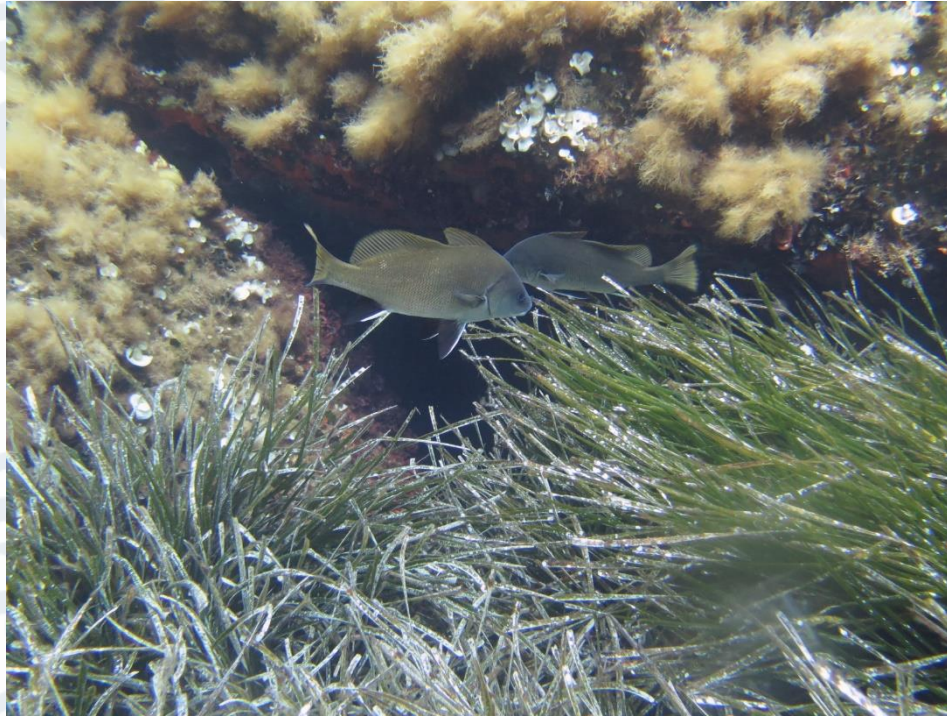


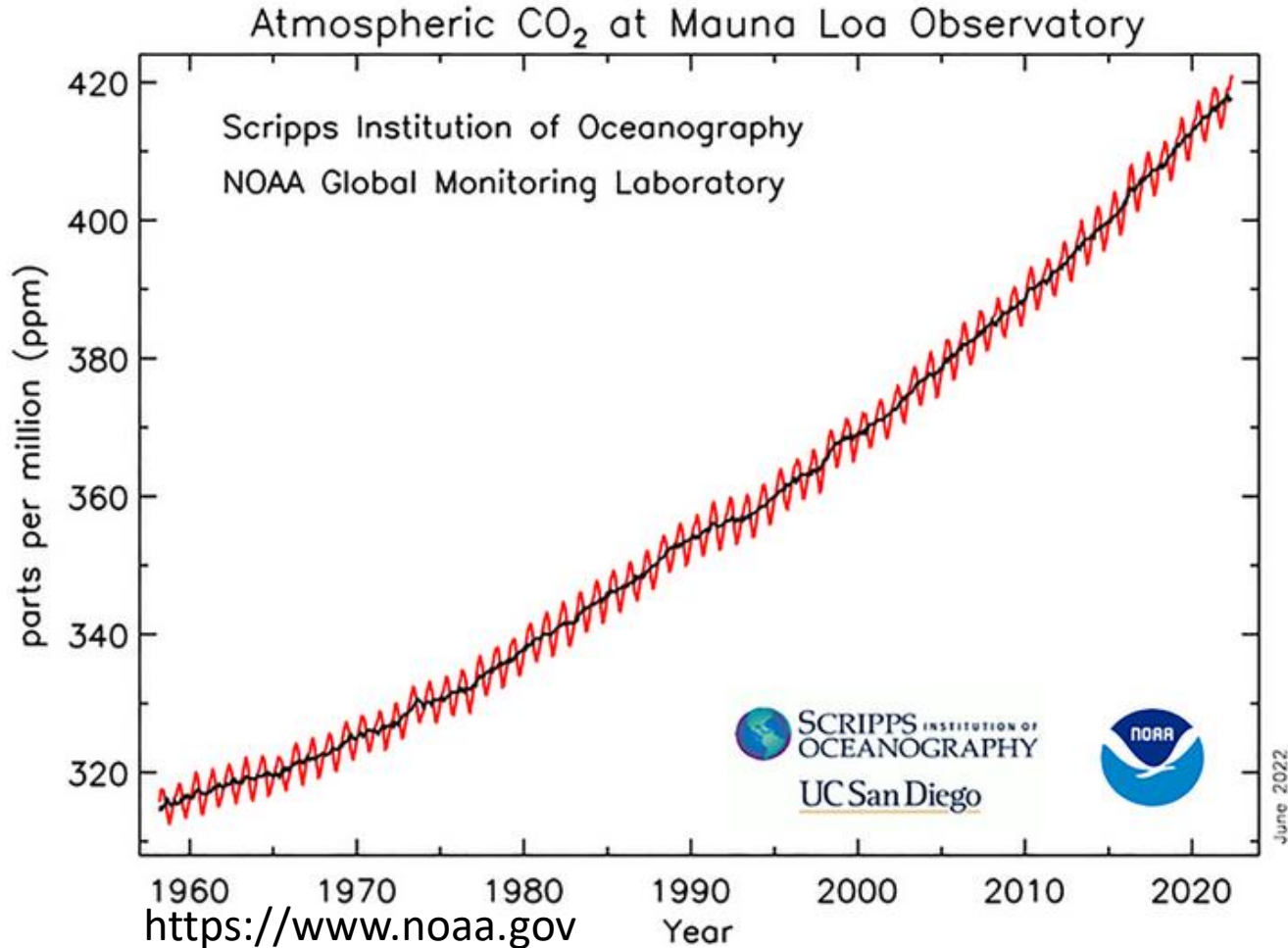
# Effetti dei cambiamenti climatici in ambiente marino



Fabio Bulleri ([fabio.bulleri@unipi.it](mailto:fabio.bulleri@unipi.it))

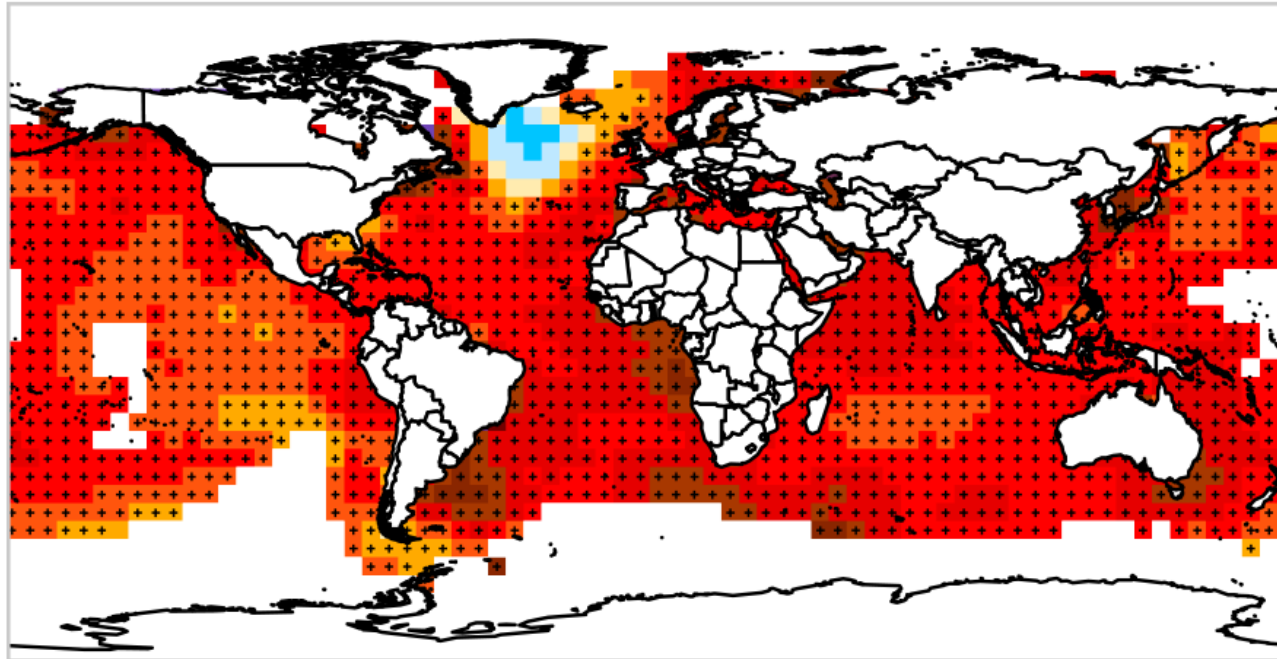
Dipartimento di Biologia, Università di Pisa, 56126, Pisa

# CO<sub>2</sub> atmosferica ed effetto serra

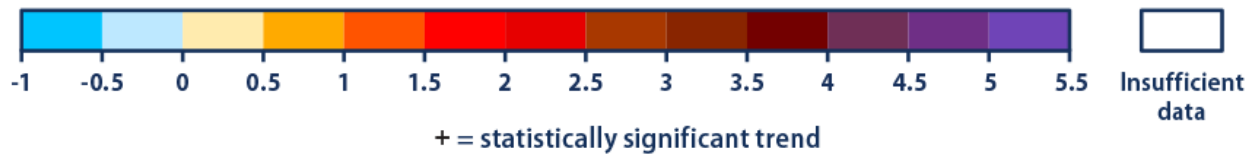


# Riscaldamento globale degli oceani

## Cambiamento in SST tra il 1901 ed il 2020

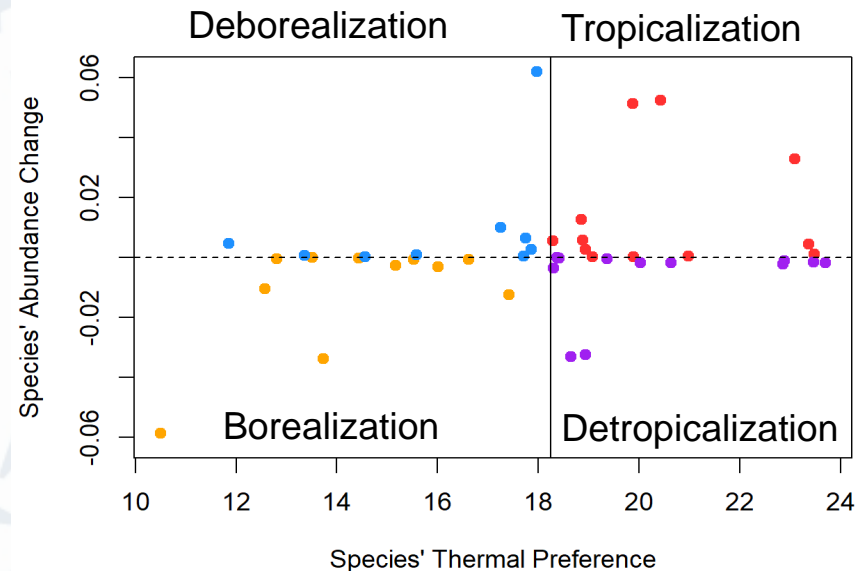
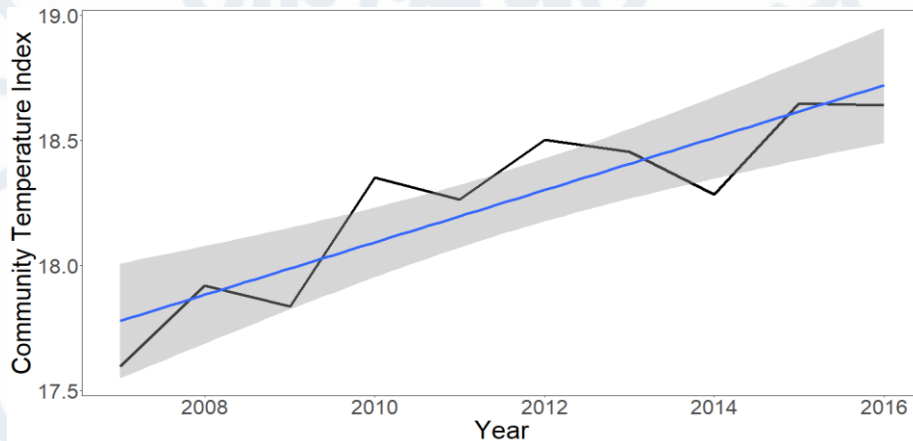


Change in sea surface temperature (°F):



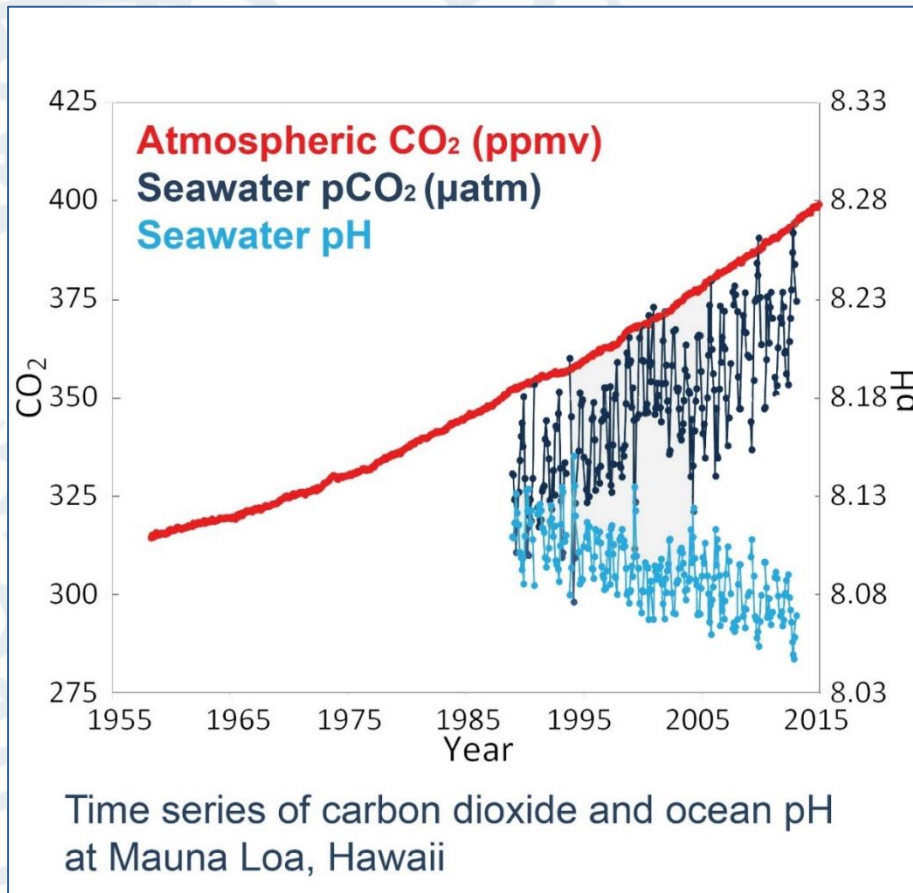
<https://www.epa.gov/climate-indicators/climate-change-indicators-sea-surface-temperature>

## Cambiamenti nella composizione di popolamenti bentonici in seguito a CC



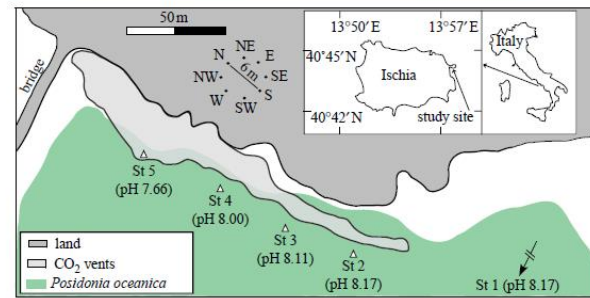
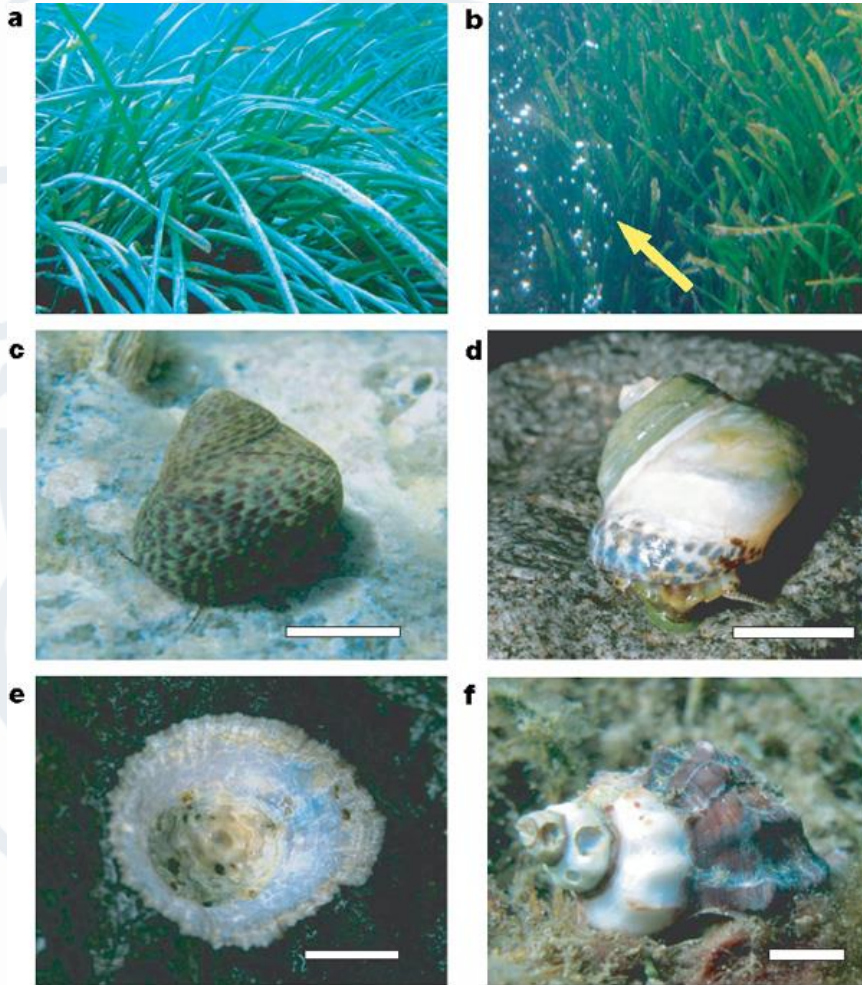
Progressivo aumento dell'abbondanza di specie con affinità per acque calde

# Acidificazione degli oceani



<https://oceanacidification.noaa.gov/OurChangingOcean.aspx>

# Effetti dell'acidificazione degli oceani



# Quali strumenti per far fronte ai cambiamenti climatici?

European Commission  
**Proposed Mission:**  
**Mission Starfish 2030:**  
**Restore our Ocean and Waters**  
 Report of the Mission Board  
 Healthy Oceans, Seas, Coastal and Inland Waters



Figure 6. Mission Starfish 2030 ©European Union, 2020

European Commission

## Bringing nature back into our lives

EU 2030 Biodiversity strategy

Biodiversity loss and the **climate crisis** are interdependent and they exacerbate each other. Restoring forests, soils and wetlands and creating green spaces in cities is essential to achieve the climate change mitigation needed by 2030.

**The new EU-wide Biodiversity Strategy will:**

- Establish protected areas for at least:
  - 30% of land in Europe**
  - 30% of sea in Europe**

With stricter protection of remaining EU primary and old-growth forests legally binding nature restoration targets in 2021.

# Quali strumenti per far fronte ai cambiamenti climatici?

## Nature-based Solutions (NBS)

*Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions*



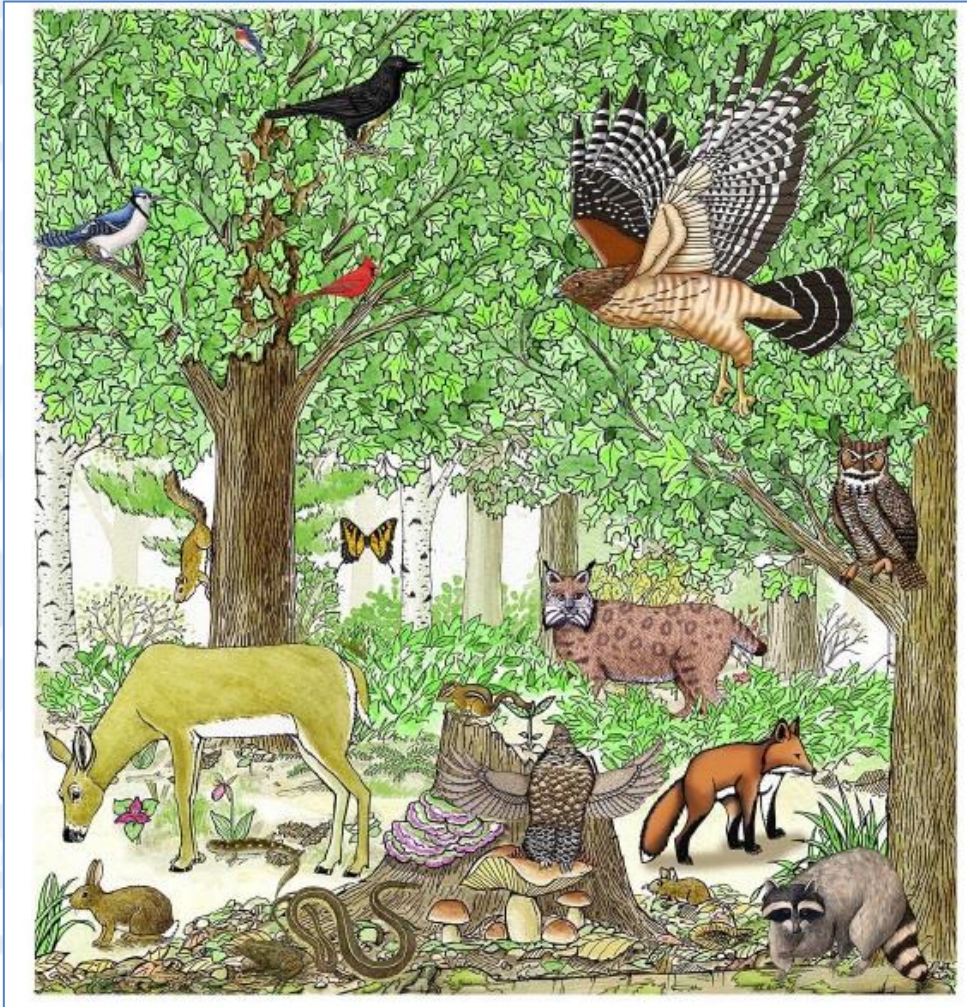
Climate Change  
and Future Marine  
Ecosystem  
Services  
and Biodiversity

<https://www.futuremares.eu/>





# Le foreste : Hotspot di biodiversità



<https://www.exploringnature.org>



- Condizioni ambientali
- Disponibilità di risorse
- Interazioni tra specie

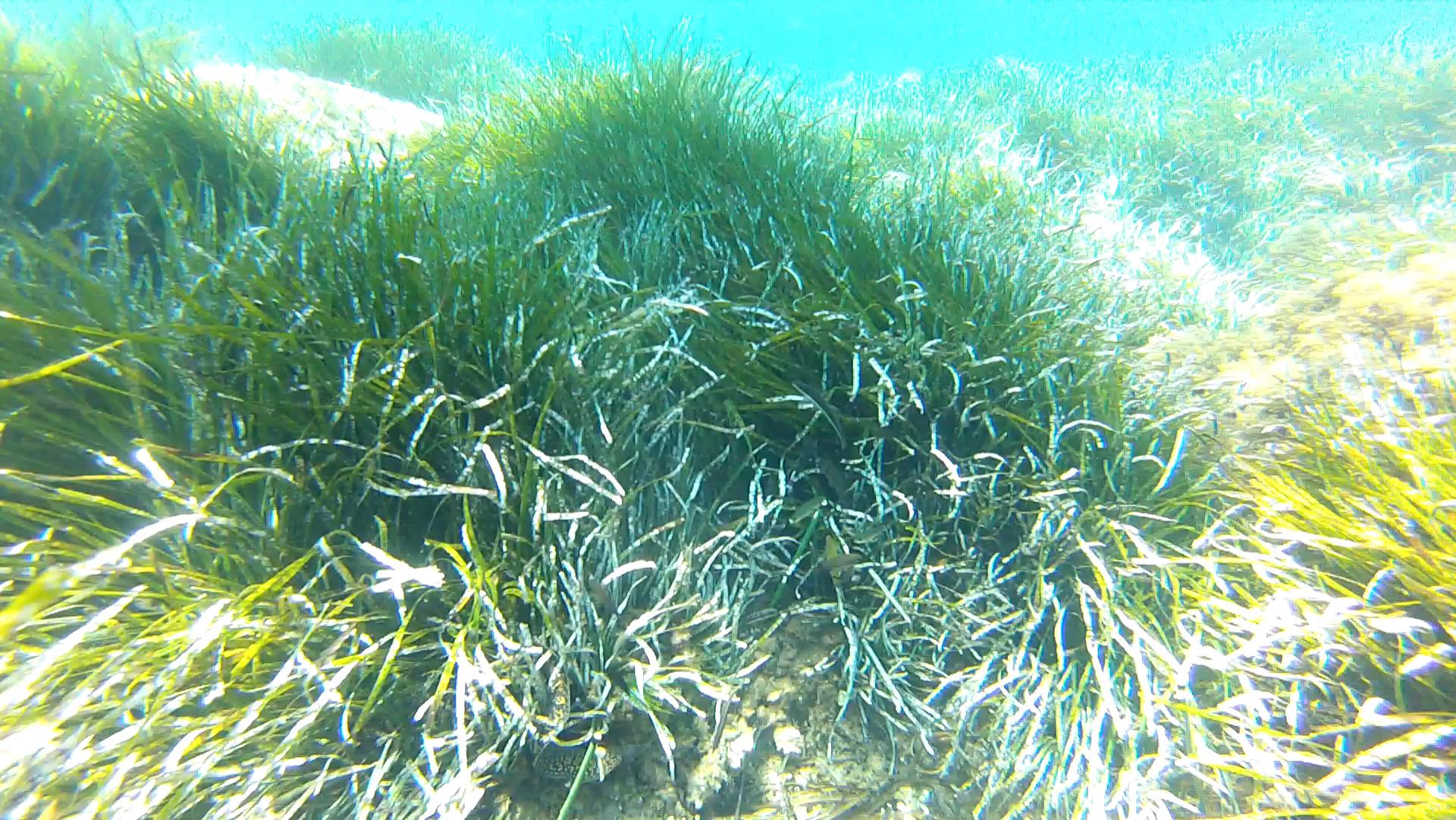
# Conservazione e ripristino di foreste sommerse



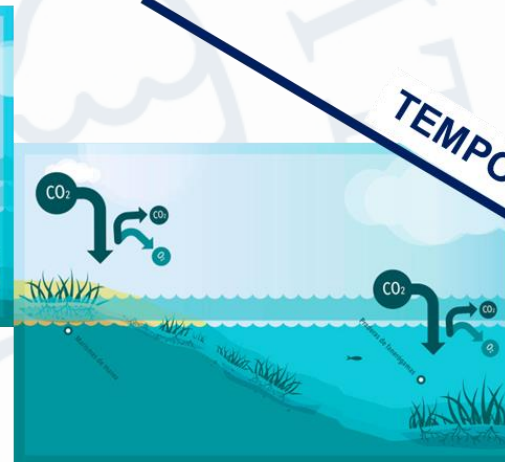
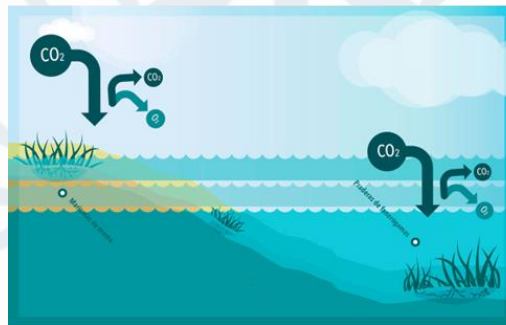
Fucales: *Ericaria* spp. in Mediterraneo

# Le foreste marine: perché sono importanti?

Formazione di habitat: alta biodiversità



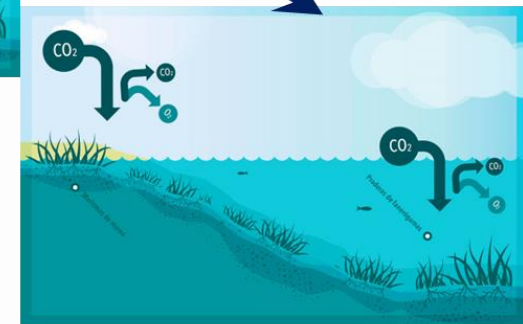
# Le foreste marine come strumento per la riduzione degli impatti dei cambiamenti climatici



<http://life-bluenatura.eu/en/blue-carbon/>



<https://www.thebluecarboninitiative.org/carbon-projects>



## Sequestro del carbonio: blue carbon

# Foreste marine come rifugio da OA

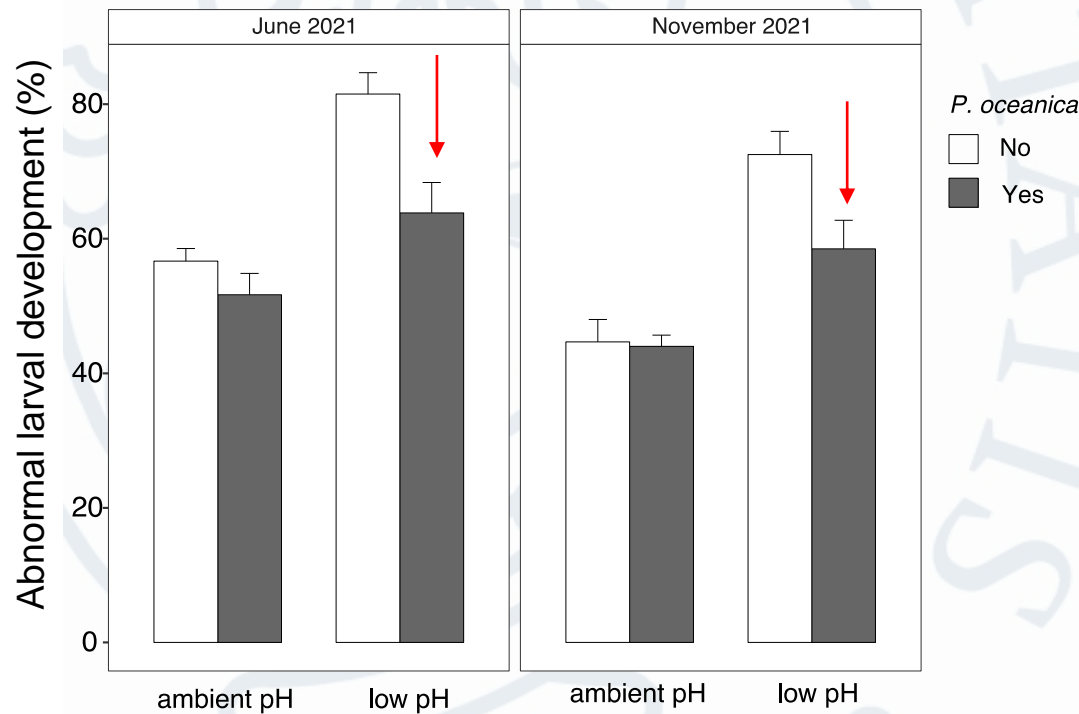
Aumento del pH durante la fotosintesi

Rilascio di gameti e fertilizzazione



# Foreste marine come rifugio da OA

Sviluppo larvale dopo 72 h in condizioni sperimentali



Maggior tasso di sviluppo normale delle larve a pH basso in presenza di *P. oceanica*

*Pluteus* larva



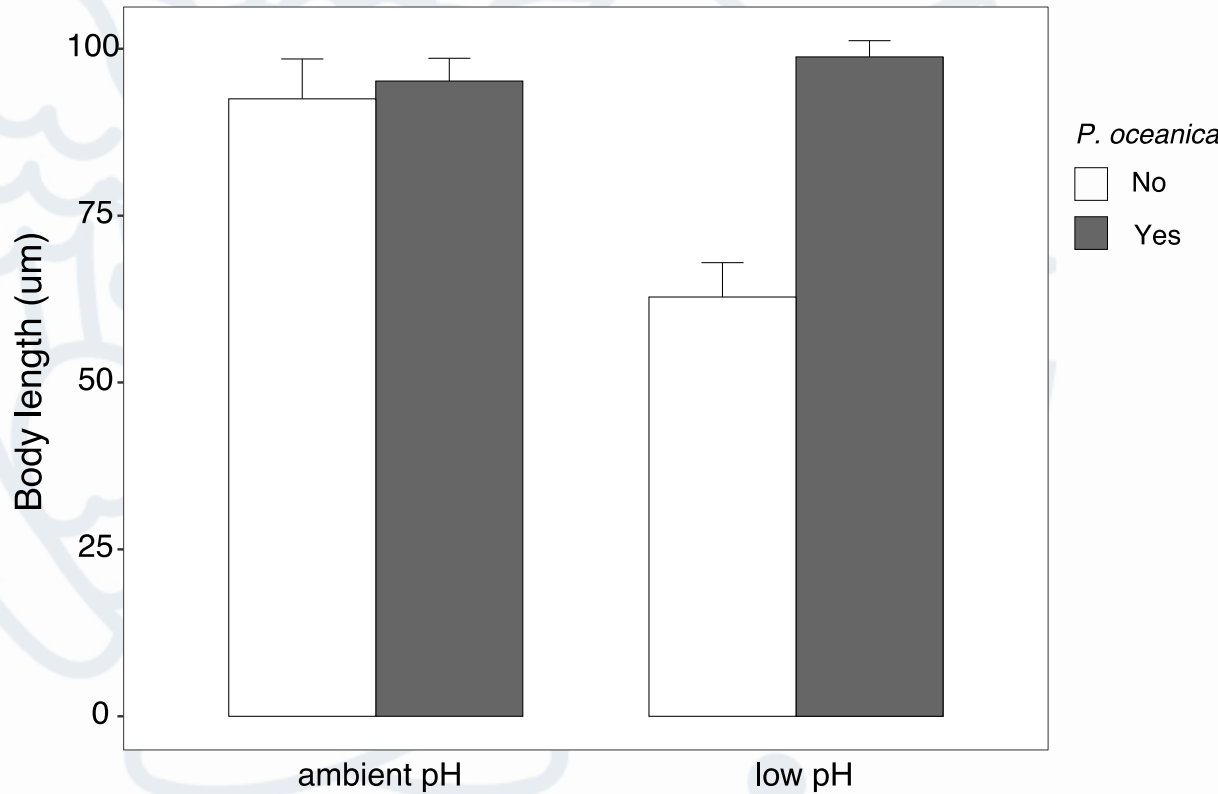
Normale



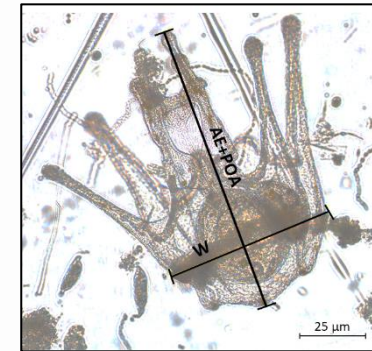
Anormale

## Foreste marine come rifugio da OA

Lunghezza delle larve dopo 30 giorni



Echinopluteus larva

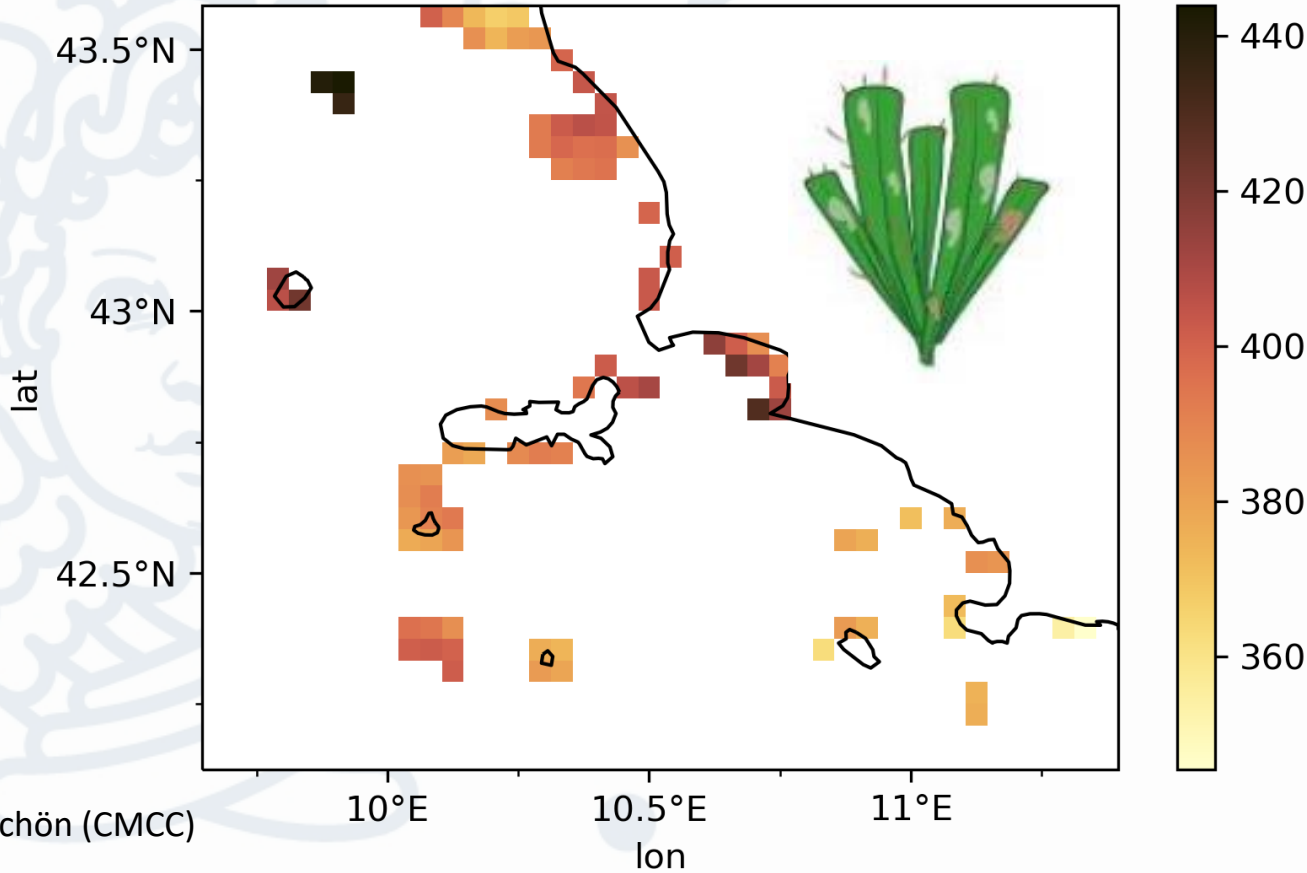


Sea urchin juvenile



# Identificazione di genotipi più resistenti a cambiamenti climatici

Cumulative Heatwave Severity [exceedance days]

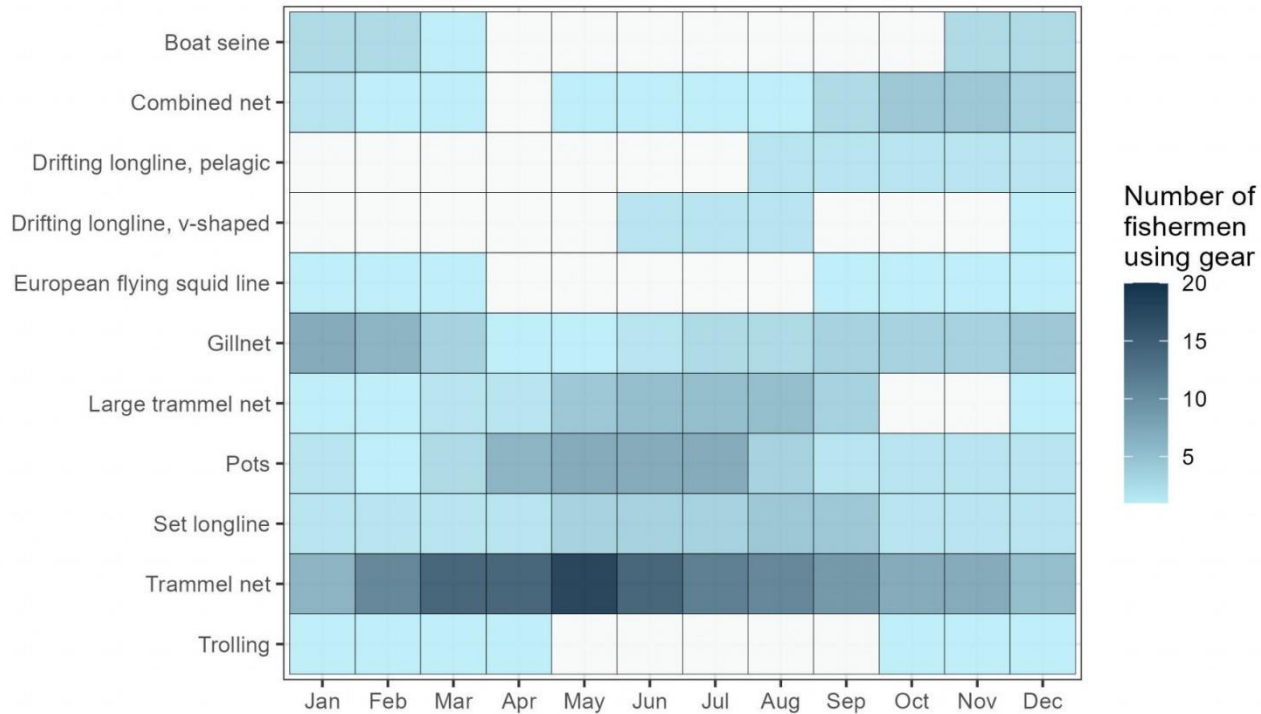


Momme Butenschön (CMCC)

Intensità e frequenza di eventi estremi (Marine Heatwaves) nel periodo 1985-2021

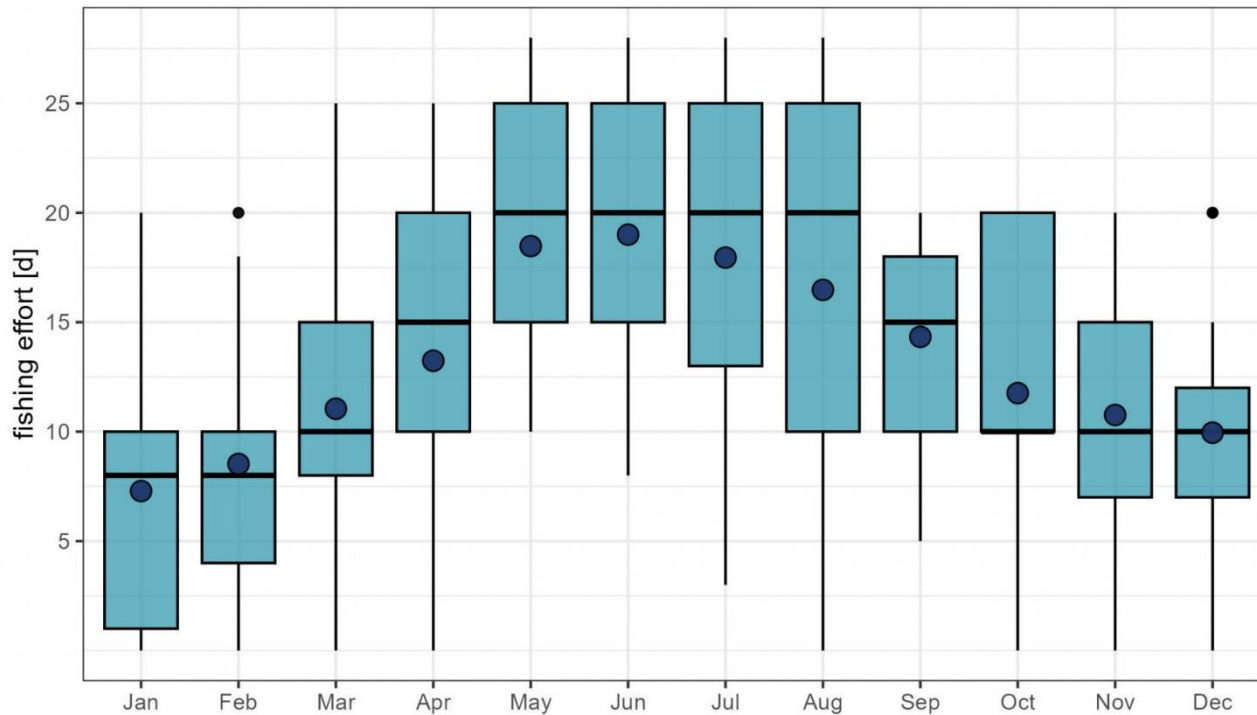


# Aspetti socio-economici



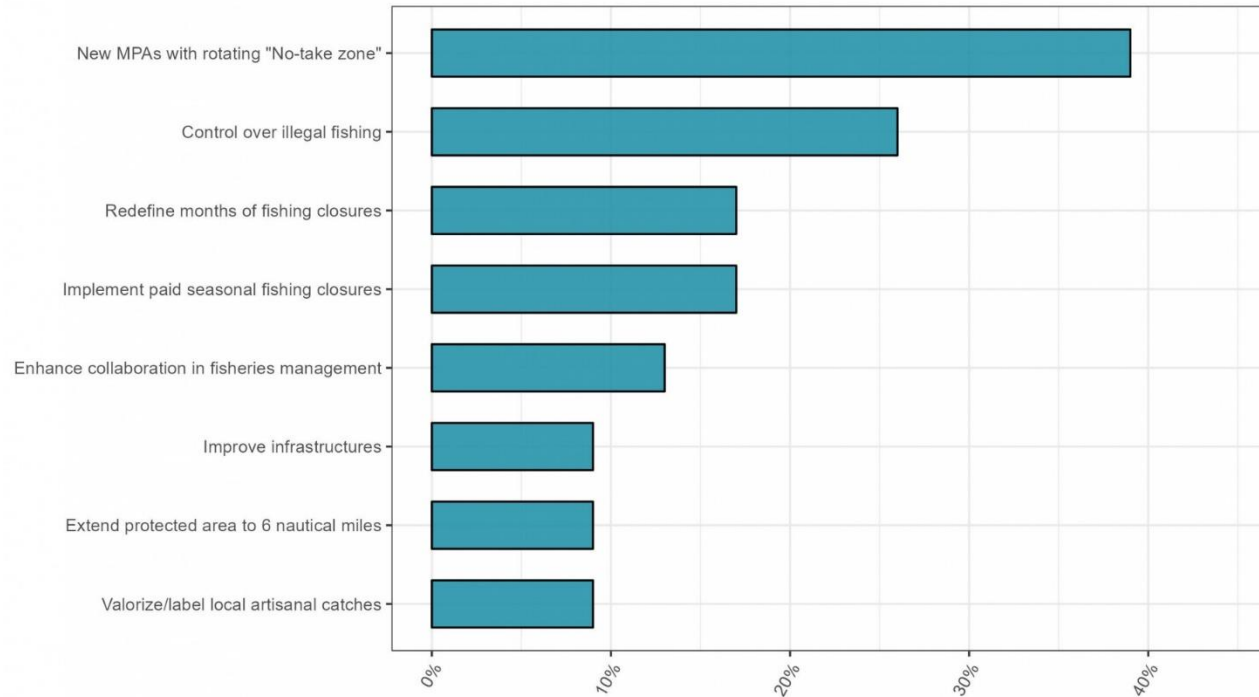
Variazione mensile nei mestieri utilizzati da pescatori artigianali nell'Arcipelago Toscano

# Aspetti socio-economici



Numero di giorni di pesca pro capite in vari mesi dell'anno

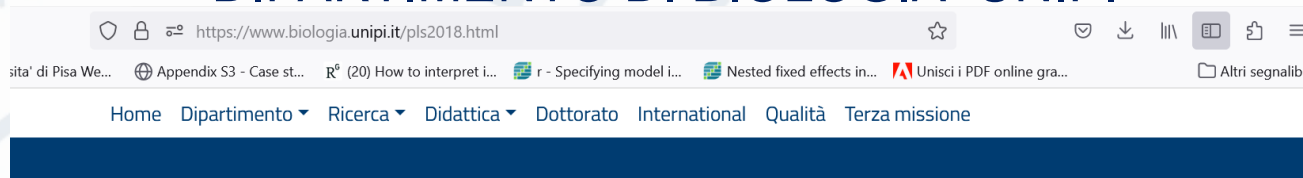
# Aspetti socio-economici



Supporto a proposte per il miglioramento della gestione della piccola pesca da parte dei pescatori nell'Arcipelago Toscano

# Opportunità per didattica e formazione

## DIPARTIMENTO DI BIOLOGIA -UNIPI



### Piano Lauree Scientifiche

Il **Piano Lauree Scientifiche** (PLS) è un progetto di lavoro con scolaresche e studenti delle scuole superiori che nasce nel 2014 da un accordo tra Ministero dell'Istruzione, dell'Università e della Ricerca, Confindustria e Conferenza Nazionale dei Presidi delle Facoltà di Scienze e Tecnologie.

- [PLS Biologia e Biotecnologie](#)
- [PLS Scienze Naturali e Ambientali](#)

### Orientamento

- [Home](#)
- [Piano Lauree Scientifiche \(PLS\)](#)
- [Career Center](#)

<https://www.biologia.unipi.it/pls2018.html>

### CIRSEC-UNIPI

<https://cirsec.unipi.it/>



**Attività 2023/2024 in definizione**

### Attività 2022/2023

- **Ricercatori in classe**
- **Formazione dei docenti**
- **Progettazione di un giardino scolastico**

# Ringraziamenti



Climate Change  
and Future Marine  
Ecosystem  
Services  
and Biodiversity

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Welcome to FutureMARES

## Research for Sustainable Marine Ecosystems and Biodiversity in a Climate Changed World

FutureMARES is an EU-funded research project examining the relations between climate change, marine biodiversity and ecosystem services. Our activities are designed around two Nature-based Solutions (NBS) and one Nature-inclusive Harvesting (NIH) :

- Effective Restoration (NBS1)
- Effective Conservation (NBS2)
- Nature-inclusive Harvesting (NIH)

We're conducting our research and cooperating with marine organisations and the public in five [Case Study Regions](#) across the globe. Our goal is to provide science-based policy advice on how best to use NBS/NIH to protect future biodiversity and ecosystem services in a future climate.

[More about FutureMARES](#) →

FutureMARES project <https://www.futuremares.eu/> has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869300.