



Accord Pelagos relatif à la création en Méditerranée  
d'un Sanctuaire pour les mammifères marins

Accordo Pelagos relativo alla creazione nel Mediterraneo  
di un Santuario per i mammiferi marini

## **Contract No. 2023-08**

**Call for Technical and Scientific Consultancy of the Pelagos Agreement**

# **Call 3 - ASSESSMENT OF CHEMICAL AND BIOLOGICAL POLLUTION STATUS IN THE SANCTUARY PRELIMINARY TECHNICAL REPORT**

**University of Siena  
Department of Physical Sciences, Earth and Environment**

The Consultants:

**Prof. M. Cristina Fossi  
Dr. François Galgani  
Dr. Matteo Baini**



## Consultancy overview

The consultancy aims to assess the current status of chemical and biological pollution in the Pelagos Sanctuary area. Specifically, to achieve this goal the consultants combined their knowledge gained over the years with the approach developed within the Plastic Busters initiative (UfM labelled project) with the update coming from the latest scientific and grey literature. The approach is based on acquiring data that have already been published including peer review publications, information available in open-source database, published reports from national and international projects and existing maps/risk analysis. This preliminary analysis facilitates both a spatial examination of various studies and an understanding of the current knowledge regarding the impact of these stressors on cetacean species inhabiting the Pelagos Sanctuary area, thereby identifying the most vulnerable species and areas. This data combined with the distribution information of cetaceans will allow spatial analyses to be carried out that will help highlighting the potential sources of contamination and high exposure risks for cetaceans.

The proposed methodology is characterized by various operational steps:

- Step 1.** Identification and collection of relevant data from scientific literature and web platforms.
- Step 2.** Screening and critical elaboration of documents and data obtained in the bibliographic research.
- Step 3.** Contaminant maps elaboration.
- Step 4.** Cetacean Maps elaboration.
- Step 5.** Risk map elaboration.
- Step 6.** Design and production of information booklet for result dissemination.

The present preliminary technical report considers step 1 and 2.



### Step 1. Identification and collecting relevant data from scientific literature concerning chemical and biological contamination, as well as marine litter in the Pelagos Sanctuary area.

Complete bibliographic research on chemical and biological contamination in the Pelagos Sanctuary Protected Area has been carried out. The review encompassed a wide range of scientific journal articles from reputable publishers, including “Web of Science”, “Scopus”, “PubMed” and “Google Scholar”, and spanning the period from 2010 to 2024. The environmental compartments considered include the water column, water surface, sediment, seafloor, beach, and biological matrices closely associated with marine mammals (zooplankton and fish species). To better understand the impact of contaminants on cetaceans, due to the wide home range and migratory behaviour of some species of cetaceans, the research on this group has been extended to the entire Mediterranean basin.

The bibliographic research was performed using specific keywords for each topic (Fig.1) and preliminary results were reported in Table 1. Most of the analysis are still ongoing.

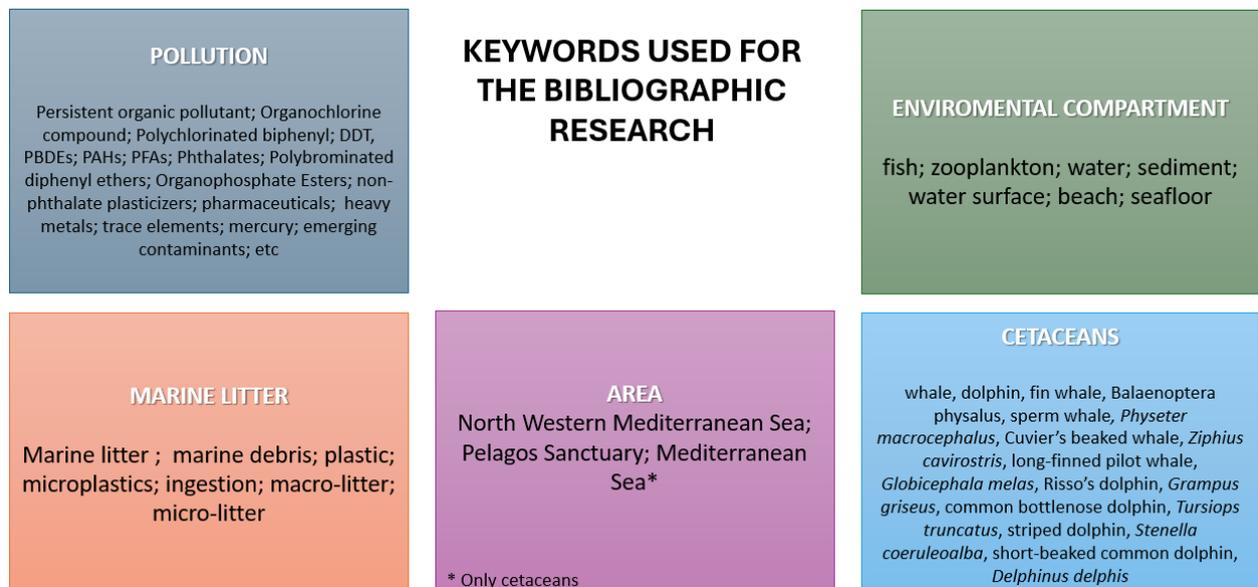


Figure 1. Keywords for search strategy



**Table 1.** Number of studies considered in the bibliographic research according to the pollution inputs and the marine organisms and environmental matrices evaluated in the Pelagos Sanctuary Protected Area and Mediterranean Sea in brackets.

Pollution inputs	Marine mammals	Fishes	Zooplankton	Water	Sediment, Sea floor, Beach
Organochlorine compound (PCBs and DDTs)	22 (51)	on going	7	on going	on going
Polycyclic Aromatic Hydrocarbons (PAHs)	1 (2)	on going	on going	on going	on going
Halogenated Flame Retardants	4 (9)	on going	1	1	1
Trace elements	on going	on going	6	on going	on going
Phthalates	3 (4)	1	5	2	0
Pharmaceuticals and personal care products (PCPPs)	0	0	0	2	0
Other emerging contaminants (OPEs, NPPs)	0	0	0	0	0
Marine Litter ingestion and distribution in the environment	17 (4)	on going	on going	22	17

In addition to peer-reviewed publications, data were obtained from environmental monitoring reports carried out in the Pelagos area by national and international research institutes. Data from the marine Strategy Framework Directive (MSFD) have been retrieved for Italy and one of the consultants is working on similar data retrieval for the French area (including also Water Directive); for marine litter, access to data from supranational initiatives such as the ACCOBAMS survey initiative is foreseen.



Moreover, various web platforms such as EMODNET (<https://emodnet.ec.europa.eu/geoviewer/>), Litter Base (<https://litterbase.awi.de/>) and MedBioLitter (Mediterranean Biodiversity Protection Community, <https://www.arcgis.com/apps/dashboards/6661b838aaff438496d56112fc26f5ff>) have played a key role in collecting relevant data on the distribution and impact of pollutants/marine litter in the Pelagos Sanctuary, acting as repositories of information from different institutions and facilitating the collation of data.

Finally, the consultants have also extracted data from project outputs in which they have been involved, such as the Plastic Busters initiative. These deliverables contain a wealth of information from specific projects aimed at tackling plastic pollution and other environmental challenges in the area.

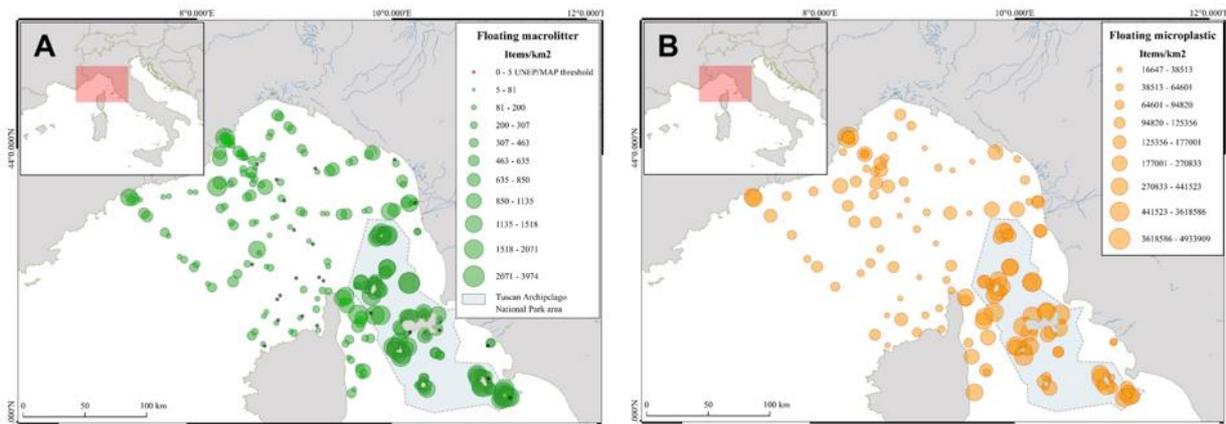
Combining data from all these sources is essential to assess the extent and impact of pollutants on the Pelagos marine ecosystem.

## **Step 2. Screening and critical elaboration of documents and data obtained in the bibliographic research**

In Phase 2 of the study, all information collected is subjected to a systematic screening and critical review process to ensure reliable data. This methodological approach is designed to meticulously extract and analyse relevant information from multiple sources. Key parameters considered in this process include contaminant classes, contaminant concentrations, matrices analysed, year of analysis, characteristics of organisms, tissues examined and the presence and type of litter. The aim is to ensure a comprehensive review and interpretation of the data, thereby facilitating a robust understanding of the ecological dynamics and anthropogenic influences within the study area. Each document and dataset are carefully screened to extract relevant data, while excluding those that do not meet pre-defined criteria or lack essential information such as sampling area or method of analysis. This process ensures consistency and accuracy of data extraction across all sources. Extracted data is compiled in a structured format to facilitate analysis. Parameters are systematically organised, allowing quality checks to identify discrepancies or inconsistencies. In addition to the analytical parameters, basic geo-referencing data has been collected to fully support the development of the contaminant map and subsequent risk assessment analyses as envisaged by the current consultancy.

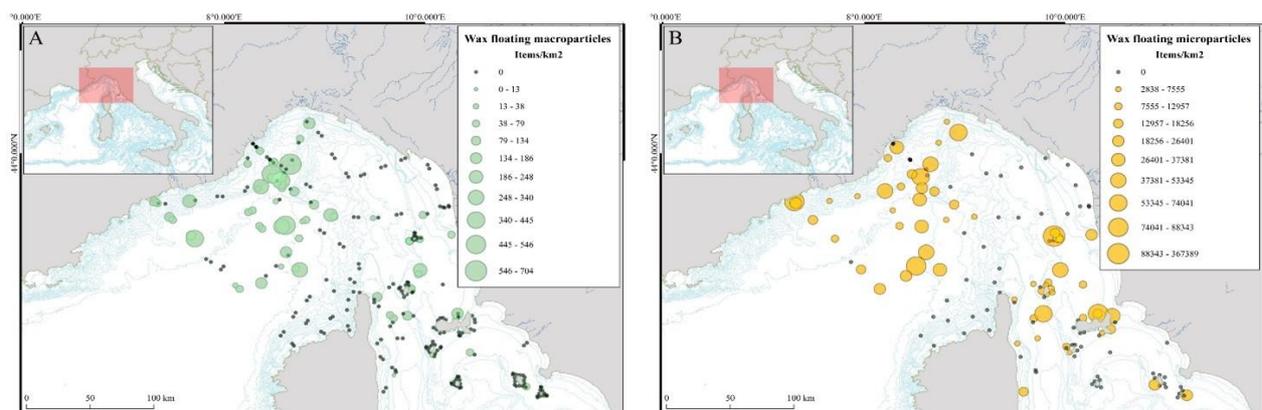


According to preliminary results on pollution and cetaceans, a total of 146 scientific articles have been published in the Mediterranean, including 35 in the Pelagos area. The analysis shows that between 1972 and 2023, a total of more than 900 organisms belonging to 9 different species have been analysed in the area. Levels of organochlorine compounds (PCBs, DDT and metabolites, HCB, HCHs, PCDEs, PCCD/Fs), PAHs, halogenated flame retardants (PBDEs, HBB, Dechloranes, OPFRs, HFRs), PFAs and Phthalates have been considered according to the sex (male, female and juveniles), body condition (stranded or free-ranging) and biological tissue (blubber, liver, kidney, lung, melon, heart, brain, skin, stomach, faeces). While much data is available on legacy and known pollutants, information on emerging pollutants such as pharmaceuticals, OPE and NPP remains poor. The impact of litter and in particular plastic and/or microplastic ingestion by marine mammals have been reported by 2 studies in the Pelagos Sanctuary (Viale et al., 1992; Corazzola et al., 2021) assessing the presence of synthetic particles in 5 species of odontocetes such as sperm whale, Cuvier's beaked whale, short finned pilot whale, bottlenose and striped dolphin. More than 170 plastic items have been identified, represented for the 80% by microplastic and among this category by fibres and fragments. A preliminary assessment of the distribution of litter on the water surface, beach/sediment and seabed in the area was carried out, taking into account both the presence and concentration of macroplastics (>25 mm) and microplastics (< 5 mm). A total of 37 peer-reviewed studies have been conducted on the presence of macro and microlitter on the sea surface and in the water column in the Pelagos Sanctuary. This area is one of the most investigated in the Mediterranean Sea with an average abundance of floating objects and MPs of  $0.73 \pm 82.3$  items/km<sup>2</sup> and  $85,122 \pm 35,726$  items/km<sup>2</sup> ( $0.30 \pm 0.23$  items/m<sup>3</sup>), respectively. Recently, the Plastic Busters MPAs Project reported average concentration slightly high from those previously found, showing a macrolitter and microplastic abundances of  $399 \pm 486$  items/km<sup>2</sup> and  $259,490 \pm 586,477$  items/km<sup>2</sup>, respectively (Galli et al., 2023) (Fig. 2).



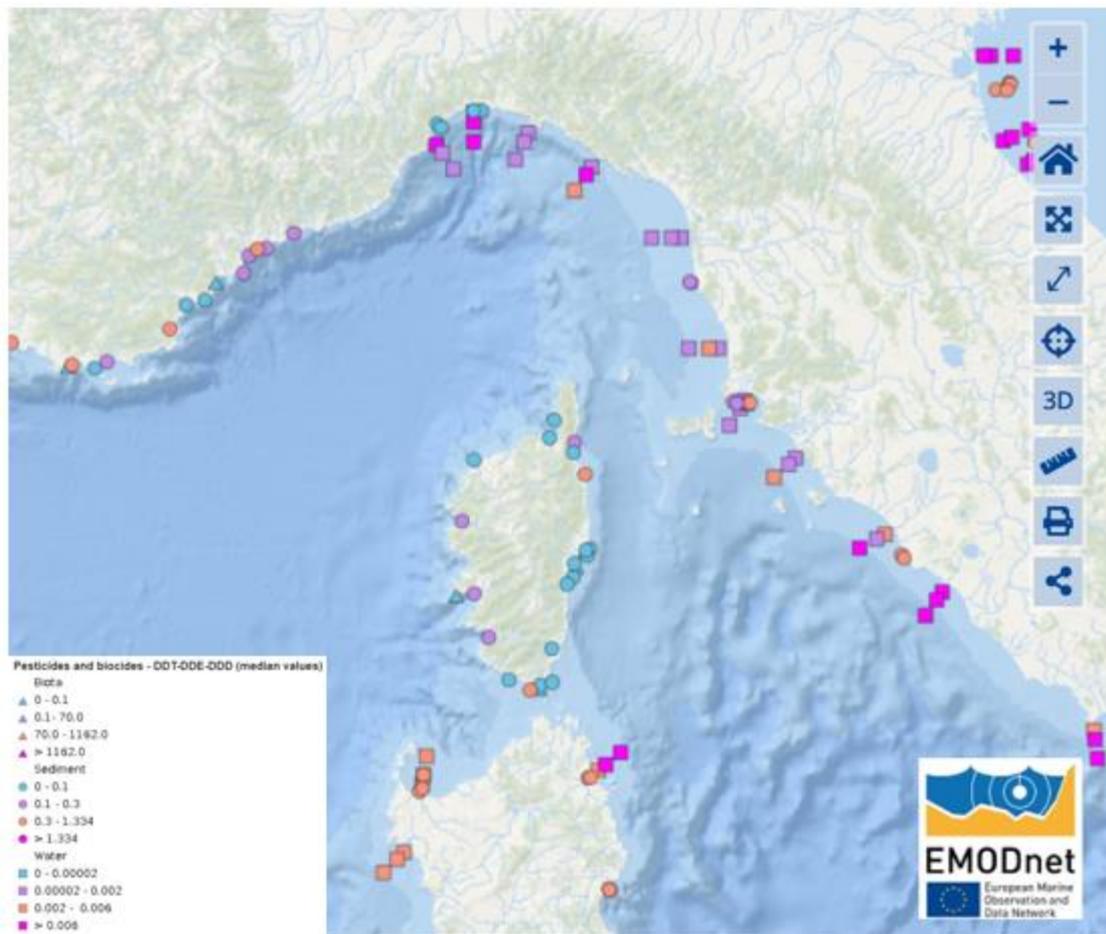
**Figure 2.** Floating macroplastic (A) and microplastics (B) detected on the sea surface within the SPAMI Pelagos Sanctuary from Galli et al., 2023.

Particular attention has been paid to the evaluation of poorly known studied contaminants such as paraffin waxes. Described as by-products of heating or distilling crude oil consisting of saturated long-chain hydrocarbons, this material may be lawfully discharged into the sea by tanker under certain conditions. Its presence in the Pelagos Sanctuary Protected Area was firstly detected by Suaria et al. (2018) and widely reported on beaches and floating at the sea surface by Galli et al. (2024) showing a mean concentration of  $29.8 \pm 87.1$  items/km<sup>2</sup> for macro residues and more than 12,000 items/km<sup>2</sup> for microparticles (Fig. 3).



**Figure 3.** The concentration of paraffin wax macroparticles (A) and microparticles (B) detected on the sea surface within the SPAMI Pelagos Sanctuary from Galli et al. 2024.

The EMODnet Chemistry Portal provides access to a very wide range of data on contaminants in the seawater, sediment and biota matrices of the Pelagos Sanctuary (Fig.4). The contaminants from which the information was extracted are: Antifoulants (Triphenyltin, Tributyltin); Hydrocarbons (Anthracene, Fluoranthene, Benzo(a)pyrene, Naphthalene); Heavy metals (Mercury, Cadmium, Lead, Nickel); Pesticides and biocides (DDTs, Hexachlorobenzene); Microlitter, Seafloor Litter, Beach Litter. EMODnet Human Activities was also used to obtain reliable information on the geographical location, spatial extent and characteristics of a wide range of marine and maritime human activities throughout the Pelagos Sanctuary.



**Figure 4.** The concentration of pesticides and biocides obtained from EMODnet (February 2024).