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4.2.2 - 2 shellfish farming involved in the collection of ML according prescribed methodology

ACT 4.2

WP 4

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PROJECT MARLESS

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CONTENT:

1. Introduction.....	4
1.1. Overall objective	4
2. Deliverable methodology	5
2.1 Stakeholder engagement – Community of practice concept.....	5
2.2 WHERE: Deliverable location description	6
2.3 WHO: Shellfish farmers involved	6
2.4 HOW: Clean-up actions.....	6
2.5 Deliverable data analysis.....	9
3. Summary	12

1. Introduction

1.1. Overall objective

Deliverable 4.2.2 (D4.2.2) is part of work package 4 (WP4), which specific objective was to involve local communities, local and regional authorities, decision makers, educational and scientific institutions, tourism sector, fisheries and maricultural sector, port authorities and environmental NGOs to prevent, compensate and even improve the state of environment. Actions to tackle the problem of litter in our sea and coast included educational programs and promotion of the more active involvement through clean-up activities.

Through awareness campaigns on marine litter management and environmental education activities addressed to students, operators in agriculture, fishing, and touristic sectors as well as to all the citizens and public decision makers, the achieved outputs of the WP4 are:

- Increase of pro-environmental behaviours and responsibility toward marine litter management among the entire population, with specific focus on target groups directly addressed in WP activities thanks to social events such as thematic hackathon events, itinerant exhibitions, contests etc.
- Enhancement of youth engagement in Marine Litter phenomenon thanks to the creation of a 2- step education methodology that will be applied within schools located in the project intervention area through the realization of clean-up activities where Italian and Croatian students and their families will be involved
- Improvement of local governance processes related to marine litter management through the realization of “coastal agreements” signed by public and private coastal actors for the implementation of shared policies on marine litter management based on shared knowledge, expertise, and best practices.

D4.2.2 is part of activity 4.2 (ACT4.2) with a goal *to sensitise the touristic sector* by actively involving stakeholders, namely for this deliverable *the shellfish farmers*, in the marine litter assessment and by applying preservation measures proposed according to data analysis deriving from WP3. Assessment on the quantity and composition of marine litter is also successfully implemented, which gives a clear overview of the specific marine litter fractions coming from the aquaculture sector, to be tackled with adequate solutions. Inclusion of shellfish farmers gives an important overview and statement considering the waste fractions in sea, deriving from this industry.

The deliverable structure is organised through the description of the background idea for stakeholder engagement where Community of practice (CoP) concept has been used, the choice of the exact location for the deliverable implementation, description of stakeholders i.e., shellfish farmers involved, and nevertheless the clean-up actions held with the marine litter data analysis.

2. Deliverable methodology

2.1 Stakeholder engagement – Community of practice concept

The main concept used for mobilization of stakeholders through the MARLESS project was the idea of a Community of Practice (CoP). This well-practiced method has become known through the research and publications of Lave and Wenger (1991), Wenger (1998) and Wenger-Trayner (2010, 2014). It is defined as a voluntary group of people who, sharing a common concern or a passion, come together to explore joint ideas, repertoire of resources, experiences, and stories. The concept has displayed a very useful perspective on learning, considering the human nature – the need to collaborate, interact and exchange knowledge inside the group of people with similar mindset. In the case of the MARLESS community, the passion connecting the stakeholders is marine environment protection and joint effort to solve the marine litter problems.

CoP for the Dubrovnik Neretva Region area, under the Regional agency DUNEA coordination, goes under the name *Community of Practice for marine litter problem in Dubrovnik Neretva County* and is a group of people acting on a regional level, created in collaboration with another EU project called SeaClear. SeaClear project plans to develop the first system of autonomous aircraft, submarines, and surface vessels to find and collect waste from the seabed and water column. The aim of the project is to control robots autonomously, without remote human intervention, and for this purpose an innovative system for mapping, classification and control of robots is implemented. These features are presented in three pilot areas where an autonomous robot system will be installed: one system for the purpose of cleaning the port with the end user of the Port of Hamburg, the other in the tourist area of Dubrovnik, near the island of Lokrum and in the Mali Ston Bay. Regional agency DUNEA coordinates the activities on the two pilot areas in Dubrovnik Neretva County. SeaClear project, fully entitled "Search, Identification and Collection of Marine Litter with Autonomous Robot", is financed in 100% from the European Union from the HORIZON 2020 program, through which more than six million HRK has been provided for the Dubrovnik Neretva County. It was applied for at the invitation of Information and Communication Technologies 2018-2020, the Science, and Innovation Funding Scheme (RIA), and out of a total of fifty-six applicants, it is one of four projects approved for funding.

As for the CoP, in order to be added in the stakeholder database and enter this specific network, each stakeholder was provided with an informational sheet and stakeholder consent form from. By reading all relevant project data in the information sheet and by signing the stakeholder consent form, person becomes the CoP member. By participating as a stakeholder in the MARLESS project, stakeholders were able to benefit from workshops and knowledge transfer between different sector participants, focusing on the same issues – marine litter problematics. They were also able to enjoy the information sharing on robotic topic, marine environment, and tourism/waste management issues among people with similar mindset. In order to respect the GDPR rules, stakeholders were informed in the informational sheet that the personal data collected will only be used for the purpose of the MARLESS project within the project consortium and the European Commission, and will not be disclosed to any external sources. Stakeholders were able to request modification or removal of the data at any time with a short request to CoP coordinator.

Data were used in accordance with Directive of European Parliament and of the Council on the protection of natural persons regarding the processing of personal data by competent authorities for the purposes of the prevention, investigation, detection or prosecution of criminal offences or the execution of criminal penalties, and on the free movement of such data, and repealing Council Framework Decision 2008/977/JHA (2016). CoP coordination meetings were organized by Regional Agency DUNEA, upon project activities dynamics, following deliverable and activities plan foreseen by the Grant Agreement.

Through work of this CoP community, it was concluded that Mali Ston Bay and marine litter situation in that area need a special attention, thus Regional agency DUNEA continued this initial idea through shellfish farmers inclusion and clean-up actions organised.

2.2 WHERE: Deliverable location description

In the D4.2.2, Regional agency DUNEA decided to involve mariculture sector and shellfish farmers from Mali Ston Bay. Mali Ston Bay is a specific area in the Dubrovnik Neretva County, enclosed by Pelješac peninsula on one side and mainland on the other side, with unique properties of its ecosystem - mildly eutrophic, making it perfect for the shellfish industry. This area is the main mariculture site for European flat oyster (*Ostrea edulis*) exploitation since ancient times, with the first written records of farming dating back to the 16th century. It is one of the few remaining sanctuaries of this oyster species in Europe, with no recorded instances of shellfish diseases to date - culpable for mass mortalities and utter devastation of other European culture sites and natural populations. For this reason, Mali Ston Bay is nowadays responsible for around 85% of total Mediterranean production of the European flat oyster and may be key to future European flat oyster restoration attempts in the Mediterranean, in order to revive natural populations of this environmentally and economically valuable species. Technologies of cultivating oysters have changed over the years, with an increased use of plastic materials in the last 50 years. Initially, oysters were cultured suspended on ropes hanging from fixed wooden structures, of which some were later replaced with steel rails. Today, both can be found in the bay, although the majority of farms now use floating longlines attached to plastic buoys with oysters suspended on ropes. Mussel (*Mytilus galloprovincialis*) farming was also popularized and performed in a similar fashion, although suspending mussel stockings or “pergolas” instead of ropes on the floating longlines. Different plastic substrates (e.g., nets, ropes, cups, etc.) have been used for collecting wild spat of both aforementioned species from the wild for stocking farms. Because of this specific gastronomy and nature experience,

Mali Ston Bay is a famous tourist destination. According to Dubrovnik Neretva County Tourist Board database, tourism data for this area, Pelješac peninsula with Ston, Janjina, and Dubrovačko Primorje municipalities, in the six-year period from 2014 to 2019, counts a total of approximately 250 000 visitors (arrivals at the destination), with an average of 40 000 visitors per year.

Mali Ston Bay is heavily affected by marine litter, although paradoxically, mainly that originating from sea, i.e., aquaculture and fisheries activities. The culture equipment used in shellfish farms is suspended in the water column from floating longlines and so is prone to snapping and falling to the seafloor during extreme weather conditions, or is just discarded in the sea due to bad management practices (intentionally or unintentionally). Since the bay is not generally prone to bad weather conditions, most farmers do not prepare for tidal waves and similar sudden destructive meteorological events that are rare but do occur occasionally. These have been shown to have devastating effects on the industry, destroying and sinking entire farms. Keeping in mind the long history of aquaculture in this area and recent increased use of non-degradable materials, it is not difficult to imagine the amounts of marine litter that clutter the seabed and are an ever-growing issue in this area. Thus, there is a higher frequency of litter around existing farms and locations with high water currents that concentrate layers of waste materials by carrying and snagging them on man-made and/or natural outcroppings. In addition, general locally-sourced marine litter originating from land is a common occurrence in the bay, especially around settlements.

2.3 WHO: Shellfish farmers involved

Regional agency DUNEA involved the shellfish farmers from the Mali Ston Bay area, through our collaboration with FLAG “Južni Jadran.” Two shellfish farmers were involved and gave permission for clean-up actions to be held on their concession areas, where they have their oyster and mussel farms:

- ✓ Shellfish farm MUŠULA
- ✓ Shellfish farm MAŠKARIĆ-SIGE

Their main work scope is shellfish farming, with mussels and oyster being the main products. Both farms fall under small and medium-sized enterprises.

2.4 HOW: Clean-up actions

In the 12 months period, for the calendar year of 2022, two clean-up actions were successfully implemented, one in the summer period and one in the winter period. The main actors of the clean-up actions were divers from Divers club Dubrovnik (Ronilački klub Dubrovnik), who managed to collect the huge amounts of litter from the sea bottom in Mali Ston. Details in Table 1 and Table 2.






1st clean-up action – Bistrina – ŠKOLJKARSTVO MUŠULA	
DATE	14.06.2022.
LOCATION	Bistrina bay – shallow, coastal area in front of University of Dubrovnik scientific concession location, concession of Matković shellfish farm – MUŠULA.
TRANSECT SIZE	Approx. 3000 m ²
NUMBER OF DIVERS	6
CLEAN-UP DURATION	1 hour
TOTAL AMOUNT OF ML COLLECTED	206,73 kg
TOTAL NUMBER OF ITEMS COLLECTED	354 items
SHORT DESCRIPTION	<i>1st clean-up action – summer period of 2022 in Regional agency DUNEA organization, with expert University of Dubrovnik collaboration and support from Nature history museum Dubrovnik. In one-hour period, 6 divers from RK Dubrovnik collected more than 200 kg of marine litter specific fractions, mostly from mariculture activities of the area, i.e., of sea origin. The collected marine litter was submerged and found on the seafloor. Divers collected the litter from the bottom in mesh nets, after which they were pulled out at the land. The main item found were plastic pergolars - shellfish farming "socks" used in oyster and mussel farming. Altogether more than 67 kg of wet weight belonged to this item fraction.</i>
PICTURES	    

Table 1: General details for 1st clean-up action – Bistrina – ŠKOLJKARSTVO MUŠULA

2nd clean-up action – Mali Ston – ŠKOLJKARSTVO MAŠKARIĆ-SIGE	
DATE	24.11.2022.
LOCATION	Mali Ston area – shallow, coastal area belonging to Maškarić family concession, shellfish farm MAŠKARIĆ-SIGE.
TRANSECT SIZE	Approx. 3000 m ²
NUMBER OF DIVERS	5
CLEAN-UP DURATION	1 hour
TOTAL AMOUNT OF ML COLLECTED	217,75 kg
TOTAL NUMBER OF ITEMS COLLECTED	83 items
SHORT DESCRIPTION	<i>2nd clean-up action – winter period of 2022 in Regional agency DUNEA organization with support from University of Dubrovnik, Public institution for nature protection of Dubrovnik Neretva County, Nature history museum Dubrovnik and Municipality Ston. In one-hour period, 5 divers from RK Dubrovnik collected more than 200 kg of marine litter specific fractions, mostly from mariculture activities of the area, i.e., of sea origin. The collected marine litter was submerged and found on the seafloor. Divers collected the litter from the bottom in mesh nets, after which they were pulled out in small boats and pulled at the land. The main item found were plastic pergolars - shellfish farming "socks" used in oyster and mussel farming. Altogether more than 105 kg of wet weight belonged to this item fraction.</i>
PICTURES	   

Table 2: General details for 2nd clean-up action – Mali Ston – ŠKOLJKARSTVO MAŠKARIĆ-SIGE

2.5 Deliverable data analysis

Two clean-up actions held, gave a clear overview of marine litter pollution in the area of Mali Ston Bay. After the clean-up actions, all waste fractions have been identified, divide by composition and characterised. The collected marine litter fractions were primarily divided by origin, if it was inland or sea origin, meaning from human activities conducted at land or from sea activities, such if for example mariculture. For every fraction, wet weight in kilograms has been measured on a digital scale.

The division by composition was deducted in seven categories:

- artificial polymer materials,
- rubber,
- cloth/textile,
- paper,
- wood,
- metal,
- glass/ceramics.

Items were also categorised by approximate size in centimetres in six size range classes for each recorded litter item, as follows:

- A. < 5cm*5cm = 25cm²;
- B. < 10cm*10cm = 100cm²;
- C. < 20cm*20cm = 400cm²;
- D. < 50cm*50cm = 2500cm²;
- E. < 100cm*-100cm = 10000cm² = 1m²;
- F. > 100cm*100cm = 10000cm² = 1m².

As for 1st clean-up action – Bistrina – ŠKOLJKARSTVO MUŠULA:

In this summer period clean-up, altogether 206,73 kg of waste was pulled out of the sea bottom on transect size of approx. 2000 m², counting 354 items in total, composed of plastic, glass, rubber and metal. Considering analysis by origin, majority of items was connected to the mariculture activities of the area, i.e., of sea origin, and the main item collected were plastic pergolars - shellfish farming "socks" used in oyster and mussel farming with more than 67 kg of wet weight belonged to this item fraction. Details on the waste composition the Chart 1.

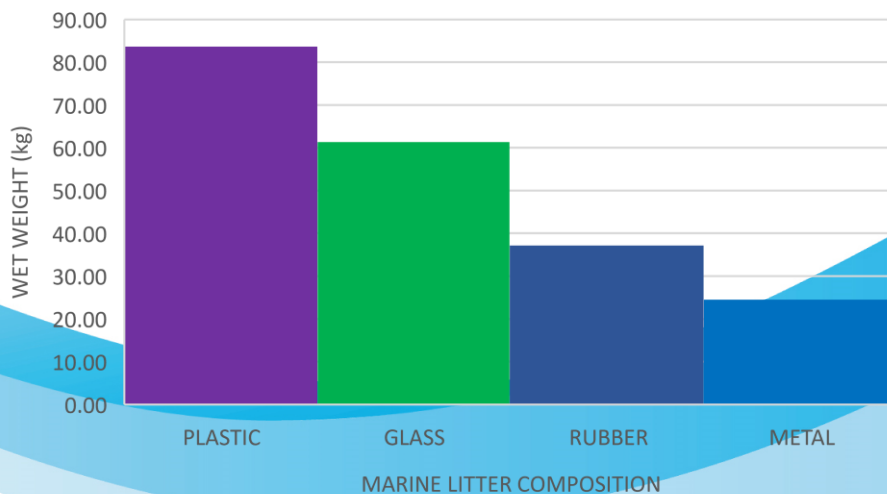


Chart 1: Wet weight (kg) of marine litter collected, divided by composition for 1st clean-up action – Bistrina – ŠKOLJKARSTVO MUŠULA

Considering the total number of items collected, the most numerous waste fraction was glass, counting total of 244 items, followed by plastic items counting 55 items. Details presented in the Chart 2.

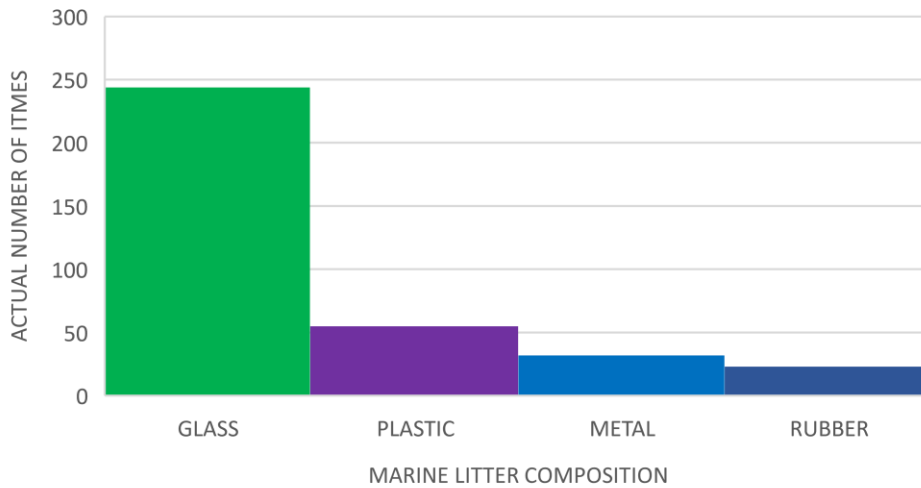


Chart 2: Actual number of items of marine litter collected, divided by composition for 1st clean-up action – Bistrina – ŠKOLJKARSTVO MUŠULA

As for 2nd clean-up action – Mali Ston – ŠKOLJKARSTVO MAŠKARIĆ-SIGE:

In this winter period clean-up, altogether 217,75 kg of waste was pulled out of the sea bottom on transect size approx. 3000 m², counting 83 items in total, composed of plastic, glass, rubber and metal. Considering analysis by origin, majority of items was connected to the mariculture activities of the area, same as for the 1st clean-up action. The main items collected were also plastic pergolars - shellfish farming "socks" used in oyster and mussel farming with more than 105 kg of wet weight. Details on the waste composition the Chart 3.

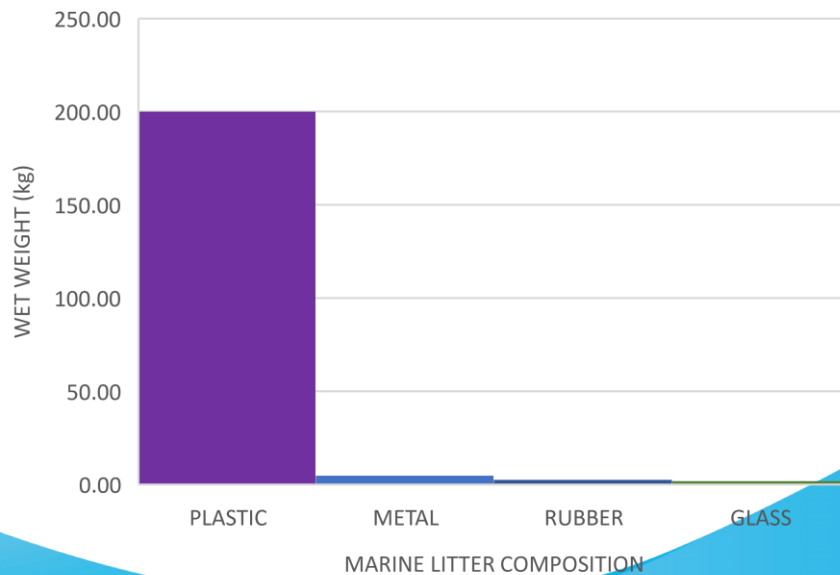


Chart 3: Wet weight (kg) of marine litter collected, divided by composition for 2nd clean-up action – Mali Ston – ŠKOLJKARSTVO MAŠKARIĆ-SIGE

Considering the total number of items collected, the most numerous waste fraction was plastic, counting total of 83 items. The most numerous waste fraction was also plastic, counting 63 items and only 10 glass fraction items. The most numerous were smaller round plastic crates (15 items) and bigger square plastic crates (20 items), all items used in shellfish farming. These fractions were in a really good condition, only covered in biofouling, with high potential to be reused. Details presented in the Chart 4.

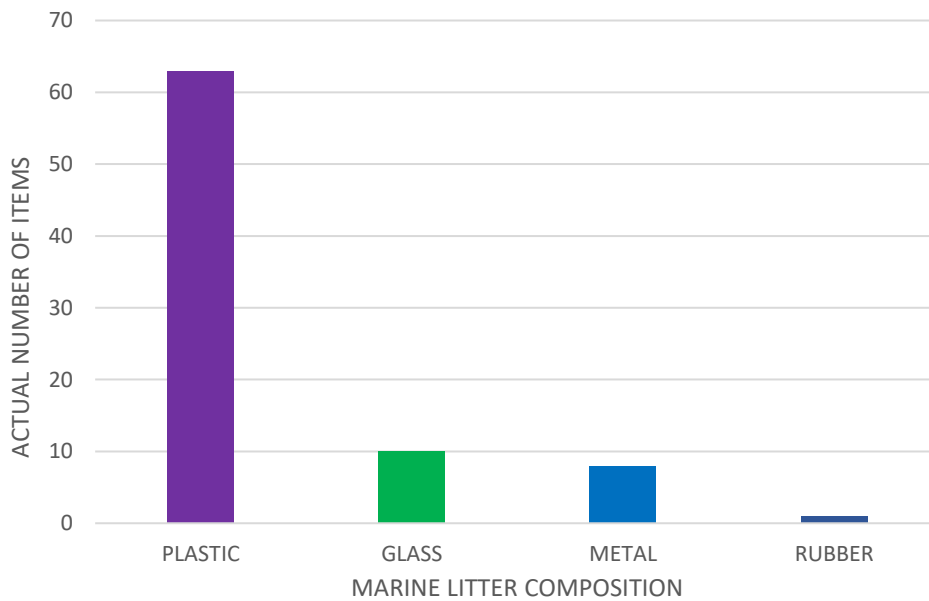


Chart 4: Actual number of items of marine litter collected, divided by composition for 2nd clean-up action – Mali Ston – ŠKOLJKARSTVO MAŠKARIĆ-SIGE

3. Summary

The choice for the involvement of shellfish farmers from the Mali Ston Bay area, gives a special addition to the project content with an overview of specific marine litter fractions derived from the shellfish industry sector, involving the Mali Ston Bay area of the utmost importance as the biggest marine reserve in the region, and with the inclusion of this specific and important stakeholder group. Mariculture holds a huge part in tourism offer of the Dubrovnik Neretva County area, thus the insight of the situations and the problems coming from mariculture sector angle, highly contribute to the project conclusions and widen the project perspective in the tourism sector, while the stakeholders from the hospitality sector are heavily covered by other regions.

Regional agency DUNEA mobilised stakeholders through specific concept of Community of practice for the relevant area of Dubrovnik Neretva County. Since marine litter deriving from mariculture industry of the area has been identified as one of the major ecological issues of the area, DUNEA organised in total two clean-up actions in Mali Ston Bay, one in summer and one in winter period, both highly supported by University of Dubrovnik. Submerged marine litter was collected by divers from the sea floor and analysed for each action. Through these two actions, total of 424,48 kg of wet weight was measured, counting altogether actual number of 437 items collected. In conclusion, the main waste fraction were pergolars - shellfish farming "socks" used in oyster and mussel farming, measuring more than 172 kg of wet weight. With this we can conclude, that an action offering solution of alternative option for this item to be used in mariculture would be crucial. Also, the majority of plastic items collected, such are plastic crates, were not damaged, only covered in biofouling, thus reuse and upcycling of these items would be highly beneficial and would give a clear solution for circular economy in mariculture industry.