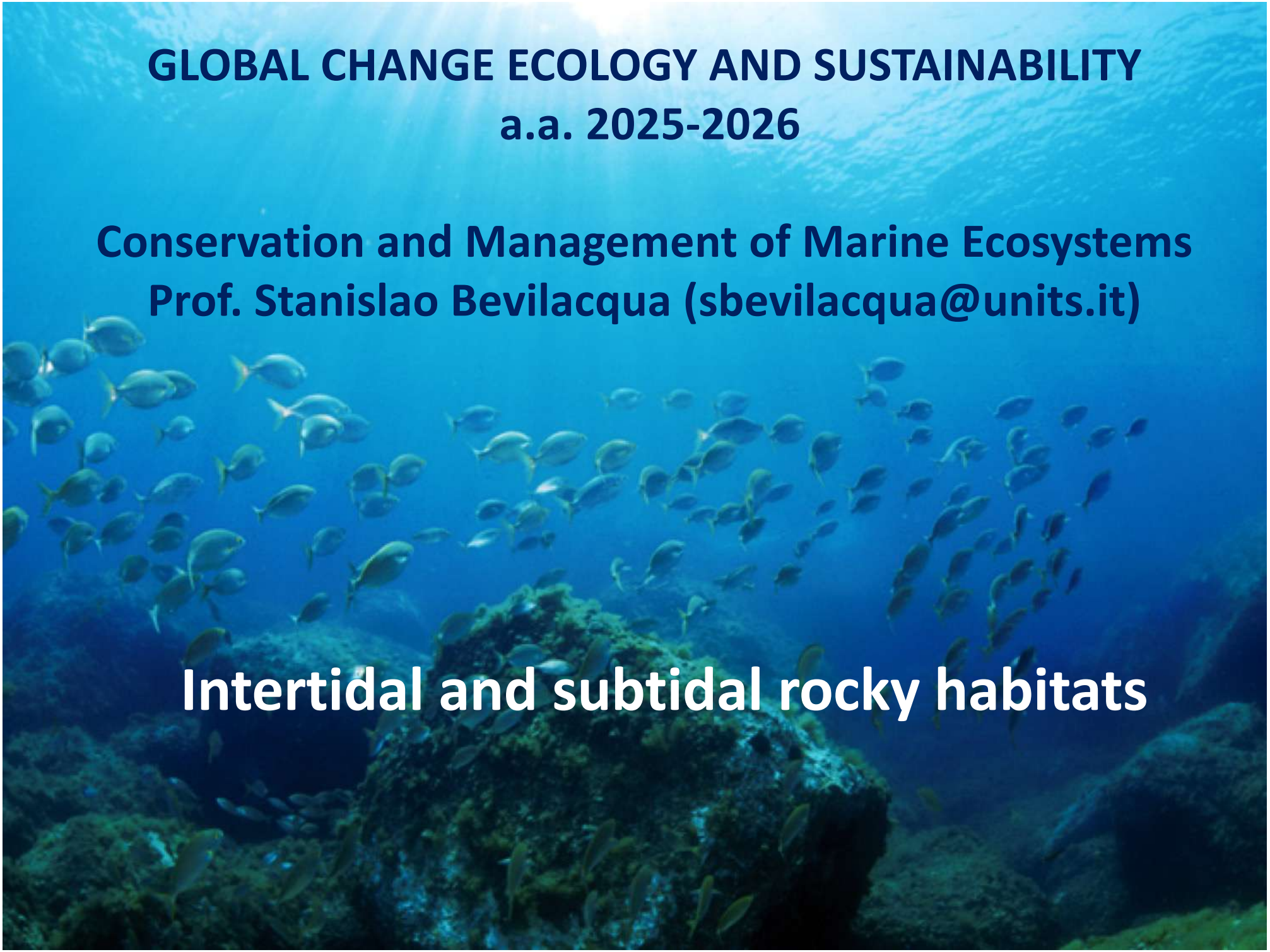


GLOBAL CHANGE ECOLOGY AND SUSTAINABILITY
a.a. 2025-2026

Conservation and Management of Marine Ecosystems
Prof. Stanislao Bevilacqua (sbevilacqua@units.it)

Intertidal and subtidal rocky habitats

Intertidal rocky reefs

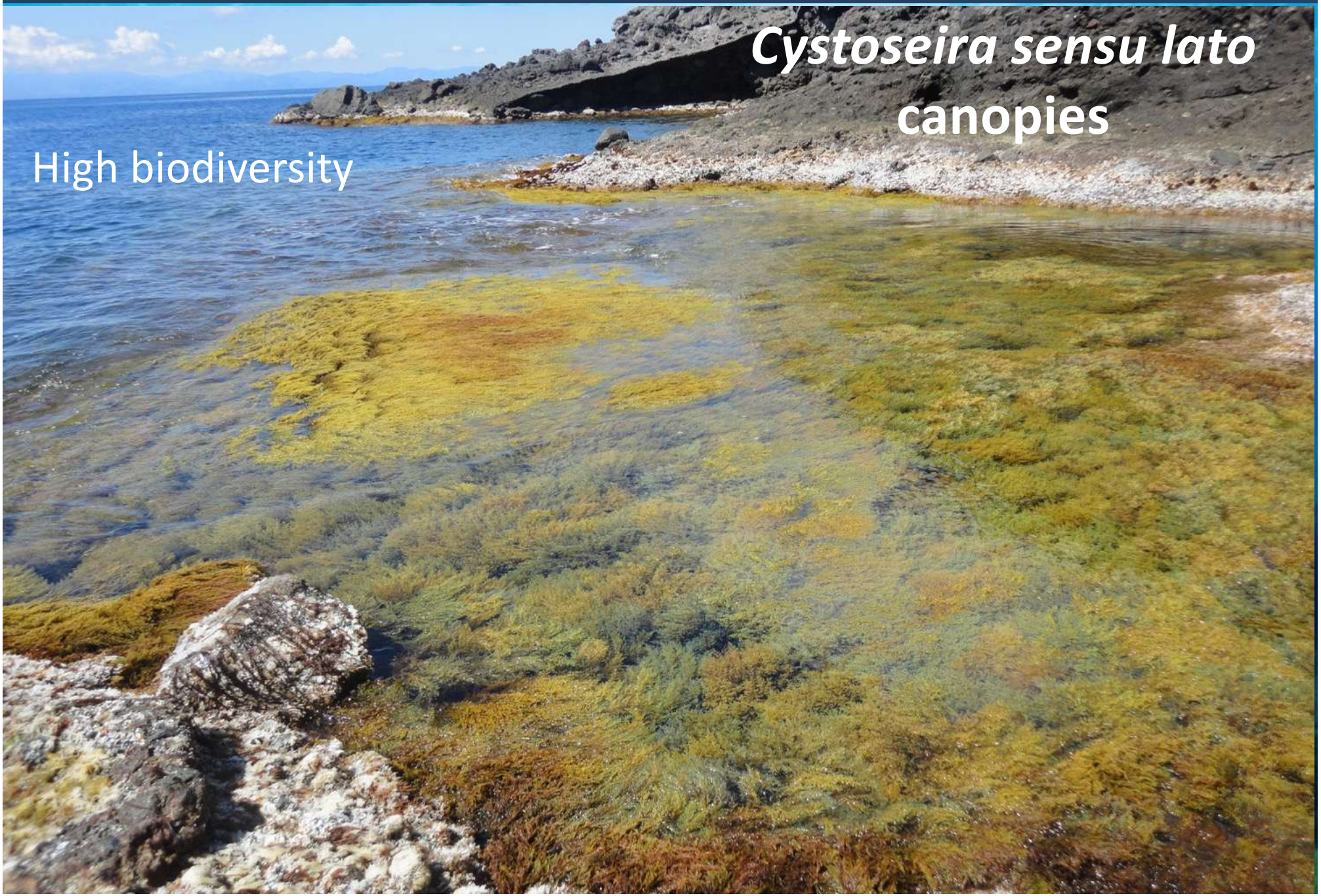
Reduced diversity

Barnacles, littorinids, limpets, cyanobacteria, anthozoans, algae (encrusting, turf). In enriched waters, mussels.

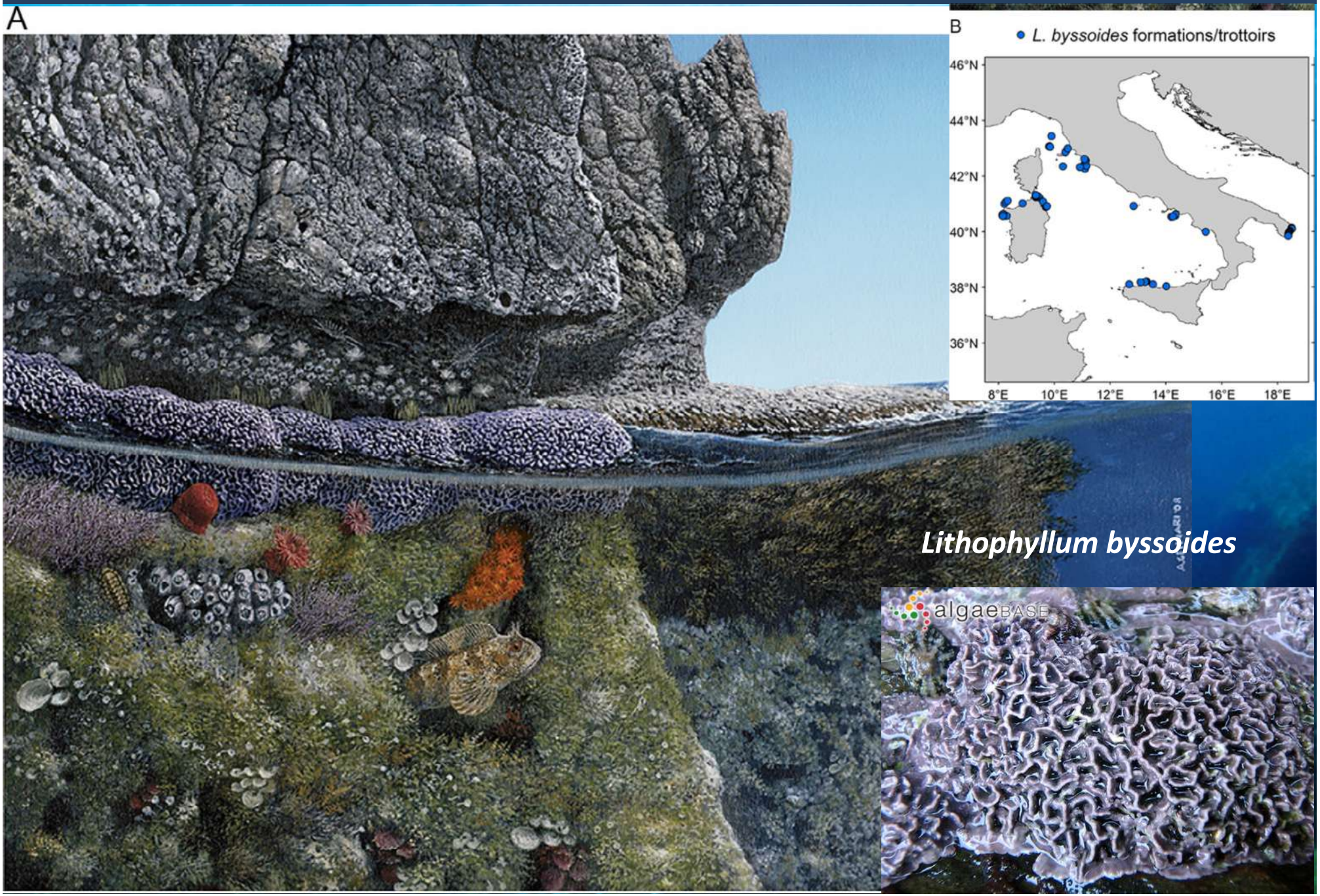
Harsh environmental conditions

due to air exposure, high temperature, hydrodinamism, so high physical disturbance

Intertidal rocky reefs



Lithophyllum rims



Lithophyllum rims

Bioconstructions

Vermetid reefs

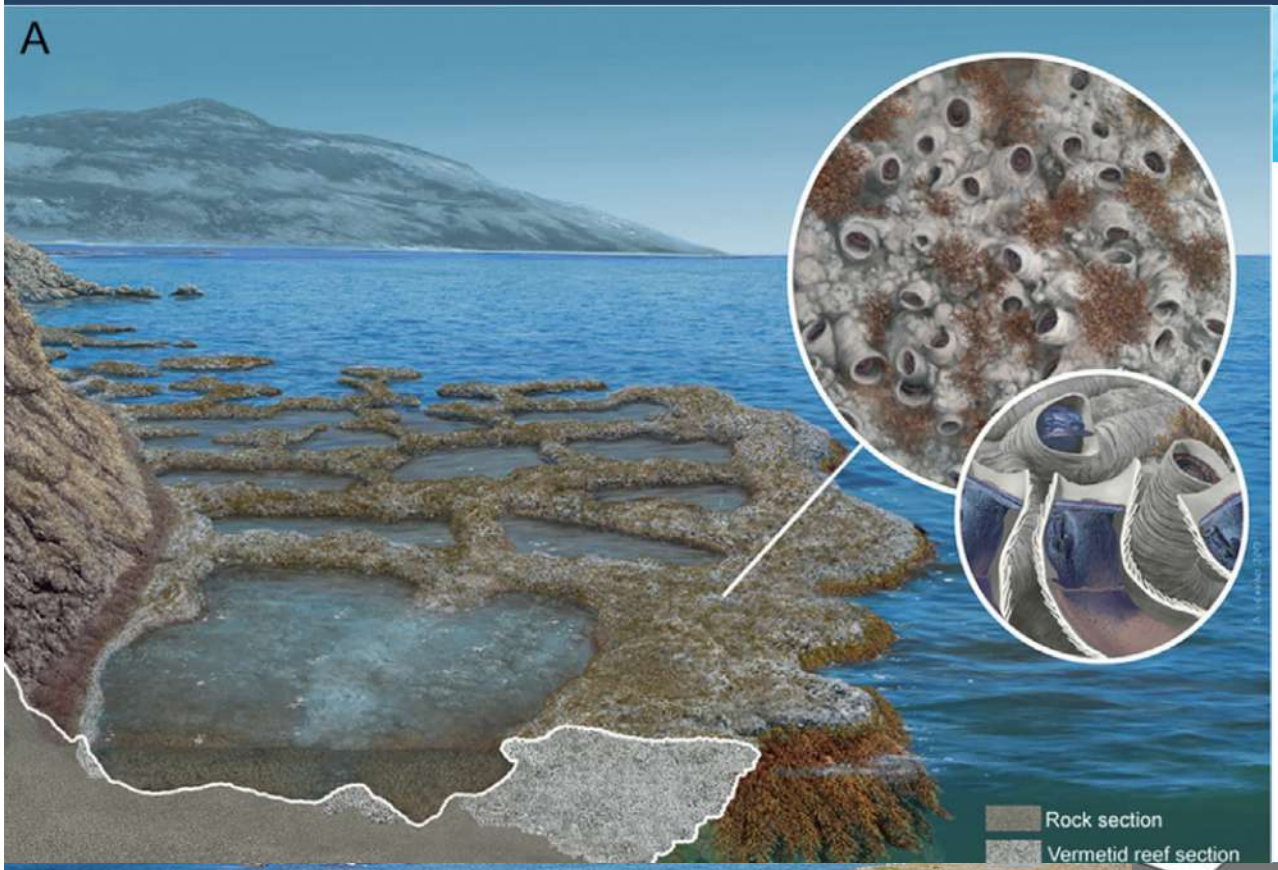
Lithophyllum incrustans

Lithophyllum byssoides

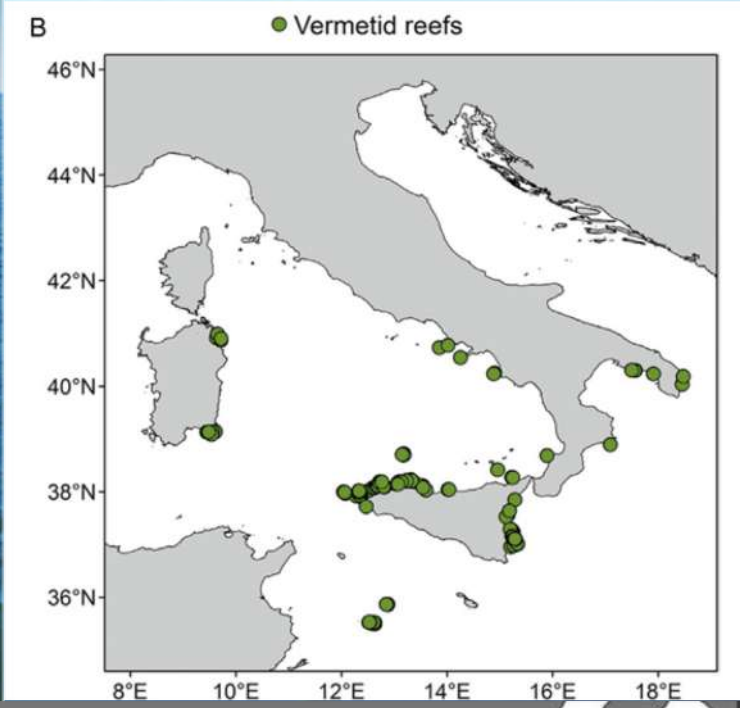
Dendropoma (Novastoa) petraeum

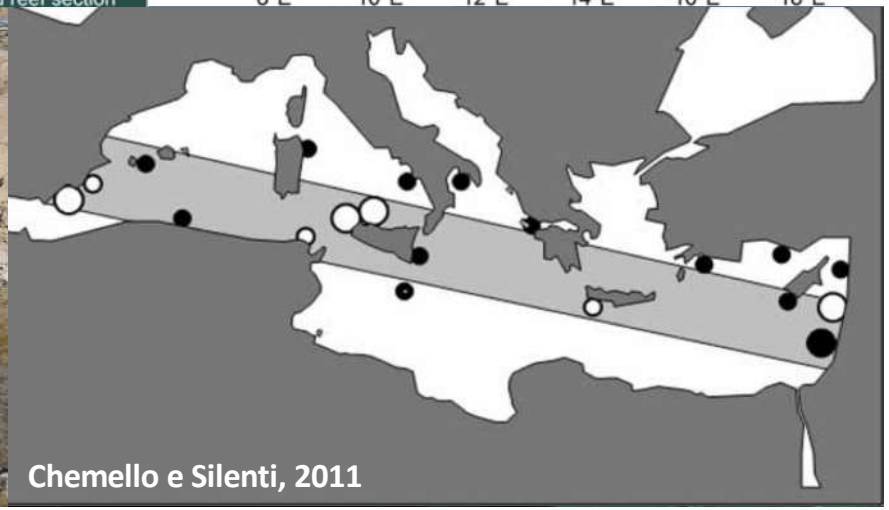
Neogoniolithon brassica-florida

Vermetid reefs



Distribution in Italy and the Mediterranean Sea





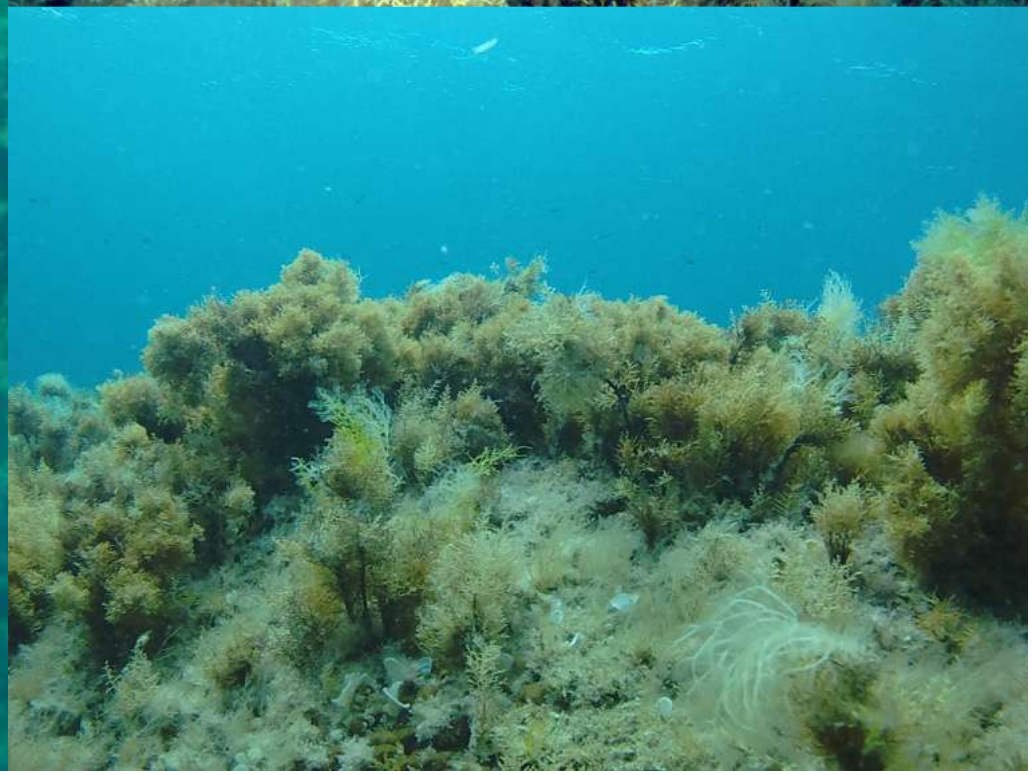
Chemello e Silenti, 2011

Vermetid reefs

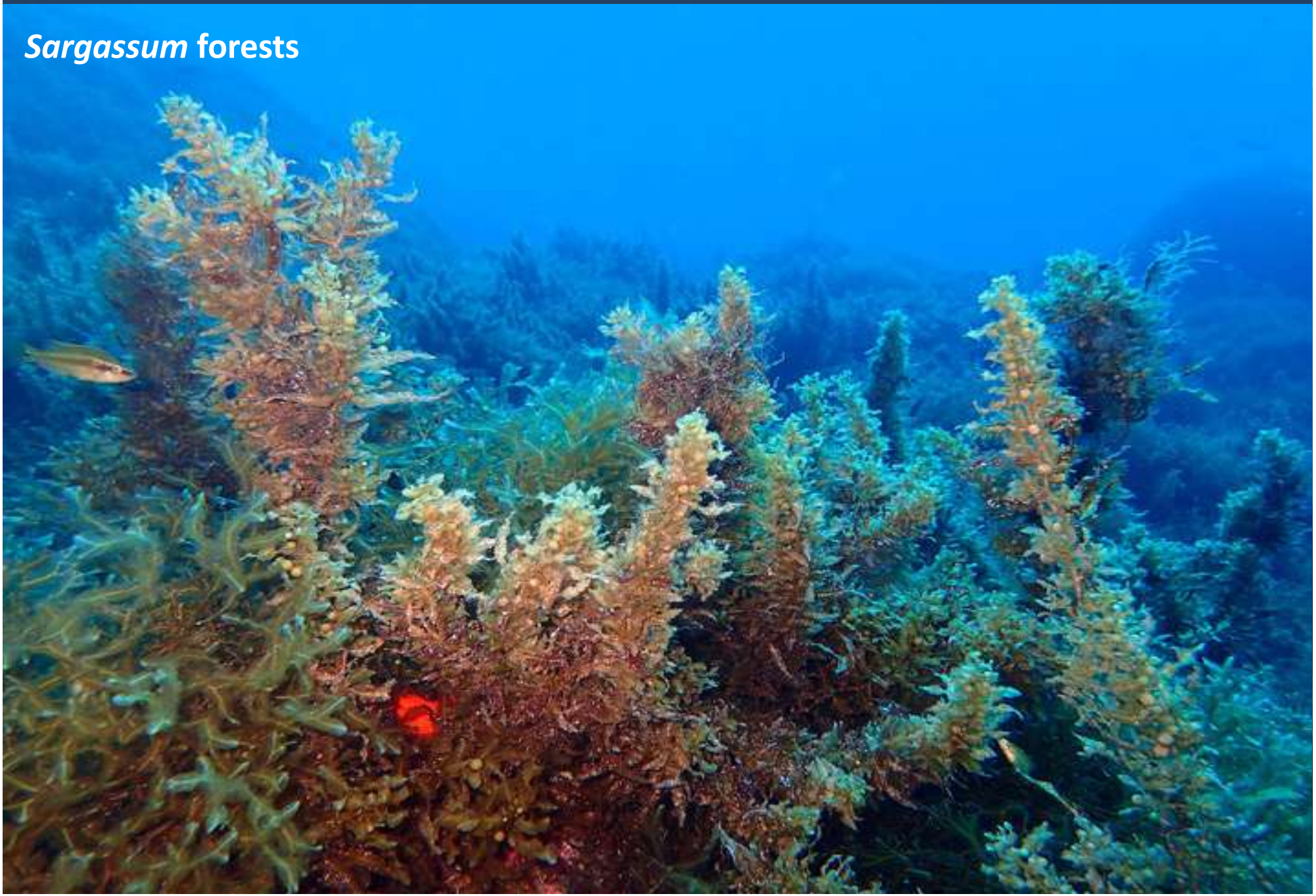
Subtidal macroalgal stands

Cystoseira s.l. forests

Fucales (*Ericaria*, *Gongolaria*, *Cystoseira*)

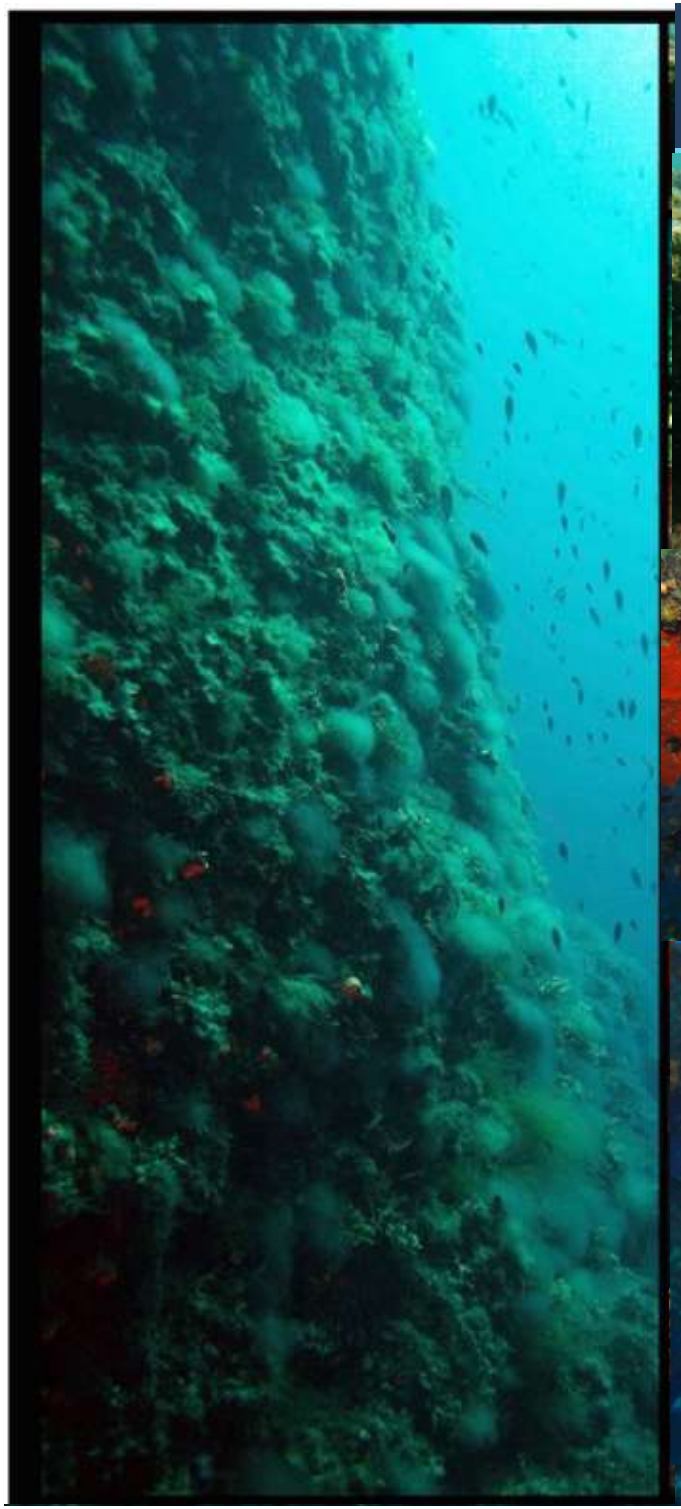


Subtidal macroalgal stands

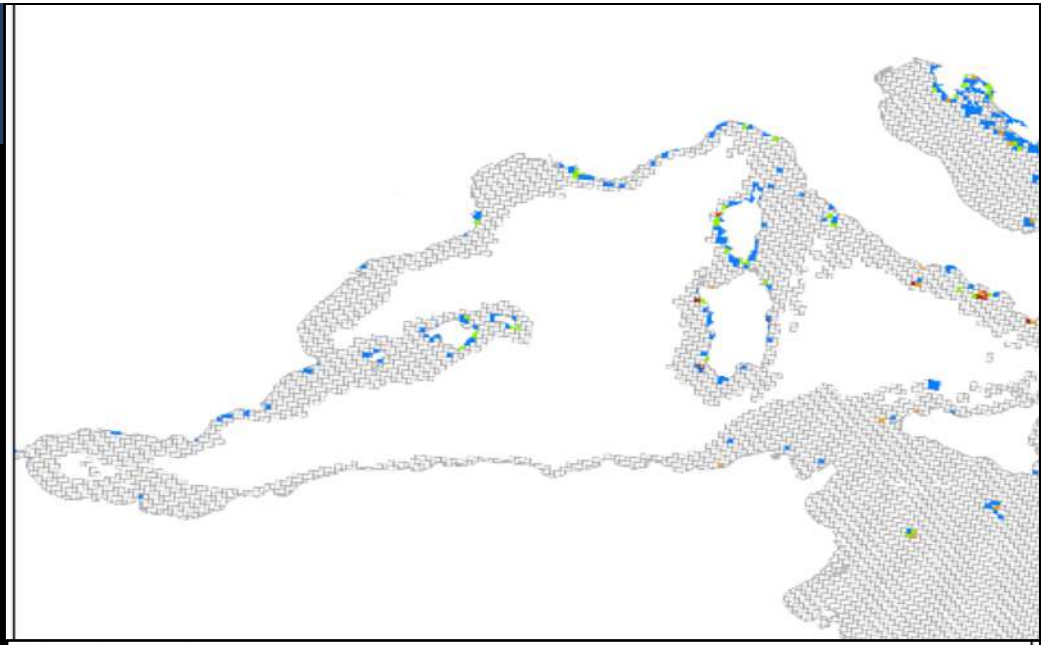


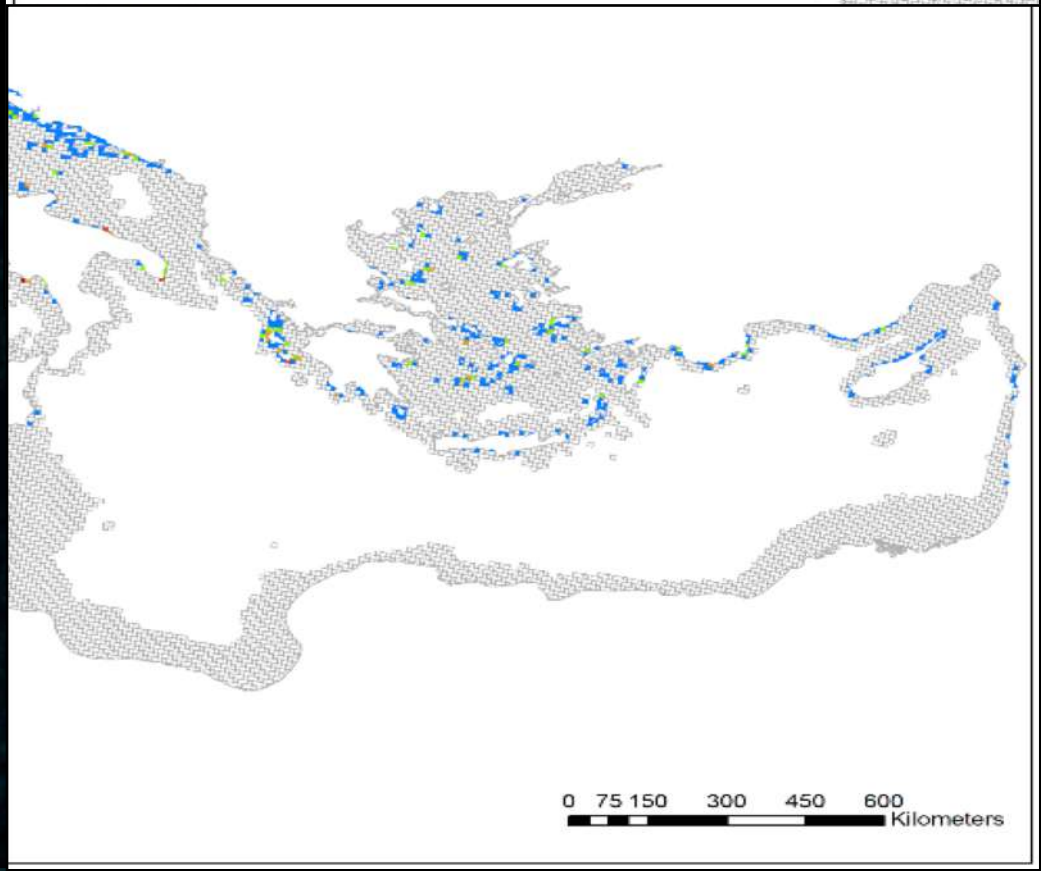
Subtidal rocky cliffs

Subtidal rocky cliffs



Submarine caves



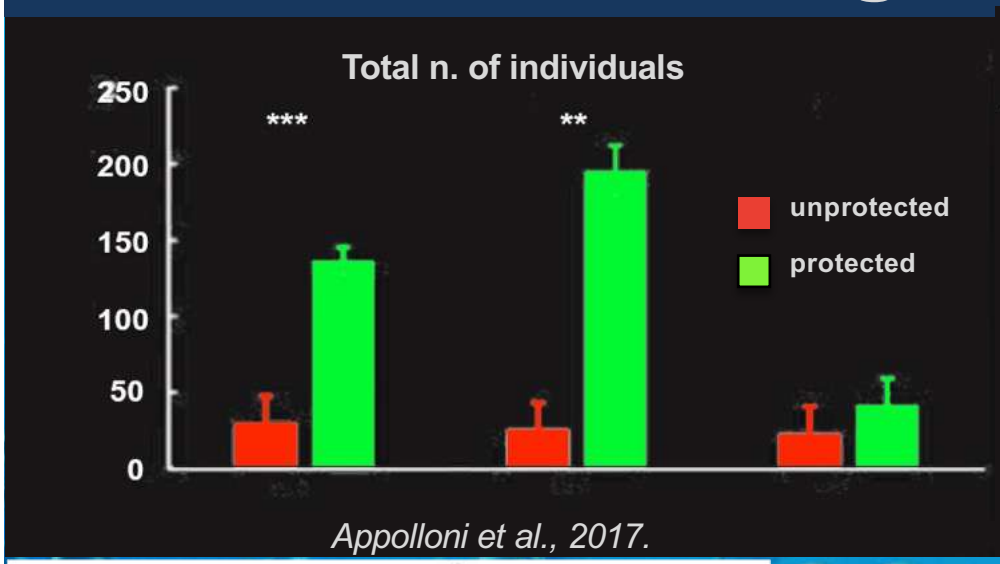


Fish assemblages

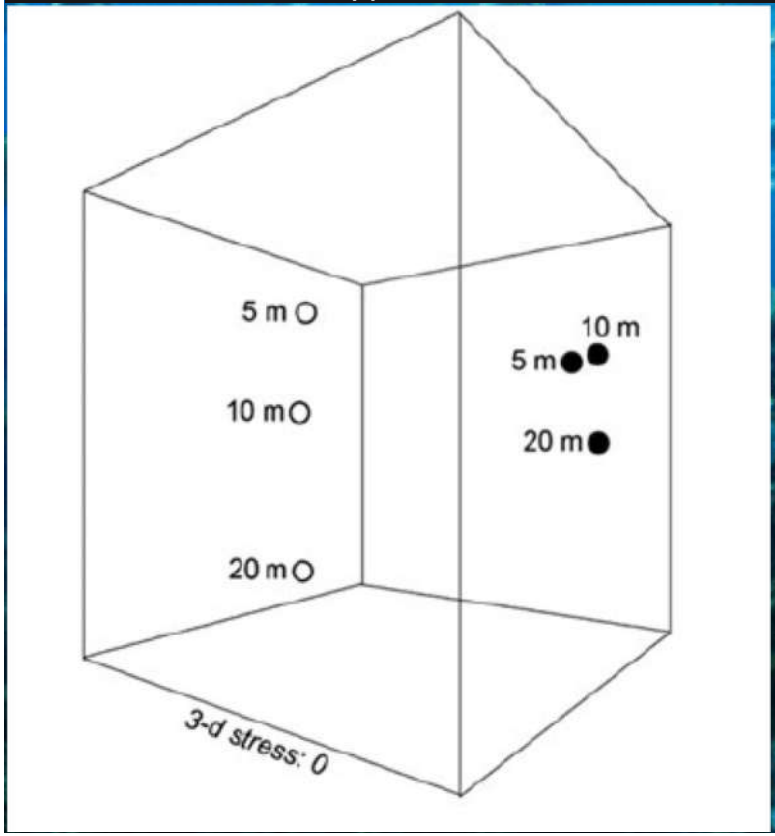
Main human threats

- Pollution
- Direct physical habitat disruption and artificialisation
- Overfishing
- Bioinvasions
- Climate change

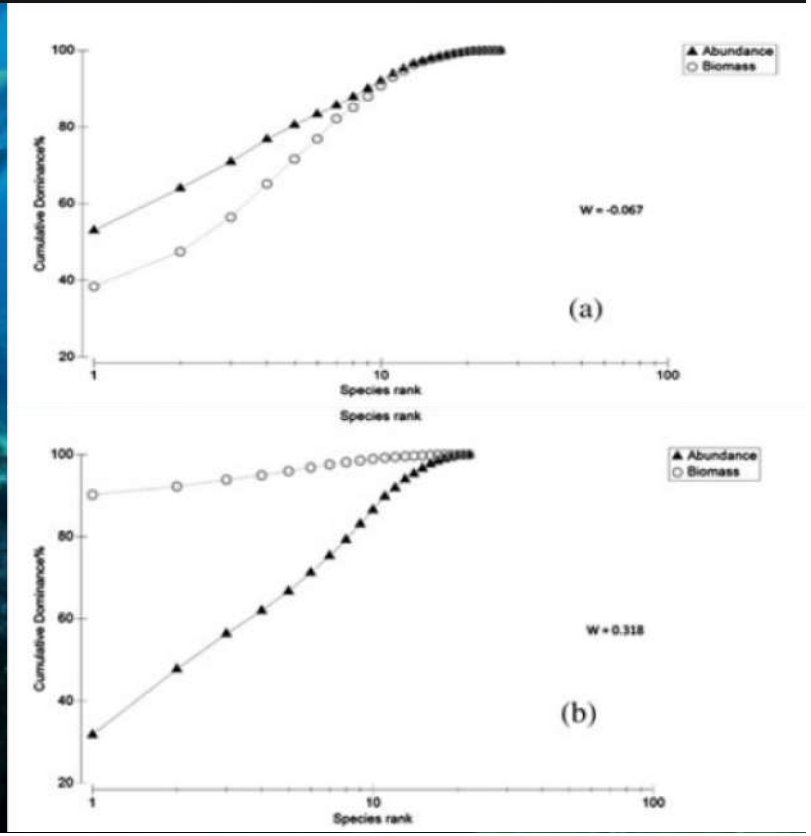
Effects of overfishing



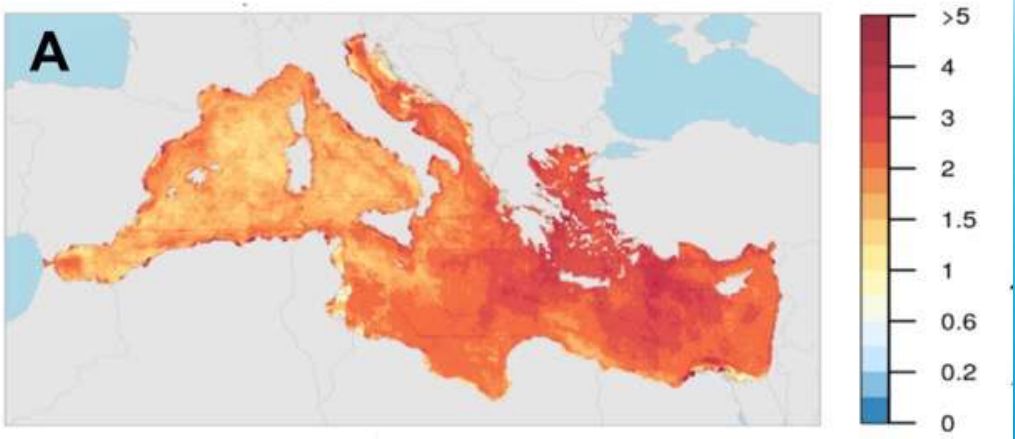
Appolloni et al., 2017.



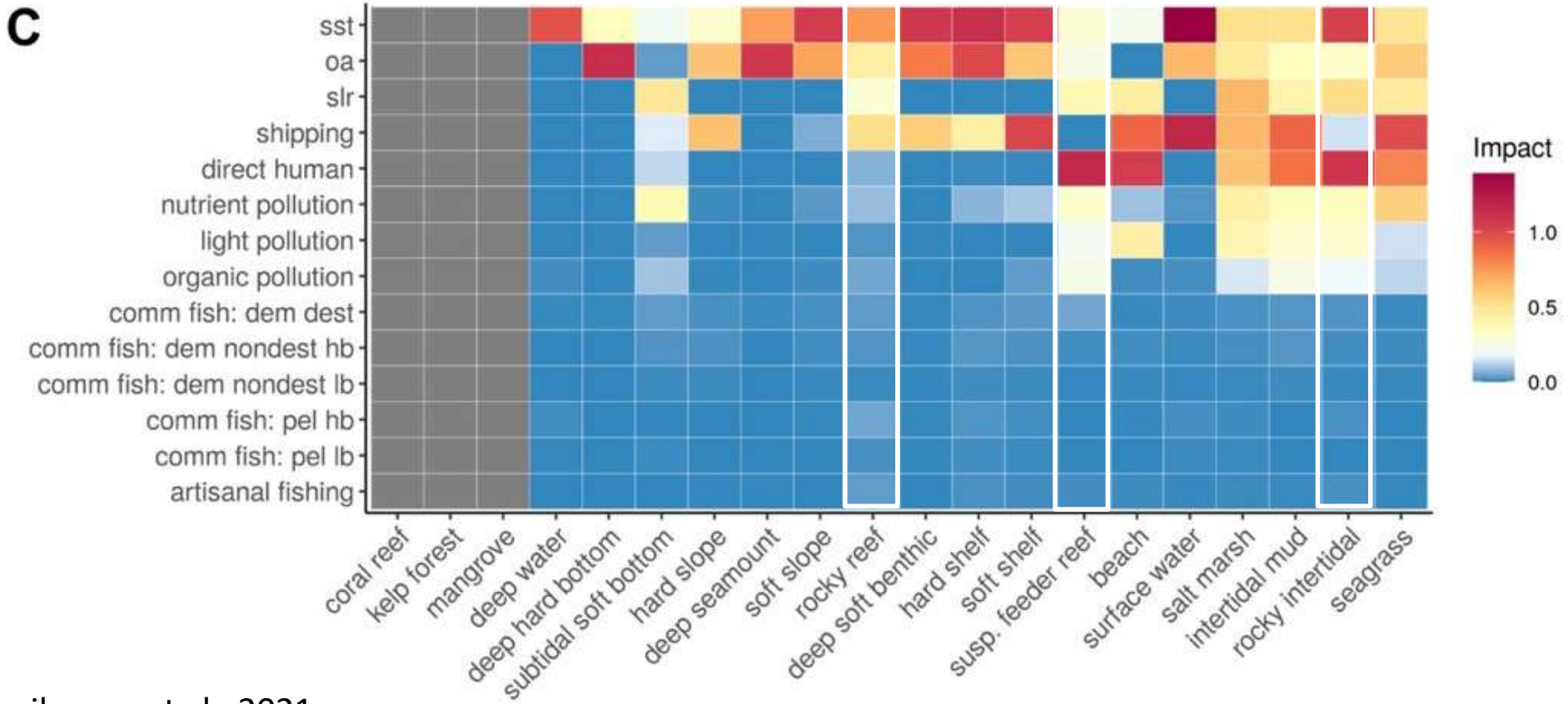
Maintainance of depth structure in fish assemblages. Abundance-biomass patterns typical of healthy conditions



Trends in cumulative impact



Climate drivers are the main contributors to increased cumulative impact to rocky reefs, but pollution are also key drivers of increased
Impact. Rocky reefs are impacted by the largest suite of different stressors



Bevilacqua et al., 2021

CARLIT

Table 1
Summarized description and sensitivity levels of the main community categories distinguished in the monitored coasts

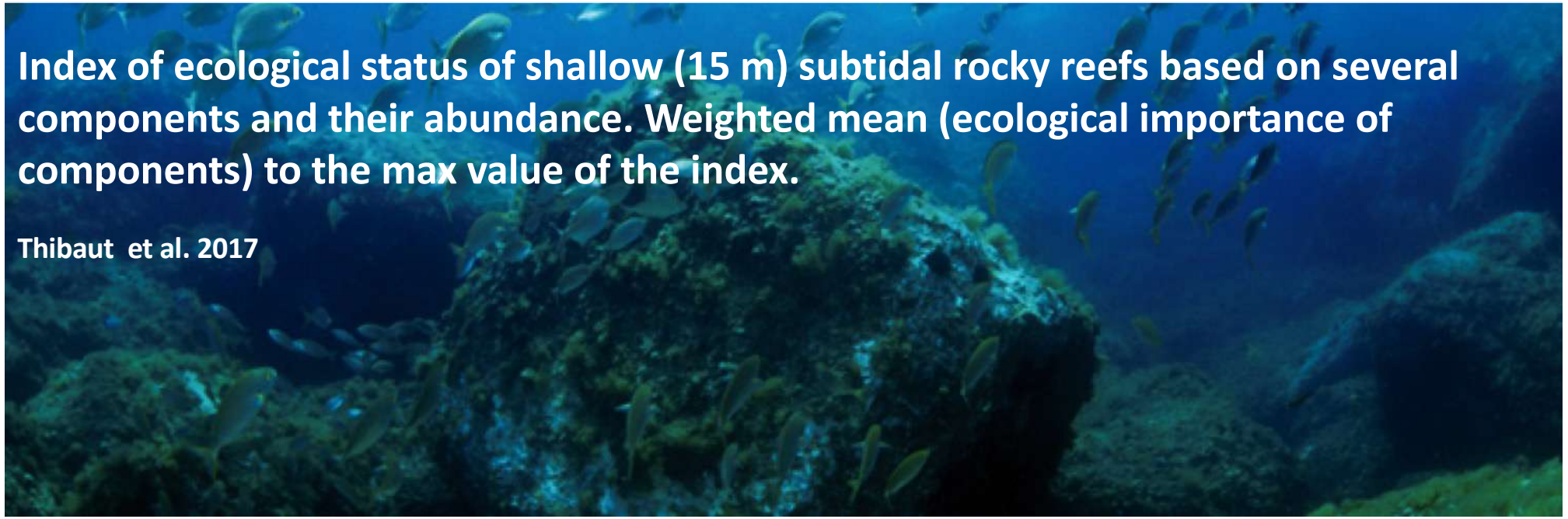
Category	Description	Sensitivity level
Cystoseira mediterranea 5	Continuous belt of *C. mediterranea/stricta*	20
Cystoseira crinita	Populations of *C. crinita*	20
Cystoseira balearica	Populations of *C. balearica*	20
Cystoseira sheltered	Populations of *Cystoseira foeniculacea/barbata/spinosa* v. *tenuior/compressav.pustulata*	20
Posidonia reef	Barrier and fringing reefs of *Posidonia oceanica*	20
Cymodocea nodosa	*Cymodocea nodosa* meadows	20
Zostera noltii	*Zostera noltii* meadows	20
Trottoir	Build-ups of *Lithophyllum byssoides*	20
Cystoseira mediterranea 4	Almost continuous belt of *C. mediterranea/stricta*	19
Cystoseira mediterranea 3	Abundant patches of dense stands of *C. mediterranea/stricta*	15
Cystoseira mediterranea 2	Abundant scattered plants of *C. mediterranea/stricta*	12
Cystoseira compressa	Populations of *C. compressa* v. *compressa*	12
Cystoseira mediterranea 1	Rare scattered plants of *C. mediterranea/stricta*	10
Corallina	Belt of *Corallina elongata* without *Cystoseira*	8
Haliptilon	Belt of *Haliptilon virgatum*, without *Cystoseira*	8
Mytilus	Mussel (*Mytilus galloprovincialis*) beds, without *Cystoseira*	6
Encrusting corallines	Belt of *Lithophyllum incrustans, Neogoniolithon brassica-florida* and other encrusting corallines	6
Green algae	Upper sublittoral belts of *Ulva* and *Cladophora*	3
Blue greens	Communities dominated by Cyanobacteria and *Derbesia tenuissima*	1

Index of ecological status of intertidal rocky fringe based on sensitivity levels (SL) of different macroalgae associations and their abundance. Value calculated as the ratio between the weighted mean of SL and the reference value for the area.

Ballesteros et al. 2007

Reef-EBQI

Functional compartment	Weigh-ting (W)	Parameter	4	3	2	1	0
1- MPOs	15	Cover type	Arborescent perennial ≥50%	Arborescent perennial 5 to <50%	Shrubby ≥50%	Shrubby 5 to <50%	Turf Encrusting
2- Detritus-feeders	3	Density (individuals 10 m^{-2})	<0.5	0.5 to 1.0	1.1 to 2.0	2.1 to 5.0	>5.0
3- Filter- and suspension-feeders	2	Density (individuals 10 m^{-2})	<2.5	2.5 to 5.0	5.1 to 10.0	10.1 to 20.0	>20.0
4- Sea urchins	10	Density (individuals m^{-2})	0.05 to 1.0	<0.05	1.1 to 5.0	5.1 to 10.0	>10.0
5- Invertivorous invertebrates	3						
- *Octopus vulgaris, Marthasterias glacialis*		Density (individuals 200 m^{-2})	>1.0	0.6 to 1.0	0.3 to 0.5	0.1 to 0.2	<0.1
- *Hexaplex trunculus*		Density (individuals 10 m^{-2})	<0.5	0.6 to 1.0	1.1 to 2.0	2.1 to 4.0	>4.0
6- Herbivorous teleosts	4	Biomass kg teleosts WM 100 m^{-2}	1.1 to 3.0	3.1 to 4.0	>4.0	0.25 to 1.0	<0.25
7–8- Omnivorous and Invertivorous teleosts	4	Biomass kg teleosts WM 100 m^{-2}	>3.5	2.6 to 3.5	1.6 to 2.5	0.8 to 1.5	<0.8
9- Piscivorous teleosts	7	Biomass kg teleosts WM 100 m^{-2}	>5.0	1.0 to 5.0	0.5 to 0.9	0.4 to 0.1	<0.1
10- Planktivorous teleosts	1	Biomass kg teleosts WM 100 m^{-2}	>2.0	2.0 to 1.5	1.5 to 0.9	0.9 to 0.3	<0.3
11- Sea birds	1						
- *Phalacrocorax* spp.		Distance to the nearest nesting site (km)	<4.0	4.0 to 7.9	8.0 to 12.9	13.0 to 17.0	>17.0
- *Pandion haliaetus*		Distance to the nearest nesting site (km)	<4.0	4.0 to 7.9	8.0 to 12.9	13.0 to 17.0	>17.0

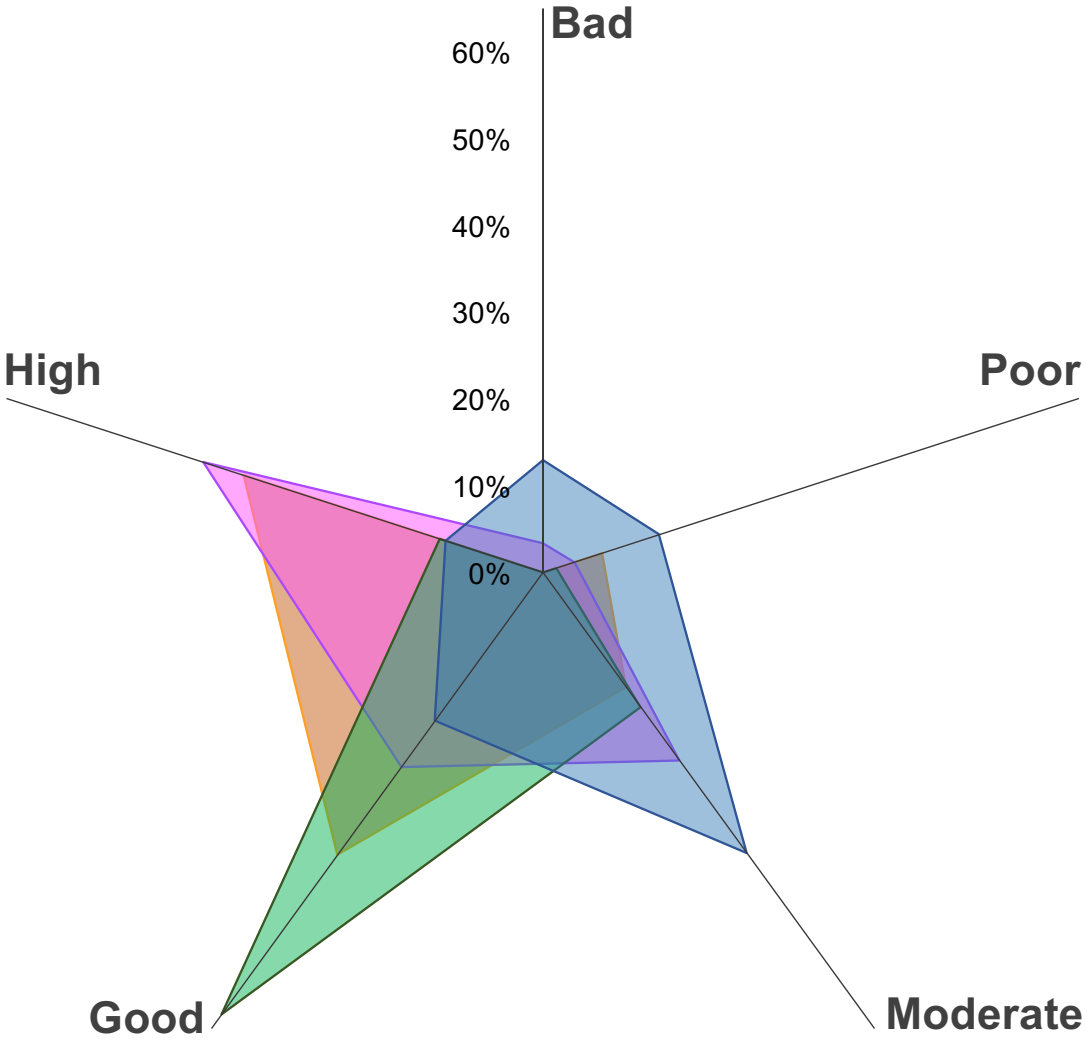


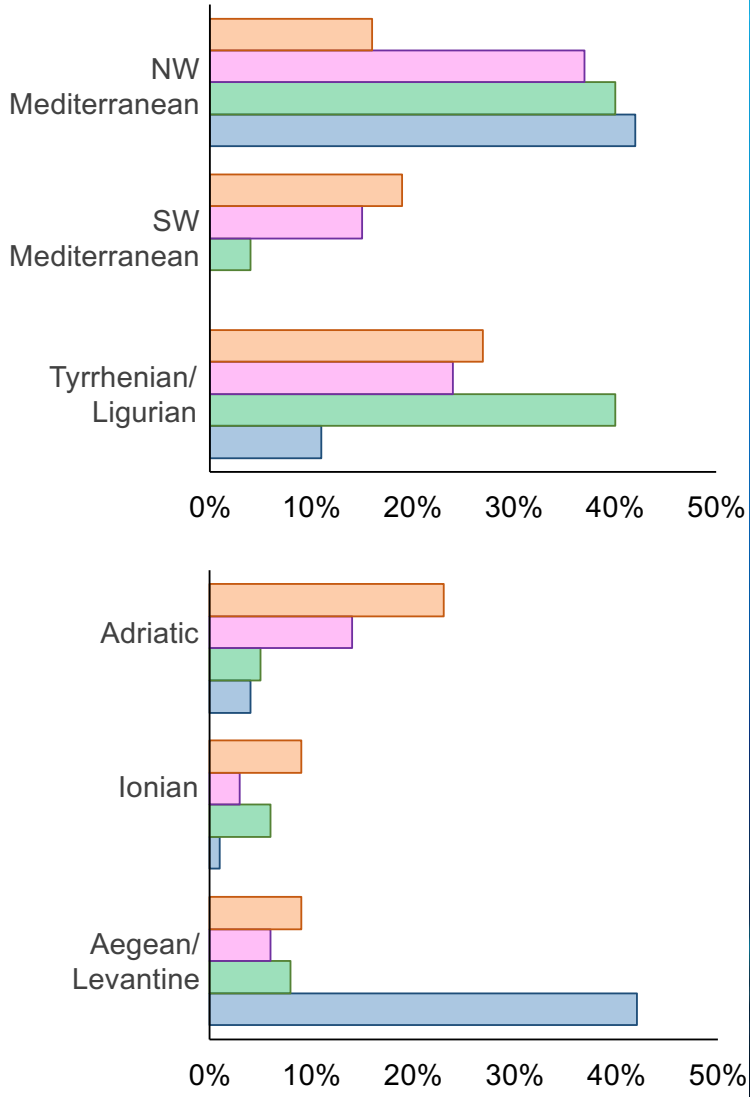
Index of ecological status of shallow (15 m) subtidal rocky reefs based on several components and their abundance. Weighted mean (ecological importance of components) to the max value of the index.

Thibaut et al. 2017

Ecological status

Bevilacqua et al., 2020





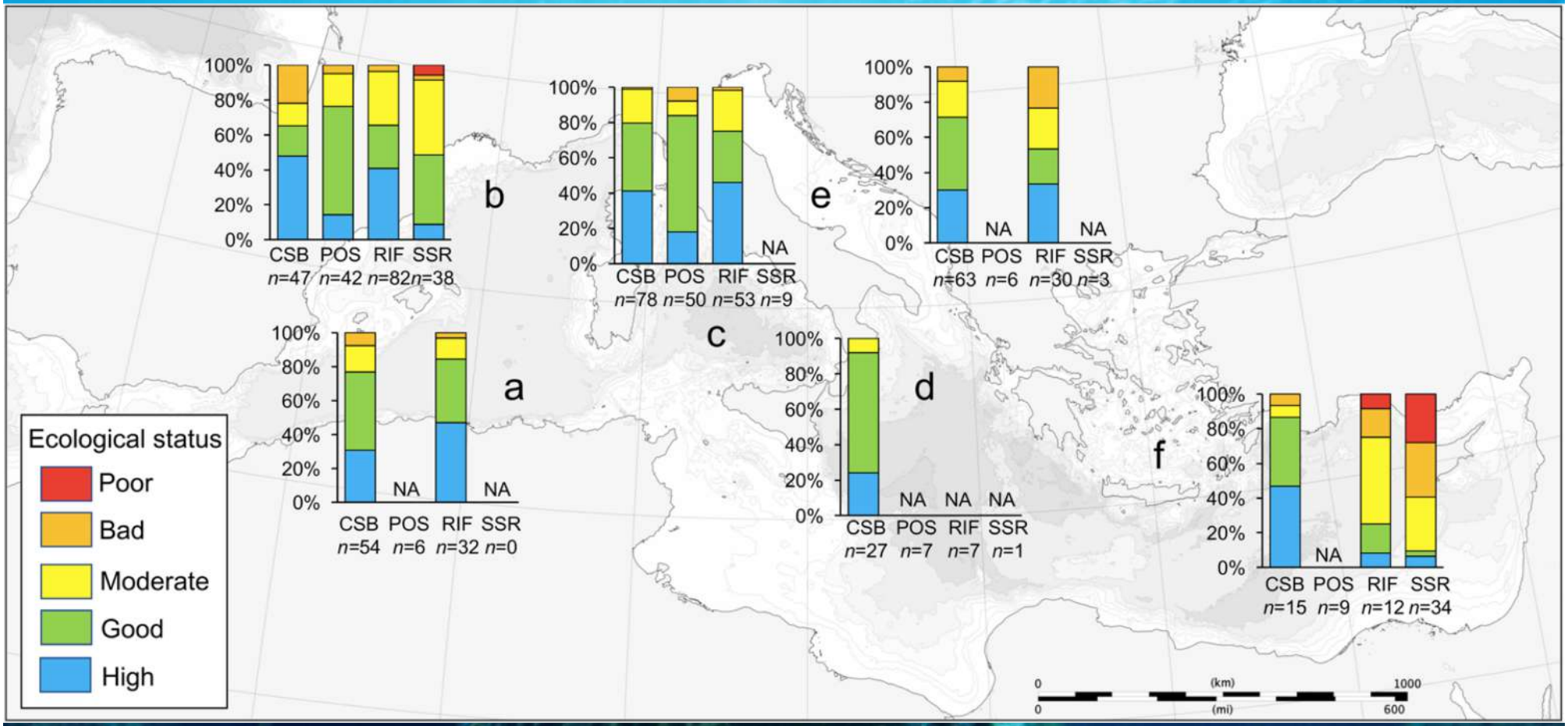
Coastal soft bottoms (CSB)

Rocky intertidal fringe (RIF)

P. oceanica beds (POS)

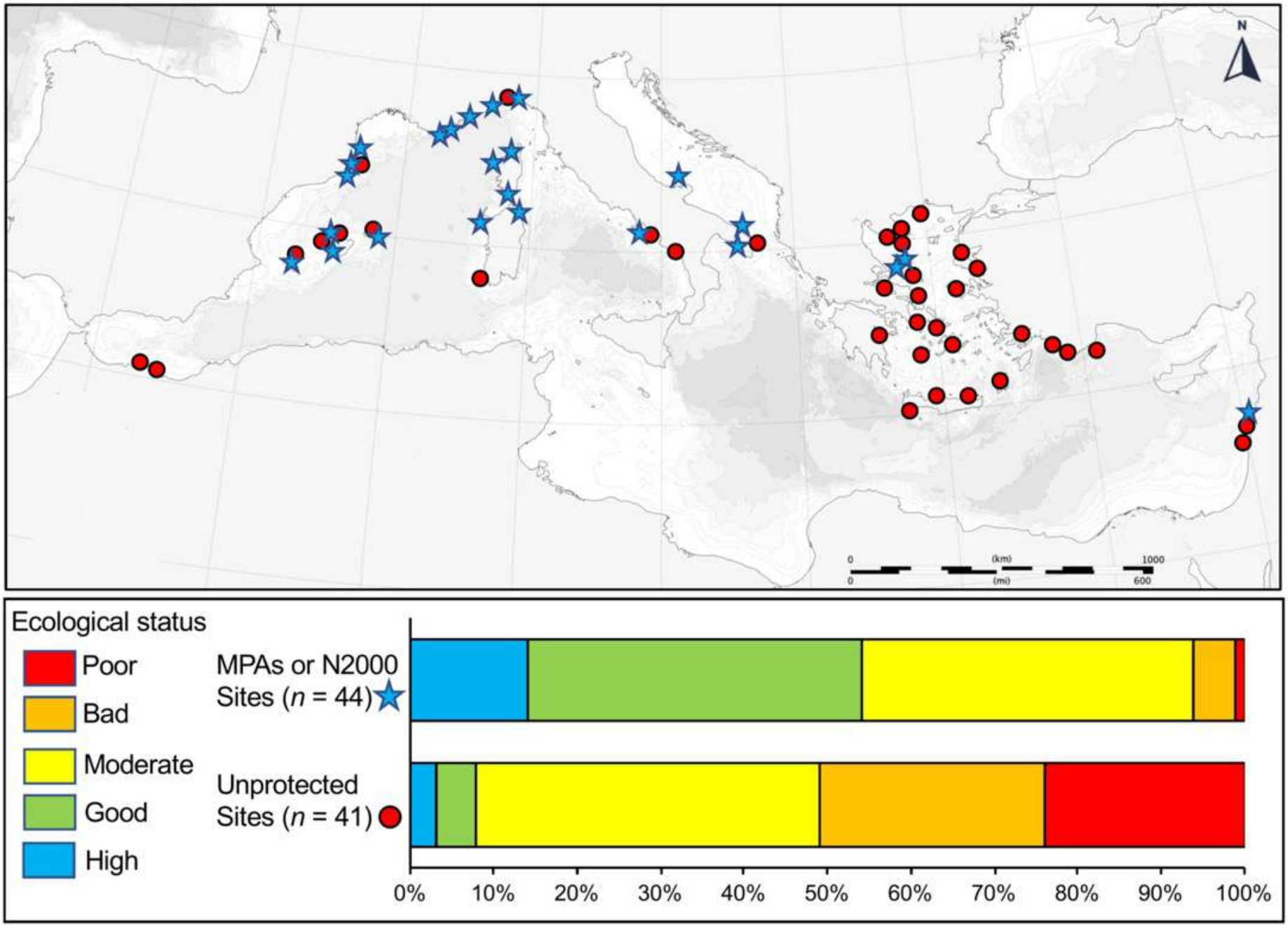
Shallow subtidal reefs (SSR)

Ecological status

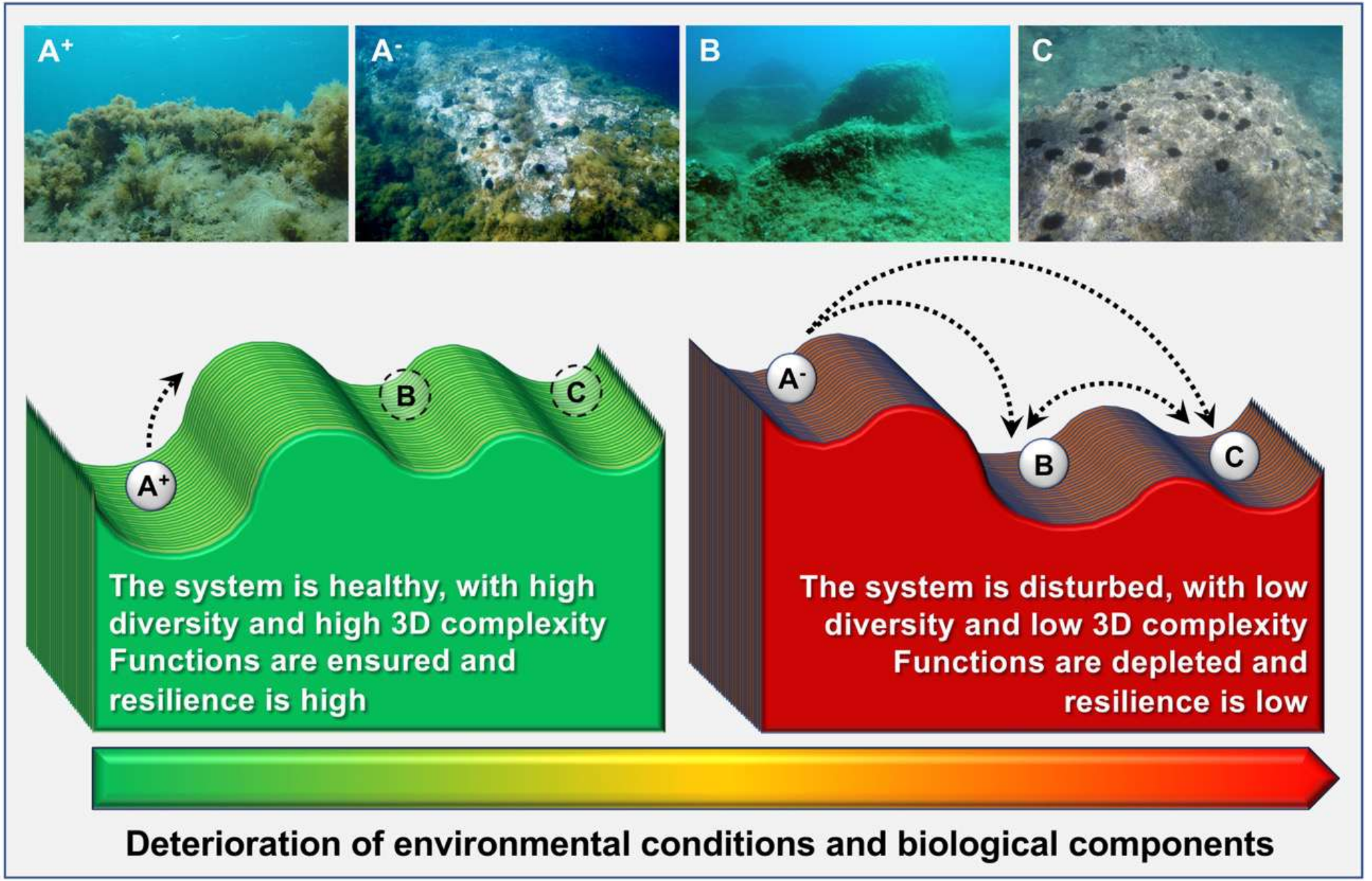


Lack of data in several areas. Apparently, rocky reefs in the Levantine basin are those in worse conditions

Ecological status



Phase shifts



The role of climate change: invasions

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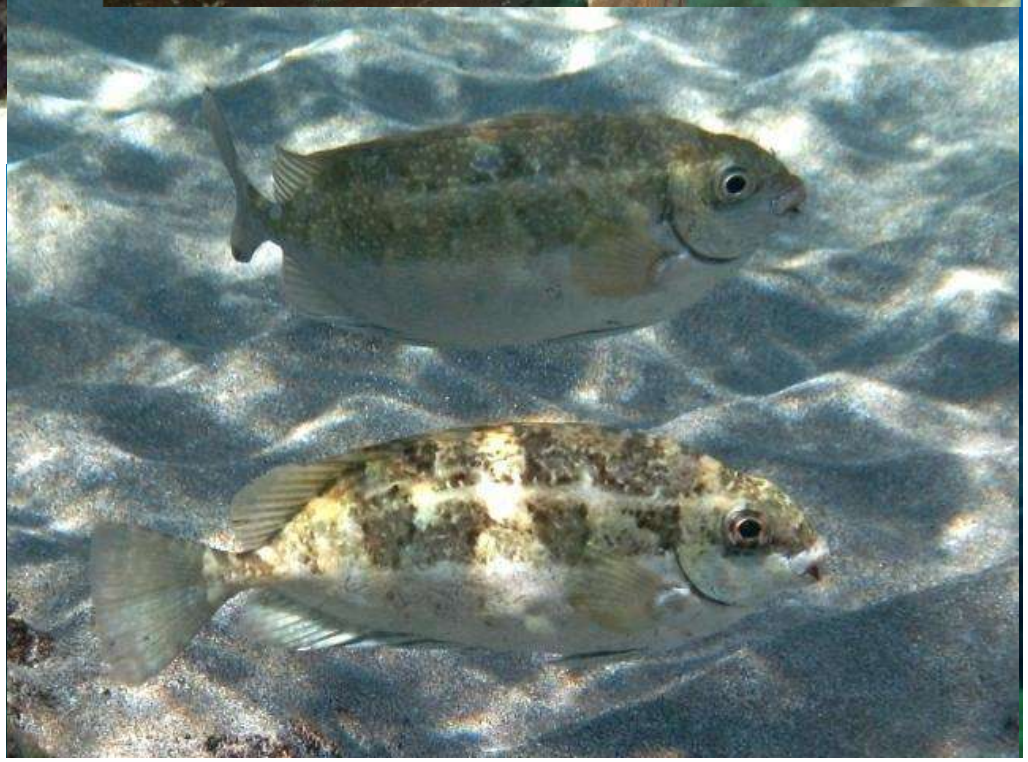
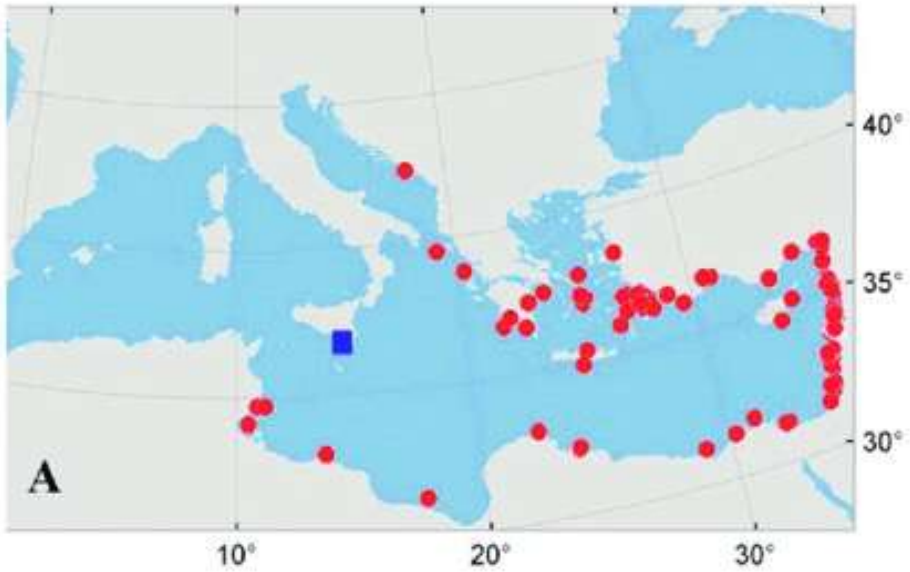




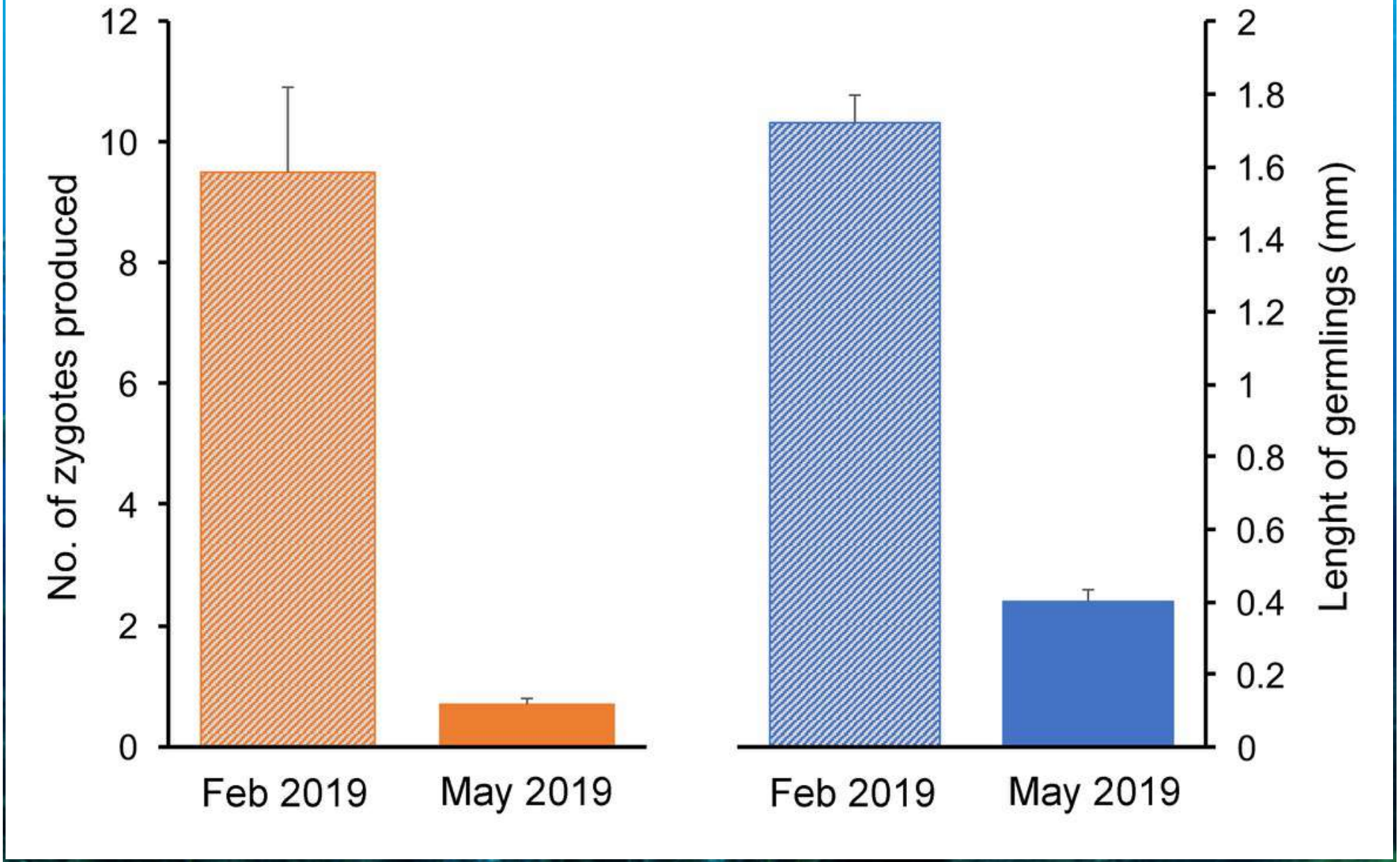
The role of climate change: heatwaves

a

b

The role of climate change

The role of climate change



Bevilacqua et al., 2019

The role of climate change