DEVELOPING DATABASE ARCHITECTURES SUITABLE TO ASSESS THE IMPACTS OF CLIMATIC AND ANTHROPOGENIC PERTURBATIONS ON MARINE ECOSYSTEMS

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Abstract
Biodiversity is helpful to assess the impacts of climatic and anthropogenic perturbations on marine life; it can be assessed at various levels and requires data from various fields of research, including genetics, taxonomy and ecology. Our challenges are (i) to quality check, authenticate and aggregate data from the different fields; and (ii) to agree on networking solutions and metadata standards.
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The Mediterranean Sea is subject to several perturbations, some of which are linked to short-term events or long-term trends in the regional and global climate and in human activity. Biodiversity is helpful to assess the impacts of these perturbations on marine life. For that reason, several European initiatives [1- 4] are gathering biodiversity data, with the aim to model and predict changes in marine systems.

Traditionally, biodiversity is assessed at the taxonomic level of species and leads to the study of biogeography and species diversity, which is of significance for the conservation of our natural heritage. Besides that interest, biodiversity also plays an important role in the functioning of marine ecosystems and their associated biogeochemical fluxes. Notably, biodiversity can be assessed at several levels of organisation including genomic diversity at one end of the spectrum and ecosystem diversity at the other end (Figure 1). Intermediate levels of organisation include the diversity of functional groups and food webs, which are being progressively incorporated into ecosystem and biogeochemical models. These various levels are complementary to species diversity and require additional data from the fields of genetics and molecular biology, and from other biological and environmental sciences.

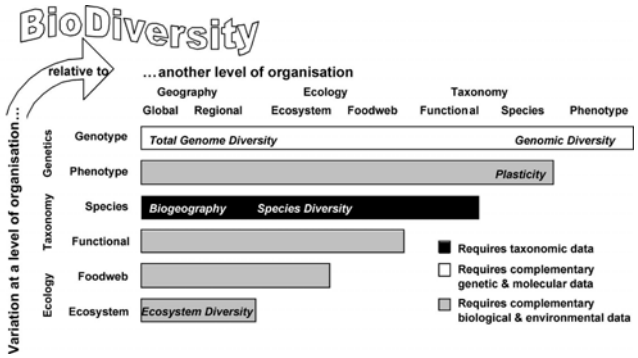

Fig. 1. Levels at which biological diversity is of interest and their respective data requirements.

Historically, the fields of genetics, taxonomy and ecology are segregated, such that each field has developed its own European Network of Excellence [4, 3 and 1, respectively] and its own databases. These have yet to be merged to successfully address the functioning of marine ecosystems and biogeochemical fluxes, but fortunately they all share, at minimum, common geo-references that allow us to assemble the puzzle. The challenges are thus (i) to quality check, authenticate and aggregate data from the different databases; and (ii) to agree on networking solutions and metadata standards.

To address the first challenge, International and European initiatives are developing authoritative taxonomic lists of marine species [5, 6] that are augmented by the scientific community and reviewed by experts. Besides nomenclature issues, traditional and emerging methodologies must be rigorously validated and corrected when necessary, e.g. systematic vs. targeted counts, expert-to-expert validation; and manual vs. imaging identification. Similar attention must be given to other biological data such as the abundance of plankton functional groups estimated from light and epifluorescence microscopy, HPLC and remote sensing. This is particularly relevant for time series analyses involving indicator species. Finally, the conversion of abundances into biomass is particularly relevant to modellers.

To address the second challenge, at least partially, European networks of marine databases were created by the different fields of research [4, 7, 8]. Besides establishing common metadata standards and exchange protocols, the proper integration and use of marine data will require that database architectures refine their granularity. Coarse granularity implies that metadata are attached to pre-assembled datasets (e.g. per project, per taxon or per geographic area), whereas fine granularity implies that metadata are attached to each datum. The latter must be achieved in order to aggregate data into customised, cross-fields data products [9].

References

1 - EUR-OCEANS: European Network of Excellence for Ocean Ecosystems Analysis (www.eur-oceans.eu).
2 - SESAME: Southern European Seas: Assessing and Modelling Ecosystem changes (www.ncmr.gr/sesame/).
3 - MarBEF: Marine Biodiversity and Ecosystem Functioning EU Network of Excellence (www.marbef.org).
4 - Marine Genomics Europe (www.marine-genomics-europe.org).
5 - ITIS: International Taxonomic Information System (www.itis.gov).
6 - APHIA combines several Registers of Marine Species (www.vliz.be/Vmdcdata/aphia/).
7 - EUROBIS: European Ocean Biogeographic Information System (www.marbef.org/data or www.iobis.org).
8 - SeaDataNet: Pan-European infrastructure for Ocean & Marine Data Management (www.seadatanet.org).
9 - WDC-MARE/PANGAEA: World Data Centre for MARine Environmental sciences (www.wdc-mare.org).