Importance of nursery habitats: Addressing threats and challenges

Sanja Matić-Skoko

Institute of Oceanography and Fisheries

Biofizikalni modeli u oceanografiji (Projektna radionica HRZZ projekta PHOTOCLIM)

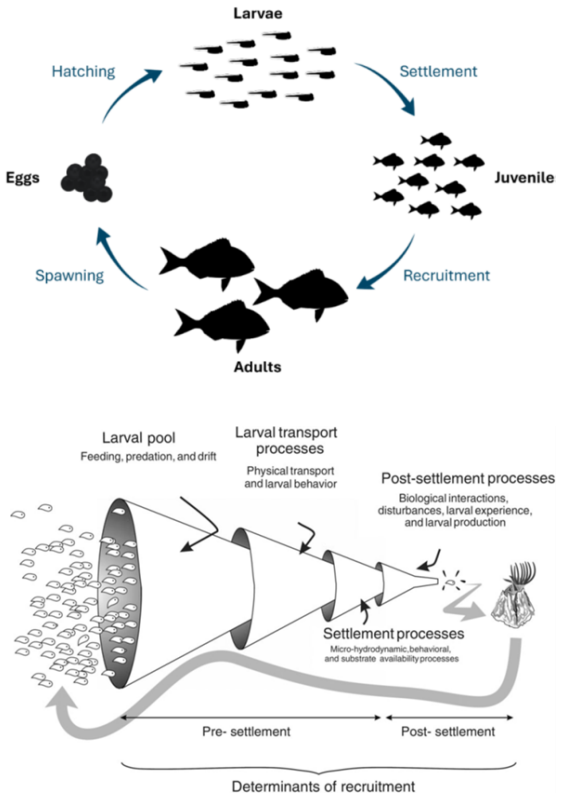
September 5th 2025

…a summer day in the clear turquoise sea and a multitude of colorful fish on an underwater reef, a remote islet or a hidden cove overgrown with meadows of seagrasses…


… where those fish came from or how they got there?
…Who would have guessed that it’s what goes on behind the scenes, in sheltered bay like the one hotel just concrete over, that keeps the main show going on?

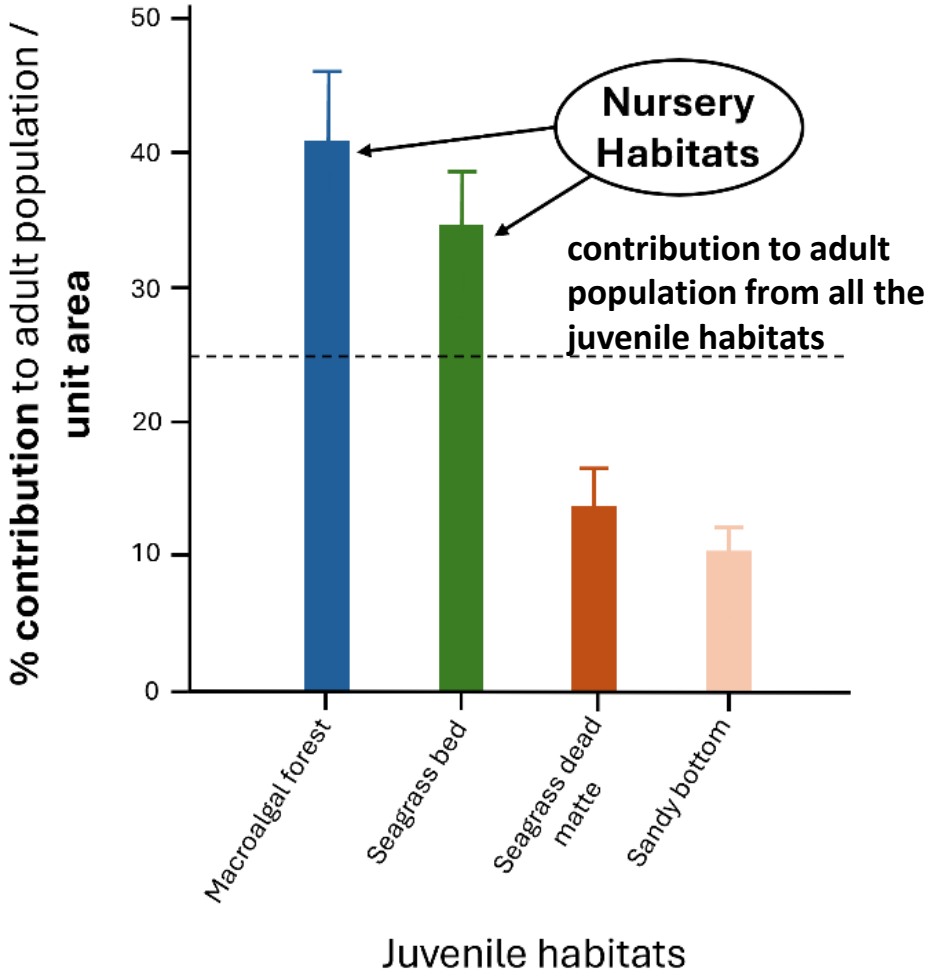
Nursery habitats and evolution of the nursery-role concept

nursery habitat - a subset of all habitats where juveniles of a species occur, which has a higher level of productivity per unit area than other juvenile habitats (Beck et al. 2001)

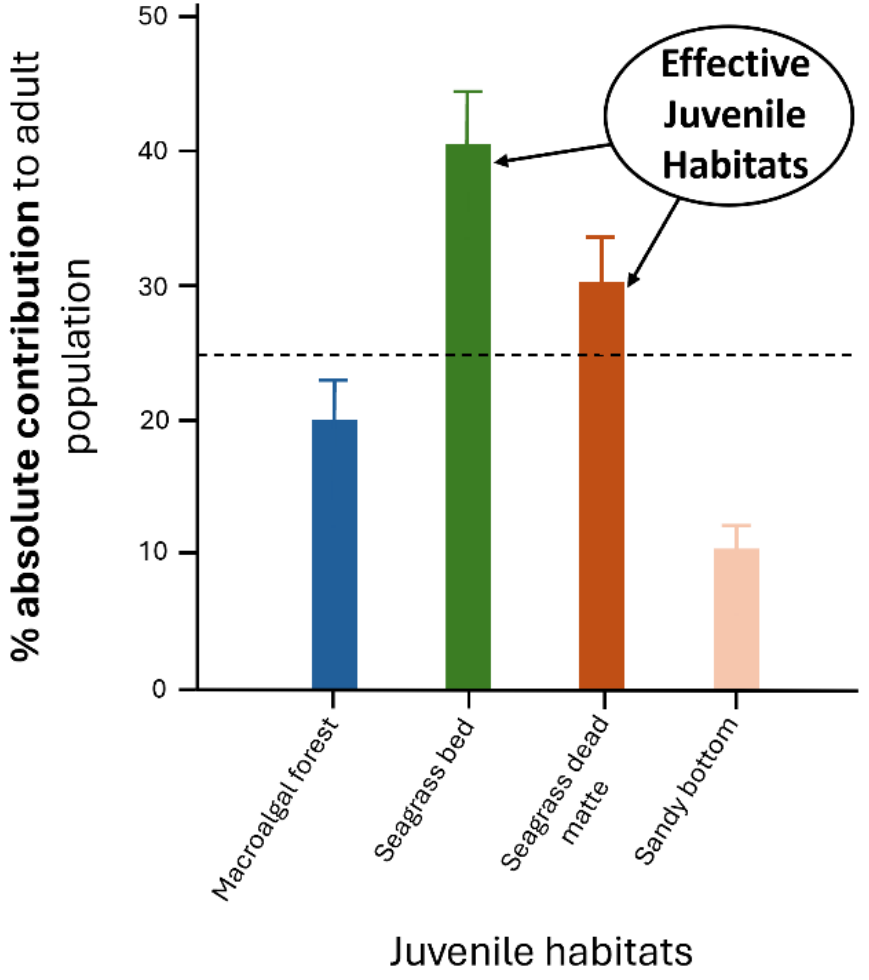


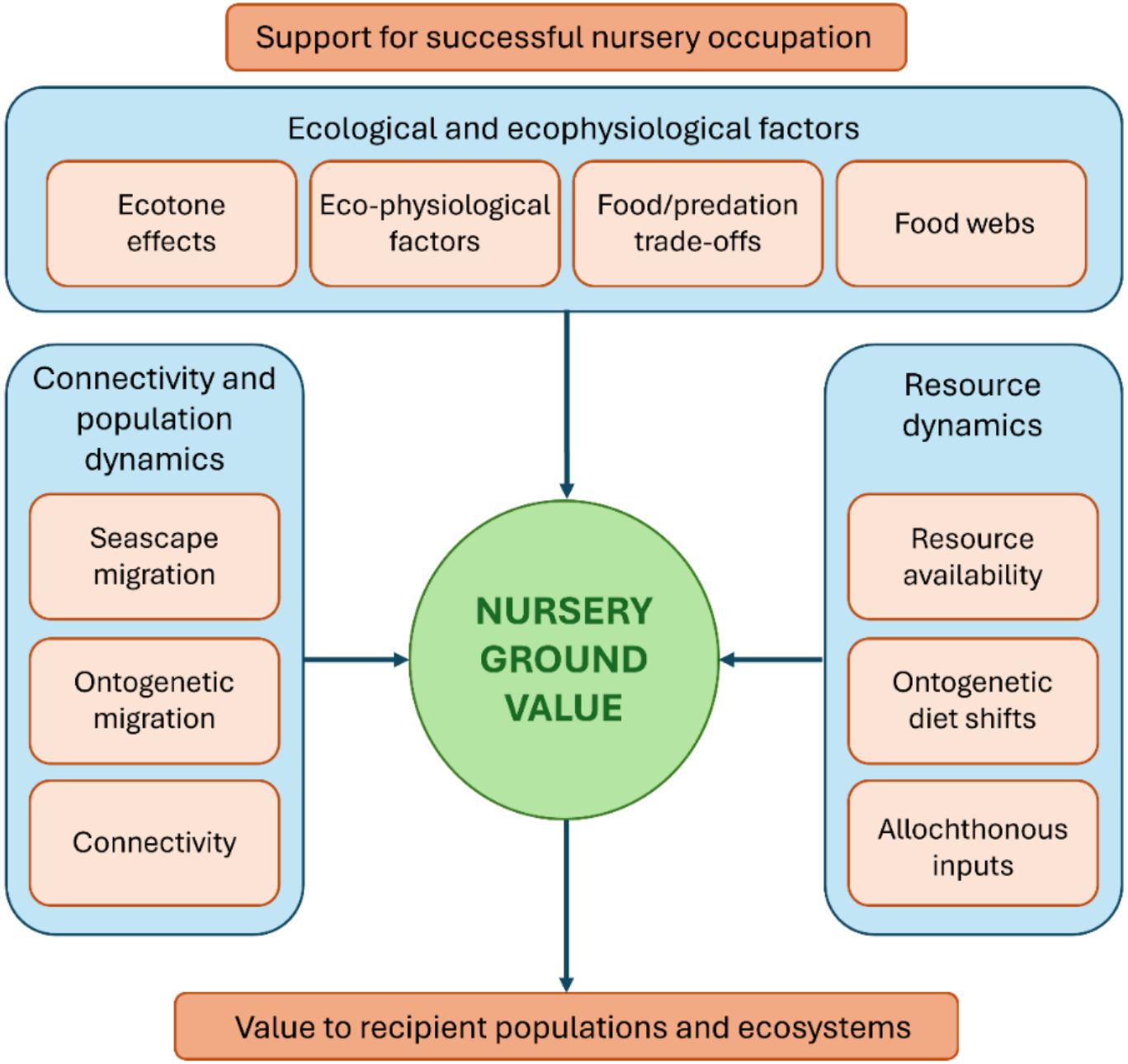
Pineda et al., 2009

a) **Nursery-role concept** (Beck et al. 2001)



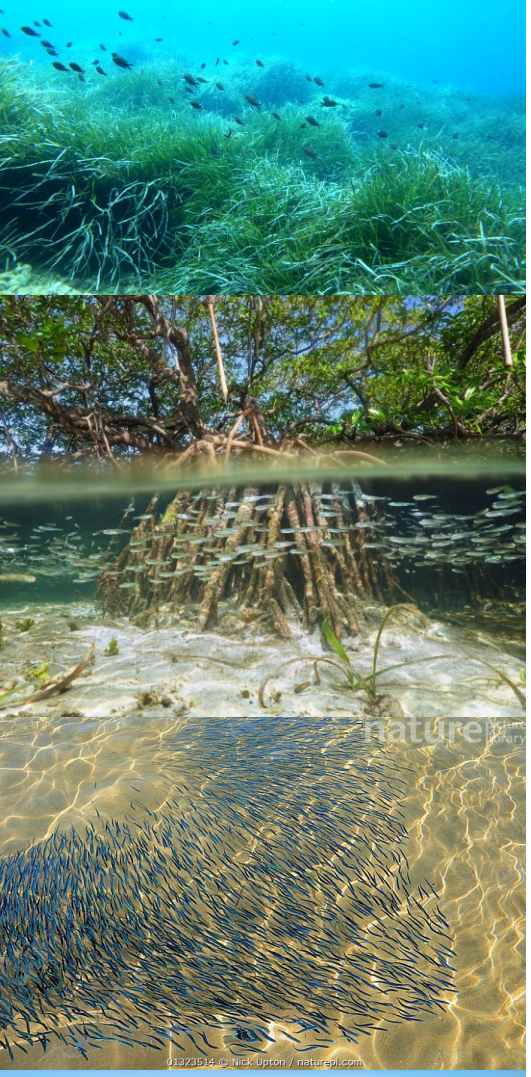
b) **Effective Juvenile Habitat** (Dahlgren et al. 2006)





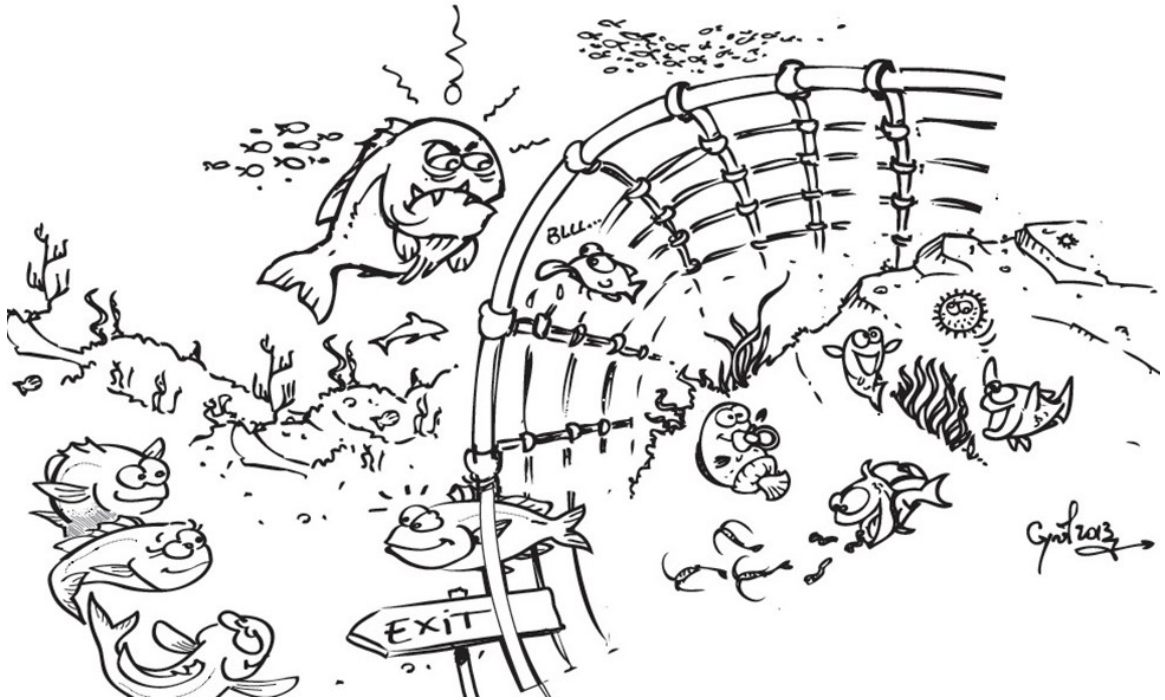
Sheaves et al. (2015)

- extends beyond numeric contributions to adult stocks, encompassing its role in sustaining future generations
- shaped by ecological and physiological factors, population dynamics and resource availability, influencing both nursery ground success and broader ecosystems



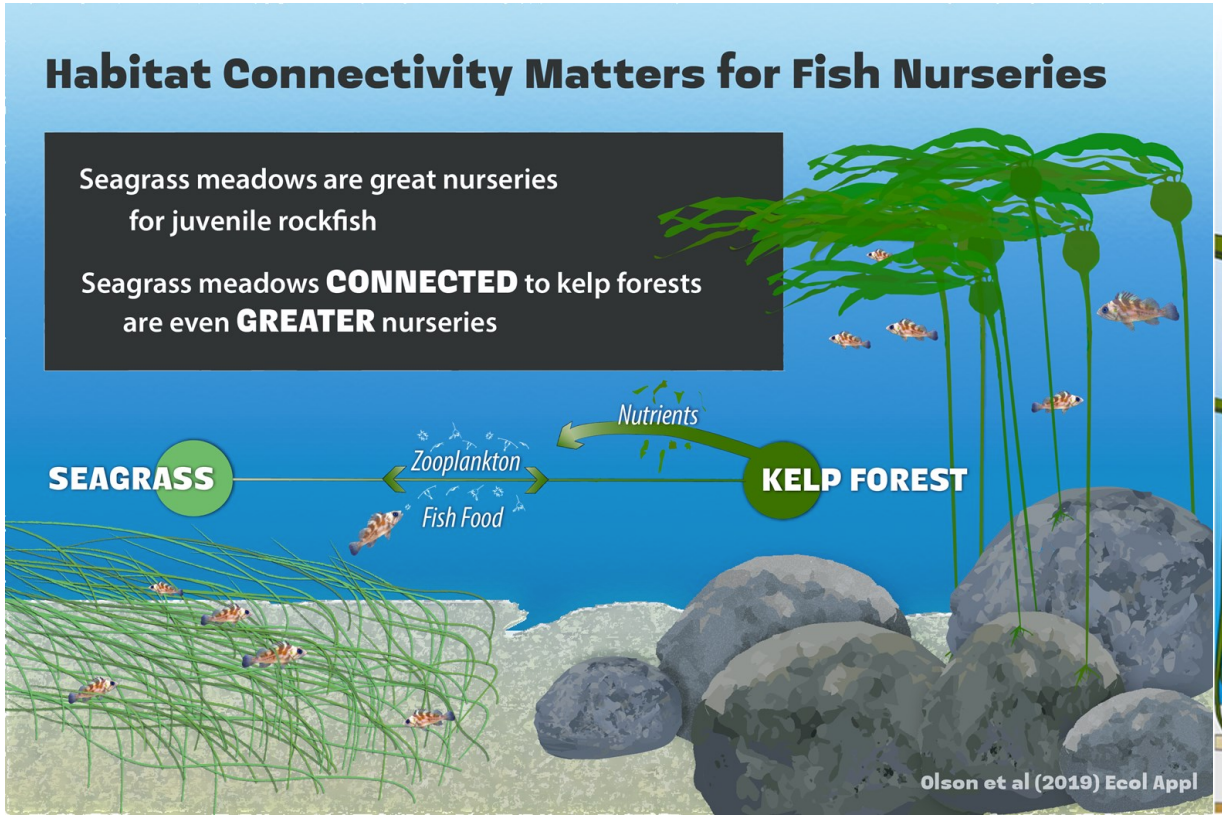
What nurseries provide for juvenile fish?

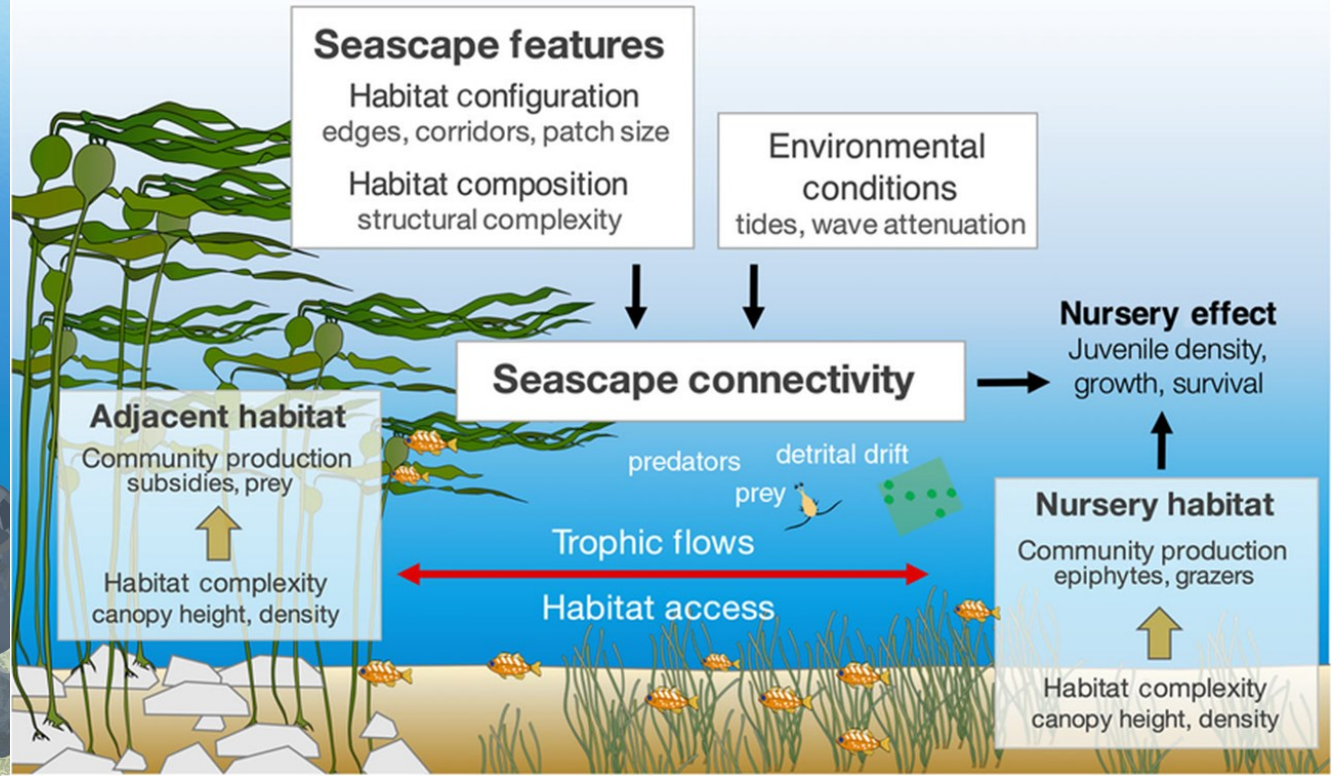
- An adapted and diversified nutrition
- A favorable shelter which protects from predators and pressures
- A productive environment with faster growth slope and better survival rate
- A location with corridor allowing migration towards adult habitats



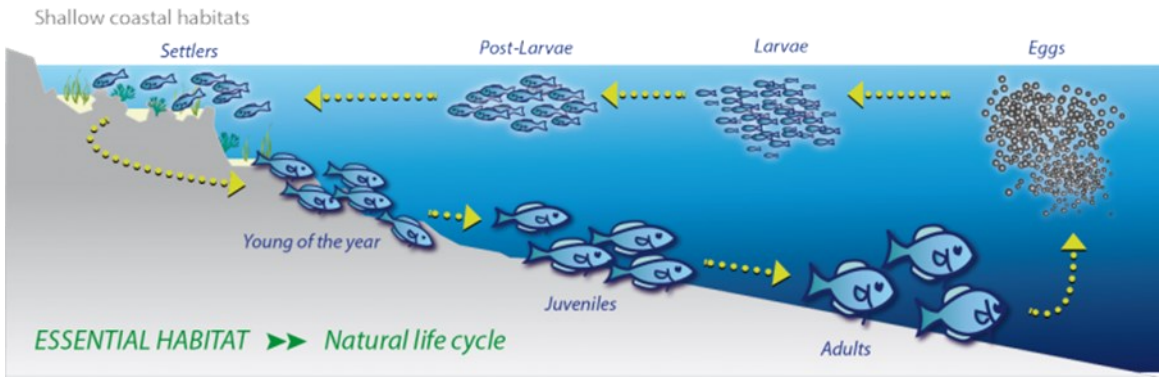
… It’s ironic: The sweltering, mosquito-filled saltmarshes, estuaries and shallow bays being so eagerly destroyed may be more important to tourism than the tennis courts and martini bars that replace them….

What are migration corridors?



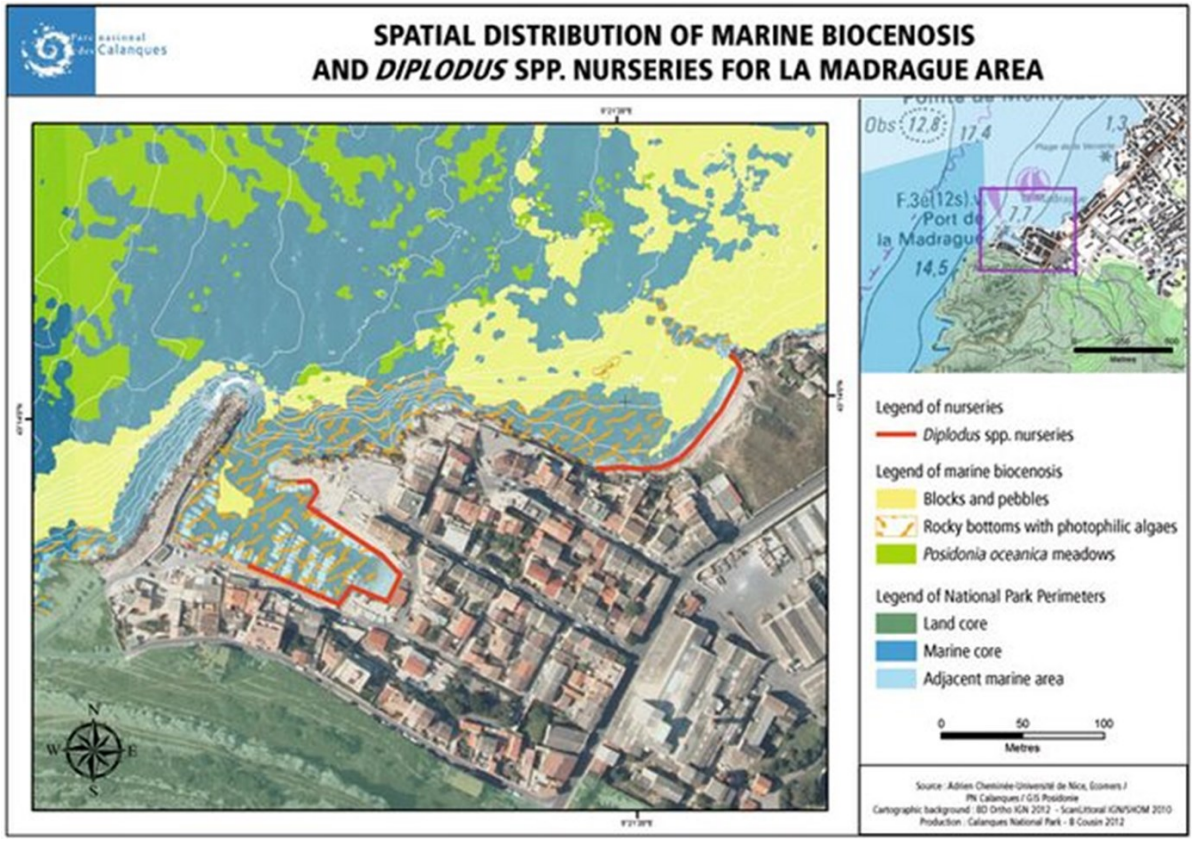


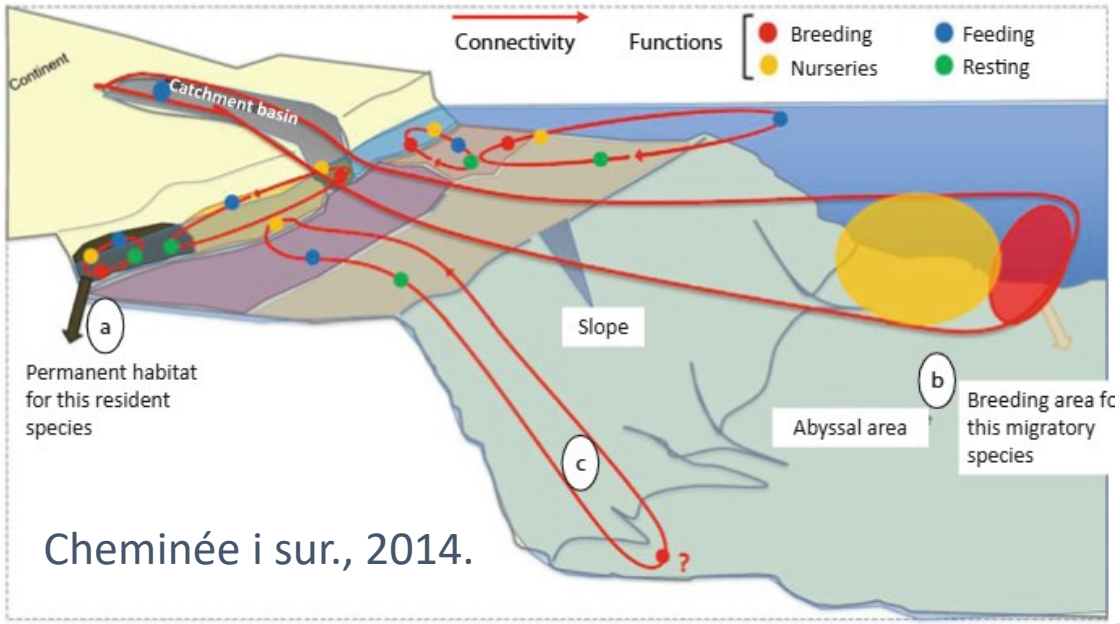
connectivity: the degree to which the seascape facilitates or impedes movement of organisms across habitat boundaries, often driven by shifts in animal needs for food and shelter, resulting in changes in habitat use over the organism's lifecycle



New approach

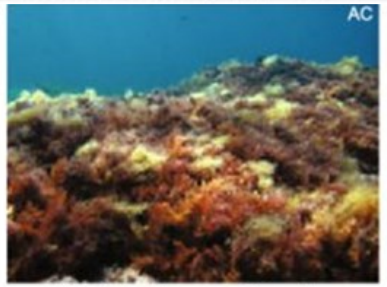
seascape nursery: a spatially explicit seascape consisting of multiple mosaics of interconnected habitat patches that are functionally connected to support juvenile fish growth and survival (Nagelkerken et al. 2015)



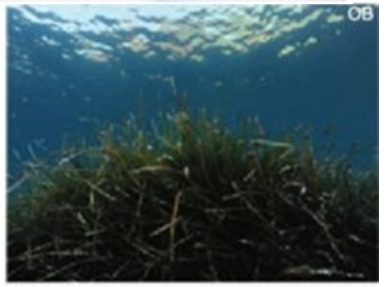


Cheminée i sur., 2014.

Heterogeneous gently sloping rocky bottoms (p = 0.5 m)



Cystoseira spp. forests (p = 3.0 m)



Posidonia oceanica meadows (p = 3.0 m)

Diplodus vulgaris (30 mm TL)

Symphodus roissali (40 mm TL)

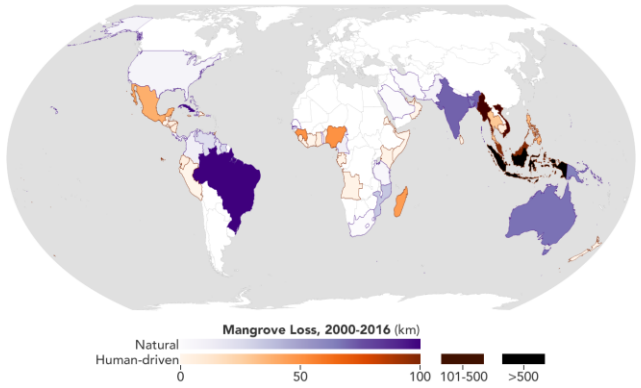
Spondyliosoma cantharus (30 mm TL)

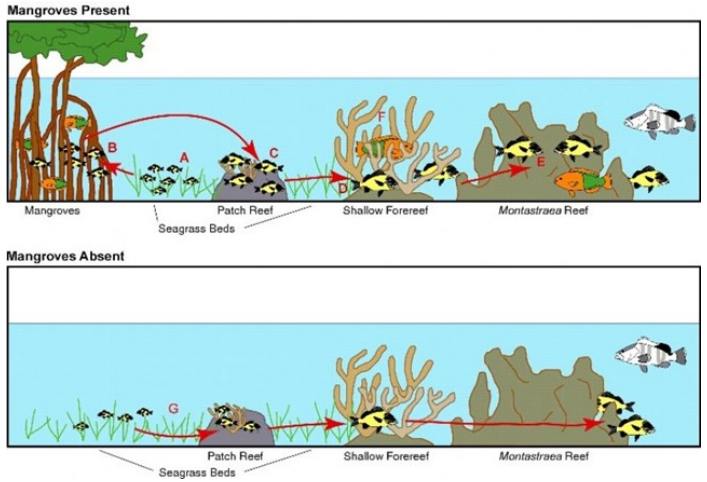
Diplodus sargus (19 mm TL)

Symphodus ocellatus (30 à 40 mm TL)

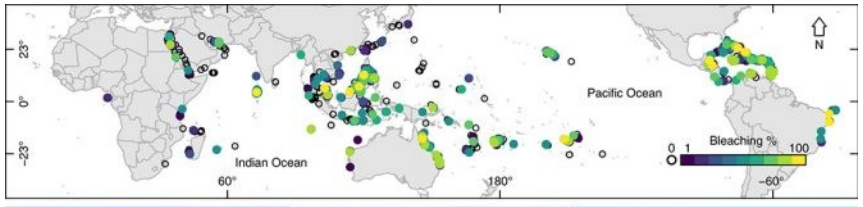
Diplodus annularis (35 mm TL)

Habitat loss and fragmentation

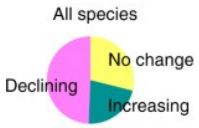


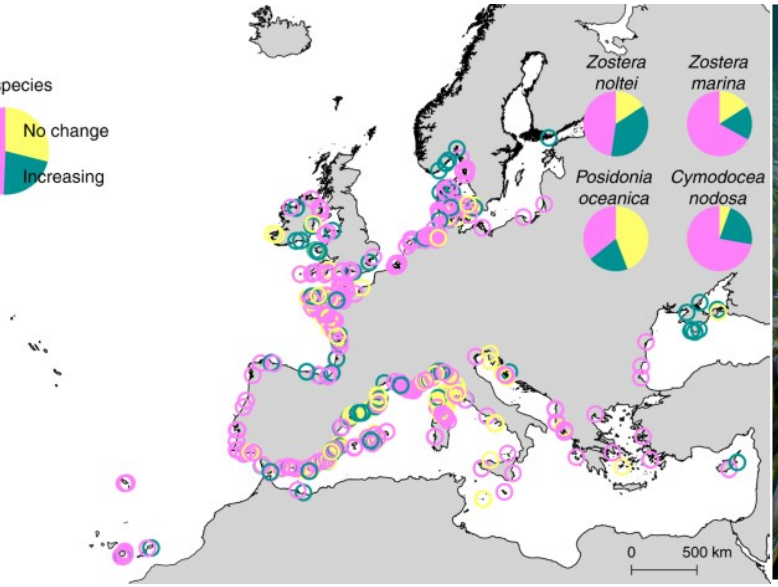


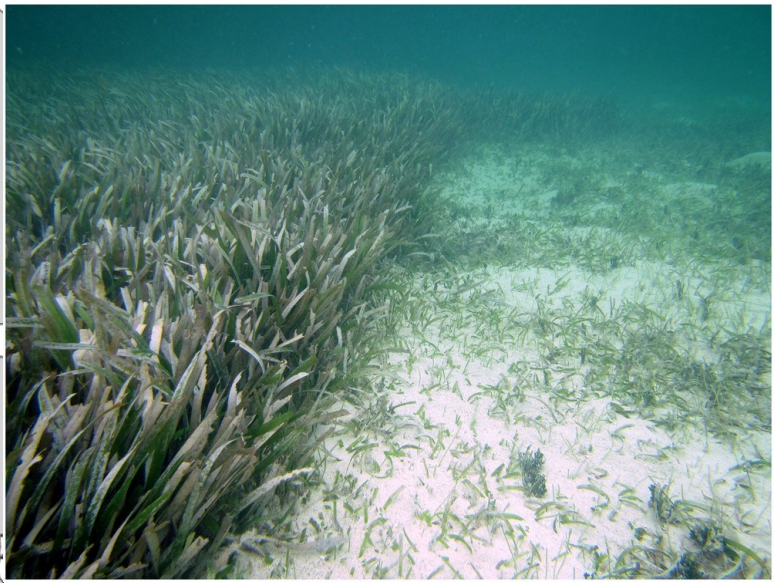
Scientists estimate that we have already lost 30 to 60% of the world's mangroves (Godberg i sur., 2020)!



… more than 70% of all reefs are threatened by human activities, from agriculture and fishing to navigation and coastal development (UNEP, 2020)



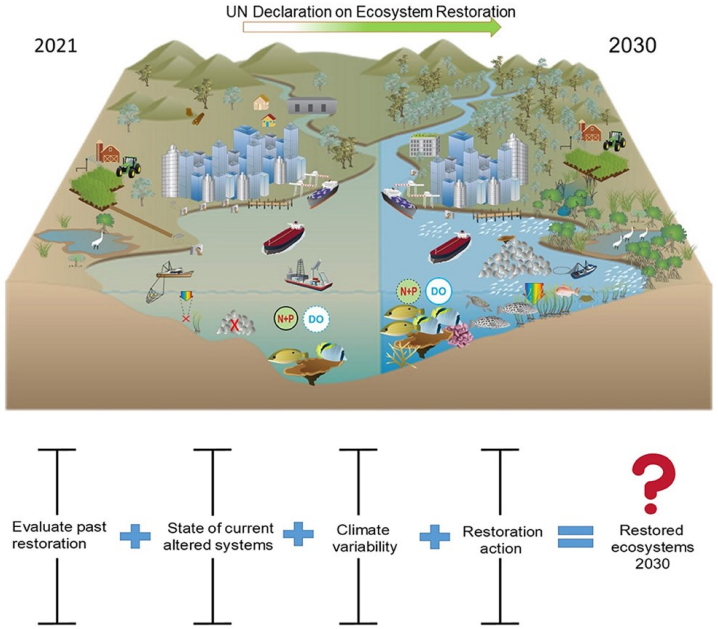




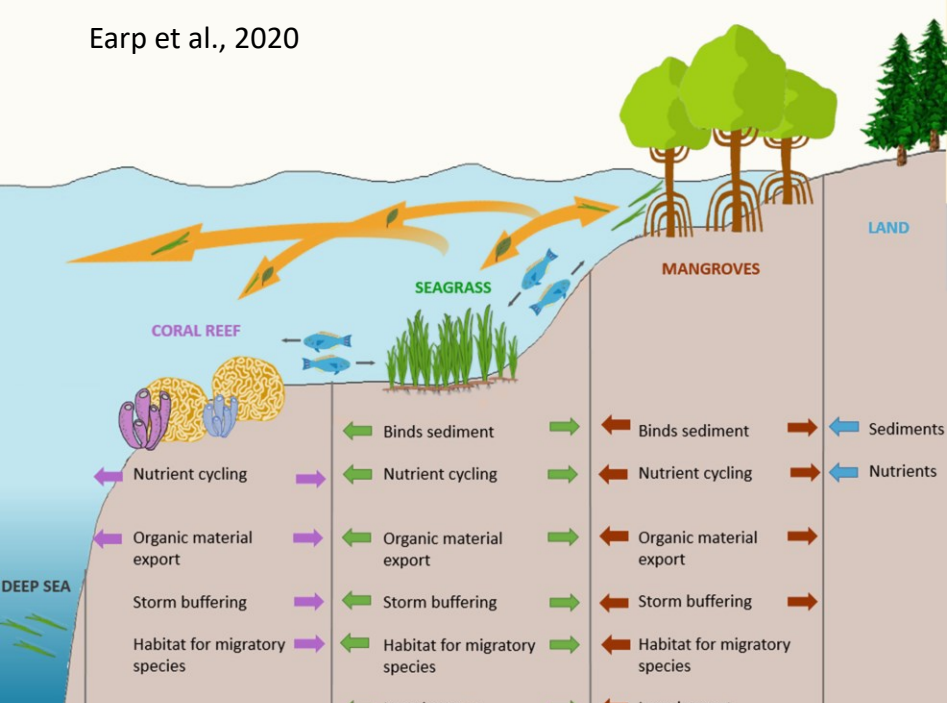
Between 1869 and 2016, 1/3 of Europe's seagrass area was lost to disease, deteriorating water quality and coastal development (de los Santos i sur., 2019)

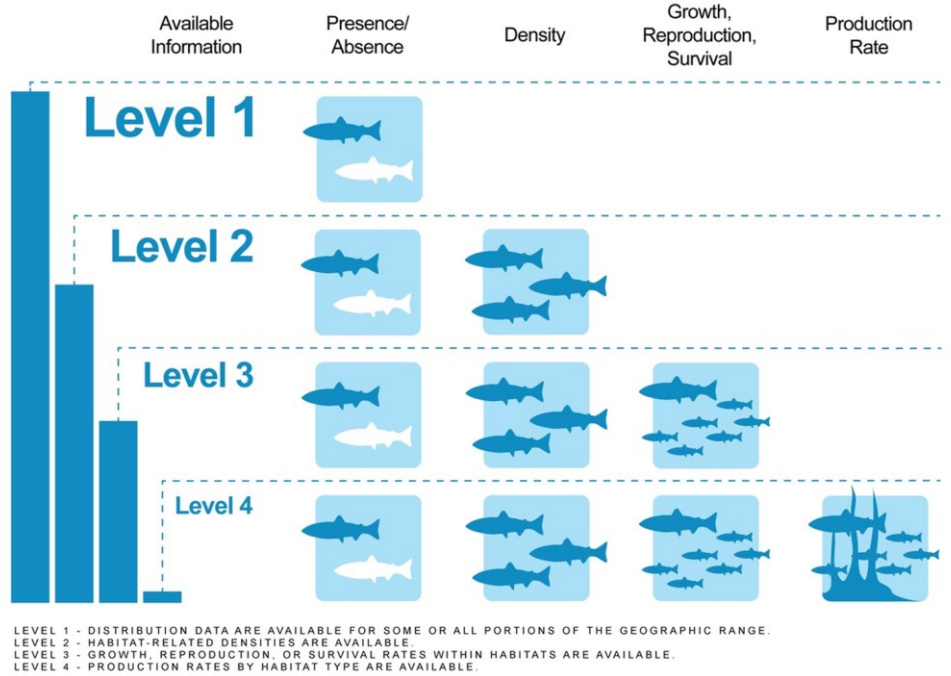
UN Decade on Ecosystem Restoration 2021–2030—What Chance for Success in Restoring Coastal Ecosystems?
https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2020.00071/full

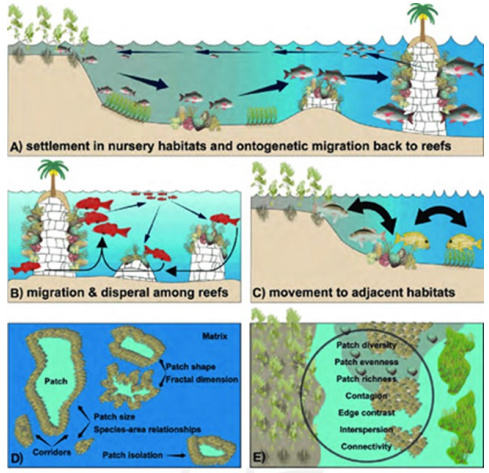
Which nurseries should we protect?



Earp et al., 2020



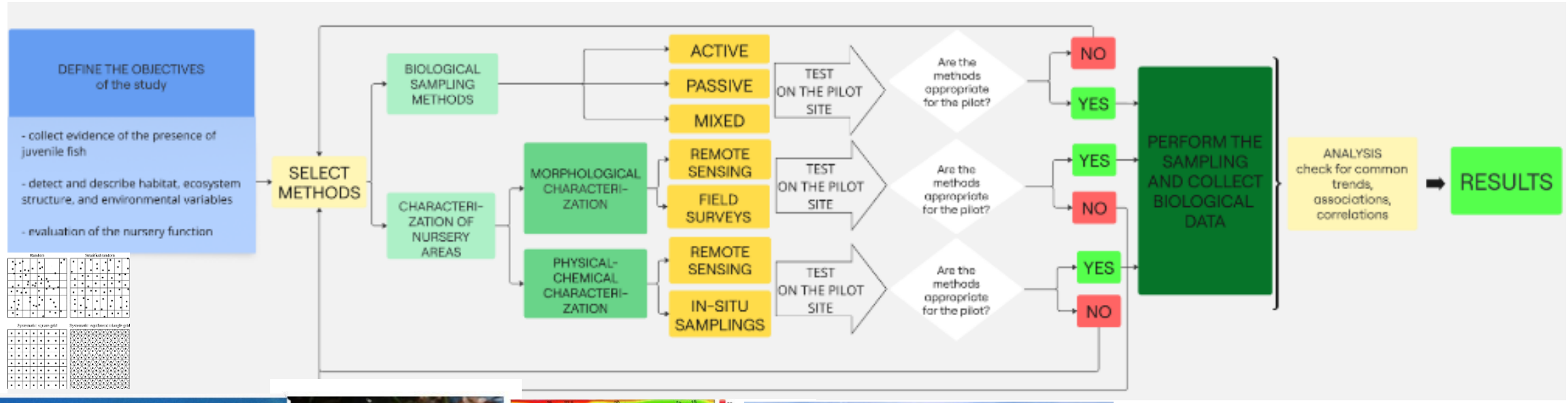


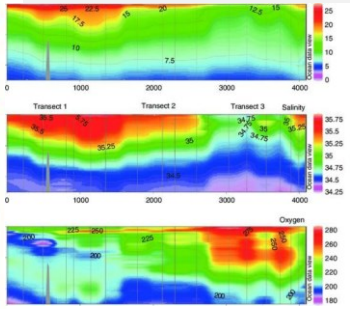


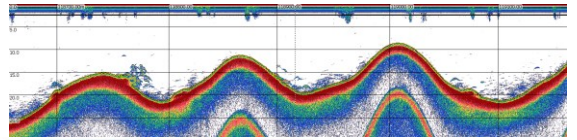
Common knowledge gaps:

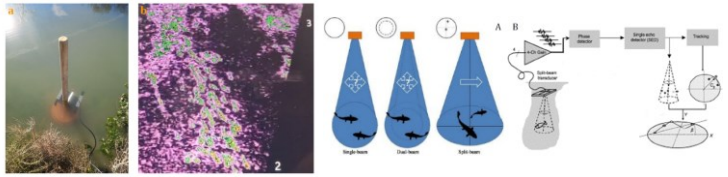
- the spawning behavior and larval development of the species
- the oceanography of the local marine environment (currents, temperature, salinity, density gradients,…)
- Predictions/models on eggs circulation after spawning/larvae hatching sites
- the duration of larval development, settlement and metamorphose into juveniles
- Community structure and composition: the presence/ absence of appropriate prey for settling larvae and young juveniles and predators
- the preferred environmental thresholds (temperature, salinity, etc.) for specific species

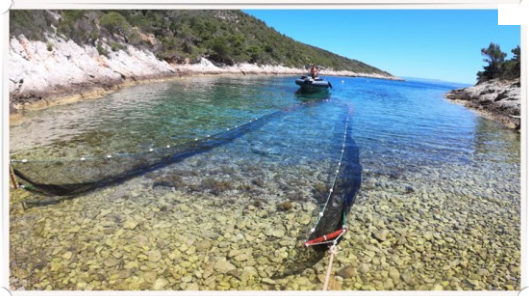
Interdisciplinary approach for nursery identification, valorisation and validation

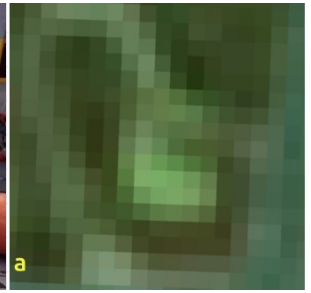


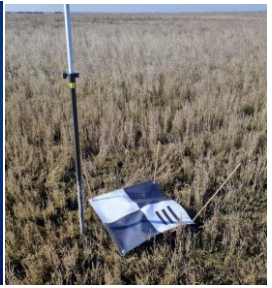


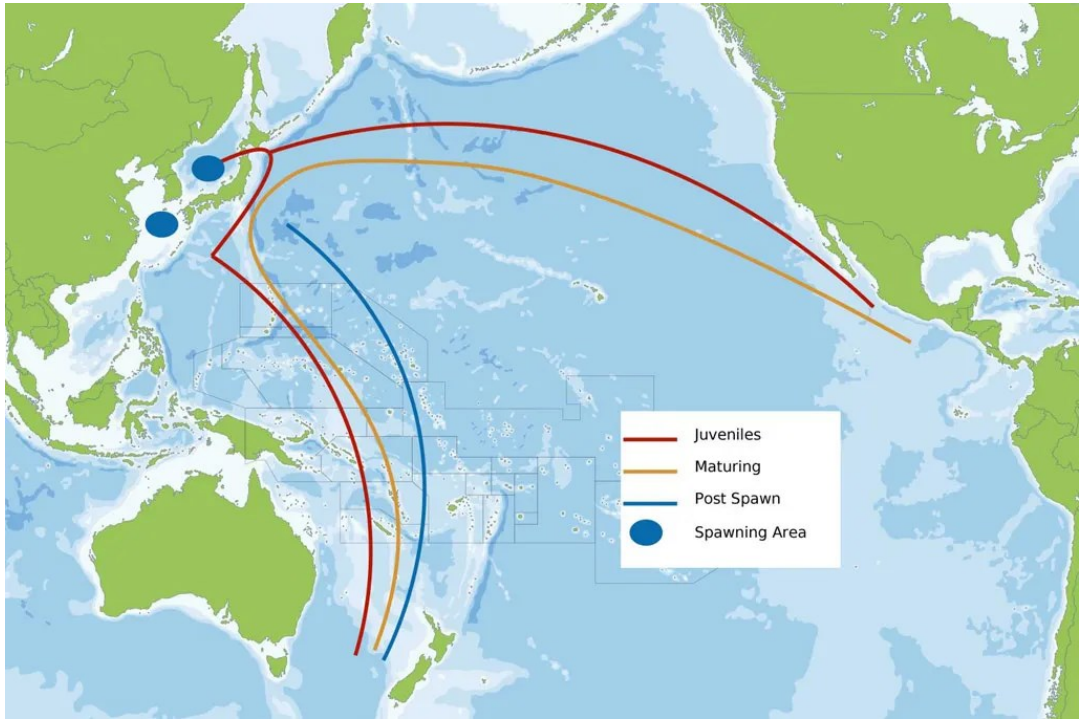


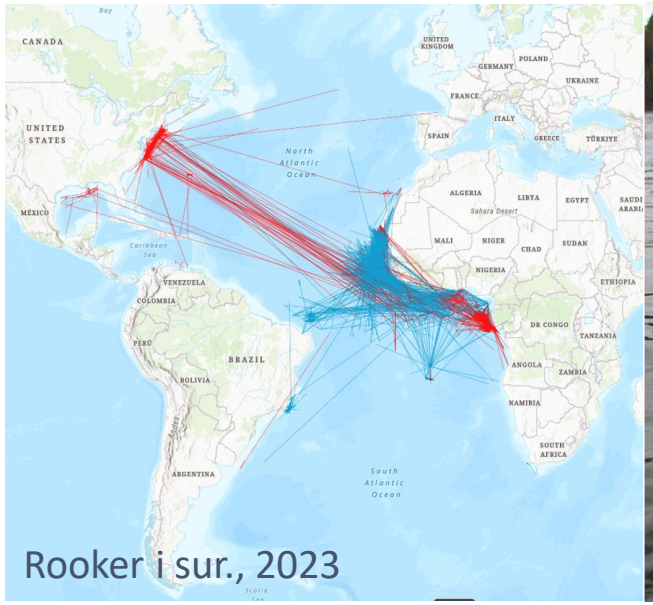




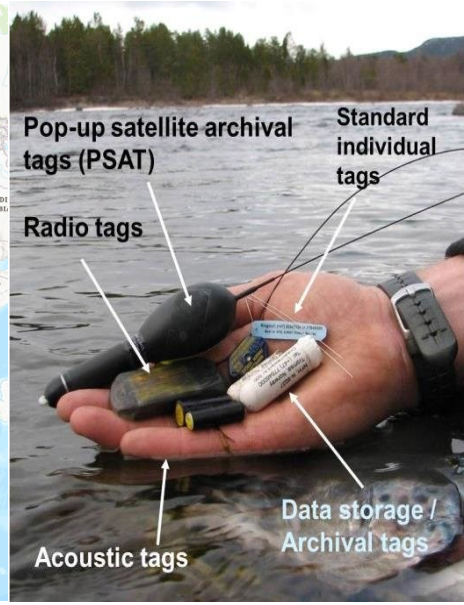


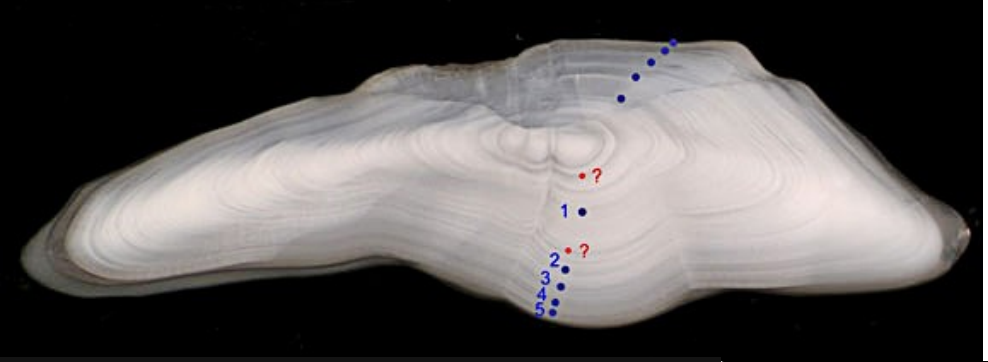


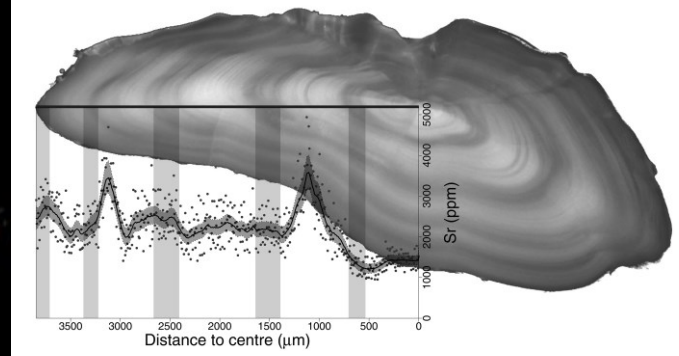


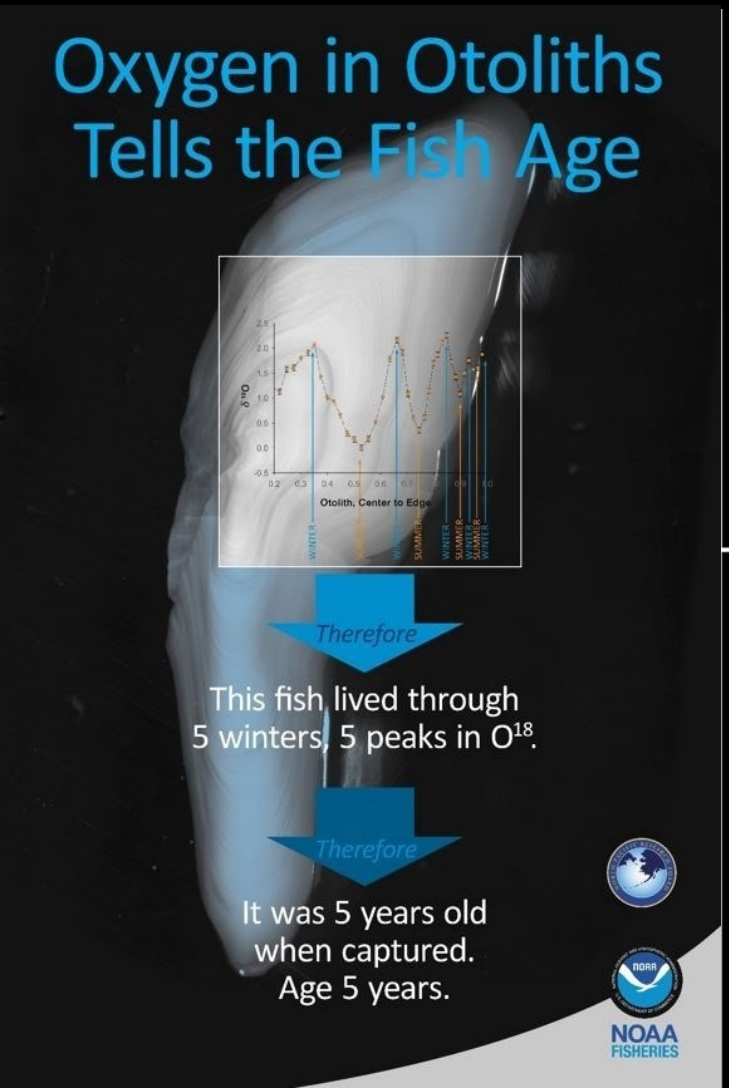


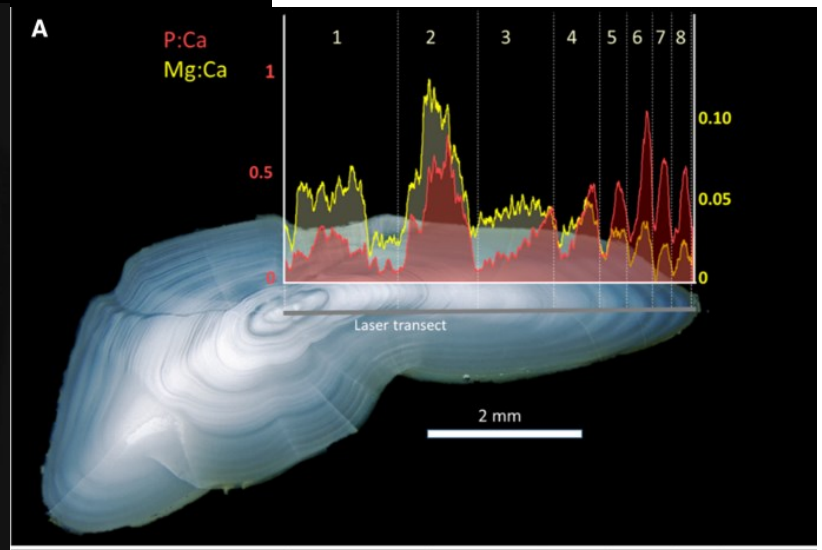
Rooker i sur., 2023

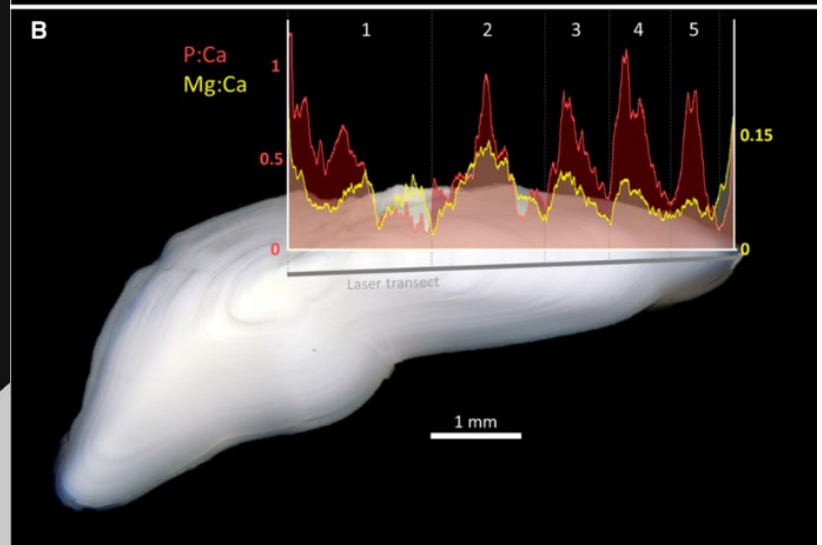


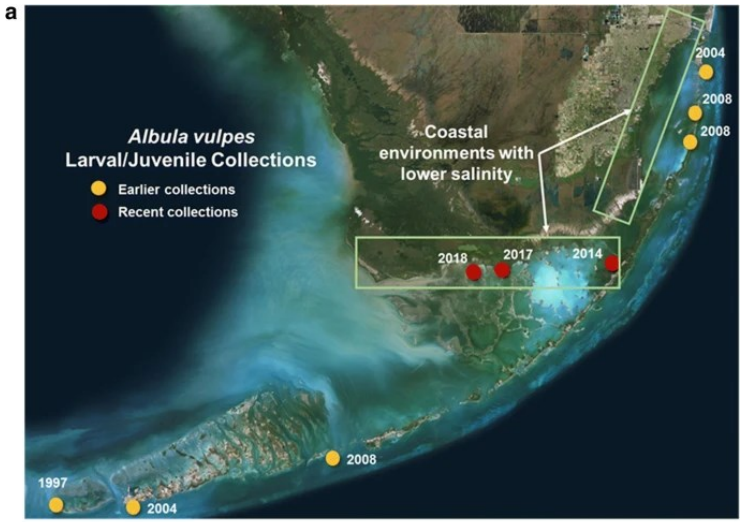


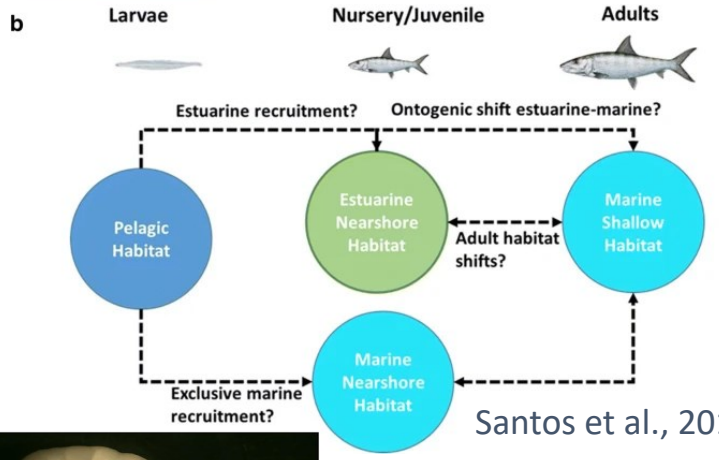




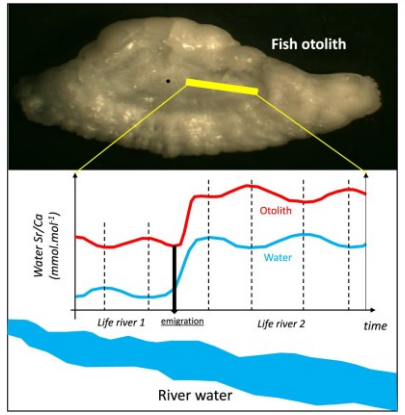


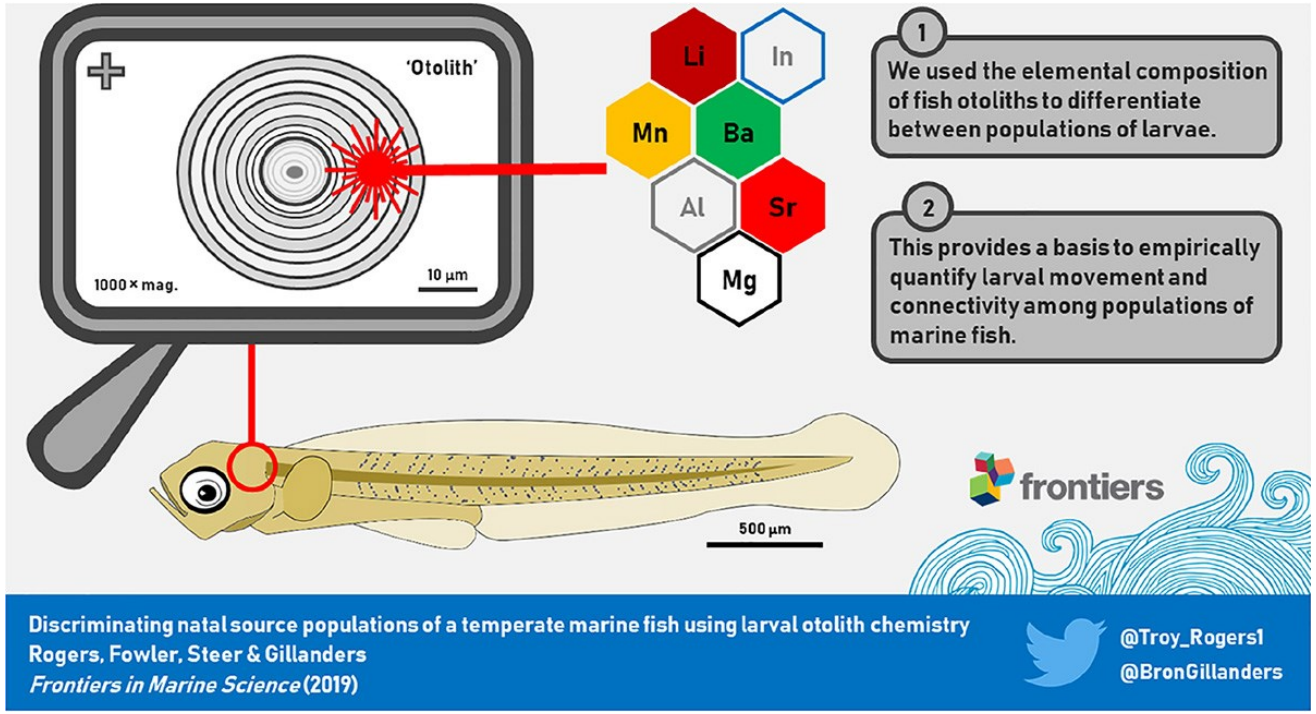


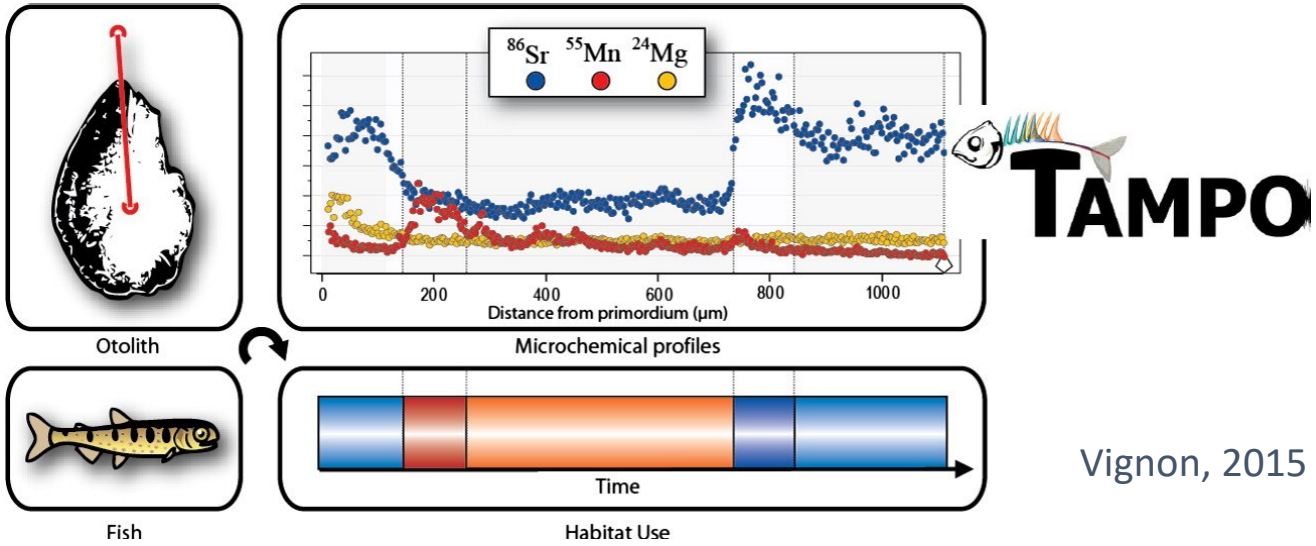




Santos et al., 2019







Vignon, 2015

Currie i sur., 2024

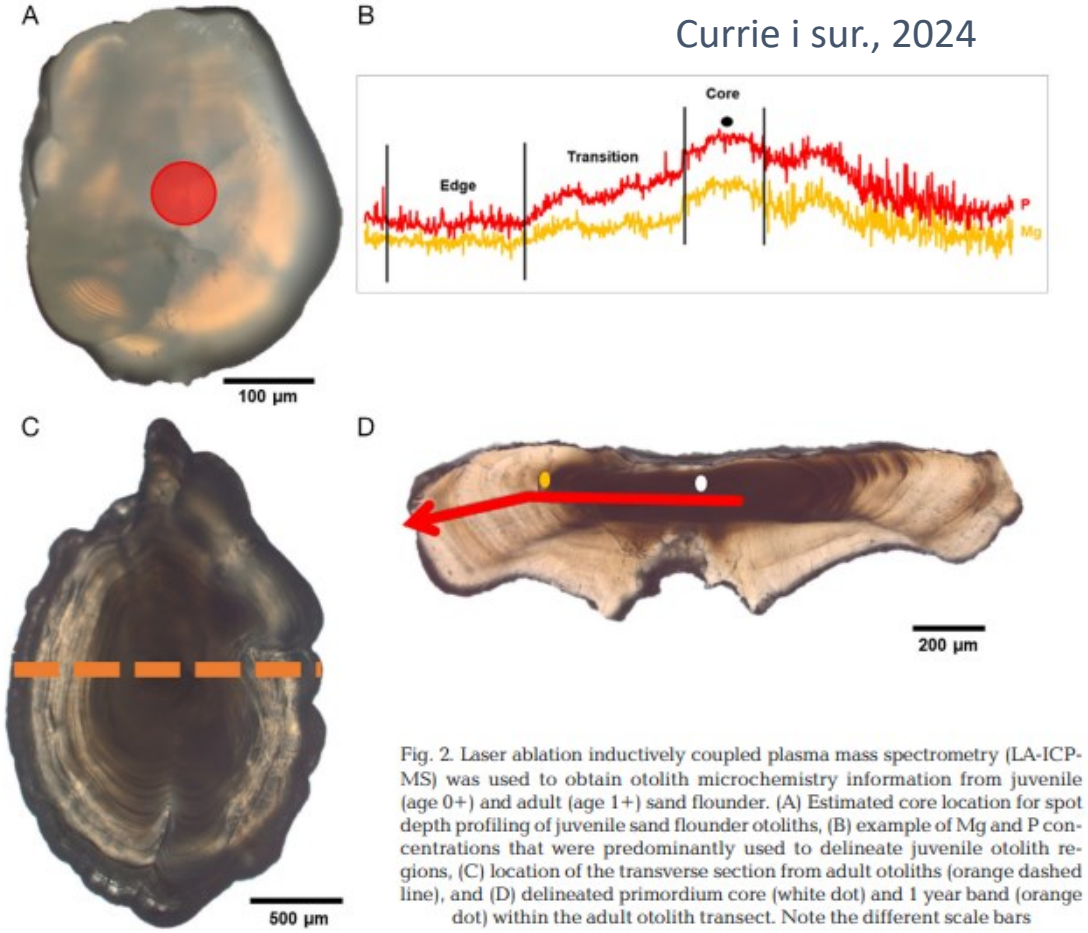
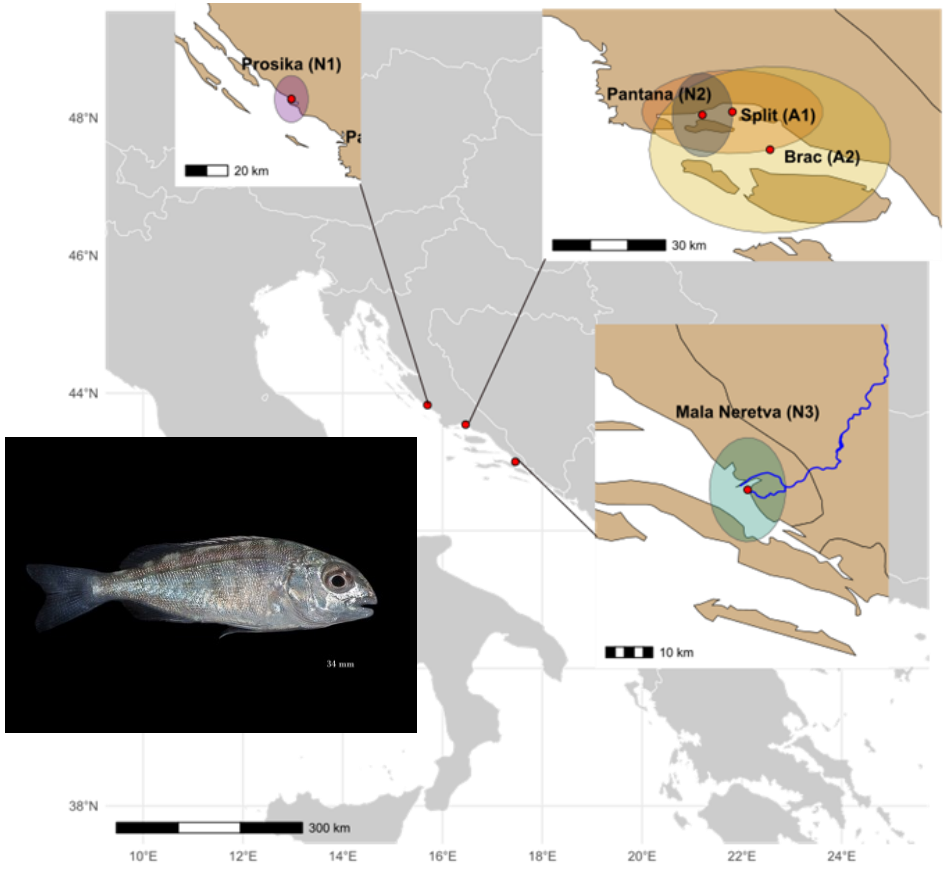
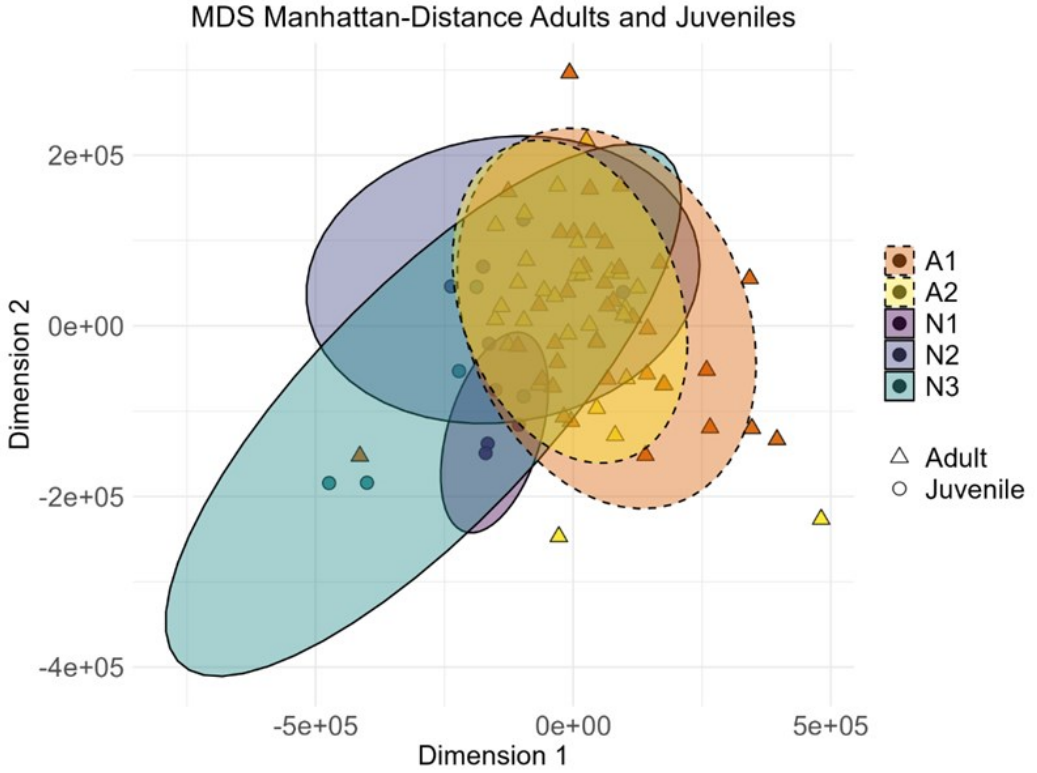


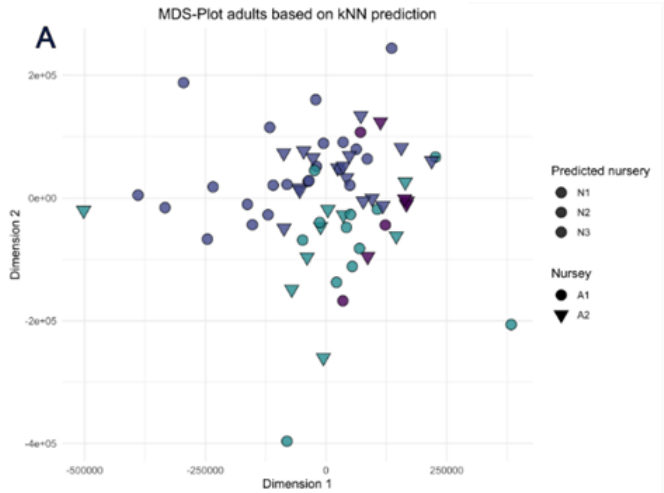
Fig. 2. Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) was used to obtain otolith microchemistry information from juvenile (age 0+) and adult (age 1+) sand flounder. (A) Estimated core location for spot depth profiling of juvenile sand flounder otoliths, (B) example of Mg and P concentrations that were predominantly used to delineate juvenile otolith regions, (C) location of the transverse section from adult otoliths (orange dashed line), and (D) delineated primordium core (white dot) and 1 year band (orange dot) within the adult otolith transect. Note the different scale bars

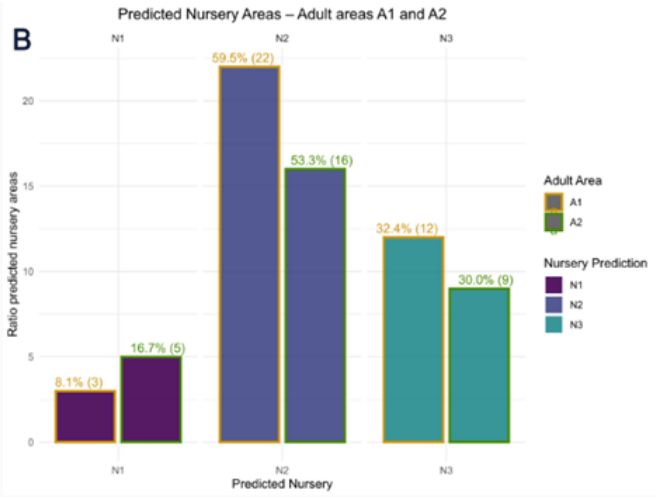
Current research

Otolith fingerprints reveal nursery discrimination of *Sparus aurata* inhabiting the middle Adriatic Sea (Matić-Skoko et al., 2025 - submitted)









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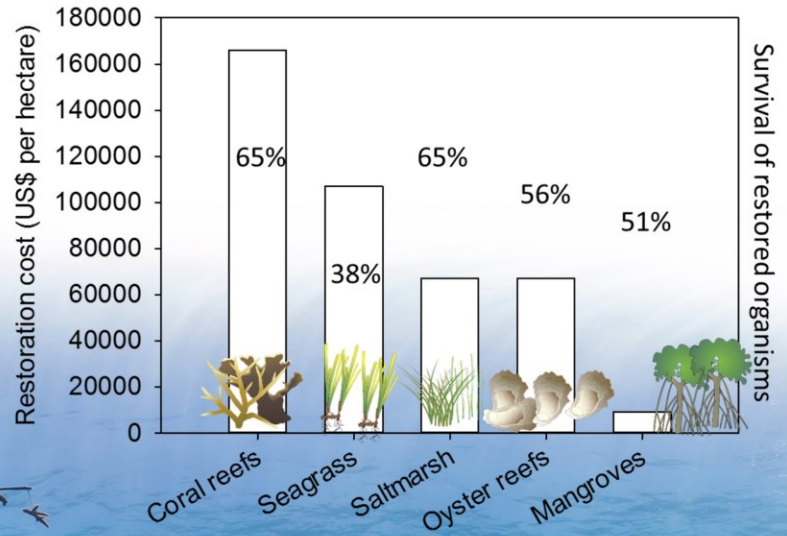
COASTAL marine RESTORATION



The median cost of coastal marine restoration is about US$80,000 per hectare but some projects are incredibly expensive, costing many millions of dollars.

Symbols – Integration and Application Network, University of Maryland Center for Environmental Science

60%
➲ Global coral reefs under immediate threat

35%
➲ Global decline of mangroves in just a few decades

80%
➲ Global decline in native oyster stocks in the past century

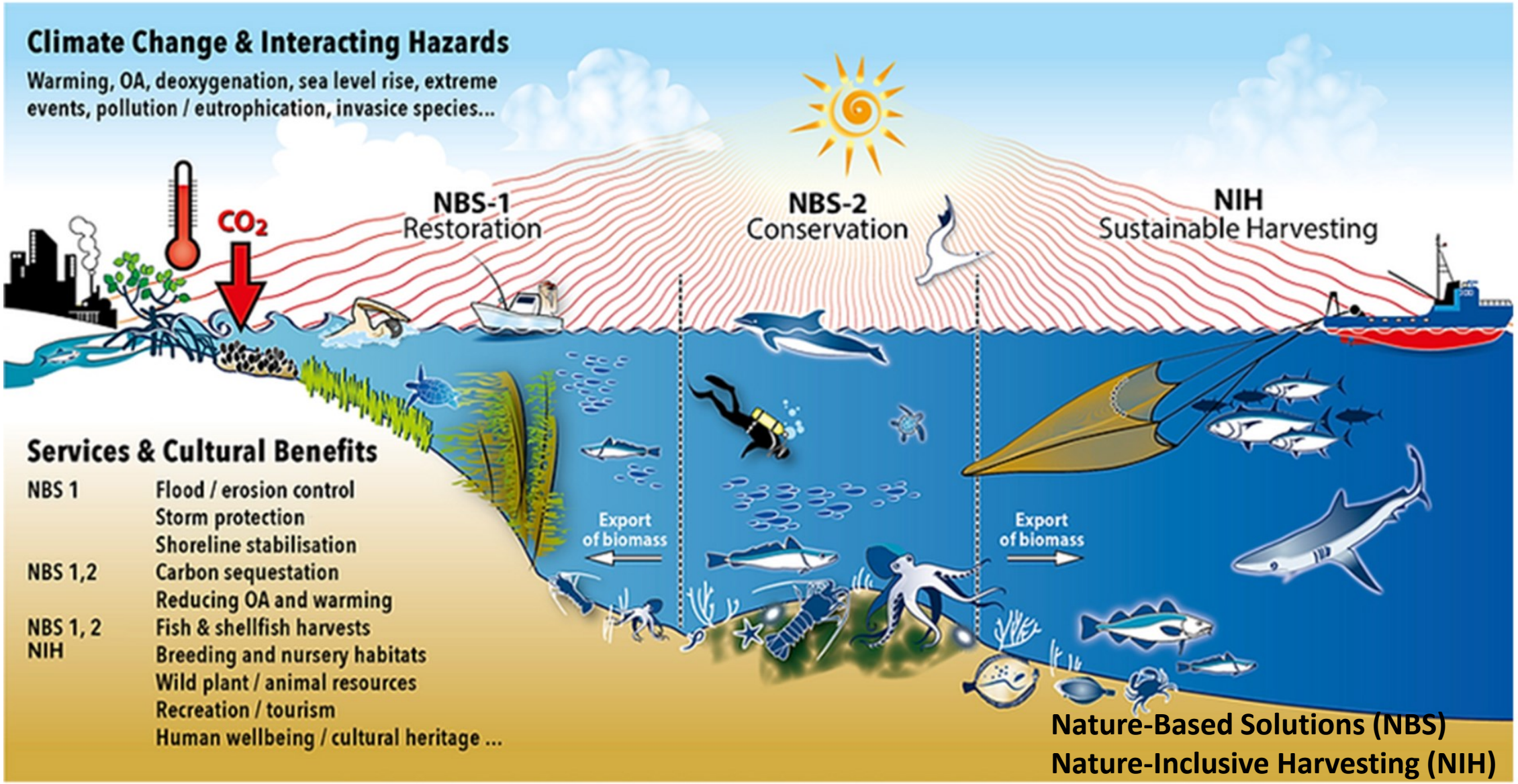
Improve marine restoration success rates by considering …

- ➲ Site selection
- ➲ Appropriate techniques
- ➲ Community involvement
- ➲ Long-term monitoring
- ➲ Cost-effectiveness in developing countries

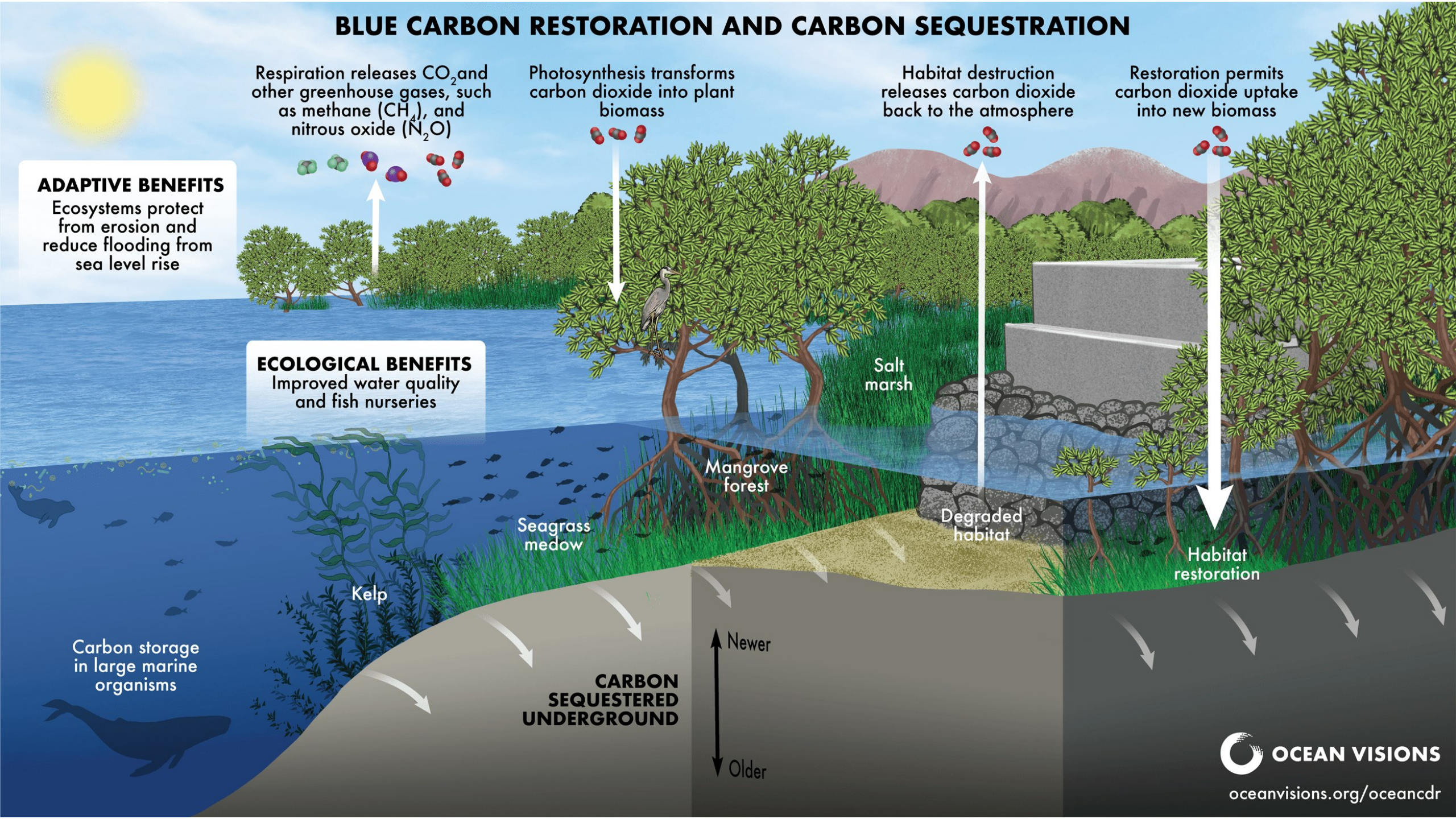
Bayraktarov, E., Saunders, M. I., Abdullah, S., Mills, M., Beher, J., Possingham, H. P., Mumby, P. J. and Lovelock, C. E. (2016), The cost and feasibility of marine coastal restoration. *Ecological Applications*

Photo – Florida Keys, XL Catlin Seaview Survey

https://www.fisheries.noaa.gov/national/habitat-conservation/essential-fish-habitat



BLUE CARBON RESTORATION AND CARBON SEQUESTRATION

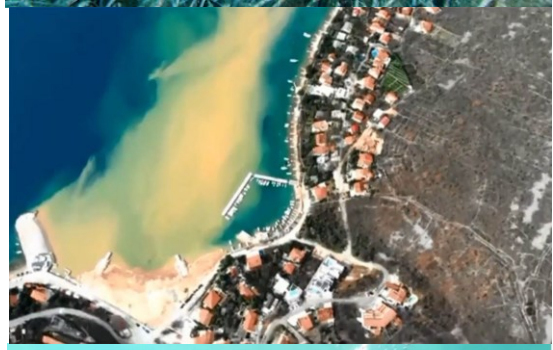


OCEAN VISIONS

oceanvisions.org/oceancdr

Conclusions

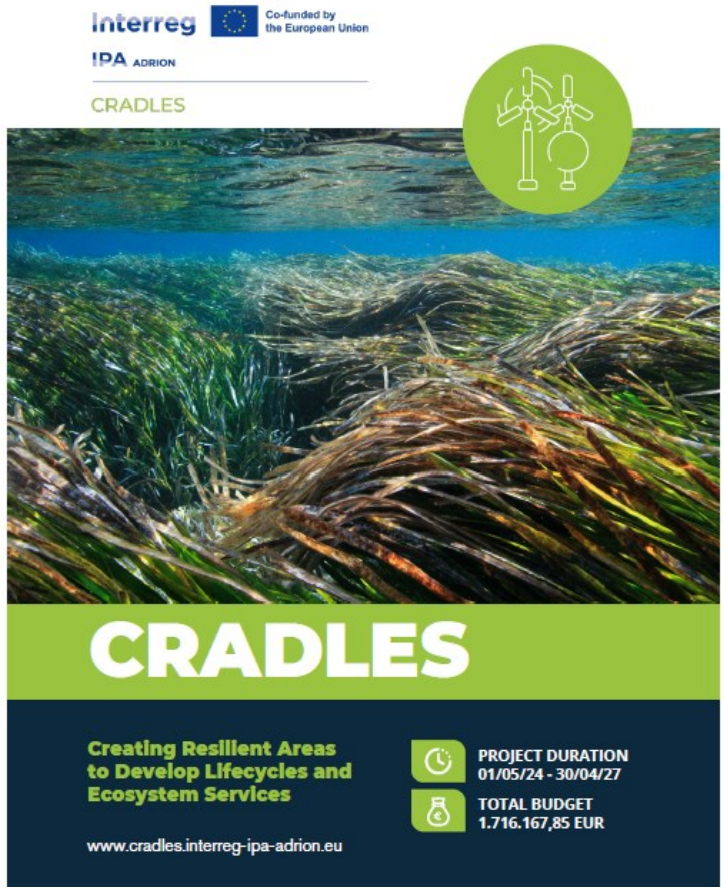
- Nurseries face significant challenges and threats that impact their existence and ecological services
- Nursery habitats are dynamic ecological systems and factors like food availability, predation risk and spatial dynamics influence their effectiveness especially under pressures like climate change and pollution
- Habitat degradation due coastal development, pollution and climate change are reducing their quality and availability of affecting species survival and growth
- Protecting marginal coastal nursery habitats can be crucial for species conservation, especially when core habitats are under threat but preserving biodiversity and ecological services are even greater important
- Traditional conservation methods often focus on single habitats, but a more integrated and spatially explicit approach is needed to be consider for the complex interactions (seascape nurseries important as NBS, NIH and sink for carbon sequestration)
- Interdisciplinary approach for studying nursery habitats are absolutely necessary with new tools, especially remote sensing and machine learning for more accurate insight into dynamic environmental and climate changes

THANKS to all collaborators involved in research projects……

https://galijula.izor.hr/en/projekti/linkfish/

Linking nursery ecological role and trophic pathways with fish population dynamics and diversity (IP -2022-10-7542)



https://galijula.izor.hr/en/projekti/cradles/

Coastal fish (and other marine organisms) communities: status, challenges and pressures (PRIMOS)

https://galijula.izor.hr/en/projekti/primos/