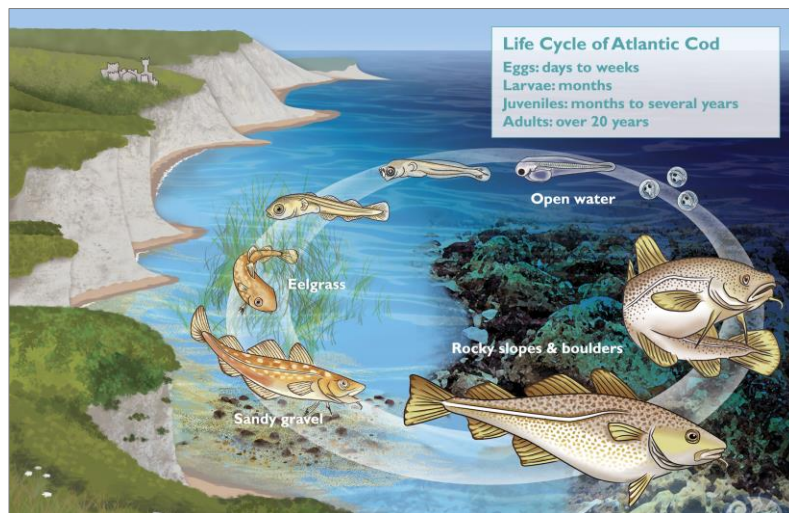
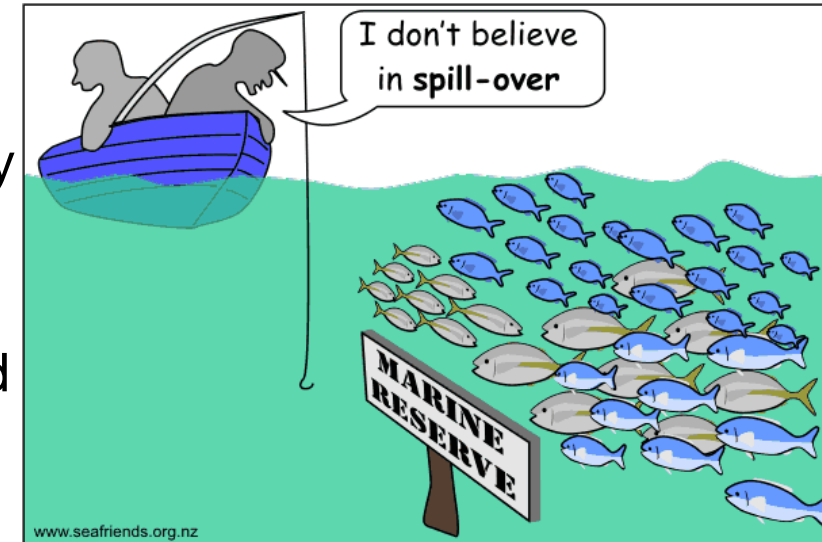
Ecological benefits of MPAs – Beyond MPA borders

Benefits beyond MPA borders

a) Spillover effect

Increases in the number and size of species may affect positively nearby un-protected areas through a the process of the **Spillover effect**.

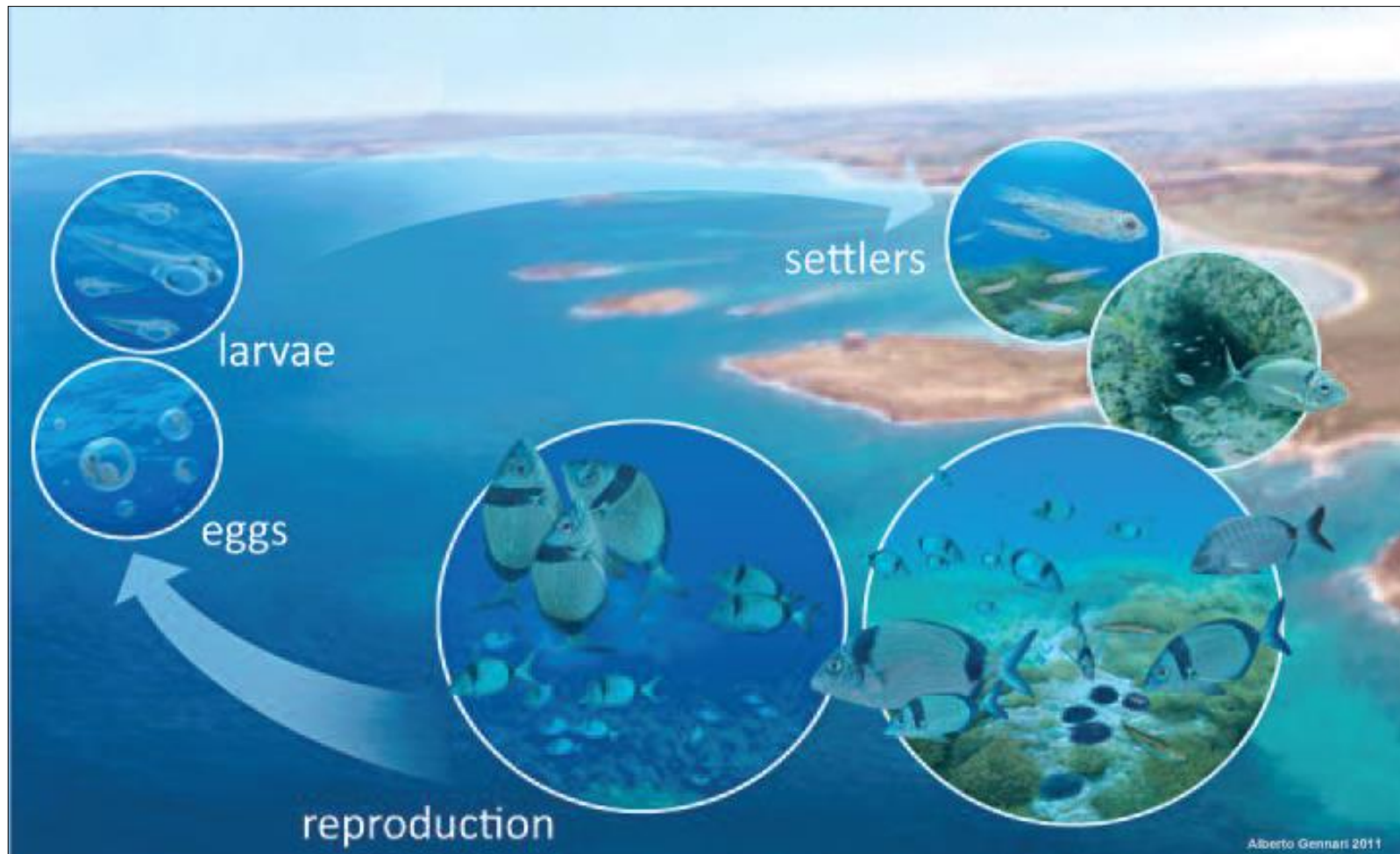
- ❑ As animals become more abundant in MPAs and resources become limited, some adults may move to other places to look for food and space to settle.
- ❑ As animals grow, they may need different types of habitats or food items.



Ecological benefits of MPAs – Beyond MPA borders

b) Dispersal of early stages

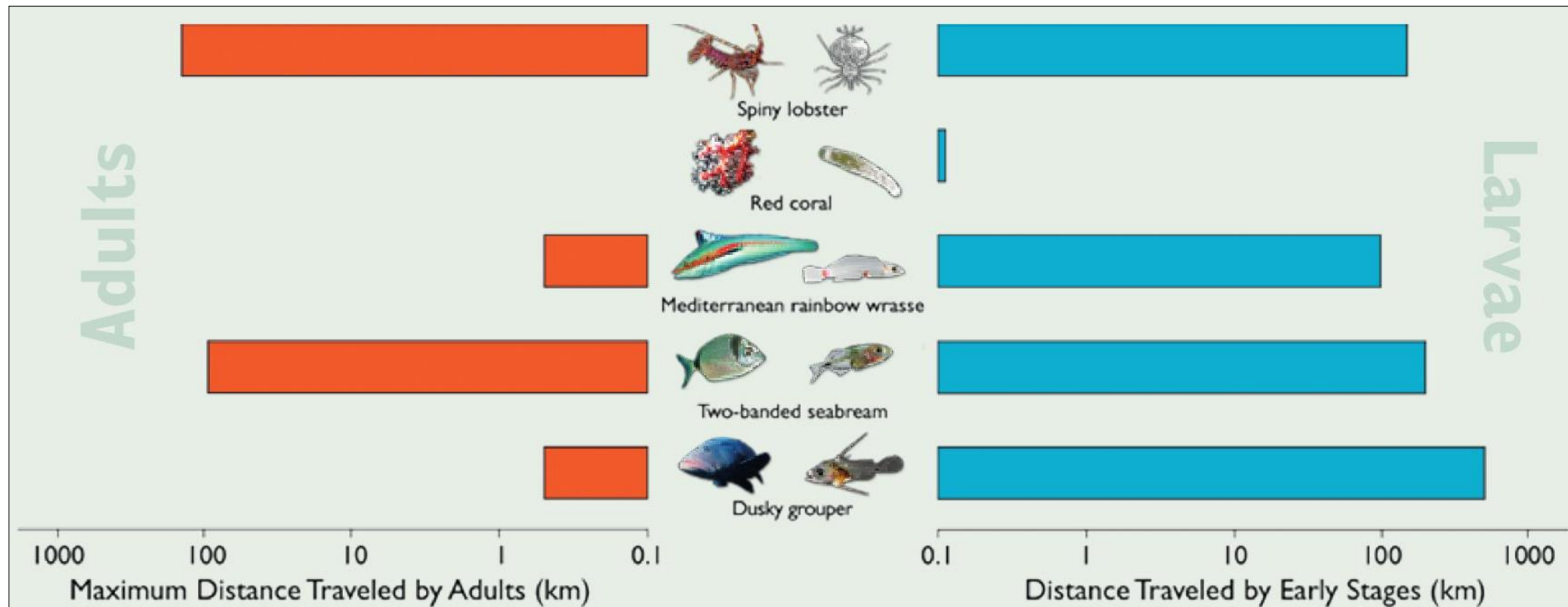
Fish & Invertebrates release a large number of eggs. After fertilization, eggs hatch into tiny larvae. Eggs and larvae can stay in the water for days or months traveling along with water currents. This process is called **dispersal**.



Ecological benefits of MPAs – Beyond MPA borders

b) Dispersal of early stages

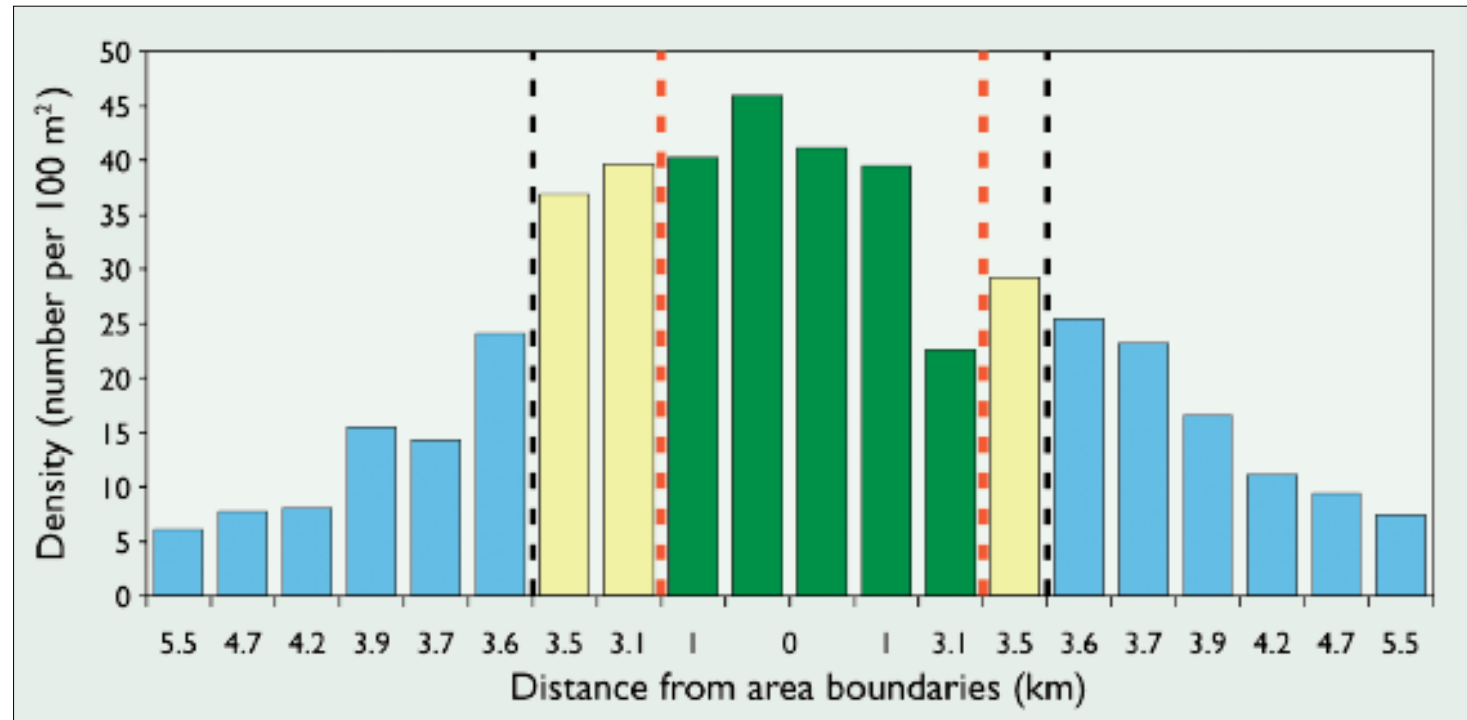
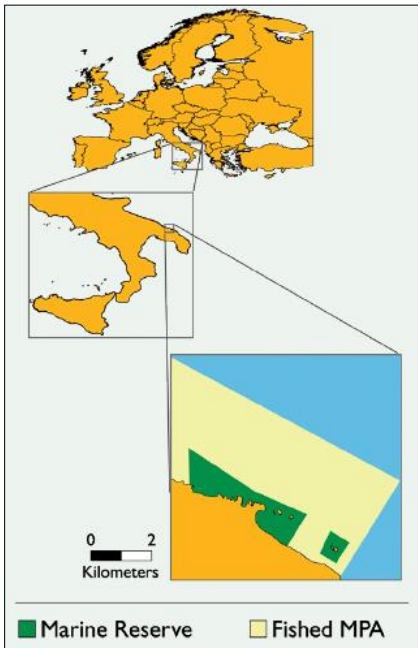
Dispersal distance in nature may range from **1 km** for macroalgae to **>100 km** for Fish (Kinlan & Gaines, 2003).



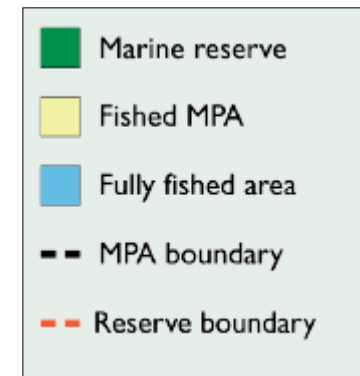
Ecological benefits of MPAs – Beyond MPA borders

Spillover & Dispersal

Torre Guaceto, MPA, Italy



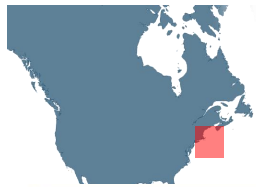
Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) 2017.
The Science of Marine Reserves (3rd Edition, Europe). 22 pages.



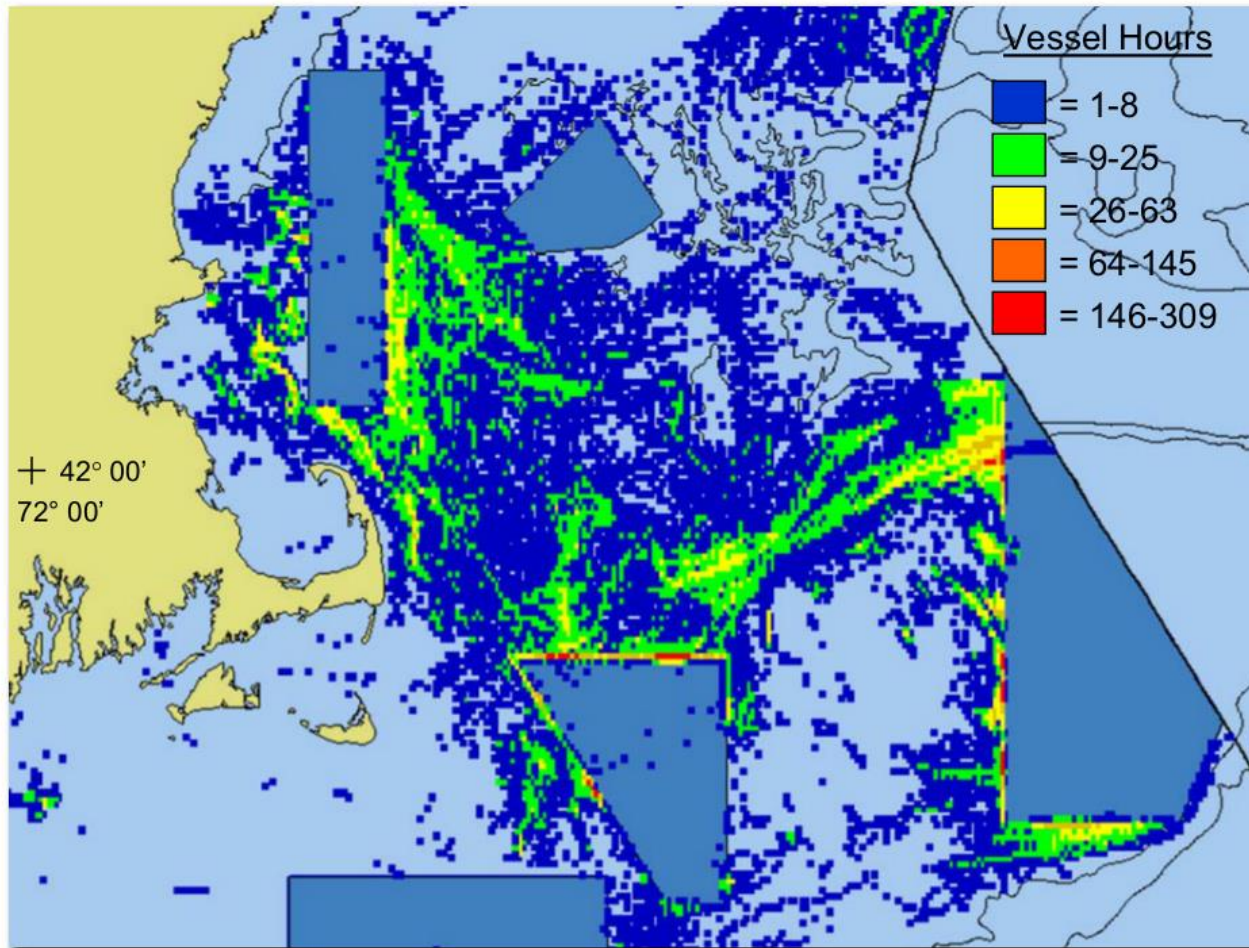
Ecological benefits of MPAs – Beyond MPA borders

Spillover & Dispersal is hard to assess.

Evidence comes from the “**fishing the line**” phenomenon



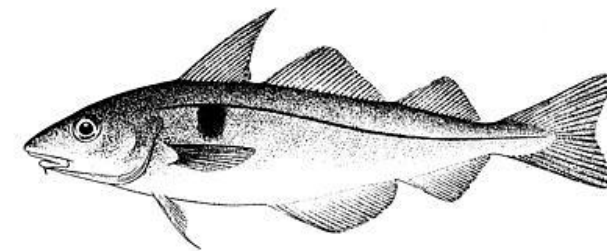
... back to George's bank



Between 2001-03:

42% of haddock catches were within 0.6 nm of closed areas

73% within 3.1 nm



NOAA Fisheries

Ecological benefits of MPAs

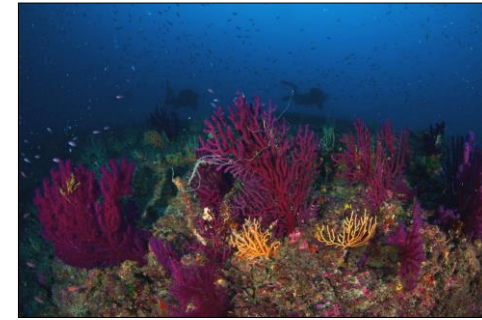
How long does it take to see a response?

Some changes happen fast, but other processes may be slow.

This is why it takes many years before the full effects of MPAs are evident.

The time of the response is influenced by the following factors:

- The level of MPA protection, compliance and enforcement.
- The availability of breeding adults.
- Growth rate of different species.
- The age of sexual maturity of different species.
- The number of youngs produced.
- The availability of suitable habitats for juveniles.
- Level of mobility / dispersal ability during each life stage.
- Interactions among species (e.g. predators and prey).
- Human impacts prior to MPA establishment (how big is the damage).
- Ongoing impacts from climate change and regional pollution.
- The habitat's and species ability to recover after an impact.





Ecological benefits of MPAs



Thank you for your protection!

The Science of Marine Reserves, PISCO:

- ✓ video: www.piscoweb.org/publications/outreach-materials/film/science-of-marine-reserves-video
- ✓ booklet: www.piscoweb.org/publications/outreach-materials/science-of-marine-reserves/smr-booklet-versions