



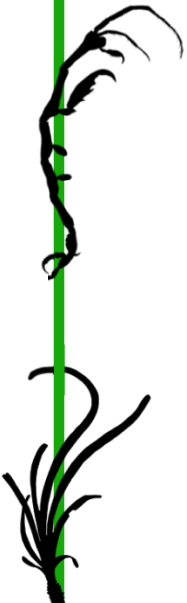
# Untangling natural variability of macrofaunal populations from protection effects

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<sup>2</sup> Marine Protected Area  
Tavolara-Punta Coda Cavallo

Amsterdam 9 Oct 2015





Decline of fish stocks



Loss of biodiversity



Degradation of habitats

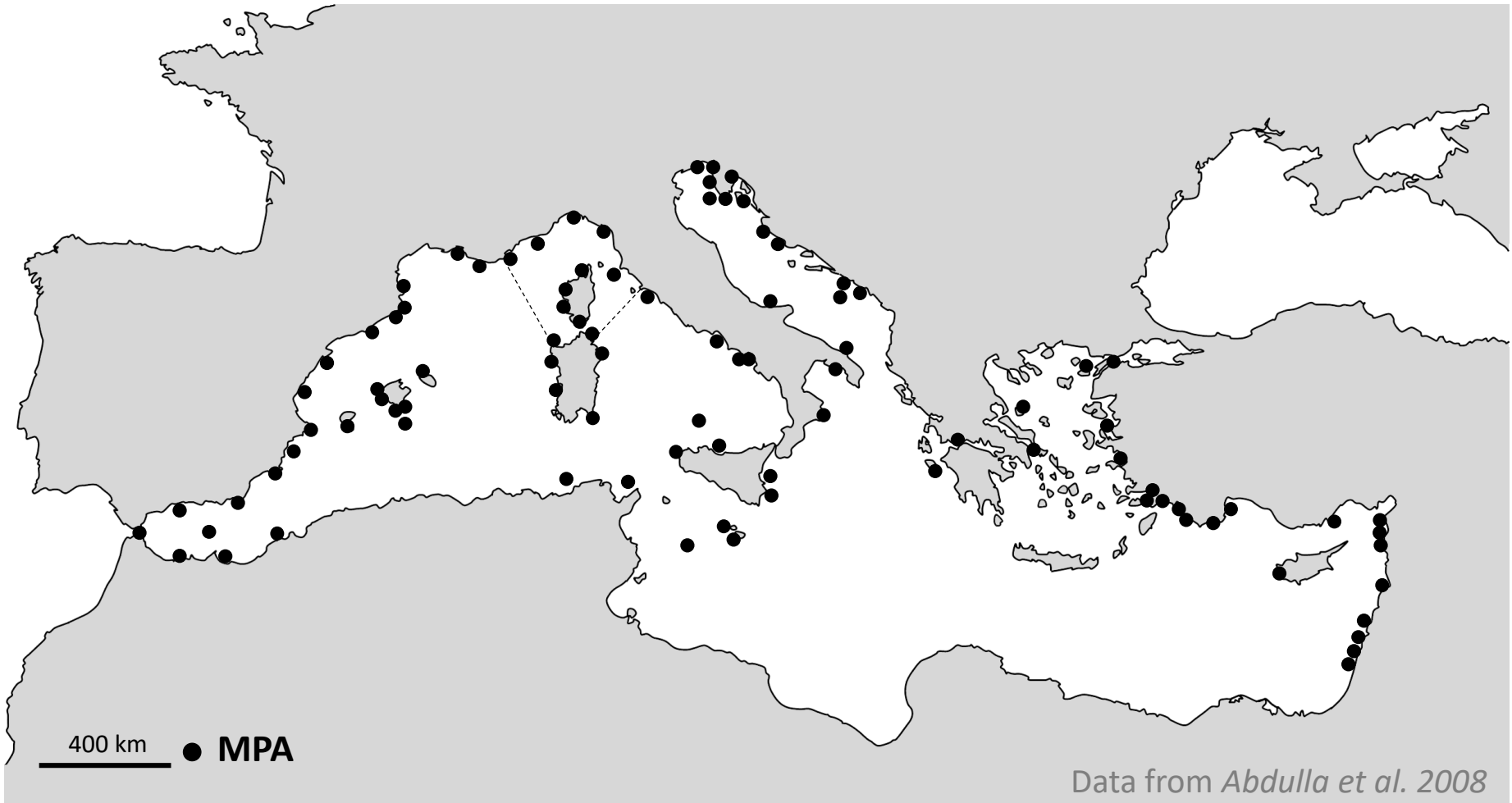


## Marine protected areas (MPAs)

*« Areas in which human activities that cause habitat alteration or focus on population exploitation are eliminated or greatly reduced »*

# In the Mediterranean Sea,

more than 94 MPAs in 2008 and 170 MPAs in 2012

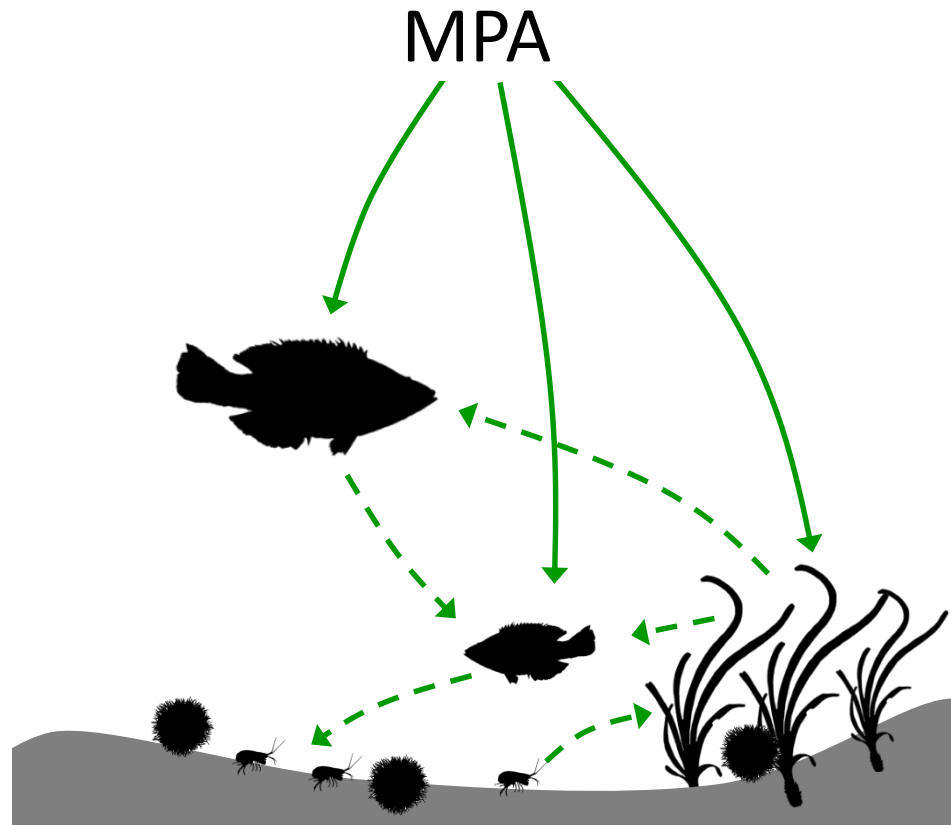


# Marine protected areas (MPAs)

## Multiple objectives

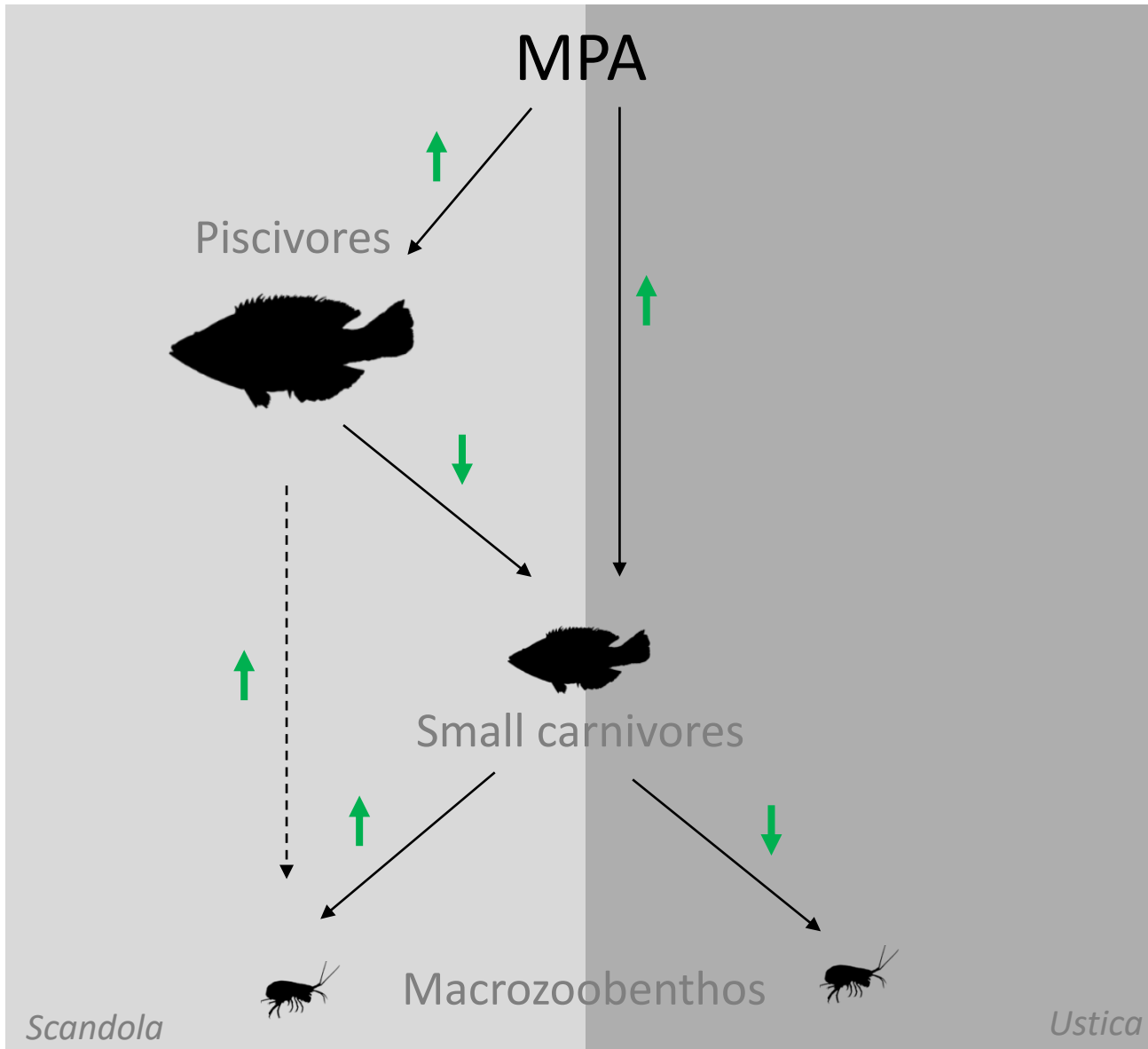
- Conservation of biodiversity & fisheries management
- Restoration of altered areas or overexploited
- Increase knowledge...

# Numerous potential ecological effects



Little research on species of the vagile macrofauna

# Results...two possible models

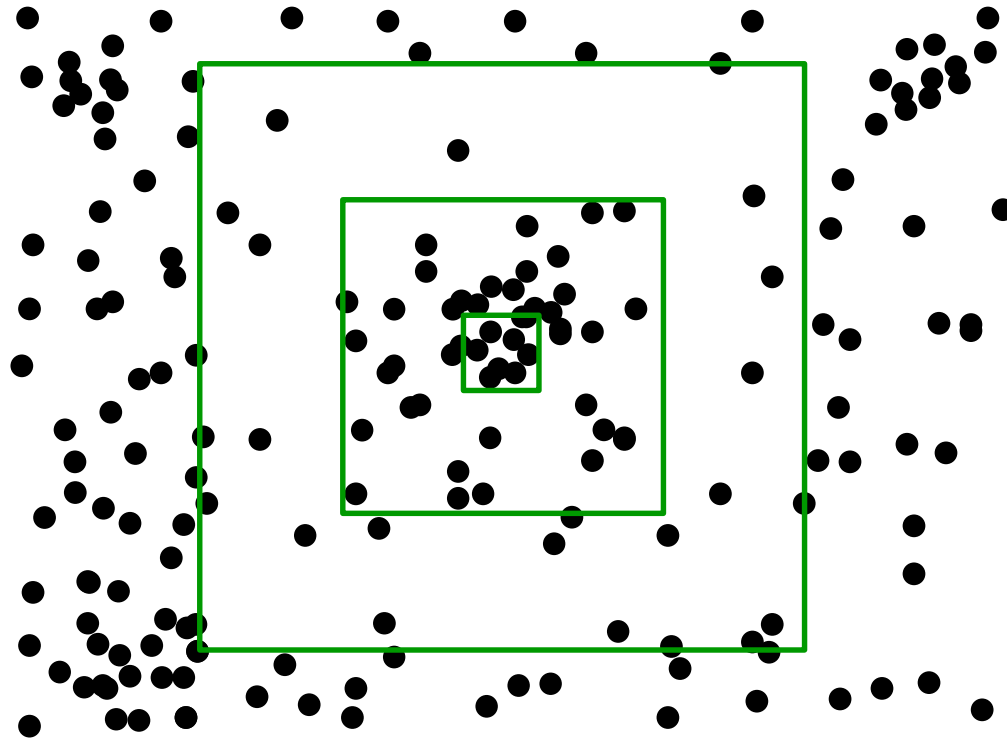


# Precaution... limited sampling designs

Protection effects vs natural variability



# Precaution... limited sampling designs



The perception of features of an assemblage depend on the scale of observation

# The seagrass *Posidonia oceanica*

Endemic to the Mediterranean Sea

Capable to cover large areas



Shelter high biomass & biodiversity of vagile invertebrates

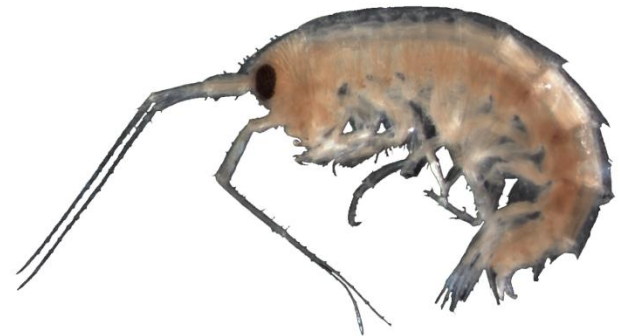
Molluscs



Polychaetes



Crustaceans




# General objective

Assess the potential responses of two groups, with different life histories, in *P. oceanica* meadows, to different protection levels.

- Examine spatial variability patterns of the populations
- Identify scales that contribute most to spatial variation
- Explore relationships between populations and habitat

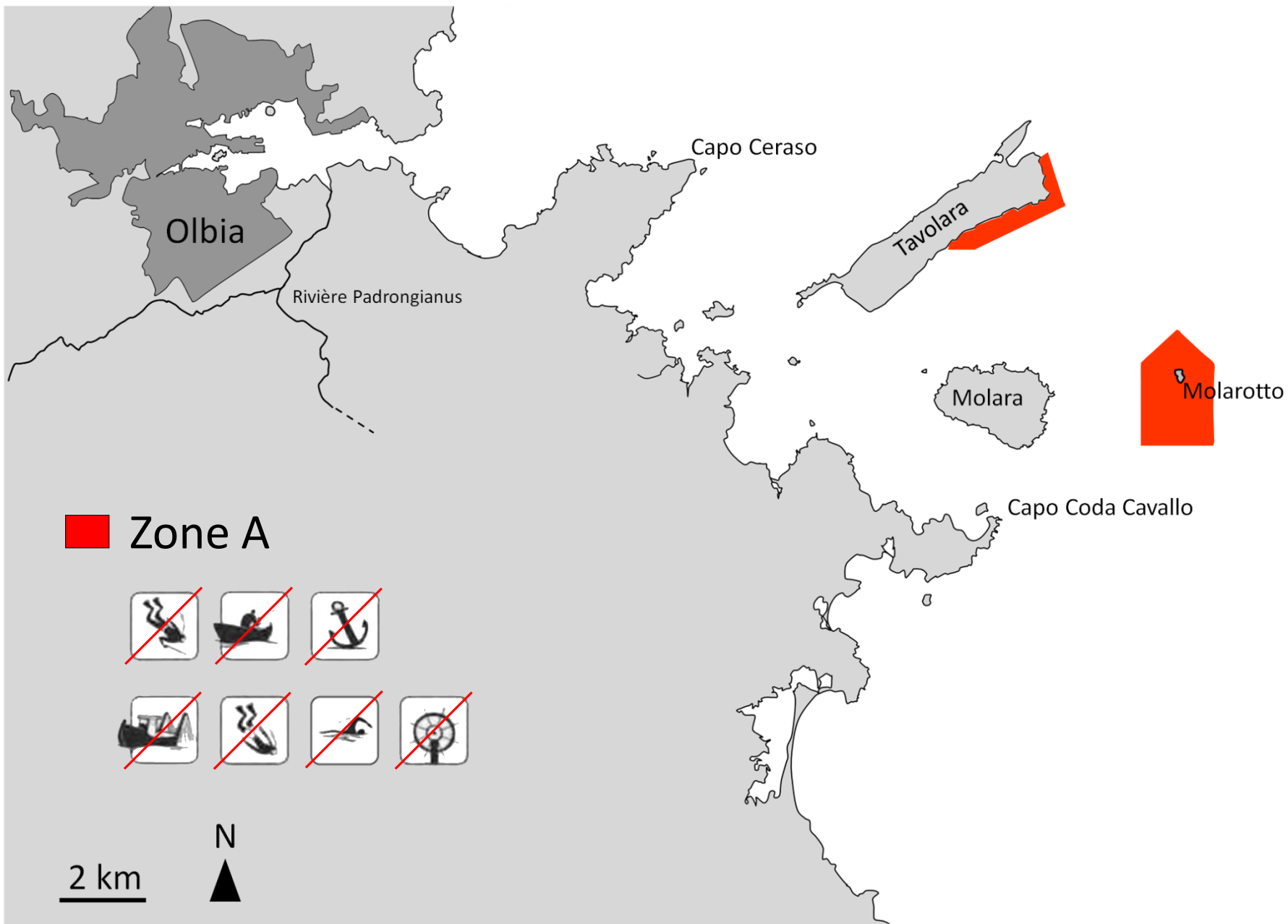


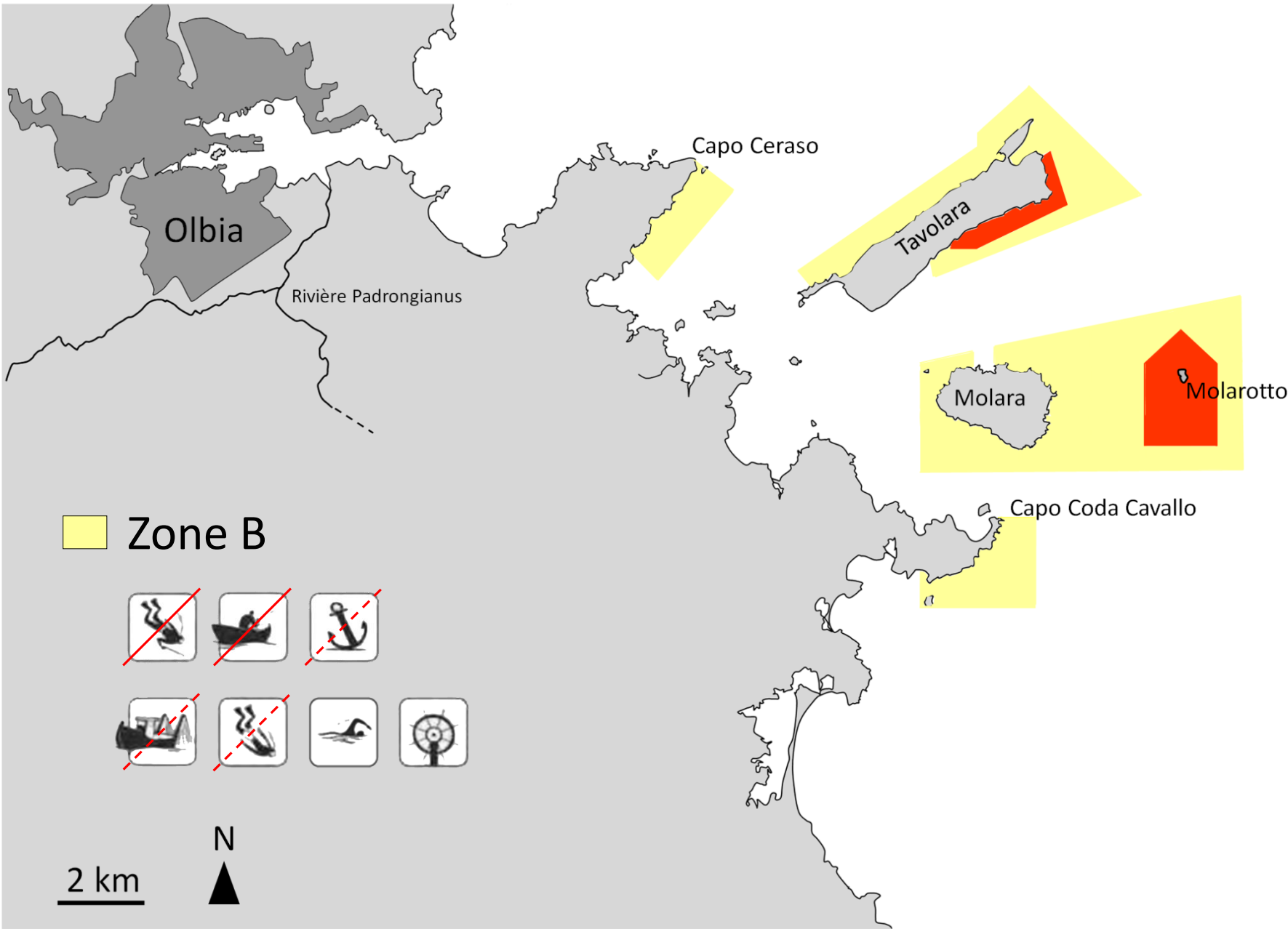
 Tavolara MPA

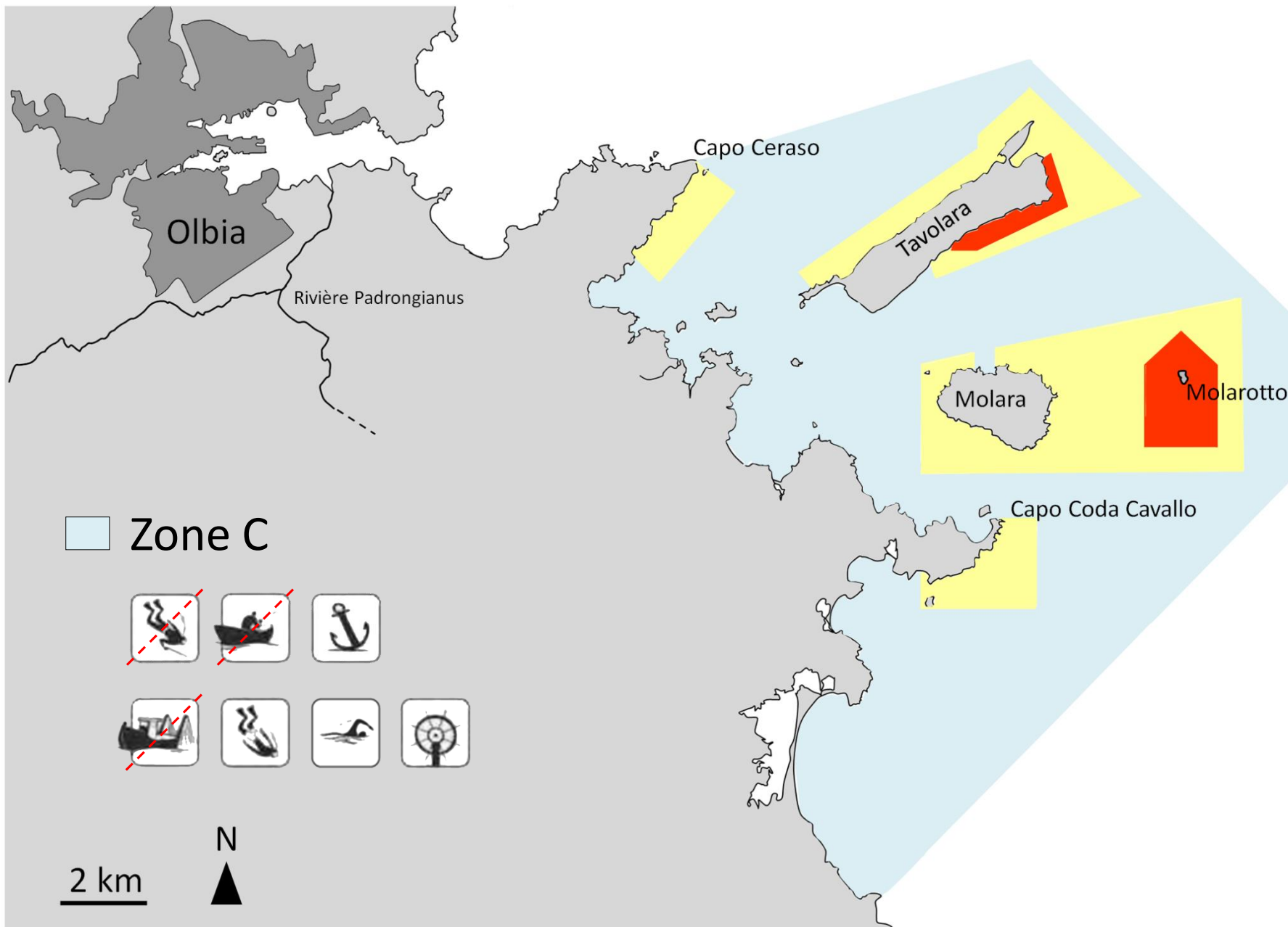
# Tavolara-Punta Coda Cavallo Marine Protected Area

- Creation 1997
- Effective protection 2003-04
- 3 protection zones

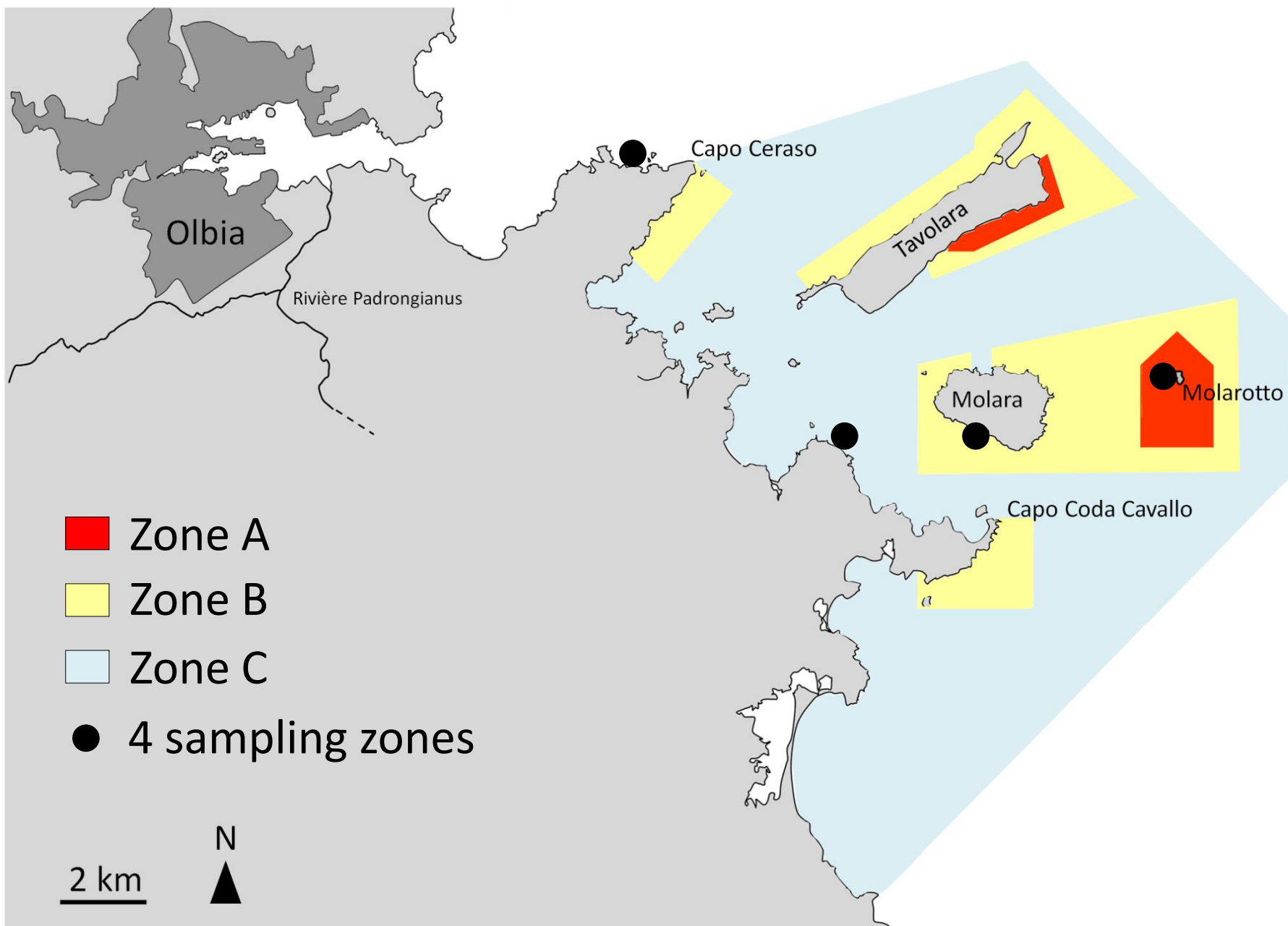












# Spatial hierarchical sampling design

Region

Sardinia

Zones  
(~ >1000 m)

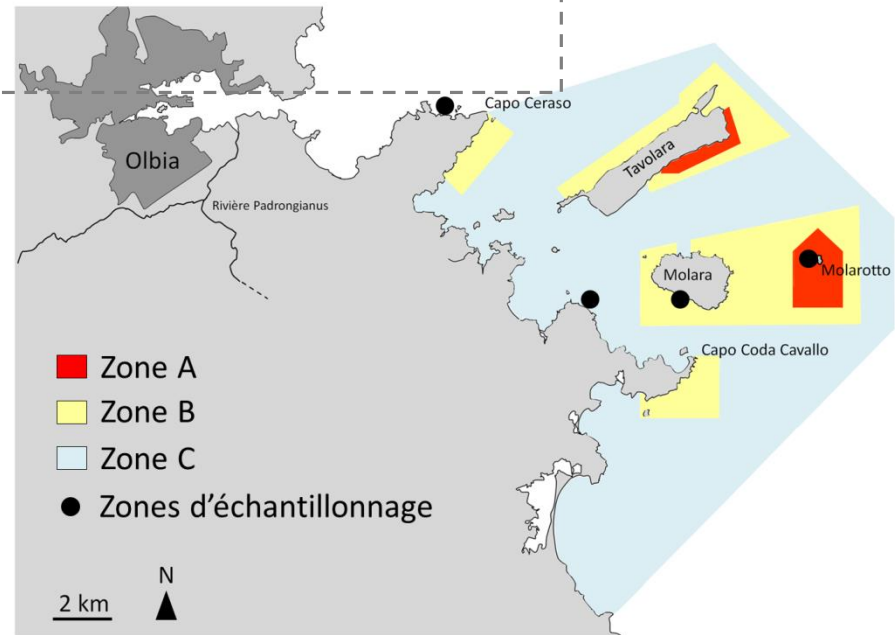
ZA

ZB

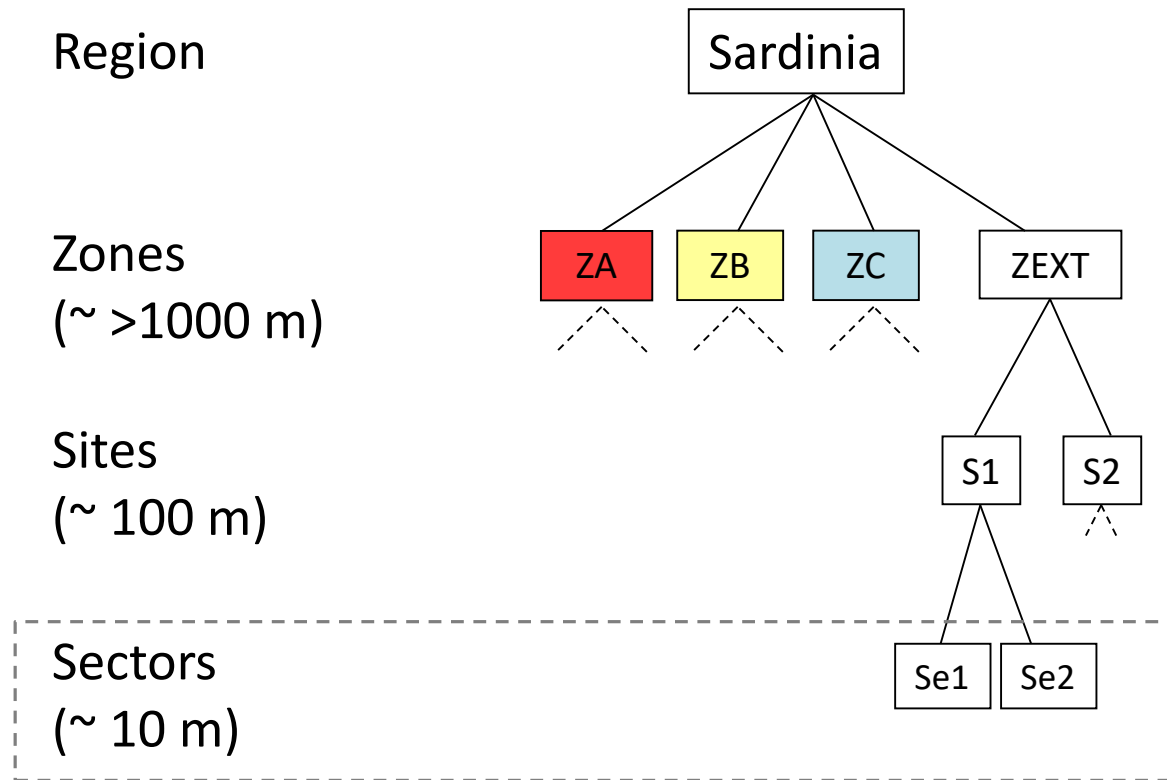
ZC

ZEXT

Sites  
(~ 100 m)



# Spatial hierarchical sampling design

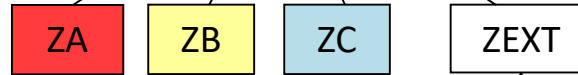


# Spatial hierarchical sampling design

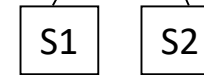
Region

Sardinia

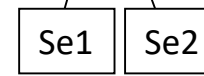
Zones  
(~ >1000 m)



Sites  
(~ 100 m)



Sectors  
(~ 10 m)



Replicates  
(~ 1 m)

X	X
X	X
X	X
X	X

July-August  
2007 & 2008

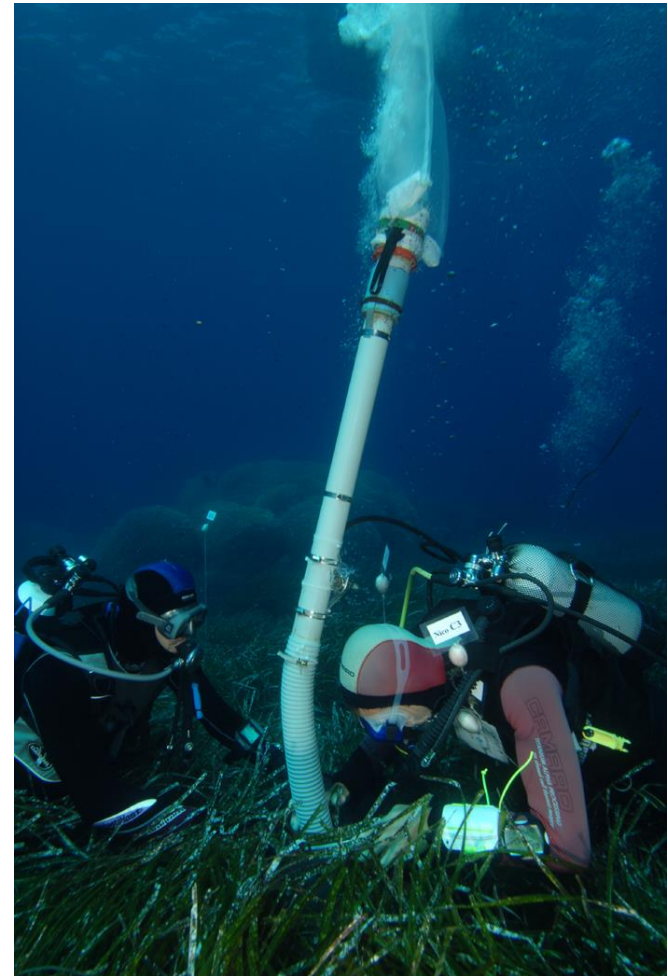
n = 112

# The air-lift to collect the vagile macrofauna

Delimitation of 0.185 m<sup>2</sup>

Minimize the escape of organisms

Sampling between 10 and 15m  
& between 10am and 3pm



## Results & Discussion

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# General features of macrofaunal populations



Abundance

> 4510

> 790

Richness

51 species

25 species

25 families

16 families

2 mm

*Apherusa chiereghinii*



*Phtisica marina*



*Aora spinicornis*



*Bittium reticulatum*



*Jujubinus gravinae*



*Rissoa variabilis*



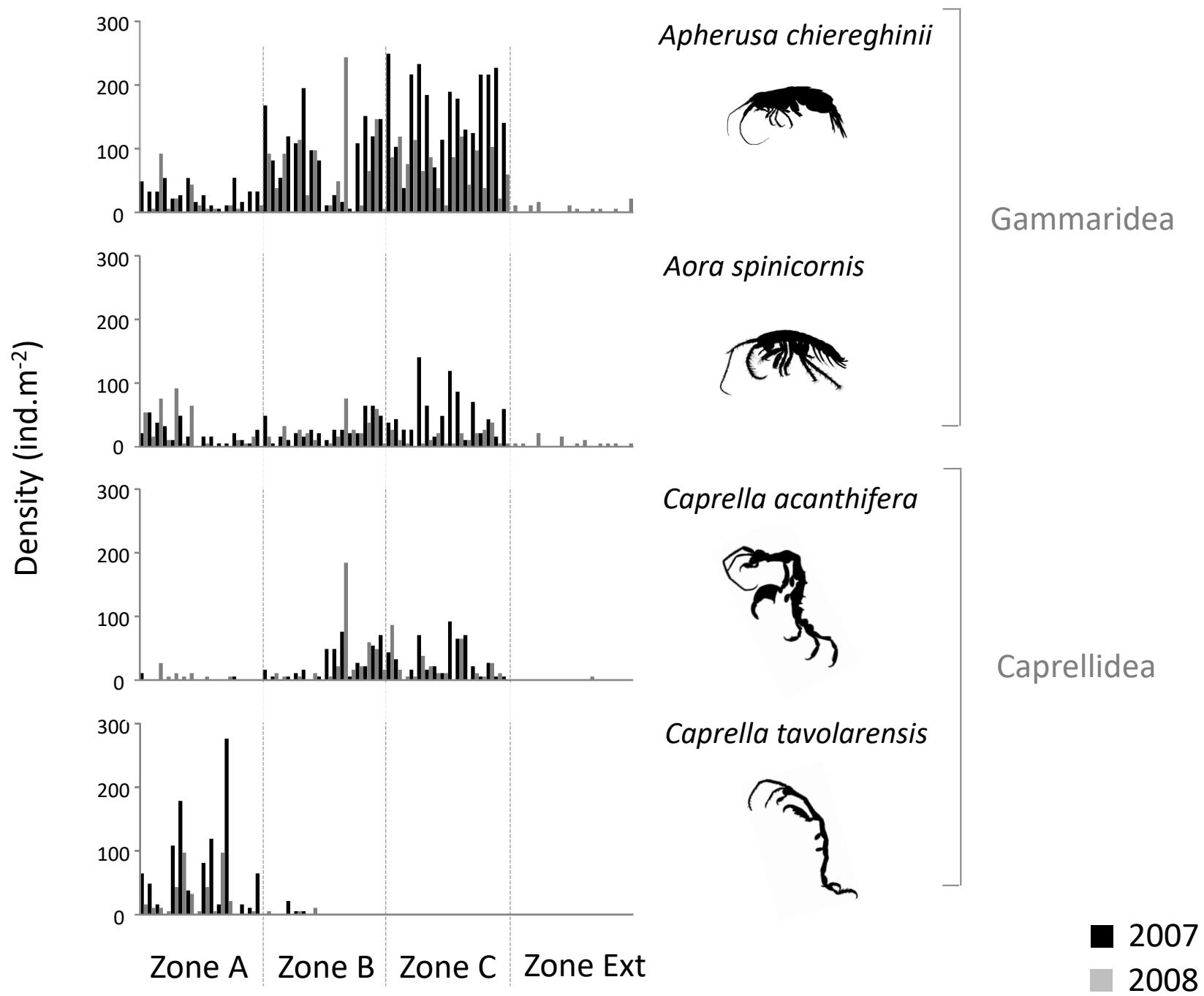
# Density of frequent species (>10%)

	Zone > 1000m	Site ~100m	Sector ~10m
<b>Gammaridea</b>			
<i>Apolochus neapolitanus</i>			
<i>Ampithoe helleri</i>			
<i>Aora spinicornis</i>			
<i>Apherusa chiereghinii</i>			
<i>Dexamine spiniventris</i>			
<i>Erichthonius punctatus</i>			
<i>Iphimedia minuta</i>			
<i>Liljeborgia dellavallei</i>			
<i>Orchomene humilis</i>			
<i>Peltocoxa marioni</i>			
<b>Caprellidea</b>			
<i>Caprella acanthifera</i>			
<i>Caprella sp. (armata-group)</i>			
<i>Caprella tavolarensis</i>			
<i>Phtisica marina</i>			
<i>Pseudoprotella phasma</i>			



Zone A < Zones B et/ou C  
except for *C. tavolarensis*

■ Significant differences



# Density of frequent species

	Zone > 1000m	Site ~100m	Sector ~10m
<b>Gastropods</b>			
<i>Bittium reticulatum</i>			
<i>Jujubinus gravinae</i>			
<i>Pusillina sp.</i>			
<i>Rissoa variabilis</i>			

High variability at the scale of one meter



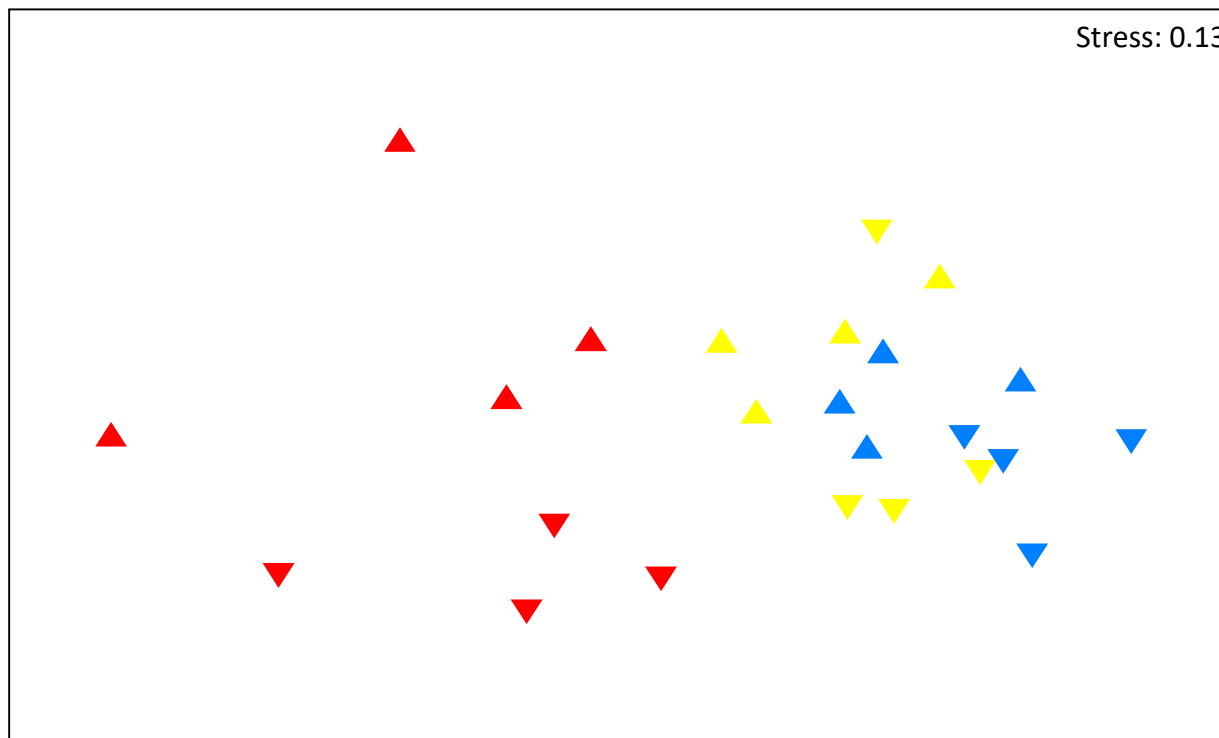
Zone A = Zone B = Zone C

■ Significant differences

# The structure of assemblages



	Zone A	Zone B	Zone C
2008	▲	▲	▲
2007	▼	▼	▼

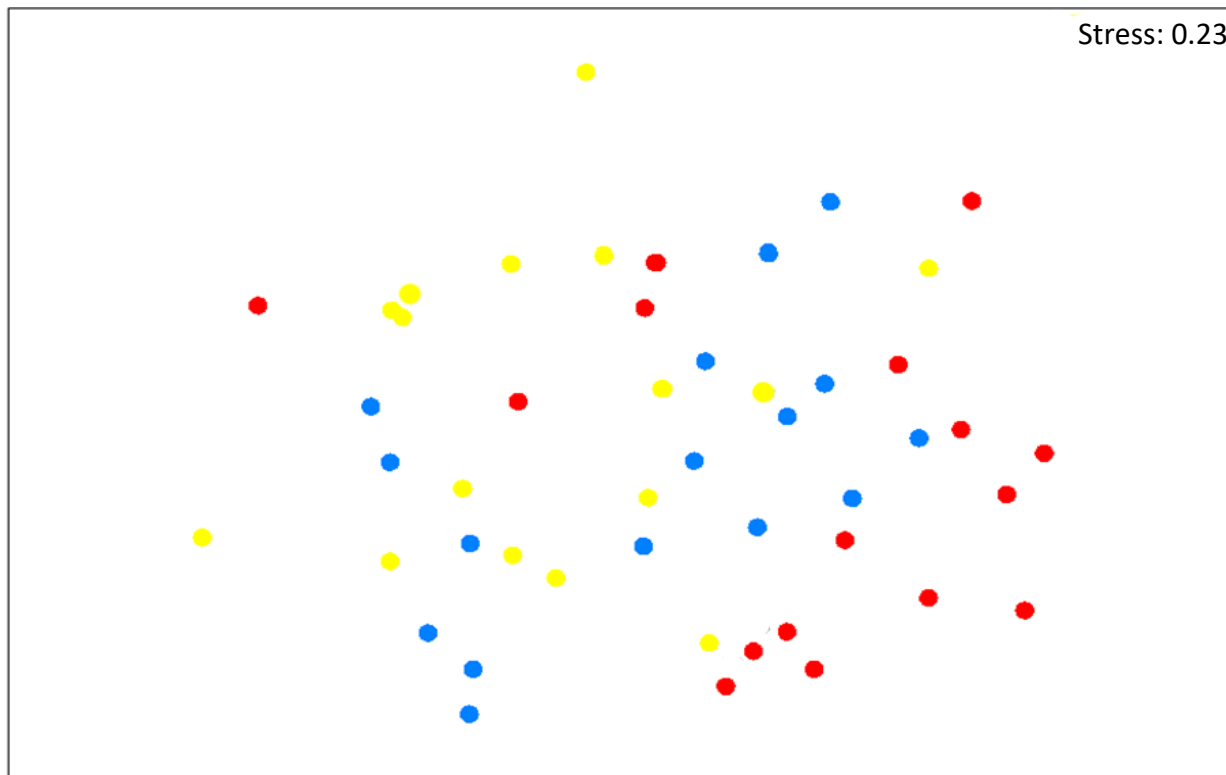


Effects of the zone, site, sector & year on the structure of amphipod assemblages

# The structure of assemblages



Zone A   Zone B   Zone C  
2007   ●   ●   ●



No effects of the zone, site and sector

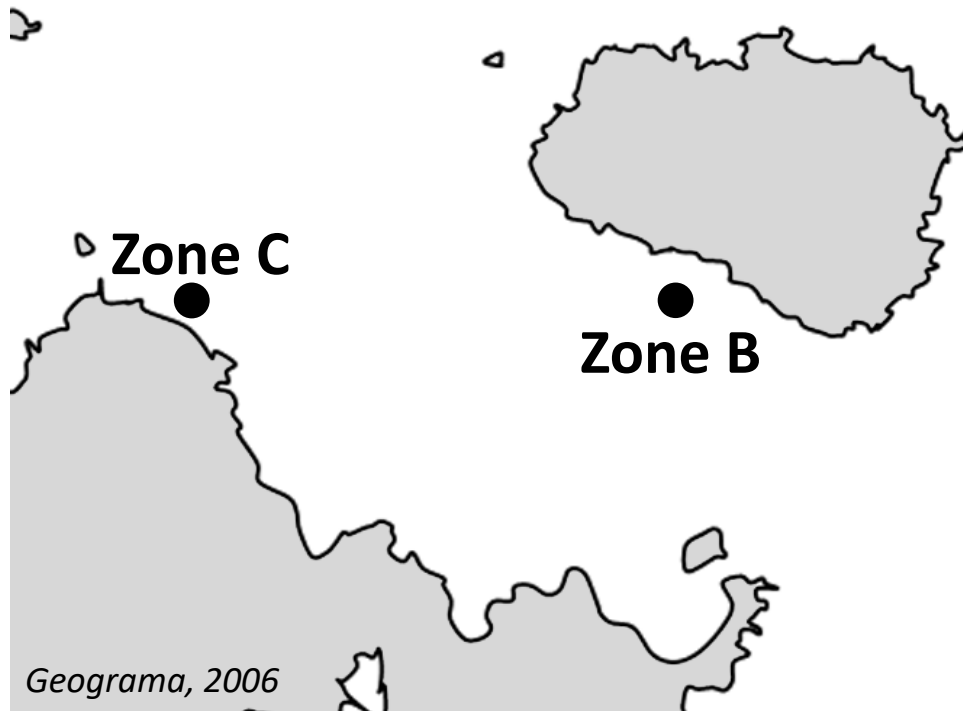
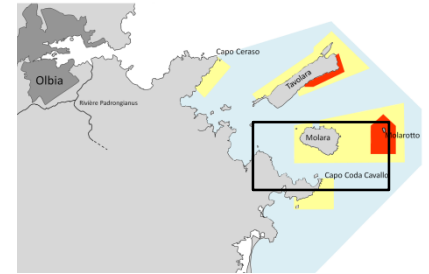
In brief...

**The difference among zones** is observed for the density of certain species and the structure of amphipod assemblages, not for mollusc assemblages

**Densities are generally lower in zone A** at the specific level

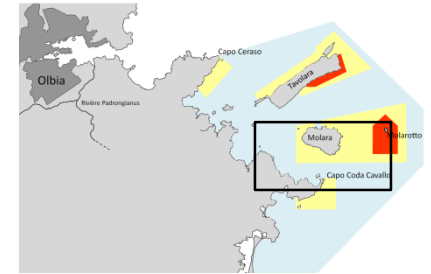
# Factors that could explain a part of these patterns...

- Remote geographic localisation and isolate meadows



# Factors that could explain a part of these patterns...

- Remote geographic localisation and isolate meadows



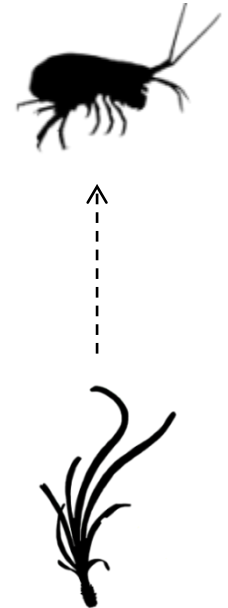


# Factors that could explain a part of these patterns...

- Habitat features

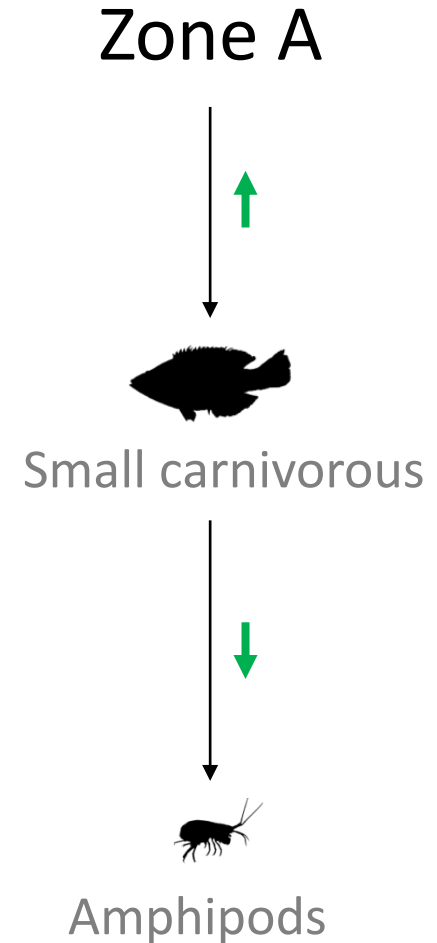
Density, biomass of leaves, epiphyte and litter are similar between zones.

The habitat explain 0-15% of the abundance variation.



# Factors that could explain a part of these patterns...

- Predation rate of fishes



# Conclusions

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- Patterns of responses to protection are different between the two groups with different life histories
- Research on the amphipod assemblage for detecting the potential effects of MPAs seems to be a stronger indicator
- Highlights the difficulties in properly assessing protection effects versus natural variability

Reasons for the patterns are multiple: ecological & behavioural traits of species to protection-dependent processes (fish predation)

# Acknowledgments



# **For more info...**

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**Or see main reference:**

**Sturaro N, Lepoint G, Pérez-Perera A, Vermeulen S, Panzalis P, Navone A, Gobert S (2014) Seagrass amphipod assemblages in a Mediterranean marine protected area: a multiscale approach. Marine Ecology Progress Series 506: 175–192**