Scienze per l'Ambiente Marino e Costiero

a.a. 2023-2024

GESTIONE E CONSERVAZIONE ECOSISTEMI MARINI - IMPATTI ANTROPICI E CONSERVAZIONE DELLA FAUNA MARINA

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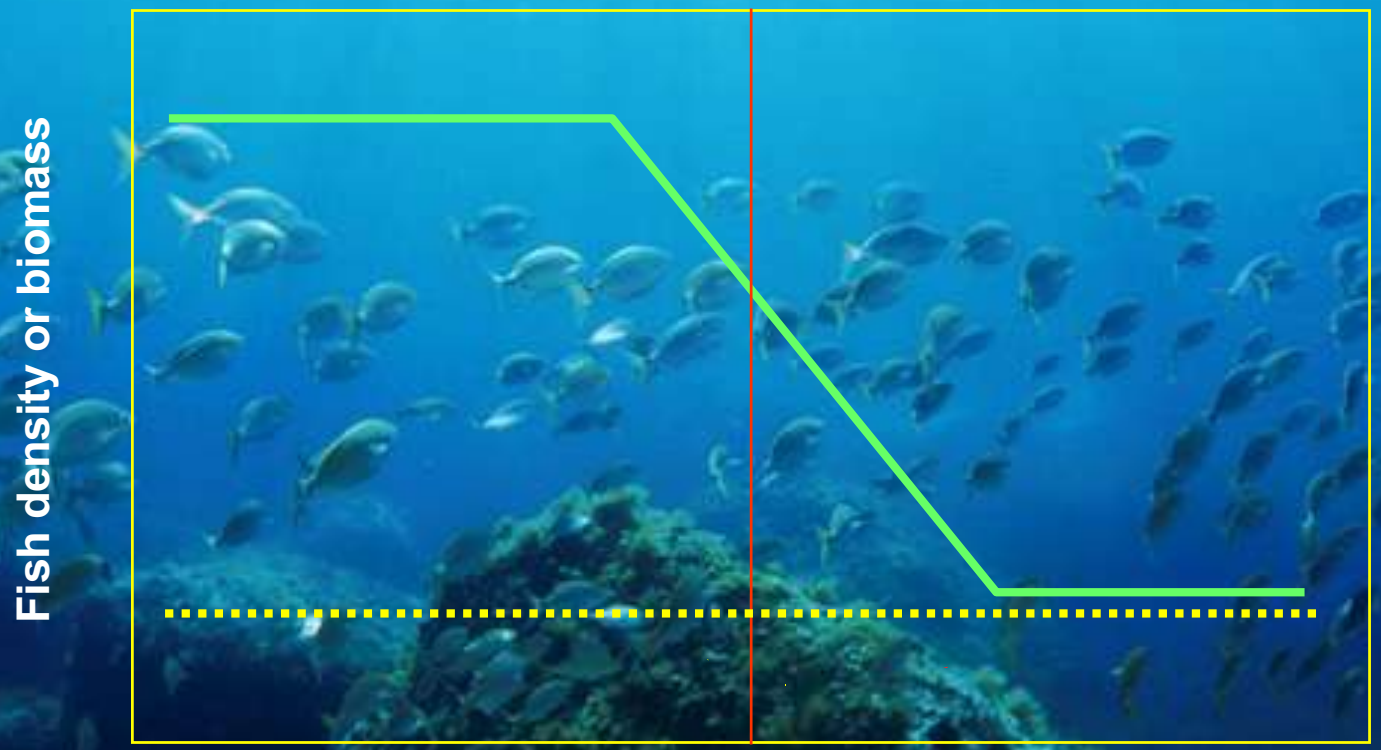
Effects of protection

Sheltering

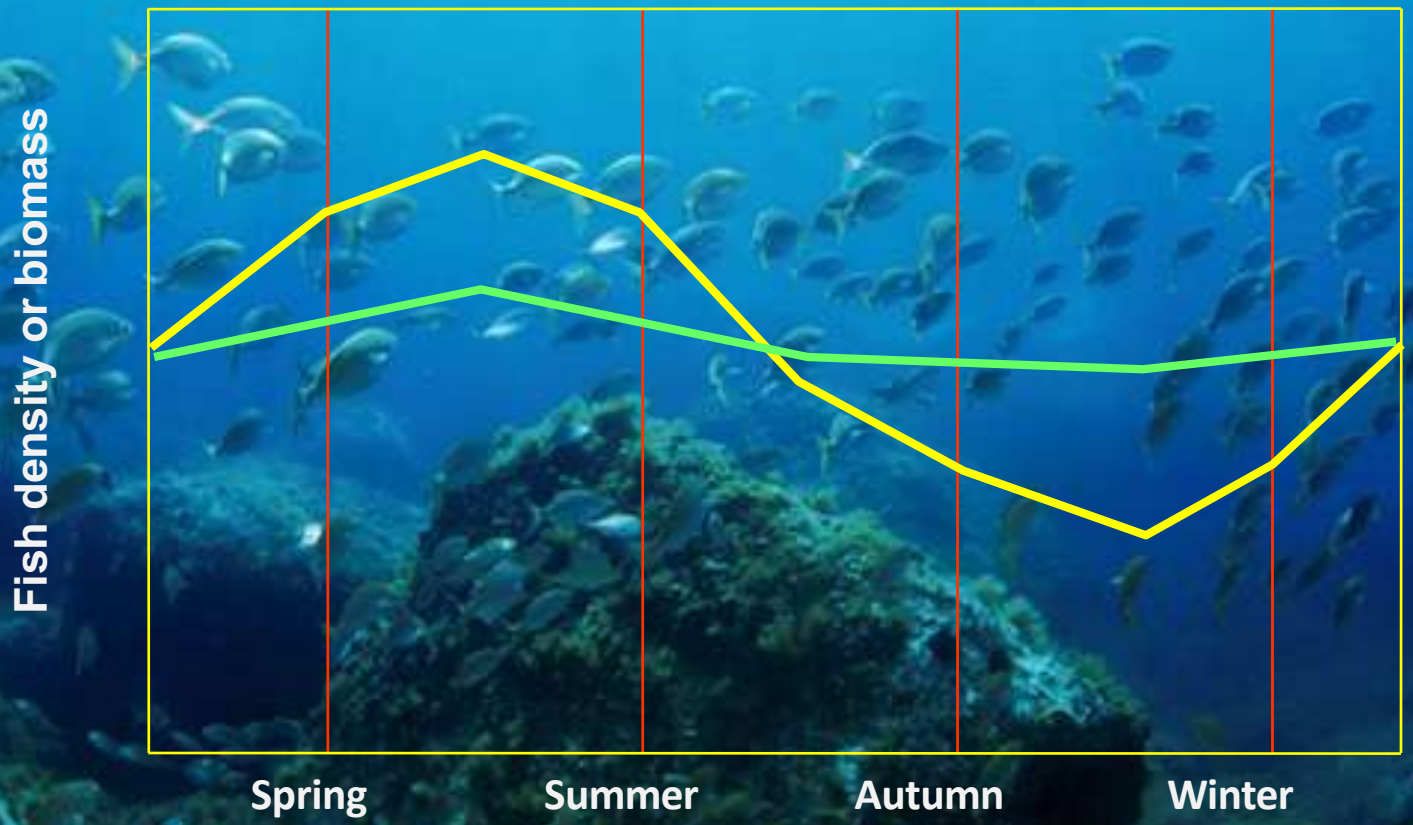
This occurs when one or more target species increase their abundance, size or biomass within the protected areas with respect to fished areas.



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)

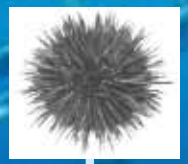


Cascading effects

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.

Diplodus spp.

(+)



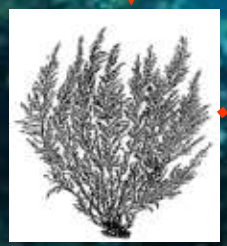
Paracentrotus lividus

(+)

(+)

Phytal fauna

(-)



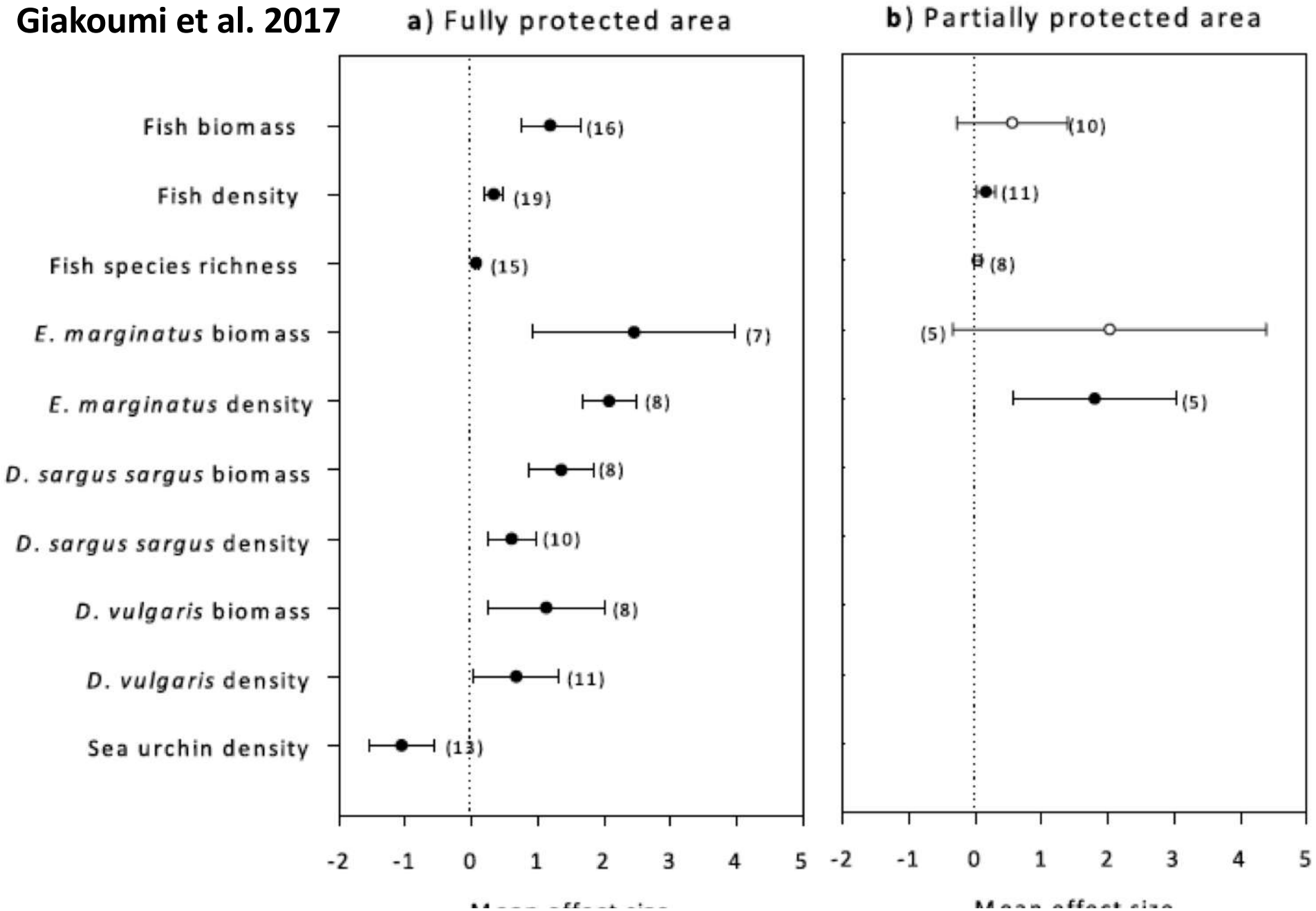
Fleshy erect algae

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

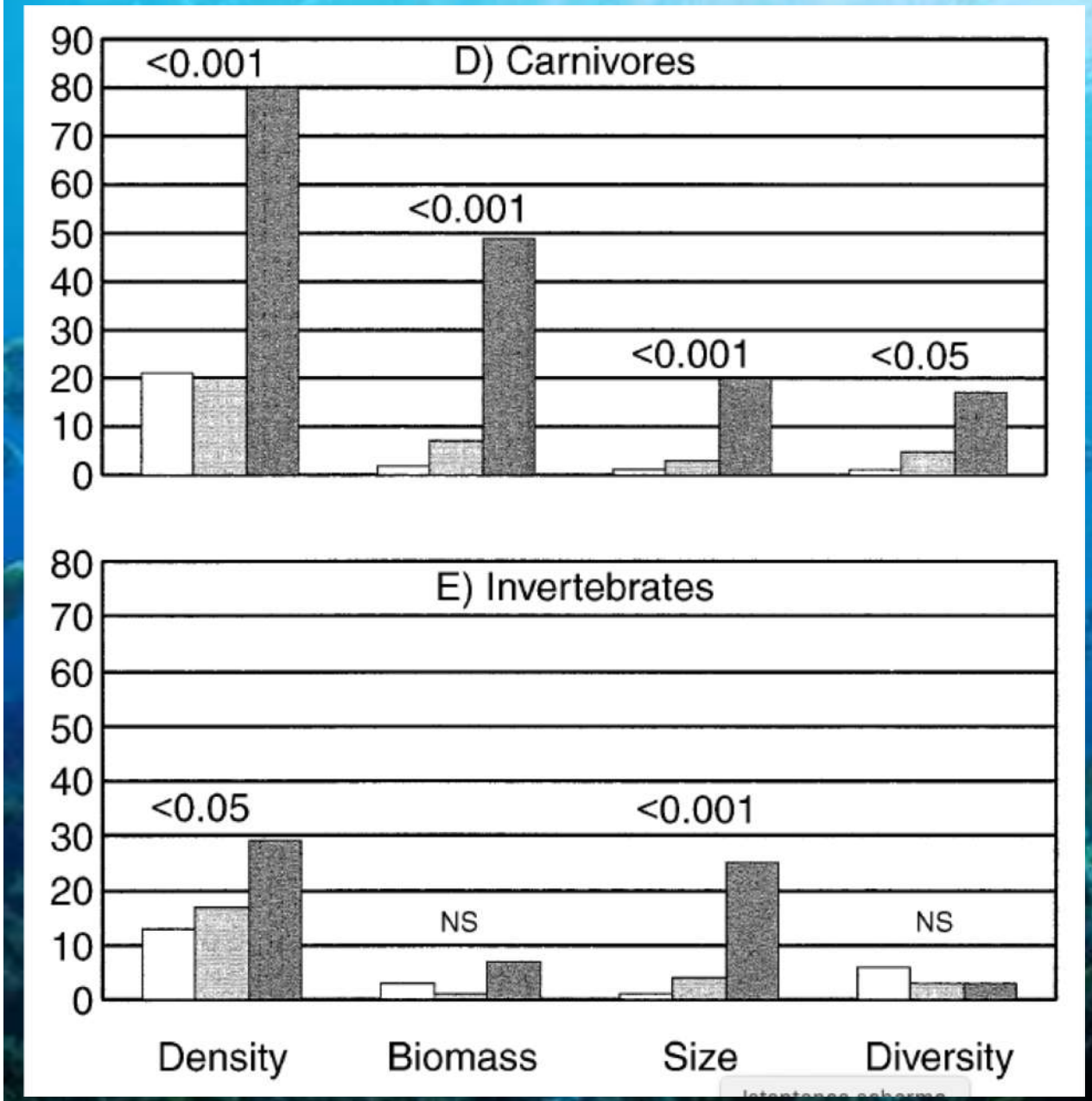
Sala et al., 1998
Guidetti, 2006

Effects on fish fauna

Giakoumi et al. 2017

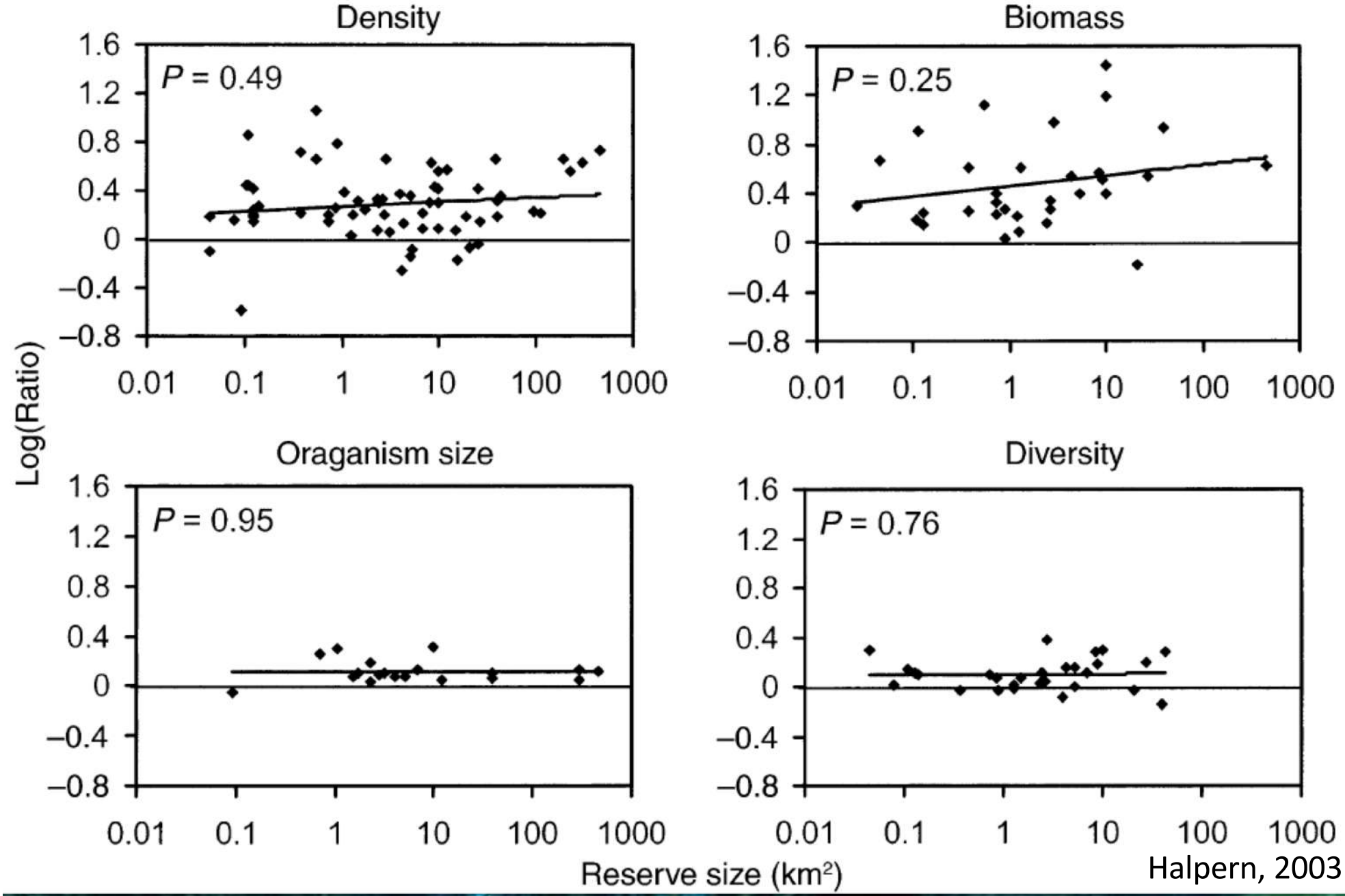


Comparing effects between fish and invertebrates



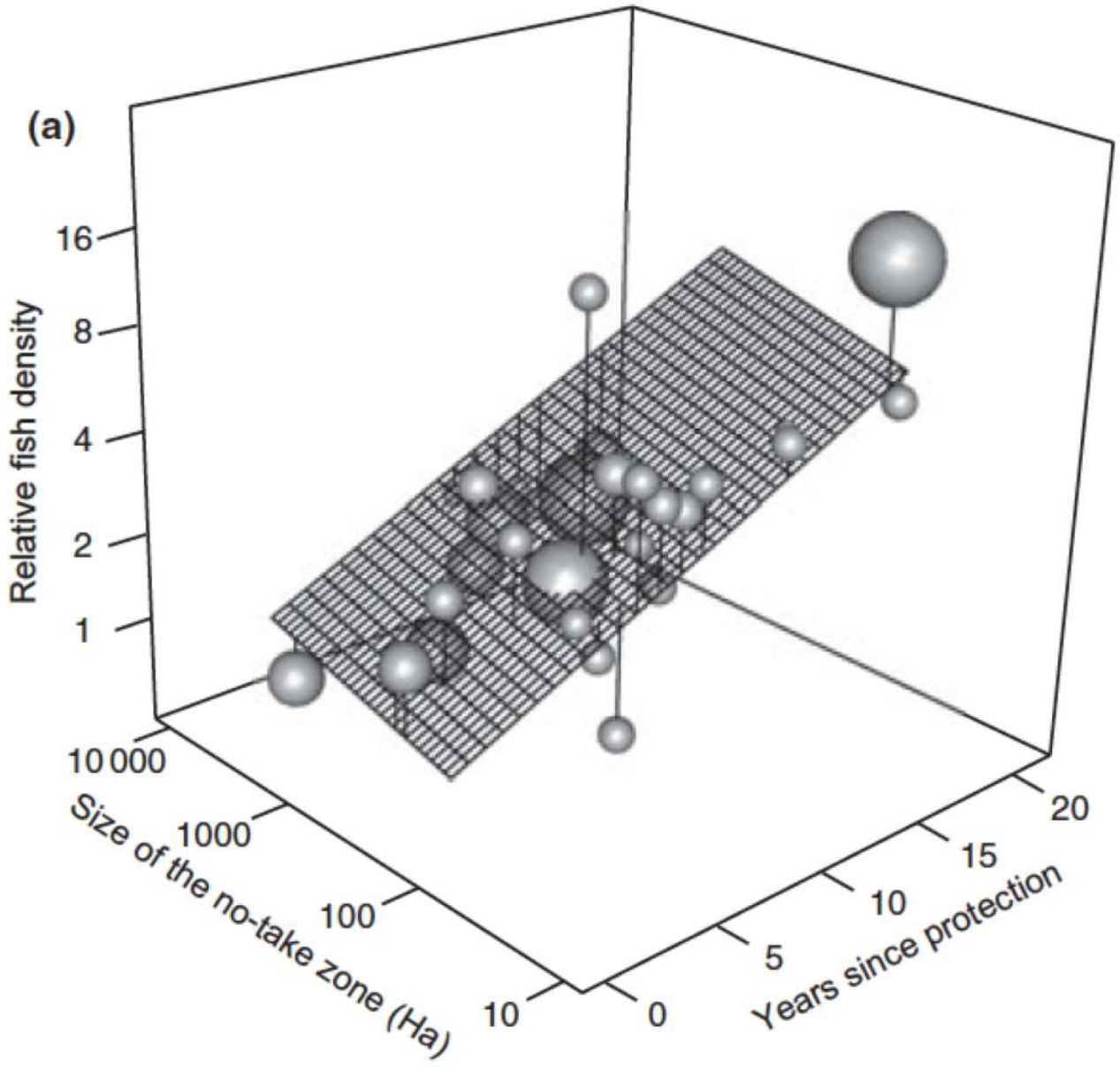
Halpern, 2003
89 MPAs.
Density, size, biomass and diversity of fish fauna were signifcantly higher within than outside the reserve. Benthic invertebrates, however, showed significant difference only for density and size

Relationship with reserve size



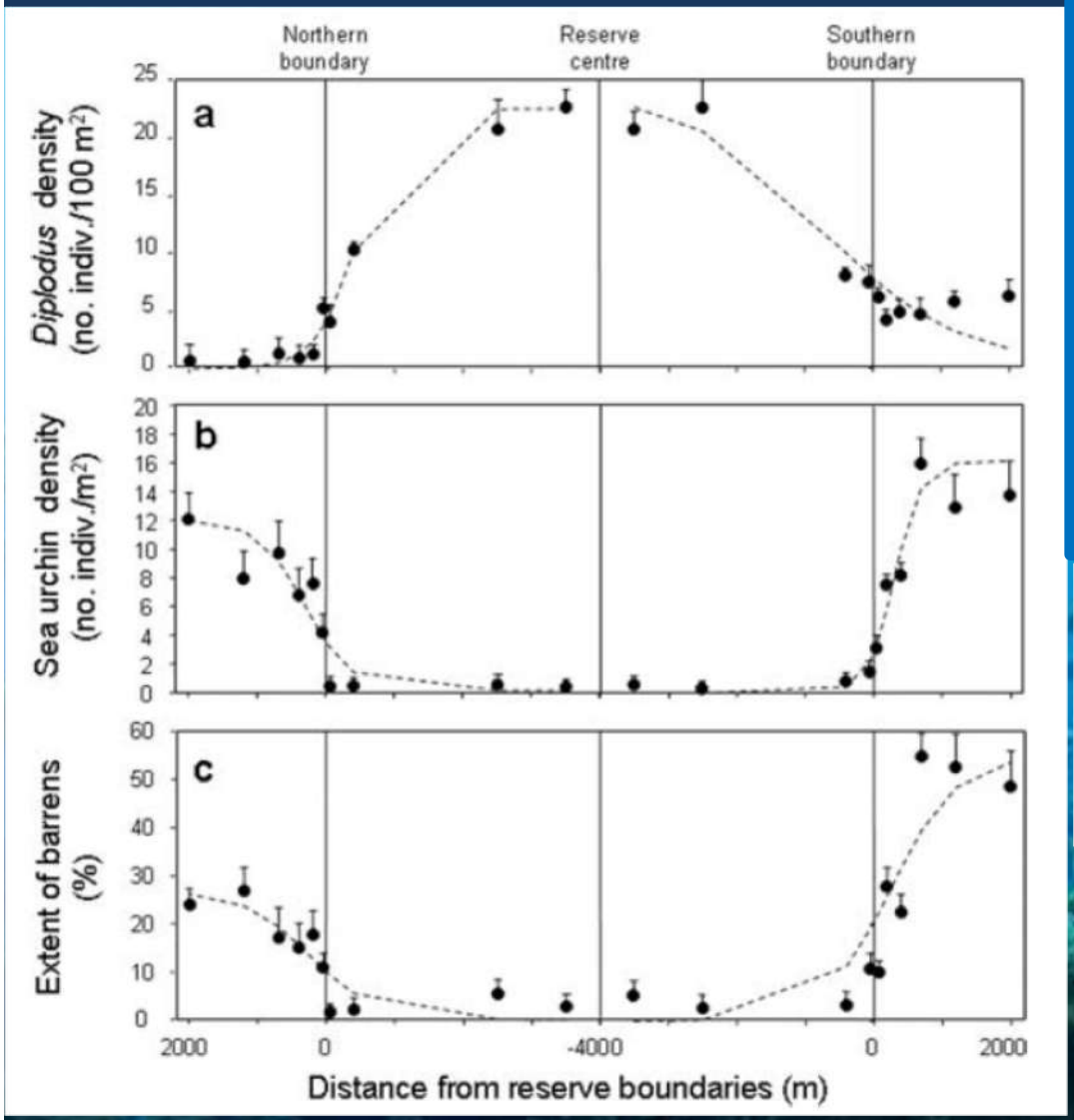
Halpern, 2003

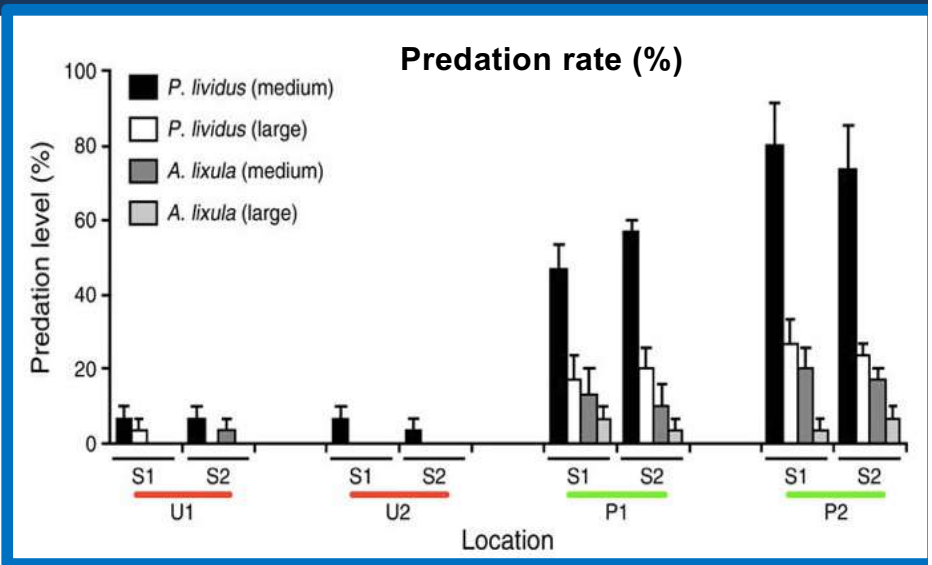
Size again…



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)

Trophic cascades



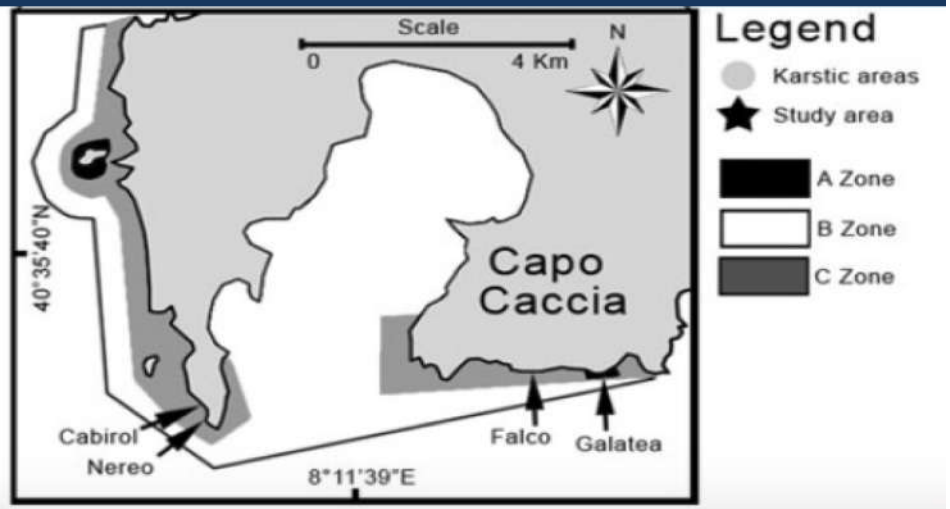


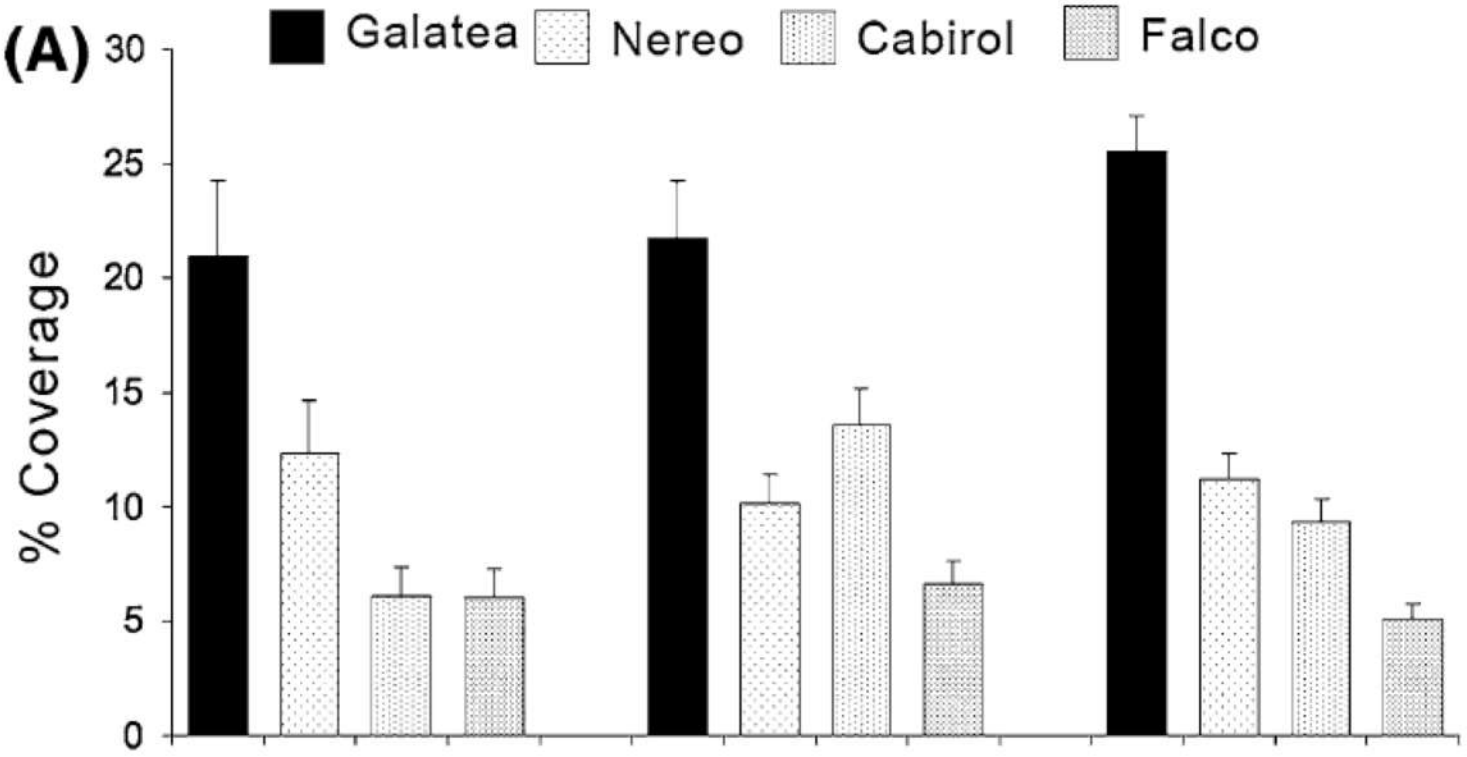
Guidetti, 2006. Ecol Appl

Predation rates within reserves can be much more intense than outside

Increase of sea urchin predators due to protection reflects in decrease of sea urchins population within reserve boundaries, and the ensuing decrease of overgrazed substrates (Guidetti et al. 2008)

Effects on fragile organisms





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

MPAs and resilience: a manipulative experiment

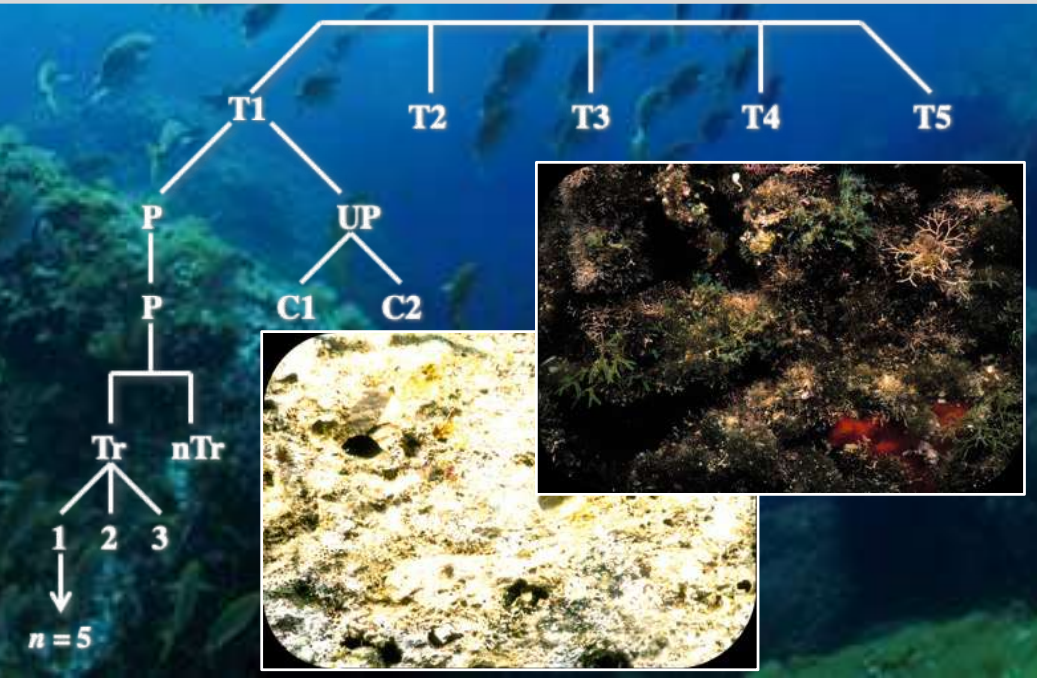
Date mussel (*Lithophaga lithophaga*) fishery

Banned in 1998 in Italy and in 2006 in EU
Caused the destruction of tens of km^2 or rocky bottoms in the Mediterranean, and especially in Italy, Croatia, Albania, Greece
Fishermen destroy the rocky surface, and everything living on the substrate, to reach the endolithic bivalve for collection
Still practiced, although illegal; costs of date mussels on the black market can range between 60-80 euros per Kg

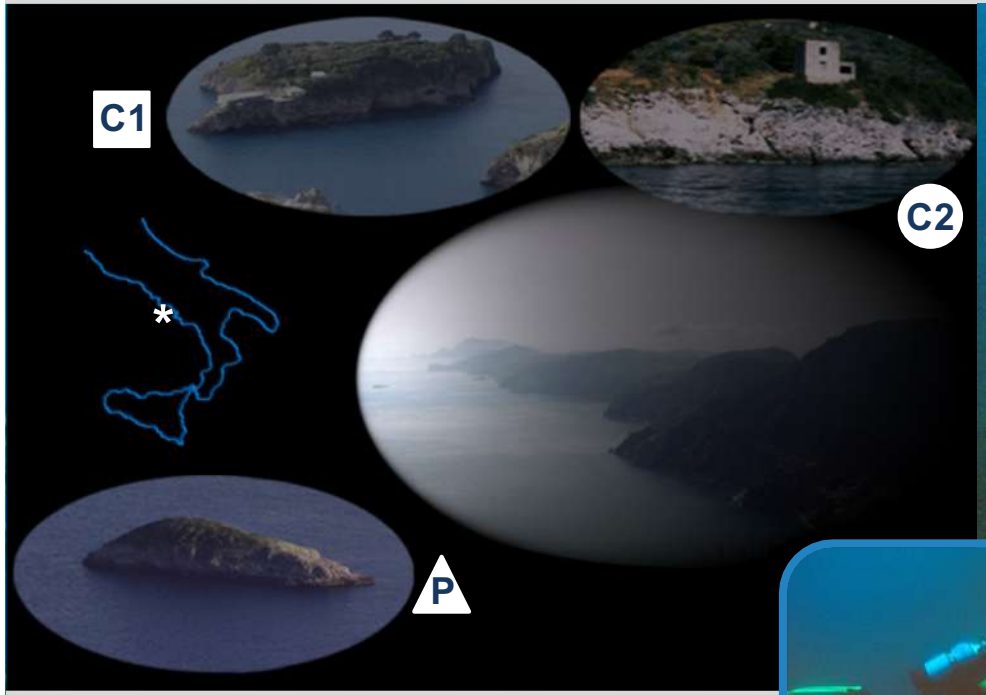
Full protection →
Unprotected →
Simulating disturbance

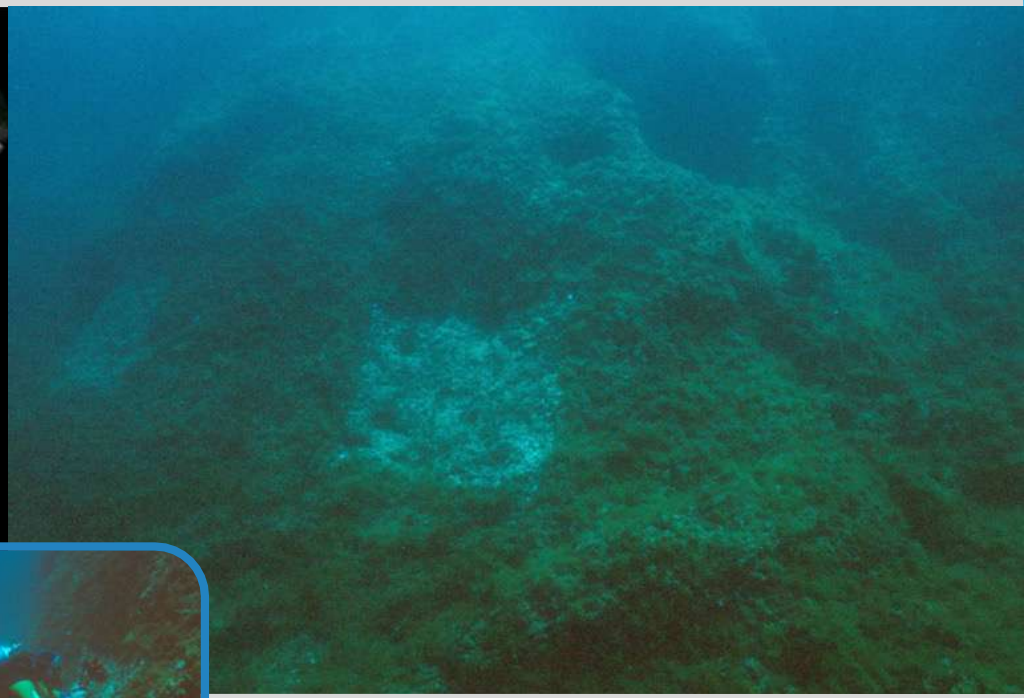
Comparing trends in recovery

H_0: no difference in recovery between the no-take zone and controls



Temporal patterns of recovery



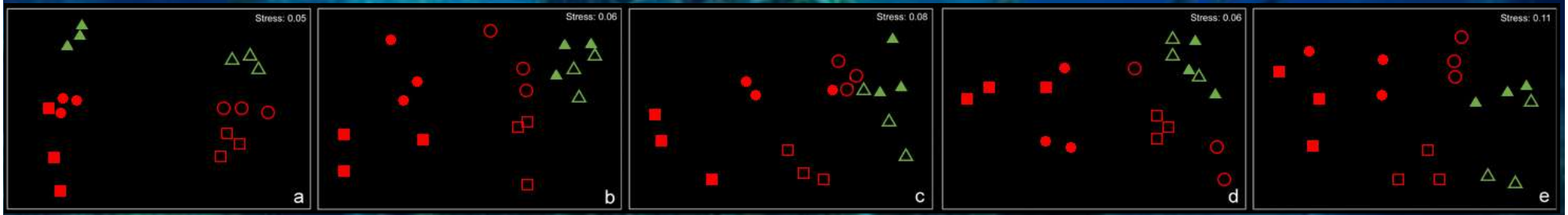


Human impact (date-mussel fishery) simulated within a no-take zone and 2 control areas (NW Mediterranean)

Recovery of macrobenthic assemblages followed during 20 months (5 times of sampling) in disturbed plots

Filled symbols = disturbed plots; empty symbols = undisturbed plots

Bevilacqua et al., 2006. J Animal Ecol



0 months | 3 months | 9 months | 12 months | 20 months

Recovery at the no-take zone was faster than at the unprotected control areas

Sea urchins

ANOVA

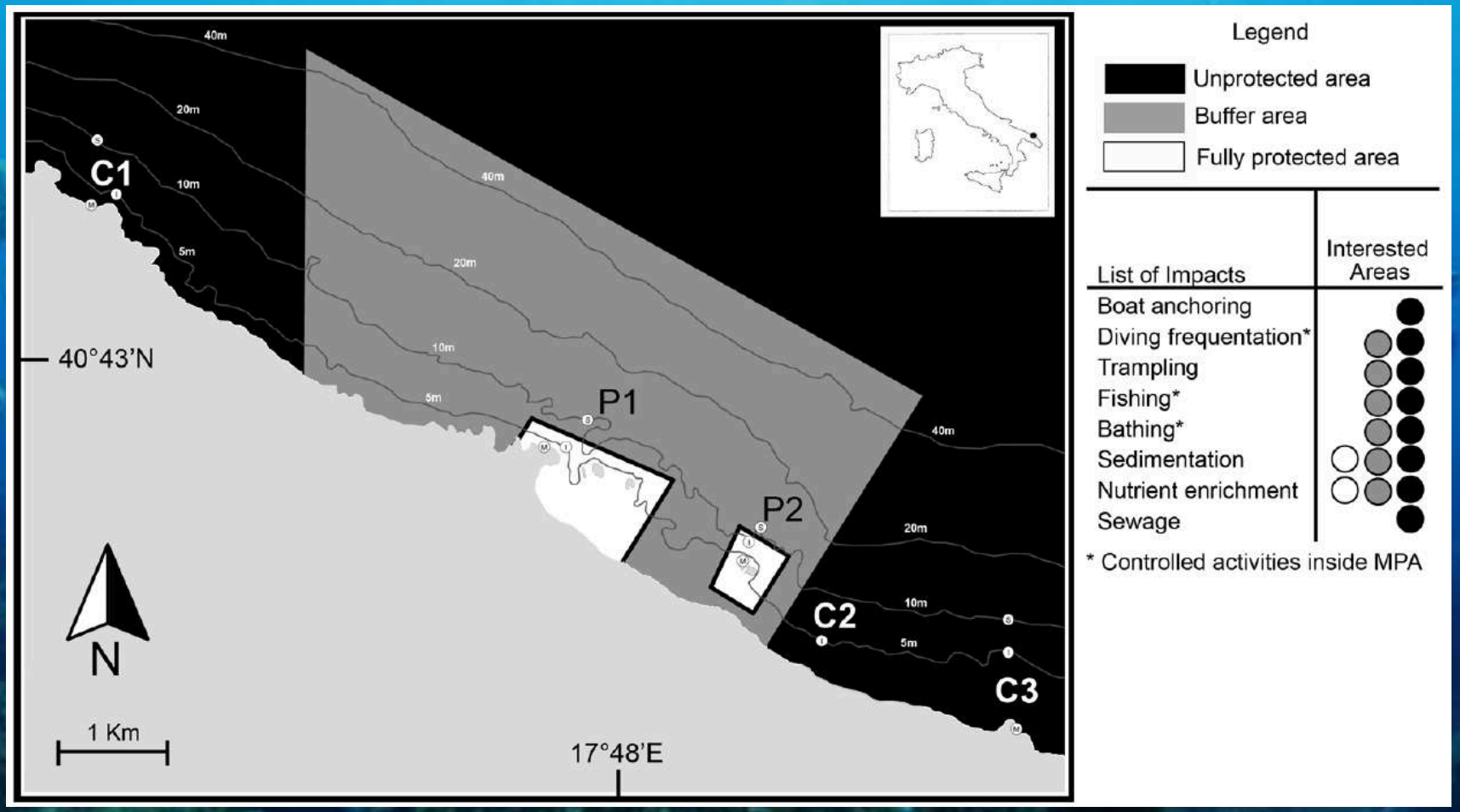
Source of variation	df	SS	MS	*F*	*F* versus
Time = Ti	2	0.08	0.04		
Location = Lo	2	1402	7.01	12086*	Ti × Lo
Controls = *Cs*	1	0.85	0.85	0.988ns	Ti × *Cs*
P-v-*Cs*	1	1317	1317	22706***	Residual
Ti x Lo	4	2.33	0.58	1.289ns	Residual
Ti × *Cs*	2	1.71	0.86	2.263ns	Res *Cs*
Ti × *P*-v-*Cs*	2	0.62	0.31	0.689ns	Residual
Residual	171	7697	0.45		
Res *Cs*	114	4349	0.38		
Res *P*	57	3348	0.59		

A. lixula

P. lividus

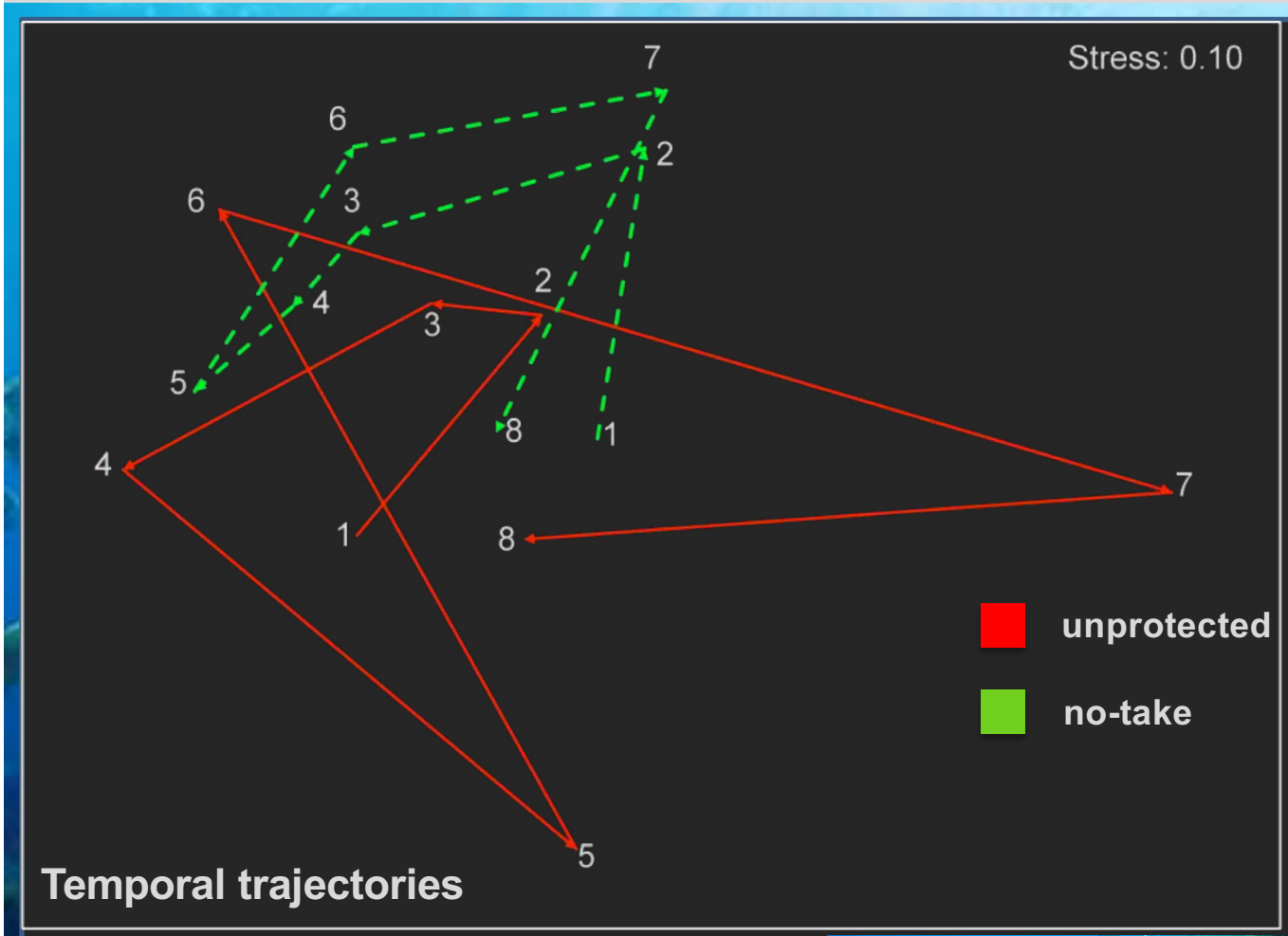
Does protection beget stability?

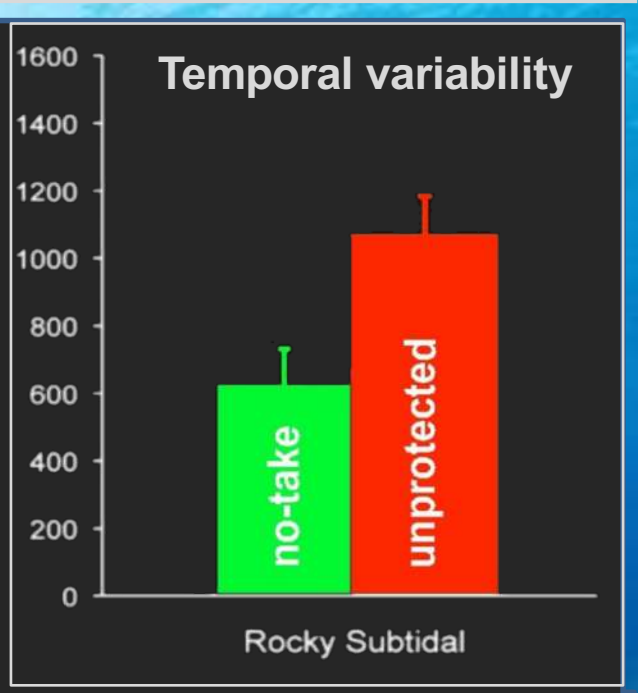
The MPA of Torre Guaceto (SE Adriatic Sea), instituted in 1991 and embedded into a human-dominated landscape, is a rare example of well-managed MPA where an adequate enforcement determined target fish recovery

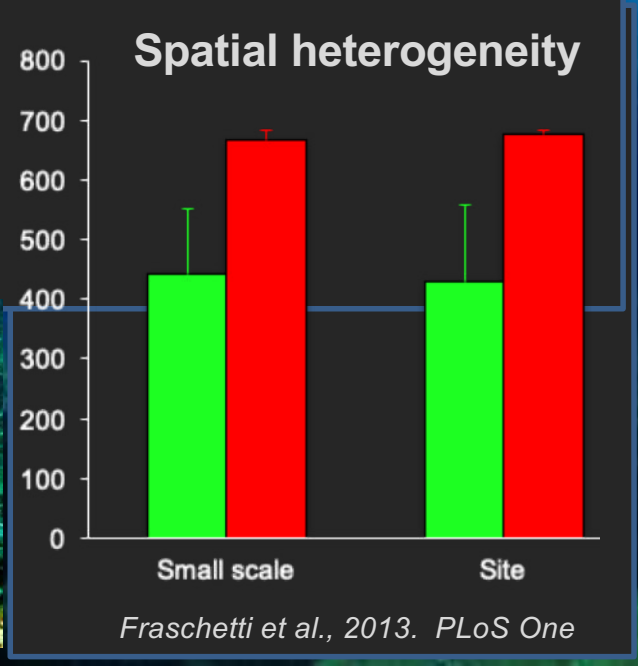


This MPA provided the opportunity to follow the effects of protection on the stability of subtidal benthic assemblages, through the comparison of protected and unprotected locations, from 2002 to 2008

Protection, stability, and heterogeneity





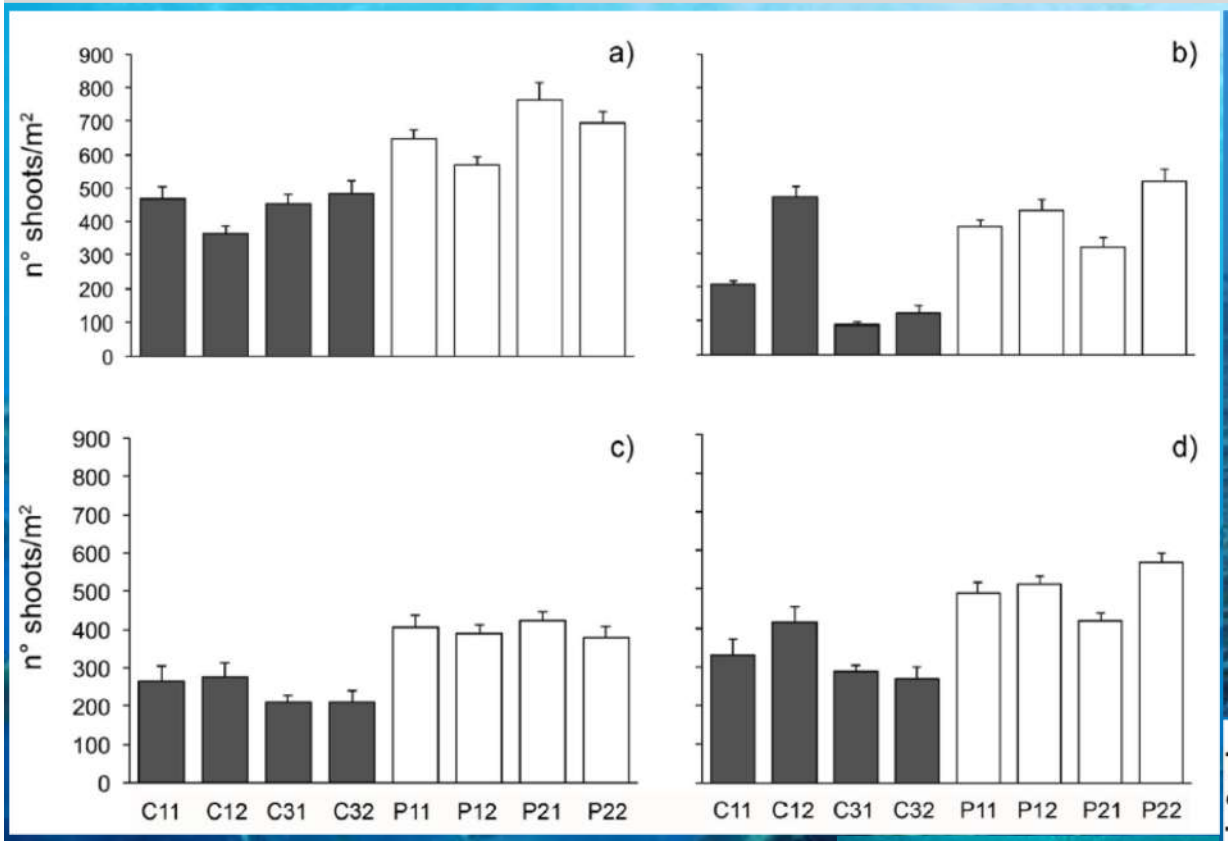


SUBTIDAL ROCKY REEFS

The structure of subtidal sessile assemblages showed larger fluctuations outside the marine protected area than within the no-take zone where, in contrast, assemblage structure showed high temporal homogeneity.

Fraschetti et al., 2013. PLoS One

Buffering effects on seagrass decline

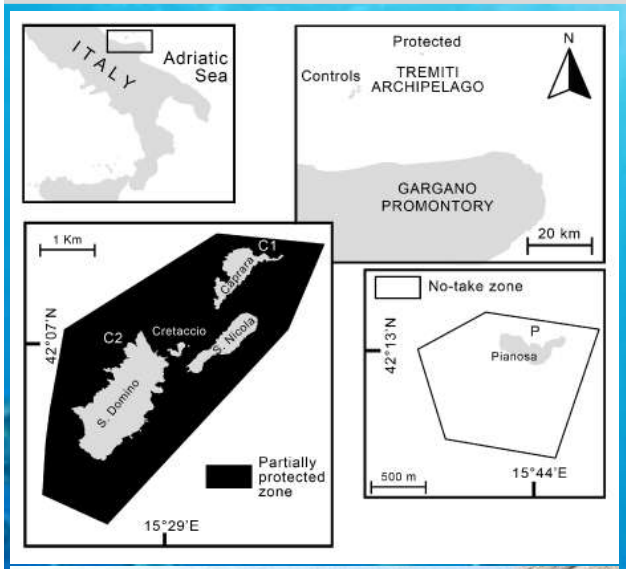


Seagrass beds under reduction in the area due to general increase in sedimentation rates and turbidity. However, the decline is less steep within the no-take areas, where additional direct human impacts (e.g., anchoring) are alleviated or excluded.

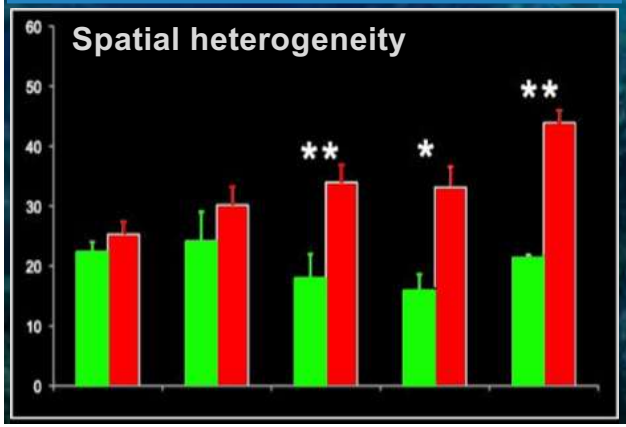
Table 6. Classification of the status of *P. oceanica* beds based on shoot density following Pergent et al. [54].

Location	Patch	2006	2007	2008	2009
P1	1	undisturbed	disturbed	Undisturbed	undisturbed
P1	2	undisturbed	undisturbed	Undisturbed	undisturbed
P2	1	undisturbed	disturbed	Undisturbed	undisturbed
P2	2	undisturbed	undisturbed	Undisturbed	undisturbed
C1	1	undisturbed	very disturbed	very disturbed	disturbed
C1	2	undisturbed	very disturbed	very disturbed	undisturbed
C3	1	disturbed	undisturbed	Disturbed	Disturbed
C3	2	undisturbed	very disturbed	very disturbed	Disturbed

Further evidence

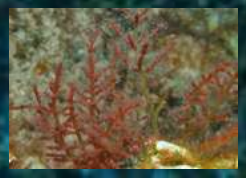


ROCKY INTERTIDAL

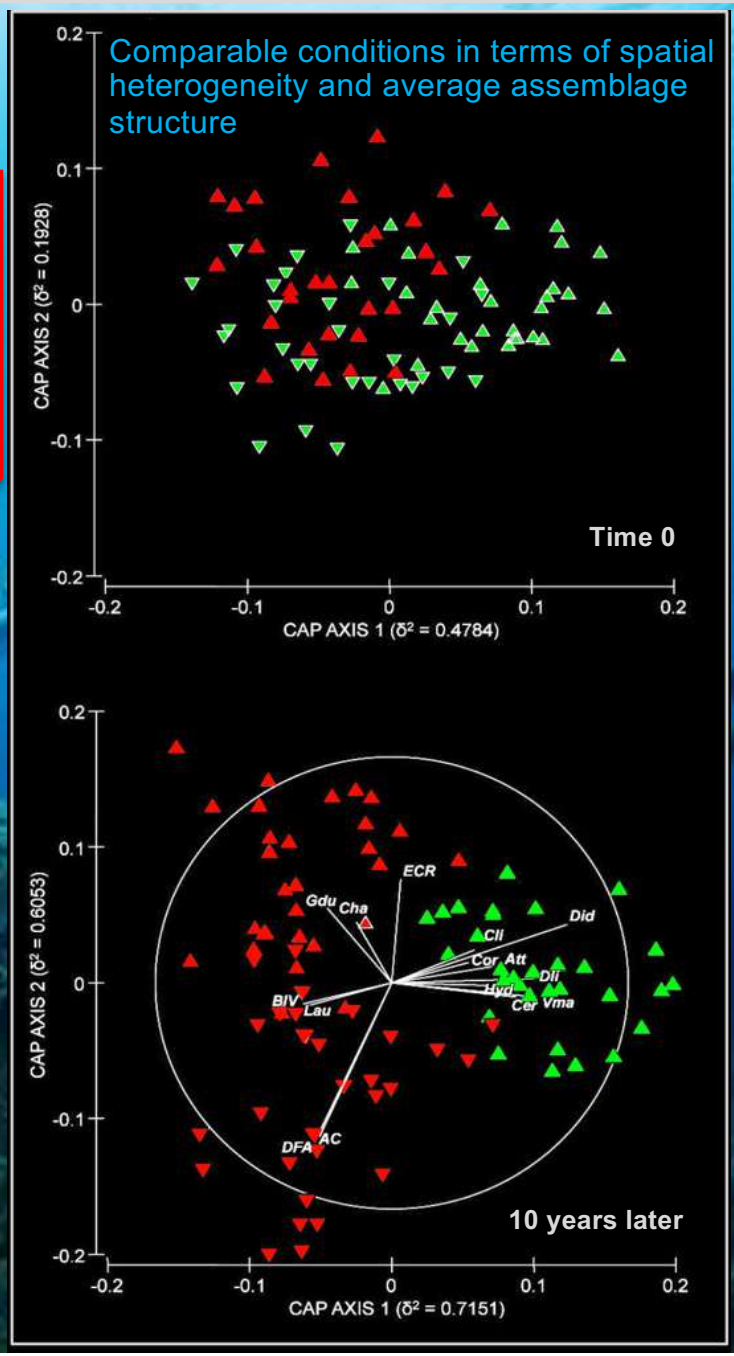


unprotected

Higher spatial heterogeneity, high temporal variability, decrease in canopy cover

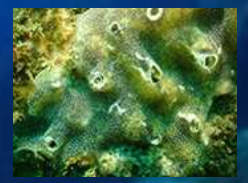


Fraschetti et al., 2012. Mar Ecol Progr Ser



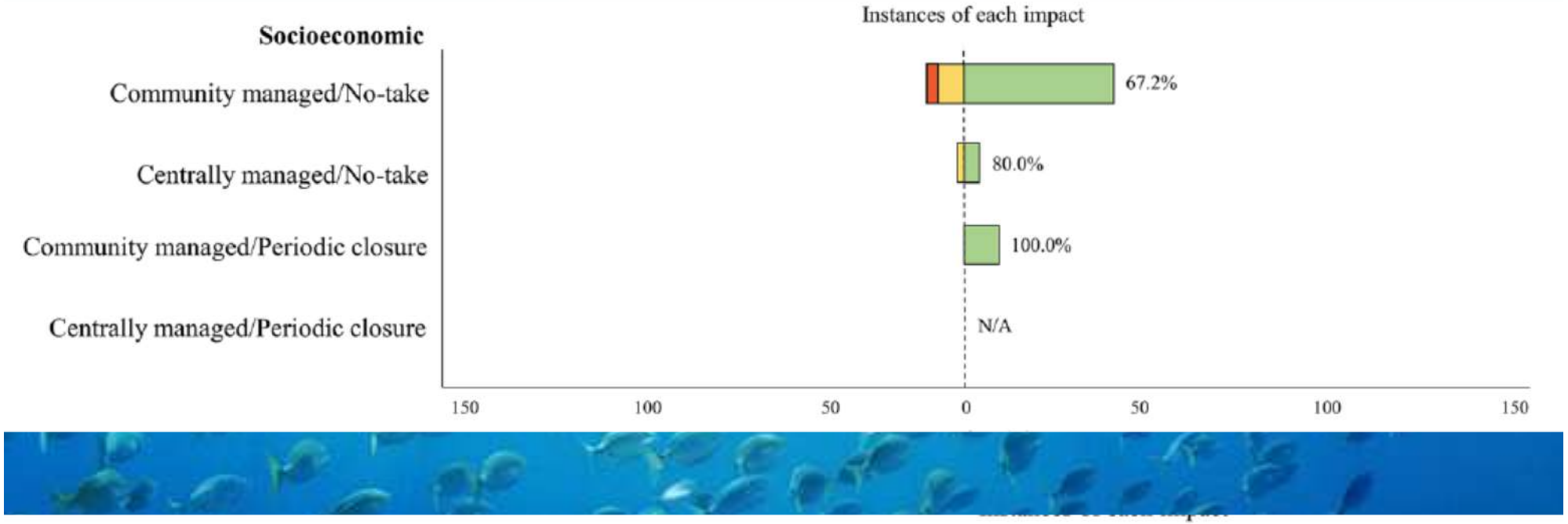
protected

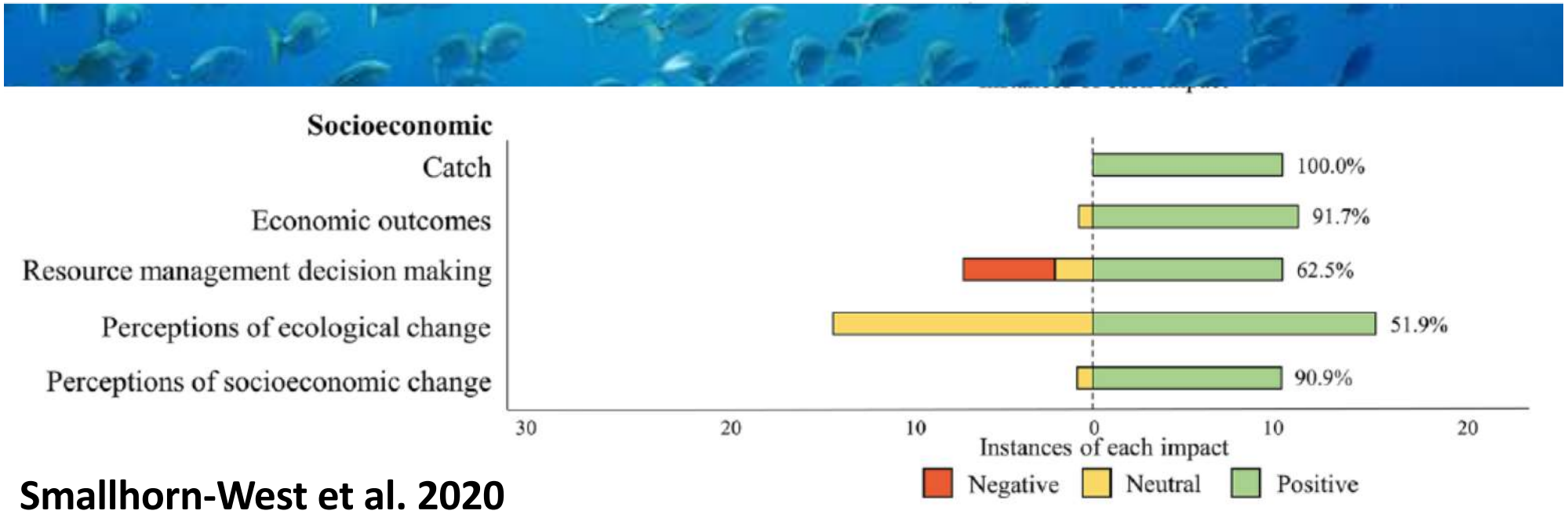
Low spatial heterogeneity, high stability in canopy cover and associated understorey assemblages



Fraschetti et al., 2012. Mar Ecol Progr Ser

Effects on socio-economy

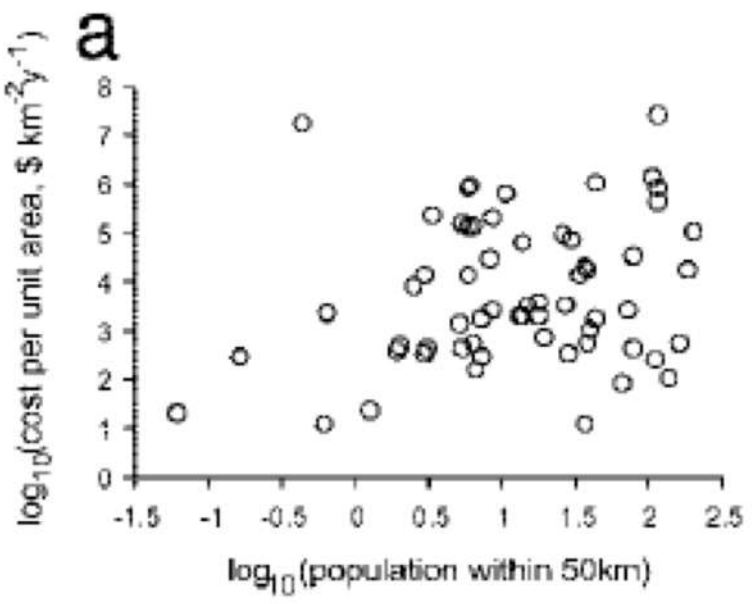


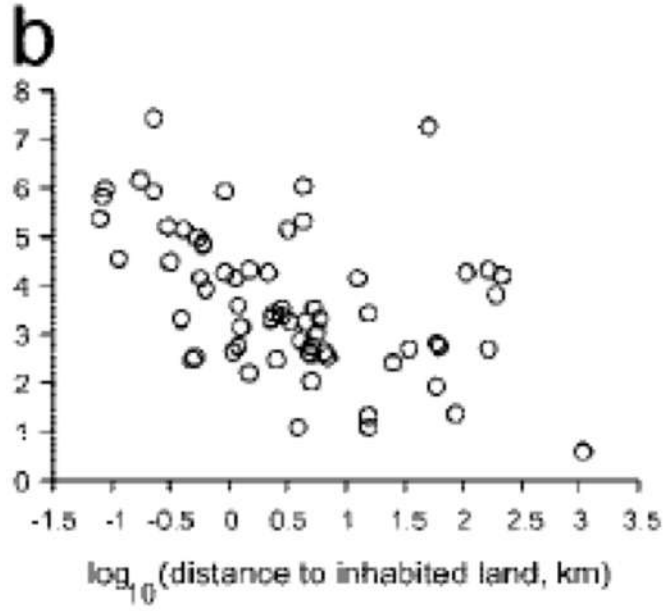


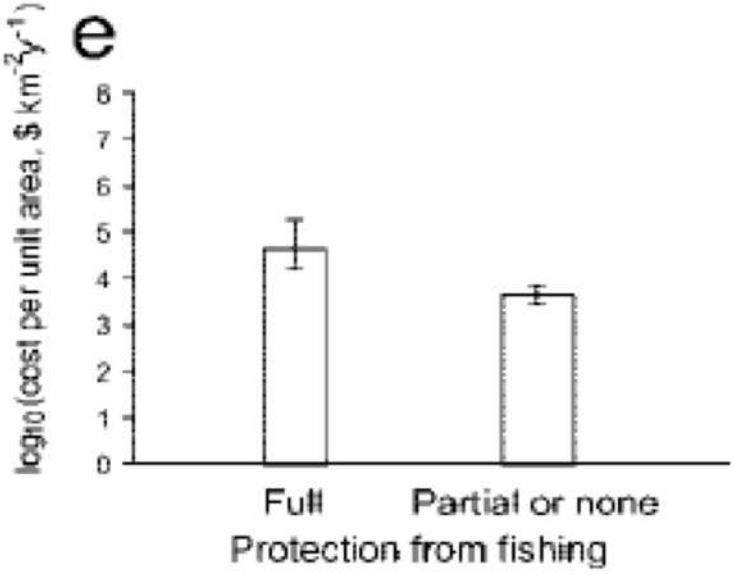
Smallhorn-West et al. 2020

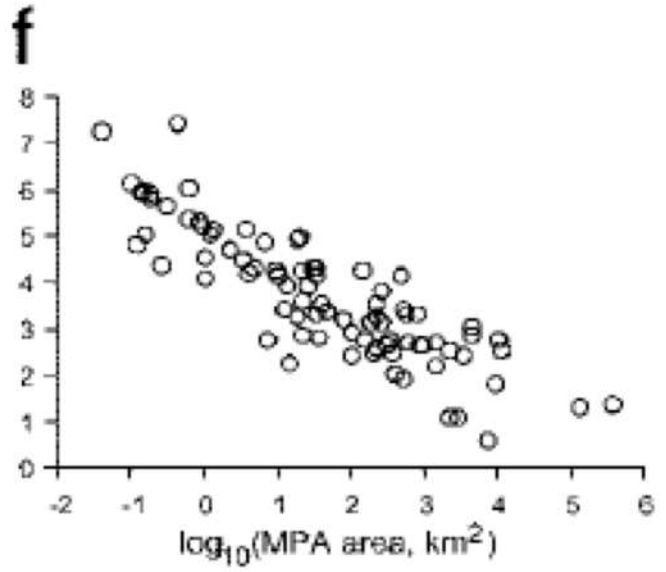
How much does conservation cost?

Balmford et al. 2004





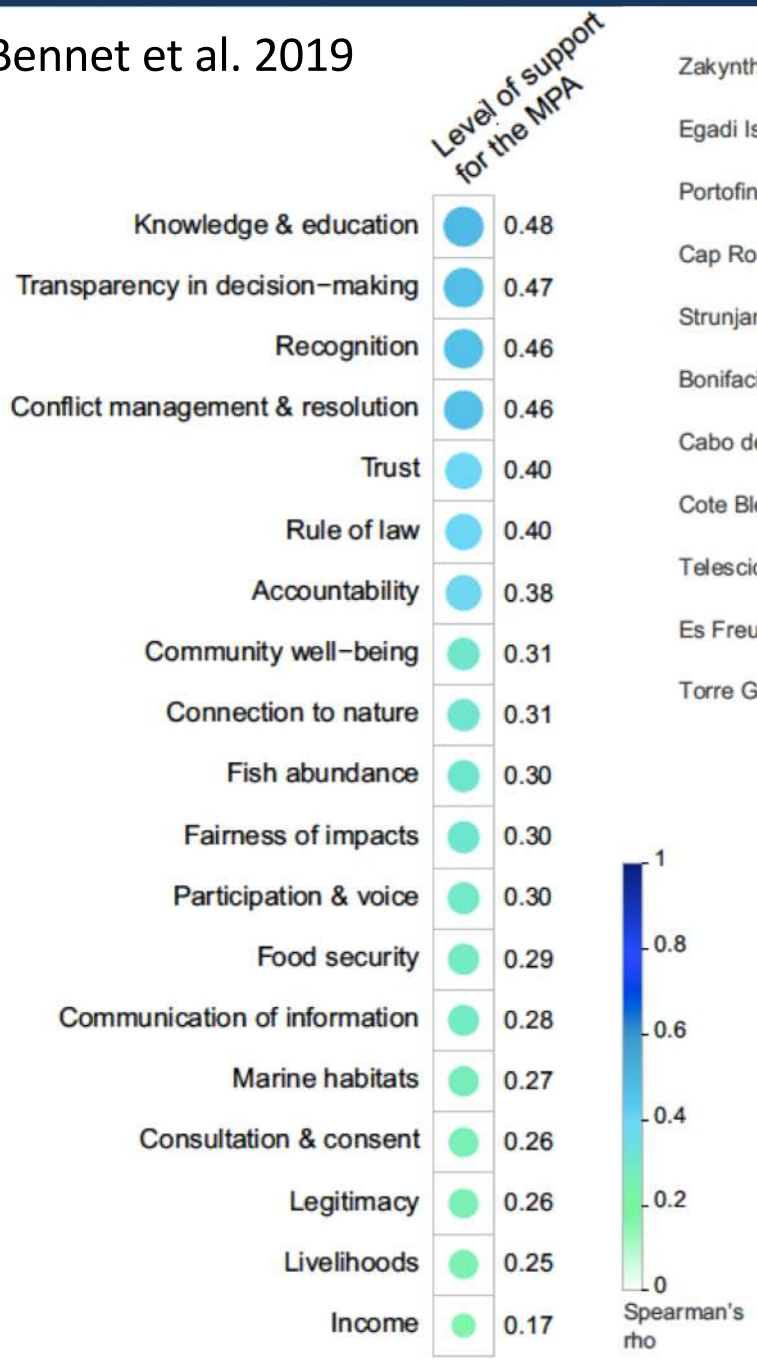


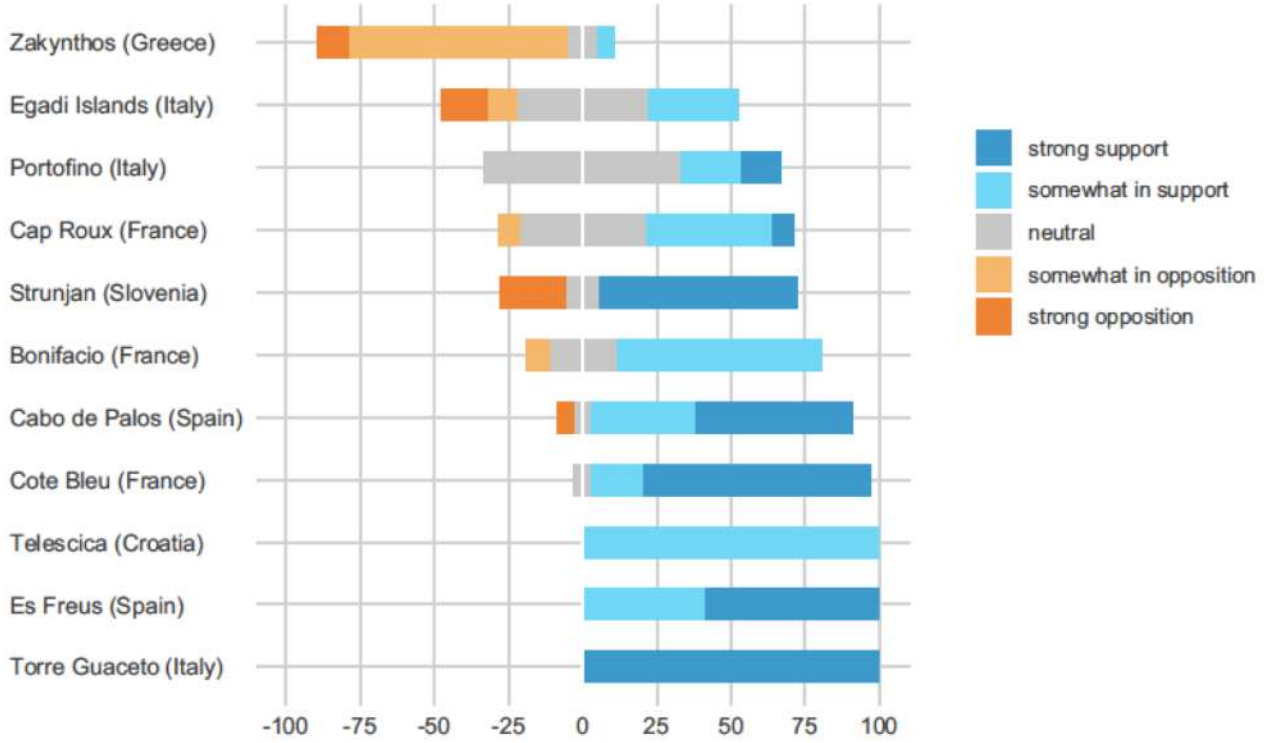


Cost ranges between 0 and about 30 millions US dollars per square km year, depending on the size of the MPA and the level of anthropization (population and urbanization)

Compliance

Bennet et al. 2019





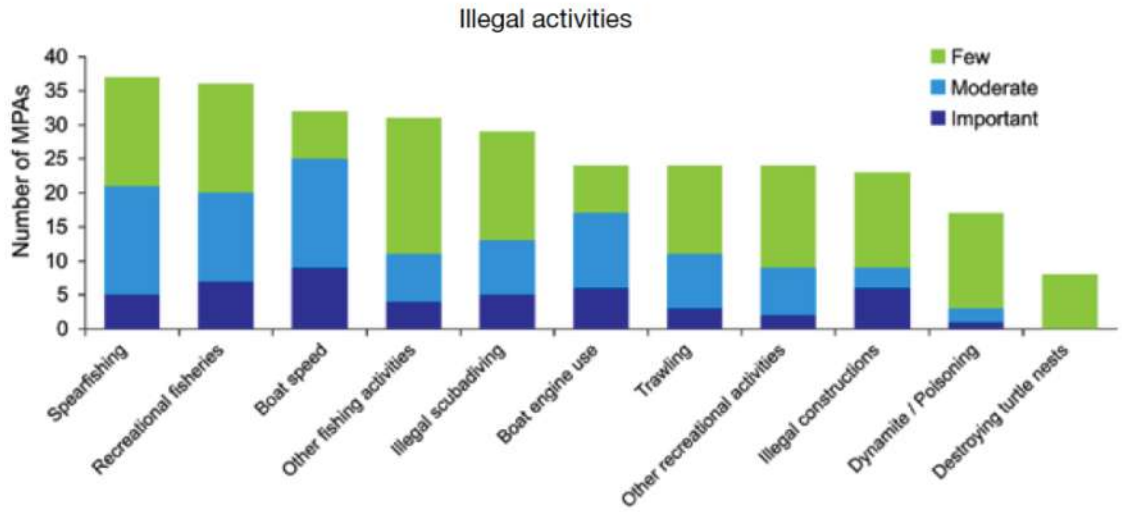


Figure 12. Illegal activities reported to occur in Mediterranean MPAs (n = 45).

The role of enforcement