

Managing marine data: Atlas of marine biodiversity in the Balearic Sea, Western Mediterranean

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ABSTRACT

This project is an atlas of marine species covering a sea area of 150.000 km² and integrating a wide array of taxonomic groups: 33 phylum, 615 families, 1058 genus and 1600 Mediterranean marine species in the Balearic islands. It is composed by a database filled with data provided by different research groups in the Centre Oceanogràfic de Balears (COB-IEO) covering data from more than 30 years time series.

A data model has been build comprising 87000 registers from 1600 marine species covering from foraminifera, sponges, algae, crustaceans, phytoplankton, to fishes. A spatial data infrastructure has been developed composed by a set of tools that allow an interoperable access to the data and the metadata with standards following the European Directive INSPIRE. A Web Map Server has been set up using ESRI ArcGis Server. It allows the publication of REST services and WMS services for being consumed by native ESRI web applications or other clients. These standards allow us to expose the data stored in the database to external applications.

A web map client was developed for the data consultation where the user could search by different parameters and the results are displayed individually and aggregately. This data is available through web services for external applications to be consumed.

This GIS geoportal represents a useful tool for decision making processes for coastal management, ranging from recreational uses, marine protected areas, fisheries, industry and conservation purposes. Moreover, the added value to the project is that this atlas is the first one carried out in the Mediterranean strictly including marine species from phytoplankton to large species.

INTRODUCTION

There is a potential need in the scientific community, public administration, and also environmental consulting companies and nongovernmental organisations to have an easy access to

biodiversity data collected by governmental agencies such the Spanish Institute of Oceanography (IEO).

The Marine Atlas on Biodiversity of Balearic Sea (MABBS) is a pioneer action in the area since it is aiming at integrating marine information about taxonomic groups from more than 40 years of research and campaigns carried out by the Centre Oceanogràfic de Balears (COB). Combining information from so many biological groups (as illustrated by figure 1) allows a more integrated vision of the distribution patterns of species, therefore representing a powerful tool for management decision processes and further planning at coastal areas.

The main goal of this project is to provide a set of tools for advanced users that help them to discover new datasets. With this information, they will be able to define the state of marine biodiversity in the Balearic Sea using quantitative methods, to define possible biodiversity hot spots for conservation of habitats and species, among other uses. This information is crucial for management of marine resources and especially for conservation purposes.



Figure 1: Surveying of endemic marine species.

PROCESS

Collecting and structuring information

All the data used in this project have been collected from research projects and oceanographic surveys carried out by the COB in the Balearic islands and it covers a long period of time. The oldest data was recorded in 1972 and the last one in 2010. Some data series covers a long period of time (up to 10 years) and others only a specific moment of a survey.

Regarding the spatial extension, the project covers all the Balearic Sea. Most of the data is located along the coast, especially in Mallorca island, and the number of records decreases as long as we move away from the coast (as illustrated by figure 2).

The usual format of the original data was an Excel file with tabulated data for a period of time. Sometimes, especially for old datasets, a digitalisation of the data was necessary. This information had to be structured and loaded in the data model.

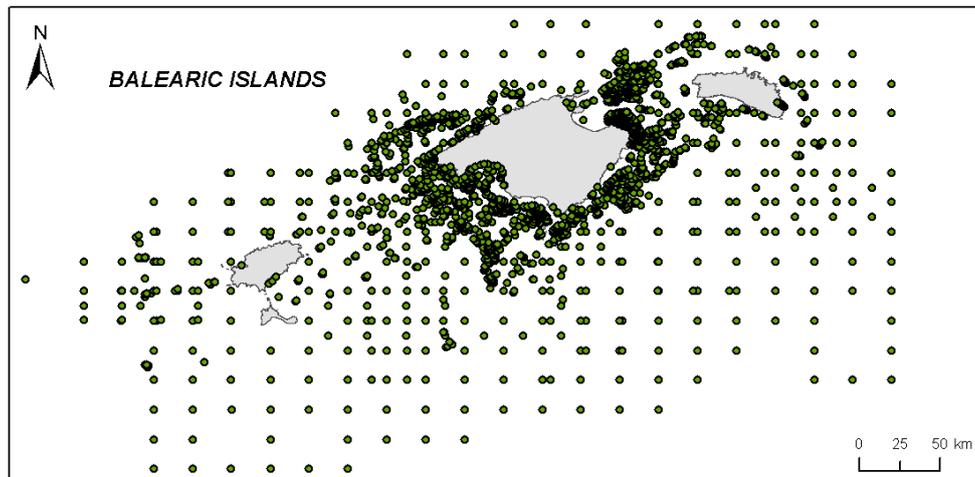


Figure 2: Distribution of the survey points collected.

Data Model

A custom data model has been created in order to store the spatial and non spatial information in a relational database (as illustrated by figure 3). Its structure allows the integration of new data coming from new projects or surveys in the future.

An Oracle database was used for the alphanumeric data and ESRI ArcSDE was used as a middleware to manage spatial information.

In addition to the survey's data on biological species, thematic information was loaded in the database: bathymetric map, physical elements (substrate, salinity...), political boundaries (fishing areas, protected areas...)... This data is important for the Map Viewer in order to contextualise the study area.

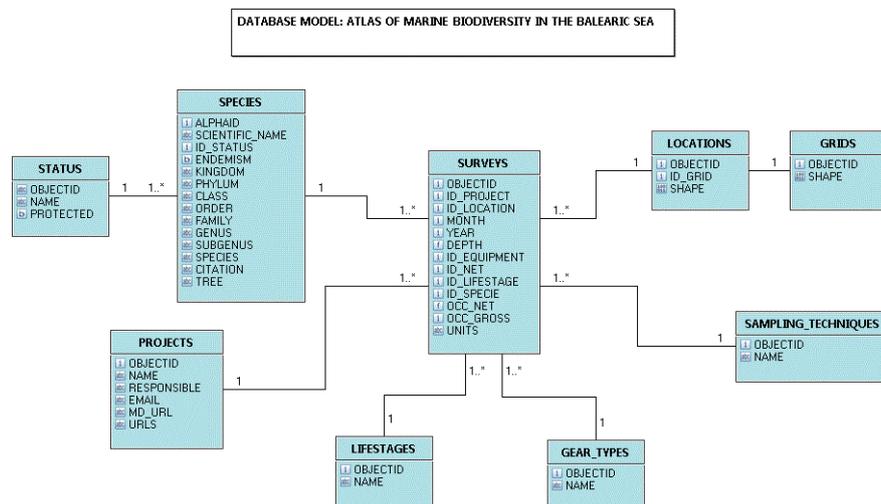


Figure 3: part of the data model.

Spatial Data Infrastructure

In order to provide an easy access to all this information a spatial data infrastructure has been developed. It is composed by a set of tools that allow an interoperable access to the data and the metadata with standards following the European Directive INSPIRE.

A Web Map Server has been set up using ESRI ArcGis Server. It allows the publication of REST services and WMS services for being consumed by native ESRI web applications or other clients. These standards allow us to expose the data stored in the database to external applications.

In our case, we have a web client with an interactive map where the user can display survey's data and support layers. An interesting part is a search form that allows the user interacts with the biodiversity data. The user can search for specific specie or taxon and other parameters like month, year, depth, method of sampling, stage, project, etc...

The results can be represented as points, with individual records per point. In this case, a new tab is showed with summarized records per point. This allows the user to see the basic elements of the dataset, and the contact details for a further contact with the author of the data.

On the other hand, the same results can be represented in an aggregate mode through a grid that represents the abundance of the results (as illustrated by figure 4): either species or taxa. In this case, there is a color ramp for a quick visualisation of the quantitative abundance.



Figure 4: Snapshot of the map viewer.

This data can be accessible from external applications through REST services for the alphanumeric data and WMS for the map images. These two gateways allow advanced users to query the database in a clear way, making the atlas open and useful for quantitative analysis. In any case, data owners are free to choose the license of the data stored in the system, and depending on the license, the system will grant external connections.

Another relevant part of an SDI is the discovery of these services and datasets. For this reason, we have implemented a web catalogue interoperable through CSW OGC standard for catalogues and following the INSPIRE directive specifications. This allows users search for a specific service or dataset within a web catalogue. On the other hand, it provides CSW services for other catalogues' search and harvest metadata from our catalogue, making it interoperable by other catalogues and vice versa.

Future use of the data

Data can be used as a primary source in a wide array of contexts from calculation of biodiversity indices to visualization of taxonomic units. The ultimate goal is to assess biodiversity hotspots, providing an innovative tool for the scientific community, managers and all sector of decision-making regarding coastal issues for conservation of marine life. This information will be extremely useful for the implementation of the European Marine Strategy regarding habitats and species knowledge.

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