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Black Sea
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Marine Litter Status on Black Sea shore through Citizen Science

Common borders. Common solutions.

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Acronyms

NGO	Non-governmental organization
NIRMD	National Institute for Marine Research and Development “Grigore Antipa”
IO-BAS	Institute of Oceanology "Fridtjof Nansen", Bulgarian Academy of Sciences
UkrSCES	Ukrainian Scientific Centre of Ecology of the Sea
TUDAV	Turkish Marine Research Foundation
TUBITAK	TÜBİTAK Marmara Research Center
MSFD	Marine Strategy Framework Directive
GES	Good Environmental Status
WFD	Water Framework Directive
RRI	Responsible Research and Innovation
GPS	Global Positioning System
MML	Mobilisation and Mutual Learning
CS	Citizen Science
POPs	Persistent Organic Pollutants
EDCs	Endocrine Disruptor Chemicals
UNEP	United Nations Environment Programme
MEPs	Members of the European Parliament
MARPOL	The International Convention for Prevention of Marine Pollution for Ships

Executive summary

This report is part of the ANEMONE project ("Assessing the vulnerability of the Black Sea marine ecosystem to human pressures"), BSB-319, funded by the Joint Operational Programme Black Sea Basin 2014-2020.

The present document presents the results of the marine litter case studies conducted in Bulgaria, Romania, Turkey and Ukraine, in 2019, spring and autumn sessions. The results of these studies, implemented with the help of citizens, on beach litter represent the ground of the educational and awareness raising campaigns focusing on real data collected from the field, analyzed and transposed

Within ANEMONE project was made a step forward in filling the scientific research gap regarding real situation of marine litter at the Black Sea and made this topic more accessible and understandable for the citizens, which represent the general public and the ones who comes in contact with the real situation.

The main aim of the project was to develop a joint Black Sea monitoring strategy using the most appropriate assessment criteria and indicators to evaluate the status of the Black Sea as a basis for future action. This project offered a very good framework to implement Citizen Science at the Black Sea basin level. The project provided such rare opportunities which will contribute to the overall research effort for marine litter monitoring in the Black Sea. Was a perfect opportunity to combine scientific activities with awareness ones.

The case studies provide scientific data that are uploaded in European and international databases for scientific purposes. The results of these studies, implemented with the help of citizens, represent the ground of the educational and awareness-raising campaigns focusing on real data collected from the field, analyzed, and transposed for public acknowledge. The direct involvement of the citizens in the marine litter monitoring process raises awareness of the current issue in a scientific way. Citizens are the main actors, contributing to raising awareness of this issue, but also to changing local communities. The direct involvement of the citizens in the beach monitoring actions raises awareness of the current issue in a scientific way, diminishing the effect of media news, that presents only sides of reality.

This deliverable presents also some measures and action that can be implemented by different stakeholders, in order to reduce the impact of marine litter, on short, medium or long term, with financial support and without it.

Citizen Science is a very important aspect and useful resource these days, and the added value brought by citizens for science, research and policy, will represent an essential step made to have the actions carried out focused on the real needs of the community. In this document are presented the ways citizens were involved in the marine litter case studies, how they contributed at the results obtained and how they can be involved in the future in different activities.

1 Marine Litter - general aspects

Marine litter can be defined as any persistent manufactured or processed solid material that is discarded, disposed of or abandoned in the marine and coastal environment. It is waste produced by human activities either on land or at sea, finding its way into the marine environment.

- Common materials that make up marine litter include plastics, rubber, paper, metal, wood, glass, cloth, etc. and can be found floating on the sea surface, drifting in the water, washed up on beaches or lying on the seabed.
- Litter that is buoyant and/or easily blown away is more likely to end up in the sea. Not all litter is buoyant, and some will sink out of sight.
- Marine litter may be visible to the human eye (macro-litter), hardly visible or even invisible (micro-litter).
- The rate at which certain litter items degrade indicates how long they remain intact or "age" in the marine environment.
- One way to classify marine litter is by the type of activity that generated it in the first place. For example, fishing, shipping, illegal dumping, smoking, etc.
- Litter items may differ in their potential impact on the environment and wildlife; some litter items are much more harmful than others (Alampei et al, 2014).

Marine litter comes mainly from land-based practices, such as:

- Inappropriate waste disposal at home.
- Inadequate waste management at all stages: collection, transportation, treatment and final disposal.
- Discharge of untreated municipal sewage, either due to the lack of treatment plants or due to heavy storms.
- Irresponsibly discharged industrial waste which may contain e.g. scrap from the production process, packaging or raw material, plastic resin pellets, as well as untreated wastewater.
- Tourism and recreational activities that fill beaches with cigarette butts, plastic bags, food packaging, beverage cans, cartons, toys, etc. Many beach goers leave behind much more than their footprints in the sand.

Litter from land-based sources finds its way to the sea via rivers, drains, sewage outlets, storm water outflows or when blown by winds, or even swept with the tide (Alampei et al, 2014).

Nevertheless, sea-based activities can also be important sources, such as:

- Commercial fishing that disposes of fishing related waste (fishing gear, nets, etc.), litter accidently caught in their nets, etc.
- Merchant and leisure shipping (large cargo ships, cruise liners, ferries, etc.) that disposes of sewage, lost cargo, etc.
- Recreational shipping (small boats used e.g. for fishing, yachting and water sports) that disposes of litter items e.g. bottles & tins, sewage, fishing and sports gear, etc.
- Offshore oil and gas platforms that dispose of drilling equipment, pipes, storage drums, packaging items, etc.
- Aquaculture fisheries that dispose of net cages, construction materials, feed sacks, etc.

Moreover, litter produced on board often ends up in the sea. Inadequate management facilities on ships, in ports and marinas make the problem worse (Alampei et al, 2014).

It is important to recognize that the origin, drift and fate of litter will be influenced by a range of factors including rainfall, riverine transport, water currents, winds and geomorphology, as well as the durability and persistence of the litter. Hence, while litter can accumulate near the source of entry to the ocean, it can also travel substantial distances and may end up far away from the point of entry, both space and time (Alampei et al, 2014).

1.1 Marine litter in Black Sea

The Black Sea is one of the most isolated inland seas in the world, with a surface area of approximately 430,000 km^2 and a volume of about 540,000 km^3. The total length of the coastline is about 4,200 km. The estimated total catchment area of the Black Sea drainage basin is approximately 2,000,000 km^2 covering partially or entirely the territories of 22 countries. The Black Sea is boarded by six countries (Bulgaria, Georgia, Romania, Russia, Turkey, and Ukraine) and the coastal population is estimated at about 18 million (UNEP, 2009).

The marine litter problem is closely linked to major problems of public health, conservation of the environment and sustainable development in the Black Sea region. Marine litter originates from various land and sea-based sources as a result of diverse human activities, and evidently causes a wide variety of negative impacts on the human population, wildlife, landscape and some sectors of the economy. Floating litter and items suspended in the water column are transported by currents and winds across maritime borders and throughout the sea to become a basin-wide problem (UNEP, 2009).

Solid waste management is one of the main environmental problems in the Black Sea region. Most uncontrolled coastal landfills and dumping sites are not protected from waves and thus serve as stationary sources of unknown (but admittedly large) quantities of marine litter. The continuing accumulation of solid wastes on the coast may cause an increase in marine litter when the wastes are carried from the dumps into the sea by erosive factors such as waves, rains and winds. Sea currents and winds also play a role in the transport and dissemination of floating litter. Therefore, land-based solid wastes continue to constitute the major component of marine litter for the Black Sea overall. This problem most likely represents a transboundary concern in the region (UNEP, 2009).

In Black Sea region, marine litter (Figure 1.1) comes mainly from land and sea-based practices, representing the human impact on ecosystems. Most of these marine litters are produced by tourists, economic activities undertaken in the beach area, but also by the harbor activities and heavy traffic of ships.

Figure 1.1 – Marine litter on Romanian southern beaches (2014)

Black Sea has the following specificities which worsen the impacts of marine litter and render the issue of tackling it a great challenge:

Rivers:

- The largest rivers flowing into the Black Sea (Figure 1.2) are the Danube, the Dnieper, the Don, the Dniester, the Kuban, the Southern Bug, the Rioni, the Kizil—Irmak and the Kamchia rivers.

- The Danube River flows into the sea in the northern part of the Romanian coast, here being brought most of the waste collected throughout the river from various tributaries in 10 European countries.
- The main contribution to pollution of the marine environment belongs to the largest rivers of Ukraine - the Danube, the Dnipro River, as well as the Dniester and Southern Bug. In general, at least 60 rivers flow to the Black Sea from the Ukrainian part. The basins of large rivers cover a large part of the country's regions, in which hundreds of thousands of people live. Each year, the waters of the rivers of Ukraine to the Black Sea comes 653 thousand tons of suspended matter, more than 8 thousand tons of organic substances (National report 1996-2000).
- The Kizilirmak river, in central Turkey flows into the Black Sea, being the longest river to originate in Turkey and reach the sea on the Turkish shore. Yesilirmak, in central Turkey, and Sakarya, in the northwest, are other rivers that flow directly into the sea (Rashid, 2002).

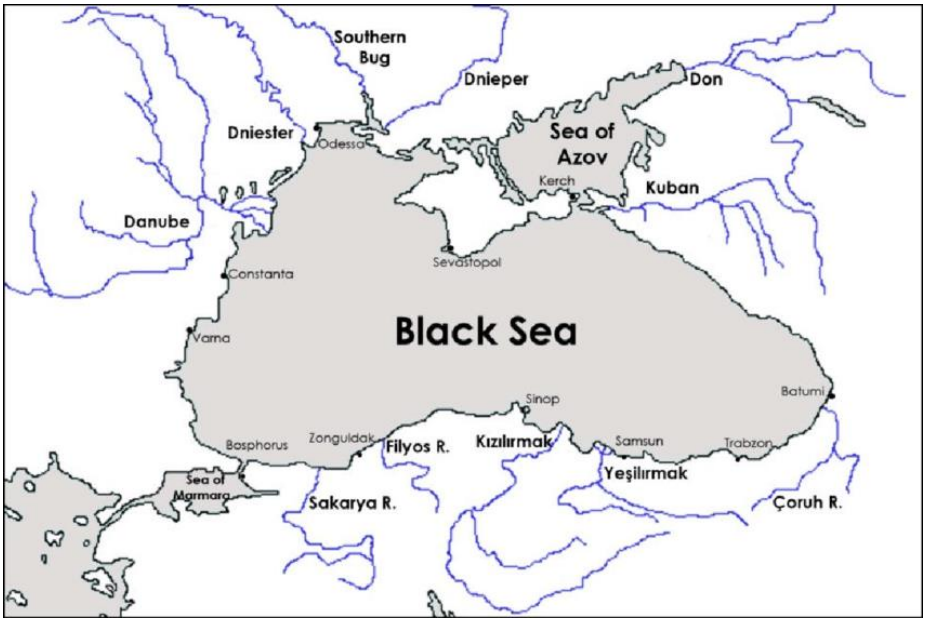


Figure 1.2 - Map of rivers flow into the Black Sea[1]

Tourism activities:

- All the coastal areas are exploited for tourism activities in all riparian countries.
- Millions of tourists are coming every year in all the countries around Black Sea.
- Hotels and commercial establishments built close to the beach and near to the marine environment.
- The lack of an adequate waste management system.

Ports:

- Tourist ports and commercial ports are situated along the coasts in all riparian countries.
- In the Black Sea exist a large number of commercial ports of different categories (small, medium, large and important) which ensure the transfer and the processing of the goods and raw materials (Bosneagu, 2018).
- In the Black Sea basin, in all six riparian countries are 54 sea and river ports (Bosneagu, 2018).

Others:

- Mentality of the people. People expect public service to clean areas of common usage such as parks and beaches. It will be important for each individual to understand the marine litter problem and change her/his attitude to improve the situation.
- Low ecological consciousness of citizens.

[1] Source: https://www.researchgate.net/figure/Map-of-rivers-flow-into-the-Black-Sea_fig1_234128754

- Pollution from agricultural land.

The impact caused by marine litter have to do with the prevailing production and consumption patterns, because the more we consume, the more waste we produce, as well as with our attitudes.

One of the main management problems affecting most Black Sea countries consists in the lack of ability to apply the existing laws and regulations. Being declared once, they should be implemented in proper way, but often this is not the case (UNEP, 2009).

Marine debris left on beaches for a long time is a danger to birds and other animals that can ingest them. Moreover, there is a risk that their decomposition will release harmful pollutants to human health. Litter as syringes, diapers, pads are carriers of pathogens. Unless appropriate measures are undertaken to address this problem, the abundance of marine litter in the area is likely to increase. Just as multiple initiatives are needed to tackle the marine litter problem, diverse approaches are required to monitor the abundance of marine litter and how this affect marine environments (Paiu et al, 2017).

1.2 Legislation in force for the Black Sea

a) The Marine Strategy Framework Directive (2008/56/EC) aims to achieve Good Environmental Status (GES) of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. It is the first EU legislative instrument related to the protection of marine biodiversity, as it contains the explicit regulatory objective that "biodiversity is maintained by 2020", as the cornerstone for achieving GES (EC, 2008). The directive establishes a framework, within which member states shall take necessary measures to achieve or maintain good environmental status (GES) in the marine environment by 2020. Marine litter is listed as the tenth of 11 qualitative descriptors for determining GES, which states that the properties and quantities of marine litter do not cause harm to the coastal and marine environment. Of the 11 descriptors listed in Annex I of the MSFD for determining GES, descriptor 10 has been defined as 'Marine litter does not cause harm to the coastal and marine environment'. Commission Decision EU 2017/848 identify the following criteria for Descriptor 10:

    - Criteria D10C1 – Primary - The composition, amount and spatial distribution of litter on the coastline, in the surface layer of the water column, and on the seabed, are at levels that do not cause harm to the coastal and marine environment.
    - Criteria D10C2 – Primary - The composition, amount and spatial distribution of micro-litter on the coastline, in the surface layer of the water column, and in seabed sediment, are at levels that do not cause harm to the coastal and marine environment.
    - Criteria D10C3 – Secondary - The amount of litter and micro-litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned.
    - Criteria D10C4 – Secondary - The number of individuals of each species which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects.

    Perhaps the most relevant is the Marine Strategy Framework Directive (MSFD), the environmental pillar of the EU Integrated Maritime Policy. This directive is an integral policy instrument for the protection of the marine environment for the European Community, following an ecosystem-based, adaptive and integrated approach to the management of human activities, which have an impact on the marine environment (MARLITER SOD, 2019).

b) The Waste Framework Directive (2008/98/EC) has already opened the way to a new thinking on waste management. It establishes an extensive liability of the manufacturer and describes powerful and innovative factors to stimulate sustainable production, taking into account the whole life cycle of products. Member States are encouraged to adopt legislative and non-legislative measures to reinforce reuse and prevention, recycling and other waste recovery operations. Manufacturers should be encouraged to engage in the creation of end-of-life acceptance points. They can engage in waste management and assume financial responsibility for the activity (MARLITER SOD, 2019).

c) The Packaging and Packaging Waste Directive has the potential to have a high impact on marine litter, given that packaging comprises a large proportion of marine litter (more than half of the plastic fraction of marine litter is composed of plastic packaging waste such as bottles and bags (European Commission, 2013b). With regards to plastic in particular, full implementation of the Packaging Directive by the Member States is important to close loopholes in the plastic packaging cycle and should have significant benefits for the quantities of marine litter generated. The addition of a specific mention of marine litter/the marine environment to the Directive could be considered to ensure that the importance of the issue is acknowledged. Another policy option would be to increase the recycling targets for packaging waste (in particular plastics) (MARLITER SOD, 2019).

d) The European Strategy for Plastics in a Circular Economy adopted on January 2018 will transform the way plastic products are designed, used, produced and recycled in the EU. Better design of plastic products, higher plastic waste recycling rates and more and better quality recycles will help boosting the market for recycled plastics. It will deliver greater added value for a more competitive, resilient plastics industry. By 2030, all plastics packaging should be recyclable (MARLITER SOD, 2019).

e) In March 2019, the European Parliament agreed on the rules on Single-Use Plastics items and fishing gear, addressing the ten most found items on EU beaches that place the EU at the forefront of the global fight against marine litter. They are part of the EU Plastics Strategy - the most comprehensive strategy in the world adopting a material-specific lifecycle approach with the vision and objectives to have all plastic packaging placed on the EU market as reusable or recyclable by 2030. The Single-Use Plastics Directive adopted by the European Parliament is an essential element of the Commission's Circular Economy Action Plan as it stimulates the production and use of sustainable alternatives that avoid marine litter. The main measures included are:

   - A ban on selected single-use products made of plastic for which alternatives exist on the market: cotton bud sticks, cutlery, plates, straws, stirrers, sticks for balloons, as well as cups, food and beverage containers made of expanded polystyrene and on all products made of oxo-degradable plastic.
   - Measures to reduce consumption of food containers and beverage cups made of plastic and specific marking and labelling of certain products.
   - A 90% separate collection target for plastic bottles by 2029 (77% by 2025) and the introduction of design requirements to connect caps to bottles, as well as target to incorporate 25% of recycled plastic in PET bottles as from 2025 and 30% in all plastic bottles as from 2030 (MARLITER SOD, 2019).

f) The Landfill Directive potentially has a direct (although possibly limited) influence on marine litter, as it establishes technical requirements for the operation of landfills, to limit the final disposal of waste through landfill and to reduce the environmental impacts of landfill sites (MARLITER SOD, 2019).

g) The Water Framework Directive (WFD) requires all surface waters (including rivers, estuaries and coastal waters) to meet ‘good ecological status’. However, although rivers are a source of marine litter, litter is not a criterion of good ecological status. As a result, Member States are not directly required to take measures under the WFD to reduce the amount of litter in suspension in their rivers (MARLITER SOD, 2019).

h) The Bathing Water Directive aims to guarantee bathing water quality, which may be threatened by pollution. In particular, the Directive provides that bathing waters must be inspected visually for pollution such as tarry residues, glass, plastic, rubber or any other waste as part of the beach profile (MARLITER SOD, 2019).

i) The Urban Waste Water Treatment Directive regulates the discharge of sewage, industrial waste water and rainwater run-off with the aim of reducing pollution to freshwater, estuarial and coastal waters. Urban Waste Water is a source of marine litter including items such as sanitary towels, tampons, condoms, plastic cotton wool bud sticks, microplastics from cosmetics and fibres from clothes washing. It is also one of the main sources of litter in all regional seas (MARLITER SOD, 2019).

2 Marine litter case studies around Black Sea

2.1 General information about case studies

Marine litter is recognized as a worldwide rising pollution problem affecting all the oceans and coastal areas of the world (Galgani et al., 2015; Ryan, 2015; Thompson, 2015) and Black Sea is no exception. But, there is a lack of comparable and reliable data and are very limited data regarding the quantities and composition of marine litter in the Black Sea. In the last years, more and more organizations started to fight marine litter and implemented a variety of projects and actions in order to minimize the extent of this issue. "Assessing the vulnerability of the Black Sea marine ecosystem to human pressures" (ANEMONE) is looking to enhance knowledge and skills and the exchange of experience and good practices, innovation, harmonized methodologies and joint research.

The A.T.4 "Enhance stakeholders participation and public awareness on environmental issues" is the activity that foresees empowerment of citizens to participate in data collecting and monitoring. One case study is dedicated to marine litter that increased the milestone of the educational and awareness rising campaigns through direct involvement in environmental activities. The results of the study case, on beach litter represent the ground of the educational and awareness raising campaigns materials focusing on real data collected from the field, analyzed and transposed for public acknowledge. The activity enhances stakeholder's participation and public awareness on environmental issues enrolling the population in data collection, but also for continuing the awareness campaign through the results of the study and experiences of those who were actively involved.

The participating riparian countries: Bulgaria (Institute of oceanology – BAS), Romania (Mare Nostrum NGO), Turkey (Turkish Marine Research Foundation) and Ukraine (Ukrainian Scientific Center of Ecology of the Sea) organized two marine debris monitoring sessions: in spring (April) and autumn (October – November) of 2019.

Mare Nostrum NGO (Romania), the task leader, prepared and made available to partners a methodology and they had adapted it, having in mind each country specificity. In Romania were performed 16 surveys, 2 surveys in Turkey, 2 surveys in Bulgaria and 6 in Ukraine, having a total of 26 surveys around Black Sea (Figure 2.1). The data was collected with the help of citizen that were part of the public engagement workshops.

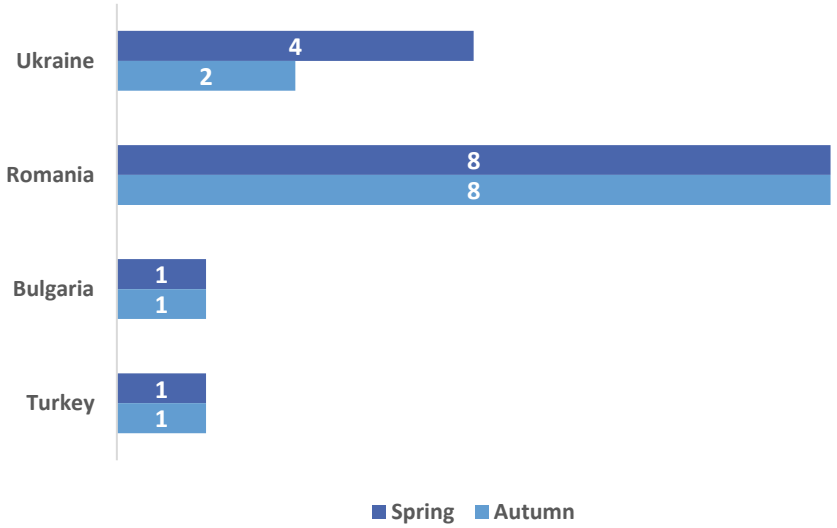


Figure 2.1 - Marine litter surveys around Black Sea – 2019

2.2 Marine litter case studies and citizen science

There is a growing recognition that members of the public represent a very important resource for finding out more about the environment, in their role as citizen scientists. There is a long tradition of citizen science volunteers in marine litter research (Hidalgo-Ruz and Thiel, 2013; Zettler et al., 2015). The main output of the activity is the citizen's involvement in scientific activities of data collection and parameters monitoring. The volunteer based involvement is an example of good practice that can be replicated every year and in other field areas. This commitment reduces costs and time dedicated to data collection from institutes and enhances the awareness of citizens related to marine issues.

The joint effort provides inter-connectivity between riparian Black Sea Countries, allowing more data to be shared and made public available. Thus, were organized around Black Sea partner riparian countries a set of workshops that followed the Public Engagement dimension of the responsible research and innovation (RRI) concept. The participants at these workshops that tackled marine litter had the opportunity to be involved in surveys.

In spring, 136 persons said yes to the challenge of monitoring Black Sea coasts in Bulgaria, Romania, Turkey and Ukraine and 112 in autumn, having a total of 248 participants (Figure 2.2).

The first survey in Turkey was attended by 39 people, including the project team (4 people). Some of the participants were part of the marine litter workshop, which was organized on 24 April by TUDAV. There were 13 male and 26 female participants, 4 of them were researchers, rest of them were students, teachers, citizens and from NGO's. For the second day, 4 people worked on sorting the plastics.

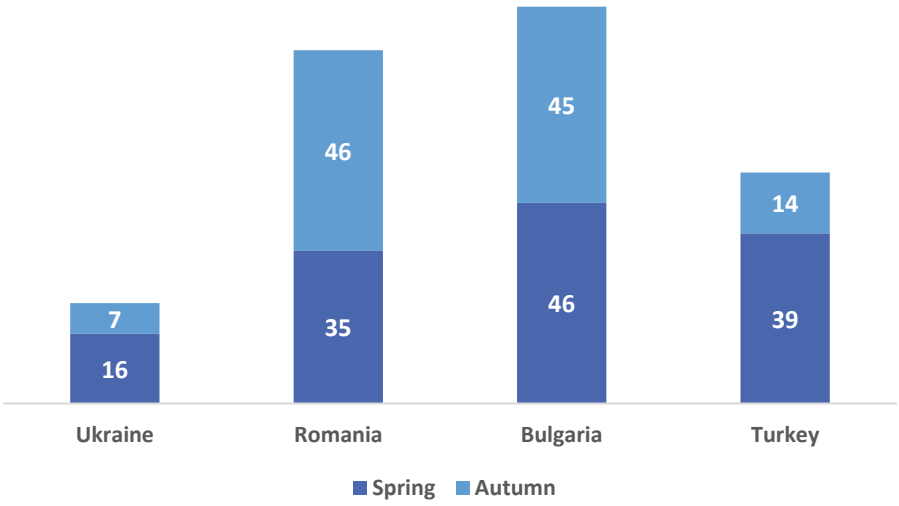


Figure 2.2 - Participants at the monitoring sessions

In Ukraine, there were 11 women and 5 men (monitoring experts – 2; scientists - 5, students – 9). In Romania, 24 persons of 35 were women and 11 men (project team, marine litter experts and volunteers).

The first monitoring session in Bulgaria was held with the help of 46 persons (37 women and 9 men). Participants were from the following organizations: Executive Agency Maritime Administration - Varna, Black Sea Basin Directorate – Varna, Executive Agency for Fisheries and Aquaculture – Varna, Varna Municipalty – Asparuhovo, Nessebar Municipalty – Ecology department, Bulgarian, Ports Infrastructure Company (BPI Co.), Technical university – Varna, Lyceum „Prosveta 1927" – Varna, IO-BAS - Varna, NGO "Green Bolkans" - Pomorie, NGO "Green Bolkans" – Stara Zagora, Black Sea NGO Network – Varna, "Via Pontica" Fondation – Burgas, Marine club "Balchik", Regional Historical Museum – Burgas, University "Prof. D-r Asen Zlatarov" - Burgas, „Black Sea University", independent experts, citizens, students.

The second survey took place in autumn and 112 persons joined. In Romania, 31 women and 15 men dedicated at least one day to monitor the 8 sectors. In Turkey, 13 people participated to the marine litter survey on the first day, including the project team (4 people). There were 7 female and 6 male participants. For the second day, 2 people worked on sorting the plastics. In Ukraine, 6 women and 1 man (monitoring experts – 2; scientists - 1, students – 4) had collected data on marine litter for one hour.

45 participants (35 women and 10 men) representing governmental organizations, universities, research institutes, NGOs and general public conducted the second survey in Bulgaria. Participants were from the following organizations: Executive Agency Maritime Administration - Varna, Black Sea Basin Directorate – Varna, Regional Inspectorate of Environment and Water – Varna, Regional Inspectorate of Environment and Water – Burgas, Executive Agency for Fisheries and Aquaculture – Varna, Varna Minicipalty – Asparuhovo, Nessebar Minicipalty – Ecology department, Technical university – Varna, Lyceum „Prosveta 1927“ – Varna, IO-BAS - Varna, IFR – Varna, NGO “Green Bolkans”, Marine club “Balchik”, Regional Historical Museum – Burgas, University "Prof. D-r Asen Zlatarov" - Burgas, „Black Sea University“, Bulgarian Society for the Protection of Birds, Association One nature, WWF, independent experts and citizens, students.

2.3 Beach litter monitoring methodology

Waste monitoring in coastal regions involves quantification of marine litter in order to support national and regional assessments, promoting the development of waste management, control measures and their implementation. It will also help us to understand the level of threats posed by marine litter to flora and fauna. The European Commission decision of September 1st 2010 on criteria and methodological standards on good environmental status of marine waters has established that marine litter should be evaluated.

Mare Nostrum NGO, as task leader, prepared a proposal of a beach litter monitoring methodology where were specified the main features that each partner must consider when designs its marine debris survey.

The methodology established:

The timeframe:

- Spring – April
- Autumn – Mid September – mid October

Preferably, monitoring should be carried out as soon as possible in a survey period for all the beach areas selected.

Monitoring and sampling units

Sampling units can be identified on the selected beach sectors. A sampling unit is a fixed section of the beach covering the entire area from the water's edge (where possible and safe) and the area where the sand ends and the asphalted / built-up part begins.

The monitoring will be done on a section of 100 m length, according to the sector's delineation, for the efficient waste monitoring. The monitored section will be the same for each monitoring.

Permanent marked GPS points should be used to ensure that exactly the same sector will be monitored for all surveys. The start and end points of each sampling unit can be identified based on the maps that establish the sectors.

Collection and identification of marine litter

All objects (size more than 2.5 cm) found on the monitoring unit must be entered on the monitoring forms. On the forms, each item has a unique identification number.

Data is required to be entered on the form while the waste is picked up. Another option is to gather all litter in closed bags and to perform the counting after. Pay attention to human errors: unclear handwriting, forgetting to enter some data in the form, not seeing all litter items (leaving litter behind), mismatching categories, etc.

Any unknown waste or items that are not on the monitoring form will be marked at the end of the

form in the special box. A brief description of the waste will be noted and photographs taken with it so that it can be identified later and whether it is necessary to add it to the form.

After counting the items please separate the litter according to the main types of materials (plastic, metal, paper/cardboard, glass, rubber, wood, textile, other), place them in separate disposal bags and weight each type. Record the amount per category in each observation sheet.

Barcode identification - optional

Intact packaging (manufacturer, country and barcode visible) was collected individually and separately in sealed bags. Each bag was marked with the date and location where the waste was removed.

Litter collected

The collected litter must be disposed of properly. It will be stored in places specially designed for the disposal of waste, and if this is not possible, the competent authorities will be notified.

Large waste that cannot be safely removed will be sprayed, paint, and so they will not be counted again at the next survey.

Preferably, a monitoring time should be set for each beach between the date the beach was last cleansed and the date when the survey was conducted. It is advisable to be informed before you begin an investigation to get the latest information on beach cleaning activities. Sometimes an incident, like a storm, will modify the monitoring program.

Categories of waste

The list of categories of waste is set out in the monitoring sheet. This includes a list of categories and products and their codes.

Interpretation

For the interpretation, the partners had to complete a data report (xls format and word) and also to upload the data on Marine Litter Watch, using ANEMONE community, code: DFBDG.

Photos

Throughout the activities, photos will be taken.

2.4 Beach selection

2.4.1 Romania

In Romania, 8 beach sectors (Table 2.1), totaling 47,995 m^2, approximately 1.57% of the Romanian beach area, were monitored.

Table 2.1 - Beach sectors in Romania

Name of the area	Coordinates S	Coordinates N	Surface (m^2)
Vama Veche	43°44′51.9″N 28°34′42.6″E	43°44′54.9″N 28°34′41.2″E	1,481
Saturn	43°50′01.1″N 28°35′26.5″E	43°50′04.4″N 28°35′26.5″E	9,160
Tuzla	43°59′56.9″N 28°39′45.4″E	44°00′00.1″N 28°39′44.7″E	1,912
Eforie	44°02′42.8″N 28°38′43.9″E	44°02′46″N 28°38′42.9″E	3,951
Constanța	44°11′35.3″N 28°39′18.6″E	44°11′38.6″N 28°39′18.4″E	10,228
Mamaia Nord	44°16′48″N 28°37′18.7″E	44°16′51.2″N 28°37′18.5″	9,844
Năvodari	44°18′33.2″N 28°37′48.9″E	44°18′36.2″N 28°37′50.3″	7,135
Corbu	44°22′00.2″N 28°42′15.4″E	44°22′03.2″N 28°42′17″E	4,284

2.4.2 Bulgaria

The selected beach is Asparuhovo beach. Sampling unit represents 100m sector, selected on the Asparuhovo beach (Figure 2.3). A sampling unit is a fixed section of the beach covering the entire area from the water's edge (where possible and safe) and the area where the sand ends and the asphalted / built-up part begins.

The monitoring was done on a section of 100 m length, marked by rope, according to the sector's delineation, for the efficient waste monitoring. The selected section will be the same for each monitoring.

GPS points of sampling area are:

- 43°10'31.34"
- 43°10'28.67"
- 27°54'45.62"
- 27°54'48.25"

The total surface is 8814 m^2.

Figure 2.3 - Sampling area of Asparuhovo beach

2.4.3 Turkey

An isolated beach on the Black Sea coast at the entrance to the Istanbul Strait with an area of 3,499, 31 m^2 was surveyed: 41°11'46.8"N, 29°07'12.5"E (Figure 2.4). There is a fishing shelter on the beach where we cleaned up. The Port of Poyraz is located about 2 km to the north of the beach, at the entrance of the Istanbul Strait. The beach is located just below the Yavuz Sultan Selim Bridge. There is no transportation by land, only accessible by boat. Because this beach is isolated and not accessible by land, there is not information available on the effect of seasonal activities such as tourism or fisheries.

Figure 2.4 - Fil Burnu Beach, İstanbul, Turkey

2.4.4 Ukraine

4 sectors per 100 meters were selected for monitoring the beach litter. The monitoring took place on beaches in the Karolino-Bugaz area. 1 sector per 100 m was monitored by 4 participants. 3 sectors of the beach were 50 m wide, with the exception of 1 area - sector 3 with a width of 30 m. The total area monitored was 18.000 m^2 (Figure 2.5, Table 2.2).

Table 2.2 - Beach sectors in Ukraine

Name of the area	Start		End	
	latitude	longitude	latitude	longitude
Sector 1	46.13759	30.53431	46.13691	30.5333
Sector 2	46.13646	30.53266	46.13583	30.53163
Sector 3	46.13562	30.53113	46.13489	30.52987
Sector 4	46.13426	30.52867	46.13339	30.52737

Figure 2.5 - Ukrainean beach sectors (Sector 1 - top left, Sector 2 - top right, Sector 3 - bottom left, Sector 4 - bottom right)

The beach is located on the territory of Karolino-Bugaz - the Black Sea resort, which is located 60 km southwest of Odesa, at the beginning of the sandbar that divides the Black Sea from the Dniester Estuary. Karolino-Bugaz is closely bordered on the south with an urban settlement Zatoka (located directly on the sandbar). The village of Karolino-Bugaz is located at an altitude, has several recreation centers and boarding houses. The beach is seasonally used; the nearest buildings to the beach are at 350-600 m.

There are no industrial facilities near the beach. The nearest river to the beach is the Baraboy River, which is at 7.3 km. The population of Karolino-Bugaz does not exceed 3000 people, but as it is a resort area, then in the summer season a significant number of tourists rest on the beaches.

2.5 Data analysis and interpretation

The Black Sea marine litter case studies took place in 4 riparian countries and a total of 78,308 m^2 were surveyed. The number of inventories and eliminated waste items was 64,703 (spring – 27,080; autumn – 37,623). The distribution of marine litter per country can be visualized in Figure 2.6. This shows that the highest number of items was identified in Romania, but here was also the highest surface monitored (45,814). Then, Turkey (9,857), Bulgaria (5,069) and Ukraine (3,963) followed in the rankings.

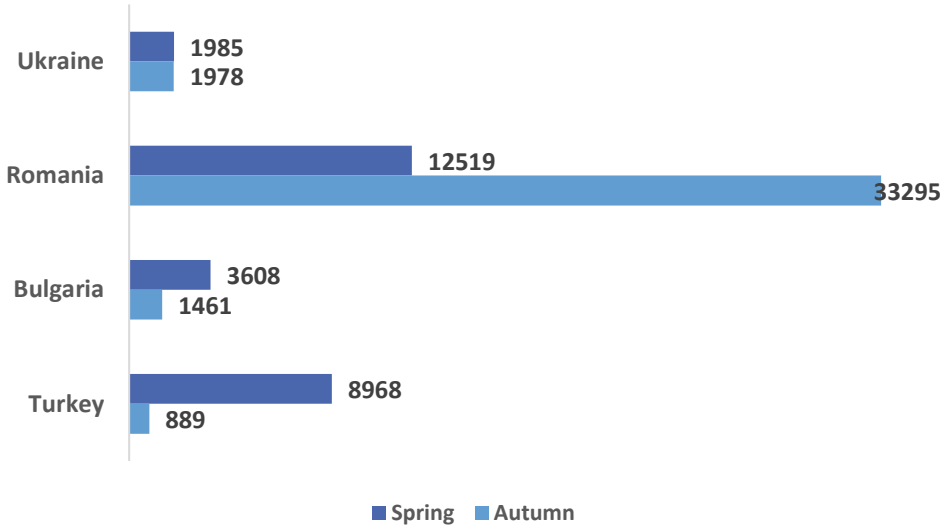


Figure 2.6 - Total marine litter items (per countries and timeframe)

Artificial polymer material has prevailed in this session, as well as in other sessions, representing 78% of the total (50,681 plastic items) (Figure 2.7).

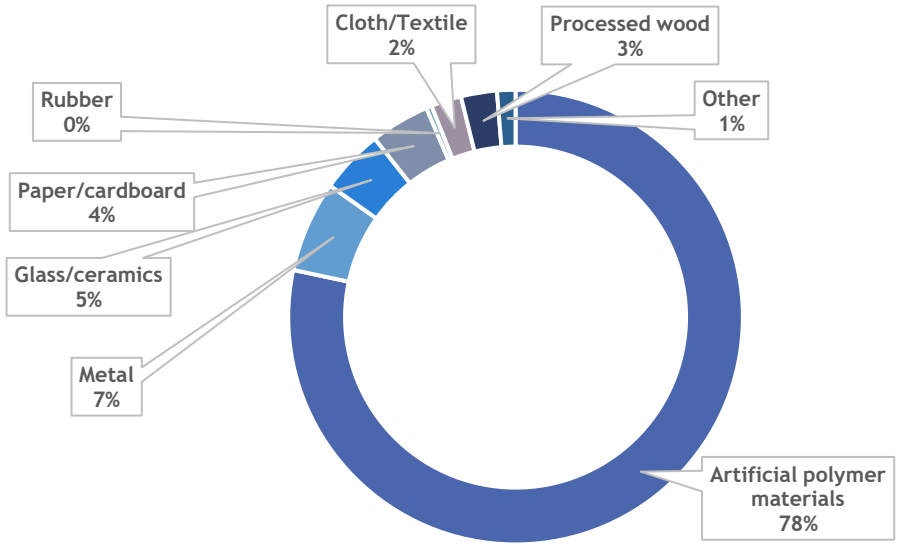


Figure 2.7 - Current situation of marine litter by categories

With a percentage of only 7% is the category of metal (4,197), followed by glass and ceramics (2,946) and the fewest were in the rubber category (252) and then the others category (847) (Table 2.3).

Table 2.3 - Distribution of marine litter by categories and countries

Category	Ukraine	Romania	Bulgaria	Turkey	Total
Artificial polymer materials	3,481	33,468	4,395	9,337	50,681
Metal	73	3,664	82	378	4,197
Glass/ceramics	49	2,642	175	80	2,946
Paper/cardboard	137	2,366	224	0	2,727
Rubber	44	147	34	27	252
Cloth/Textile	40	1,291	39	29	1,399
Processed wood	135	1,399	115	5	1,654
Other	4	837	5	1	847

From perspective of abundance, the marine litter had a frequency of 0.82 items/m^2. The highest abundance was registered in Turkey, 2.81 items/m^2, being followed by Romania, 0.95 items/m^2 (Figure 2.8).

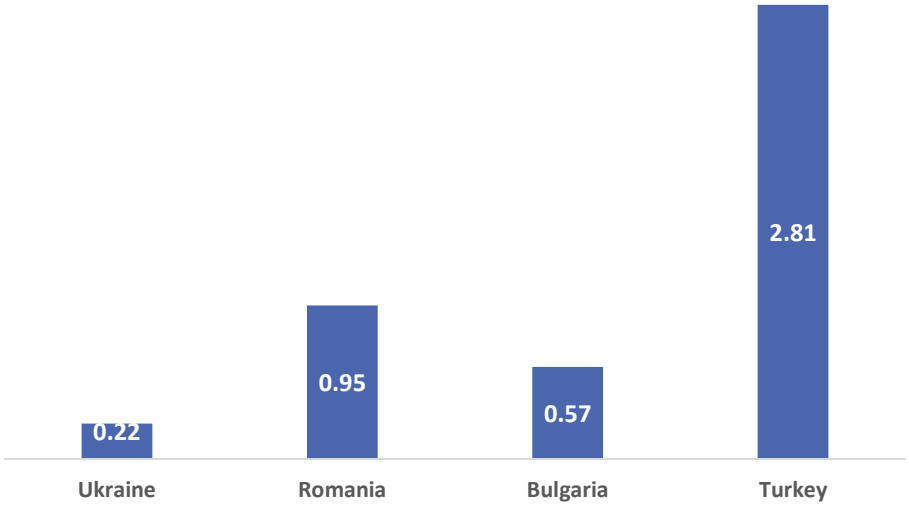


Figure 2.8 - Marine litter abundance (items/m^2)

Marine litter is not only an environmental, but also a health problem. Medical and sanitary wastes constitute a health hazard and could potentially seriously injure people. Many cotton bud sticks (475), diapers (32), syringes and their needles (25), medical/pharmaceuticals containers/tubes (48), as well as sanitary towels (103) were identified around Black Sea. To all these numbers, are added 82 condoms (including packing), tampons and tampon applicators and other medical items (swabs, bandaging, adhesive plaster etc.).

2.5.1 Riverine marine litter case studies in Turkey

The Scientific and Technological Research Council of Turkey (TUBITAK) and SINOP University organized in Turkey, two data collection sessions on the beaches under the influence of Yesilırmak (Eastern Black Sea) and Sakarya Rivers (Western Black Sea).

These sessions took place in September and December 2019 on Karacu, periurban beach and Çarşamba, rural beach.

Karacu beach had a total of 2,849 items and 2,622 were of artificial polymer material, meaning 92%. On the other hand, Çarşamba beach registered a number of 692 items and artificial polymer materials prevailed, 93% of total (Figure 2.9).

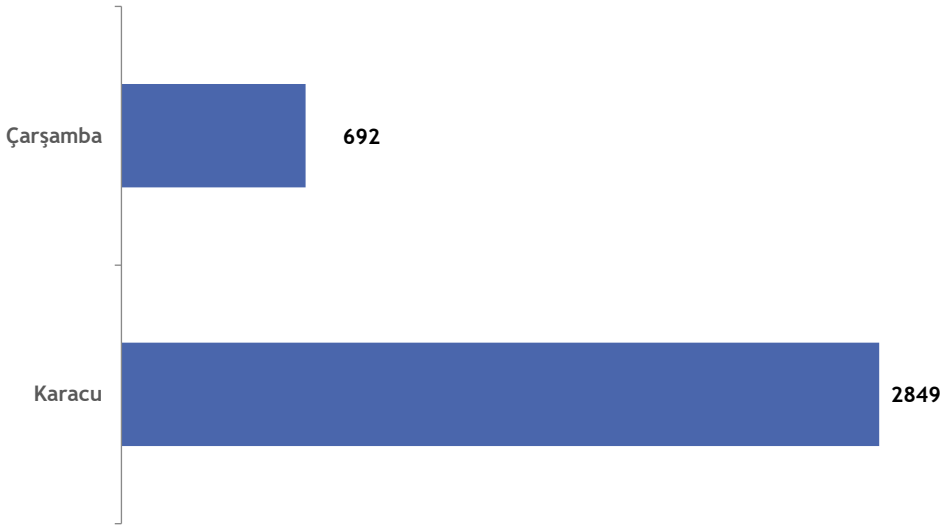


Figure 2.9 – Marine litter abundance (number of items)

The top 3 the most common items on Karacu beach were: plastic caps/lids drinks (302), polystyrene pieces 2.5 cm > < 50cm (300) and plastic pieces 2.5 cm > < 50cm (272). On Çarşamba beach, plastic pieces 2.5 cm > < 50cm (125), polystyrene pieces 2.5 cm > < 50cm (81) and plastic caps/lids drinks (44) predominated.

The study included some information regarding the provenance of some items, by identification of the barcode. Thus, on Karacu beach were identified 8 items: 3 from Russia, 2 from Georgia and 3 unknowns, as the brand name was written in Cyrillic alphabet and was hard to be read. On Çarşamba beach were found 8 litter items and all coming from Russia.

2.6 Plastics

Plastic is a synthetic organic polymer made from petroleum with properties ideally suited for a wide variety of applications, including packaging, building and construction, household and sports equipment, vehicles, electronics and agriculture. Plastic is cheap, lightweight, strong and malleable. Over 300 million tons of plastic are produced every year, half of which is used to design single-use items such as shopping bags, cups and straws.

At least 8 million tons of plastic end up in our oceans every year. Floating plastic debris are currently the most abundant items of marine litter. Waste plastic makes up 80% of all marine debris from surface waters to deep-sea sediments. Plastic has been detected on shorelines of all the continents, with more plastic materials found near popular tourist destinations and densely populated areas.

Under the influence of solar UV radiation, wind, currents and other natural factors, plastic fragments into small particles, termed microplastics (particles smaller than 5 mm) or nanoplastics (particles smaller than 100 nm).

At the global level, the 2030 Agenda for Sustainable Development calls for action to ‘Conserve and sustainably use the oceans, seas and marine resources’ (Goal 14) and ‘By 2025, prevent and significantly reduce marine pollution of all kinds, particularly from land-based activities, including marine debris and nutrient pollution’ (target 14.1).

During the two monitoring sessions that took place within ANEMONE project, the litter of artificial polymer materials are the most common (50,681), representing 78% of total. As can be seen in the figure below, the highest number was registered in Romania (33,468), followed by Turkey (9,337). In Ukraine, 3,481 items of artificial polymer materials were found (Figure 2.10).

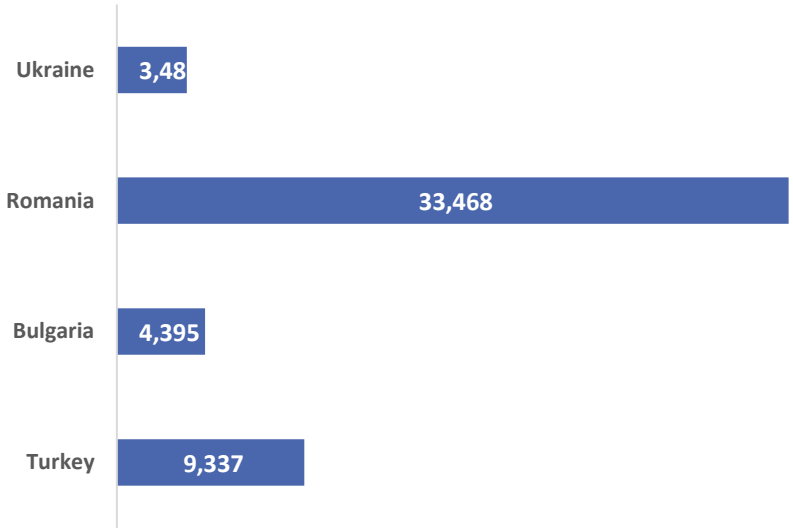


Figure 2.10 – Artificial polymer materials around Black Sea (number of items)

The most 10 common artificial polymer material items are:

Plastics are undeniably a key environmental concern — particular in terms of impacts to ocean health and wildlife. But it's also important to acknowledge the value plastic plays across many aspects of society. It is a unique material: often lightweight, resilient, usually non-reactive, waterproof and cheap. One example where plastic plays an important role is food packaging. Whilst over-packaging can undoubtedly be a significant issue, packaging of food products is essential for the prevention of food losses, wastage and contamination (Marsh, 2007). Storage and packaging plays a crucial role from harvest all the way through to final consumption of the foods.

There have been many documented incidences of the impact of plastic on ecosystems and wildlife. Peer-reviewed publications of plastic impacts date back to the 1980s.

There are three key pathways by which plastic debris can affect wildlife (Law, 2017).

- Entanglement - the entrapping, encircling or constricting of marine animals by plastic debris. Entanglement cases have been reported for at least 344 species to date, including all marine turtle species, more than two-thirds of seal species, one-third of whale species, and one-quarter of seabirds (Kühn, 2015). Entanglement by 89 species of fish and 92 species of invertebrates has also been recorded. Entanglements most commonly involve plastic rope and netting (Gall, 2015) and abandoned fishing gear (Kühn, 2015).
- Ingestion - can occur unintentionally, intentionally, or indirectly through the ingestion of prey species containing plastic. It has been documented for at least 233 marine species, including all marine turtle species, more than one-third of seal species, 59% of whale species, and 59% of seabirds (Kühn, 2015). Ingestion by 92 species of fish and 6 species of invertebrates has also been recorded. The size of the ingested material is ultimately limited by the size of the organism. Very small particles such as plastic fibres can be taken up by small organisms such as filter-feeding oysters or mussels; larger materials such as plastic films, cigarette packets, and food packaging have been found in large fish species; and in extreme cases, documented cases of sperm whales have shown ingestion of very large materials including 9m of rope, 4.5m of hose, two flowerpots, and large amounts of plastic sheeting (de Stephanis, 2015). Ingestion of plastics can have multiple impacts on organism health. Large volumes of plastic can greatly reduce stomach capacity, leading to poor appetite and false sense of satiation (Day 1985). In laboratory settings, biochemical responses to plastic ingestion have also been observed. These responses include oxidative stress, metabolic disruption, reduced enzyme activity, and cellular necrosis (Browne, 2015; Cedervall, 2012; Oliveira, 2013; Rochman, 2013).
- Interaction – interaction includes collisions, obstructions, abrasions or use as substrate. There are multiple scenarios where this can have an impact on organisms. Fishing gear, for example, has been shown to cause abrasion and damage to coral reef ecosystems upon collision. Ecosystem structures can also be impacted by plastics following interference of substrate with plastics (impacting on light penetration, organic matter availability and oxygen exchange).

In addition to the detrimental consequences that ingestion of plastics by marine biota may entail (Wright, 2013; Werner, 2016; Anderson, 2016), worrying environmental consequences of marine litter also stem from microplastics (less than 5 mm in diameter) and nanoplastics (less than 100 nm in at least one of its dimensions), which could potentially affect marine biota both from their physical nature if ingested and by transfer of chemicals associated with them, including persistent organic pollutants (POPs) and endocrine disruptor chemicals (EDCs). Most micro- and nanoplastics originate from the degradation of macroplastics through different pathways, e.g. photodegradation and other weathering processes of plastics that have leaked into the sea (Andrady, 2011), e.g. bags, bottles, lids, food packaging, etc.; from plastic pellets lost into the environment during production or freight process; or from textile fibres coming from washing machine runoff (UNEP, 2016; Duis, 2016). They may also be present as deliberately manufactured plastic microbeads used as scrubbing agents or for other purposes that can be found in some personal care and cosmetic products.

Invisible plastic has been identified in tap water, beer, salt and are present in all samples collected in the world's oceans, including the Arctic. Several chemicals used in the production of plastic materials are known to be carcinogenic and to interfere with the body's endocrine system, causing developmental, reproductive, neurological, and immune disorders in both humans and wildlife.

Toxic contaminants also accumulate on the surface of plastic materials as a result of prolonged exposure to seawater. When marine organisms ingest plastic debris, these contaminants enter their

digestive systems, and overtime accumulate in the food web.

The transfer of contaminants between marine species and humans through consumption of seafood has been identified as a health hazard, but has not yet been adequately researched.

Plastic, which is a petroleum product, also contributes to global warming. If plastic waste is incinerated, it releases carbon dioxide into the atmosphere, thereby increasing carbon emissions.

At a global level, UNEP has estimated the economic impact of marine plastics (excluding microplastics), including losses incurred by fisheries and tourism due to plastic littering, as well as beach clean-up costs, at around $13 billion per year (UNEP, 2014).

A total ban is proposed for single-use plastic items for which alternatives in other materials are already readily available: cotton buds, cutlery, plates, straws, drink stirrers and balloon sticks. MEPs also added oxo-degradable plastic products and fast-food containers made out of polystyrene to the list. For the rest, a range of other measures was approved:

- Extended producer responsibility, especially for tobacco companies, in order to strengthen the application of the polluter pays principle. This new regime will also apply to fishing gear, to ensure that manufacturers, and not fishermen, bear the costs of collecting nets lost at sea.
- Collection target of 90% by 2029 for drink bottles (for example through deposit refund systems).
- A 25% target for recycled content in plastic bottles by 2025 and 30% by 2030.
- Labelling requirements for tobacco products with filters, plastic cups, sanitary towels and wet wipes to alert users to their correct disposal.
- Awareness-raising.

For fishing gear, which accounts for 27% of sea litter, producers would need to cover the costs of waste management from port reception facilities. EU countries should also collect at least 50% of lost fishing gear per year and recycle 15% of it by 2025.

Recycling and reuse of plastic materials are the most effective actions available to reduce the environmental impacts of open landfills and open-air burning that are often practiced to manage domestic waste. Sufficient litter and recycling bins can be placed in cities, and on beaches in coastal areas to accelerate the prevention and reduction of plastic pollution. Governments, research institutions and industries also need to work collaboratively redesigning products, and rethink their usage and disposal, in order to reduce microplastics waste from pellets, synthetic textiles and tyres. This will require solutions which go beyond waste management, to consider the whole lifecycle of plastic products, from product design to infrastructure and household use.

Everyone can do something to reduce the amount of plastic that enters the ocean. Here are five ways that can make a difference.

- Reduce use of single-use plastics - the easiest and most direct way is by reducing your own use of single-use plastics. Single-use plastics include plastic bags, water bottles, straws, cups, utensils, dry cleaning bags, take-out containers, and any other plastic items that are used once and then discarded. The best way to do this is by refusing any single-use plastics that you do not need (e.g. straws, plastic bags, takeout utensils, takeout containers), and purchasing, and carrying, reusable versions of those products, including reusable grocery bags, produce bags, bottles, utensils, coffee cups, and dry cleaning garment bags.
- Recycle properly - this should go without saying, but when you use single-use (and other) plastics that can be recycled, always be sure to recycle them. At present, just 9% of plastic is recycled worldwide. Recycling helps keep plastics out of the Black Sea and reduces the amount of “new” plastic in circulation.
- Support bans - many municipalities around the world have enacted bans on single use plastic bags, takeout containers, and bottles. You can support the adoption of such policies in your community.
- Avoid products containing microbeads - tiny plastic particles, called “microbeads,” have become a growing source of ocean plastic pollution in recent years. Microbeads are found in some face scrubs, toothpastes, and bodywashes, and they readily enter our oceans and waterways through our sewer systems and affect hundreds of marine species. Avoid products containing plastic microbeads by looking for “polythelene” and “polypropylene” on the

ingredient labels of your cosmetic products.

- Spread the word - Stay informed on issues related to plastic pollution and help make others aware of the problem. Tell your friends and family about how they can be part of the solution or host a viewing party for one of the many plastic pollution focused documentaries, like Bag It[2], Addicted to Plastic[3], Plasticized[4], or Garbage Island[5].

[2] Source: http://www.bagitmovie.com/

[3] Source: https://topdocumentaryfilms.com/addicted-plastic/

[4] Source: www.plasticizedthemovie.com

[5] Source: https://video.vice.com/en_us/video/garbage-island/563b9c912aab5c416bc75039

3 Measures for marine litter in Black Sea region

In order to fight with the impact of marine litter and to reduce the amount of them, is very important to have a good cooperation between all stakeholders (citizens, researchers, policy makers, etc.) and riparian countries, at sea basin level, to implement the most appropriate measures by each involved parties.

The following sets of measures and actions are identified by different stakeholders which attended several workshops and meeting organized in the last years by Mare Nostrum NGO, on the topic of marine litter, like "Mobilisation and Mutual Learning (MML)" workshop, organized within MARINA-EU-project, "National Fora" from MARLISCO-EU-project, and also by the participants (citizens) at the public engagement workshop (AT4.1), organized in ANEMONE project, and were grouped according to the stakeholders that can implement them.

Measures and sctions that can be applied by citizens, consumers, NGOs, teachers:

- Raising public awareness on the real problems faced by marine ecosystem, caused by solid waste problem through: Environmental education (programs) and Information/awareness campaigns;
- Volunteering actions;
- Environmental education in schools;
- Practical education for evaluators;
- Encouraging civic spirit;
- Marine litter monitoring (case studies);
- Notification to the authorities;
- Use of eco-friendly products;
- Change of consumption habits;
- Establishment of social clubs to increase environmental awareness of students;
- Flexibility in environmental education according to geographical needs;
- Marine Litter Cleanup Campaigns, Adopt-a-Beach campaigns or similar practices.

Measures and actions that can be applied by public authorities, policy makers:

- Active involvement of local authorities, beach administrators and business representatives by: equipping and marking waste collection spaces, increase frequency of waste collection, application of penalties;
- Involving the local beaches administration, economic, volunteers and control bodies through testing actions, control and encouraging civic spirit, education in context of compliance and updating the legislation;
- Updating legislation for economic traders;
- Intensifying verification/inspection;
- Applying concrete methods for waste selective collection;
- Identifying and treating pollution sources;
- Increasing inspections on industrial enterprises for their wastes;
- Establishment of modern and full-capacity treatment facilities by local administrations;
- Increase of control over waste disposal of marine vessels waiting offshore;
- Development of new methods for fishermen to collect marine litter, to bring them to ports, and to encourage them to do so;
- Local Council Decisions for eliminating single-use plastics;
- Involving and sustaining population in law enforcement and its development;
- Update legislation for economic operators on boosting recycling – introduction of package tax;
- Fishing for Litter actions to clean up of the floating litter and the seabed (marine litter generated by fishing vessels or caught accidentally);
- Port facilities according to obligations from the MARPOL Convention;
- Verifying actions with increased frequency, coupled with a former position of the authorities in application of existing legislation (MARPOL);
- Using of circular economy in marine litter management.

Measures and actions that can be applied by industry and businesses:

- Providing the infrastructure and innovative technologies for selective waste collection (land, marine);
- Development of new technologies (recycling; environmentally friendly packages);
- Change of production habits;
- Using ID chips, satellite tagging, or a barcode system to identify the owner of the abandoned nets;
- Product design and use of environmental friendly materials;
- Blue Flag certification by the Foundation for Environmental Education;
- Financing anti-waste companies by the packaging manufacturers.

Measures and actions that can be applied by scientists:

- Identifying and monitoring of polluting sources (land and marine), creating and maintaining a viable date base;
- Monitoring of polluting sources (e.g. ships), over-monitoring;
- Use of citizen science in data collection;
- Collaboration with all relevant stakeholders.

During the "Mobilisation and Mutual Learning (MML)" workshop, participants were invited to vote the actions that should be taken by the community in order to reduce marine litter, having in mind three aspects about marine litter: priority, feasibility challenges and economic challenges. The top 3 actions identified for each category are illustrated in the image below (Figure 3.1).

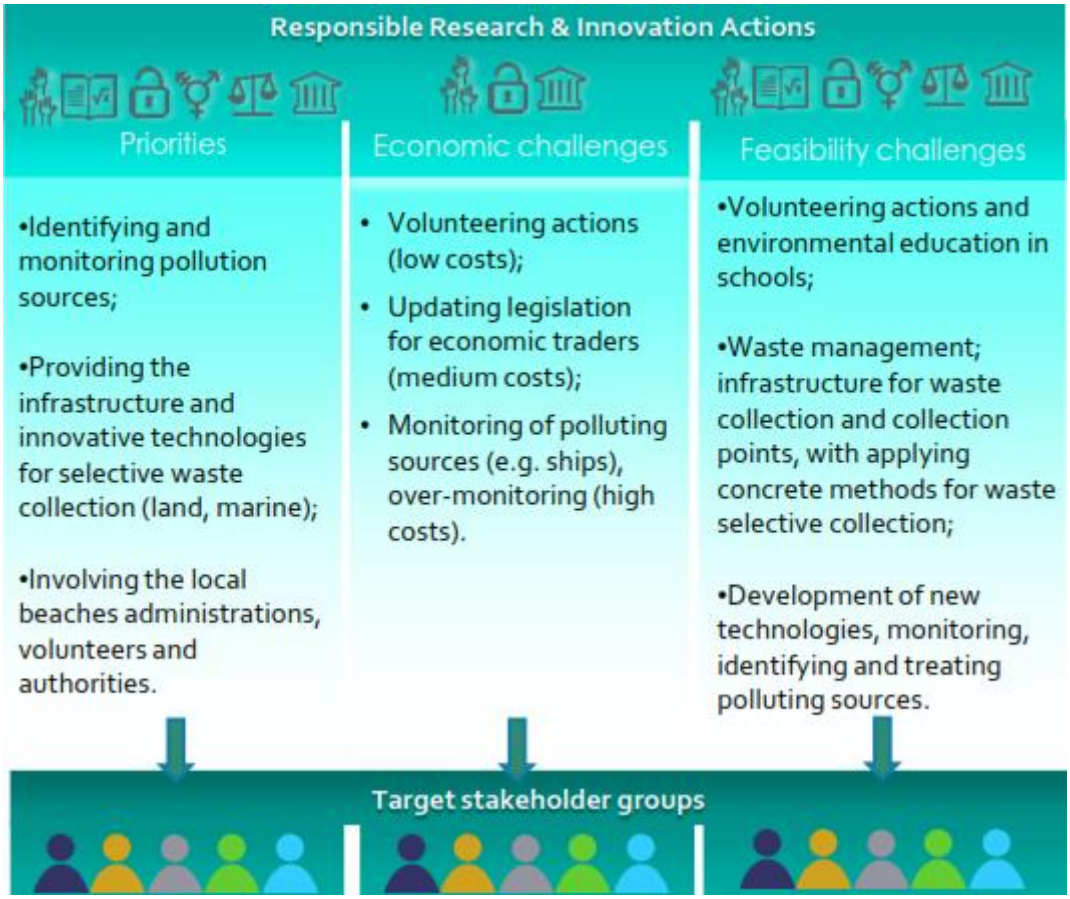


Figure 3.1 – MARINA MML Leaflet "Pollution by human pressure with a special focus on marine litter", Mare Nostrum NGO, Constanta, Romania

4 Citizen science

Citizen science can be defined as the non-professional involvement of volunteers in the scientific process, commonly in data collection, but also in other phases of the scientific process, such as quality assurance, data analysis and interpretation, problem definition, or dissemination of results. (Other definitions exist and are under debate in the scientific community).

Citizen science is growing and attracting increasingly the attention of the scientific community, governments and the media, but it is not new. It is born out of a long history of public participation in scientific research enacted through many approaches. Volunteers in many local and national bird monitoring schemes and networks of weather collectors and ocean monitoring have been collecting data for decades (e.g. UK's Breeding Bird Survey, Vigie-Nature in France, Rainfall Observers in Scotland, and the US National Weather Service programme on storm spotters).

Citizen science is mostly connected with the environmental domain, because provides an opportunity to expand the knowledge base, through local involvement, and in the same time provides an increase in citizens' awareness and engagement. Citizen science plays a critical role in advancing knowledge about biodiversity, e.g. in relation to monitoring trends in occurrence, distribution, or status of species. The vast data volume that can be collected in a cost-efficient manner by a large number of volunteers dwarfs any professional capacity for monitoring (Environmental Citizen Science, 2013).

This is better applicable for biodiversity monitoring spanning large spatial (e.g. Europe) and temporal extents (e.g. decades).

The new technologies, such as mobile internet and apps for mobile devices, have broadened the scope and the number of citizens' contributions. There are many different types of citizen science projects in the environmental area. According to a recently published study, the majority are 'contributory' projects, designed by scientists, but enlisting the help of volunteers to collect monitoring data (Environmental Citizen Science, 2013).

The value of citizen science is being more and more recognized in the literature and practices, having an important effect on policies, science and society. It should be noted that the value in most citizen science projects is not easy to categorize and may emerge from broad aims, or as projects develop beyond their original scope. It is common for projects fitting the public participation in research model to have both scientific and educational goals. However, social and policy benefits may also emerge, for example, when projects are based around local people motivated by solving local environmental problems.

- **Policy value:** Citizen Science can contribute to various phases of the policy-making cycle (Figure 4.1), including:
  - Identify problems or issues, by making valuable, systematic observations and voicing public concerns with supporting scientific evidence to decision makers.
  - Help formulate public policy, for instance by contributing to the development of policy options and assessing their potential impacts. Here, citizen science can particularly facilitate the inclusion of diverse societal perspectives in decision-making processes.
- **Scientific value:** policy decisions increasingly rely on the best available scientific evidence, but this does not necessarily come from the best peer-reviewed publications from the academic sector alone. Citizen science can complement or provide advantages over conventional science in multiple ways. One of its primary benefits is the collection of data that would otherwise be unavailable (e.g., because of its temporal or local granularity and detail, long time scales of observations, amount of data submitted etc.). Key aspects are however fit-for-purpose, data quality, long-term access and re-usability. The access and inclusion of tacit knowledge proves equally important.
- **Societal value:** Citizen Science projects empower citizens to draw public attention to local issues and provide them the evidence base to ask for, propose or collaborate towards solutions (e.g., noise pollution). Promotion of citizen science projects and their outcomes can also help to raise broader awareness for environmental issues, supports life-long learning and potentially stimulate behavioral change – here, especially related to issues that are not immediately visible (e.g., air pollution near schools, radiation from radon or longer-term health effects).

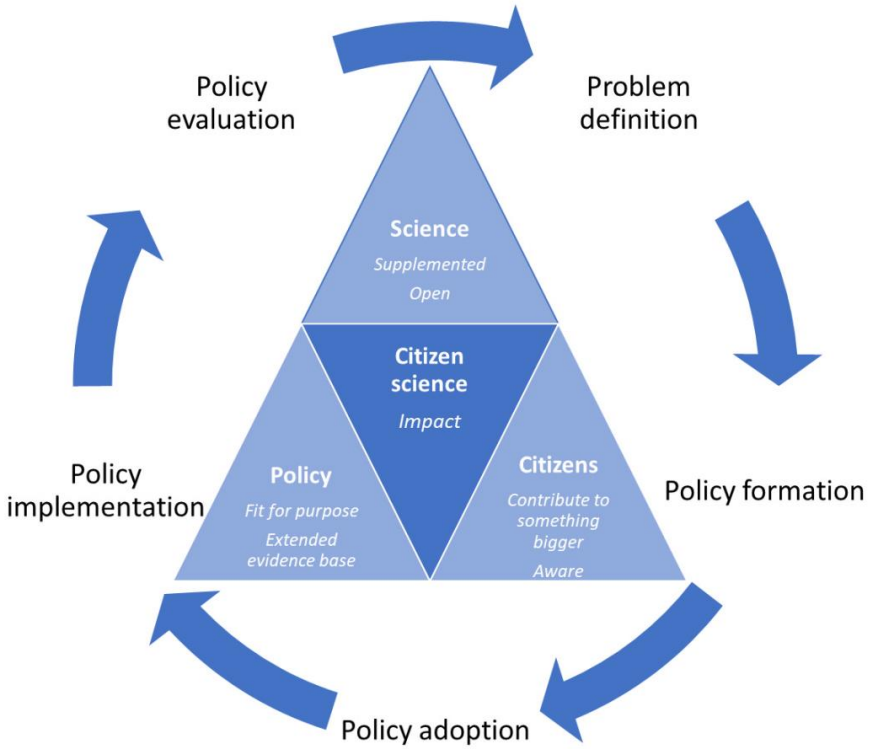
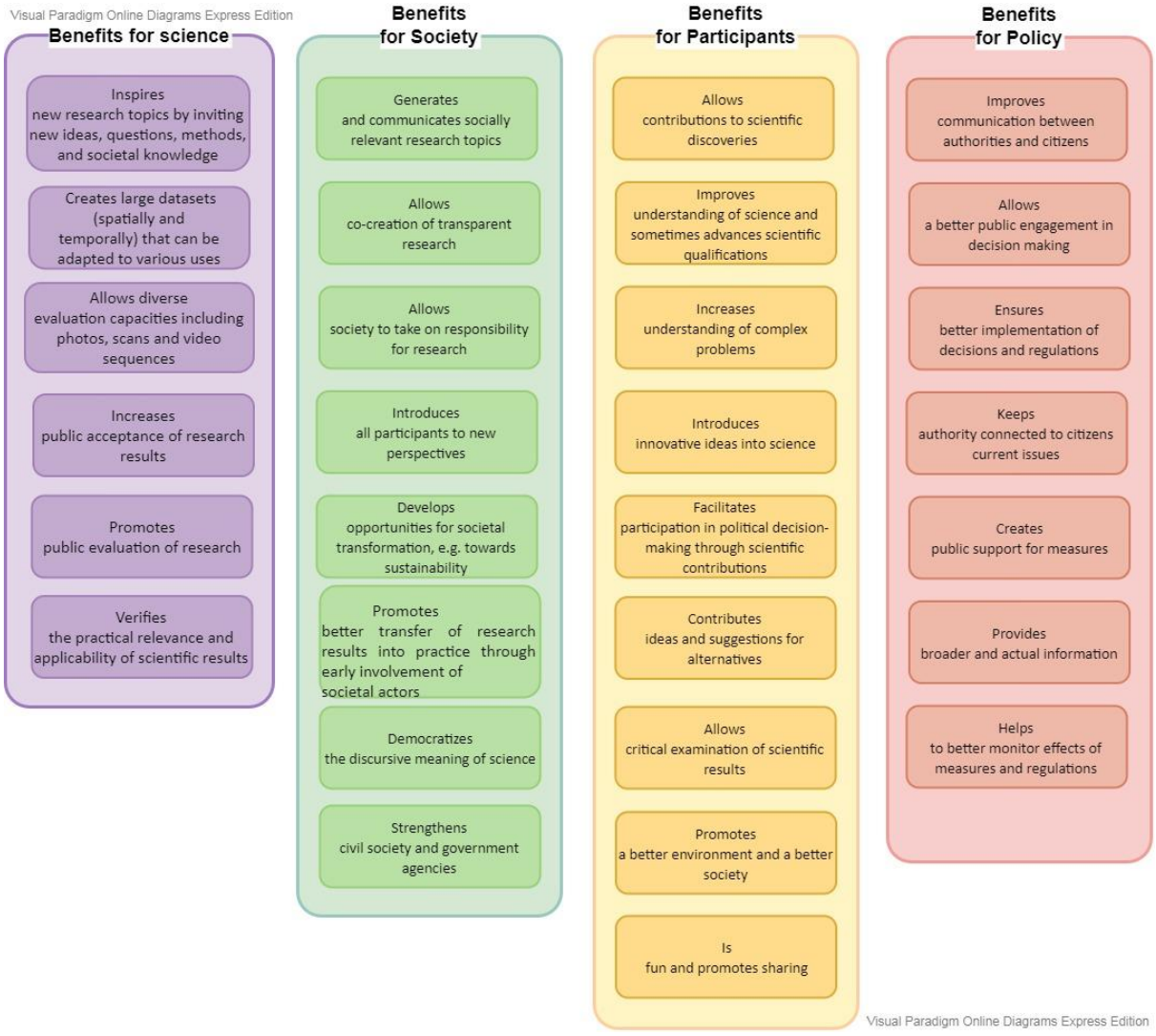


Figure 4.1 - Interaction between policy, science, society and citizen science

4.1 Citizen science benefits

Citizen science can bring a lot of benefits for the society, for science, policy and for the participants themselves.



4.2 How was citizen science used in ANEMONE project?

Having in mind the previous experience of the partners involved in the Citizen Science activity, Anemone project offered a very good framework to implement Citizen Science at Black Sea basin level. The purpose was to prove that citizens can provide real, useful and accurate data for scientists to use. Just by looking at the numbers resulted, it is clear that it would have been impossible to reach such an extensive extent by only involving researchers.

The figure below (Figure 4.2) shows the huge dimensions of the citizens involvement, area covered, the items collected and the fact that was used a unique, common methodology in parallel, makes this effort a premiere in Marine litter monitoring in the Black Sea.

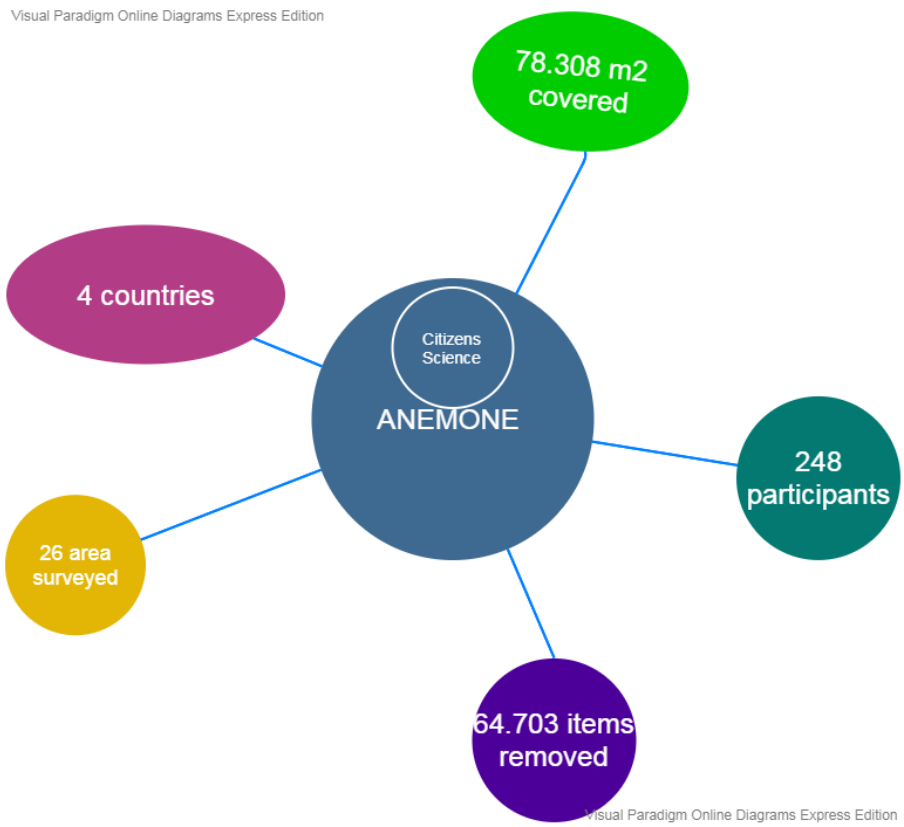


Figure 4.2 – Citizens Science dimensions in ANEMONE project

The success of the activity was assured through a complex process of public engagement and continuous communication. In order to have a useful citizen science project and to maximize the results for all the stakeholders and beneficiaries, it is very important to have a clear and agreed process and to communicate all details to all participants. The 4 workshops organized within the same project, in spring 2019, in each partners country (Bulgaria, Romania, Turkey and Ukraine) made an introduction of the topic marine litter. Also, it provided the participants with knowledge about the methodology, the possible biases and the tools to be used in the field. Citizens felt more dedicated because they were part of the solutions finding stage and in the next part some of the measures identified will be presented and analyzed from the policy value point of view (Figure 4.3).

The direct involvement of the citizens in the beach monitoring actions raises awareness of the current issue in a scientific way, diminishing the effect of media news, that presents only sides of reality, most of time being considered as fake news. Moreover, the community created had the change to interact and discuss with some researchers that explain the way data will be interpreted and how results will be extrapolated for the whole area/country.

Becoming part of the monitoring stage and having the possibility to propose measures and solutions, that have a high chance to be adopted, gives people a sense of ownership of an area, an issue, or a project. In this way, they will ensure the follow up and the sustainability of the process.

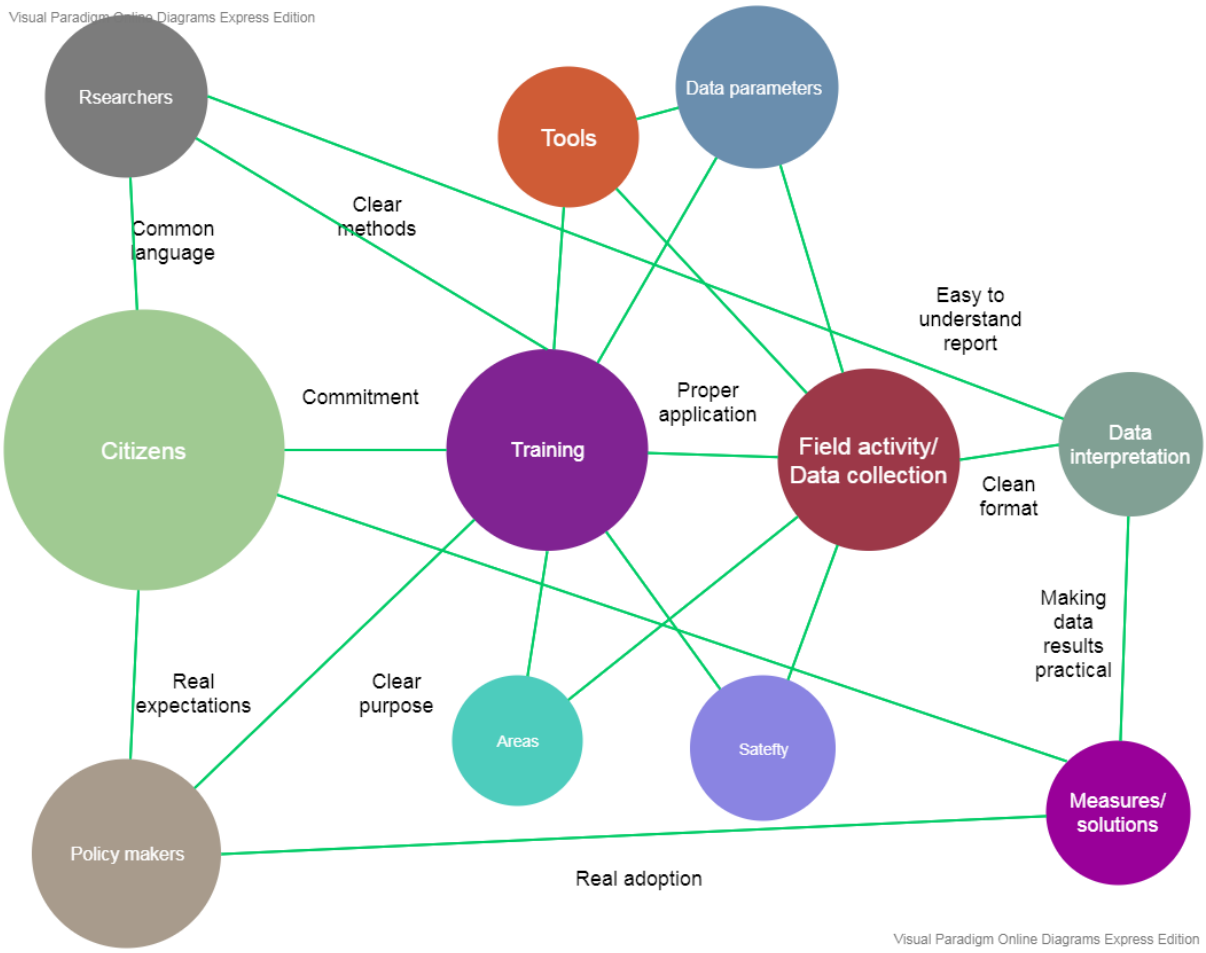


Figure 4.3 – Graphical representation of a successful Citizens Science process

4.3 Measures resulted from the citizens' science action

Following the results for the workshops organized during the last four years, under the framework of several European projects (MARINA, ANEMONE, MARLITER), citizens engagement offered a grassroots vision of the marine litter issue.

People, no matter their professional background, tent to project their own direct experience when approaching one topic, bringing some biases in the final results of the workshops organized. This alteration of results comes mainly from the huge difference of the expectancy that one will present the official opinion of the sector/institution, and the real perspective brought at the table, from an individual point of view. Usually the second one is more emotional, though more convincing.

In citizens science workshops, that target measures and solutions definition, there is a more close connection between the expectancy of the facilitators (the citizens view) and the real one presented (their own or their close ones experience). In this way, the final roadmap will have the clear dimension and will offer the authorities an accurate picture of the situation and the solutions identified.

Most of the measures proposed are spinning around three main areas: education, legislation and infrastructure. All the citizens involved agreed that education plays the most important role and is a continuous process, targeting all ages and professional backgrounds. The solutions proposed exceed the institutional framework and imply public campaigns, trainings for companies, volunteer work, media involvement and info boards).

Even though there is a consensus on the improvement needed, legislation is considered to be a key

factor in marine litter reduction. Most of the people involved urge the implementation of punitive measures and also demand for a more severe monitoring and control of both companies and private people.

The speed that makes technology and research change is seen as a benefit that could be applied only by continuous adapting the infrastructure and using the best available techniques at the time. This requirement is addressed to private entities and authorities since both have the responsibility and capability to apply it.

The main benefit of involving citizens in science activities and then in measures proposal is the fact that people become more aware, directly involved and concerned. By thus people can see the most easy to apply, less costly and high efficient ways to solve issues. Sometimes, researchers and public authorities have a huge paper burden that complicates every step and makes hard to accept that complex problems need simple solutions.

5 Conclusions

From the marine litter case studies organized in ANEMONE project, in four countries around Black Sea, with the involvement of the citizens, we conclude the following:

- Increasing awareness of the population about the issue of marine litter help to make them understand the real problem and bring them on board, by involving in activities related to marine litter.
- It is important to have a good cooperation between all stakeholders and riparian countries, at sea basin level, for fighting with the impact of marine litter and to reduce the amount.
- Implementing a common methodology for marine litter monitoring, in all countries, contribute to a better monitoring and obtaining common data.
- Conducting of marine litter monitoring for the further development of measures to reduce pollution of the marine environment and rivers.
- Litter of artificial polymer materials (plastics) were the most common (50,681), representing 78% of total.
- Citizen Science has many benefits for all the actors involved.
- If we are to consider the cost-benefit analysis of Citizen Science, it takes the effort, resources and the time allocated to obtain the results in terms of commitment, awareness and knowledge gathered.
- Decision-makers and researchers should dedicate more time and attention to Citizen Science, in order to ensure the valuable results.
- Marine litter and waste in general, are topics very close to people since they pay for it, they produce it, they see it and most of the time, they remove it.
- Using Citizen Science for marine litter monitoring can be very advantageous since waste travels with the people. Thus, it can reach very remote areas or can be very spread in space, making research or interventions costly and difficult.

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