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CORMEDNET: BUILDING A DATABASE ON THE DISTRIBUTION, DEMOGRAPHY AND CONSERVATION STATUS OF SESSILE SPECIES FROM MEDITERRANEAN CORALLIGENOUS ASSEMBLAGES

Abstract
Coralligenous assemblages are one of the biodiversity-richest ecosystems in the Mediterranean Sea, hosting up to 10% of the Mediterranean marine biodiversity; however, it is increasingly affected by several local and global stressors. Besides the recognition of the relevance of Mediterranean coralligenous assemblages at European and regional levels as well as the increasing research efforts to study this key habitat, there is a lack of updated and comprehensive information about basic data on coralligenous species. Here, we present CorMedNet, an initiative that aims to gather information on distribution, demography and conservation status of key coralligenous species, such as octocorals, bryozoans and sponges. At present, this dataset has gathered information, obtained between 1882 and 2019, from published scientific papers, grey literature and technical reports using different search strategies in the ISI Web of Knowledge and Google Scholar, introducing distinct sets of keywords, and contacts with researchers across the Mediterranean. Now, the database includes 4656 records for more than 230 species covering all Mediterranean ecoregions, but with a strong bias towards the north-western basin. CorMedNet is being developed as a collaborative database to promote a continuous update from research efforts conducted by the scientific community. Gathering all the available information is crucial to guide management strategies to enhance the conservation of coralligenous assemblages across the entire Mediterranean Sea.

Key-words: Coralligenous, Sessile invertebrates, Distribution, Demography, Conservation

Introduction
Coralligenous reefs are one of the biodiversity-richest ecosystems in the Mediterranean Sea, hosting more than 1600 species (up to 10% of the Mediterranean marine biodiversity) (Ballesteros, 2006). In fact, they represent a mosaic of different habitats allowing the development of assemblages ranging from the dominance of calcareous algae to invertebrates such as corals, sponges, bryozoans or tunicates. Beyond the inherent natural value of their exceptional biodiversity, coralligenous assemblages provide highly valuable ecosystem services and benefits and have a fundamental role in supporting human wellbeing (Paoli *et al.,* 2017). These habitats provide humans with several services belonging to provisional (i.e., food, pharmaceutical molecules), regulating (i.e., carbon sequestration, nutrient recycling), and cultural ecosystem services, including numerous services (i.e., high biodiversity, fish abundance) that enhance the quality and the enjoyment of underwater recreation activities (Ville

d'Avray *et al.*, 2019). The relevance of Mediterranean coralligenous assemblages has been recognised in different international, European, and national conservation frameworks (e.g., Habitats Directive; European Water Framework Directive). Despite the research efforts to study this habitat (e.g., Ballesteros, 2006; Gómez-Gras *et al.*, 2021), there is a lack of updated and comprehensive information about basic aspects such as distribution, demography or they conservation status (Kipson *et al.*, 2011). Such information is vital to guide management strategies to ensure the conservation of coralligenous assemblages in the Mediterranean Sea (Çinar *et al.*, 2020), specially bearing in mind the increasing threats affecting this habitat such as the recurrent impact of marine heatwaves (Garrabou *et al.*, 2019). To fill this gap, here we present the CorMedNet dataset, which was created to compile data on geographic and depth distribution, demography and mortality of different habitat-forming invertebrate species dwelling in Mediterranean coralligenous assemblages, such as octocorals, bryozoans, and sponges, among others.

Material and methods

The CorMedNet completed database is deposited in https://www.emodnet-biology.eu/toolbox/en/download/occurrence/dataset/6462 and updated in the online version https://cormednet.medrecover.org, where users can visualize, download, and update data to enhance collaboration and interoperability. The CorMedNet database includes published scientific papers, grey literature, and technical reports from both in situ SCUBA sampling and video-photo surveys. A literature survey was conducted by using different search strategies in the ISI Web of Knowledge and Google Scholar, combining the word "Mediterranean" and different key-words, such as the names of the specific target species from the phyla Cnidaria, Bryozoa, and Porifera (e.g., *Paramuricea clavata, Eunicella singularis, Corallium rubrum, Pentapora fascialis, Spongia officinalis*). The last date of our literature search was October 2020.

Database description

One database record corresponds to the observation or sampling of a local population in a specific geographic location (site), depth range, and time (or period). A local population is considered as a group of colonies, specimens, or individuals of the same species, ranging from tens to thousands, depending on the species.

For each database record, the following distribution and demographic information are provided:

<u>Distribution information</u>

- Site name;
- Taxa/species;
- Ecoregion (following Spalding *et al.*, 2007), country;
- Geographic position (latitude and longitude in decimal degrees, datum WGS84);
- Depth range in meters of the sample record (upper and lower limits);
- Year of the survey (starting and ending year);
- Habitat type if available (boulders, cave, overhangs, vertical walls);
- Protection level of the database record at the time of the sampling (protected and unprotected), and marine protected area identification;
- Species habitat map (species habitat map reported: yes/no);
- Demography (demographic data reported: yes/no);

- Genetics (genetic data reported: yes/no);
- Other type of study or description;
- Data availability (public/private);
- Publication id (identification of the corresponding scientific publication and/or data source).

Demographic information

- Year of the survey;
- Sampling technique of the database record (in situ, photo or video surveys, living specimen, material sample);
- Sampling strategy of the database record (permanent or random survey);
- Date of the survey (following the ISO 8601);
- Colonies density per square meter of the database record;
- Colonies height measures of the database record in mm (sample size, mean, standard deviation, maximum, minimum, and percentage of *C. rubrum* colonies equal or larger than 100 mm in height);
- Colonies diameter of the database record in mm (sample size, mean, standard deviation, maximum, minimum, and percentage of *C. rubrum* colonies equal or larger than 7 mm in diameter);
- Mortality measures of the database record (mean and standard deviation of the percentage of necrosis, and percentage of colonies affected by necrosis – considering a colony affected by necrosis when it is equal or larger than 10 % of the total tissue);
- Recruitment measures of the database record (mean number of recruits per square meter observed in the population).

Geographic coordinates were extracted from the publication source and standardized to decimal degrees in the World Geographic System 1984 (WGS 84) coordinates system. When geographic coordinates were not specified nor in the publication source nor in the auxiliary information, latitude and longitude were estimated whenever possible using figures and maps provided in the publication. When the position was inaccurate, we removed the data from the database.

The protection level is assigned using Marine Protected Areas in the Mediterranean GIS database (MAPAMED; Marine Protected Areas in the Mediterranean www.mapamed.org). MAPAMED integrates information about both Marine Protected Areas and the more general sites of interest to the conservation of the marine environment. MAPAMED latest version is incorporated into the CorMedNet database in order to visualize the most updated version of the protection level.

The CorMedNet database was integrated into the EMODnet Biology catalogue. It is linked to the Ocean Biodiversity Information System (OBIS, 2020), so our database is also introduced to this international open access platform. This helps us to use different international system protocols to standardize the CorMedNet database, as the Darwin Core Archive (DwC-A) standards for the biodiversity informatics data – recommended by GBIF (2022) – the species validation using WoRMS matched tool, or the use of international dates following the ISO 8601 standard. Moreover, it helps us to revise all the database records with the LifeWatch and EMODnet-Biology Quality Control tool,

the BioCheck (https://rshiny.lifewatch.be/BioCheck/), which uses for example bathymetric layers to check all the depth range parameters.

Results

The CorMedNet dataset includes 4656 records from more than 230 species covering all Mediterranean ecoregions, but with a strong bias towards the northwest basin (Figure 1). Most of the available information belongs to the 3 major taxonomic groups, in order of importance: Cnidaria, Porifera and Bryozoa (Fig. 1). Regarding the type of information, density is the parameter estimated in most of the studies, followed by size of colonies and mortality (Fig. 2). Most information concerns the northern Mediterranean coast while there is almost a complete lack of reports from the southern and eastern Mediterranean coasts, from Morocco to Lebanon (Fig. 1 and 2).

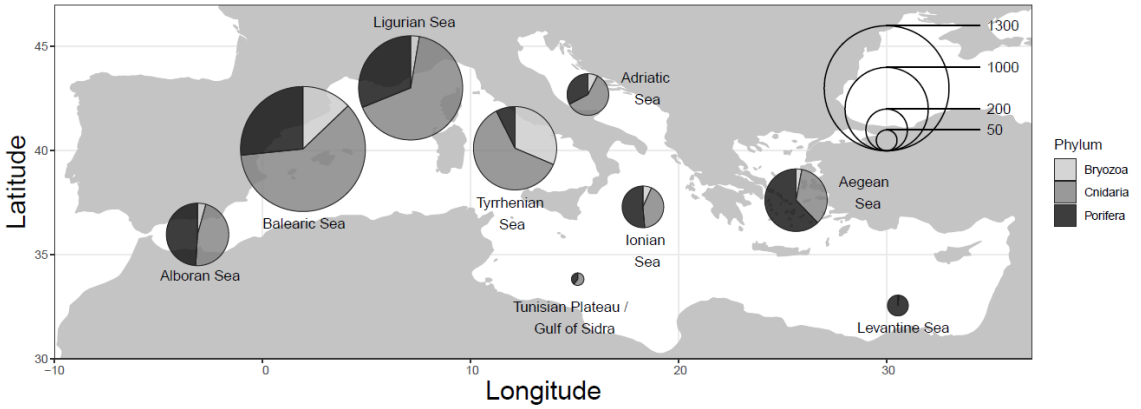

Fig. 1: Taxonomic coverage of the CorMedNet database across Mediterranean ecoregions. Note that the Western Mediterranean was divided into three sub-ecoregions: Balearic Sea, Ligurian Sea, and Tyrrhenian Sea. The number of occurrences is expressed by bubble width.

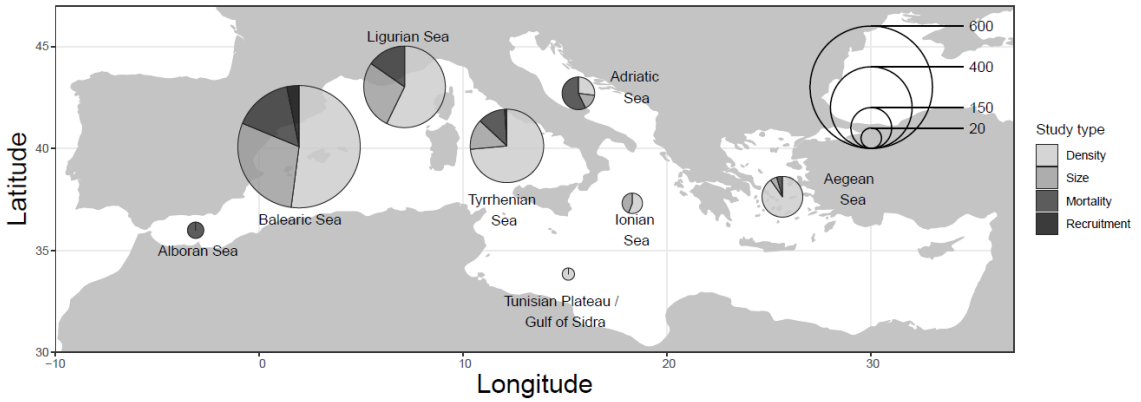

Fig. 2: Distribution of the type of information reported in CorMedNet database across Mediterranean ecoregions. Note that the Western Mediterranean was divided into three sub-ecoregions: Balearic Sea, Ligurian Sea, and Tyrrhenian Sea. The number of occurrences is expressed by bubble width.

Discussion and conclusions

We contend that this collaborative initiative is a unique opportunity to build a regional map of distribution and conservation status of coralligenous species while identifying knowledge gaps (e.g., geographic, depth ranges, species) to be incorporate in the future. CorMedNet is being developed as a collaborative database to promote a continuous update from research efforts conducted by the scientific community. Gathering all the available information is crucial to guide management strategies to enhance the conservation of coralligenous assemblages across the entire Mediterranean Sea (Giakoumi *et al.*, 2013; Doxa *et al.*, 2016). We expect researchers and managers of Marine Protected Areas, technical staff of environmental to contribute with non-published information. Besides, the database will benefit from including the information gathered by citizen science actions such as Observadores del Mar and ReefCheck. In the next future, the database will include data from genetics and species traits.

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