



# Effects of climatic changes and alternative fisheries management measures in the Adriatic Sea

Simone Libralato<sup>1,\*</sup>

Natalia Serpetti<sup>1</sup>, Igor Celić<sup>1</sup>, Pasquale Ricci<sup>2</sup>, Davide Agnetta<sup>1</sup>, Silvia Angelini<sup>3</sup>, Isabella Bitetto<sup>4</sup>, Roberto Carlucci<sup>2</sup>, Giulia Cipriano<sup>2</sup>, Gianpiero Cossarini<sup>1</sup>, Igor Isailovic<sup>5</sup>, Svjetlana Krstulović Šifner<sup>6</sup>, Francesco Masnadi<sup>3,7</sup>, Diego Panzeri<sup>1,8</sup>, Marco Reale<sup>1</sup>, Tommaso Russo<sup>2,9</sup>, Giuseppe Scarcella<sup>3</sup>, Maria Teresa Spedicato<sup>4</sup>, Walter Zupa<sup>4</sup>, Nedo Vrgoc<sup>5</sup>

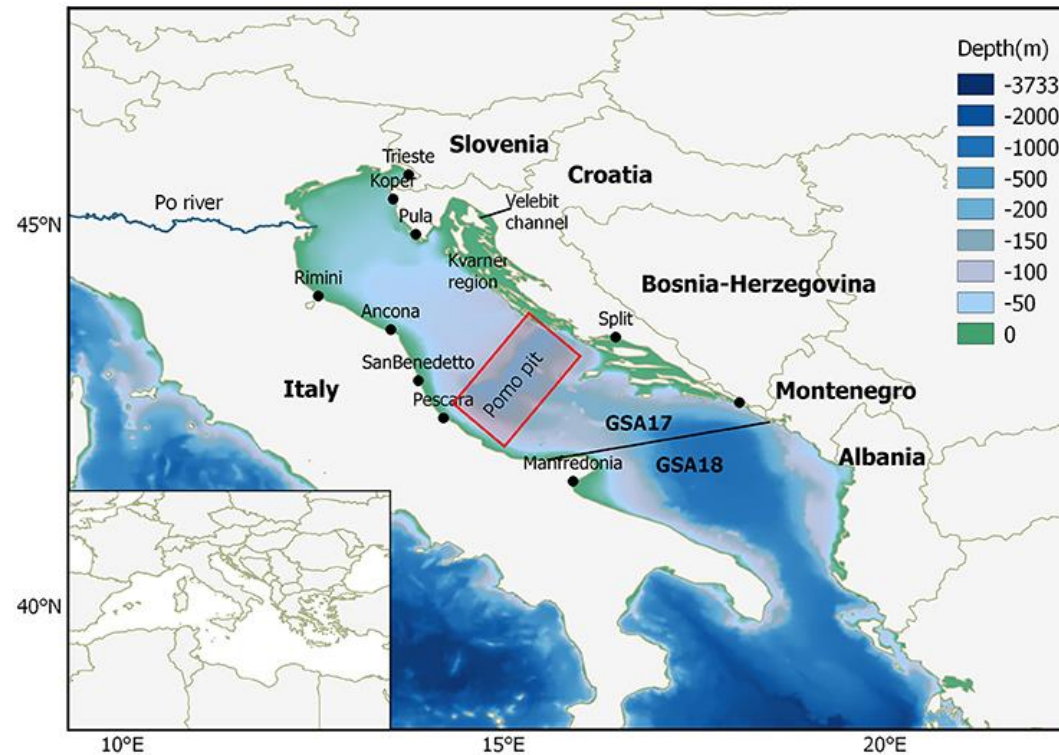


# Fisheries and climate impacts on the Adriatic Sea

The Adriatic Sea is one of the most trawled areas of the world (*Amoroso et al., 2022, PNAS*) with long history of exploitation with several species in overfishing

Climate is negatively affecting the basin productivity (*Piroddi et al., 2020*) with cascading effects on marine communities (*Libralato et al., 2015*)

Among several recent mgm measures adopted (reduction of capacity, effort), **establishment of a large Fisheries Restricted Area (FRA) in the central Adriatic (Pomo/Jabuka Pit, *GFCM, 2017*)**



## OBJECTIVES:

- disentangle the effect and efficacy of the several measures in place;
- considering new mgm measures ones foreseen by Multiannual Management plans (reduction of effort), and new spatial measures (30% by 2030).
- Disentangle the role of climatic changes.

USE of the ECOSPACE model of the Adriatic Sea developed in FAIRSEA

# An Ecospace model of the Adriatic Sea

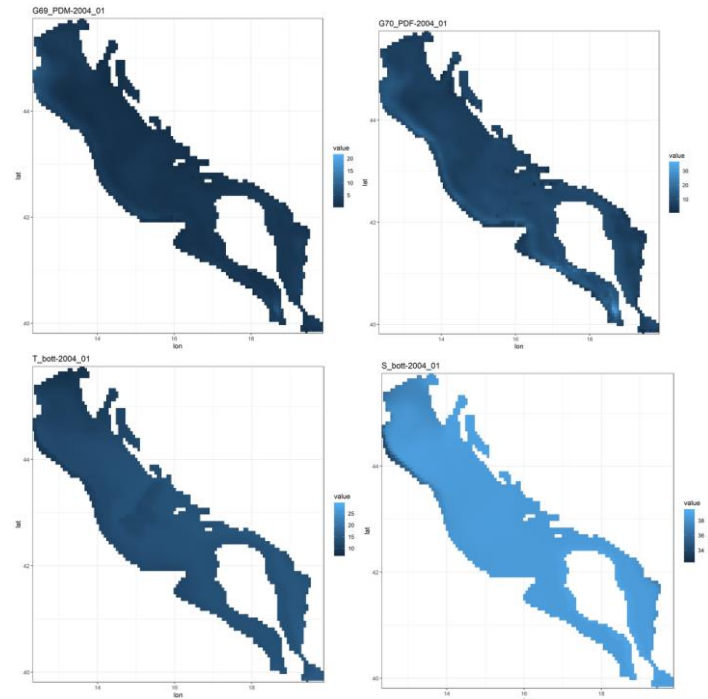
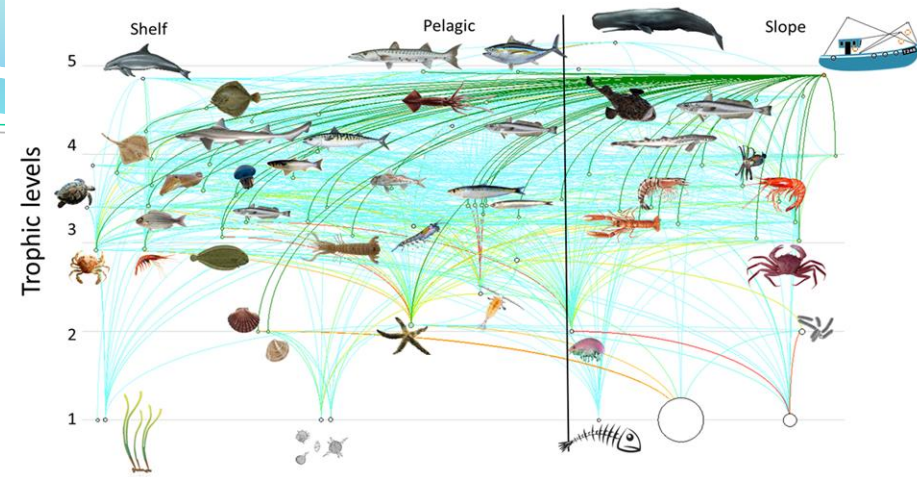
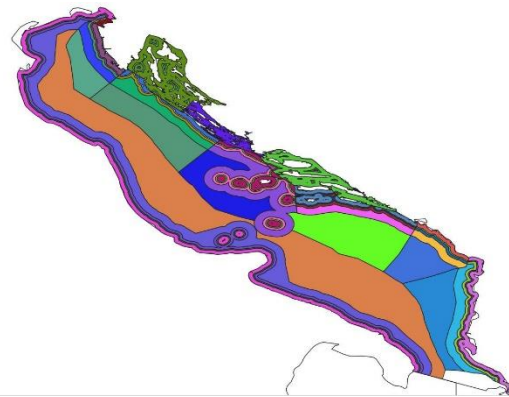
- Food web model described with **73 functional groups**, with key target species (hake, red mullet, norway lobster, anchovy, sardine, mantis shrimp, common sole, deep water rose shrimp) detailed into size/age classes
- Lower trophic levels (plankton) are described with **several plankton functional types** integrating results from physical-biogeochemical 3D models
- **33 Fishing fleets** distinguished by gear type, fleet segment size (based on LOA) and country, describing specific landings, discards, capacity and effort
- **Dynamic model calibrated over data for the period 2000-2018**, considering administrative boundaries for fisheries and regulations implemented
- **Spatial model resolution 1/16 of degree** (approximately 6 km x 6 km) using spatial temporal framework, i.e., monthly 2D fields of physical and biogeochemical variables

## Main Data sets used

MEDITS & SOLEMON trawl survey data; stock assessments; MEDIAS data

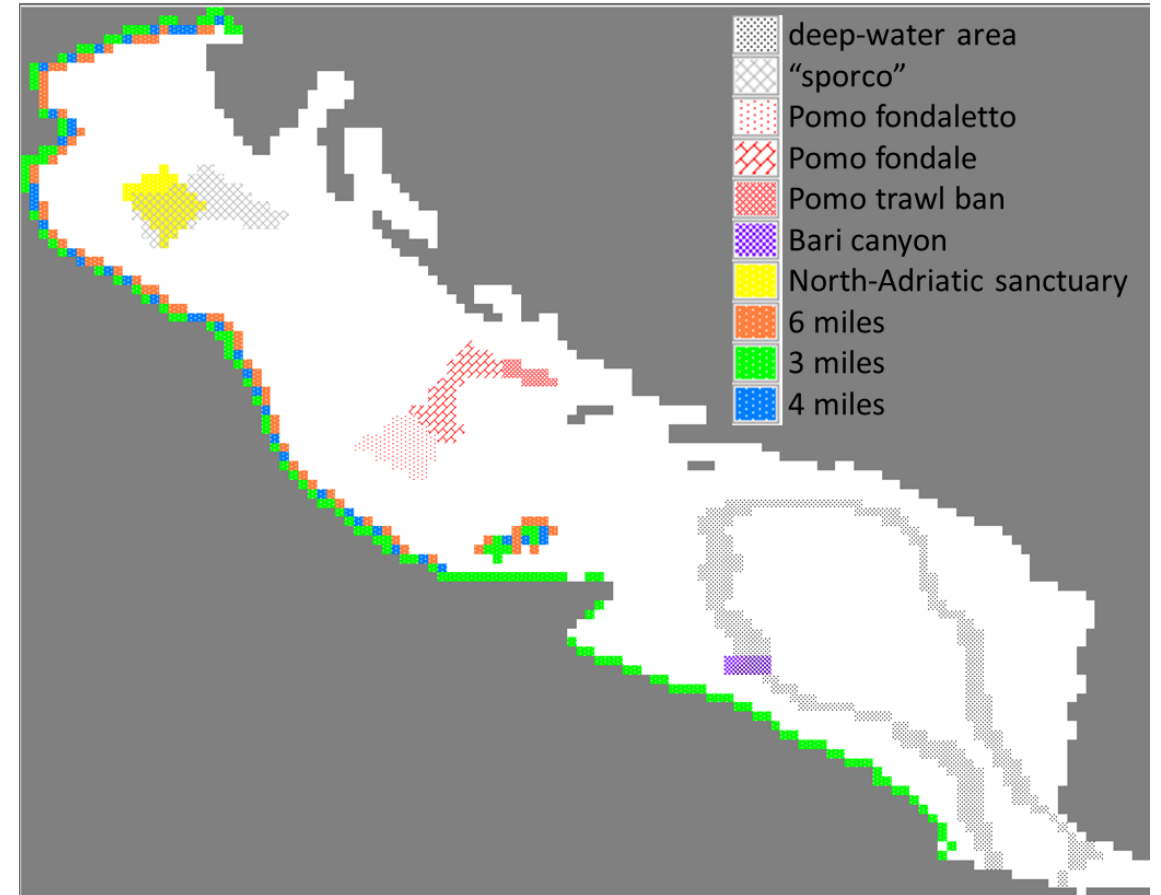
Copernicus Mediterranean model (OPATM-BFM)

EU-DCF data, Fleet register, Eurostat, VMS-AIS analysis

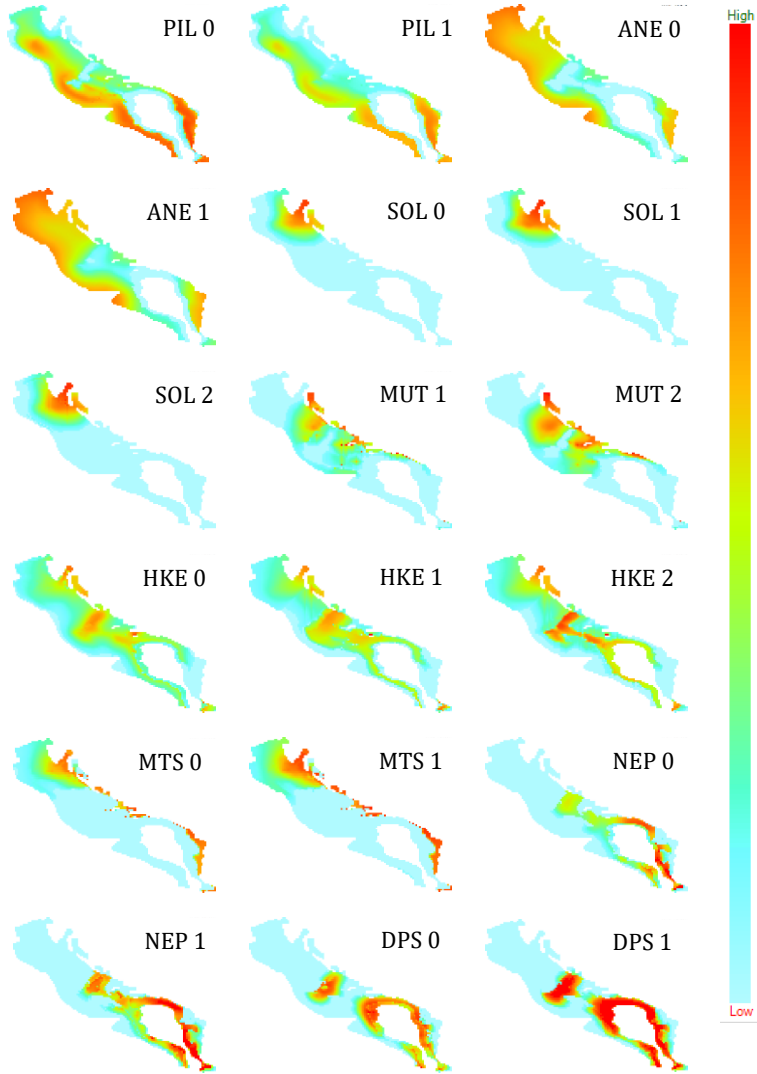


# Scenario analysis

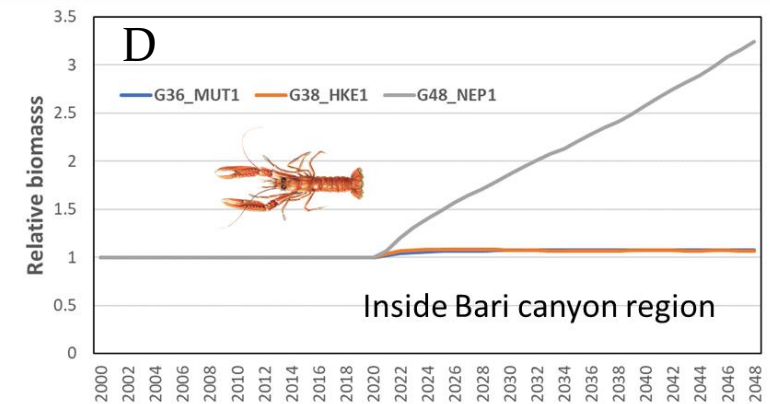
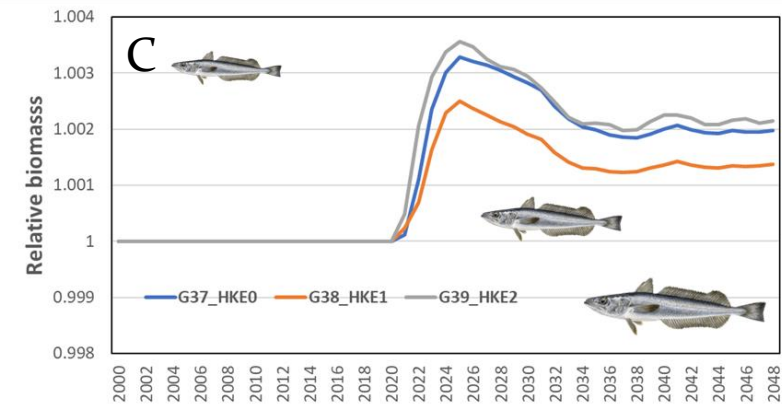
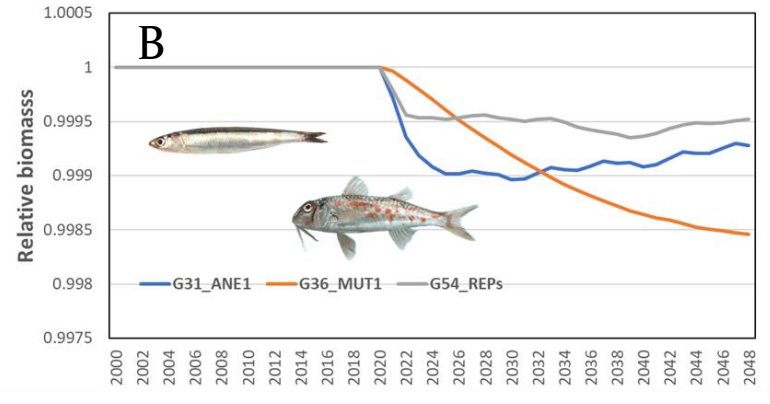
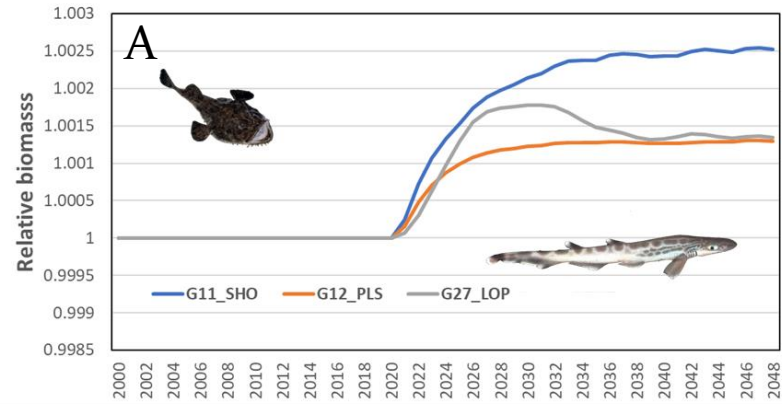
- Tested the role of FRA implemented (e.g. Pomo) and planned (e.g., North Sanctuary; Bari Canyon).
- Sc0) business as usual (effort 2018 kept constant);
- S1) coastal closure (no trawling 0-6 NM) on Italian side;
- S2) effort reduction for trawlers up to 2026 as foreseen by the MAP;
- S3) effort reduction (2021-2026) & implementation of additional FRAs (Bari & Sanctuary)
- S4) climatic changes effects (RCP8.5) forced with results of Mediterranean biogeochemical model (plankton biomass)



# Effects of FRA



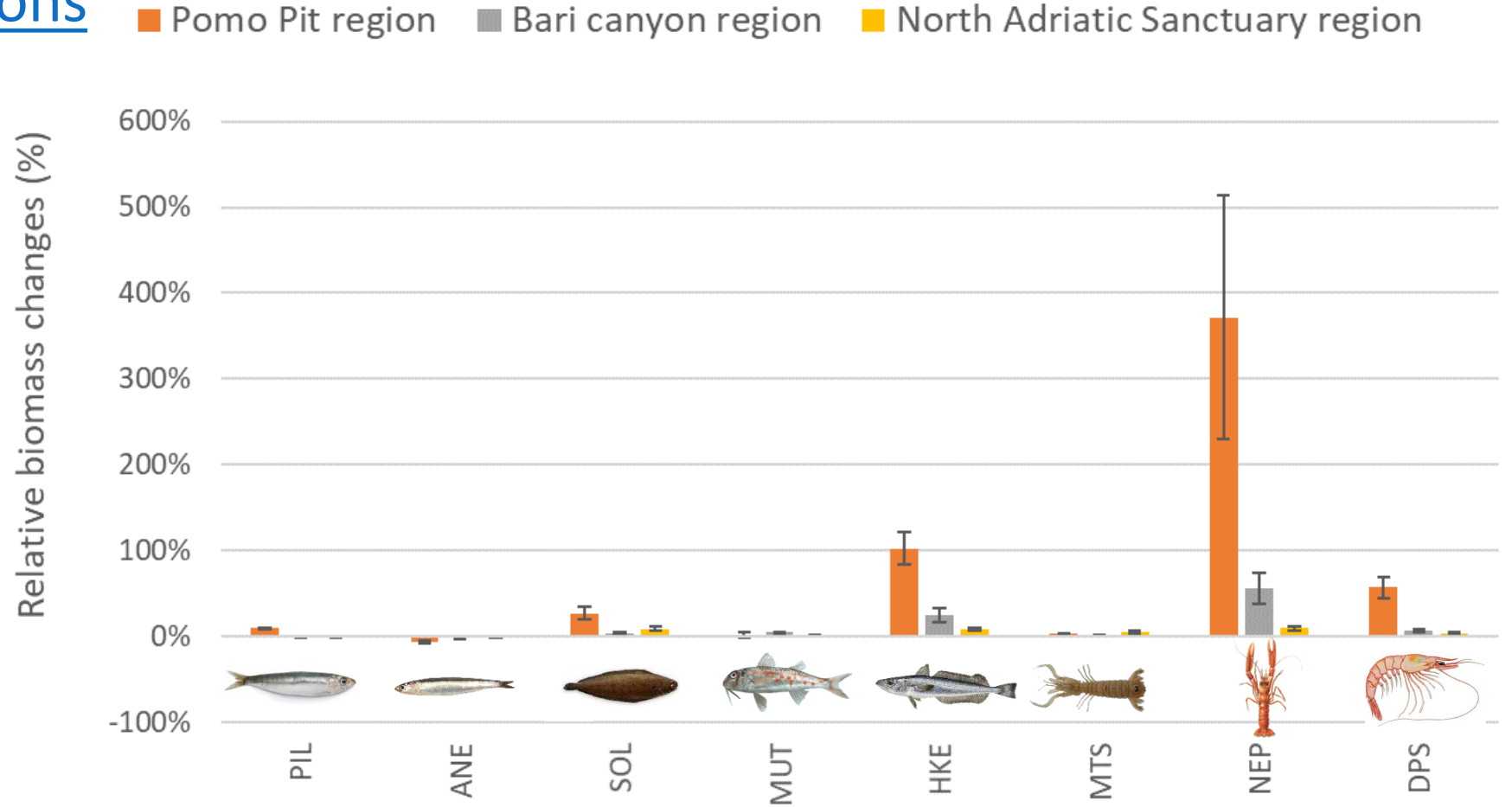
Dynamic evaluation of spatial closure and their positive (direct) effects and cascading effects. Example of Bari canyon: positive for exploited top-predators (A), negative for some of their preys (B), interesting intra-specific effects due to cannibalism (C), effect of depleted targets species (D).



# Effectiveness of different FRAs: INSIDE restricted regions

Inside the area restricted by fisheries the effects are similar but bigger for Pomo than for Bari Canyon than for North Adriatic Sanctuary. Effects inside the FRA is very high with rebuilding of stocks locally

FRA sensitivity biomass @ regions

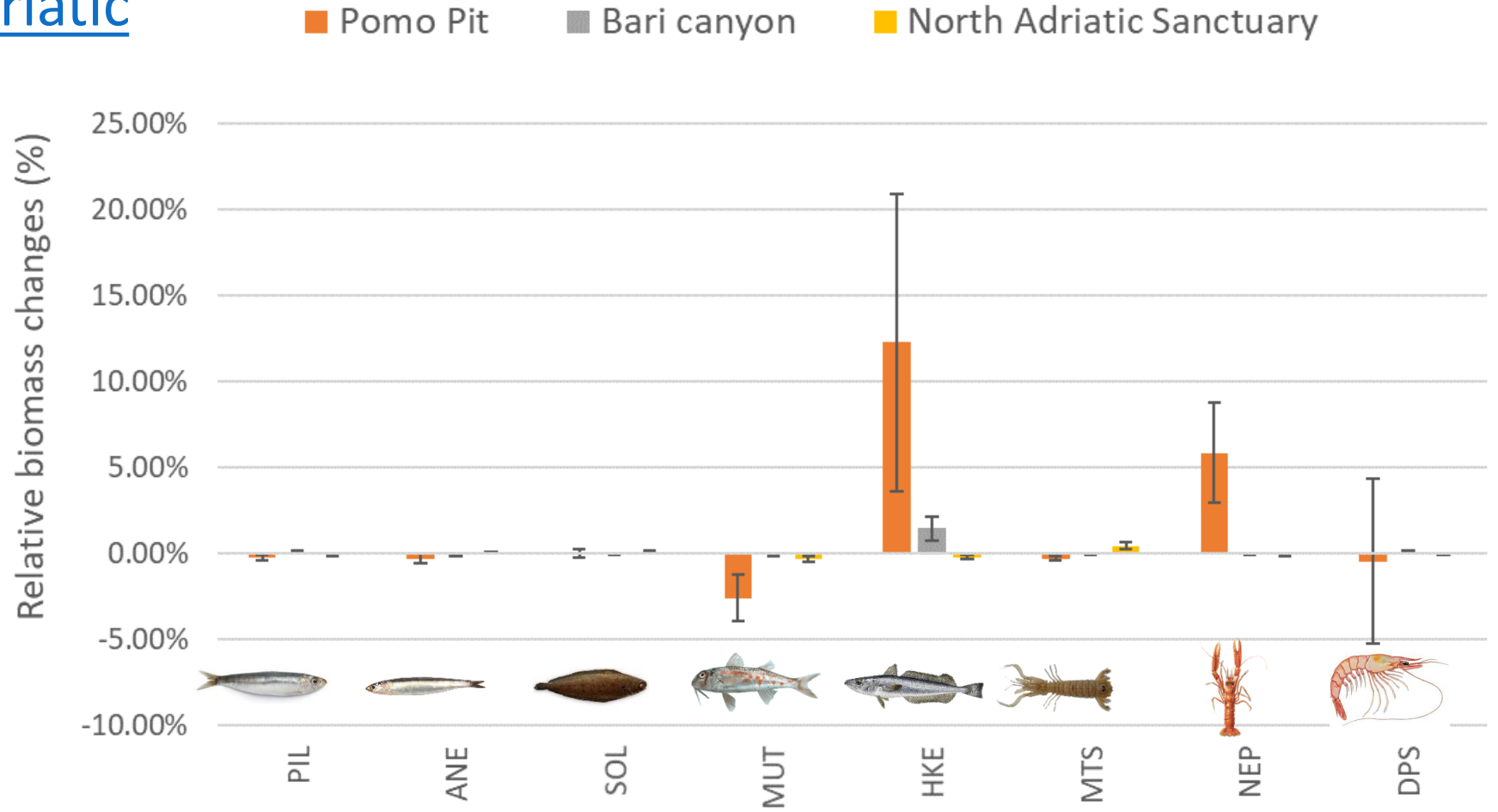


# Effectiveness of different FRAs: Effects in the whole Adriatic

One is expected to see effects on the whole Adriatic (e.g., from stock assessment?): appreciable effects at the level of the Adriatic only for Pomo FRA.

So size matters, smaller FRAs might be useful when used in combinations (networks of managed areas).

FRA sensitivity biomass @ sea

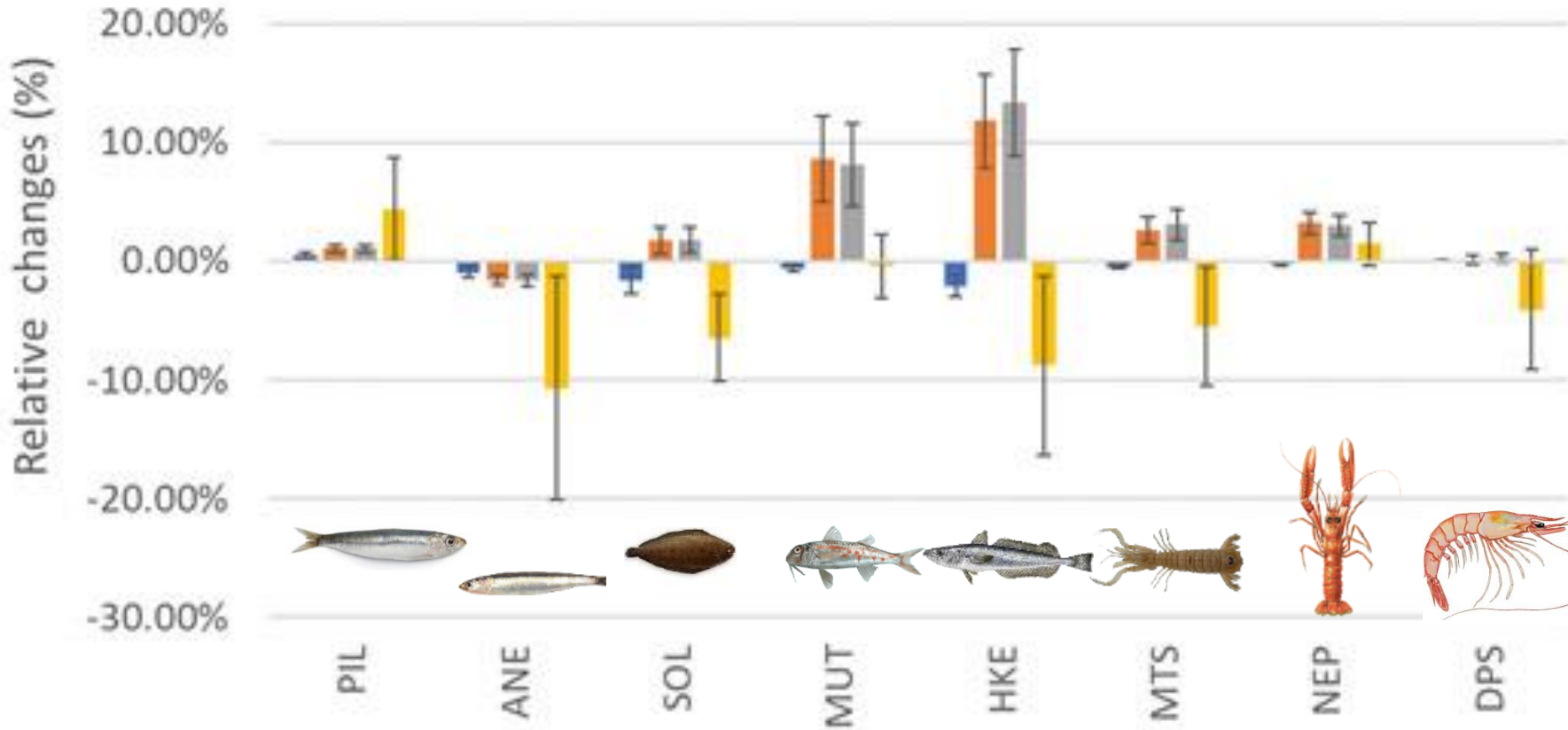


# Comparison of Management scenario analysis (averages at 2050)

A)

## Management scenarios biomasses

- S1\_Italian coastal closure (6M)
- S2\_effort reduction (2022-2026)
- S3\_effort reduction (2022-2026) + FRAs
- S4\_Climate



The implementation of the **coastal closure 4-6 miles from the Italian coastline (S1)** caused a **dislocation of the fishery activity** towards areas with high abundances of target species causing a reduction of biomass at sea. The impact of the implementation of all FRAs (S3) applied in a scenario with reduced effort (S2) was not significant as **the impacts of the FRAs is of one order of magnitude smaller than the impact of effort reduction.**

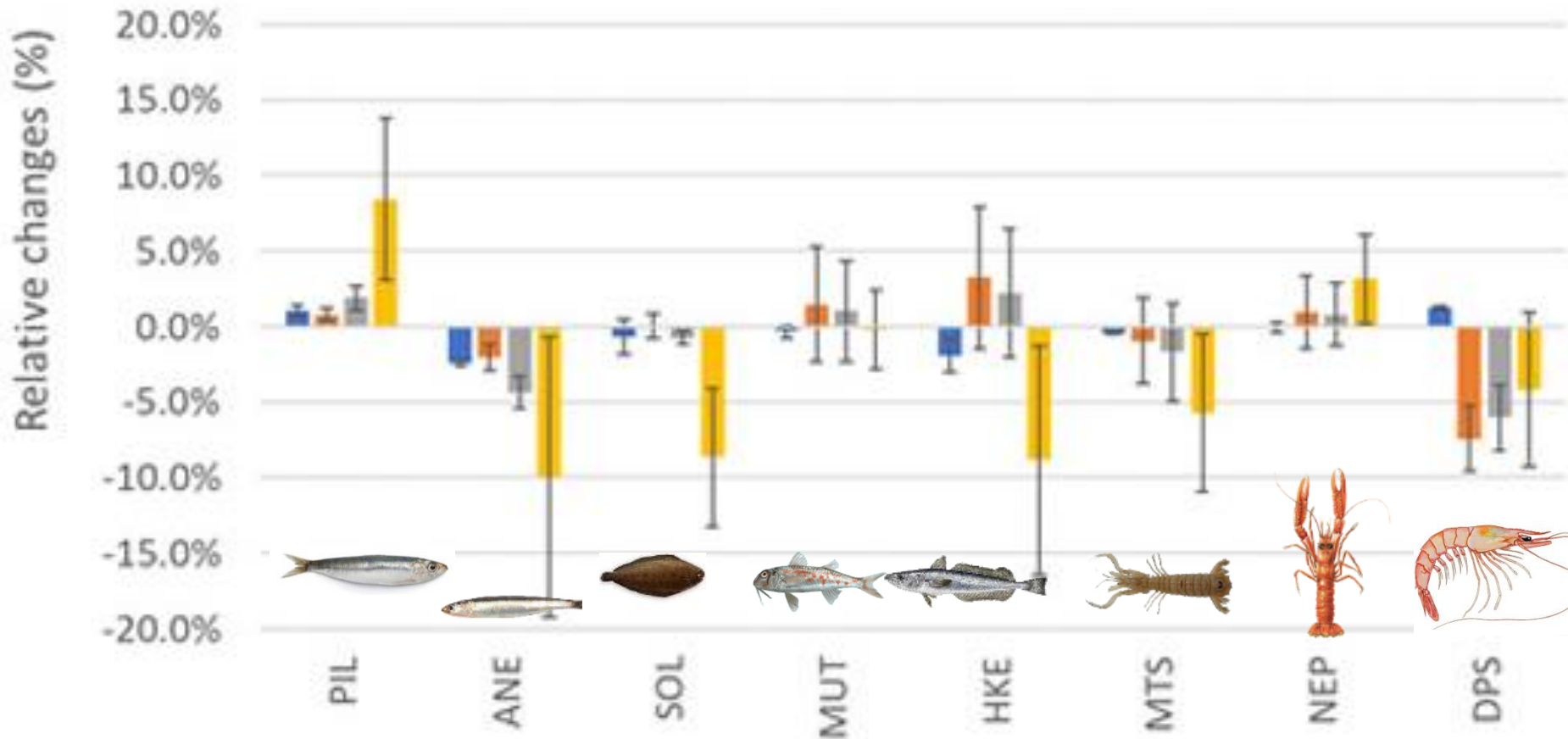


# Comparison of Management scenario analysis (averages at 2050)

B)

## Management scenarios catches

- S1\_Italian coastal closure
- S2\_effort reduction (2022-2026)
- S3\_effort reduction (2022-2026) + FRAs
- S4\_Climate



Predicted reductions of **-10%±11%**

for large phytoplankton and

**5%±7%**

for small phytoplankton **by the end of 2050 due to CC** are **affecting very negatively the whole system**

## Conclusions

The Adriatic scenarios developed with ECOSPACE, **although might be improved in accuracy**, provide a set of important results that have potentially large implications:

- **The DIMENSION and POSITION of FRA matters**, and larger the area larger the effects inside and outside the managed area. Nevertheless, the trophic cascade due to protection of top predators (e.g., European hake) result in cascading reduced biomass of some other commercially relevant preys (anchovy).
- Among management scenarios the **coastal closure (S1) represents the most controversial** because of reduction of catches even in the long run due to the simple displacement of fishing pressure from the coast (increasing offshore).
- **The impact of the effort reduction (-25%) was an order of magnitude higher than the effect of implementation of the FRAs.** After expected initial decrease of catches, however, the rebuilding of biomasses at sea for several species determined a subsequent increase of theirs catches at mid-end terms (after 10 years). **INCREASE in fishing EFFICIENCY**
- Copernicus IPCC RCP 8.5 scenario predicted strong reductions of biomass for small and large phytoplankton groups, driven by rising water temperature that increased the metabolism and the overall turnover rates of the phytoplankton groups. These cause an overall reduction of the entire ecosystem production that cascade and can be amplified through the food web with the highest decreases found for anchovy. **Climate effects are bigger than effects induced by any management measure.**

# THANK YOU!



## Effects of climatic changes and alternative fisheries management measures in the Adriatic Sea

Simone Libralato<sup>1,\*</sup>

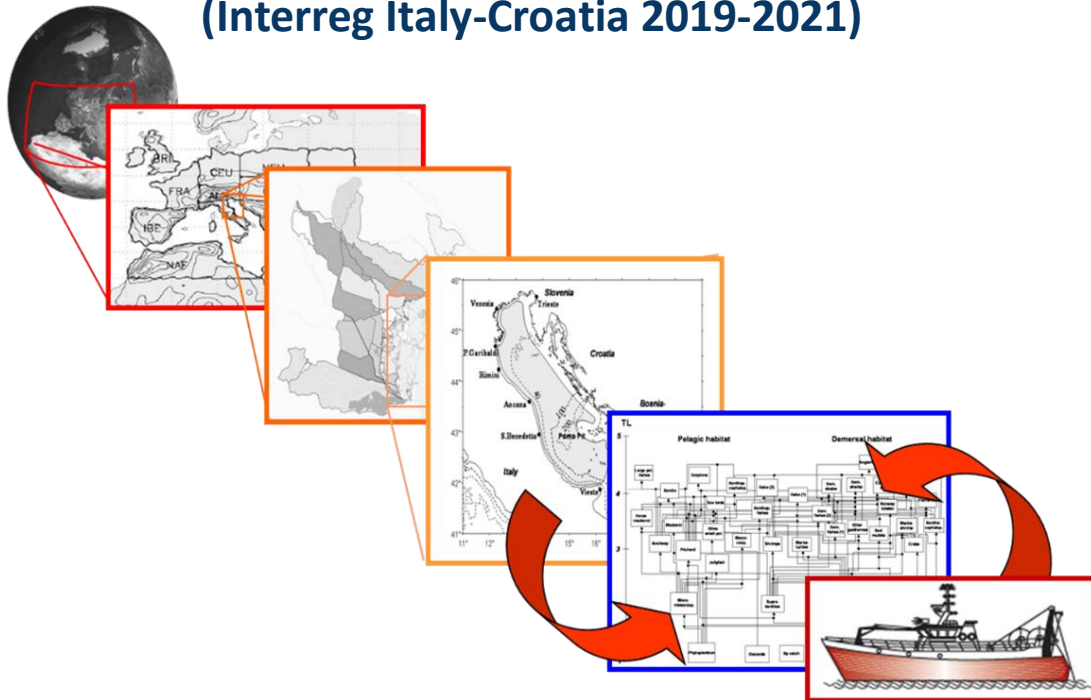
Natalia Serpetti<sup>1</sup>, Igor Celić<sup>1</sup>, Pasquale Ricci<sup>2</sup>, Davide Agnetta<sup>1</sup>, Silvia Angelini<sup>3</sup>, Isabella Bitetto<sup>4</sup>, Roberto Carlucci<sup>2</sup>, Giulia Cipriano<sup>2</sup>, Gianpiero Cossarini<sup>1</sup>, Igor Isailovic<sup>5</sup>, Svjetlana Krstulović Šifner<sup>6</sup>, Francesco Masnadi<sup>3,7</sup>, Diego Panzeri<sup>1,8</sup>, Marco Reale<sup>1</sup>, Tommaso Russo<sup>2,9</sup>, Giuseppe Scarcella<sup>3</sup>, Maria Teresa Spedicato<sup>4</sup>, Walter Zupa<sup>4</sup>, Nedo Vrgoc<sup>5</sup>



\* **Contact:** Simone Libralato, National Institute of Oceanography and Applied Geophysics – OGS (Trieste, Italy), e-mail: [slibralato@ogs.it](mailto:slibralato@ogs.it)

## Fisheries in the Adriatic Region - a Shared Ecosystem Approach (FAIRSEA)

(Interreg Italy-Croatia 2019-2021)



## Need for a scientific-based tool to support management in a changing environment

- **Participatory approaches** highlighted need to consider the complexity of **multi-target and multi-gear fisheries** (including small scale fisheries and recreational), as well as **effects of oceanographic changes on marine ecosystem**
- **Transnational approach** based on best and updated information shared among countries in the basin
- Need to **disentangle the effect and efficacy of the several measures in place**, before considering new ones foreseen by Multiannual Management plans (reduction of effort), and new spatial measures (30% by 2030).
- Need to develop a scientific based tool used to support management in a quickly changing environment