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MARLESS (MARine Litter cross-border awarenESS and innovation actions)

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D.6.3.1 – Fishermen cooperatives trained on FFL actions and equipped with specifically created networks

AT 6.3

WP 6

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PROJECT MARLESS

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CONTENT

1. INTRODUCTION

The United Nations Environment Programme (UNEP) defines marine litter as any solid material that is manufactured or transformed, persistent, and later dumped, abandoned, or lost at sea or along the coast. It is estimated that approximately 8 million tons of solid plastic waste are introduced into the marine ecosystem each year (Jambeck et al., 2015; UNEP/MAP, 2015; Villarrubia-Gómez et al., 2018). This material could originate from various sources including commercial and pleasure-boats, fishing, aquaculture, river discharges, urban and industrial areas, legal and illegal shoreline dumping, as well as recreational activities along the coast and harbours (Sheavly and Register, 2007). Once reached the marine ecosystem there several factors that determine the distribution of marine litter. In fact, marine litter could accumulate on beaches, on the sea surface (Palatinus et al., 2019), and on the seafloor and sediments (Renzi et al., 2019).

The Adriatic Sea is a semi-enclosed basin characterized by slow currents and extended water retention time so it is highly susceptible to pollution from marine litter, predominantly composed of plastic materials. However, all forms and compositions of marine litter are a growing concern due to their adverse effects on marine and coastal ecosystems.

Marine animal species can be directly affected by marine litter through ingestion or entanglement, leading to fatal outcomes. Moreover, rubbish can be easily transferred through the trophic web (Setälä et al., 2014; Romeo et al., 2015b).

The ingestion of marine debris may induce damage to the digestive system, and lead to death from starvation and debilitation. Conversely, entanglement in nets can result in physical injuries or amputations of body parts, as well as accidental captures. Ghost nets, in particular, pose a significant threat to marine life, as they restrict or prevent movement, thereby impeding the search for food and, in some cases, breathing.

The Adriatic Sea is among the regions that are most impacted by benthic litter (Pasquini et al. 2016), and the deposition of debris on the substrate results in physical harm to the environment and the inhibition of gas exchange between pore waters and overlying seawater, leading to anoxia and hypoxia. Furthermore, marine debris has the potential to modify the composition of marine communities, upsetting the equilibrium of ecosystems and resulting in additional environmental challenges. Apart from the aforementioned factors, the socio-economic aspect also warrants attention, encompassing reduced tourism, mechanical harm to boats and fishing gear, diminished catch and clean-up expenses, as well as a decline in aesthetic worth and public utilization of the environment.

Nowadays, waste pollution is a complex and continuously expanding environmental problem with multiple sources and few straightforward solutions. Hence, addressing marine litter issues requires a joint effort from different countries, and their collaboration is essential in finding a suitable and appropriate solution.

2. FISHING FOR LITTER

Fishing for litter is the process of removing trash and waste from marine environments such as oceans, rivers, and lakes. The main goal is to prevent pollution of the marine environment and to protect marine life. Conventionally, this practice involves using specialized equipment such as nets, hooks, and traps to collect and remove various types of waste from water bodies. Additionally, fishing for litter means any kind of voluntary agreement with the fishing sector in order to engage fishermen in the removal of marine debris from marine waters and seabeds. This is a growing practice that aims to increase the involvement of fishing communities in the protection of the marine environment. By working together, fishing communities can play a critical role in preventing pollution and protecting the oceans and marine life.

Infact, the waste that lies on the seafloor or floats in the water column is commonly captured by fishing nets, especially bottom trawlers, and constitutes a variable part of the daily catch of fishermen. If fishermen dispose of these items safely on land, the result is a direct removal of waste from the sea without the need for a specific cleaning action. Fishing for litter activity is built on the assumption that the activity must be as simple as possible for fishermen and that it must not have direct or indirect costs for them. There are several initiative that ficilitate the Fishing for litter activities: provides fishers with bags or bins in which to store litter and ensures that disposal facilities are established and easy to access and help fisherment to directly remove the litter from marine enviroments (F. Ronchi et al.2018).

In Italy, waste fishing is a relatively new practice, but it is becoming increasingly widespread and important. Waste fishing is mainly carried out by non-governmental organizations and volunteer groups, who collaborate with local authorities and public institutions to organize clean-up campaigns of marine waters and seabeds.

Since the problem of waste in the oceans has become a globally significant issue, it requires immediate and concrete solutions. Waste fishing represents an important step forward in the fight against marine pollution, but it must be accompanied by public and private policies that promote greater attention to waste management.

Over the past seventy years, there has been a significant increase in the consumption of plastic materials in Italy. However, until the end of the 1990s, fishermen regularly brought ashore the waste caught in their nets in response to the continuous increase in marine litter from boats that increasingly plow the seas and from rivers that transport them from the hinterland.

In the early 2000s, legislative decrees were introduced to regulate the management of coastal and port waste. Legislative Decree 182/2003 aimed to reduce waste and cargo residue discharges from ships into the sea, as well as improve the availability and use of port collection facilities for such waste and residue. On the other hand, Legislative Decree 152/2006 regulates all aspects relating to the disposal of urban and industrial waste. However, it is worth noting that while waste present on beaches or in ports is classified within the aforementioned decrees, waste collected from the sea is not mentioned.

As a result, "marine litter" is not classified as either urban or industrial waste and is considered as special waste within the regulatory framework described. Consequently, it is subject to different

regulations, and contracts for its disposal were won by companies that applied much higher rates than those applied to normal waste. This caused fishermen to stop depositing it, leading to a continued accumulation of waste at sea.
A step forward in the regulation of marine waste management was taken in 2022 when the new "Salvamare" decree was approved. This decree aims to contribute to the restoration of the marine ecosystem and the promotion of the circular economy, as well as raising awareness among the community for the adoption of virtuous behavioral patterns aimed at preventing waste abandonment in the sea, lakes, rivers, and lagoons and ensuring their proper management. Additionally, it provides that waste accidentally collected by fishermen will be equated to waste produced by ships, and the cost of disposal will be included in the citizens' waste tax. Since we are still in the early stages of implementing the law, there are still some issues, therefore the change must be evaluated over time. However, at the moment we can say that this law will encourage fishermen to collect and dispose of plastic material, recognizing and valuing the activities that were previously carried out involuntarily by the fishermen themselves.

3. **MATERIAL AND METHODS**

The aim of the project deliverable 6.3.1 is to develop new pilot actions that can improve the ML collection and to define a protocol for collecting macro-litter data in scientific fisheries surveys. Cetacea Foundation participated in this action by developing a new bottom trawler net that catch only marine litter on the sea bottom. The procedure covers observation of macro-litter collected during trials of a new net that is structured to catch only for marine litter. The protocol does not cover the observation of floating litter or non-fishing surveys.

3.1 Net design

Given the intended purpose of the designed net, which is solely to capture marine litter, it is imperative to develop a fishing tool that minimizes the incidental catch of any type of animal. Consequently, the fishing gear was designed as a trawl net in which the lateral panels of the net are constructed with square meshes measuring 20 cm by 20 cm, while the upper section is comprised of longitudinal ropes to facilitate the escape of turtles or large fish (As shown in **Figures 1** and **2**). Furthermore, in order to mitigate substantial impacts on the seabed, the net has been engineered to possess a relatively lighter weight. The gear's rigging and configuration were designed to recover waste of varying sizes and weights without causing any stress to the biomass. The rigging and use of the gear are similar to those of a traditional trawl net, with the aim of facilitating its implementation among operators. Minimal impact is expected when using it, both in terms of deployment and recovery operations, as well as onboard equipment and devices required.

Figure 1 - Photo of the net.

Figure 2 *- Detail of the longitudinal ropes in the upper part of the net.*

3.2 Location description

The Fishing For Litter activity was conducted in collaboration with Commanders Massimo Bottacchiari and Massimo Rimas, from the port of Cesenatico, in Emilia-Romagna region. The specially designed nets were carefully deployed approximately 4 miles offshore, precisely in the vicinity of the mussel farms located in Cesenatico. This strategic placement aimed to target areas with a higher concentration of marine debris. The sampling areas of the two boats, Rimas and Michela, are illustrated in the **Figures 3 and 4**, providing a visual representation of the precise locations where the nets were deployed. These designated regions represent the areas where sampling took place during the comprehensive MARLESS project, encompassing the temporal span of 2022 to 2023, while the dots represent the coordinates registered during each champaign.

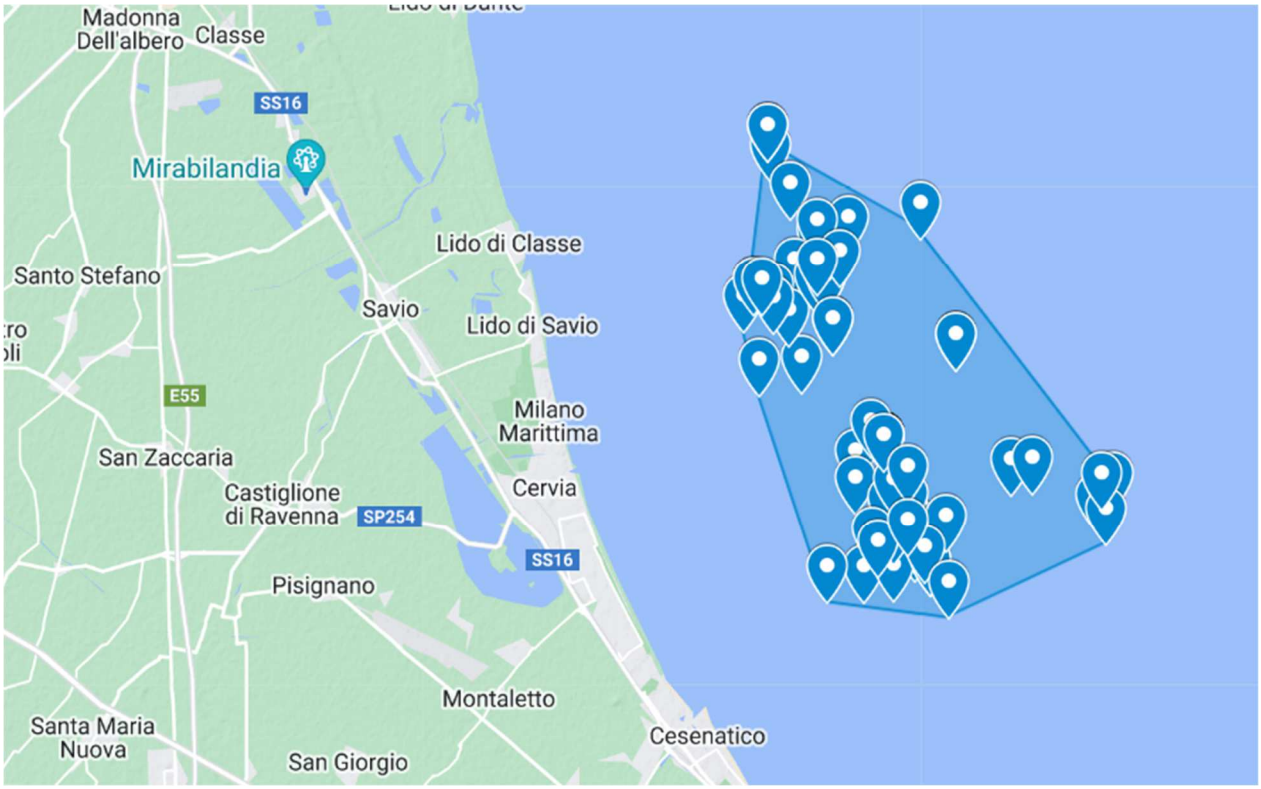

Figure 3 *- Rimas sampling area*

Figure 4 *- Michela sampling area*

3.3 Sampling methodology description

The seabed cleaning activities were carried out during non-working days, separate from the regular fishing activities. The activity included 40 campaign (20 with each boat) and two samplings per campaign, lasting approximately 1.5 hours each, for a total of 80 samplings.
To simplify the activity and ensure its replicability, it requires approximately half a day. The activity does not necessitate advanced technology, but only a scale and gloves for waste sorting, as well as designated areas in ports for proper waste disposal.
The sampling of collected waste followed the protocol proposed by DeFishGear (Fiorentino et.al 2013). On the vessels, the marine litter is weighed and divided into various categories and sub-categories, as listed below (**Table 1**). It is mandatory to record or estimate the overall weight of the litter, regardless of the categories and sub-categories, as well as the number of items in each main category. Recording the weight by categories and the number of items by sub-category is optional. If there is a large amount of litter in the catch, all large-sized litter objects must be documented, while a smaller sample could be analysed for small-sized litter items like lids. The litter should be coded in terms of total, category, and sub-category. Detailed information about the total weight and composition of the litter must be included in the designated litter form. It is recommended to take a photograph of the entire litter catch in a haul.
The qualitative and quantitative data about the litter must be linked to the data concerning the characteristics of the haul, such as the date, haul code, GPS positions of the haul's start and end points, average speed, and characteristics of the haul's depth (**Table 2**).
It is also mandatory to record the weight and the species accidentally caught for each haul (**Table 3**).

Campaign: | Date: | Haul:

TOTAL weight of litter in the haul (kg)

Type of Litter		Weight (kg) (facultative)	Number (mandatory)	Large item (cm)	Small item (cm)
L1 Plastic	**a**. Bags				
	b. Bottles				
	c. Food wrappers				
	d. Sheets (table covers, e.t.c.)				
	e. Hard plastic objects (crates, containers, tubes, ash-trays, lids,etc.) (specify)				
	f. Fishing nets				
	g. Fishing lines				
	h. Other fishing related (pots, floats, etc.) (specify)				
	i. Ropes/strapping bands				
L2 Rubber	**a**. Tyres				
	b. Other (gloves, boots/shoes, olskins etc.) (specify)				
L3 Metal	**a**. Beverage cans				
	b. Other food cans/wrappers				
	c. Middle size containers (of paint, oil, chemicals)				
	d. Large metalic objects (barrels, pieces of machinery,electric appliances) (specify)				
	e. Cables				
	f. Fishing related (hooks, spears, etc.) (specify)				
L4 Glass / Ceramic	**a**. Bottles				
	b. Pieces of glass				
	c. Ceramic jars				
	d. Large objects (specify)				
L5 Cloth (textil)/ natural fibres	**a**. Clothing (clothes, shoes)				
	b. Large pieces (carpets, mattresses, etc) (specify)				
	c. Natural ropes				
	d. Sanitaries (diapers, cotton buds, etc.)				
L6 Wood processed (palettes, crates, etc.)					
L7 Paper and cardboard					
L8 Other (specify)					

Table 1 - List of the litter typology and codes

CHARACTERISTICS OF THE HAUL

Name of the boat: _____ Data: _____/_____/_____

	HOURS	SPEED	DEPTH	GPS POSITIONS
START				
END				

Table 2 *- Characteristic of the haul*

SPECIES CAUGHT:

HAUL	WEIGHT
LIST OF THE SPECIES	

Table 3 *- Species caught during the hauls*

4. **RESULTS**

Throughout the duration of the net experimentation, which took place between 2022 and 2023, a comprehensive set of 80 samples was conducted, resulting in the retrieval of a notable quantity of 406.877 kg of marine litter. **Figure 5** displays the item count for each category, amounting to a total of 829 items. The category with the highest frequency is plastic, with a total of 757 items, followed by processed wood with 45 items. **Figure 6** depicts the proportions of the categories, highlighting the percentage of the most frequently encountered ones: plastic (93%) and processed wood (6%).

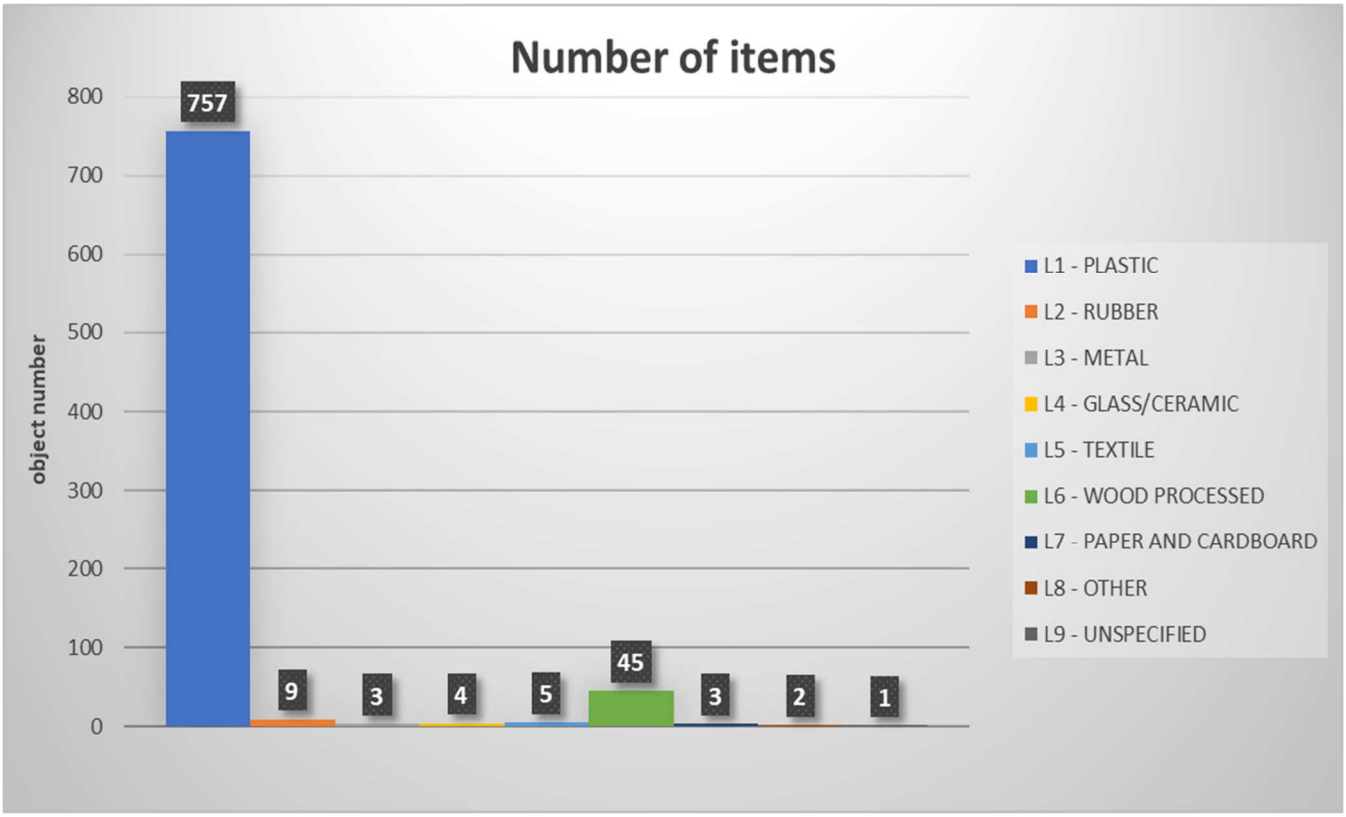

Figure 5 - Number of items per category of seabed litter collected.

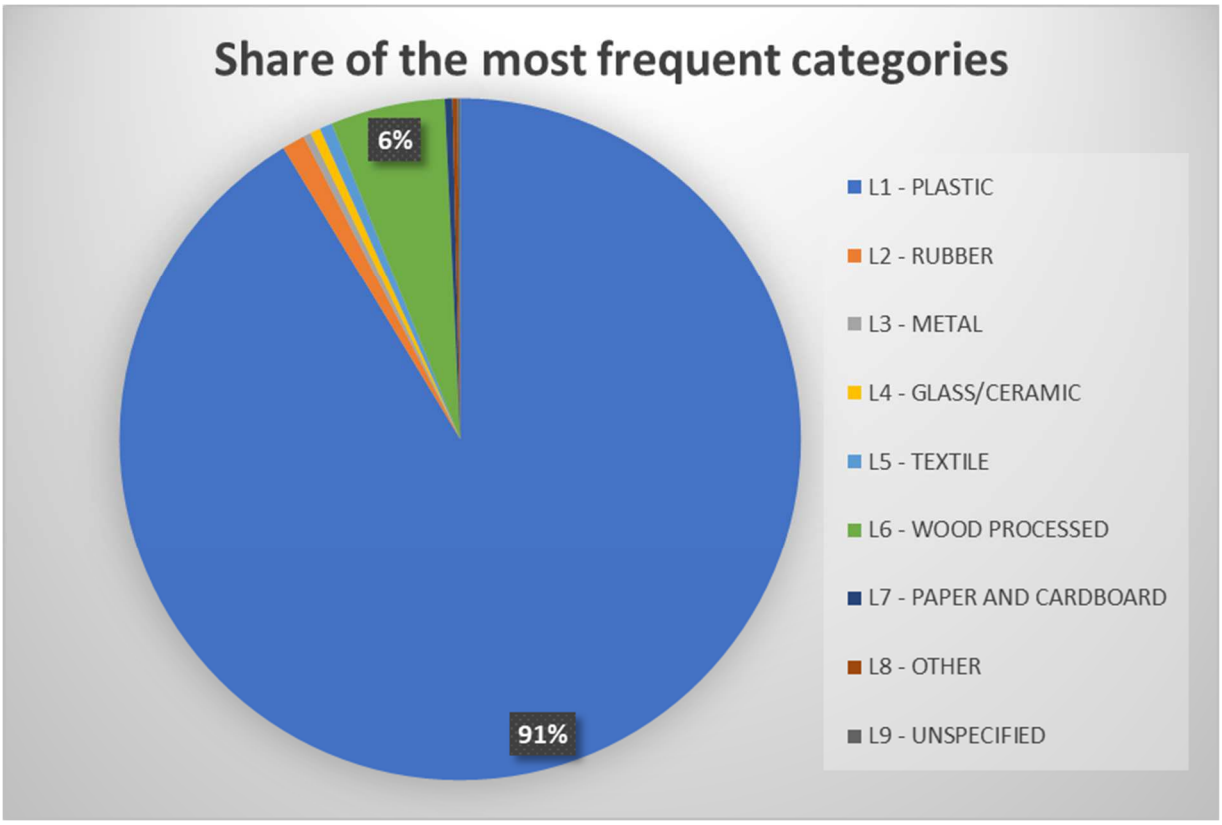

Figure 6 *- Share of the most frequent categories of seabed litter collected.*

5. **CONCLUSION**

During the conducted experiments, a total of 400 kg of waste was collected in just 80 samplings carried out in the port of Cesenatico. Throughout these experiments, several modifications were made to the net in order to improve the efficiency of the tool, adapting it to the specific characteristics of the vessels and the different types of seabed where the sampling campaigns took place. The main objective of this experimental phase was to develop a net that would be easy to use and would require a reduced number of operators to ensure its replicability. Thanks to the similarity of the tool to a trawl net, it was easier to involve fishermen in the sampling activities, as they were able to use the net independently without the need for technical support. From our perspective, the volume of the recovered waste turned out to be lower than expected, considering that we anticipated a greater quantity. Additionally, some accidental captures occurred during the process, such as marine turtles and a few stingrays. However, it is important to highlight that significant improvements were observed during subsequent campaigns following the implementation of modifications made by the fishermen. Finally, a considerable progress should also be emphasized in terms of reducing non-target catches.

Although the results obtained from this pilot study did not reach complete satisfaction, it can be affirmed that further modifications will allow for the refinement of the tool. In order to fully exploit the potential of this net, it would be advisable to conduct preliminary studies on the areas to be cleaned, in order to identify the hotspots of marine litter and remove them at a later stage.

6. **REFERENCES**

Fiorentino, F., Lefkaditou, E., Jadaud, A., Carbonara, P., Lembo, G., F., G., 2013. Protocol for litter data collection during the MEDITS trawl surveys. Rapp. Comm. Int. Mer Medit. 40.

Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A., Narayan, R., Law, K.L., 2015. Plastic waste inputs from land into the ocean. Science 347, 768-771.

Palatinus, A., Kovač Viršek, M., Robič, U., Grego, M., Bajt, O., Šiljić, J., Suaria, G., Liubartseva, S., Coppini, G., Peterlin, M., 2019. Marine litter in the Croatian part of the middle Adriatic Sea: simultaneous assessment of floating and seabed macro and micro litter abundance and composition. Mar. Pollut. Bull. 139, 427–439.

Pasquini, G., Ronchi, F., Strafella, P., Scarcella, G., Fortibuoni, T., 2016. Seabed litter composition, distribution and sources in the northern and central Adriatic Sea (mediterranean). Waste Manag. 58, 41e51. https://doi.org/10.1016/ j.wasman.2016.08.038.

Renzi, M., Čižmek, H., Blašković, A., 2019. Marine litter in sediments related to ecological features in impacted sites and marine protected areas (Croatia). Mar. Pollut. Bull. 138, 25–29.

Romeo, T., Battaglia, P., Pedà, C., Consoli, P., Andaloro, F., Fossi, M.C., 2015b. First evidence of presence of plastic debris in stomach of large pelagic fish in the Mediterranean Sea. Mar. Pollut. Bull. 95, 358–361.

Setälä, O., Fleming-Lehtinen, V., Lehtiniemi, M., 2014. Ingestion and transfer of microplastics in the planktonic food web. Environ. Pollut. 185, 77–78.

Sheavly, S.B., Register, K.M., 2007. Marine debris & plastics: Environmental concerns, sources, impacts and solutions. Journal of Polymers and the Environment 15, 301-305.

UNEP/MAP, 2015. Marine Litter Assessment in the Mediterranean 2015, in: United Nationals Environmental Program/ Mediterranean Action Plan (Ed.), Athens.

Villarrubia-Gómez, P., Cornell, S.E., Fabres, J., 2018. Marine plastic pollution as a planetary boundary threat – The drifting piece in the sustainability puzzle. Marine Policy 96, 213-220.