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## **MEDTRIX: A CARTOGRAPHIC DATABASE FOR MARINE ECOLOGY AND ANTHROPOGENIC PRESSURES ALONG THE MEDITERRANEAN COAST**

### **Abstract**

*Biodiversity hotspot, commercial exchanges area and major touristic destination in the world, the Mediterranean sea concentrates important and paradoxical stakes. In this context, it is even more essential to analyze species and habitat distribution, environmental variables and human threats but also their correlates, and likely consequences. The spatial distribution of anthropogenic pressures is particularly interesting because this is the basis of numerous other studies: ecological indicators development, species distribution analysis, reserve design, conservation plan... But the data that we need in order to provide spatial resolution relevant for management considerations are still lacking or not easy to reach. Here we describe Medtrix (<http://www.medtrix.fr>), a cartographic platform that regroups different databases made available for marine professionals (scientists, managers, stakeholders). This meta-database is the first one available at such a good resolution (20 m for the anthropogenic pressures) all along the French Mediterranean coast and along some other countries (Tunisia, Italia). These cartographic data concern for the moment anthropogenic pressures (harbors, wastewater, population density, aquaculture), 1:5000 seabed habitat maps, marine mammals observations but also monitoring of the two most important ecosystems in Mediterranean sea: *Posidonia oceanica* seagrass (presence/absence, vitality) and coralligenous habitat (presence/absence and diversity data). The platform proposes different functionalities like editing maps but also to directly comparing sites. One of the databases is already the basis of a management tool: DONIA® application which helps yachtsmen to anchor in a safe (environment and security) way.*

**Key-words:** coastal; water quality; marine habitats; human-driven; impact; modelling

### **Introduction**

Conservation biology interests in addressing the biology of species, communities and ecosystems that are directly or indirectly perturbed by human activities or other agents in order to preserve biodiversity. It necessitates data from different scientific fields, at a spatial resolution relevant for management considerations and appropriate analysis tools. Large-scale data are more and more available concerning biodiversity data (Kaschner *et al.*, 2013) or human threats (Halpern *et al.*, 2008) but the resolution remains low (mostly  $0.5^\circ$  (=75 km) or sometimes  $0.1^\circ$  =15 km).

Here we describe Medtrix, a cartographic platform that regroups different databases made available for marine ecologists. Medtrix makes available seabed habitat maps and ecological data concerning the two most important Mediterranean marine ecosystems (*Posidonia oceanica* seagrass and coralligenous habitat), but also anthropogenic pressures (man-made coastline, wastewater, population density, aquaculture, boat anchoring, land use, macrowaste, hydrocarbon pollution localization and/or impact). This meta-database is the first one available at such a good resolution (20 m for the anthropogenic pressures) all along the French Mediterranean coast and along some other countries (Tunisia, Italia).

## Materials and Methods

The data hosted by Medtrix are only disabled for logged-in people through the “connection” index at <http://www.medtrix.fr/>. Interested people need thus previously to freely create a count at the homepage by clicking on « inscription ». Data made available on the platform Medtrix are provided according to the terms of the Creative Commons Attribution-Non Commercial-NoDerivs 3.0 Unported License.

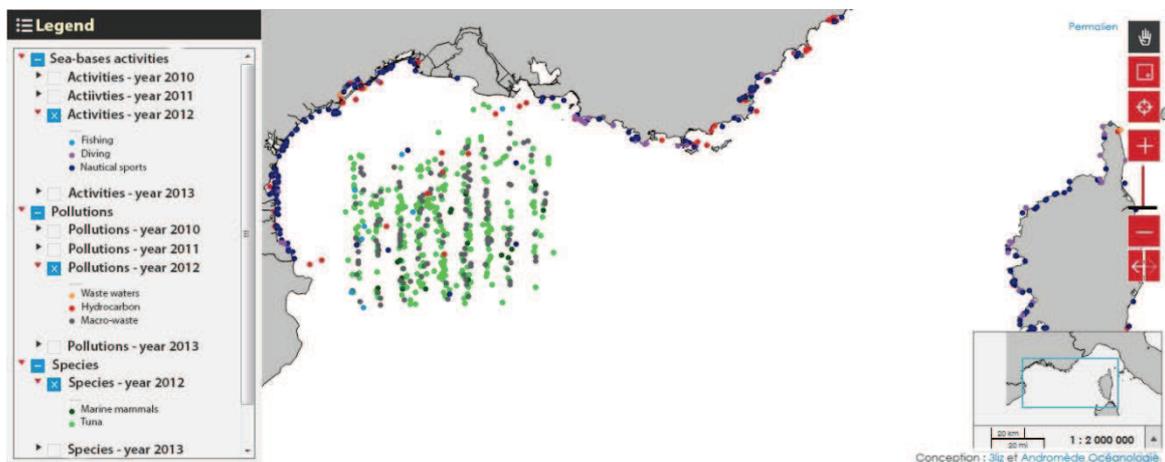
Medtrix uses the open source application LizMap, a complete solution for the publication of QGIS maps on the web. The basic operations of Medtrix consist of making available different databases (projects) related to the Mediterranean coastal water quality and proposing dynamic and cartographic results. Once the user is logged-in, he can choose the project he wants to open.

## Results

For the moment (August 2014), 338 professionals are registered on Medtrix.fr and we count two new users, 55 connections and 40 prints of maps every day.

Five databases (called “projects” on the platform) are made available on Medtrix; they concern water quality monitoring networks (RECOR, TEMPO), pressure monitoring networks (Anthropo-map, MEDOBS) and a seabed habitat description (DONIA® expert with its so-called application). The methodologies used for each project are detailed on the website <http://www.observatoire-mer.fr/en/>.

Briefly, MEDOBS identifies and positions pressures (activities and pollution) undergone by the Mediterranean Sea since 2010 with the help of a sophisticated numeric video camera taken on a plane. Since 2012, data concerning marine mammals and tuna are also referenced (Fig. 1).



**Fig. 1: Example of map built with MEDOBS data (activities, pollutions and species) collected in 2012**

Anthropo-Map consists in modeling at a large-scale (French Mediterranean) the spatial extent (resolution = 20 m) of anthropogenic pressures impacts on the marine environment. Six different pressures (bases on quantitative data) are visualized for their spatial extent: aquaculture, boat anchoring, sewage, man-made, land use and costal population density. RECOR is a monitoring network for coralligenous assemblages using a non-destructive methodology (Andromède océanologie, 2013a). Along the French coast, RECOR includes 157 stations regrouped in 86 sites (several stations = sampling depths per site)

localized within the coralligenous habitat distribution known from DONIA (see thereafter). These stations are distributed between 17 and 90 meters deep and are monitored every three years at the end of spring (June). Coralligenous assemblages (sessile organisms) are described from photographic quadrats taken at each station by a CCUBA (Closed Circuit Underwater Breathing Apparatus) diver (Deter *et al.*, 2012a). TEMPO is a monitoring network that collects descriptive data concerning *Posidonia oceanica* beds dynamics and studies their evolution in time and space. Since 2011, 60 sites (100 m<sup>2</sup> in average) between 5 and 40 m depth are monitored all along the Mediterranean French coast at a rate of one third of the coast per year. Each TEMPO site is monitored at the end of spring (June) according to the method detailed in (Andromède océanologie, 2013b).

DONIA®expert makes available a 1:5000 map for seabed habitats using ten habitat classes. Besides the complete French Mediterranean coast (L-R, PACA, Corsica), several Mediterranean islands are concerned in DONIA®expert: Galite archipelago in Tunisia, Zembra island in Tunisia and Tavolara - Punta Coda Cavallo in Sardinia (Italy). This work pools, homogenizes and completes the maps built in the framework of numerous programs (see acknowledgments). A simplified database called DONIA® intended for general public is also available on Medtrix without any login. The same regions are concerned but habitats were simplified into four classes (seagrass, dead matte, sand, rock) instead of ten. This simplified dynamic map is freely accessible to all through DONIA® application (App Store and Google play), helping boat to anchor safely outside of sensitive habitats.

### Discussion

Since its opening in September 2013 with only two databases at the beginning, the cartographic platform Medtrix has largely expanded with six projects in August 2014. Its utility is demonstrated by its 338 professional users with varied profiles: stakeholders, managers, researchers, engineers and other ecologists. In spite of its opening in the first place, RECOR and TEMPO (respectively 1837 and 1659 views) are largely less visited than DONIA® and DONIA®-expert (8113 and 6375 views) opened three months later. But the perspectives remain huge and we briefly expound them thereafter. The success of DONIA® is easily explained by its general public target without any log-in and the communication it benefited thanks to two awards received: “enterprise and biodiversity” from the French Ministry of environment and “bateau bleu” from the French nautical industrials. Linked to this simplified database and proposing more general data, DONIA®-expert is thus naturally more consulted than RECOR and TEMPO. Note that these maps are now available in two dimensions but the passage to 3D is in progress and will permit to calculate real areas covered by habitats in reliefs (Andromède océanologie, 2013c; Andromède Océanologie, 2014; Hoehstetter, 2008). This will be the aim of the next project available soon on Medtrix: SURFSTAT (Andromède océanologie, 2013c). RECOR, TEMPO (and to a lesser extent MEDOBS) provide abundance and localization data for diverse species among which several ones are protected (*Corallium rubrum*, *Pinna nobilis*, *P. oceanica* ...). Moreover, sampling at a community scale (RECOR) permits to consider conservation questions on the base of an integrated ecosystem approach more than on some charismatic species (Fraschetti *et al.*, 2002, 2005). Data were already used for different studies (Deter *et al.*, 2012a, 2012b) (Doxa *et al.* in preparation; Holon *et al.*, 2014).

Anthropo-map is particularly interesting for all the scientists working on the Mediterranean Sea as it regroups spatial quantitative data concerning the most important pressures undergone by the basin. Some data already do exist but they are either very localized and restricted to one or some pressures (Forchino *et al.*, 2011; Kress *et al.*, 2004) or very extended with a higher resolution (one degree = 25 km; (Halpern *et al.*, 2008; Micheli *et al.*, 2013). The fine resolution of Anthropo-map (20 m) allows at last apprehending the spatial scale managers are interested in.

### **Conclusion**

The cartographic platform Medtrix is a prodigious source of information for a large community of scientists with varied questions. Different functionalities allow to display information concerning the project, see pictures, print a pdf of the map at the chosen scale, measure areas, perimeters or lengths and geolocalized your position via the web navigator. Moreover, stations may be easily and directly compared between each other thanks to the generation of tables and graphic cursors.

Medtrix is continually updated and suggestions-collaborations from other researchers are welcome.

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