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Editorial: A plea for the Mediterranean sea: understanding impacts of multiple anthropogenic stressors on coastal and marine biodiversity, ecosystems and their services

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Editorial on the Research Topic

[A plea for the mediterranean sea: understanding impacts of multiple anthropogenic stressors on coastal and marine biodiversity, ecosystems and their services](#)

Environmental stressors, such as biodiversity loss, climate change and fluctuations, alien species invasions, land-based pollutants and anthropogenic stressors, such as intensive pressure on natural resources, maritime transport, over-fishing, eutrophication, contamination, are of major concern for the health of marine ecosystems in the Mediterranean Sea (Katsanevakis et al., 2014; Corrales et al., 2018; Piroddi et al., 2020; Mandić et al., 2022). Environmental stressors with anthropogenic disturbances potentially exacerbate their ecological effects and could lead to irreversible environmental damage in the Mediterranean basin. Such stressors impact biological processes, alter ecosystem functions, and decrease global and local biodiversity (Côté et al., 2016, Halpern et al., 2019, Carrier-Belleau et al., 2021).

Global change over the last decades is imparting variations in primary productivity levels across the Mediterranean Sea, indicating changes in spatial distribution of certain commercial marine species and their reproduction zones, which can significantly affect their abundance and total allowable catch (TAC) (Estrada, 1996; Piroddi et al., 2017; Veloy et al., 2022). Analysing series of data can provide answers to the causes and changes occurring in the environment, but also provide recommendations for the preparation of management plans for highly commercial fish species and make the natural resources of the sea sustainable (Matić-Skoko et al.; Džoić et al.).

Changes in marine ecosystems usually have several causes, and their joint effect with degrading pressures on the living world of the sea has a critical role in maintaining diversity of species, ecosystem health and achieving good ecological status (Mandić et al., 2021).

In the present Research Topic, four contributions improved our understanding related to environmental stressors that affect marine organisms and ecosystems. The increasing influence of various changes and pressures in the environment affects the ecosystem regime. Among these changes, the increase in temperature and the apparent impact of climate change result in decreasing mobility of highly commercial benthic species. Matic-Skoko et al. investigated the influence of decadal changes in sea bottom temperature in the landing biomass, fishing effort and CPUE (kg/day) data of the European lobster *Homarus gammarus* in the eastern Adriatic Sea. They reported that significant rises in sea bottom temperature in both the northern and central Adriatic Sea caused significant increase in landings and CPUE of *H. gammarus*, while the possible establishment of the alien species *Homarus americanus* in the Mediterranean Sea can lead to high rate of competition for habitat and food, and possible hybridization is possible. The influence of increasing temperature on the early developmental stages of species, their success in growth, development and reproduction is still not sufficiently known. However, the analysis of the data series shows a positive trend of increasing temperature on spawning, shortened egg incubation period and increased recruitment of *H. gammarus* in the northern Adriatic.

In contrast to the influence of temperature on benthic species, salinity and Chl-a play a much more significant role in the patterns of spatial distribution and abundance of pelagic species of marine organisms (especially fish) (Džoić et al.). This research investigated multiple dependencies between early developmental stages of anchovies (*Engraulis encrasicolus*) with regards to environmental variables using a nonlinear method called Growing Neural Gas Network. The research was conducted in the central and northern Adriatic Sea, showing a clear negative trend between anchovy early life stages abundances (eggs/m²; larvae/m²) and environmental variables (SST, temperature and chlorophyll data, numerically simulated salinity, maps of primary production).

There are certain specificities of the Adriatic Sea that relate to depths, ingressions periods (when the salty Levantine Intermediate Water (LIW) is transported towards the Adriatic Sea by cyclonic gyre in the Ionian Sea), different hydrodynamic regimes during summer and winter and upwelling processes that bring nutrients from deeper water layers. Those specificities affect the spatial distribution of species, spawning and feeding zones, which should be carefully taken into account during the definition of pelagic fishery management plans in the Adriatic Sea. Džoić et al. found that anchovy abundance and spatial distribution are mainly influenced by the interaction of Chl-a and salinity and that temperature does not play a direct role.

Monitoring the degree of biodiversity of fish species in the coastal and marine ecosystems, as well as possible changes in the composition of species, is most often carried out using traditional and standardized methodologies, such as visual census, which has significant limitations. Recently, investigations using eDNA metabarcoding are increasingly being conducted because it

represents an alternative to rapidly, accurately, and cost-effectively analyze thousands of environmental samples simultaneously, together with analyses of species composition. Using eDNA metabarcoding, Cananzi et al. investigated the fish community composition in different seasons and habitats of the northern Adriatic Sea (Venice Lagoon). Their results support the more regular application of this methodology for analysing and profiling possible ecological consequences on species composition, especially in areas under high pressure, such as coastal lagoons and shallower parts of the marine ecosystem.

The anthropogenic influence on species composition is most intensively reflected in species on the verge of extinction, such as the monk seal *Monachus monachus*. Deliberate killing, drowning from accidental entanglement in fishing gear, overfishing that causes food scarcity, increased pollution levels, habitat degradation and destruction are the most common threats to this species. Panou et al. addresses the current status of the endangered Mediterranean monk seal in the Adriatic-Ionian basin and seeks to propose a strategy for the recovery of the species in the region. The Monk seal is one of the world's most endangered species, and the only one endemic to the Mediterranean Sea. Its abundance and distribution in the Adriatic-Ionian region are practically unknown. Direct observations in the last decades have been few and scattered, making it difficult to determine its distribution. The core distribution area of this species is the Aegean Sea, which is crucial for the further conservation and recovery of the species in the entire Adriatic-Ionian basin.

Overall, these articles presented in this Research Topic provide new results, data series, methodologies and recommendations for management plans for commercial and threatened species of the Mediterranean area.

Author contributions

MM; invited the other guest editor SP to design this Research Topic. All guest editors have edited and reviewed the editorial article, and approved the submitted version.

Conflict of interest

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