Climate change and the shifting distribution of Mediterranean fishes

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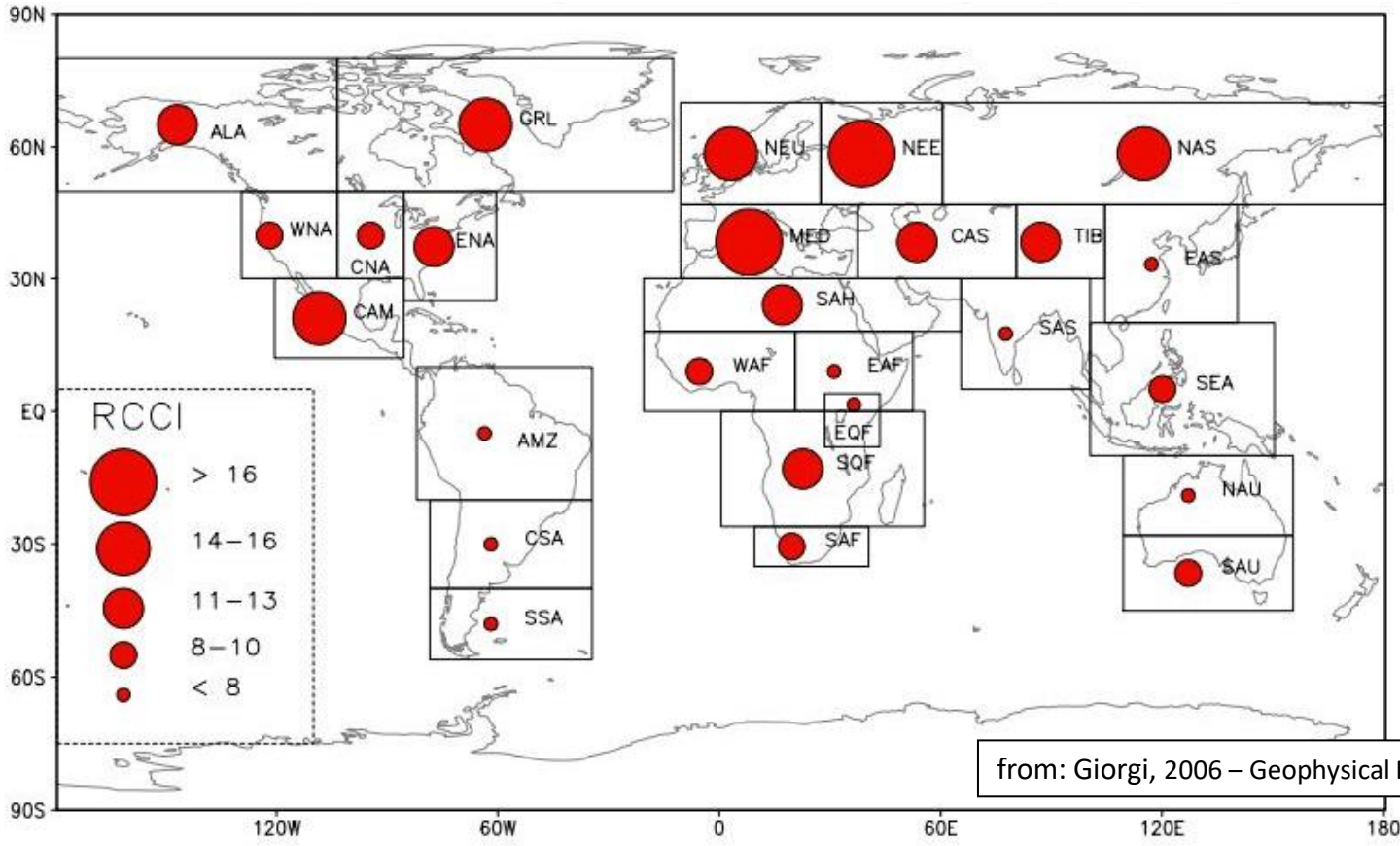

from: Giorgi, 2006 – Geophysical Research Letters

The Mediterranean is one of the most prominent and vulnerable climate change "hotspots" and responds quickly to atmospheric forcing.

The Euro–Mediterranean region frequently experienced extreme climate and weather events such as the hottest summer 2003 and 2010.

The magnitude and frequency of the extreme temperature events over land and sea tend to increase in recent years and are expected to increase in the future.

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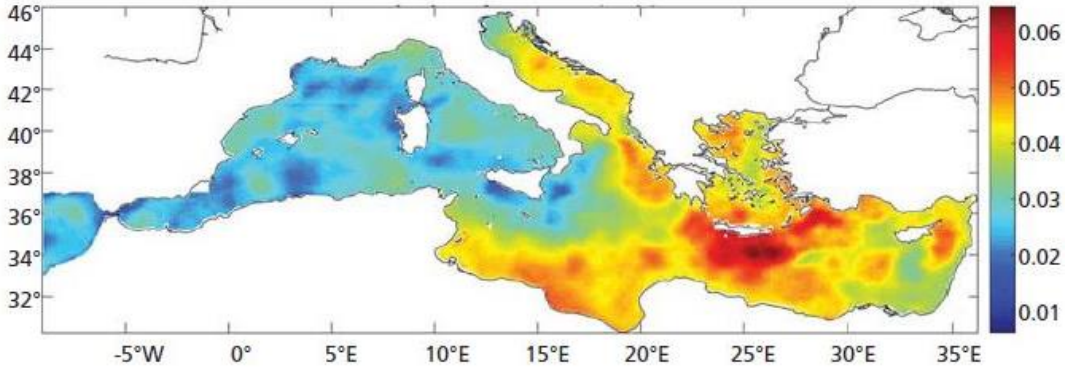

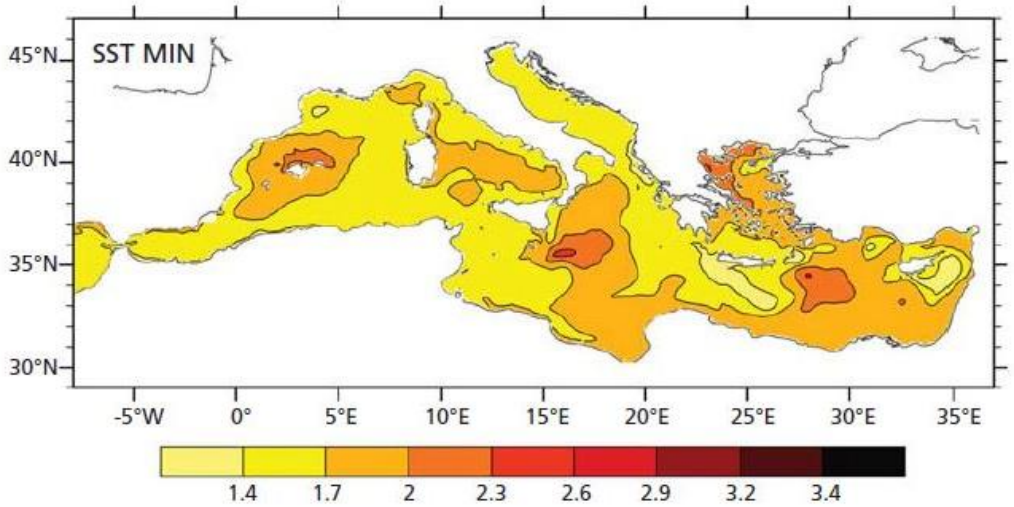

from: FAO, 2018

Recent warming of the Mediterranean Sea (from the early 1990s) results from the combination of natural climate variability (Atlantic Multidecadal Oscillation) and climate change, with a resulting stronger trend in the Eastern Mediterranean from the early 1990s.

The available estimates of future surface warming in the Mediterranean range from +1.73 °C to +2.97 °C in 2070 to 2099 in respect to 1961 to 1990.

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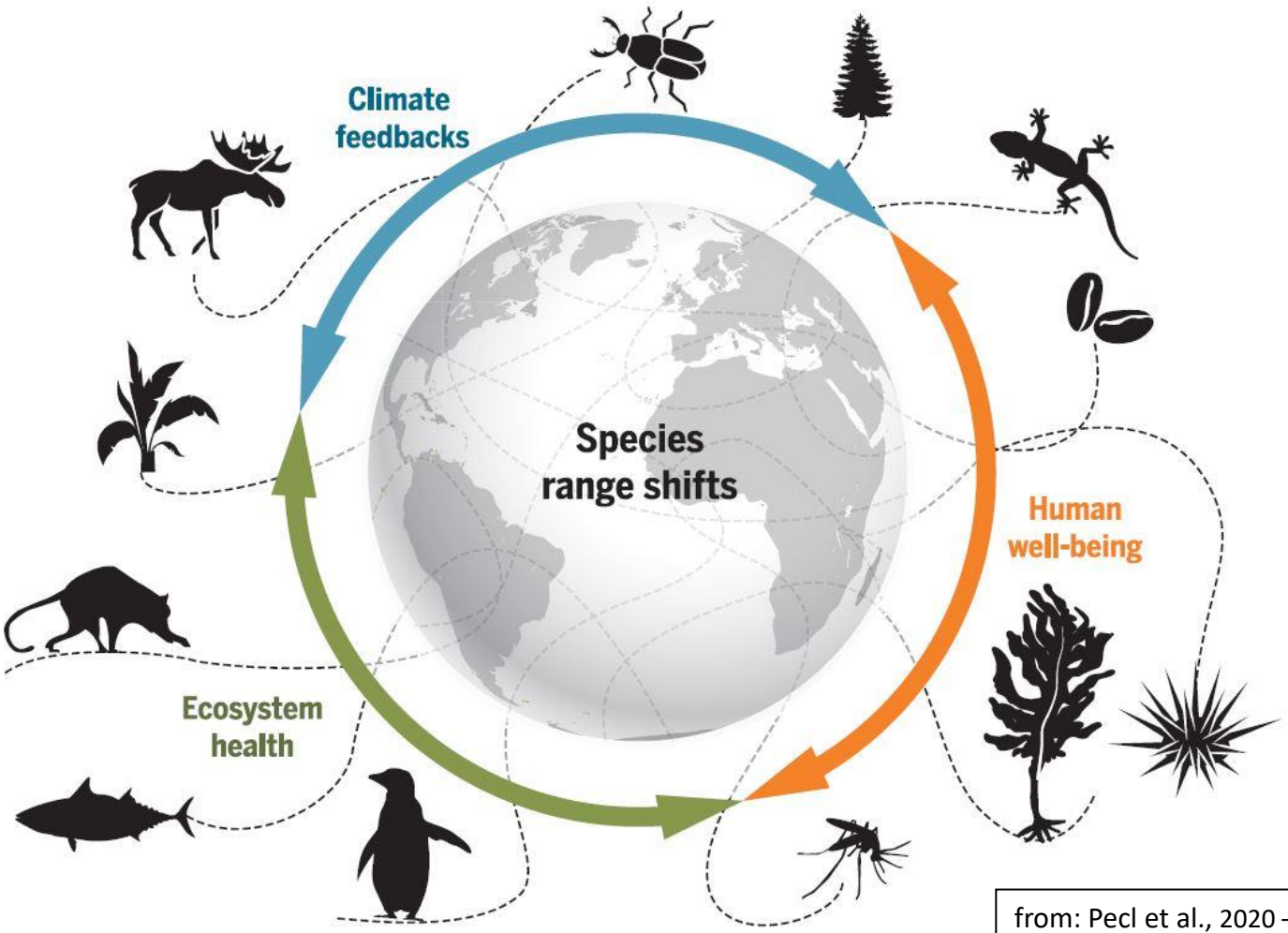

from: Pecl et al., 2020 – Science

As the global climate changes, human well-being, ecosystem function, and even climate itself are increasingly affected by the shifting geography of life.

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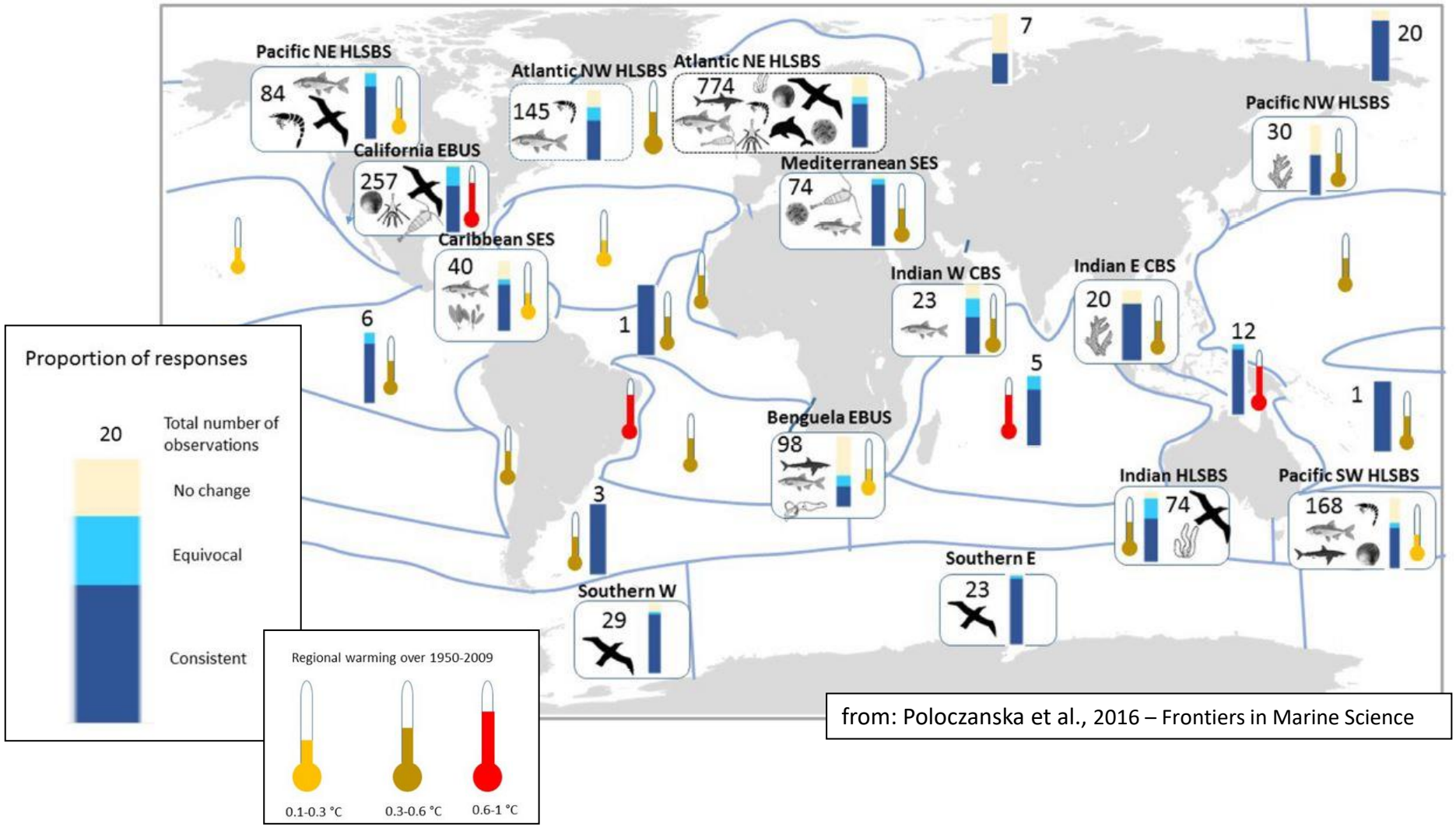

from: Poloczanska et al., 2016 – Frontiers in Marine Science

The Mediterranean shows a regional increase of water temperature between 0.3 and 0.6 °C over the period 1950-2009, and the taxa mostly impacted were zooplankton, bony fish and benthic mollusks.

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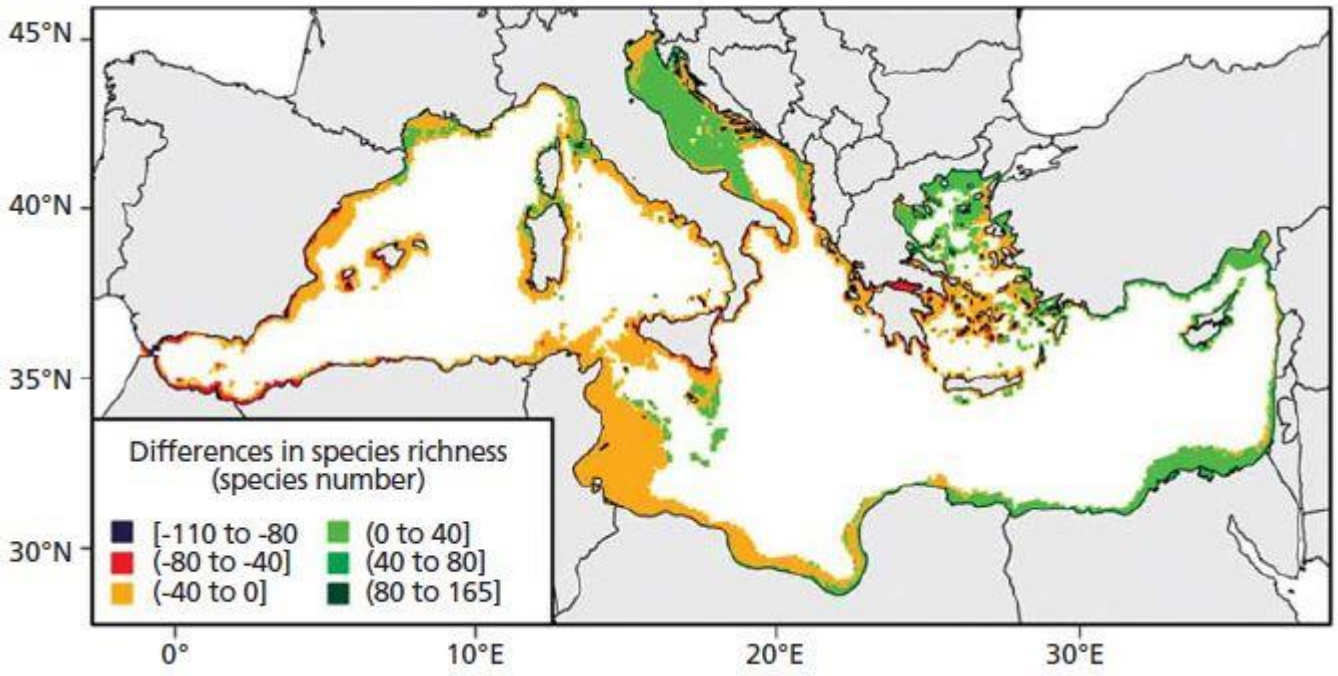

from: FAO, 2018

Future projections show that regional changes in fish abundance and their distribution will alter species richness, with an expected increase in overall richness by the mid-twenty-first century in the Eastern Mediterranean, and a decrease in the western region. Similar changes in the community structure and diversity are predicted at smaller spatial scales (e.g. Gulf of Gabes). A likely decrease in connectivity between neighbouring ecosystems within the Mediterranean is expected because of a decrease in the size of the spawning areas and an increase in larval retention on smaller areas of the continental shelf.

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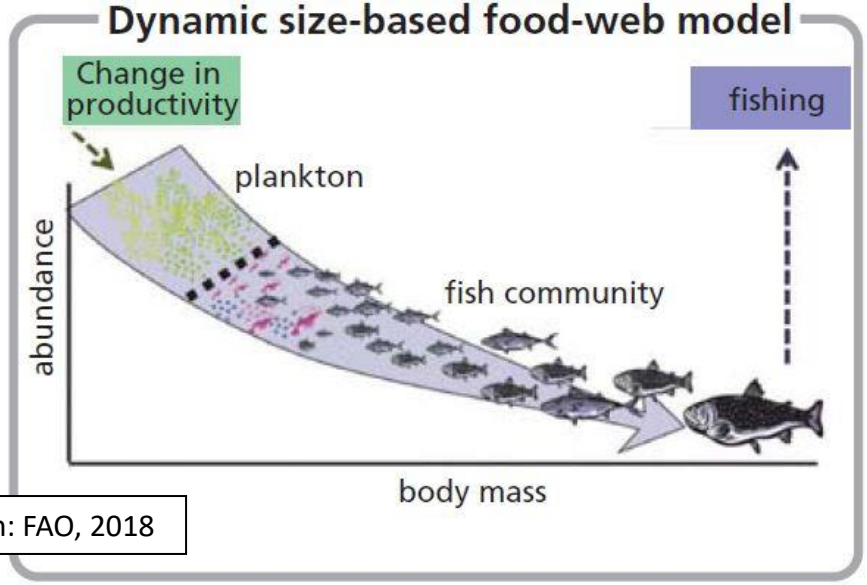
Small and medium pelagic fish are among the main fisheries resources in the Mediterranean. These species are very sensitive to climate change because of their dependence on surface hydroclimatic conditions affecting primary production.



from: FAO, 2018

Important trends observed over the twenty-first century are a decrease in stocks of anchovy and sardine, the expansion of other thermophilic species (round sardinella) and the contraction in distribution of cold-water species (sprat).
The strong dependence of pelagic species upon river runoff variability and the very likely decrease in precipitation in the Mediterranean will have negative implications for pelagic species.

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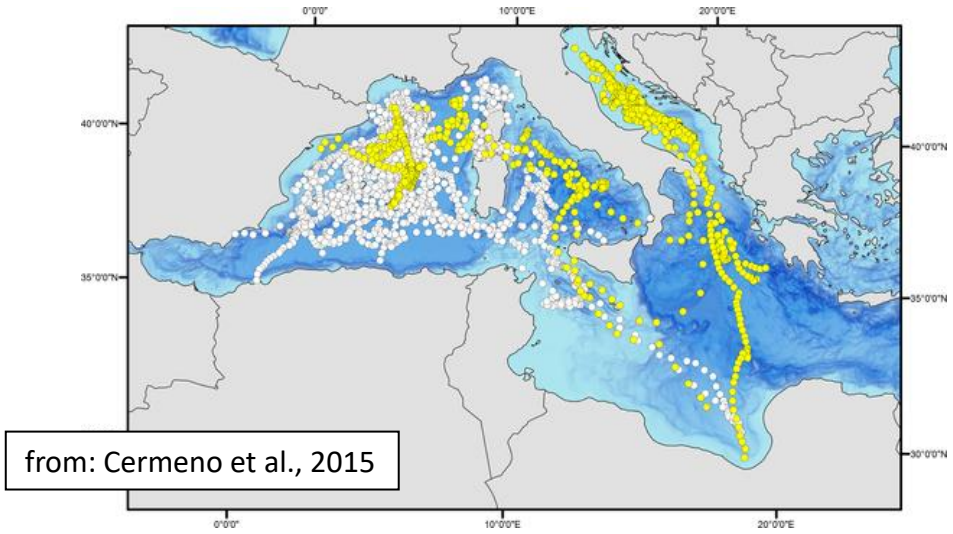
Phenology and migratory patterns of large pelagic species seasonally entering the Mediterranean for spawning will likely be impacted by warming, e.g. bluefin tuna, in addition to the meridionalization of the migratory behaviour of resident tuna species, e.g. albacore and dolphinfish.



from: Cermeno et al., 2015

Projected likely changes in thermohaline circulation, with the Atlantic water that enters the Mediterranean becoming lighter, is likely to trigger a change in the temporal and spatial dynamics of mesoscale oceanographic structures (e.g. eddies and fronts), which are key for the reproductive behaviour of large pelagic fish.

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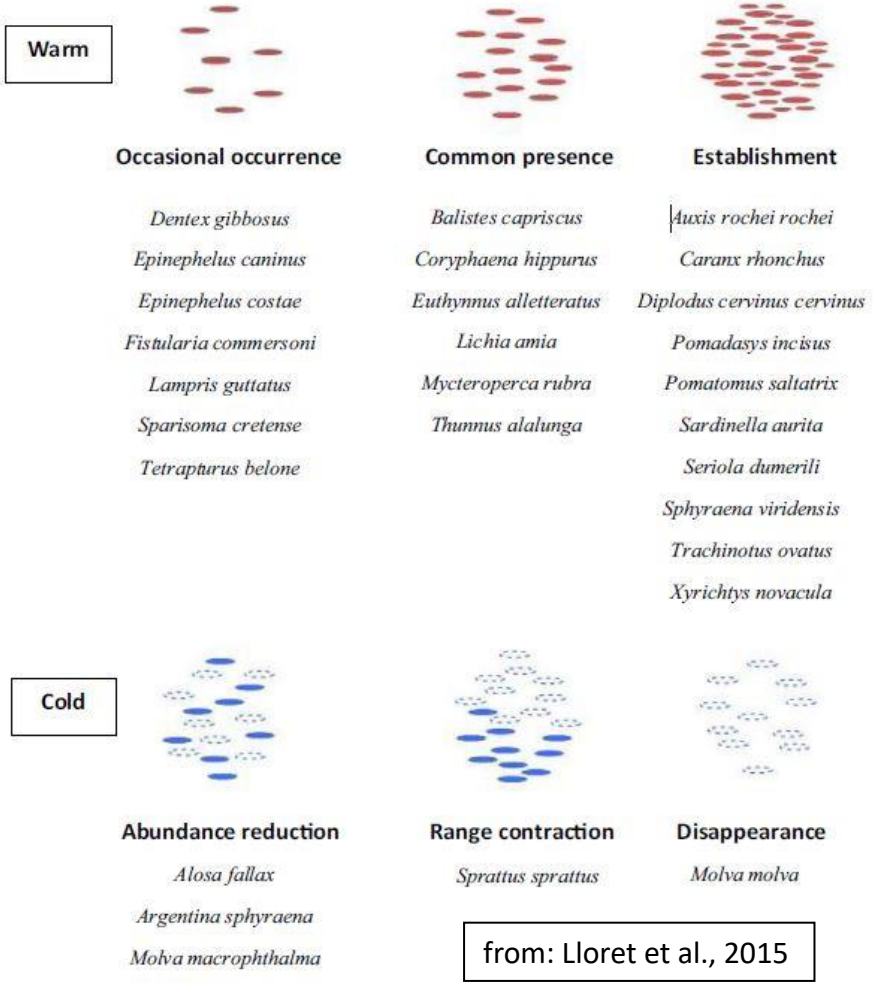
The composition of the demersal communities has changed in the Mediterranean region in recent decades with a higher contribution of warm-water species, which are progressively colonizing northern areas concomitant with a regression of cold-water species.



from: Lloret et al., 2015

The high diversity of physical drivers impacting demersal species and the geographic variation of their effects makes regional projections by climate change models difficult and hinders the assessment of future directional changes.

Winter hydroclimatic processes also shape primary production at subregional scales, impacting fish such as hake and blue whiting, and can also produce cascading episodes in canyons and intense vorticity events that reduce the catchability of benthic crustaceans such as red shrimp.

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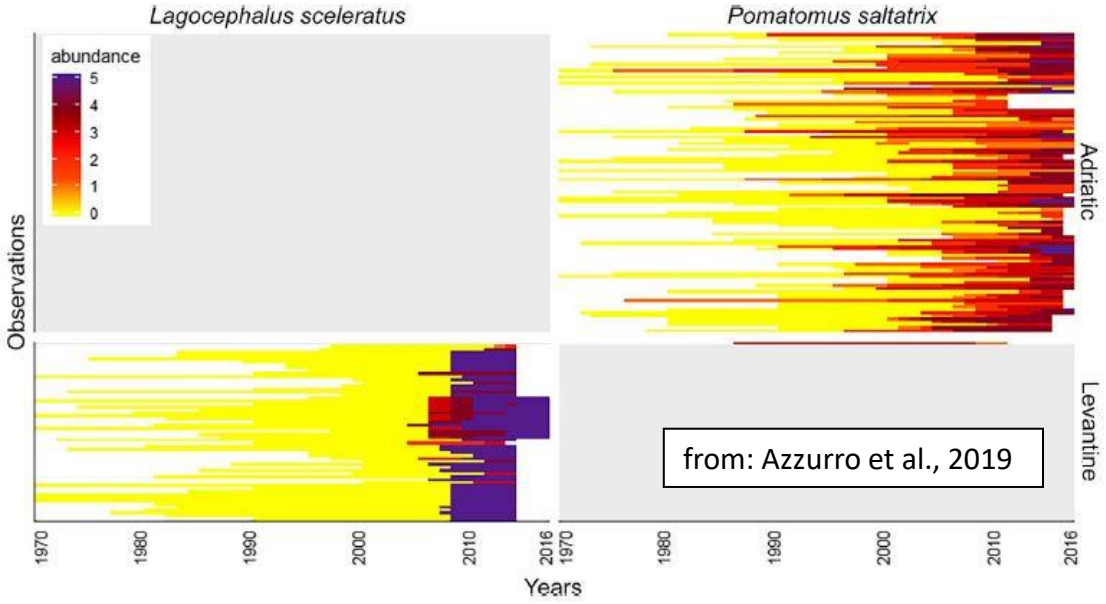
The progressive occurrence and establishment of warm-water species is expected to generate both positive and negative effects on fisheries, especially on SSF because of their socio-economic and ecological sensitivity.



There are numerous examples, from bluefish and barracuda as examples of "meridionalization" in northern Mediterranean areas to mounting evidence of tropicalization of Indo-Pacific species (Lessepsian migrants) in the Eastern Mediterranean, or the extension of the distribution ranges of Mediterranean species (mediterranization) and detection of non-indigenous species in the Black Sea. These species compete with native species (e.g. rapa whelk) or include highly damaging toxic species such as pufferfishes.