*diversity*

MDPI

*Editorial*

# Historical and Current Diversity Patterns of Mediterranean Marine Species

**Sabrina Lo Brutto** [1,2]

[1] Department of Biological, Chemical, and Pharmaceutical Science and Technology (STEBICEF), University of Palermo, 90123 Palermo, Italy; sabrina.lobrutto@unipa.it
[2] Museum of Zoology "P. Doderlein", SIMUA, University of Palermo, 90123 Palermo, Italy

The Mediterranean is a sea which, despite its peculiar geomorphological history and ecological–oceanographic features, still receives less attention than it ought to. The Mediterranean is a semi-enclosed basin where different natural and anthropogenic phenomena have caused changes at the community or intra-species level over time. The basin went through dramatic changes in its biota during the last six million years and more quickly in the past century [1]. The contemporary physical factors, such as hydrodynamic patterns, temperature and salinity, further affect species distribution, interacting with biological factors such as bioinvasions [2].

All the events and all the processes have left and leave a mark in the gene pool of marine species [3], their morpho-physiological traits [4], and the extent of the loss or expansion of their geographic range [5].

Currently, the Mediterranean Sea is changing its physical and ecological features, whose trends can be extrapolated by comparing historical collections and present-day observations. Natural history museums have a fundamental role in this research field as they preserve historical biodiversity and reference material of a region [6]. Notwithstanding, they have been overlooked by academic researchers for a long time.

The Mediterranean has been described as a miniature ocean [7] for its species richness and the overall response to the diverse pressures affecting its biota. Accordingly, the basin can be considered a natural laboratory, and the case studies from this marine realm can be symbolic of specific topics [8].

Recently, a growing number of studies has focused on themes such as alien or vagrant species spread [2,9] or warming climate forecasts [10,11]. Scarce literature deals with patterns obtained from long-term datasets or museum collections which can provide information on a large temporal scale, while few articles report relevant data on an extensive variety of species, in some cases focusing on conservation purposes [12,13]. Consequently, more research is needed to fill these gaps and provide additional information.

In this issue, the biodiversity in the Mediterranean Sea has been described at a synchronic and a diachronic level, highlighting the past two centuries for which museum collections can provide overlooked information. Historical records are preserved for the major marine taxa, knowledge of which would greatly benefit from employing specimens and data collected in the past. All of the articles review the current status of the marine diversity of species belonging to several taxonomic groups (seagrasses, macroalgae, sponges, polychaetes, bivalves, sharks, fishes, mammals) and explore the ecological and conservation implications of some of the most threatened ones.

A study examined the extent of the cetacean strandings in Italy [14]. The authors estimated the number of marine cetacean strandings by means of a long-term dataset, covering a thirty-year period. The pattern described reflects the knowledge on the distribution of common and rare cetacean species and raises some questions about the necessity to organize the recovery of carcasses in some regions, to not lose samples and data.

The Mediterranean Sea hosts the Mediterranean monk seal (*Monachus monachus*), one of the most endangered marine mammals in the world. It is a charismatic species very

check for updates

**Citation:** Lo Brutto, S. Historical and Current Diversity Patterns of Mediterranean Marine Species. *Diversity* **2021**, *13*, 156. https://doi.org/10.3390/d13040156

Received: 1 April 2021
Accepted: 1 April 2021
Published: 6 April 2021

close to extinction. However, an increase in sporadic sightings has been recorded in recent years. The paper by Fioravanti et al. [15] reports the results of the genetic characterization of a monk seal pup stranded on the southern Italian coast, underlining the need to intensify conservation activities for this species as it could be much more widespread than previously thought.

Sharks are also one of the most threatened marine animal groups worldwide, and the Mediterranean Sea is considered an extinction hotspot for such species. Historical data have provided important information on how chondrichthyan populations have changed over time. A study included in this Special Issue [16] focuses on some selected species, for which a bibliographic search was conducted on the literature from the 19th century to the first half of the 20th century. The results showed that all the sharks were considered common until the beginning of the 20th century but have declined for the past 70 years. The authors attributed the strong decline to overexploitation, bycatch, habitat loss, depletion of prey items, and environmental pollution.

The above historical pattern drives us to deal with the issue of shifting baseline syndrome (SBS) [17], a behavior of new-generation scientists with a lack of perception of the past ecological conditions and changing ecosystems. In other words, most young people are not conscious of how abundant some species were and how much they have declined today. The paper by Gravina et al. [17] highlights that having a reliable ecological reference baseline is pivotal to understanding the current status of marine biodiversity. Ecological awareness of our perception of environmental changes could be better described based on historical data. Combining historical data with contemporary biomonitoring is required for conservation strategies. The authors advocate for the crucial role of taxonomy as a study of life diversity and the informative value of museum collections as memories of past ecosystem conditions. The paper [17] focuses on six Mediterranean benthic habitats to track biological and structural changes that have occurred in the last few decades.

Herbaria and zoological collections are certainly fundamental for taxonomic studies, and they are also invaluable, though currently underestimated, resources for understanding ecological and evolutionary responses of species to environmental changes. In particular, macroalgae herbarium collections, which exist in some European herbaria, can be successfully used as real "witnesses" to biodiversity changes [18].

Investigations on the temporal genetic variation within a species are also relevant in stock assessment studies. The paper by Righi et al. [19] describes the complex situation of one of the most exploited fish species, the Mediterranean swordfish, of which abundance has drastically decreased. The possible relationship between fishery activities and the loss of genetic diversity in the Mediterranean fish populations is a further crucial point.

The diversity of hard bottom fauna is also largely underestimated and needs regular updating in order to detect and monitor changes in benthic communities. For this reason, Mikac et al. [20] contributed to updating the information on polychaete diversity and depicted a pattern of spatial variation in relation to changes in algal coverage at increasing depth.

In conclusion, this Special Issue filled some gaps, though the Mediterranean Sea still remains an unexplored basin regarding some taxa and some areas, as geopolitics influence the collection of data, and inadequate funds limit the survey of peculiar habitats such as the deep sea. The Mediterranean Sea is currently experiencing a decline in the abundance of several key species, as a consequence of anthropogenic pressures (increase in human population, habitat modification and loss, pollution, coastal urbanization, overexploitation, introduction of non-indigenous species, and climate change), and the scientific community has a relevant role in the present day. It should not have to rely on sporadic and fragmented efforts towards an uncoordinated framework. We all know how much biodiversity is relevant for human life, and how much information still needs to be discovered and organized.

**Funding:** This study was supported by the University of Palermo.

**Conflicts of Interest:** The author declares no conflict of interest.

## References


1. Bianchi, C.N.; Morri, C.; Chiantore, M.; Montefalcone, M.; Parravicini, V.; Rovere, A. Mediterranean Sea biodiversity between the legacy from the past and a future of change. In *Life in the Mediterranean Sea: A Look at Habitat Changes*; Stambler, N., Ed.; Nova Science Publishers Inc.: New York, NY, USA, 2012; Volume 1, p. 55.
2. Servello, G.; Andaloro, F.; Azzurro, E.; Castriota, L.; Catra, M.; Chiarore, A.; Crocetta, F.; D'Alessandro, M.; Denitto, F.; Froglia, C.; et al. Marine alien species in Italy: A contribution to the implementation of Descriptor D2 of the marine strategy framework directive. *Mediterr. Mar. Sci.* **2019**, *20*, 1. [CrossRef]
3. Maggio, T.; Lo Brutto, S.; Cannas, R.; Deiana, A.M.; Arculeo, M. Environmental features of deep-sea habitats linked to the genetic population structure of a crustacean species in the Mediterranean Sea. *Mar. Ecol.* **2009**, *30*, 354–365. [CrossRef]
4. Mejri, R.; Lo Brutto, S.; Hassine, N.; Arculeo, M.; Hassine, O.K.B. Overlapping patterns of morphometric and genetic differentiation in the Mediterranean goby *Pomatoschistus tortonesei* Miller, 1968 (Perciformes, Gobiidae) in Tunisian lagoons. *Zoology* **2012**, *115*, 239–244. [CrossRef] [PubMed]
5. Lo Brutto, S.; Iaciofano, D.; Guerra García, J.M.; Lubinevsky, H.; Galil, B.S. Desalination effluents and the establishment of the non-indigenous skeleton shrimp *Paracaprella pusilla* Mayer, 1890 in the south-eastern Mediterranean. *BioInvasions Rec.* **2019**, *8*, 661–669. [CrossRef]
6. Lo Brutto, S. The case of a rudderfish highlights the role of natural history museums as sentinels of bio-invasions. *Zootaxa* **2017**, *3*, 382–386. [CrossRef] [PubMed]
7. Lejeusne, C.; Chevaldonné, P.; Pergent-Martini, C.; Boudouresque, C.F.; Pérez, T. Climate change effects on a miniature ocean: The highly diverse, highly impacted Mediterranean Sea. *Trends Ecol. Evol.* **2010**, *25*, 250–260. [CrossRef] [PubMed]
8. Lo Brutto, S.; Iaciofano, D.; Lo Turco, V.; Potortì, A.G.; Rando, R.; Arizza, V.; Di Stefano, V. First assessment of plasticizers in marine coastal litter-feeder fauna in the Mediterranean Sea. *Toxics* **2021**, *9*, 31. [CrossRef] [PubMed]
9. Mannino, A.M.; Balistreri, P.; Iaciofano, D.; Galil, B.S.; Lo Brutto, S. An additional record of *Kyphosus vaigiensis* (Quoy & Gaimard, 1825) (Osteichthyes, Kyphosidae) from Sicily clarifies the confused situation of the Mediterranean kyphosids. *Zootaxa* **2015**, *3963*, 45–54. [PubMed]
10. Azzurro, E.; Sbragaglia, V.; Cerri, J.; Bariche, M.; Bolognini, L.; Ben Souissi, J.; Busoni, G.; Coco, S.; Chryssanthi, A.; Fanelli, E.; et al. Climate change, biological invasions, and the shifting distribution of Mediterranean fishes: A large-scale survey based on local ecological knowledge. *Glob. Chang. Biol.* **2019**, *25*, 2779–2792. [CrossRef] [PubMed]
11. Sarà, G.; Milanese, M.; Prusina, I.; Sarà, A.; Angel, D.L.; Glamuzina, B.; Nitzan, T.; Freeman, S.; Rinaldi, A.; Palmeri, V.; et al. The impact of climate change on Mediterranean intertidal communities: Losses in coastal ecosystem integrity and services. *Reg. Environ. Change* **2014**, *14*, 5–17. [CrossRef]
12. Landi, M.; Dimech, M.; Arculeo, M.; Biondo, G.; Martins, R.; Carneiro, M.; Carvalho, G.R.; Lo Brutto, S.; Costa, F.O. DNA barcoding for species assignment: The case of Mediterranean marine fishes. *PLoS ONE* **2014**, *9*, e106135. [CrossRef] [PubMed]
13. Cariani, A.; Messinetti, S.; Ferrari, A.; Arculeo, M.; Bonello, J.J.; Bonnici, L.; Cannas, R.; Carbonara, P.; Cau, A.; Charilaou, C.; et al. Improving the conservation of Mediterranean chondrichthyans: The Elasmomed DNA barcode reference library. *PLoS ONE* **2017**, *12*, e0170244. [CrossRef] [PubMed]
14. Lo Brutto, S.; Calascibetta, A.; Pavan, G.; Buffa, G. Cetacean strandings and museum collections: A focus on Sicily Island crossroads for Mediterranean species. *Diversity* **2021**, *13*, 104. [CrossRef]
15. Fioravanti, T.; Splendiani, A.; Righi, T.; Maio, N.; Lo Brutto, S.; Petrella, A.; Caputo Barucchi, V. A Mediterranean monk seal pup on the Apulian Coast (Southern Italy): Sign of an ongoing recolonisation? *Diversity* **2020**, *12*, 258. [CrossRef]
16. Leonetti, F.L.; Sperone, E.; Travaglini, A.; Mojetta, A.R.; Signore, M.; Psomadakis, P.N.; Dinkel, T.M.; Bottaro, M. Filling the gap and improving conservation: How IUCN red lists and historical scientific data can shed more light on threatened sharks in the Italian Seas. *Diversity* **2020**, *12*, 389. [CrossRef]
17. Gravina, M.F.; Bonifazi, A.; Del Pasqua, M.; Giampaoletti, J.; Lezzi, M.; Ventura, D.; Giangrande, A. Perception of changes in marine benthic habitats: The relevance of taxonomic and ecological memory. *Diversity* **2020**, *12*, 480. [CrossRef]
18. Mannino, A.M.; Armeli Minicante, S.; Rodríguez-Prieto, C. Phycological Herbaria as a useful tool to monitor long-term changes of macroalgae diversity: Some case studies from the Mediterranean Sea. *Diversity* **2020**, *12*, 309. [CrossRef]
19. Righi, T.; Splendiani, A.; Fioravanti, T.; Casoni, E.; Gioacchini, G.; Carnevali, O.; Caputo Barucchi, V. Loss of mitochondrial genetic diversity in overexploited Mediterranean Swordfish (*Xiphias gladius*, 1759) population. *Diversity* **2020**, *12*, 170. [CrossRef]
20. Mikac, B.; Licciano, M.; Jaklin, A.; Iveša, L.; Giangrande, A.; Musco, L. Diversity and distribution patterns of hard bottom polychaete assemblages in the North Adriatic Sea (Mediterranean). *Diversity* **2020**, *12*, 408. [CrossRef]