NET4mPLASTIC PROJECT

WP3 – Act. 3.3 Study and Design of the Integrated Platform's structure associated with early warning system

D 3.3.1

EWS Requirements Definition

October, 2019 - Version 1.3

Project Acronym	NET4mPLASTIC
Project ID Number	10046722
Project Title	New Technologies for macro and Microplastic Detection and Analysis in the Adriatic Basin
Priority Axis	3
Specific objective	3.3
Work Package Number	3
Work Package Title	Preliminary activities and project implementation
Activity Number	3.3
Activity Title	Study and Design of the Integrated Platform's structure associated with early warning system
Partner in Charge	PP3
Partners involved	LP, PP1, PP2, PP3, PP4, PP7
Status	Final
Distribution	Public

CONTRIBUTING PARTNERS	LP, PP1, PP2, PP3, PP4, PP7

Data	Vers	Prep	Resp	Appr	Rev	Comment
17.09.2019	1.0	LP,PP1, PP2,PP3, PP4,PP7	PP3	Daniele Calore	Draft	Comment and approval
30.09.2019	1.1	LP,PP1, PP2,PP3, PP4,PP7	PP3	Daniele Calore	First Release	Comment and approval
24.10.2019	1.2	LP,PP1, PP2,PP3, PP4,PP7	PP3	Daniele Calore	Second Release	Comment and approval
30.10.2019	1.3	LP,PP1, PP2,PP3, PP4,PP7	PP3	Daniele Calore	Final	Approved

INDEX

Acronyms / Abbreviations

ACRONYM	DEFINITION
EWS	Early Warning System
MP	Microplastic
OBU	On board Unit
PP	Project Plan
PT	Project team
TC	Technical task coordinator
TGS-ML	Technical Subgroup on Marine litter, European Union expert group On marine litter
TM	Task Manager
UML	Unified Modelling Language
WP	Work package

1 Introduction

1.1 Background of the project

The main goal of the NET4mPLASTIC project is to achieve an efficient monitoring system for plastic and MP distribution along the Croatian and Italian coastal and marine areas in order to improve the environmental coastal and marine sea quality conditions.

According to doc R1, the Act 3.3 deals with the study and design of the EWS - Early Warning System including:

- a control center, based on system hardware and network (Prosoft), and a EWS application (Hydra Solutions) integrated with the transport model and external systems (such as the oceanographic model - (Marche Region);
- Integrated Marine Drone, for collection of MP - microplastic, and geolocalized water indicators on the route (Hydra Solutions);
- Integrated Marine OBU, a unit to be installed on board of ships for improved MP collection with geolocalized water indicators on the route (Hydra Solutions).

The design shall be carried out with the modern system engineering approach based on UML - Unified Modelling Language (Hydra Solutions). UNITS and RERA SD will provide data for the first set up of the platform related to MP. Based on this WP, the transport model will be developed in WP4. The development of the EWS platform integrated with the transport model will be done in WP5.
The expected deliverables are the following:

- D 3.3.1 – EWS Requirements definitions based on the stakeholders and users' needs, through questionnaires and specific meeting
- D 3.3.2 – EWS Hardware Architecture and network design (central Data Centre Hardware Architecture Client/Server, Data network architecture and related communication segments)
- D 3.3.3 – EWS Software Architecture design (data modelling software, GIS applications, early warning detection software, etc.), the Relational Database to manage all collected data with related meta data, the communication Front-End for web remote access, the Data Centre Software Interfaces for users
- D 3.3.4 – EWS Hardware and other software Components Specifications design (Integrated Marine Drone and Marine OBU, with details of required components (hardware and firmware), firmware and other software components (mobile apps for managing the drones and for remote mobile activities).
- D 3.3.5 - Report and database provision with all the collected data

1.2 Purpose of the report

This document is the deliverable D.3.3.1 - EWS requirement definition, based on the stakeholders and users' needs collected through questionnaires and specific meeting, within the activity 3.3 of the

Net4mPlastic project - New Technologies for Macro and Microplastic Detection and Analysis in the Adriatic Basin.

The purpose of this document is summarized as follows:

- State of the art based on input from the questionnaire and other data collection
- List of stakeholders relevant to guide the execution of the project;
- Selection of main stakeholders for questionnaire data collection;
- Questionnaire preparation;
- Questionnaire data collection and list of all the questionnaire collected;
- Analysis of the questionnaires;
- List of main requirements.

1.3 Reference documentation

No	Title	Rif/Report N.	Pubblished by
[R1]	**APPLICATION FORM - NET4mPLASTIC Project - New Technologies for macro and Microplastic Detection and Analysis in the Adriatic Basin** 2014 - 2020 Interreg V-A Italy - Croatia CBC Programme Call for proposal 2017 Standard - NET4mPLASTIC Priority Axis: Environment and cultural heritage	Application ID: 10046722, dated 30/06/2017	Lead applicant: UNIVERSITY OF FERRARA
[R2]	**Legal aspects on survey activities on the plastic and microplastic pollution of the sea in Croatia**	Contribution to Activity: 3.1 State of art of legal aspects, methodologies, technologies, MP and related pollutants occurrence	PP4 - ProSoft d.o.o.

2 State of the art

2.1 Introduction

This chapter provides an introduction of microplastic and the state of the art from the legal and the technical point of view.
https://www.researchgate.net/publication/309760547_Microplastics_in_Seawater_Recommendations_from_the_Marine_Strategy_Framework_Directive_Implementation_Process

2.2 On microplastic

Microplastic litter is a pervasive pollutant present in marine systems across the globe. The legacy of microplastics pollution in the marine environment today may remain for years to come due to the persistence of these materials. Microplastics are emerging contaminants of potential concern and as yet there are few recognized approaches for monitoring.
The global mass-production of plastics which started mid last century has been followed by the accumulation of plastic litter in the marine environment.
The term “microplastics” (referred to as MPs from hereon) first entered the published literature in 2004 (Thompson et al., 2004), but is now used extensively to describe small fragments of plastic.
There is no widely accepted “lower boundary” in size as the limit of detection is dependent on the sensitivity of the sampling technique used (e.g., mesh size of the net or size of the filter).
Microplastics are widely dispersed in the marine environment and are present in the water column, on beaches and on the seabed.

2.3 EU directive

The EU directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establish a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive), and included microplastics as an aspect to be measured.
The European Directive 2008/56/EC (MSFD) is a key element in Europe’s actions to protect seas and oceans.
The MSFD represents the first instance, worldwide, that MPs in the marine environment have been included in a legislative proposal. In this sense is important to mention that MPs were not included in the Water Framework Directive (WFD), the main EU directive dealing with pollution of river basins.
A Technical Subgroup on Marine Litter (TSG-ML) was established in 2010 to support Member States in harmonizing monitoring protocols and streamlining monitoring strategies in the framework of the MSFD (Galgani et al., 2013a, b).
The Directive calls for all of the EU’s marine regions and sub-regions to establish a “Good Environmental Status” (GES) by 2020. GES is defined by means of 11 qualitative “descriptors.” The relevant criteria and

indicators applicable to those descriptors are defined in the Commission Decision 2010/477/EU (European Commission, 2010).

Microplastics are considered specifically in descriptor 10 of the MSFD [10.1.3 "Trends in the amount, distribution, and where possible, composition of micro-particles (in particular micro- plastics)"], and not directly but implicitly in the indicator related with impacts of litter on marine life. The descriptor will establish baseline quantities, properties, and potential impacts of MPs. It must be noted however that the decision was reviewed recently for changes in order to make it simpler and clearer, to introduce minimum standards and to be coherent with other EU legislation.

Within the process, the TSG-ML suggested that micro-litter be considered as a size fraction integrating micro-litter along with other litter fractions in the matrix related indicators. Not all of the experts support this view, arguing that micro litter is different from other litter types (meso/macro) and that micro-litter may have considerably different effects to those caused by larger items of litter. The idea of merging indicators 10.1.2 (litter at sea, floating and on the sea floor) with indicator 10.1.3 (microplastics) aimed to avoid treating microparticles as a separate issue while measures to combat marine litter need to be formulated covering all size classes.

Finally, the revised decision (article 9/3 and 11/4) kept (the review has been done but not published yet) criteria separated for macro litter (10DC1) and microplastics (D10C3), now defined as "The composition, amount, and spatial distribution of micro-litter in the surface layer of the water column, in sea-floor sediment, and possibly on coastlines, is at a level that does not cause harm to the coastal and marine environment."

MPs should be categorized according to their physical characteristics including size, shape, and colour (see Table 1). It is also important to obtain information on polymer type.

The size definition of MPs according to the TSG-ML (Galgani et al., 2013b) is in line with the NOAA definition. We strongly suggest using this size (<5 mm) as an international standard. One aspect that should be refined is the definition of the lower size boundary for MPs in the MSFD. The lower size has not been defined strictly and nanoparticles have not been considered as a category despite their potential relevance (Galgani et al., 2013a).

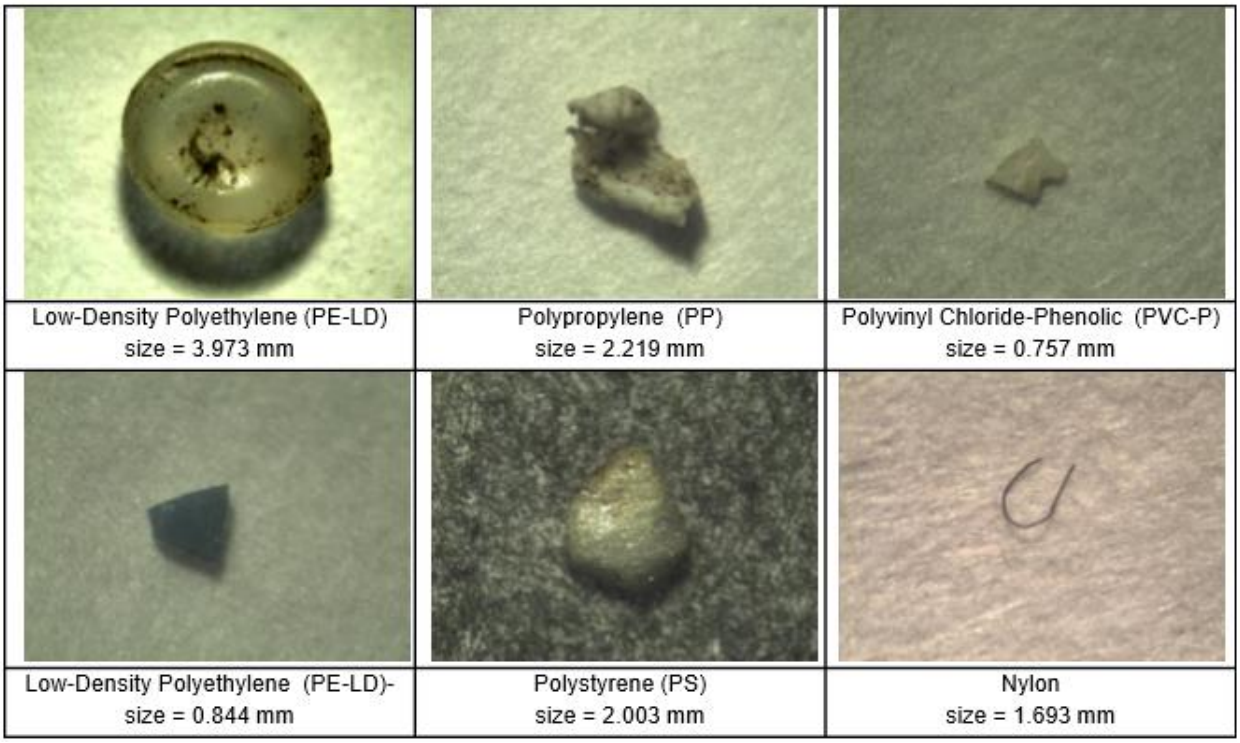
Sampling of MPs in the different marine compartments (sea water, sediment, and biota) requires different approaches:

samples can be selective, bulk, or volume-reduced (see e.g., Hidalgo-Ruz et al., 2012). Selective sampling in the field involves visual identification and manual sorting of fragments from different matrices and is not very effective for MPs due to difficulties in handling small size items. The subsequent identification of plastic particles in the matrix follows similar procedures (section Quantification and nature of MPs).

Bulk samples refer to samples where the entire volume of the sample is taken without reducing it during the sampling process.

Bulk samples are most appropriate when MPs cannot be easily identified visually because in the field because (i) they are covered by sediment particles, (ii) their abundance is small requiring sorting/filtering of large volumes of sediment/water, or (iii) they are too small to be identified with the naked eye (Hidalgo-Ruz et al., 2012).

Volume-reduced samples, in seawater, refers to sampling where the bulk volume of the sample is reduced during sampling, preserving only that portion of the sample that is of interest for further processing. While on board a vessel seawater samples can be volume-reduced by filtering water through nets or screens.



2.4 EU and other relevant projects

2.4.1 ML-REPAIR

The Adriatic Sea is a semi-closed pool with slow streams, making it vulnerable to pollution.

Marine Litter (ML) is defined as any solid, manufactured or processed solid material discharged into the marine and coastal environment. The prevailing part of marine waste consists of plastic materials. Specifically, micro-plastics is an increasing cause for concern for the degradation of the marine and coastal ecosystems, potentially endangering the functionality of the ecosystem itself and reducing the quality of coastal waters for fishing and tourism. Furthermore, cross-border effects are already known in marine

litter, with a floating sea layer of waste that travels regardless of the state / administrative boundaries of a country. Therefore, marine litter issues require a common approach of different countries and their joint efforts to find a proper and appropriate solution and approach.

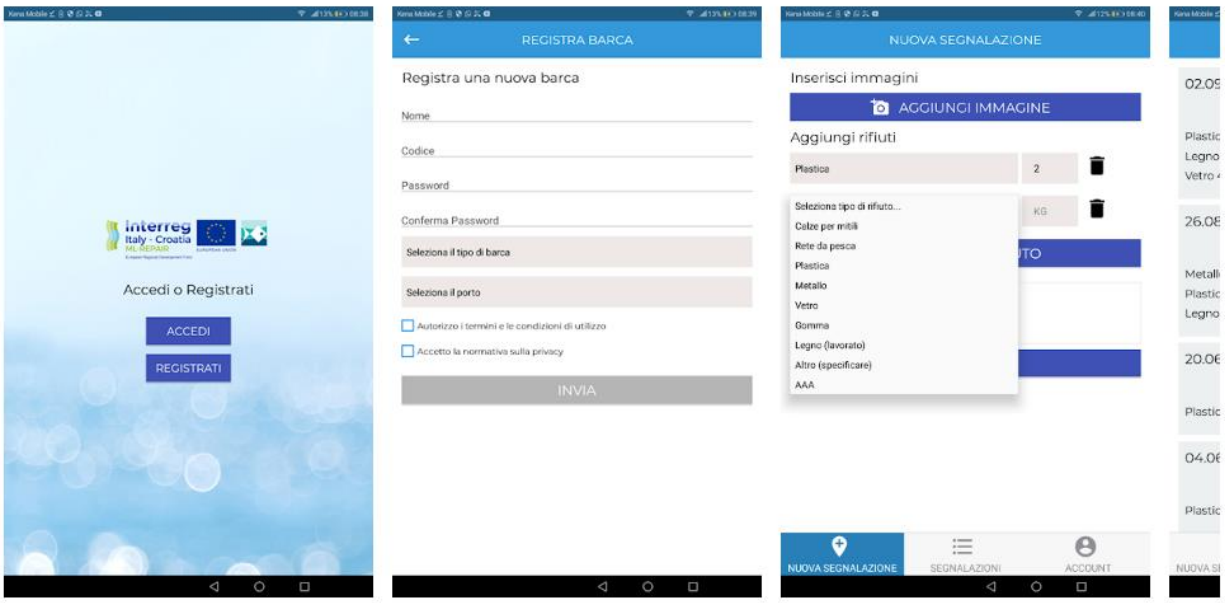
The ML-REPAIR project is a continuation of the DeFishGear-Derelict Fishing Gear Management System project in the Adriatic Region. In research conducted during the DeFishGear (DFG) project, the tourism sector has shown a strong contribution to the creation of marine litter while the fisheries sector is considered to be an important intermediary in the process of reducing marine litter. As identified in the DFG project, although local communities, coastal tourism and the fisheries sector contribute to the problem of marine litter, they can also be part of the solution. The fishing sector has great potential in tackling ship waste issues, both in terms of prevention and awareness-raising about the proper disposal of outdated fishing gear and reducing the existing amount of marine litter by participating in initiatives called 'fishing for litter' (FFL).

The main project partners are ISPRA, RERA, SucCe, SlowVenice, Venice Ca Foscari University, COOP Mare Cattolica. Within the ML-REPAIR project, activities are carried out in Croatia and Italy, and the core of the project's activities is to involve the predefined target groups of the project (fishermen and fishing associations/cooperatives, local communities and the younger population, tourism sector, public administration bodies and the FLAGs and LAGs) through the implementation of activities related to:

- investigating new educational tools to encourage positive change in attitudes and behaviour towards marine litter and generally pollution among future generations in the local community/among the younger population and in fishing communities/professional associations / cooperatives;
- raising the awareness of tourists on coastal areas, thus stimulating the sustainable growth of the tourism sector;

- providing data and innovative tools to decision-makers (public administration bodies), meeting the need for better understanding of the obstacles that need to be removed in order to launch more comprehensive transboundary initiatives to establish a proper marine litter management system;
- reducing marine litter through a participatory approach to the fisheries sector; improving cooperation between science and fisheries-related organizations, including the Fisheries Local Action Groups (FLAGs);
- consolidating cross-border co-operation, exchanging knowledge and reducing the gap between different approaches to marine litter issues;
- reduction and prevention of pollution of the sea, which in the long term will improve the quality of the Adriatic Sea ecosystem;
- evaluation of the potential contribution of the activities of the so-called 'fishing for litter' (FfL) to reduce the occurrence of micro-plastic;
- monitoring of the situation in the Natura 2000 area in terms of the presence of marine litter and its impacts.

Within this project, it has been created an application that allows to monitor the accidental collection of waste at sea by fishermen. On April 1 2019, the app was officially unveiled in Split, Croatia.
Through the ML-REPAIR App, each boat, after registering, can report the waste caught: you take a photo and fill out a report card where you specify the type of waste caught, its weight and any notes. The reports are geolocated: tapping the pin on the map opens the detail of each of them.



Here are the main website where additional information can be collected:
http://www.ml-repair.eu/en/aplication
https://www.obliquacomunicazione.it/obliqua-realizza-lapplicazione-del-progetto-europeo-ml-repair/

2.4.2 DeFishGear project

The DeFishGear project was implemented within the framework of the IPA Adriatic Cross-border Cooperation Programme, co-funded by the European Union.

http://www.defishgear.net/
http://www.defishgear.net/news-events/defishgear-news/item/381-elsevier-selects-defishgear-research-to-promote-prevention-of-plastics-ocean-pollution-on-world-oceans-day-2016

The 3-year long DeFishGear project undertook the challenge to address the need for accurate, coherent and comparable scientific data on marine litter in the Adriatic-Ionian macroregion. The DeFishGear project also piloted coordinated and harmonized actions on the science-policy-society interface for litter-free Adriatic and Ionian Seas. The DeFishGear project provided a strategic input to regional efforts in successfully achieving good environmental status in the Mediterranean Sea.

The DeFishGear project was implemented within the framework of the IPA Adriatic Cross-border Cooperation Programme, co-funded by the European Union

The IPA-Adriatic DeFishGear project aims to facilitate efforts for integrated planning to reduce the environmental impacts of litter-generating activities and ensure the sustainable management of the marine and coastal environment of the Adriatic and Ionian Seas.

The DeFishGear objectives are:

- Address the knowledge gaps and research needs to facilitate effective decision making against marine litter and its impacts;
- Address the emerging threat of microplastics;
- Pilot prevention and mitigation measures to combat marine litter in the Adriatic-Ionian macroregion;
- Enhance sub-regional cooperation in order to ensure a coordinated, coherent and integrated approach to achieve the good environmental status of the marine environment and effectively design and implement measures to address marine litter;
- Implement coordinated and harmonized actions on the science-policy-society interface for litter-free Adriatic and Ionian Seas

Marine litter -any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment- poses a major threat to wildlife and ecosystems, as well as, to humans and their livelihoods. Marine litter is a complex and multi-faceted issue with environmental, economic, safety, health and cultural implications. Marine litter knows no boundaries and represents a pervasive and persistent problem that expands beyond borders away from the source of origin. Coordinated and multi-sectoral action is key to combating marine litter.

A pilot project for coordinated and harmonized actions on the science-policy-society interface for litter-free Adriatic and Ionian Seas

The DeFishGear Project originated as a response to the need for dealing effectively with the issue of marine litter in the Adriatic-Ionian macroregion, towards **litter-free coasts and sea**. It aims to facilitate efforts for integrated planning to reduce the environmental impacts of litter-generating activities and ensure the sustainable management of the marine and coastal environment of the Adriatic and Ionian Seas.

DeFishGear

The DeFishGear approach to combat marine litter entails sharing scientific knowledge and obtaining accurate, coherent and comparable scientific data that will ultimately facilitate the implementation of coordinated and multi-sectoral actions.

Results

- Improved knowledge on the occurrence, amounts, sources and impacts (including socio-economic impacts) of marine litter (including microplastics) in the Adriatic;
- Harmonized marine litter monitoring activities in the Adriatic region and enhanced collaboration as a building block for future actions;

- Strengthened & reinforced science-policy interface to support the integration of sound science into policy and decision making in effectively tackling marine litter;
- Joint, coordinated and/or complementary schemes to manage human activities generating litter in the Adriatic Sea and strengthened implementation of relevant policy frameworks (Marine Strategy Framework Directive, Regional Plan for Marine Litter Management in the Mediterranean, Ecosystem Approach, Maritime Spatial Planning, Integrated Coastal Zone Management, etc.)

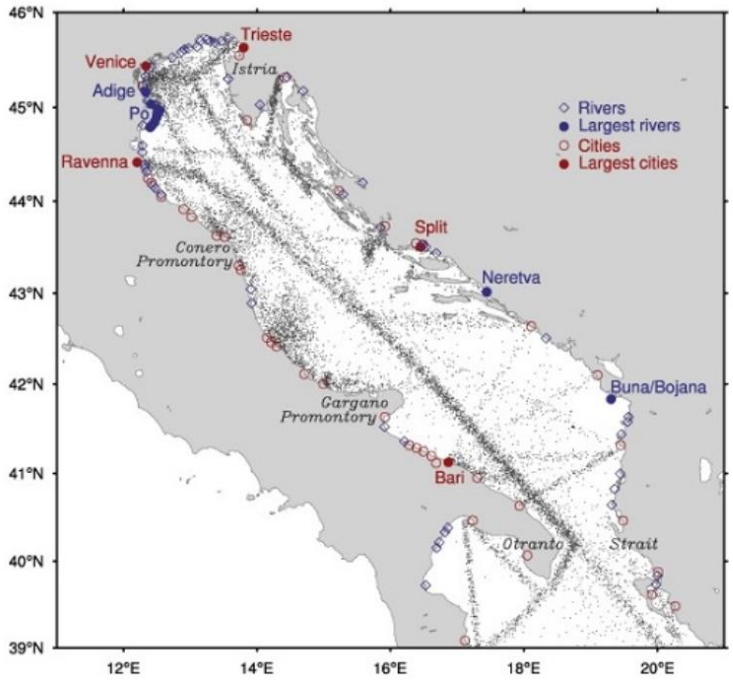
Target groups

- policy and decision makers at local, national, european and regional levels;
- the research community;
- NGOs and CSOs;
- key stakeholders that benefit from and depend on the marine environment such as professionals from economic sectors such as fisheries, aquaculture, tourism and shipping, as well as the wider public.

Strategic input

The DeFishGear project provides strategic input to European and European Regional Seas efforts in successfully achieving good environmental status with regards to marine litter.

The DeFishGear project is a concrete contribution to the main legislative marine litter related frameworks in the Adriatic-Ionian macroregion, the EU Marine Strategy Framework Directive and the UNEP/MAP Regional Plan for Marine litter Management in the Mediterranean. Furthermore, the project activities and outputs promote the implementation of the ecosystem approach and the implementation of the ICZM protocol.



Spatial distribution of the floating debris inputs into the Adriatic Basin:

shipping lanes (gray scatter plot); rivers (open blue diamonds), the largest rivers (closed blue circles); cities (open red circles); and the largest cities (closed red circles).

2.4.3 EUCYS

The EU Contest for Young Scientists (EUCYS) is part of the Science with and for and Society activities managed by the Directorate-General for Research of the European Commission and it is funded under the Horizon 2020 programme. You can find out more about Science with and for and Society via the web site, which also contains a page on the Contest for Young Scientists.

The link to the EU program is the following: https://eucys.eu

EUCYS is the most important student science fair in the EU, showcasing the best of student scientific achievement in the EU and beyond. Each year it brings together talented students from more than 40 countries in a different European city. EUCYS unites the efforts of each participating country to encourage more young people to dedicate their lives to careers in science and technology. The competition serves as both a scientific forum and a networking event and as such receives a great deal of media attention. It also holds strong ties with sponsoring companies and organizations that create long-term opportunities for the participants to proceed with their academic and professional paths. In these ways, EUCYS is a major event that empowers students from all over Europe to pursue answers to some of the most important contemporary questions and advance the world through science and technology.

After being hosted by Ireland in 2018, this year EUCYS comes to Bulgaria and will take place in Sofia from the 13th to the 18th of September.

A special focus is available in the following website:
https://eucys.eu/projects-2019/microplastic-on-our-doorstep/
The team analysed the **degradation of microplastic in their home river**. They found out, that even after 30 days of treatment through contact with the microorganisms in the sewage sludge, the small plastic particles do not degrade completely. Even plastic polylactate, which is labelled as biodegradable, is particularly resistant to sewage sludge. Polyethylene terephthalate (PET for short) is the only material in which the sewage treatment promotes significant chain degradation. The outstanding team addressed a serious problem and worked on a scientifically advanced level.

2.4.4 EUCLIFE - MERMAIDS - Mitigation of microplastics impact caused by textile washing processes

The main objective of the LIFE - MERMAIDS project is to contribute to the mitigation of the environmental impact of microplastic and nanoplastic particles resulting from laundry wastewater on European sea ecosystems. This objective will be achieved by demonstrating and implementing innovative technologies, and additives for laundry processes and textile finishing treatments. The following specific objectives are listed in decreasing order of importance:

To demonstrate innovative additives to improve finishing textiles and finishing fiber treatments to avoid garments' microplastic removal in laundry processes;
To demonstrate innovative additives for detergent and laundry products to avoid garments' microplastic removal in laundry processes in wastewater;
To elaborate good practices guidelines on microplastic retaining for plastic fibers manufacturers, textile industry and textile auxiliaries manufacturers, detergent manufacturers, and households; and
To consolidate the knowledge of microplastic fiber-retaining technologies, the basis for the development of future policy recommendations in order to promote the widespread implementation of technologies that will contribute to reaching a good environmental status (GES) by 2020, as foreseen by the European Marine Strategy Framework Directive (2008/56/EC).

Expected results:

- Reducing at least 70% of the total amount of microplastic fibers currently discharged in laundry waste water;
- An estimation and study of the amount of micro- and nano-fibers in effluents of domestic washes of different types of synthetic textiles;
- A characterization and quantification of microplastic and nanoplastic contents contained in almost ten different samples coming from washing wastewater;
- A set of tested recommendations for the optimization of washing process using the new finished textiles, the new detergents, and synergistic combinations of the new finished textiles and the new detergents;

- Increasing the knowledge and awareness of 3 000 consumers and professionals on measures to reduce microplastics arising from washes by means of providing them with the Good Practices Guidelines handbook; and

- A set of policy recommendations based on a previous overview and a SWOT analysis of the regulatory framework concerning microplastic pollution control and prevention at a regional, national, European and International level.

2.4.5 HAZADR IPA project

The main objective of the HAZADR project, running from October 2012 to March 2015, is the establishment of a cross-border network for the prevention of risks and for the early management of emergencies, in order to reduce the risk of pollution and contamination of the Adriatic Sea and its coasts. Therefore, HAZADR aims at strengthening a common reaction capacity of the communities belonging to the Adriatic Region against environmental and technological hazards due to collisions, shipwrecking and spillage of oil and toxic material into the sea that could seriously pollute the marine environment and damage the socio-economic activities of the Adriatic coastal communities. In synthesis, HAZADR helps the Adriatic regions

You can have a look at EU project HAZADR where Marche region as well as Split Dalmatia County participated together with Primorsko-goranska region (Rijeka, and Split Institute for oceanography.

More information are available in the following website. https://www.hazadr.eu/partners.

Within this project, the equipment was procured for Marche region and ATRAC center in Rijeka (link: http://atrac.hr/en/atrac/)

2.4.6 BASEMAN: a project by JPI Ocean

The Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans) was established in 2011 as an intergovernmental platform, open to all EU Member States and Associated Countries who invest in marine and maritime research. By joining forces, JPI Oceans focuses on long-term collaboration between EU Member States, Associated Countries and international partners.

The BASEMAN project focus on microplastic: although microplastics (MP) are recognized as an emerging contaminant in the environment, currently neither sampling, extraction, purification nor identification approaches are standardized, making the increasing numbers of MP studies hardly -if at all- comparable. The overall goal of this interdisciplinary and international collaborative research project, is to overcome this problem through a profound and detailed comparison and evaluation of all approaches from sampling to identification of MP. Our collaborative research project combines experienced MP scientists (from different disciplines and countries) in a cutting-edge project addressing the JPI Oceans (JPI-O) pilot call “Ecological aspects of MP in the marine environment”. Our project tackles two major topics: 1) “The validation and harmonization of analytical methods” which is indispensable for 2), the “Identification

and quantification of MP". The results of the project will equip EU authorities with tools and operational measures that may be applied to describe the abundance and distribution of MP in the environment. Such tools will permit JPI-O evaluation of member state compliance with existing and future monitoring requirements.

Current status: With respect to the first major topic - "validation and harmonization of analytical methods"- it was crucial to first gain an overview and discuss the analytical skills and capabilities of the BASEMAN project partners which were then individually consolidated in the respective labs. Since currently no standard operation procedures exist for purification, extraction and analyses of MP, it was expected, that the different procedures and approaches applied by the BASEMAN partners, directly reflect the diversity of approaches of the scientific community analyzing MP in the marine environment. As a consequence, and since purification, extraction and analyses had to be seen per se as variable, for a validation or inter-comparison, samples used for validation, had to be standardized as much as possible. The prerequisites were I) standardized MP (specified polymers with specified sizes) and II) standardized matrices (from which polymers had to be extracted, purified and analyzed). Based on the discussions of the consortium during the BASEMAN kick off meeting, a final choice was made for the polymer-types to be implemented in the study: High Density Polyethylene (HDPE), Low Density Polyethylene (LDPE), Polypropylene (PP), Polystyrene (PS), Nylon6.6 (PA66), Poly(ethylene Terephthalate) (PET), Poly(methyl methacrylate) (PMMA), Polyvinyl chloride (PVC), and Polycarbonate (PC). These polymers represent I) a selection of the most common polymer types typically found as MP in the marine environment and II) a broad range of polymers with different densities facilitating a comparison of different extraction approaches (e.g. density separation). Concerning particle sizes, the consortium finally agreed on three categories -~1 mm, ~100 µm and ~20 µm- facilitating comparative MP analyses ranging from simple light microscopy and "expert knowledge based identification" (large particles) to "state of the art" analytical techniques like FTIR-and Raman-Microscopy or mass-spectrometry (PyGCMS) (small particles). In parallel to the definition of standardized MP, standardized matrices were defined by the consortium: I) three types of natural plankton, II) three types of sediment and III) three types of biota (e.g. fish- and mussel tissues). These matrices represent I) a selection of the most common matrices where MP have to be detected for instance in the framework of monitoring approaches and II) a variety of natural polymers (e.g. proteins, cellulose, chitin) and abiotic compounds facilitating a comparison of different extraction and purification approaches. All polymers were purchased as commercially available production pellets, characterized (by usage of TGA, DSC, FTIR, Raman, MVR and GPC), milled and sieved according to the specified size classes and finally provided for the consortium as single fractions (polymer, size class). For a validation and harmonization of analytical methods, an approach in analogy to ring trials was chosen. Hence the beforehand mentioned natural samples representing plankton, sediments and biota were spiked with a defined mixture of polymer particles and send to the participating labs. Analyses are ongoing and first results are to be expected in late autumn 2017.

A reliable identification of small MP particles (~< 500 µm) by simple light microscopy and "expert knowledge" is prone to misidentification and as a consequence data on numbers (and sizes) are not valid. Hence several "state of the art" analytical techniques like FTIR-and Raman-Microscopy or mass-spectrometry (PyGCMS) are applied in the framework of BASEMAN. Since identification of polymers by spectrometry (FTIR, Raman) is generally based on comparison with databases, "in house" databases for identification of polymers are generated. In contrast to commercially available databases, all data will be

"free to use", be provided for the BASEMAN consortium and be available upon request for e.g. the scientific community or environmental agencies. The ATR-FTIR database (Bruker format and JCAMP-DX

3 format) currently comprises 312 spectra, the respective database in Perkin Elmer format comprises currently 100 spectra and the Raman database 209 spectra. Since environmental MP particles are exposed to several stressors (e.g. radiation, radicals, biological activity) the FTIR or Raman spectra of these particles display on the hand the general pattern of the respective polymer but on the other hand also "signals" deriving from an alteration of the polymer backbone (e.g. carbonyl, hydroxyl introductions). Hence in 2016 a pilot-scale weathering system using UV/Vis metal halide lamps was installed for mimicking the environmental influence. Preliminary analyses on the simulated samples drawn from the weathering device have already carried out. Weathering influence will be examined by FTIR spectroscopy and data will be introduced in the databases (as weathered polymers). JPI-O BASEMAN and JPI-O WEATHERMIC will exchange experience and data here. The final aim will be to provide a comprehensive multi spectrometric database considering also hyperspectral and mass-spectrometric analytical approaches.

Furthermore, an automated analysis pipeline for FTIR-Imaging data regarding identification, quantification and sizing of MP was developed and published. All scripts (Phyton, SimpleTK) are available as supplement of the publication and were provided for the consortium.

The evaluation of sampling methods for seawater, sediments & biota and standardization & intercalibration of sampling methods was partly performed on a research cruise in the Galway Bay in 2016. Another research cruise to the Bay of Biscay was conducted in April 2017.

http://www.jpi-oceans.eu/news-events/news/microplastics-projects-report-their-first-year-activities

2.4.7 Paper on Microplastic Pollution - The Policy Context

This paper has been drawn up as background input to work by the European Commission's Scientific Advice Mechanism (SAM) aimed at delivering science-based policy advice on the health and environmental impacts of microplastics, dated November 2018. The European Commission's Group of Chief Scientific Advisors launched work on this topic following exploratory discussions in the first half of 2018 including a scoping workshop with experts on 26 April 2018 and publication of an Initial Statement published by the Advisors on 09 July 2018.

In the first stage of this work, an independent group of experts set up by the SAPEA consortium of European science academy networks3 will produce by December 2018 an evidence review report on microplastic pollution and its impacts. This evidence review, based on publicly-available scientific literature, will cover the natural sciences including a specific focus on scientific modelling, the social and behavioural sciences as well as political and legal sciences.

One of the purposes of this background paper is to help set the policy scene for the SAM work, and notably for the political and legal sciences component of the SAPEA evidence review. That part of the SAPEA

evidence review should provide a synthesis of state-of-the-art academic and any other readily-available and published expert analyses of legislation, regulation and policies relevant to microplastics.
This document also forms part of the basis on which the Group of Chief Scientific Advisors will build the Scientific Opinion it plans to deliver to the European Commission in 2019.
See doc in annex 1 for more details.

2.4.8 Articles on Microplastic and drones

Several articles and research studies have been collected on microplastic and microplastic on the existing available literature, with specific focus on the use of drones and techniques of data processing:

- Remote sensing of the ocean surface refractive index via short-wave infrared polarimetry, authors: Matteo Ottaviania, Jacek Chowdharya, b Brian Cairnsa
- Outlook on optical identification of micro and nanoplastics in acquatic environments, Peiponen;
- Towards a definition and categorization framework for environmental plastic debris
- Wagner, Martin; Hartmann, Nanna B.; Verschoor, Anja; Hüffer, Thorsten; Hassellöv, Martin ; Thompson, Richard C.
- High-throughput NIR spectroscopic (NIRS) detection of microplastics in soil
- Andrea Paul1 & Lukas Wander1 & Roland Becker1 & Caroline Goedecke1 & Ulrike Braun1
- Classification of Hyperspectral Remote Sensing Images with Support Vector Machines Farid Melgani, Member, IEEE, and Lorenzo Bruzzone, Senior Member, IEEE
- High resolution prediction of organic matter concentration with hyperspectral imaging on a sediment core
- Feature Selection Based on High Dimensional Model Representation for Hyperspectral Images Gül¸sen Ta¸skın, Member, IEEE, Hüseyin Kaya, and Lorenzo Bruzzone, Fellow, IEEE
- Hyperspectral imaging: a review on UAV base sensors, data processing and application for agriculture and forestry
- Sensing Ocean Plastics with an Airborne Hyperspectral Shortwave Infrared Imager Shungudzemwoyo P. Garaba, Jen Aitken, Boyan Slat, Heidi M. Dierssen, Laurent Lebreton, Oliver Zielinski, and Julia Reisser
- A low-cost drone-based application for identifying and mapping of coastal fish nursery grounds, Daniele Ventura,
- A novel GIS-based tool for predicting coastal litter accumulatio and optimizing coastal cleanup actions, Marthe Larsen Haarra, LeviWe
- Airborne sensors for detecting large marine debris at sea
- An airborne remote sensing case study of synthetic hydrocarbon detection using short wave infrared absorption features identified from marine harvested macro- and microplastics Shungudzemwoyo P. Garabaa, Heidi M. Dierssen
- Anthropogenic marine debris over beaches: Spectral characterization for remote sensing applications Tomás Acuña-Ruza, Diego Uribea, Richard Taylora, Lucas Amézquitaa, María Cristina Guzmána, Javier Merrillc, Paula Martínezb, Leandro Voisinb, Cristian Mattar B.
- Concept for a hyperspectral remote sensing algorithm for floating marine macro plastics Lonneke Goddijn-Murphya, Steef Petersb, Erik van Sebillec, d, Neil A. Jamesa, Stuart Gibba

- Detection of floating plastics from satellite and unmanned aerial systems (Plastic Litter Project2018) KonstantinosTopouzelisa, Apostolos Papakonstantinoub, Shungudzemwoyo P.Garabac
- Mapping coastal marine debris using aerial imagery and spatial analysis☆ Kirsten Moya, ⁎, Brian Neilsonb, Anne Chunga, Amber Meadowsa, Miguel Castrencec, Stephen Ambagisc, Kristine Davidsona
- Mapping seabed sediments: Comparison of manual, geostatistical, object-based image analysis and machine learning approaches Markus Diesinga, n, Sophie L. Greenb, David Stephensa, R. Murray Larkc, Heather A. Stewartb, Dayton Doveb
- Remote sensing of marine debris to study dynamics, balances and trends
- Seabed Mapping in Coastal Shallow Waters Using High Resolution Multispectral and Hyperspectral Imagery - Javier Marcello, Francisco Eugenio, Javier Martín, and Ferran Marqués
- Seabed mapping with remote sensing using drones, Maja Berden Zrimec, Dean Mozetič, Sašo Poglajen
- Towards Quantitative Spatial Models of Seabed Sediment Composition, David Stephens, Markus Diesing
- Using MODIS Terra 250 m imagery to map concentrations of total suspended matter in coastal waters

In summary, in this stage some research is available on techniques for identification of micro and microplastic, there is no specific solution available using drones applied for microplastic data collection. See annex 2 for detailed information.

2.5 Existing data collection in Italy

2.5.1 Legal analysis

In Italy the EU directive 2008/56/CE has been approved in the DL 13 October 2010, n.190, and in force since 2010.

The responsible body in Italy is the **MATTM, the Ministry of the Environment and the Protection of the Territory and the Sea**, that entrusted the Regions with the task of starting the first monitoring experiences and then starting from the year 2015 many of the activities provided for by the Directive have been entrusted directly to the **ARPA** (Regional structures for environmental protection, depending on the Regions). It was therefore possible for the 19 ARPAs / ARTAs concerned to set up a network of public structures and create a System capable of carrying out the investigations and controls necessary to protect the sea in an incisive, coherent and coordinated manner.

Coordination is performed by ISPRA, the Higher Institute for Environmental Protection and Research, an Italian public research institution, established by law n. 133/2008, and subject to the supervision of the MATTM - Minister for the Environment and the Protection of the Territory and the Sea.

The institute deals with environmental protection, including marine, environmental and research emergencies. ISPRA is also the body that directs and coordinates regional environmental protection

agencies (ARPA) and cooperates with the European Environment Agency and with national and international institutions and organizations working on environmental protection. .
With the entry into force in 2017 of the National System for Environmental Protection, a network was created that fuses together the institute, the 19 regional agencies (ARPA) and those of the two autonomous provinces (APPA) and of which ISPRA has the coordination.
For which ISPRA carries out technical and scientific functions, both to support the Ministry of the Environment and the protection of the territory and the sea, and directly through monitoring, evaluation, control, inspection and management activities environmental information.
Following this Agreement with the Regions, the Ministry has therefore stipulated three Conventions, one for each sub-region, with ARPA identified as "leader" representing the other Agencies of the same marine sub-region: ARPA Liguria for the Western Mediterranean, ARPA Emilia Romagna for the Adriatic Sea, ARPA Calabria for the Central Mediterranean and the Ionian Sea. Lead Agencies ensure operational coordination and use of financial resources for each sub-region.]

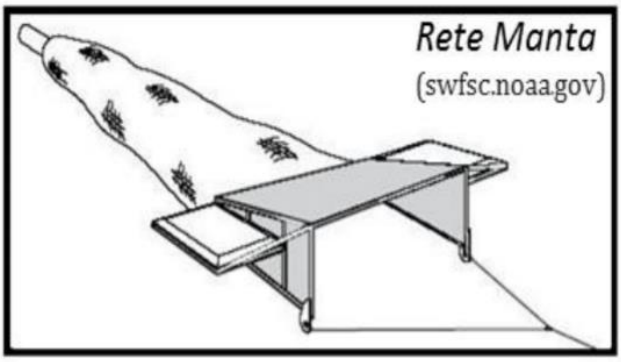
2.5.2 Existing program on macro and microplastic data collection

The program relevant to macro and micro plastic monitoring and data collection implemented by ARPA is described in the following link within the MATTM website, form 2.
https://www.minambiente.it/pagina/attivita-di-monitoraggio-svolte-dalle-arpa
The form 2 form describes the analytical reference methods to determine:

a) the chemical-physical variables of the water column (depth, temperature, salinity, dissolved oxygen, pH and transparency)
b) the amount of microplastics, expressed as the number of microparticles per m3 of water of sea sampled.

The microplastics include all the plastic material **with dimensions of less than 5 mm** dispersed in the marine environment. The sampling and analysis activities are aimed at evaluating them abundance and composition in seawater.
Due to the very small size, weight and relative density, microplastics tend to accumulate preferably on the surface of the sea. Second, microplastics can to accumulate also at the base of the thermocline, i.e. that layer, present above all in conditions of intense solar radiation, where there is a sudden change in the water temperature of the sea, and that separates the warmer and less dense surface layer from the deeper, colder layer more dense.
The presence and depth of the thermocline is determined by detecting the chemical-physical variables

(depth, temperature, salinity, dissolved oxygen and pH) along the water column, by means of a multiparameter probe equipped with specific sensors for the individual parameters to be analysed. There transparency is determined by the Secchi disk.
For the sampling of microplastics, instead, the so-called "manta" network is used (in figure) purposely built to sample only the surface layer of the water column.



Using this network allows you to sample large one's volumes of water, retaining the plastic microparticles present. The manta is constituted by a rectangular mouth from which the network cone and a collecting glass depart the final; two empty metal wings, outside the mouth, the they keep floating on the surface. For the calculation of the amount of microplastics in relation to the volume of filtered water the manta net is equipped with a flow meter.
The identification and quantification of the microplastics collected, divided by shape and colour, it is carried out in the laboratory by a stereomicroscope.

The analysis of CHEMICAL-PHYSICAL VARIABLES for MICROPLASTICS ANALYSIS is according to the following requirements:

- Sampling frequency: half-yearly
- Number of sampling stations: 3 stations at 0.5, 1.5 and 6 MN from the coast
- Instruments: multiparameter probe with fluorimeter, Secchi disk, flow meter, stereomicroscope

The analysis of **macroplastics** and other floating waste is carried out in conjunction with surveys for microplastics, through visual monitoring to study their composition, quantity and distribution territorial.
A dedicated observer checks a 10-meter strip at the side of the boat for the entire route of the boat transept, noting all the features reported in the survey form and in particular: GPS code, source, type of use, buoyancy, composition, size class, colour, state. To delimit the Observation strip is used a measuring stick or graduated stick. It is a ruler graduate specially created from an excel file to help identify distances to the sea the height of the observer on the boat. The ruler is printed and glued on a rigid support (e.g. cardboard). A graduated stick can also be used to help maintain the external limit of the strip so that only objects that fall within it are annotated.

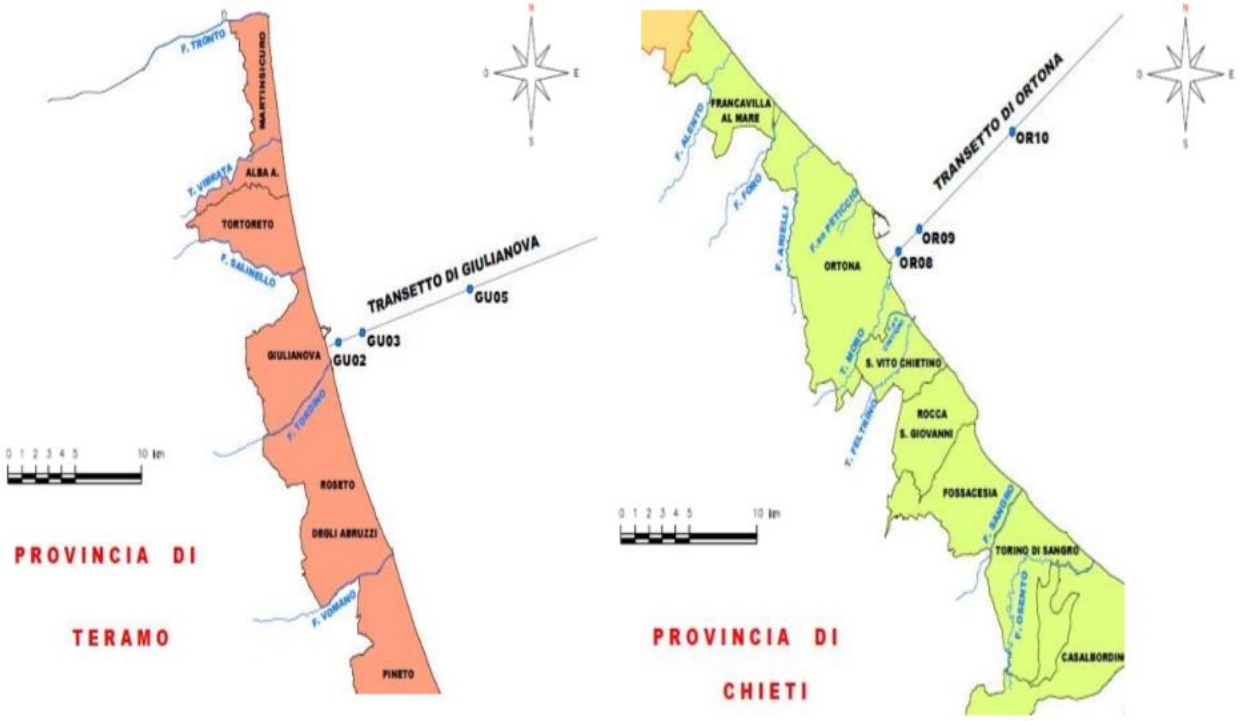
For MACROPLASTIC ANALYSIS the following requirements applies:

- Sampling frequency: half-yearly
- Number of sampling stations: 3 stations at 0.5, 1.5 and 6 MN from the coast
- Tools: dedicated observer, portable GPS, data collection form, evaluation tool
- distance (e.g. measuring stick, fig.1), tool for the evaluation of size classes (e.g. ruler
- pre-graduated specific for the type of boat / height of the observer)
- cardboard). A graduated stick can also be used to help maintain the external limit of the
- strip so that only objects that fall within it are annotated.

Here is example of implementation in some Italian regions.

2.5.3 ARTA Abruzzo region

ARTA is the "ARPA" organization in Abruzzo Region, overlooking the Adriatic Sea, that is enpowerd to carry out sampling and analysis activities to assess the composition and distribution of microplastics in marine waters from a qualitative and quantitative point of view. Two areas along the coast have been identified to carry out monitoring, at the port of Ortona (CH) and at Giulianova (TE).



The results of the surveys of the first two years (2016/2017) showed a total average of microparticles per cubic meter equal to 1.36 in the Junlanova trancetto and 0.84 in the Ortona traset. The highest value in

Giulianova is probably due to important contributions of continental waters and the circulation of sea water that insists on the stretch of coast studied.
The choice of areas took into account the requirements of the Directive in particular:

- presence of deep-water rising areas usually rich in nutrients (upwelling) and areas of accumulation and sinking of water at high density and low temperature below lower density water and higher temperature (downwelling);
- accumulation areas for local hydrodynamic conditions;
- distance from direct input sources such as river mouths;
- distance from port facilities or significant urban settlements.

Here is an **example of how data collection and analysis is performed**.
At the starting point of the sampling of the microplastics, the chemical-physical variables were measured using a multi-parameter probe. In particular, we have found: temperature, salinity, dissolved oxygen (% and mg / l), pH for the whole profile and transparency.
Knowledge of this information is important since microplastics, due to their characteristics of size, weight and relative density, tend to accumulate mainly on the surface, but also in the basal zone of the thermocline.
For sampling, a "manta" type screen was used with a net opening of 25 * 50 cm, with a 330 µm mesh vacuum and a final collector glass. To estimate the volume of filtered water, an essential datum for calculating the amount of microplastics present per cubic meter, a flowmeter was used (photo on the side)

This was followed by sampling along transept orthogonal to the coast, pulling the net for 20 minutes, at speeds around 2 knots. The set was made in the opposite direction to the surface current or in any case to the wind direction. For each screen, the GPS coordinates (degrees and thousandths; GG °, GGGGG) of sampling start and end in WGS84 UTM32 were detected.
At the end of the sampling the screen was hoisted on board and the number of laps reported on the flowmeter was recorded.
Subsequently the net was washed with sea water under pressure from the mouth towards the glass in order to convey any material present towards the final part of the net. Once detached from the net, the contents of the glass were transferred to appropriate jars for subsequent analysis in the laboratory.
In the laboratory each sample was processed using a series consisting of two 5 mm and 300 µm sieves recovering the microplastics in a beaker with distilled water.

Subsequently, the various fragments were separated and identified on a Petri dish with a crosslinked bottom using a stereomicroscope.
The microplastics thus identified have been subdivided according to the shape (sphere, filament, fragment, sheet) and color (white, black, red, blue, green, other color, transparent).
All the values thus obtained were normalized to the total filtered volume calculated thanks to the flowmeter. The concentrations of microplastics, in shape and color, were expressed as the number of objects per m3 of filtered water.
The data obtained is transmitted to the coordinator for validation and final delivery for EU reporting.

2.5.4 Other initiatives

In several Italian Regions there are initiative to promote the data collection of macroplastics mainly at sea. Here are examples of some initiatives.

2.5.4.1 Marche Region macroplastic collection

The Marche region has been active since 2015 for a law proposal in accordance with the provisions of the Prgr (2015 Regional Waste Management Plan), in order to promote the reduction of the dispersion at sea of the same plastic waste and their beaching, with particular reference to those deriving from fishing, and to favor the adoption of production cycles with low environmental impact. "
In the Marche region, 7 beaches have been monitored, for a total of 22,000 square meters, and over 4,000 beached waste have been registered, of which 95.2% is represented by both small plastic objects and tubular nets for the breeding of "mussels.
"The institutional technical table started, already established by the current integrated waste regulation, has the task of proposing to the Board a three-year program of interventions and actions to be supported with regard to raising public awareness, sharing experiences and good practices, experimentation with new technologies, contrasting the phenomenon of dispersion of waste from fishing and aquaculture activities at sea, identifying measures for the benefit of operators in the sector ".
In addition, among the tasks of the table also that of identifying tariff reward systems with the aim of "encouraging the use of separate waste collection of plastic waste consisting of so-called mussel socks in port facilities, in order to safeguard the income of economic operators in the sector ".
The planned actions are activated in full consistency with the European Plastics Strategy in a circular economy.

The Marche region activated since 2015 a law in accordance with the provisions of the Prgr (Regional Waste Management Plan of 2015), in order to promote the reduction of the dispersion at sea of the same plastic waste and their stranding , with particular reference to those deriving from fishing activities, and to favor the adoption of production cycles with low environmental impact.

In the Marche, 7 beaches were monitored, for a total of 22,000 square meters, and more than 4,000 beached waste was recorded, of which 95.2% is represented by both small plastic objects and tubular nets for breeding "mussels.

The technical institutional table in force has the task of proposing to the Executive a three-year program of interventions and actions to be supported with regard to raising public awareness, sharing experiences and good practices, experimentation with new technologies, combating the phenomenon of dispersion of waste deriving from fishing and aquaculture at sea, the identification of measures for the benefit of the operators in the sector.

Moreover, among the tasks of the Table is also to identify tariff reward systems with the aim of "encouraging the use of separate collection of plastic waste consisting of so-called mussel stockings in port facilities, in order to safeguard the income of economic operators in the sector ".

The planned actions are activated in full consistency with the European Plastics Strategy in a circular economy.

2.5.4.2 Puglia Region macroplastic collection

An agreement is in place among the Puglia Region, Corepla and Ager. Also included in the new agreement is the Port Authority of the Southern Adriatic Sea and the Puglia ARPA to promote the exchange of information and promote the development of good practices.

The protocol proposes to encourage, throughout the regional territory, the separate collection of plastic packaging and the "**fishing for litter**" activities to monitor the quantities and types of waste coming from boats and unloaded in one or more ports of the Region.

"Transforming a problem for the environment into a new opportunity for the community: this is the objective of the actions contained in the Protocol", says Antonello Ciotti, President of Corepla, the National Consortium for the collection, recycling and recovery of packaging plastic "We know that 80% of marine litter comes from the mainland due to incorrect waste management, careless behavior by citizens and illicit disposal. The "fishing for litter" activities allow us to monitor the health of our seas and separate collection, recycling and recovery are the tools to combat the marine litter phenomenon and create true circular economy "and continues" In 2018 Puglia has improved its performance, going from 14 to 17 Kg per person per year, an important signal for a Region with such a high tourist vocation that it has decided to combine the promotion of its territory with the need for sustainable development ".

Molfetta fishing for litter - In the stretch of sea between the Tremiti and Molfetta an experimental project has been launched to quantify and verify the effective recyclability of the waste collected by fishermen who use the trawling system. After an initial adjustment period, "Molfetta fishing for litter" started successfully in November 2018 with the involvement of 9 boats and 36 employees. For each day of activity, the fishermen traveled about 100 miles, separated the foreign material from the catch and delivered it to the bins located in the port area.

More than 400 of the approximately 1,200 kg of waste collected and selected at the ASM Molfetta center were examined. The sample analyzed is distributed as follows:

44% non-packaging plastic, such as fishing nets, construction site networks and mussel nets.
40% other fractions, of which: 27% rags, hemp ropes, etc.
16% plastic packaging, of which: 9% film, 3% bottles and bottles, 1% expanded polystyrene, 0.03% plates and glasses.
All the material collected, selected by type of plastic, is periodically sent to a recycling center to evaluate its actual use as a second raw material. The "fishing for litter" activity, made possible thanks to the active contribution of Assopesca, was also launched in Barletta and will soon be extended to Manfredonia and other coastal municipalities.
Summer dedicated to recycling - To prevent the abandonment of waste and to make residents and tourists aware of the collection and recycling of plastic packaging, this summer the Municipalities of Molfetta, Barletta, Manfredonia, Brindisi, Castellaneta and Porto Cesareo will be the protagonists of a singular competition; up for grabs, a playground in recycled plastic donated to the citizens. The Municipality that will have recorded the greatest percentage increase in the collection of plastic packaging compared to a "sample" month, will win the challenge.
http://www.corepla.it/news/fishing-litter-corepla-regione-puglia-e-ager-rinnovano-l-accordo#

2.6 Existing data collection in Croatia

The matter of waste management in the Republic of Croatia is regulated by the Law on Sustainable Waste Management (Official Gazette 94/13, 73/17, 14/19, hereinafter: ZOGO), which lists marine waste as a separate category of waste.

• In Article 4, paragraph 1, item. 24. ZOGO is the definition of marine wastes

- waste/litter in the marine environment and in the coastal area in direct contact with the sea arising from human activities on land or at sea, located on the surface of the sea, in a water column, on the seabed or flooded... "

• In Art. 16. ZOGO regulates the manner of waste management in the marine environment:

- Waste management in the marine environment includes waste management resulting from the exploration and exploitation of the continental shelf, seafloor and subsoil, sinking of waste from vessels and aircraft and marine waste management.

- Waste management resulting from the exploration, treatment and storage of mineral resources of the continental shelf, seabed and marine subsoil, conditions for submersion of seabed, conditions for burial of wastes in the subsoil from a vessel or aircraft, and the types of substances permitted to be submerged in the sea pursuant to the permit referred to in Article 86 of this Act (waste management permit), the Minister shall prescribe the ordinance referred to in Article 104 of this Act (* Ordinance on methods and conditions of waste disposal, categories and conditions of work for landfills OG 114/15, 103/18)

- The management of marine waste shall be prescribed by the Minister in an ordinance referred to in Article 53, paragraph 3 of this Act. (* The Ordinance on the management of marine wastes should have been adopted within one year of the entry into force of the Act, however, it has not yet been adopted).

• Art. 17 of ZOGO defines what the Waste Management Plan (PGO) of the Republic of Croatia contains as an umbrella document with which the waste management plans of local self-government units (LSGs) must be aligned, and in paragraph 1 item 12 as one of the measures and guidelines (policy) for implementation The plan outlines marine waste management measures.

The PGO RH clause 1.1.5.11 states:

"… There are currently no official data or satisfactory estimates regarding the quantities of waste ships and marine waste in the Republic of Croatia. It is necessary to develop a methodology for monitoring marine waste data, as foreseen in the Adriatic Monitoring Plan, which is in preparation based on the obligation from the Decision on the adoption of the Action Program of the Marine Environmental Management Strategy and the Coastal Zone: Monitoring and Observation System for the Continuous Assessment of the Adriatic Sea (OG 153/14).

The PGO RH clause 1.2.2.11 states:

"… The LPPG stipulates that waste ships and marine wastes are considered to be a separate category of waste, but a system for managing ships and marine wastes has not been established and there are no official data or estimates regarding the quantities of these types of waste. In the Republic of Croatia, there are locations where potholes (sunken ships) and sunken items (e.g. sunken cargo on the seabed containing lubricating oil, fuel, residual weapons, explosive devices or other dangerous substances) are located. Ruins and sunken items do not fall into the category of waste ships or marine waste, but are regulated by a special regulation.

One of the goals of the PGO RH is to establish a marine waste management system (by year 2022) and stipulates a number of measures ***(for detail list of measures and the relevant document contact RERA S.D.).***

One of the goals is to establish a system for managing old ships and sunken items on the seafloor and stipulates a number of measures ***(for detail list of measures and the relevant document contact RERA S.D.).***

Local stakeholder are listed within the DECISION ON APPOINTING THE PROFESSIONAL NATIONAL COMMITTEE FOR THE EXECUTION OF THE TASKS REFERRED TO BY THE DRAFT (Official Gazette - NN 31/17, 42/18).

The stakeholders (institutions as well as professionals are listed and divided across different national and regional institutions -for detail list of measures and the relevant document contact RERA S.D.).

About the use of Drones in Croatia, the relevant legal aspect has been addressed in the document [Annex 8, part of Act 3.1], and are regulated by following Acts and Regulatory Acts:

- The Air Traffic Act (Official Gazette NN 69/2009)
- The Act on Amendments to The Air Traffic Act (NN 84/2011, NN 127/2013, NN 92/2014)
- The Ordinance on Unmanned Aircraft Systems (NN 104/2018)

2.7 Existing relevant system in Italy

2.7.1 MATTM web portal for data collection on micro/macro plastic

The data collected by ARPAs in Italy are added in a specific application available for MATTM for reporting to EU commission. No specific data are available in this stage.

2.7.2 Other solution available

No specific solution is available to collect in a GIS environment the collected data in Italian waters.

2.8 Existing relevant system in Croatia

The document title - Action program of the Marine environment and coastal zone Management Strategy provides the description of the Monitoring and observation system for continuous assessment of the Adriatic Sea.

The Monitoring and Observation System for the Continuous Assessment of the Adriatic Sea (hereinafter referred to as ***monitoring program***) has been developed as the first action program of the Marine and Coastal Zone Management Strategy in the framework of the implementation of Directive 2008/56 / EC of the European Parliament and of the Council establishing a framework for Community action in the field of marine environmental policy (OJ L 164 of 17.6.2008) (hereinafter referred to as the Marine Strategy Framework Directive, ODMS) and Commission Decision 2010/477 / EU on the criteria and methodological standards for the good status of the marine environment (OJ L 232 2.9.2010) (hereinafter referred to as the Decision) or the national Decree on the drafting and implementation of documents of the Marine Environmental and Coastal Zone Management Strategy (Official Gazette 112/2014). In accordance with the recommendations of the European Commission (EC), monitoring has been viewed from a regional point of view, both in terms of spatial coverage and temporal frequency of sampling and in the selection of parameters for the assessment of the situation. Namely, since these are transboundary marine ecosystems, neither monitoring nor research, and in particular the management of these ecosystems, cannot be partial, since in this case there will be no effect of any measures. This is best reflected in the northern Adriatic, since the Po River has an extremely large impact on the ecosystem of the entire Adriatic. Namely, the Po River brings more than half of the waters flowing into the Adriatic, and is also the largest source of load for the Adriatic. Also, the state of living resources in the area of *Jabučka kotlina* is extremely important for the state and restoration of living resources throughout the Adriatic, since this area is the most important hatchery and breeding ground for most of the Adriatic Fisheries Fund. It is also important to emphasize the importance of the Palagruškog praga, which is a key area for water exchange between the southern and northern Adriatic.

In addition to spatial coverage, the frequency of sampling is extremely important for monitoring, which, due to insufficient staff and financial resources, makes it difficult to carry out programs of systematic monitoring and observation of the Adriatic Sea. For such a demanding project, such as Adriatic monitoring, optimization of sampling frequency is an important step and must be driven by the assumption that the data obtained must presuppose all the next steps in the implementation of the ODMS, such as programs of measures and realization of the set goals. Because of this, the frequency of sampling must come from the set statistical goals of the program, and one is for sure that we must be certain that no change in the DSO has occurred with a certain probability (usually 90%). Therefore, sub-sampling prevents us from properly managing the ecosystem and its resources, which can ultimately cause significant damage, either on the ecosystem side or from an economic standpoint. On the other hand, measuring too much is economically demanding without contributing to better management.

It is important to note that this monitoring program partly overlaps with some existing monitoring programs in the Republic of Croatia (1. Systematic testing of the quality of transitional and coastal waters of the Adriatic, 2. Monitoring of the state of fishery resources, 3. Monitoring of the quality of the sea and shellfish in production areas and areas 4. Monitoring of the state of radioactivity of the environment in the Republic of Croatia-sea) *, but due to the comprehensive approach to the problem of implementation of the monitoring system in the Adriatic within the framework of the ODMS, this proposal covers all parameters and all areas. In order to rationalize costs, all national monitoring programs implemented in the Adriatic waters under the sovereignty of the Republic of Croatia should be consolidated.

In addition to integrating pre-existing systematic monitoring programs, it is important for this approach to have systematic data on coastal loads, which is important from a driving, loading, state, impact, response (u: Driving forces, Pressures, States, Impacts, Responses; hereinafter referred to as DPSIR). A special part of systematic observation should be devoted to this. It is also important that due to the significant transboundary transfers, loads are also considered regionally, especially in the northern part of the Adriatic. High-quality load imaging enables the full implementation of the DPSIR approach (as required by the European Commission), and thus better system manageability, i.e. better ability to meet ODMS goals.

The disadvantages of measurement can be partly overcome by using the results of numerical models whose spatial domains and simulation periods can cover study areas and time periods with spatial and temporal resolutions that are dominantly constrained by the computing capacity and are regularly superior to any measurement system. Still at using the results of numerical models, either for dynamic interpolation of data, for their interpretation, or for predicting oceanographic conditions, account should be taken of model limitations related to the applied numerical methods and processes at spatial scales smaller than the grid resolution, which ultimately affect the level of calculation reliability. Due to the limitations of different measurement techniques and numerical models, optimal results in continuous monitoring of the marine environment can be achieved by a system in which both components are represented. Careful selection of metering stations, sampling frequency, and the appropriate model system enables optimal results to be achieved with significant cost rationalization.

The Content of the document (Action program) is the following: ***(for detail list of measures and the relevant document contact RERA S.D.).***

In folder attached to the state of art sent by RERA S.D. please find the document in annex 7 named – *MarineEnvironemntProtection_Croatia_MZOE* where you can find more information on the existing system and future plans to implement the measures.

2.9 Other systems in EU – EMODnet

An important system that shall be considered is EMODnet.

The European Marine Observation and Data Network (EMODnet) consists of more than 150 organisations assembling marine data, products and metadata to make these fragmented resources more available to public and private users relying on quality-assured, standardised and harmonised marine data which are interoperable and free of restrictions on use. EMODnet is currently in its third development phase with the target to be fully deployed by 2020.

3 Stakeholder list

3.1 Introduction

All partners have been involved in the collection of the main stakeholders relevant to the data collection on micro and macro plastic.
Stakeholders are classified (based on importance / influence) in:

- Internal, within the Net4mPlastic partnership, and other internal stakeholder (Legaambiente, AIPO, Feder cooppesca);
- External, outside the Net4mPlastic partnership

Here is the list of stakeholders identified, per country. Other details and classification of stakeholders are available in annex 3.

3.2 List of main stakeholders in Italy

Groups of stakeholders
Fishing industry
Casa del Pescatore, fishermen cooperative (www.pescatori.it)
Consorzio Pesca Ancona, fishing consortium (copemo.it)
Cooperativa Casa del Pescatore Cesenatico, fishermen cooperative (www.casapescatore.it/La-Cooperativa/)
OP Bellaria Pesca Soc. Coop., fishermen cooperative (www.bellariapesca.it)
Chioggia Mitili (http://www.confcooperativevenezia.coop/scheda_cooperativa.php?id=181)
Clodiamare 1 Piccola Soc. Coop.Va A R.L.
Consorzio Cooperative Pescatori del Polesine (http://www.consorziopescatoripolesine.it/chisiamo.html)
Consorzio Cooperative Pescatori del Polesine Organizzazione di Produttori Soc. Coop. A r.l. (http://www.scardovari.org/scardovari/default.asp)

Consorzio per la Gestione e la Tutela della Pesca dei Molluschi Bivalvi nel Compartimento Marittimo di Venezia (http://www.cogevo.it/node/7)
Wholesale fishmarket of Chioggia
Organizzazione Produttori Pesca San Marco (http://www.sanmarcopesca.it/)
Marine transportation
Endeavor Lines (http://www.endeavor-lines.com/en/home)
Grimaldi Lines (http://www.grimaldi-lines.com/en)
Minoan Agencies s.r.l. (http://www.minoan.it/en/company.shtml)
Superfast Ferries (http://www.superfast.com/adriatiki/it)
DelfinoVerde Navigazioni (http://delfinoverde.it/ita/)
Oil&gas exploitation
ENI s.p.a.
Adriatic LNG (http://www.adriaticlng.it/wps/portal/alng/en/home)
SIOT (https://www.tal-oil.com/de/) (siot@tal-oil.com)
Military
Coast Guard of Cesenatico, Rimini and Cattolica
Corpo Forestale dello Stato (Foce Bevano)
General Command of the Coast Guard, Marine Fisheries Department (www.guardiacostiera.it)
Coast Guard - Port Authorithy of Chioggia
guardia costiera di TS (http://www.guardiacostiera.gov.it/trieste)
Groups concerned about the management decision
Non-governmental organizations
NGO Halieus (www.halieus.it)
Cooperativa Bagnini, cooperative lifeguard
Legambiente Emilia-Romagna, environment union

Associazione "Tegnue di Chioggia" - ONLUS (www.tegnue.it)
Legambiente Veneto (http://www.legambienteveneto.it/)
Fondazione della Pesca Chioggia (http://www.fondazionedellapesca.com/)
Riserva Naturale Marina di Miramare (http://www.riservamarinamiramare.it/)
Area Marina Protetta Torre del Cerrano (http://www.torredelcerrano.it/en/)
WWF Italia (http://mediterraneo.wwf.it/component/k2/item/49-manifestowwf.html)
Area Marina Protetta Riserva Naturale dello Stato Torre Guaceto (http://www.riservaditorreguaceto.it/index.aspx)
Riserva di Miramare (http://www.riservamarinamiramare.it/)
Business interest organizations
LEGA PESCA, National Fishing Association (www.legapesca.coop)
AMA, National Acquaculture Association (www.a-m-a.it)
Acquario di Cattolica, seaworld park
Gruppo Hera Multiutility leader in environmental services (www.gruppohera.it)
Azienda di Promozione Turistica della provincia di Venezia (http://en.turismovenezia.it/Chioggia/Sea-and-Nature/1395237400.html)
Federcoopesca (http://www.federcoopesca.it/)
LegaCoop Veneto (http://www.legacoop.veneto.it/)
Adriamar Società Cooperativa (http://www.adriamar.info/)
Federpesca (http://www.federpesca.it/)
Consorzio Armatori Pescherecci di Chioggia

Pescaturismo Laudamar (348 522 5281); Imbarcati con Joseph (contact@joseph.land); Enrico Maria Milič (milic@bora.la)
Società velica di Barcola Grignano (http://www.svbg.it/15/); lista di diverse società diportistiche (http://www.dnsistiana.it/utilita/societa-nautiche/)
National and international development agencies
Regional level
Regional Advisory Council for the Mediterranean (RAC MED- CCR MED) (www.racmed.eu)
OGS (https://www.inogs.it/)
Groups with interest over the area or resources
National governments
Italian Ministry of Agricultural, Food and Forestry Policies (http://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/202)
Italian Ministry of the Environment and Protection of Land and Sea (http://www.minambiente.it/)
Regional authorities
MARCHE region, Service fishing activities (www.pesca.marche.it/web/index.htm)
EMILIA-ROMAGNA Region (Environment branch)
VENETO Region (Service fishing activities) (http://www.regione.veneto.it/web/guest/sezione-caccia-e-pesca)
ARPA (Regional Environmental Agency of Emilia-Romagna)
ARPAV (Regional Environmental Agency of Veneto) (http://www.arpa.veneto.it/)

arpa fvg (http://www.arpa.fvg.it/cms/)
Local authorities
Municipality of Cattolica (www.cattolica.net)
Municipality of Cesenatico
Municipality of Chioggia
Municipality of Grado
Municipality of Lignano
Municipality of Monfalcone
Groups dependent upon resources to be managed
Research organizations
Centro Italiano Ricerche e Studi per la Pesca (CIRSPE) (http://www.cirspe.it/)
Centro Ricerche Marine (http://www.centroricerchemarine.it/)
Consiglio Nazionale delle Ricerche – Istituto di Scienze Marine of Venice (CNR-ISMAR) (http://www.ismar.cnr.it/organization/venezia-sede-n)
Istituto Zooprofilattico Sperimentale delle Venezie (http://home.izsvenezie.it/)
Laguna Project (LagProject) (http://www.lagunaproject.it/)
Osservatorio Socio Economico della Pesca (http://www.venetoagricoltura.org/content.php?IDSX=19&SIDSX=79)
Reef Check Italy Association (http://www.webalice.it/francodiving/)
University of Padua, Department of Biology (http://chioggia.scienze.unipd.it/Inglese/indexEnglish.html)
Groups with special seasonal or geographic interests
SIMAP, marine litter managment Ltd. (www.simapravenna.it)

Gruppo Veritas (waste management) (http://www.gruppoveritas.it/)

3.3 List of main stakeholders in Croatia

Groups of stakeholders
Fishing industry
Fishing association "ADRIA", Tribunj (cca. 27 trawling boats)
http://www.adria-tribunj.com/
Fishing association "HVAR", Vira, Island of Hvar
(cca. 14 trawling boats)
CROMARIS d.d. (Cromaris is a company that specializes in growing, processing and sale of indigenous Adriatic fish and shellfish.)
web: www.cromaris.hr
Orada Adriatc d.o.o. (Orada Adriatic primarily operates in four main segments: mariculture, the purchase of fresh tiny blue fish, processing and sales)
https://www.royal-adriatic.com
Marine transportation
Jadrolinija, Društvo za linijski pomorski prijevoz putnika i tereta, Rijeka / Jadrolinija Rijeka
http://www.jadrolinija.hr/
Blue-line Ferries (Blue Line International, international shipping company, specialized for passengers transport and vehicle transport on relation Croatia-Italy)
http://www.blueline-ferries.com/plovidbeni_red
Rapska plovidba d.d. (Rapska plovidba d.d. is a local ferry boat company with its headquarter on the island Rab. The main activity of the company is to connect the island of Rab with the mainland by ferry boats.)
http://www.rapska-plovidba.hr
Katarina line LTD. (KATARINA LINE is one of the leading DMC's in Croatia and the premier small ship cruise company with weekly guaranteed departures from the end of April to mid-October from the major tourist centers of Opatija, Split and Dubrovnik.)
https://www.katarina-line.com
Oil&gas exploitation

INA d.d. (The principal activities of INA and its subsidiaries (the INA Group), are: Exploration and production of oil and gas in Croatia and abroad; Processing of oil and production of oil derivatives in the refineries located in Rijeka (Urinj) and Sisak, where fuels production is located, and Zagreb, where lubricants are produced; Provision of drilling, workover and other services related to oil and gas exploration and production, both on-shore and off-shore - services provided by Crosco d.o.o.
https://www.ina.hr
Pharmaceutical industry
JGL d.d. (international pharmaceutical company)
https://www.jgl.hr
Groups concerned about the management decision
Non-governmental organizations
NGO "SUNCE", Split
http://sunce-st.org/hr/
Udruga "Eko Kvarner"
http://www.ekokvarner.hr/
Udruga "Eko Liburnija"
www.eko-liburnia.hr
Business interest organizations
Croatian Association of private shippers / Hrvatska udruga privatnih brodara, Split, Jesenice
http://cruising-the-adriatic.com/
Goals of the association (among other goals): development of environmental protection awareness and protection of the Adriatic Sea; fostering tradition and nurturing of Croatian shipbuilding…
Rijektank d.o.o. (Waste management)
www.rijekatank.hr
IND-EKO (Waste management)
http://ind-eko.hr
Dezinsekcija (Waste management)
https://dezinsekcija.hr
National and international development agencies
Regional level

Split Dalmatia County, 1) Department for Spatial Planning; 2) Department for Environmental protection; 3) Department for maritime affairs
http://www.dalmacija.hr/
(Upravni odjel za pomorstvo i turizam; Upravni odjel za graditeljstvo, komunalne poslove, infrastrukturu i zaštitu okoliša;
Upravni odjel za prostorno uređenje)
Javna ustanova za upravljanje zaštićenim prirodnim vrijednostima na području Splitsko Dalmatinske županije
http://www.dalmatian-nature.hr/
Town of Hvar, Office for Spatial Planning
http://www.hvar.hr/
Služba za komunalne djelatnosti, prostorno uređenje, graditeljstvo i zaštitu okoliša
Waste management company/Komunalno Hvar d.o.o., Town of Hvar (public entity in ownership of Town of Hvar)
http://www.hvar.hr/portal/?page_id=32
Nautički centar d.o.o. (public entity in ownership of Town of Hvar)
www.nautica-hvar.hr
Primorje-Gorski Kotar County
https://www.pgz.hr/
Istria Region
https://www.istra-istria.hr/
Public Institution “Priroda” (management of protected areas in the Primorje-Gorski Kotar County)
https://ju-priroda.hr/
Public Institution Kamenjak (The institution looks after two forest parks (Kašteja and the Soline hill in Vinkuran) and two significant landscapes (Lower Kamenjak and Medulin Archipelago and Upper Kamenjak))
http://www.kamenjak.hr/
Public institution Natura Histrica (Natura Histrica is a public institution for the management of protected areas and other protected natural values in the Istria county.)
www.natura-histrica.hr
Waste management company/Komunalno društvo Čistoća d.o.o., Rijeka
https://www.cistoca-ri.hr/
Ponikve voda d.o.o. island Krk

Liburnijske vode d.o.o. Opatija
KTD Žrnovnica d.o.o. Novi Vinodolski
Vodoopskrba i odvodnja Cres d.o.o. Islands Cres and Lošinj
Vodovod i kanalizacija d.o.o. Rijeka
National level
Croatian Environment Agency / Agencija za zaštitu okoliša
http://www.azo.hr/Default.aspx
Fond za zaštitu okoliša i energetsku učinkovitost
http://www.fzoeu.hr/hrv/index.asp
International level
UNEP: PAP/RAC, Split Office
….
Insert additional rows if necessary
Groups with interest over the area or resources
National governments
Ministry of Environmental and Nature Protection, Croatia, Department for Sea Protection
http://www.mzoip.hr/default.aspx?ID=5299
http://www.mzoip.hr/
Ministry of maritime affairs, transport and Infrastructure
http://www.mppi.hr/
….
Port Authority Split Dalmatia County
http://www.lucka-uprava-sdz.hr/
Port Authority of Šibenik Knin County
http://www.cpa-sibenik-knin.hr/hrv/luke/tribunj.asp
Port of Rijeka Authority
https://www.portauthority.hr/en/port-of-rijeka-authority/
Port of Pula Authority
http://www.lup.hr/en/home/
International organizations, e.g. fisheries management
International Maritime Organization
http://www.imo.org/Pages/home.aspx
Insert additional rows if necessary
Groups dependent upon resources to be managed
Research organizations
Institute for oceanography and fisheries, Split, Croatia

www.izor.hr
Hydrographic Institute of the Republic of Croatia / Hrvatski hidrografski institut Split
http://www.hhi.hr/
(remark: the institute has in implementation phase several IPA projects on prevention of sea pollution)
Institut Ruđer Bošković – Centar za istraživanje mora, Rovinj
http://www.cim.irb.hr/
Fakultet građevinarstva, arhitekture i geodezije, Split
http://www.gradst.hr/
Faculty of maritime studies, Split / Pomorski fakultet, Split
http://www.pfst.hr/index.php?lang=hr
Ured za transfer tehnologije, Sveučilište u Splitu
http://www.utt.unist.hr/hr/
Insert additional rows if necessary
Teaching Institute of Public Health
http://www.zzjzpgz.hr/
Natural History Museum, Rijeka
http://www.prirodoslovni.com
Faculty of Maritime Studies of the University of Rijeka
https://www.pfri.uniri.hr
Groups with special seasonal or geographic interests
Tourist operators
Tourist offices
(TZ of Split Dalmatia County / http://www.dalmatia.hr/hr)

4 Selected stakeholder for data collection

4.1 Introduction

A list of stakeholders has been selected based on importance, and level of interest for the delivery of the questionnaires. The following chapter report the list of the stakeholders for both countries.

4.2 List of selected stakeholders

The following table provides the list of stakeholders contacted.

member state	stakeholder	WEBSITE
CRO	The institute of oceanography and fisheries Split	http://www.izor.hr/web/guest;jsessionid=70091FCBFF456A9CC724AE8439B43E32
CRO	Association SUNCE, Split	http://sunce-st.org/en/about-sunce/why-are-we-here/
CRO	Scuba diving association UPA ROSTRUM	http://uparostrum.com/
CRO	Split Dalmatia County	https://www.dalmacija.hr/en/
CRO	Ravnateljstvo civilne zaštite	https://civilna-zastita.gov.hr/
CRO	More i krš	http://www.dalmatian-nature.EN/
CRO	Fishery association RZ ADRIA	https://www.rzadria-tribunj.hr/en/history
CRO	Fishery association FRIŠKA RIBA	http://www.friska-riba.en/
CRO	Ministry of Internal Affairs Section of Civil Protection	https://civilna-zastita.gov.hr
CRO	Public institution for the management of protected areas in the region of Split-Dalmatia County "Sea and Karst"/"More i krš"	www.dalmatian-nature.hr
IT	Legaambiente	https://www.legambiente.it
IT	NoplanetB	https://it.noplanetb.net
IT	regione marche - servizio tutela gestione e assetto del territorio	www.regione.marche.it
IT	Comune di NUMANA	www.comune.numana.an.it
CRO	Prosoft	prosoft.hr
IT	University of ferrara	www.unife.it
CRO	Orada Adriatc d.o.o.	https://www.royal-adriatic.com
CRO	Jadrolinija, Društvo za linijski pomorski prijevoz putnika i tereta, Rijeka / Jadrolinija Rijeka	http://www.jadrolinija.hr/
CRO	Primorje-Gorski Kotar County	https://www.pgz.hr/
CRO	Port of Rijeka Authority	https://www.portauthority.hr/en/port-of-rijeka-authority/
IT	AIPO	www.agenziapo.it
IT	Federcoopesca	www.federcoopesca.it
IT	FIPSAS	http://www.fipsas.it/
IT	ISMAR	http://www.ismar.cnr.it
IT	DAPHNE	https://www.arpae.it/index.asp?idlivello=90

5 Questionnaire preparation

5.1 Introduction

This chapter address the preparation of a questionnaire to collect the needs by the selected stakeholders, identifying the main expected benefits, and assess the level of participation to the EWS business simulation.

5.2 Content of the questionnaire

The questionnaire contains:

- A short description of the project
- The information relevant to the stakeholder, including their role and contact point
- Any relevant system and solution in place
- List of questions to identify the main needs
- List of questions to identify the main benefits
- Any other problem related to identification and collection
- Any other suggestion for Macro and Microplastic collection
- Their willingness to participate to the business simulation

Questionnaire has been prepared in Italian, English and Croatian.

5.3 Preparation of the questionnaire

The questionnaire has been provided in Italian, English and Croatian. The English version is available in Annex 4, The Italian version is available in annex 5, the Croatian version in annex 6.
Some slides to give an introduction on the EWS have been made available to all the partners, as in annex 9.
Here is the content of the version in English.

ID	question	reply

Net4mPlastic Partner	NET4MPLASTIC PARTNER	
	Surveyor name	
	Data	
	Time	
	Location (Country, city)	
Stakeholder data collection		
GE-GE-001.0 / General information	Name of the organization	
	Country	
	Address	
	n. of total personnel /specific personnel relevant to plastic issues	
	Phone	
	Email	
	Fax	
	Web	
	Contact point	
	Gender	FEMALE
		MALE
	Age group (years)	<30
		30-40
		40-50
		50-60
		>60
	General description of your activity	
GE-GE-002.0 / Stakeholder	Type of company	1. Public Institution
		2. Private company
		3. University
		4. Other

		1. Monitoring
		2. Macro plastic Data collection and analysis
		3. Microplastic Data collection and analysis
		4. Analysis
		5. Research
		6. Fishing activity
		7. Regulating authority
		8. Management authority
GE-GE-003.0 / Stakeholder activity (multiple choice)	Activity	9. Other
GE-GE-004.0 / Information on existing systems	Did you already implement a general monitoring system in your organization relevant to marine data? (not specific to plastic)	YES
		NO

	If yes, please provide a description.	
	Did you already implement a general early warning system in your organization relevant to marine data? (not specific to plastic)	
	If yes, please provide a description.	
	Do you own any existing system where macro or micro plastic data are collected and processed?	
	If yes, please provide a description, and availability of data for integration	
	If you know the operating procedure or similar early warning systems (e.g. the ones adopted for oil spill detection, etc.) please indicate the modalities/strategies you adopt to generate a reliable warning.	
	Any indication related to existing warning systems that can be adapted to the macro and micro plastic warning system is welcomed.	

GE-GE-005/ On field activities and data collection	While doing activities at the sea, are you willing to collect data useful for localization / distribution of macro / micro plastic? (an EWS application on mobile phone will be provided to simplify data collection)	
GE-GE-006.0 / On field activities and data collection	When activities are at shore, are you willing to collect data useful for localization / distribution of macro / micro plastic? (using the EWS application, through a PC or laptop)	
General questions on EWS for need assessment		
CC-FUN-001.0	Do you think it is useful to see the macro plastic distribution and concentration in real time in the Adriatic basin (through drones, OBU and information collected using smartphones?	
CC-FUN-002.0	Do you think it is useful to see the micro plastic distribution and concentration in real time in the Adriatic basin (through drones and OBU)?	
CC-FUN-017.0	Which data are required to be collected to get chemical and physical seawater parameters? Please tick (multiple choice) and add any other data you think it is relevant.	◯ water Transparency ◯ water temperature ◯ water salinity ◯ water dissolved oxygen (% and mg / l) ◯ water pH ◯ Micro plastic classification V ◯ data Localization ◯ Flow (attached to the aperture of the trawl) ◯ Weather conditions (e.g. wind, current) ◯ other, please specify

CC-FUN-003.0	Which other data are of your interest related to the macro plastic? please specify (for instance meteo data, current, wind, water data, etc).	
CC-FUN-004.0	Which other data are of your interest related to the micro plastic? please specify (for instance meteo data, current, wind, water data, etc).	
CC-FUN-005.0	Do you think it is useful to see the forecast level of plastic distribution and concentration in the Adriatic basin?	
CC-FUN-006.0	Which is the optimal forecast timeframe of the plastic values? please select one of the values mentioned.	◯ 8h ◯ 24h ◯ 72h ◯ other, please specify
CC-FUN-007.0	Which specific data are of your interest to see related to the macro plastic?	
CC-FUN-008.0	Which specific data are of your interest to see related to the micro plastic?	
CC-FUN-009.0	Which is the level of distribution resolution you need for macroplastic? please select one of the values mentioned.	◯ 200m ◯ 500m ◯ 1km ◯ other, please specify
CC-FUN-0010.0	Which is the level of concentration resolution you need for microplastic? please select one of the values mentioned.	◯ 200m ◯ 500m ◯ 1km ◯ other, please specify

CC-FUN-011.0	Do you think it is useful to see the plastic distribution and concentration in the depth?	
CC-FUN-012.0	In case yes, do you need to see the plastic distribution up to which depth? please select one of the values mentioned.	◯ 2m ◯ 5m ◯ 10m ◯ other, please specify
CC-FUN-013.0	Any other specific functions you need related to macro plastic? please specify	
CC-FUN-014.0	Any other specific function you need related to micro plastic? please specify	
CC-FUN-015.0	How many users from your organization do you think will use the EWS system?	
CC-FUN-016.0	Are you willing to use and test the EWS when ready?	
CC-FUN-018.0	Do you consider it useful to also collect specific data relating to microplastic in fixed locations in real time?	◯ YES ◯ NO ◯ don't know
CC-FUN-019.0	Do you think it useful to also collect specific data relating to microplastic in real time using drones on paths to be defined?	◯ YES, please indicate any reason ◯ NO ◯ don't know
CC-FUN-020.0	Do you consider it useful to also collect specific data relating to the microplastic in real time using vessels equipped with "manta", and with OBU onboard units equipped with appropriate instruments?	◯ YES, please indicate any reason ◯ NO ◯ don't know
CC-FUN-021.0	Do you think it useful that personnel on boats in navigation, report the presence of plastic? (using an application on a smartphone).	◯ YES, please indicate any reason ◯ NO

		◯ don't know
ND	Please specify any other need according to your point of view	
Benefit assessment		
BE-GEN-001.0	Sharing of information among the two countries, Italy and Croatia	
BE-GEN-002.0	Data entry among the two countries, Italy and Croatia, for common analysis and definition of required actions	
BE-GEN-003.0	To improve the awareness of the macro plastic and microplastic in the Adriatic area	
BE-GEN-004.0	Monitoring of Macro plastic in real time	
BE-GEN-005.0	Provide forecast of monitoring of Macro plastic based on currents and wind	
BE-GEN-006.0	Monitoring of Micro plastic in real time	
BE-GEN-007.0	Provide forecast of monitoring of Micro plastic based on currents and wind	
BE-GEN-008.0	Reduce the time of intervention in case of potential alerts	
BE-GEN-009.0	Reporting the microplastic presence at sea	
	Any other benefit according to the stakeholder point of view?	
SPECIFIC QUESTIONS RELEVANT TO SYSTEM REQUIREMENTS - SECTION RESERVED TO INSTITUTE /RESEARCH CENTER/PUBLIC BODY DIRECTLY INVOLVED IN PLASTIC MONITORING		
CC-SYS-001.0	Which is the expected amount of data (in Mbyte) relevant to plastic that is provided in a measurement campaign (data, images, maps information, parameters, other) and the n. of campaign performed per month.	

CC- SYS-002.0	Is it convenient to foresee a dedicated hardware infrastructure facility located in a single site (or cloud) or in different sites (e.g. one in Italy and one in Croatia) for back-up purposes?	
CC-SPE-001.0	Based on your past experience, which are the parameters to be considered to generate a warning? (example, the concentration, distance to the coast, etc)	
CC-SPE-002.0	With reference to the parameters considered to generate a warning, please indicate their typical threshold values to overpass to start the warning procedure (please report any norms if available).	
MD-OPE-001.0	Shall the Marine Drone execute mission survey and data/samples collection only on surface or also at the seabed and at different depths?	
MD- OPE -002.0	Which is the maximum expected operative depth in the survey areas of the marine drones?	

MD-OPE-004.0	Which areas are suggested for the Marine Drone missions?	
MD-OPE-005.0	in which use case you suggest the use of the drone (please multiple tick)	◯ following a warning due to a plastic forecast over a threshold
		◯ in open waters
		◯ in shallow waters
		◯ in coastal area, on planning
		◯ in lagoon areas, on planning
		◯ in river areas, on planning
		◯ other (specify)
MD-OPE-007.0	Is there any authorization request to the competent ~~port~~ authority required to execute the Marine Drone missions in the planned monitored areas? Please indicate which authority is competent.	
MD-FUN-008.0	Which data are required to be collected on board of the Marine Drone to get chemical and physical seawater parameters? Please tick (multiple choice) and add any other data you think it is relevant.	◯ water Transparency
		◯ water temperature
		◯ water salinity
		◯ water dissolved oxygen (% and mg / l)
		◯ water pH
		◯ Micro plastic classification
		◯ Pressure / depth
		◯ data Localization
		◯ Flow (attached to the aperture of the trawl)
		◯ Weather conditions (e.g. wind, current)
		◯ other, please specify

MD-FUN-009.0	Any specific sensors/instrumentation suggested to be installed on board of the Marine Drone to get chemical and physical seawater parameters?	
MD-FUN-010.0	Which data acquisition rates are suggested for the chemical and physical seawater parameters collected on board of Marine Drone?	◯ every second ◯ every minute ◯ other
MD-FUN-011.0	Which data analysis (in real time or "near" real time) are considered useful during the Marine Drone mission?	◯ Micro plastic quantity (n. of) ◯ Macro plastic quantity (n.of) ◯ Volume information ◯ Micro plastic classification (colour, material, other classification) ◯ other
MD-FUN-012.0	Given an area, which is the frequency suggested for the plastic monitoring campaign using a drone?	◯ monthly ◯ every six months ◯ other
OB-OPE-001.0	Which is the expected size of the area to monitor during a monitoring campaign by a vessel equipped with "Manta"?	
OB-OPE-002.0	Which areas are suggested for vessel equipped with "Manta" where the OBU On Board Unit will be installed?	
OB-OPE-003.0	Which data are required to be collected on board of the OBU to get chemical and physical seawater parameters? Please tick (multiple choice) and add any other data you think it is relevant.	◯ water Transparency ◯ water temperature ◯ water salinity

		◯ water dissolved oxygen (% and mg / l)
		◯ water pH
		◯ Pressure / depth
		◯ data Localization
		◯ Weather conditions (e.g. wind, current)
		◯ other, please specify
OB-FUN-005.0	Which sensors/instrumentation are suggested to be installed on board of the On-Board Unit to get chemical and physical seawater parameters?	
OB-FUN-006.0	Which data acquisition rates are suggested for the chemical and physical seawater parameters collected on the OBU?	◯ every second
		◯ every minute
		◯ other
OB-FUN-007.0	Which real time or "near" real time data analysis are suggested after the completion of an On-Board Unit survey mission?	◯ Micro plastic quantity (n.of)
		◯ Macro plastic quantity (n.of)
		◯ Volume information
		◯ Micro plastic classification (color, material, other classification)
		◯ other
OB-FUN-008.0	Given an area, which is the frequency suggested for the plastic monitoring champaign using an OBU?	◯ monthly
		◯ every six months
		◯ other

6 Questionnaire data collection

6.1 Introduction

Several questionnaires have been collected from the selected stakeholders.

6.2 List of questionnaires collected

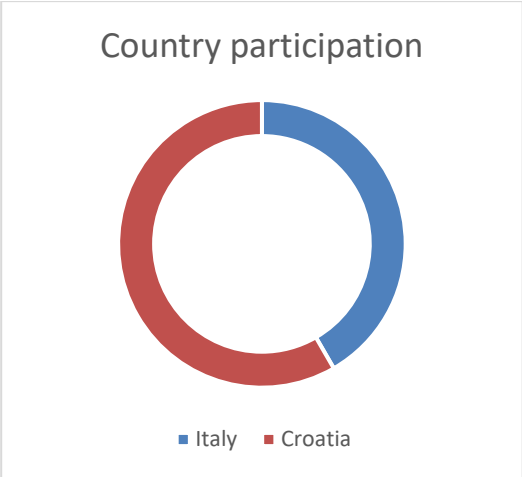
The list of questionnaires collected is available in the following table (and annex 10). Some stakeholder didn't reply at the moment. In case other input will be received will be evaluated and considered in the framework of the project.

member state	stakeholder	WEBSITE	Questionnaire filled
CRO	The institute of oceanography and fisheries Split	http://www.izor.hr/web/guest;jsessionid=70091FCBFF456A9CC724AE8439B43E32	yes
CRO	Association SUNCE, Split	http://sunce-st.org/en/about-sunce/why-are-we-here/	yes
CRO	Scuba diving association UPA ROSTRUM	http://uparostrum.com/	yes
CRO	Ministry of Internal Affairs Section of Civil Protection	https://civilna-zastita.gov.hr	yes
CRO	Public institution for the management of protected areas in the region of Split-Dalmatia County "Sea and Karst"/"More i krš"	www.dalmatian-nature.hr	yes
IT	regione marche - servizio tutela gestione e assetto del territorio	www.regione.marche.it	yes
IT	Comune di NUMANA	www.comune.numana.an.it	yes
CRO	Prosoft	prosoft.hr	yes
IT	University of ferrara	www.unife.it	yes
CRO	Orada Adriatc d.o.o.	https://www.royal-adriatic.com	yes
IT	ISMAR	http://www.ismar.cnr.it	yes
IT	DAPHNE	https://www.arpae.it/index.asp?idlivello=90	yes

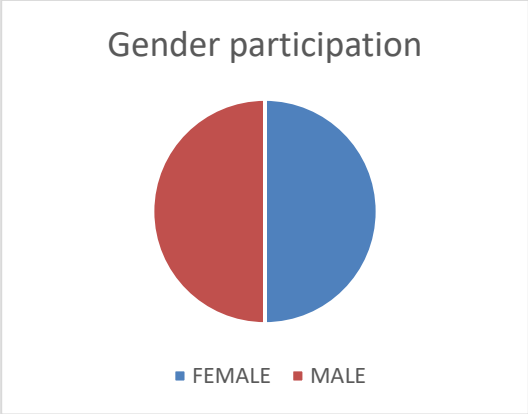
7 Analysis of the Questionnaires

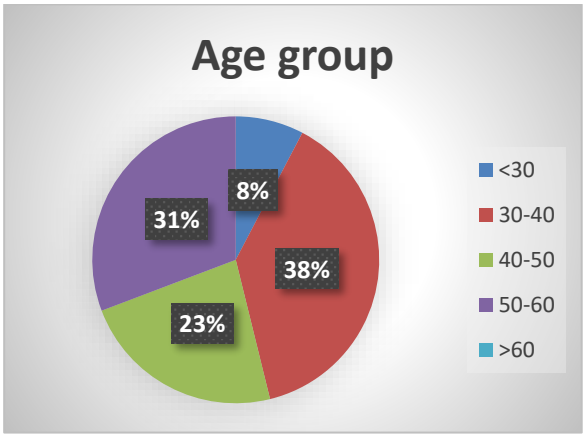
7.1 Introduction

An analysis of the questionnaires received have been performed by the main Act3.3 partners. Here are the main results. The main stakeholders from both countries participated to the process filling the questionnaires.



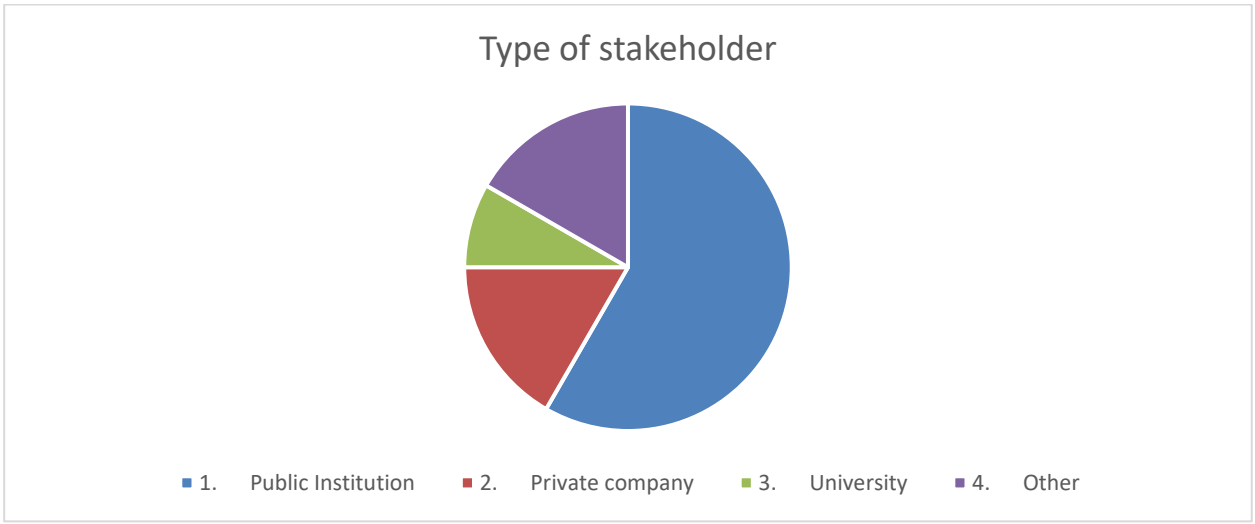
The gender participation was the same from both genders.



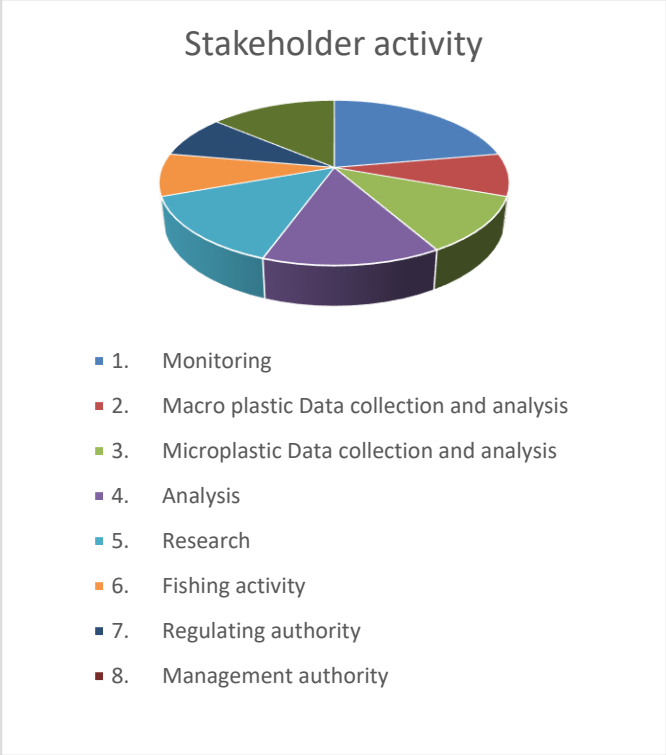


Age of the group is well balanced.

Stakeholders involved was mainly from Public Institutions, but participated in addition private companies, University and associations.



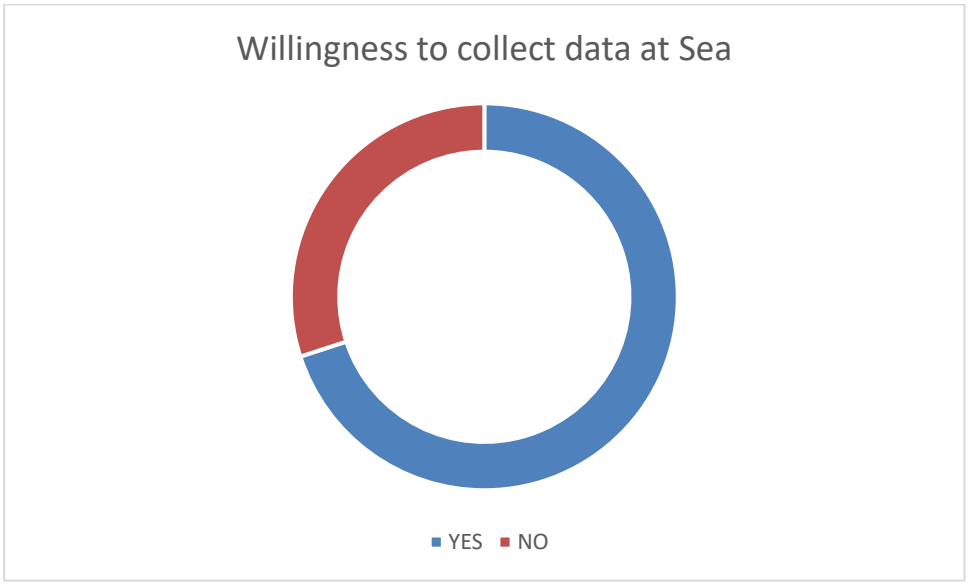
The following picture shows the activities of the involved stakeholders, and demonstrate the coverage of all the main needed works in the data collection and processing.

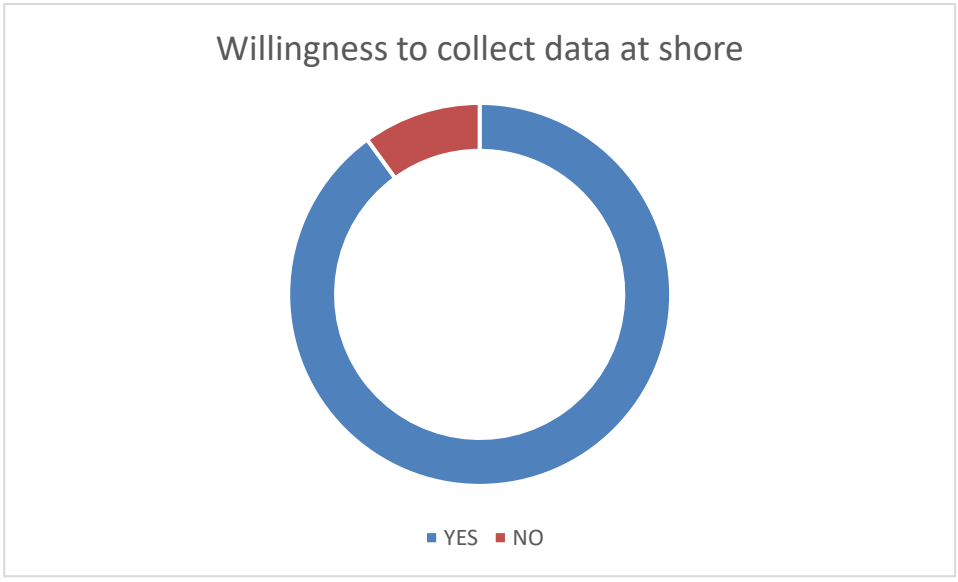


7.2 Data Analysis

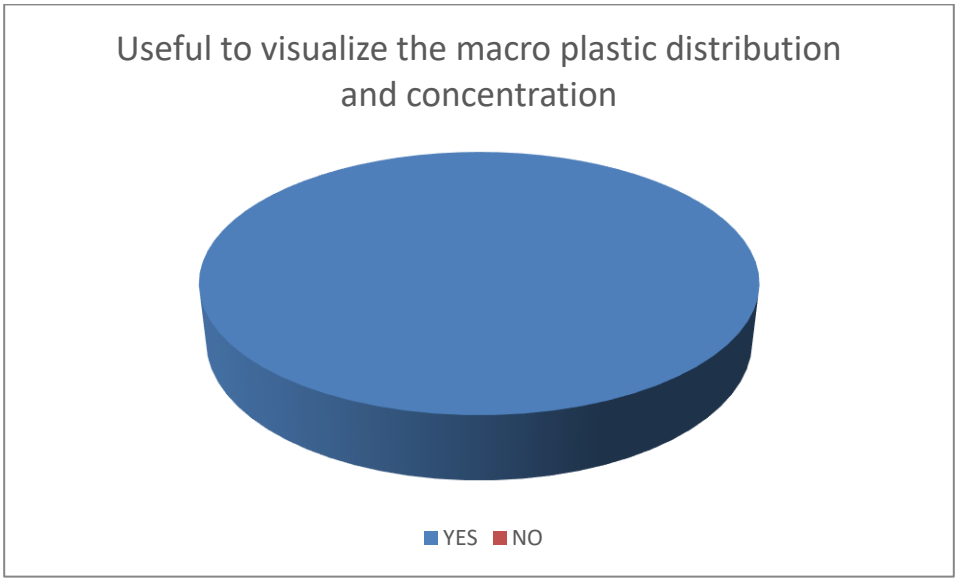
About existing systems, in this moment are in place a formal data collection of micro and macro plastic according to marine strategy.
ISMAR in Italy manages or collaborates with various marine data storage and management systems. These are mainly chemical-physical-biological measurements collected during measurement campaigns at sea. Data are collected by the ARPAs in the regions and delivered to a coordinator at national level for validation and data input in the national system.
The same is performed in Croatia and managed by the Institute of Oceanography and Fisheries in Split.
http://faust.izor.hr/autodatapub/postaje
https://www.seadatanet.org/
http://www.izor.hr/web/guest/web-kamera

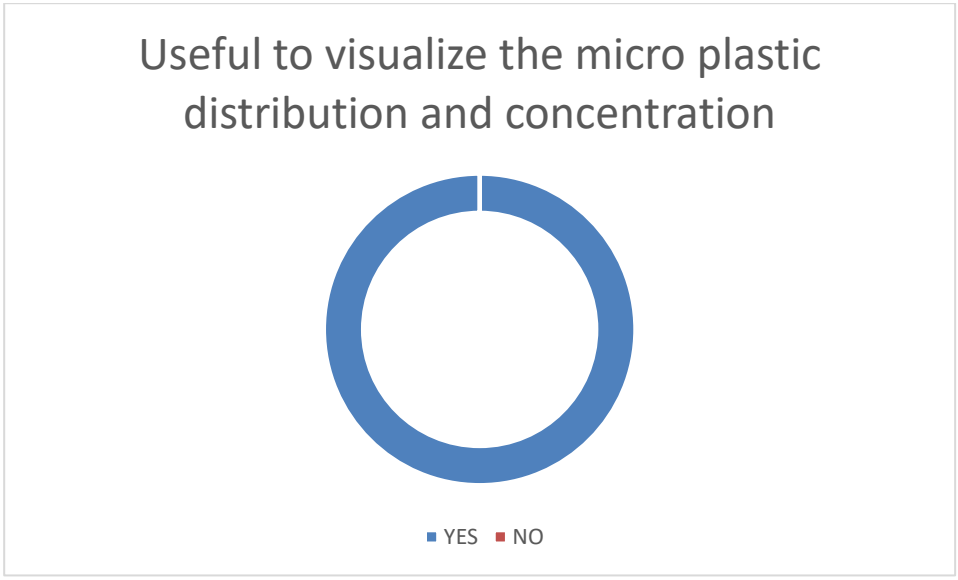
Most of the partners gave their willingness to provide data at sea and shore.



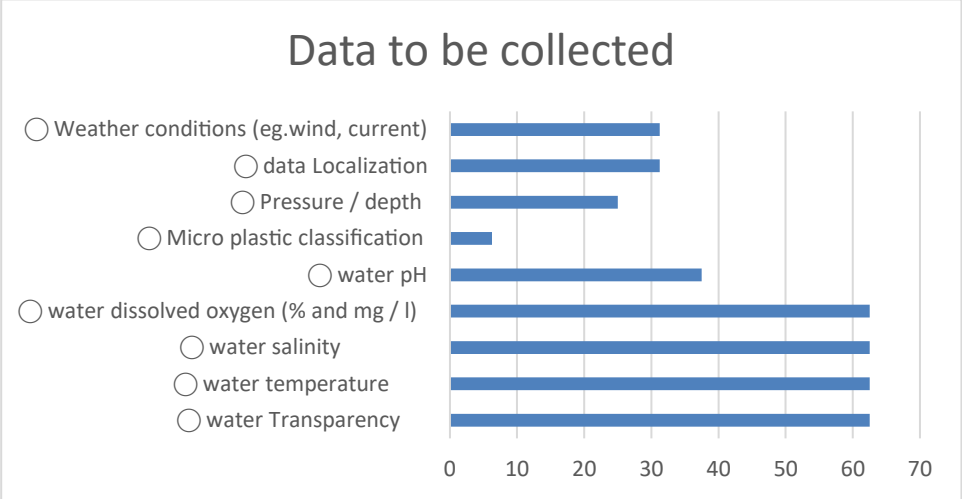


All stakeholders confirmed that is useful to visualize the Macro and micro plastic within the EWS system.

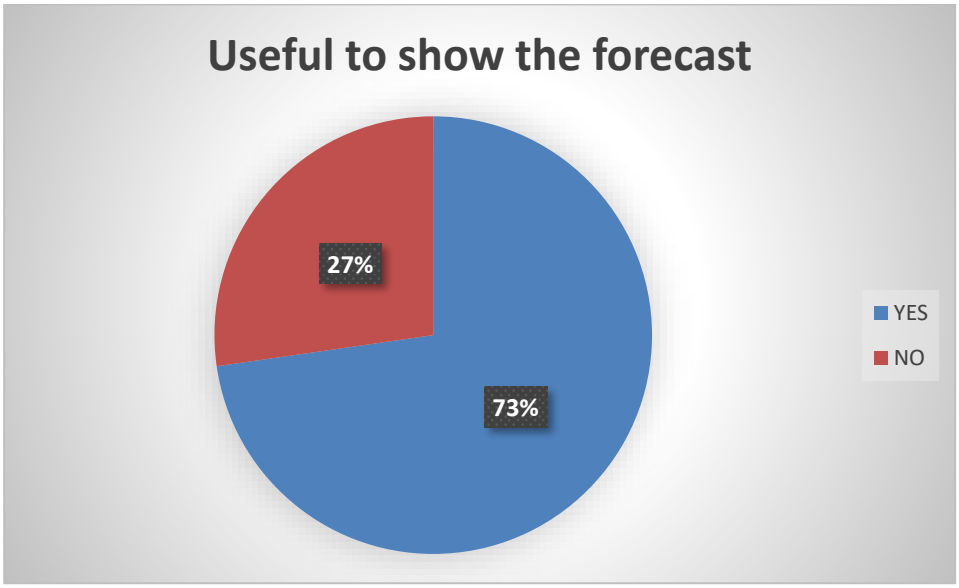




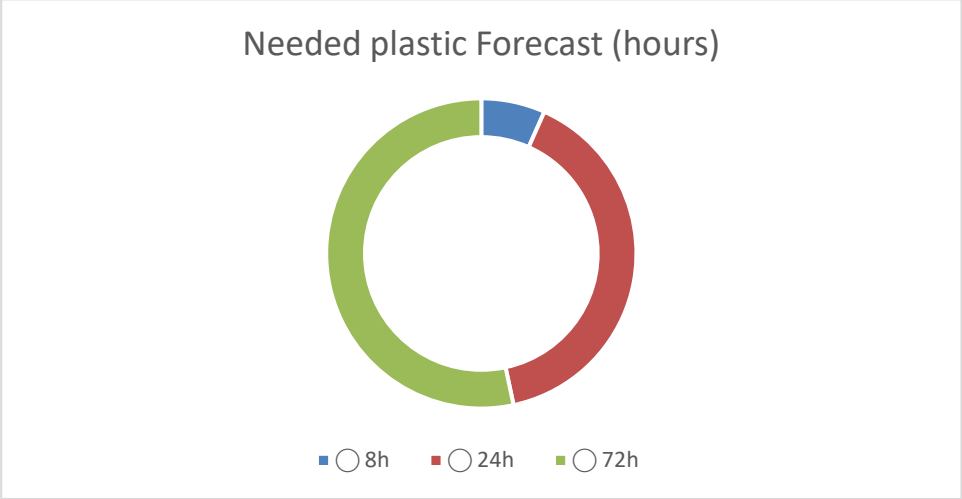
The following picture shows the main data required to be collected to get chemical and physical seawater parameters according to the stakeholders (in %).
Among all the only one that looks less interest is the microplastic classification.



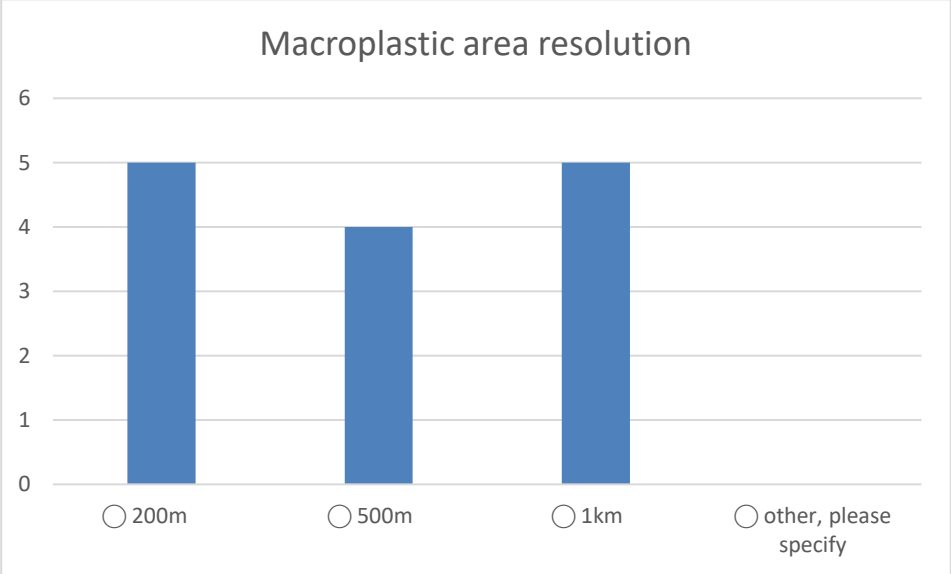
Most of the stakeholders declared that is useful to provide the forecast level for plastic (in general).



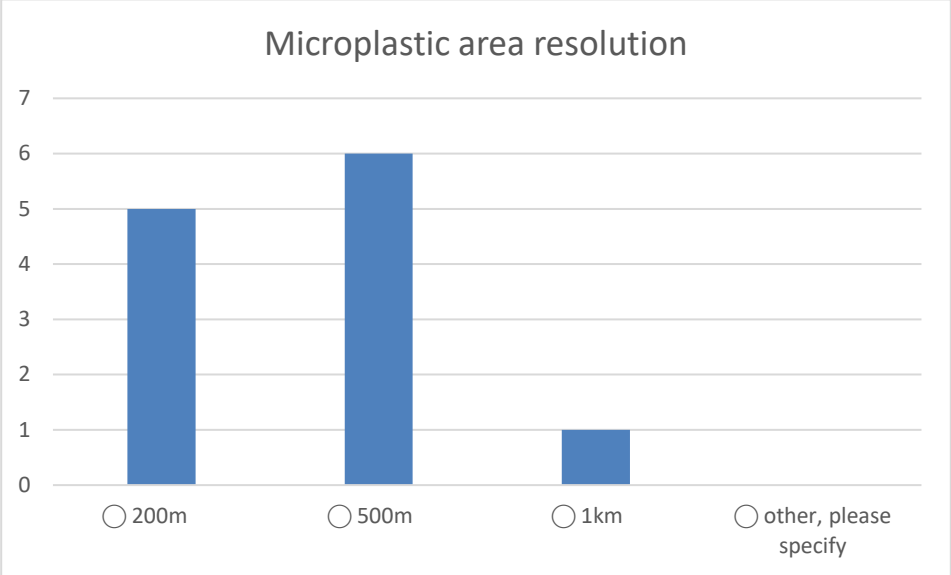
Most of the stakeholders declared that the forecast period of 72 hours shall be implemented.



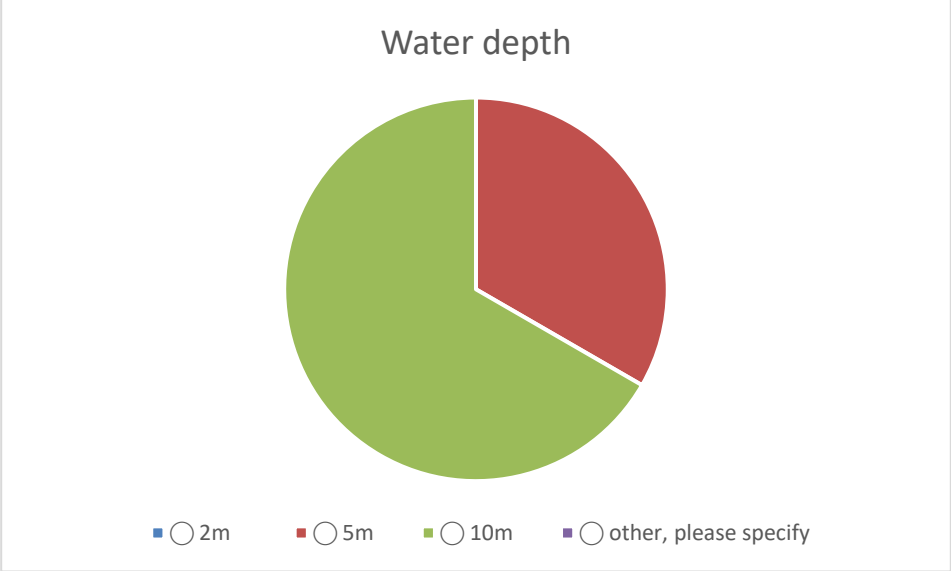
The level of distribution resolution needed for **macroplastic** according **to the stakeholders is from 200m.**



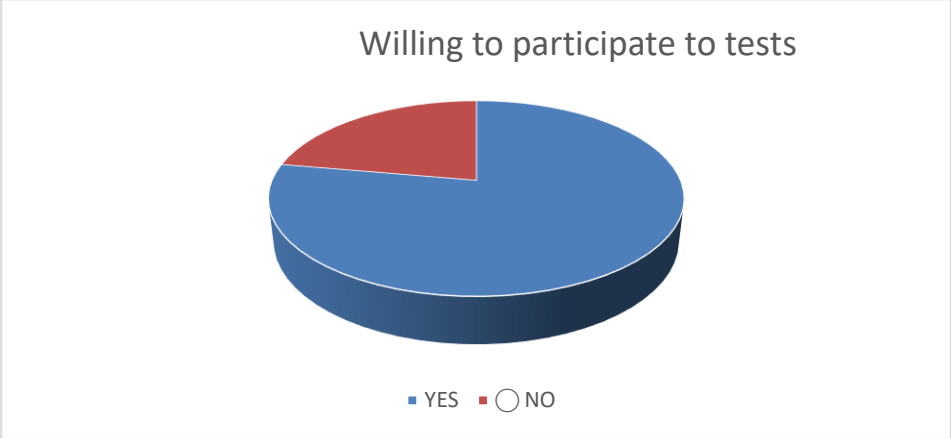
The level of distribution resolution needed for **microplastic according to the stakeholders** is mainly **between 200m and 500m.**



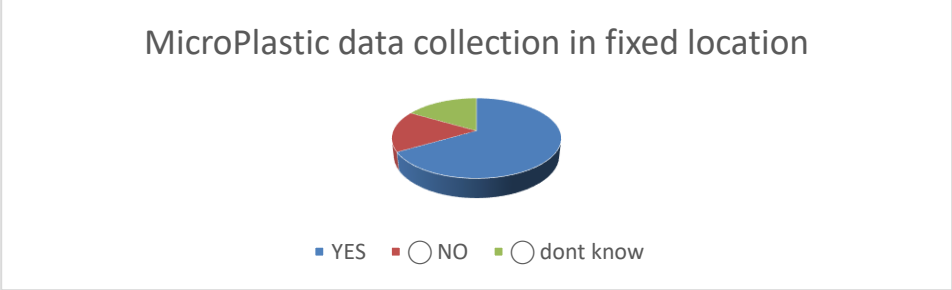
With reference to the depth, the level of distribution needed for microplastic according to the stakeholders is for most 10m.



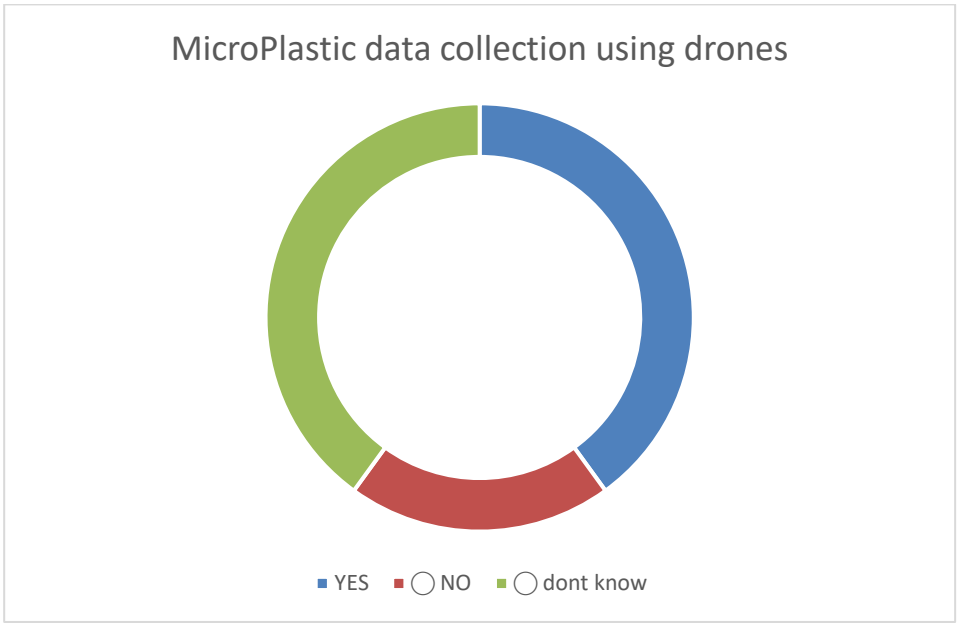
Most of the stakeholders are willing to use and test the EWS when ready.



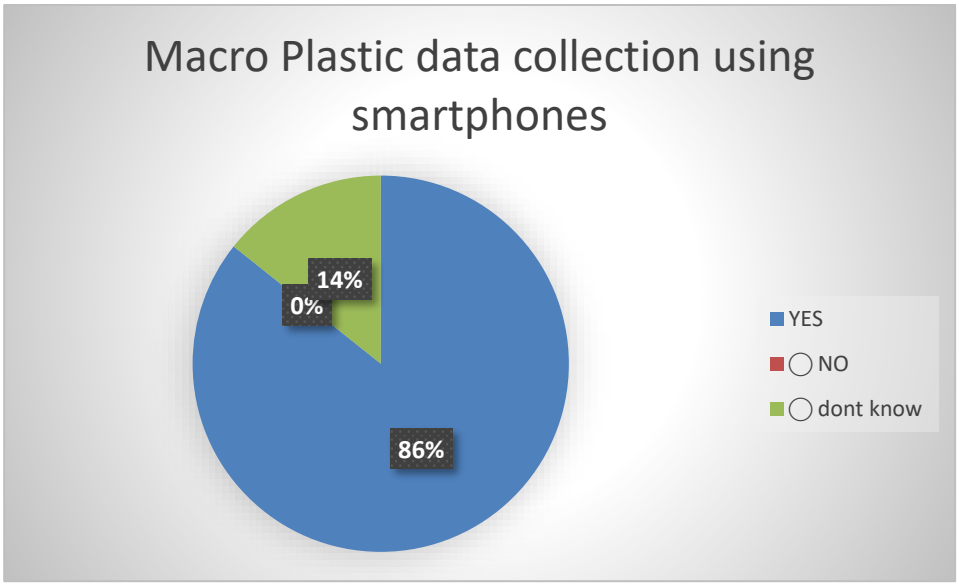
It is considered useful also to collect specific data relating to microplastic in fixed locations in real time, according to most of the stakeholders.



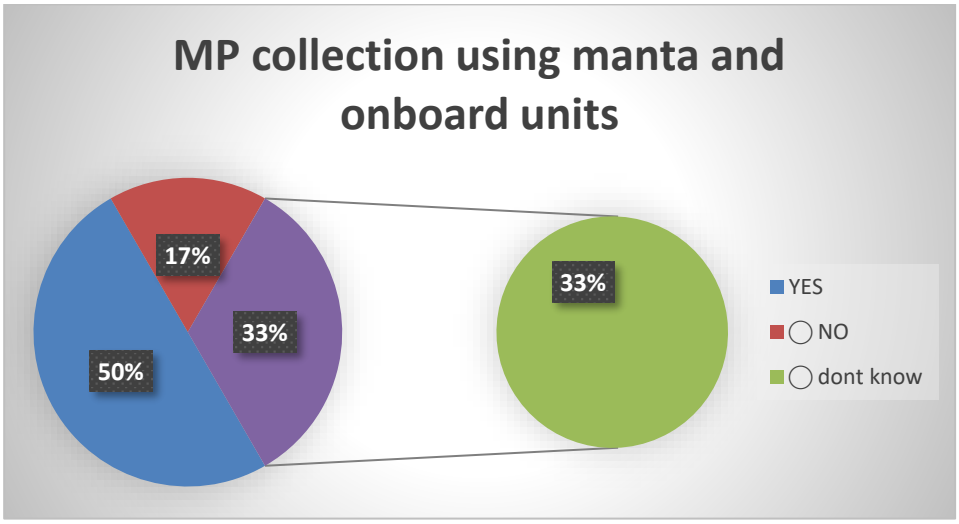
It is considered useful also to collect specific data relating to microplastic using drones on paths to be defined, according to most of the stakeholders.



It is considered useful that personnel on boats in navigation, report the presence of plastic (using an application on a smartphone), according to most of the stakeholders.



It is considered useful also to collect specific data relating to the microplastic in real time using vessels equipped with “manta”, and with OBU onboard units equipped with appropriate instruments, according to most of the stakeholders.

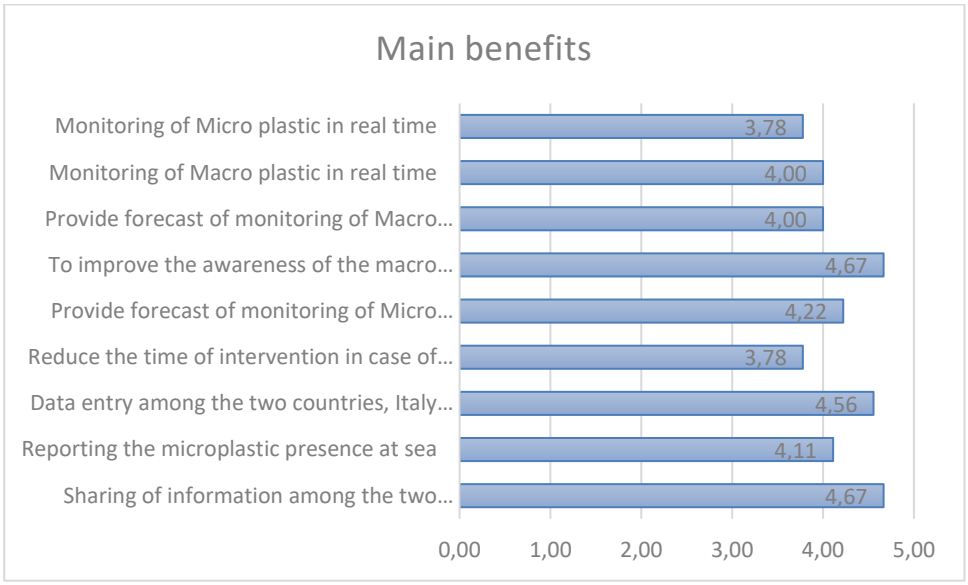


Here is the list of the main benefits expected with the introduction of the solution, according to the stakeholders.

Among the benefits collected the highest values are the following:

- Sharing of information between the two countries, Italy and Croatia
- Data entry between the two countries, Italy and Croatia, for common analysis and definition of required actions
- Reporting the macroplastic and microplastic presence at sea

All the other benefits received in any case a high score.



The “Public institution for the management of protected areas in the region of Split-Dalmatia County "Sea and Karst"/"More i krš"” in Croatia highlighted as additional benefit that access to such a system should

be provided by all utility companies, local governments and institutions managing a particular area in order to be able to intervene in case of pollution caused by macro plastic on beaches, etc., especially after the windy season and before the tourist season.
In Italy, Marche Region highlighted as benefit the QUANTIFICATION OF THE PLASTIC WASTE, AND FORECAST OF THE OF STRANDING (AREA / BEACH). Numana Council emphasized the need that operational procedures for data collection in case macroplastic is close to the coast. Definition of alert levels shall follow the civil protection model.

7.3 Conclusions

The data collected is considered of good quality, useful and sufficient for defining the high-level list of requirements, considering in addition the type of stakeholders that participated.
Stakeholders highlighted the need to plan interventions according to defined operational procedures in case an alert is generated by the EWS. Its shall be considered a different logic from the ones established by the civil protections and for safety interventions. Operational procedures shall be defined for data collection in case macro plastic is close to the coast.
About the typical threshold values to overpass, alert levels shall be defined following the civil protection model. Emergency level attention shall be setup with reference to civil protection parameters. At present, no limit values for the quantities of microplastics and macro plastics in the sea have been set at the global or local level, according to stakeholders. Reasonable values shall be defined to startup an additional collection survey. On procedures, stakeholders suggested to integrate the coastal pollution plan with a section dedicated to the microplastic, maintaining therefore the same operative procedure.
Stakeholders highlighted in addition that an evaluation shall take place about the use of data in term of divulgation, to avoid alarms to population.
On data collection, even using drones, stakeholders highlighted the need to collect data on the sea surface and seafloor, along the water column. In terms of collecting data at different depths it is considered a very useful thing. Nevertheless, at this time, a methodology for evaluating data on the presence of waste in the sea at different depths of the water column has not been elaborated.

8 Requirement list

8.1 Introduction

The requirement list is based mainly on the analysis of the questionnaires.

8.2 Stakeholders requirement

Code	Need	Stakeholders
	High level requirements	
R-001	The EWS shall provide the sharing of information between the two countries, Italy and Croatia	ALL
R-002	The EWS shall allow the reporting of the microplastic presence at sea	ALL
R-003	The EWS shall allow the data entry between the two countries, Italy and Croatia, for common analysis and definition of required actions	ALL
R-004	Shall be implemented for the Adriatic Sea, localization in this stage available for Italian regions and Croatian coastal regions.	ALL
R-005	The solution shall reduce the time of intervention in case of potential alerts	ALL
R-006	The EWS shall provide forecast of monitoring of Micro plastic based on currents and wind	ALL
R-007	The EWS shall improve the awareness of the macro plastic and microplastic in the Adriatic area	ALL
R-008	The EWS shall provide forecast of monitoring of Macro plastic based on currents and wind	ALL
R-009	Monitoring of Macro plastic in real time shall be implemented	ALL
R-010	Monitoring of Micro plastic in real time shall be implemented	ALL
R-011	The EWS shall allow to visualize the macro plastic distribution and concentration in real time in the Adriatic basin (through drones, OBU and information collected using smartphones	ALL
R-012	The EWS shall allow to visualize the micro plastic distribution and concentration in real time in the Adriatic basin (through drones and OBU)	ALL
R-013	The EWS shall allow to visualize the forecast level of plastic distribution and concentration in the Adriatic basin	ALL
R-014	Water Transparency is required to be collected to get chemical and physical seawater parameters	ALL

R-015	Water temperature is required to be collected to get chemical and physical seawater parameters	ALL
R-016	Water salinity is required to be collected to get chemical and physical seawater parameters	ALL
R-017	Water dissolved oxygen (% and mg / l) is required to be collected to get chemical and physical seawater parameters	ALL
R-018	Water pH is required to be collected to get chemical and physical seawater parameters	ALL
R-019	Micro plastic classification required to be collected to get chemical and physical seawater parameters	ALL
R-020	Pressure / depth is required to be collected to get chemical and physical seawater parameters	ALL
R-021	Data Localization is required to be collected to get chemical and physical seawater parameters	ALL
R-022	Weather conditions (e.g. wind, current) is required to be collected to get chemical and physical seawater parameters	ALL
R-023	Specific information for both macro and micro plastic shall be available in proximity to the discharge into the sea of effluents, from purifiers or other discharges. To get data from effluent rivers	ALL
R-024	Meteo-marine climate data (wave, wind, tide), data on sea currents, sea bottom information shall be available	ALL
R-025	effluent flow rate shall be available (from both countries, in Croatia especially Buna-Bojana basin)	ALL
R-026	Meteorological data, Precipitation shall be available	ALL
R-027	Data shall not be available directly to the public, to avoid panic	ALL
R-028	The optimal forecast timeframe of the plastic values shall be up to 72hours (including 24 and 48 hours)	ALL
R-029	Distribution and concentration on maps for macroplastic shall be available	ALL
R-030	Distribution and concentration on maps for microplastic shall be available	ALL
R-031	Alert threshold shall be available	ALL
R-032	Meteo marine data, precipitations, meteo data, sea currents, sea bottom, shall be available on a map and connected to data on macro and micro plastic	ALL
R-033	The level of distribution resolution needed for macroplastic shall be at least 200m	ALL
R-034	The level of distribution resolution needed for microplastic shall be at least 200m	ALL
R-035	The solution shall allow to see the plastic distribution and concentration in the depth up to 10m	ALL

R-036	For macroplastic it is required COMPOSITION (TYPE OF MATERIAL, AND POLIMERS), %	ALL
R-037	For macroplastic it is required to show the level of impact on seabirds, and large vertebrates (mammals, turtles)	ALL
R-038	The expected number of users can be about 1000	ALL
R-039	The solution shall collect specific data relating to microplastic in fixed locations in real time	ALL
R-040	The solution shall collect specific data relating to microplastic in real time using drones on paths to be defined	ALL
R-041	The solution shall collect specific data relating to the microplastic in real time using vessels equipped with “manta”, and with OBU onboard units equipped with appropriate instruments	ALL
R-042	The solution shall allow personnel on boats in navigation to report the presence of macro plastic (using an application on a smartphone).	ALL
R-043	QUANTIFICATION OF THE PLASTIC WASTE, AND FORECAST OF THE OF STRANDING (AREA / BEACH)	ALL
R-044	useful as a tool to raise awareness and alert you to higher pollution	ALL
R-045	Operational procedures for data collection in case macroplastic is close to the coast. Definition of alter levels following the civil protection model	ALL
R-046	Possibility to plan interventions according to defined procedures. To evaluate the use of data in term of divulgation to avoid alarms	ALL
R-047	*The solution shall be available in Italian, English and Croatian languages.*	ALL
R-048	*Solution shall be open to other countries*	ALL
	Specific system requirements	ALL
R-049	OPEN DATA IS REQUIRED	INSTITUTE /RESEARCH CENTER/PUBLIC BODY
R-050	Few hundred Mb is required for each measurement campaign. Assuming in a year 1000 campaigns, shall be considered less than 1 Tbyte per year.	INSTITUTE /RESEARCH CENTER/PUBLIC BODY
R-051	About the hardware infrastructure, as summary, it would be useful to have a reliable solution with backup, as optimal solution one common and each country one as its back up. Determined data should be uploaded to a shared server or Cloud, and each country maintains its statistics and all tests without backfilling in common base with all measurements and reports	INSTITUTE /RESEARCH CENTER/PUBLIC BODY

R-052	Concentration, and spatial distribution and position relative to areas of particular socio-economic or environmental value shall generate a warning.	INSTITUTE /RESEARCH CENTER/PUBLIC BODY
R-053	At present, no limit values for the quantities of microplastics and macroplastics in the sea have been set at the global or local level. Reasonable values SHALL BE DEFINED TO START UP A COLLECTION SURVEY. About the OPERATIONAL PROCEDURE, A DIFFERENT LOGIC FROM THE CIVIL PROTECTION AND FOR THE SAFETY INTERVENTION shall be implemented.	INSTITUTE /RESEARCH CENTER/PUBLIC BODY
R-054	Marine Drone are required to execute mission survey and data/samples collection on surface and also at the seabed and at different depths, up to 200m	INSTITUTE /RESEARCH CENTER/PUBLIC BODY
R-055	Areas suggested for the Marine Drone missions shall be Coastal area, rock marine areas where is not possible to use the existing solution, areas frequently used/visited by the tourists / secluded and uninhabited areas to monitor accumulation, up to 1km2.	INSTITUTE /RESEARCH CENTER/PUBLIC BODY
R-056	Drones are required following a warning due to a plastic forecast over a threshold, mainly in areas around major cities at sea, frequency routes for ferries and maritime lines, proximity to river mouths, in open waters, in shallow waters, in lagoon waters, in rivers.	INSTITUTE /RESEARCH CENTER/PUBLIC BODY
R-057	Water Transparency, Water temperature, Water salinity, Water dissolved oxygen (% and mg / l), Water pH, Pressure / depth, Data Localization, Flow (attached to the aperture of the trawl), Weather conditions (e.g. wind, current), are required to be collected by the drones during the survey, for model calibration and data analysis.	INSTITUTE /RESEARCH CENTER/PUBLIC BODY
R-058	Specific sensors/instrumentation are suggested to be installed on board of the Marine Drone to get chemical and physical seawater parameters, such as CTD, fluorimeter, oximeter, turbidimeter, ADCP	ISPRA, Institut za oceanografiju i ribarstvo Split
R-059	On data acquisition rates are suggested for the chemical and physical seawater parameters collected on board of Marine Drone, as minimum every minute, but variable according to the sensor, in general the maximum frequency should be kept and then decide the post-processing frequency	INSTITUTE /RESEARCH CENTER/PUBLIC BODY

R-060	Specific micro plastic data analysis (in real time or "near" real time) is considered useful during the Marine Drone mission, about quantity, volume, classification (colour, type od material, other classification)	INSTITUTE /RESEARCH CENTER/PUBLIC BODY
R-061	Frequency suggested for the plastic monitoring campaign using a drone is every month	INSTITUTE /RESEARCH CENTER/PUBLIC BODY
R-062	Area under monitoring shall be between 1km2 and 2NM square	INSTITUTE /RESEARCH CENTER/PUBLIC BODY
R-063	The solution shall be available in Italian, English and Croatian languages.	ACT3.3 partners
R-064	Solution shall be open to other regions	ACT3.3 partners
R-065	The monitoring tool shall allow to provide specific alerts in case of threshold is over	ACT3.3 partners
	Performance requirements	
R-066	EWS shall be interoperable	ACT3.3 partners
R-067	EWS shall provide data to other external system	ACT3.3 partners
R-068	EWS shall be open for any other future integration and interoperability using web services	ACT3.3 partners
R-069	The EWS functions should be available simultaneously from the control centres and from other remote sites.	ACT3.3 partners
R-070	the EWS application in the control centre shall be available using web application	ACT3.3 partners
R-071	EWS shall be scalable and able to grow in the future (with more components connected and level of integration)	ACT3.3 partners
R-072	Operation shall be 24h/7d with availability of 99.9% and overall system availability of 99.7%.	ACT3.3 partners
R-073	To consider the equipment must operate continuously (24h/7d) under all local weather condition.	ACT3.3 partners
R-074	Power supply backup required	ACT3.3 partners

R-075	Any civil work shall be done in accordance to local laws	ACT3.3 partners

	Other requirements	
R-076	To use the drones to feed the forecast microplastic model	Regione Marche

9 Conclusion

According to data collected from main stakeholders, main requirements of the EWS solution have been defined. This document is an input for preparation of the concept solution and the preparation of next project deliverables:

- D 3.3.2 – EWS Hardware Architecture and network design (central Data Centre Hardware Architecture Client/Server, Data network architecture and related communication segments)
- D 3.3.3 – EWS Software Architecture design (data modelling software, GIS applications, early warning detection software, etc.), the Relational Database to manage all collected data with related meta data, the communication Front-End for web remote access, the Data Centre Software Interfaces for users
- D 3.3.4 – EWS Hardware and other software Components Specifications design (Integrated Marine Drone and Marine OBU, with details of required components (hardware and firmware), firmware and other software components (mobile apps for managing the drones and for remote mobile activities).
- D 3.3.5 - Report and database provision with all the collected data