Threats to marine biodiversity in the Mediterranean

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Changes and loss in marine biodiversity are driven by anthropogenic factors in addition to natural forces. In the past geological and physical changes were the main responsible of the most dramatic changes in biodiversity in the Mediterranean sea. Nowadays human activities are essential elements to be considered. The most important threats are habitat loss, degradation and pollution, overexploitation of resources, invasion of alien species (NIS non indigenous species) and climate change. These threats affect the greatest number of taxa; some of them come from maritime traffic (collisions, pollution, noise) and aquaculture (alien species, diseases, habitat destruction, pollution).

The relevant role of climate fluctuations on biodiversity derives by a combination of direct effect on the organisms (survival, reproduction, dispersal and behavior, all controlled by the temperature), effects mediated by biotic interactions and indirect effects as those through marine currents.

If the trend is towards warming, as it seems to be, the natural systems (communities, habitats) that are most vulnerable may be those cold or cold-temperate in the northern part of the Mediterranean and in the Black Sea. A large impact is predicted for habitats at the level of the summer thermocline, between the upper infralittoral and the circalittoral, and the surface fringes of the infralittoral. Catastrophic mortality events of populations of sessile invertebrates, such as several gorgonians and sponges, have been documented in the last years. Among habitats, those most threatened probably are the most characteristic of the Mediterranean, such as coralligenous assemblages, or structures at the sea surface such as the "fringes" of *Lithophyllum byssoides* and Vermetids.

As regards species, the most vulnerable will clearly be long-lived plants and sessile invertebrates (gorgonians, sponges and corals) as well as those species with boreal affinity, the numbers of which are currently falling and risking local extinction. Lastly, the increase and greater spread of invasive alien species, favored by the increase in temperature, will have consequences for resident species.

The predictable impacts are multiple. Generally speaking, the impact expected should be that of an increase in the abundance of thermophilic species and an expansion in their range. The opposite effect is expected for species with affinity for cold waters. Climate change in the Mediterranean also favors epidemiological outbreaks, as the most pathogens are temperature sensitive.

The most important processes currently underway as a consequences of global change are two. The first process is "meridionalization", with native thermophilic species expanding their ranges northward and retractions of the southern margins of marine species of the Mediterranean temperate component. The second is "tropicalization", with non-indigenous species – coming mainly from the Eastern Atlantic and Red Sea regions – extensively colonizing waters and moving their ranges at fast rates.

The anthropogenic and climate actions can combine their effects and man is now directly influencing the climate. Air and seas are warning due to increased atmosphere dioxide content as result of anthropic activities. So climate change can no more be considered of natural origin alone.

The increased amount of CO_2 produce higher acidification of sea water with negative consequences on biogenic calcifications in many marine organism both planktonic and benthic.

The habitat loss and degradation is currently, and probably it was also in the past, the most widespread threat in particular for the coastal zone where urban and industrial development, port construction, sediment loading, pollution have reduced and sometime completely destroyed important habitats as sea grass meadows, coralligenous bottoms, biocoenosis of midlittoral rock (in particular platforms and rims, with *L. byssoides*, *L. trochanter*, Vermetids).

As above mentioned, NIS represent an additional threat. The spatial overlap between non indigenous and indigenous species may produce biotic homogenization and hence a decrease of β-diversity (diversity at regional level). The establishment of tropical invasive species may change the specific character of indigenous communities that became similar to their tropical analogs. The NIS invasion may produce local population losses and niche contraction of native species, reduction of genetic diversity, loss of ecosystem functions, processes and habitat structure.

The main threat of fishery and aquaculture is centred on the effect of overfishing, physical impact on the habitat and communities, overload of nutrient, spread of diseases. High fishing pressure over longtime has lead to that spawning stocks of many species are at critical levels and some ever close to collapse, in addition it may lead to reduced genetic variability and less effective and simplified food webs where the energy flow has been severely disturbed. By selective removal of species and changing the size structure of population, predator-prey interaction might be changed. Possible consequences are less resilience and less stability in the ecosystem and then reduced capacity to adjust to natural changes in the environment.

At present a large number of fish stocks are over-exploited in terms of growth potential and reduced recruitment a clear sign that the current harvest is not sustainable. High market valuable species are replaced by less valuable species and many not target species are destroyed, some are threatened protected species.

Main reference

[1] Coll M., Piroddi C., Steenbeek J., Kaschner K., Ben Rais Lasram F. *et al.* (2010). The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. *PLoS ONE*, 5(8), e11842.