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MARLISCO
Stopping Marine Litter Together

MARine Litter in Europe Seas: Social AwarenesS and CO-Responsibility

DELIVERABLE 6.6 – PROJECT SYNTHESIS: 'RECOMMENDATIONS FOR SCIENCE AND SOCIETY INTERACTIONS: A CASE STUDY FROM ML'

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Document Information

The present document aims to showcase and reflect experiences gained in the FP7 MARLISCO project, through the work carried out on the science-society interface focusing on developing, implementing and evaluating mechanisms to enable society to understand the impacts of marine litter, engage and empower stakeholders in identifying viable solutions and eventually trigger and facilitate concerted actions to address this complex issue. The report distils lessons learned and recommendations drawn by the project's innovative approaches to connect science to society, using the emerging threat of marine litter as a vehicle. The aspiration is that these will elicit thoughts and discussions that will contribute to a deepened understanding of the science-society nexus and the improvement and/or expansion of relevant efforts to address some of the major environmental challenges of our time.

Approvals

Date	Partner
21.05.15	MIO-ECSDE (WP6 Leader & Regional Node Leader)
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1 EXECUTIVE SUMMARY

This document has been developed within the framework of the FP7 MARLISCO project that seeks to raise public awareness, trigger co-responsibility across the different sectors and facilitate dialogue between the different actors on both the problems and the potential solutions related to marine litter. The project focuses on the development, implementation and evaluation of mechanisms to better understand and communicate the problem in its environmental and social dimensions, encouraging society to gain a deeper understanding of the issue of marine litter and actively engaging and empowering stakeholders to act constructively and identify viable solutions, facilitate the definition of a collective vision and eventually trigger concerted actions to address this complex issue.

There is a growing need for stronger, more-reliable links between science and society in order to address urgent and complex interconnected challenges towards achieving global sustainability demands. This document encompasses the results of the MARLISCO effort to address this need, while distilling lessons learned and recommendations drawn by the project's innovative approaches to connect science to society, using the emerging threat of marine litter as a vehicle.

The issue of marine litter and its inherent environmental, economic, social, political and cultural dimensions presents a good example to explore and/or illustrate the complexity and the bottlenecks of interactions on the science-society interplay. The MARLISCO experiences offer insights that contribute to an improved understanding of the science-society nexus, while setting a precedent for effective use of knowledge towards sustainable and responsible individual and collective actions.

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2 INTRODUCTION & BACKGROUND

The growing urgency and complexity of the interconnected challenges that need to be addressed in order come closer to achieving global sustainability demands a better understanding of the science–society nexus and the conditions for translating research-based knowledge into action (Weichselgartner and Marandino, 2012). The need for stronger, more reliable links between science and society is well documented in both popular and academic literature and various approaches have been deployed worldwide to meet this demand (Lubchenco, 1998).

The present document aims to showcase and reflect experiences gained in the FP7 MARLISCO project, through the work carried out on the science-society interface focusing on developing, implementing and evaluating mechanisms to enable society to understand the impacts of marine litter, engage and empower stakeholders in identifying viable solutions and eventually trigger and facilitate concerted actions to address this complex issue. The document distills lessons learned and recommendations drawn by the project's innovative approaches to connect science to society, using the emerging threat of marine litter as a vehicle. The aspiration is that these will elicit thoughts and discussions that will contribute to a deepened understanding of the science-society nexus and the improvement and/or expansion of relevant efforts to address some of the major environmental challenges of our time.

3 METHODOLOGICAL APPROACH

The methodological approach deployed towards developing the project synthesis was based on the following considerations related to the information provided: that it is accurate based on sound scientific evidence and state-of-the art science, easy to access and easy to understand; that it is relevant and interesting to the intended audience; that it is delivered through appropriate channels; that directs target audiences to where they can access further information if required. The first chapters (1,2,3, 4, 5) and the final recommendations and conclusions related chapters and conlusion (7, 8) were drafted and elaborated by the lead author (P16) and sent for peer reviewing to the partners involved. In order to capture and collect the MARLISCO experiences and lessons learned a template was developed by the lead author and was sent to all Work Package Leaders. The guidelines for contributions requested the following:

- ✓ **ACTIVITY DESCRIPTION:** Briefly provide a description of the activity, including objectives, expected outcomes
- ✓ **METHODOLOGY DESCRIPTION:** Describe the methodology (tools, meetings, consultations, technology) and the specific actions.
- ✓ **THE RESULTS:** Summarize the results and impact of this activity.
- ✓ **LESSONS LEARNED:** Share the lessons learned, including successes during the activity, unintended outcomes, and recommendations for others involved in similar future activities, things that might have been done differently, the root causes of problems that occurred, and ways to avoid those problems, etc. While drafting the lessons learned please take into consideration the replication potential of your activity, effectiveness/efficiency and sustainability issues.
- ✓ **IMPACTS (optional):** Include a success story that shows the impact of the activity on people's lives and the change it has made. This should include reactions from people, officials or experts depending on the activity.
- ✓ **REFERENCES:** How can someone interested in using or adapting this experience get more information? Please provide relevant website(s), documentation, etc. Please also include literature references (if necessary) in the following format: *"Thompson RC, Olsen Y, Mitchell RP, Davis A, Rowland SJ, John AWG, McGonigle D,*

Once the inputs were received from the corresponding partners they were consolidated by P16 team. The elaborated document was sent to partners for final reviewing and was finalized.

4 THE SCIENCE-SOCIETY NEXUS

4.1 The emerging need for effective science-society interaction

As scientists call for more research on global environmental changes in an effort to gain a better understanding of the human induced implications for all of life on Earth, it remains an inconvenient truth that if the world had acted upon the knowledge that the scientific community already produced, the state of many ecosystems would be different today. One of the deterrents of action seems to have been the dizzying volume of knowledge that lacks association and interaction with society itself. In our time, it is not the production of more detailed knowledge that is of urgency, but the proper context within which to use knowledge and turn it into sustainable actions (Weichselgartner and Marandino, 2012). This compelling fact, where society, functioning within a democratic governance context, plays a key role in both setting research agendas and modulating research trajectories towards socially desirable ends, has pointed to an emerging need for effective interaction between science and society (Fisher et al, 2006; Owen et al, 2012). A better understanding of the science-society nexus is what provides the enabling environment and creative power to address the complex challenges that society faces towards sustaining the vitality and integrity of socio-ecological systems, taking into account the way people think, function within their social context and the decisions and actions they take.

4.2 European policies and initiatives framing the science-society interaction

In the recent decades of European policy making, it has been increasingly recognised that bridging the gap between the scientific community and society at large to build an effective and democratic European knowledge-based society is very important. The basis for interaction between science and society was set by the European Commission in 2001 with the 'Science and Society Action Plan', which provides a strategy and corresponding actions to make science more accessible to European citizens (European Commission, 2002). These actions were planned under three themes: promoting a scientific and education culture in Europe; bringing science policies closer to citizens; and putting responsible science at the heart of policy making.

In 2002, a European Council decision adopted a specific programme for research, technological development and demonstration "Structuring the European Research Area" (2002–2006). The 'Science and Society' initiative was launched within the Sixth Framework Programme (FP6) aiming to develop the means for more constructive and effective communication and dialogue between research and citizens in general, so as to enable society at large to have a better-informed and more constructive influence on the future development and governance of science, technology and innovation (European Council, 2002). It was considered to be a key factor in the implementation of the Lisbon Strategy. In 2007, under the Seventh Framework Programme for Research and Technological Development (FP7) for 2007-2013, 'Science and Society' expanded and evolved to 'Science in Society', with the main objective of fostering public engagement and a sustained two-way dialogue between science and civil society. This effort continues to be pursued within the Horizon 2020 Innovation Union, a Europe 2020 flagship initiative, under the 'Science with and for Society' theme and the 'Responsible Research and Innovation' approach, aiming to address European societal challenges, build capacities and develop innovative ways of connecting science to society (European Commission, 2010).

4.3 Understanding the science-society notion and its multiple manifestations

The contemporary intertwining of science and society is not fundamentally new, as science has always occupied a place in society by shaping our views of the world, of ourselves and our societies. However, perceiving the 'science-society' notion can be challenging as it is by no means clearly delimited or predefined, but rather continuously evolves and takes multiple shapes within heterogeneous context-specific setups in terms of format, intensity and timing (Felt et al, 2013). The multiple manifestations of the science-society nexus vary from the rather classical and relatively narrow form of science communication to the wider public, to the full range of knowledge-action linking approaches, such as public engagement and empowerment, decision-relevant synthesis, distillation of results, and science translation and dissemination, through a variety of media to meet the needs of diverse audiences (Driscoll et al, 2012). A framework of the different perspectives in the relation between science and society are indicated in the table below:

Table 1: *Different perspectives and modes of the science – society relationship (Regeer and Bunders, 2008)*

Mode-0 **SEPARATE** **AUTONOMOUS KNOWLEDGE**	Scientific knowledge development and society are (relatively) separate from one another. It is unclear whether they have any significance for one another.
Mode-1 **CO-OPERATION** **INSTRUMENTAL KNOWLEDGE**	Co-operation between science and society. No change in the modus operandi of both actors. Society does not interfere in the structure of scientific research and researchers do not interfere in the use of scientific knowledge.
Mode-2 **CO-PRODUCTION** **TRANSDISCIPLINARY KNOWLEDGE**	Science and society are both actively seeking the best way of structuring and guiding complex change processes. Their responsibilities differ, but their modi operandi are starting to become similar. Not only is scientific knowledge considered relevant, but also experiential knowledge.

4.4 Unfolding the key challenges and implications of science-society relations

There are inherent difficulties and implications that hamper effective engagement, communication and understanding between science and society, and which could otherwise help address contemporary sustainability challenges. The main barriers that hinder efficient transfer of knowledge into socially meaningful actions and aggravate implementation of policy measures are institutional, functional, social and individual, with: divergent objectives, needs, scope and priorities; different institutional settings and standards; differing cultural values; and a lack of understanding and trust (Weichselgartner and Kasperson, 2010). Emerging literature sheds further light on some of these barriers (Siune et al, 2009; Weichselgartner and Marandino, 2012; Felt et al, 2013), which are summarized below:

- ✓ The mutation of research-based knowledge as it travels along the 'chain' from science to policy and society;
- ✓ The difficulties in making the impacts of (global) environmental change visible to people and linking them to what their perception of reality is;
- ✓ The inherent scientific uncertainties and knowledge gaps, which produce 'social' uncertainties as they travel down the 'knowledge–action chain';
- ✓ The diversity in histories, values and traditions, as well as in science systems and research cultures;

- ✓ The 'wicked' nature of certain phenomena of our times, referring to the fact that they are hard to define, not perceived and recognized in the same way by people and have no optimal solution;
- ✓ The poor understanding of the societal mandate and limitations of science by scientists themselves. In addition, the performance of science in terms of relevance and excellence generates tensions and frictions on the science-society nexus, as current moves have been noted towards separating 'research excellence' from 'societal relevance';
- ✓ The practice of 'dialogue' and 'public engagement' on issues taking place in the science-policy-society interface is often only skin-deep when it comes to transparency, accountability and proper governance.
- ✓ The difficulties in identifying all actors on the science-society interplay and tailorring approaches where necessary. The growing number of stakeholders, the dynamic changes in their type and the fluctuations in their power and interests make this a very challenging task.
- ✓ The role of psychological processes such as cognitive and affective challenges when dealing with distributed risks that are potentially distant in time and space; discrepancies between abstract goals and the constraints of daily life, as well as low perceived responsibility and /or control over the issues.

The aforementioned barriers represent some of the challenges in achieving effective science and society interaction and in working toward solutions, but they also offer great opportunities for the eventual, albeit difficult, resolution of problems.

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5 MARINE LITTER: FRAMING THE PROBLEM THAT TRIGGERED MARLISCO'S ACTIONS

5.1 The global societal challenge of marine litter

Marine litter is globally acknowledged as a major societal challenge of our times due to its significant environmental, economic, social, political and cultural implications (Sutherland et al, 2010). Marine litter negatively impacts coastal and marine ecosystems and the services they provide, ultimately affecting people's livelihoods and well being (Gall and Thompson, 2015; Oosterhuis et al, 2014; Kershaw et al, 2013).

According to the Marine Strategy Framework Directive Technical Group on Descriptor 10 (Galgani et al, 2010): '*Marine litter is any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. It consists of items that have been made or used by people and have been deliberately discarded or unintentionally end up in the sea or on the coast, including such materials that have been transported into the marine environment by rivers, drainage or sewage systems or the wind*'.

5.1.1. Marine litter impacts on wildlife and ecosystems, ecosystem services, human livelihoods and wellbeing

Growing scientific literature (Gall and Thompson, 2015; Galgani et al, 2011) documents the threats that marine litter poses to wildlife and ecosystems, with impacts varying from entanglement and ingestion, to bio-accumulation and bio-magnification of toxins either released from plastic items (e.g. PBDEs, phthalates, Bisphenol A) or adsorbed and accumulated on plastic particles (e.g. POPs, PAHs) (Rochman and Browne 2013; Teuten et al, 2009; Oehlmann et al, 2009); facilitation of the introduction of invasive alien species (Barnes and Milner 2005; Aliani and Molcard, 2003); damage to benthic habitats and communities (e.g. through abrasion of coral reefs from fishing gear, disruption of colonies, and reduced oxygenation or 'smothering' of communities) (Richards and Beger 2011; Gregory 2009).

Understanding the full economic significance of the impacts of marine litter still remains relatively limited, however it is well known that every year, marine litter results in very high economic costs and significant losses for the economic sectors involved, such as tourism and recreation, fisheries (including aquaculture), maritime transport and navigation, and infrastructure and services for local communities and municipalities (Leggett et al, 2014). The most considerable economic impacts include reduced fish catches due to 'ghost fishing' or increased costs related to time spent for cleaning and repairing fishing equipment; clean-up costs of beaches and waterways or reduced recreational opportunities due to aesthetic degradation of coasts; and increased costs related to fouled vessel propellers.

Furthermore, some items, such as sewage related waste, present health hazards for humans. Other debris items such as rusty metal and broken glass on the beach or the seabed may injure people, while rope and netting can present a hazard to mariners (STAP 2011; Kershaw et al, 2011, Mouat et al, 2010). Marine litter can also interfere with the psychological benefits derived from visits to coastal environments (Wyles et al, 2014).

5.1.2. Marine litter a symptom of our unsustainable production and consumption patterns

Understanding the true nature and root causes of the marine litter issue, in its multi-dimensional entirety, is fundamental to addressing it effectively. Marine litter is often considered as a waste management issue, but marine litter is primarily a symptom of the unsustainable production and consumption patterns of contemporary society.

Human activities both on- and off-shore introduce growing amounts of litter into the coastal and marine environment (but also to water bodies like rivers, lakes, etc.). These include: (a) land-based practices such as inappropriate waste disposal at household level; inadequate urban solid waste management at all stages: collection, transportation, treatment and final disposal; discharge of untreated municipal sewage; discharge of untreated runoff and storm waters; discharge of inappropriately treated/untreated industrial waste; unsustainable tourism and recreational activities; (b) commercial fishing that does not properly dispose of fishing related waste, as well as litter accidently caught in their nets, etc (the same applies for fisheries and aquaculture with nets, cages, construction material, feed sacks, etc); merchant and leisure shipping that does not properly manage solid waste, sewage, loose cargo, etc; recreational shipping with improper management of solid waste, sewage, fishing and sports gear, etc; off-shore oil and gas platforms that lose drilling equipment, pipes, etc.

While marine litter consists of a very wide range of items of different origin, use and composition, plastics consistently rank as being the most abundant type of marine debris on a global scale (STAP, 2011; Galgani et al, 2010). In recent years, there has been increasing environmental concern about 'microplastics', tiny plastic particles (<5mm), resulting mainly from the breakdown of macroplastics, as well as from the loss of preproduction plastic pellets and the use of plastic particles in products such as cosmetics or other industrial applications (Ivar do Sul et al, 2014; Andrady, 2011; Thompson et al, 2004). The ubiquitous presence of plastics and microplastics in the marine environment, coupled with their durability which makes them highly resistant to degradation, poses a significant threat. Despite representing only 10% of all waste produced, plastics account for between 50-80% of marine litter (OSPAR, 2009; HELCOM 2009; UNEP/MAP MEDPOL 2008) and these figures are expected to continue to grow, following the increase of plastics production over the last 60 years from around 0.5 million tonnes in 1950 to over 260 million tonnes today (Thompson et al, 2009).

From a resource efficiency perspective, the excessive and ineffective linear use of resources, throughout the life-cycle of products is a central underlying cause of the accumulation of waste (Thompson et al, 2009). This is exacerbated by short-lived single-use of products. Marine litter represents a pervasive, persistent and growing problem that parallels the overall increases in solid waste. According to Eurostat (2014), in 2012 there was little improvement in municipal waste prevention in the European Member States (EU-28), with an average production of 492 kg per capita in relation to 503 kg (EU-27) in 2011. From the reported municipal waste treated, on average, 34% was landfilled, 24% was incinerated, while only 27% and 15% were recycled and composted, respectively. However, waste production and rates of treatment vary considerably across countries, with Germany recycling 65% of the 610 kg collected per capita, while countries like Estonia recycling 40%, but producing considerably less at only 279 kg per capita.

5.1.3. Combating marine litter at EU level: policy frameworks, legislation and key initiatives

In recent years, marine litter has received major attention from the European Commission and the EU Member States, as it is one of the eleven Descriptors within the Marine Strategy Framework Directive (MSFD – European Directive 2008/56/EC). Monitoring programmes and measures need to be implemented in order to assess progress towards reaching or maintaining "Good Environmental Status" of the marine environment by 2020. Furthermore, considerable work is ongoing at European Regional Seas Conventions with regards to the development and/or implementation of Regional Action Plans on Marine Litter. A considerable number of other EU policy frameworks and related legislation also exist (Kershaw et al, 2013b), including the Waste Framework Directive, the Packaging and Packaging Waste Directive, the Landfill Directive, the Port Reception Facilities Directive, the Water Framework Directive, the Bathing Water Directive, the Urban Waste Water Treatment Directive, the Industrial Emissions Directive, and the Cosmetic Products Regulation. Each presents varying potential to tackle marine litter, which underscores the need for coordination and coherence among them and with the MSFD. In addition, the growing awareness of the problem of marine litter in recent years by scientists, policy makers, environmental NGOs and citizens has led to a number of EU (and non-EU) funded initiatives, actions and projects to improve our understanding of the marine litter issue and to promote and facilitate the coordination of multi-level efforts towards effective solutions.

5.2 INTRODUCING MARLISCO

As with many multifaceted societal problems, effective solutions require joint multi-level and coordinated actions from: industrial sectors; users of coastal and marine waters; the waste management and recycling sectors; Regional Sea Conventions; the European Commission and European Member States; local municipalities; citizens' groups; environmental NGOs; school children and the general public; social and natural scientists.

MARLISCO seeks to raise public awareness, trigger co-responsibility across the different sectors and facilitate dialogue between the different actors on both the problems and the potential solutions related to marine litter (Calilli et al, 2014). The project focuses on the development, implementation and evaluation of mechanisms to better understand and communicate the problem in its environmental and social dimensions. It aims to encourage society to gain a deeper understanding of the issue of marine litter, actively engage and empower stakeholders to act constructively and identify viable solutions, and facilitate the definition of a collective vision and eventually trigger concerted actions to address this complex issue.

MARLISCO incorporates a set of activities including a scoping study of the trends and policies regarding marine litter in the European Regional Seas; a collection of best practices from all partner countries; an assessment of the prevailing perceptions and attitudes of different stakeholders regarding marine litter, national forums in 12 partner countries involving representatives from the industry sector, academia and the wider public; a European video contest for school students; a wealth of awareness raising and educational activities and innovative tools targeting the younger generation; diversified, tailor-made national activities aiming to raise public awareness.

A key aspect of MARLISCO is the wide geographic coverage with twenty partners and also cross sectoral coverage. The consortium is composed of a diverse range of entities, from regional and local authorities, research institutes and academia, environmental associations, industries and multimedia companies (Table 2). Fifteen of these organisations have been responsible for implementing a set of national activities in their countries and therefore MARLISCO is covering 14 EU Member States and Turkey, with representation in each of the four European Regional Seas.

Table 2: *MARLISCO's partnership*

Consortium Member	Country	Type
Provincia di Teramo (Lead Partner)	Italy	Regional Authority
Coastal and Marine Union, Netherlands	Netherlands	Environmental NGO and Network
Centre for Environment, Fisheries and Aquaculture Science	United Kingdom	Government Agency for Marine Science
Plymouth University	United Kingdom	University
European Plastics Converters	Belgium	Association of Plastic Industries
European Plastics Recyclers	Belgium	Association of Plastic Recyclers
MerTerre	France	Environmental NGO
Regionalni Razvojni Center Koper	Slovenia	Regional Development Centre
University College Cork, National University of Ireland	Ireland	University
Mare Nostrum	Romania	Environmental NGO
Die Küsten Union Deutschland	Germany	Environmental NGO
IsoTech LtD	Cyprus	Environmental Consultancy
Union of Bulgarian Black Sea Local Authorities	Bulgaria	Association of Local Authorities
Plastics Europe AISBL	Belgium	Association of Plastic Industries
Universidade Nova de Lisboa	Portugal	University
Mediterranean Information Office for Environment, Culture and Sustainable Development	Greece	Federation of Environmental NGOs
Turkish Marine Research Foundation	Turkey	Research Institute
Kommunernes Internationale Miljøorganisation	Denmark	Environmental Association of Municipalities
Honky Tonk Film	France	Multimedia Company
Media Tools	France	Multimedia Company

6 SHOWCASING MARLISCO'S ACTIONS AT THE SCIENCE-SOCIETY INTERFACE: APPROACHES, REFLECTIONS AND OUTCOMES

6.1 Delivering clear messages based on sound scientific evidence and findings

Today, interest in the validity of scientific claims has expanded to wider audiences while public trust in the problem-solving competence of experts has eroded (Weichselgartner and Marandino, 2012). It is indisputable that there are still uncertainties and knowledge gaps related to marine litter, specifically on amounts, pathways, their fate in the marine environment and toxicological impacts and potential misconceptions that can arise in the media and society. It is therefore imperative to base messages on clear, evidence- and scientific consensus-based information when informing, engaging and empowering stakeholders, including the general public.

One of the initial activities of MARLISCO was to set a clear picture regarding marine litter in each of the European Regional Seas. This included a review of the state of understanding on amounts, sources, distribution and impacts of marine litter (Kershaw et al, 2013a) to provide science-based information to define key topics and clear messages for the national forums, and educational and exhibition activities in the project. This study summarised information on the sources, amounts, distributions and ecological and socio-economic impacts of marine litter, indicating limitations and gaps in the current state of knowledge, discussing potential solutions, providing examples, facts and figures, and explanations for some popular misconceptions.

It also provided the results of national surveys that were implemented in MARLISCO partner countries and MSFD regions, as sources of evidence to assess the state of marine litter (from official monitoring, NGOs or local authorities survey activities). The review of the national surveys indicated a large disparity on availability of data and information among countries. This exercise was found to be very useful by several countries as it helped to increase their knowledge on sources of evidence to assess marine litter in their own countries. In many cases the process proved to be very demanding due to difficulties to trace and access relevant information at a national level, highlighting the need to improve coordination and communication.

MARLISCO provided a summary of methods for monitoring and assessment of marine litter as a guide for other MARLISCO activities, aiming to promote a participatory science approach (Maes and Garnacho, 2013). This guide was considered very helpful as there are significant efforts made by NGOs and the public for beach clean-ups and other activities that could potentially provide valuable information if they are using the proper methodology. A review of existing policies and legislative frameworks aiming to mitigate the impact of marine litter was also elaborated by MARLISCO (Kershaw et al 2013b). This review considered legislative instruments and highlighted the effectiveness of non-legally binding initiatives and the need for a change in the behaviour of organisations and individuals. The main policy gaps indentified were as follows: lack of specific national legislation on marine litter; lack of implementation and enforcement of existing legislation in all European countries; need for a greater coordination for proper law implementation; need for a competent authority to specifically oversee the marine litter framework; lack of systematic knowledge on existing rules among several stakeholders; lack of well established strategies to be followed at national and local level (selection of main measures to be adopted); absence of reference to marine litter in some Directives (UWWTD, BWD, WFD); inadequate landfill practices, and lack of measures to address the problem at a transboundary level.

There are important aspects regarding the impacts of marine litter that need further clarification in order to update and deepen our understanding of the risks linked to marine litter. Such uncertainties have been recognised in MARLISCO and discussed in national fora activities. For example, there is

evidence that some marine organisms contain chemicals that are used in plastics (Fossi et al, 2012; Tanaka et al, 2013) but it is not entirely clear how these organisms have acquired the chemicals. In addition to chemicals incorporated during manufacture that could leach out, it has been shown that plastic debris can adsorb and concentrate contaminants such as persistent organic pollutants (POPs) from the water column (Teuten, 2009; Mato, 2001). Furthermore, it is essential that new materials that are designed to have enhanced environmental performance be fully tested along their entire life-cycle before being released onto the market. The dangers of not doing so are already apparent in some industry-centred responses such as the development of 'degradable' plastic products. Whilst such products may be designed with good intentions, they merely fragment at the end of their life time into numerous small but essentially non-degradable pieces, the environmental impact of which is not yet known (Roy et al, 2011).

6.2 Assessing the perceptions and attitudes of European society on marine litter

Understanding societal perceptions and evaluating communication and engagement with different stakeholder groups is critical in order to develop better strategies to improve understanding about the problem and solutions surrounding marine litter and influence behavioral change. Yet surprisingly little is known about this. MARLISCO sought to assess society's perceptions about marine litter and evaluate the impact of a number of educational and engagement activities with a range of stakeholder groups across Europe. To achieve this, MARLISCO developed social surveys applicable to a variety of participants, including children, the general public and educators.

MARLISCO conducted an extensive European-wide survey on awareness and perceptions about marine litter. More specifically, the survey sought to examine individuals' understanding about the quantity, location, causes and consequences of marine litter, perceived risk and responsibility, and intentions to engage in solutions. The survey was launched in 16 coastal countries targeting key sectors, including the manufacturing industry, retailers, coastal and marine industry, waste management, government and policy makers, environmental organizations, the media, the education sector and the general public. A total of 3876 respondents completed the survey, and results enabled a better understanding of the barriers and opportunities in understanding this issue and engaging in effective solutions. According to the survey results (Hartley et al, 2013; 2015a) 87% of respondents agreed that "marine litter is an important problem"; 88% of respondents disagreed that "marine litter is only a problem for coastal communities"; 23% of respondents agreed that "marine litter is a future environmental threat rather than a present one". In other words, people are concerned about marine litter overall and acknowledge that it is a problem for everyone, but are somewhat inclined to see it as a future threat. Further analysis of the survey results reveals that people's knowledge can often lag behind the state of scientific data, even despite much media coverage of the issue. For example survey respondents correctly identified that the majority of items of marine litter are plastic, but still greatly underestimated the actual percentage of marine litter that was plastic – and this was true across a number of stakeholder groups.

A fundamental component of the MARLISCO project was the evaluation of the educational and engagement activities that were conducted between 2012 and 2015 with a number of stakeholder groups. Throughout the evaluation process, MARLISCO applied principles and methods from the social sciences in the design and implementation of social surveys to measure the impact of participation in the national fora, video competition, public exhibitions and an E-learning course to accompany pedagogical resources for educators.

The evaluations helped assess whether and how each activity changed people's understanding, attitudes and behaviour. For example, the national forums were evaluated with a short survey that participants completed before and then again after they attended the event. It was designed to assess participants' level of concern, feelings of efficacy, responsibility and motivation, perceptions about

solutions and their personal intentions to engage in actions to reduce the potential causes of marine litter. A similar 'before-after' method was implemented to determine the impact that the video competition had on youngsters' understanding of the causes and consequences of marine litter and their level of action. Another survey was developed to evaluate whether MARLISCO's e-learning course and educational pack increased educators' understanding of the issue and their level of confidence, motivation and intention to integrate the topic into their formal or non-formal teaching practice. Finally, the survey developed for the public exhibitions provided a snapshot of what visitors recalled as the most memorable aspect of the exhibits, and recorded their level of concern about marine litter and the number of action pledges they were prepared to make.

The evaluation of MARLISCO activities demonstrates the potential for engaging different populations (the general public, children, educators and key stakeholders) in order to raise awareness about marine litter, increase understanding and encourage commitment to solutions. Detailed results from each survey evaluation are presented in MARLISCO's evaluation report (Hartley et al, 2015b). These findings contribute to informing recommendations for effective communication and engagement with stakeholders about marine litter, and support future efforts to influence attitude and behavioural change (Hartley et al, 2015a). It is crucial that educational activities are evaluated in order to gauge their success and provide an evidence base for future design and practice.

6.3 Showcasing best practices towards effective actions

As with other complex environmental issues, the marine litter problem is not always related to a lack of knowledge, but rather on how to use this knowledge and create incentives to actually transform knowledge into action (Naustdalslid, 2011). It is important to demonstrate that it is possible to move towards better practices and effective actions, through enhanced co-responsibility across the different sectors of society and fostering synergies between sectorial policies and key actors. To achieve this, MARLISCO identified and compiled a series of examples of such initiatives and policies (Fig. 1) from all the countries covered by the project and elsewhere, using the extensive network of the project's consortium to do so. These practices are implemented by a range of stakeholder groups (local authorities, public bodies, fishermen and their associations, NGOs) and address marine litter in different phases of its lifecycle (from prevention of waste to collection of litter from the marine environment).

The 72 recorded practices were collected, analysed and evaluated in terms of their effectiveness, sustainability (environmentally, economically and socially) and potential to be replicated. These practices are publically available in a data-base within the web-portal (www.marlisco.eu) and searchable via a series of criteria.

The practices were evaluated by a panel of experts representing key actors in the marine litter issue. These experts favored preventive measures over mitigating actions, as well as practices with a proven track record and that took an integrated approach to solving the marine litter problem. The involvement of key stakeholders through a participatory approach early on was also appreciated, since this gives stakeholders a sense of ownership of the problem and its solutions, and thus increases their commitment to address it. The experts also showed a preference for practices that have a high degree of social responsibility and practices that involve the public and promote active citizenship. Practices that are supported by a local administration were also preferred, as they were considered more sustainable.

An analysis of policy or regulation related to the recorded practices shows that if they are properly implemented and reinforced, they can be very successful tools for the reduction of marine litter, particularly if they focus on prevention. However, regulatory instruments must be complemented by initiatives that have an awareness-raising character. Policies alone are not enough to raise awareness,

deepen the understanding about the problem or emphasize the need to take action to a wider audience. Measures should take a well-rounded, integrated and holistic approach to the issue of marine litter, one that includes a range of activities, covers a variety of themes and involves a range of different actors.

A successful example of an economic market-based instrument enforced by regulation is the plastic bag levy. In Ireland, this was introduced in March 2002, to discourage the use of plastic bags. Charged at €0.15 per bag, the levy reduced the number of bags entering the consumption stream by approximately 94% according to S. McDonnell (unpublished thesis) in just a few years. This resulted in annual revenues in the order of €12–14 million, which were ring fenced into an environment fund operated by the Department of the Environment, Heritage and Local Government, to be used for defraying the costs of administration of the levy and the support and promotion of a variety of environmental programs (Convery et al, 2007). Most importantly however, the levy influenced main stakeholder (the public and the retail industry) behavior with the majority of them supporting its implementation (Poortinga et al, 2013).

Another particularly successful practice is the voluntary scheme "Responsible Snack Bars" in Spain. This project, which was launched by the Biodiversity Foundation of the Spanish Ministry of Agriculture, Food and the Environment, aims to encourage environmentally friendly behavior in "chiringuitos" (traditional beach snack bars) through the promotion of a "Decalogue of Good Environmental Practices". In order to promote this "Code of Conduct" and its adoption, the Spanish Biodiversity Foundation contemporaneously launched the responsible snack bars awards, focused on awarding those activities that are considered exemplary. Over the first edition of the project, 526 snack bars have joined the initiative. The project was considered a great success and its second edition has been launched.

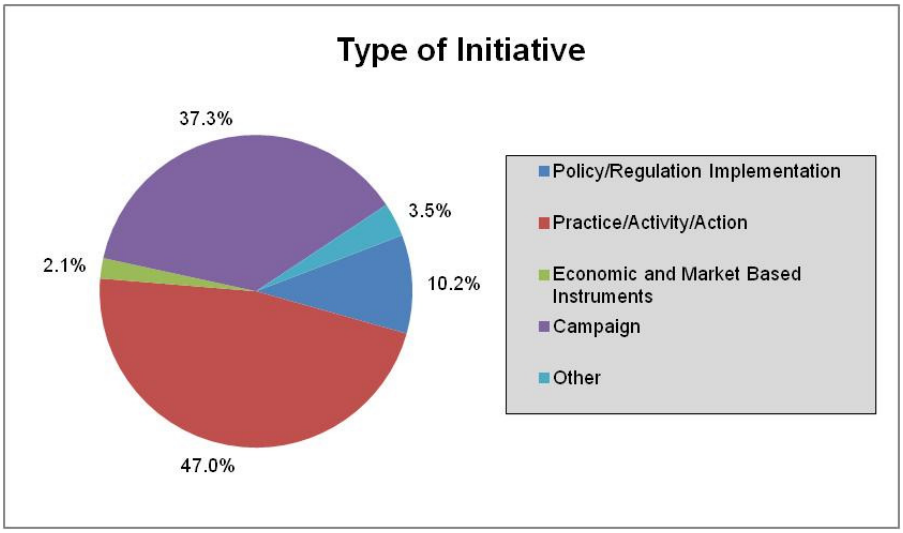

Figure 1. *Type of initiative of the 72 examples of good practices collected in MARLISCO*

A range of programmes have been implemented throughout Europe that focus on empowering the general public to take action against marine litter or to be actively engaged in waste prevention and management. One such example is the Blue Lid Campaign that was initiated in Turkey. This campaign encouraged the centralised collection of blue plastic lids from bottles that were sent to the initiators (the Faculty of Dentistry of Ege University and the Spinal Cord Paralytics Association of Turkey), who would in turn sell them to a plastic conversion company. The proceeds from this sale were used to buy wheelchairs for those who could not afford them. Without much publicity, the project managed to collect over 500 tonnes of plastic bottle lids and to provide over 2000 wheelchairs, without any

external funding, while at the same time encouraging the collection for recycling of an item that could be disposed in another way.

Such actions are very encouraging and show that when it comes to the issue of marine litter, the general public is not a passive receiver of information but can be an active player and a key part of the solution. This is also supported by the fact that most of the recorded best practices (45.8%) were initiated by non-governmental organisations and civil society and a significant portion of practices (13.9%) were initiated by private entities (Fig. 2). The success and expansion of such initiatives shows that increasingly people are becoming aware of the problem and are taking action to solve it.

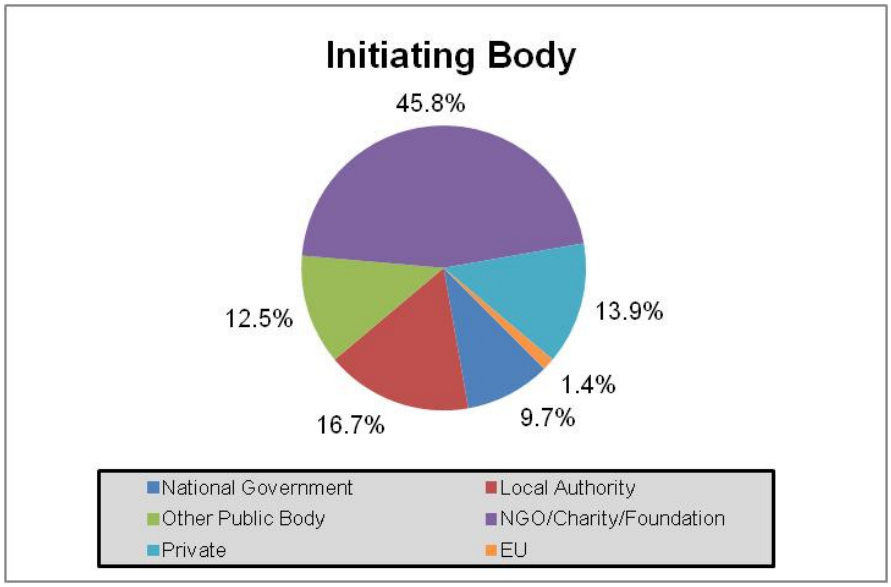

Figure 2. *Initiating entities of the 72 good practices collected in MARLISCO*

MARLISCO only recorded a relatively small number out of the many practices that are being implemented around Europe, but even so, they show that a plethora of actions are taken by a variety of stakeholders. This MARLISCO database can serve as a starting point, a learning platform and a source of inspiration for anyone wishing to take action towards solving this important environmental, economic and social problem. Complementing the web-based database, a Guide for Reducing Marine Litter (http://www.marlisco.eu/best-practice-guide.en.html) provides additional information on how to turn these practices into action (Orthodoxou et al, 2014).

6.4 Empowering society through national fora

One of the key activities of MARLISCO was the development of national platforms (fora) for structured dialogue between key stakeholders, relevant experts and the general public on the topic of 'marine litter: developing solutions together'. The MARLISCO Marine Litter fora had the objectives:

- ✓ To provide participants and stakeholders with the necessary scientific information in an accessible format so that both the scale of the marine litter issue and the difficulties in providing long-term solutions given varying levels of public perception of the problem and the technical, economic and waste management policy constraints on industry can be appreciated.
- ✓ To afford the opportunity for stakeholders to become more informed on the issues associated with marine litter and its impacts at the national and regional sea level, and

- ✓ To provide an opportunity for stakeholders to participate in debates and actively contribute to providing viable solutions to this serious problem.

A common format for 12 national events was successfully implemented across Europe between April 2014 and April 2015. The format was designed, trialled and first applied in Ireland in April 2014. The developed format was modelled on participatory methodology developed for the MARGOV fora (Vasconcelos and Caser, 2012) promoting large-scale public involvement. The MARLISCO fora format was designed to be flexible allowing individual MARLISCO partners to modify aspects to take advantage of unique national characteristics, to react to relevant on-going and/or current events in their countries and to incorporate lessons learned between events and incorporate improvements (Kopke et al, 2015).

A novel feature of these events had been an on-line webcasting element which led to the development and use of a Running Order (a document used in live broadcasting to describe the order of events in detail [minute by minute], the general dialogue and who is speaking when and where), which was seen as one of the key enablers towards the success of the Irish forum (Kopke and Doyle, 2014) and was used in the subsequent events across Europe.

To allow accessible transfer of the latest scientific knowledge, the MARLISCO fora included interactive activities for participants (e.g. table quiz and hands-on activity). These activities were used to communicate key messages to fora participants but also to generate and promote dialogue between all participants. In addition, an animation *Sources and Impacts of Marine Litter*, which premiered at the Irish event, was specifically developed for all MARLISCO fora to facilitate knowledge transfer (Kopke and Doyle, 2014).

One innovative element of the MARLISCO fora is the use of 'venue teams' that are present at the event and remote 'satellite teams'. The two types of teams (venue and satellite) are ideally composed of five participants per team to keep the dialogue effective, as smaller teams are associated with higher performance and shorter decision making durations (Katzenbach and Smith, 1993).

Using a consensus approach, which is linked to higher quality decisions and greater satisfaction within a group and in turn better acceptance of group decisions (De Dreu and West, 2001; Yang, 2010), each team was asked to work together in a group and come up with actions, ideas and suggestions that may help to address the problem of marine litter in their country. Using this approach the stakeholders were able to bring their unique experience to the table and work together through knowledge exchange and consensus building, in order to develop suggestions that were agreeable to the entire group (Kopke and Doyle, 2014).

Once actions were submitted by all teams, participants were asked to vote which action they thought was the most 'effective measure' and which action they felt was the 'most implementable'.

The MARLISCO Marine Litter fora engaged about 1540 stakeholders across Europe with 644 live audience members attending and reaching approximately a further 896 online participants though the interactive live webcasts. Forum participants across Europe represented a wide range of sectors, which provided an opportunity to utilise sector specific knowhow during the event and allowed for mutual learning between forum stakeholders (Kopke et al, 2015). Participants' pre- and post-event perceptions were assessed and indicated that the fora were viewed as a positive experience and after participating, individuals felt significantly more responsible, more able to help, and that their actions would be more effective compared to before the fora. Participants' intentions to engage in several solutions to reduce marine litter also increased.' (Hartley et al, 2015b). The outcomes of the individual fora provide informed views about how to address marine litter issues in participating countries. In summary, across all events the fora outcomes present a snapshot of informed stakeholder opinions on marine litter across Europe (Kopke et al, 2015).

In all twelve national events the majority of submitted actions, suggestions and ideas relate to recognised concepts and approaches that address issues of waste and litter in general, indicating that the overall approaches such as increasing Education/Awareness, Appropriate Disposal of Waste and the Reduce, Reuse, Recycle, Recover and Redesign concepts are well known and are appreciated to work. But it is also clear that participants across Europe perceive that more and more defined measures and actions are required to specifically address issues of marine litter. The largest amount of fora submissions across all events link to concepts of increasing education and awareness about marine litter, highlighting that fora participants perceive a general lack of knowledge about the subject, a matter that needs to be addressed to successfully tackle marine litter in countries that implemented a marine litter forum (Kopke et al, 2015).

Channelling the input and perspective of the regional seas into the fora and vice versa, proved very useful. The outcomes of the fora contributed directly to the formulation of the OSPAR Regional Action Plan, confirmed that the Regional Plan for Marine Litter Management in the Mediterranean was on the right track, linked to the HELCOM related agenda and provided a foundation for further dialogue in the Black Sea.

One of the really interesting aspects of this stakeholder engagement has been the mutual learning that has come to pass not only between MARLSICO partners, but mutual learning between the fora participants as well as between project partners and fora stakeholders. This added knowledge coming from the fora stakeholders helped develop the content and format of the forum in Ireland and also influenced subsequent events, where stakeholders and potential participants of events influenced aspects of the overall format, which were adjusted to include stakeholder knowledge.

6.5 Children as agents of change in Society

Children can be powerful agents of change in society, not only because they represent the next generation of consumers and decision-makers but because they can inspire and influence directly the behaviour of their families and even their close community (Vaughan et al, 2003). MARLISCO foresaw a specific activity to engage youngsters, and trigger awareness and critical thinking by doing – it organised and launched a video competition targeting young students in 14 of the countries involved in the project. The competition encouraged youngsters to develop short videos about the issue of marine litter, related to or combining the topics of: - Where does marine litter come from and why is it a problem? - What can be done to help solve the problem? - What has been done in our school/local community to deal with this issue?

The MARLISCO Video Contest targeted formal and/or informal groups of students (e.g. school classes, scout groups), mainly between 12 and 18 years old. A common framework, timeframe and set of conditions to regulate the competition were developed for all participating countries but were adjusted and implemented at the national level, by the respective MARLISCO partners, which defined the age-range and school levels to target, based on the suitability of the contest and its themes to the school curricula and activities. The contest was officially launched in September 2013, in line with the beginning of the school year, although information about the contest had been sent before the end of the previous year (around May 2013), when teachers start to define activities for the following period. Participants had approximately 5 months to submit their works. The project provided resources to support a limited number of school teams in every country through professional technical support on video production, mainly as workshops attended by students, during different phases of the video elaboration. This helped addressing potential logistic and technical capacity weaknesses in these institutions and provided an added-value for this initiative, as schools receive multiple invitations to take part in activities such as this every year.

National Juries were set-up in the participating countries to select the best national video and other categories defined by partners (e.g. the most informative video). In order to have the wider public engaged and to foster the dissemination of the videos, an intermediary step in the video selection process to capture public preferences was organised, with a sub-set of the national videos going on "public voting" on Youtube. National events were organised, where the national winners were announced and prizes attributed. A final multimedia product has been developed featuring all of the 14 national winners, with English subtitles and including an interactive menu that allows the user to choose the videos, together with a short video introduction, which showcases the national winners.

In terms of results, across the 14 participating countries, 135 institutions were directly supported and 379 videos were submitted to the MARLISCO Video Contest. This reflects a total of 2123 youngsters between 7 and 18 years old that were actively involved in the making of these short films. The dissemination of the candidate videos in social networks, such as Facebook, during the "public-voting" period, allowed for a wide out-reach, with some of the videos reaching 1.000 "views" within the first week.

The "teaser" that showcases the winning videos was premiered during the plenary session of the 7th European Maritime Day Ceremony (EMDC) in Bremen, Germany, a high-level stakeholder event organised by the European Commission, with over 1300 participants registered. The teams behind each of the 14 winning national videos were invited to take part in the EMDC event and a 2-day joint, intercultural and facilitated programme in the city of Bremen, organised by MARLISCO. Eighty young people in total from 13 different countries in Europe took part and had a very interesting and rewarding experience, not only because they received public recognition during such an event but also for the socio-cultural opportunity to meet and interact with other international youngsters.

Close to the conclusion of the project (May 2015) the 14 winning videos had received a total of approximately 33.500 views on Youtube, had been screened at 6 European events and over 30 national ones, including most of the MARLISCO National fora and at some of the venues of MARLISCO exhibition.

Following the assessment of the impact of this activity (Hartley et al, 2015b), the participation in the Video Contest resulted in an increase in the youngsters' concern about the problem, their understanding of the various causes and negative impacts, and their practical actions to reduce marine litter (Hartley et al, 2015c).

The participants in the MARLISCO Video Contest were later encouraged to submit their videos to the Youth Making Ripples Film Competition (based in the USA) and 2 entries were the winners of the categories 'Best Scientific Message-High School and the 'Viewer's Choice'.

In conclusion, the issue of marine litter seems to be an appealing topic taken up by schools – not only as a subject that is easy to communicate and understand but that can be approached through a combination of disciplines – e.g. biology, chemistry, sociology, psychology, hydrology, economy or even mathematics. In addition, participation in the video contest brings in other important educational approaches, such as arts and creativity, use of technology and multimedia tools, development of narratives and critical thinking about an environmental and social issue. The European dimension of the competition, in particular because it included the gathering of the winning teams from all participating countries, provided a very interesting intercultural experience to the youngsters involved, brought together under a common theme and purpose. To a short questionnaire provided a few days after the gathering of the winning teams in Bremen, approximately 40% of respondents considered interacting with people from other countries & cultures as the most important aspect of the event and 75% mentioned that the experience had made them more confident in approaching and interacting with other nationalities.

When involving schools in such a competition, it is important to inform the boards and teachers with sufficient time in advance (often before the end of the previous school year), so they have the

opportunity to evaluate, plan and integrate the activity in the curricula but also support the educator with as "ready-to-use" educational material as possible. This was one of the gaps within the MARLISCO video contest, as the educational material that was foreseen to be developed in the project was only available at a later stage. The technical support provided to a number of schools, was particularly helpful for schools that had less experience with the topic or had fewer resources – i.e., those who may not have otherwise considered taking part.

The MARLISCO Video Competition is a good example of an educational activity that can foster a sense of citizenship and ownership in the younger generation and give them an active voice in such a societal problem. It represented a fun but challenging activity to youngsters, embodying the multi-disciplinary process of getting in touch with the issue of marine litter and critically thinking about possible solutions. On the other hand, the videos themselves served as tools that have been widely used to inform and trigger awareness in a wider audience - indeed in the evaluation survey, this was one of the key suggestions that children made as to what should be done next (Hartley et al, 2015b).

6.6 Awareness raising and educational tools for informed decisions and responsible behaviour

Enhanced awareness and deepened understanding of the issue of marine litter is crucial for catalysing change in the perceptions and attitudes of the different stakeholder groups, including the wider public, towards more informed decisions and responsible individual behaviours. In this context, MARLISCO undertook the development of a diversified set of awareness raising activities and educational tools, specifically an educational pack and a corresponding e-learning course targeted to educators on how to apply it; a public exhibition; a web-documentary; a brochure targeting different stakeholder groups and a 'serious game'.

The methodological approach deployed towards developing effective awareness raising and educational tools was based on the following considerations related to the information provided: that it is accurate based on sound scientific evidence, easy to access and easy to understand; that it is relevant and interesting to the intended audience; that it is delivered through appropriate channels; that it is tailored where necessary in language, style and content and it directs target audiences to where they can access further information if required. Furthermore, as depicted in MARLISCO's guide on 'How to communicate with stakeholders about marine litter' (Hartley et al, 2015a) towards influencing attitudinal and behavioural change, additional elements that guided the elaboration process of the aforementioned tools included: the provision of a sense of ownership and collective action to the target audiences; showcases of feasible immediate actions and solutions to the issue of marine litter, while keeping in mind a longer term engagement in action; framing the problem as a current one, not just a future one and overall having a solution- and action-oriented approach.

The educational pack (Alampei et al, 2014), entitled 'Know, Feel, Act to Stop Marine Litter' and accompanying e-learning course were developed to inform, sensitise and enable European teachers and students to take action and tackle the issue of litter in our seas and coasts. The educational pack, which addressed a lack of relevant pedagogical material in Europe, contains 17 learning activities examining the characteristics, sources, effects and possible ways to tackle the problem, addressing it from an environmental, social, cultural and economic point of view. Each activity consists of a specific learning task or game (4 pages) and a worksheet for students (1 page). The activities, which are designed in a flexible and adaptable format, are self-standing and can be applied separately or combined in clusters according to the needs of the educator. It was designed to primarily serve young people aged 10-15 years in formal (schools) or non-formal (e.g. NGOs, museums, youth groups & associations) educational settings. This material is complemented by an asynchronous e-learning course, based on the principle of adaptive collaborative learning, targeted to educators on how to apply this material in their teaching.

An attractive and engaging exhibition was designed in collaboration with national artists, aiming to inform and inspire action in the general public with scientific information. A series of posters and interactive exhibits documented the composition, sources, and impacts of marine litter and possible solutions to tackle the problem and were exhibited in a range of locations, including museums, aquariums, galleries, and outdoor areas. The exhibition was translated in all partners' national languages and was adapted to their regional and national contexts. It was designed in such a way so as to allow easy transportation, indoor or outdoor set-up, and has been travelling ever since in the 15 involved countries (http://www.marlisco.eu/exhibition-journey-map.en.html).

In order to address the diverse needs of individuals in relation to differences in motivation, attitudes and responses towards learning and learning styles (Lee et al, 2014; Kassim, 2013), MARLISCO produced two web-based multimedia tools, a web-documentary and a 'serious game' for youngsters, both offering an interactive learning environment. 'Serious games', that have been found to be popular and fairly effective, use interactive digital technologies for training and education, include role-play experiences, create immersive simulations for exploring real-world events or processes and promote adaptive thinking (Raybourn, 2014). MARLISCO's serious game entitled the 'Sea Dream Team' immerses the player into a marine litter related learning experience. The player, by choosing among eight different characters representing key sectors with a share of responsibility in generating marine litter (e.g. fisherman, beach-user, etc.), encounters various situations revolving around marine litter and is asked to explore and make decisions and behavioural choices. The web-documentary entitled 'Troubled Waters' demonstrates best practices and concrete solutions to address marine litter in an interactive manner. Unlike traditional audiovisual documentaries and the linearity they present, with the viewer following a path predetermined by the author, in the interactive web-documentary the boundaries of the authorship and control over the discourse are loosened. Interactive documentaries, in addition to more cognitive interpretation, require interaction related to decision-making involving movement around the virtual scenario, thus resulting in a different engagement of the viewer (Gaudenzi, 2009). MARLISCO's multimedia tool, featured on the portal, is composed of audiovisual elements and text, allowing the user to navigate and access some of the activities carried out throughout the MARLISCO project, while also discovering some of the best practices promoted by MARLISCO. It is an interactive journey into the project results and inputs.

Last but not least, a brochure, entitled 'Stopping marine litter together! Each and every one of us can contribute in keeping our coasts and seas litter free!' (Vlachogianni et al, 2015) has been developed, targeted to citizens mainly in their professional capacity but also as individuals. The economic sectors that are addressed are tourism, the maritime and wider manufacturing sector. It provides essential information on the marine litter issue (sources, composition and impacts) and suggestions on how one can contribute to tackling this growing pressure. The aim is not only to instil a sense of co-responsibility within the various stakeholder communities as co-contributors to the marine litter problem but also to foster a sense of empowerment and take up of individual and/or collective actions.

Among the key challenges of this cluster of activities has been the 'selection' and 'transformation' of the current state-of-the-art knowledge into relevant and informative, but also motivating and engaging, awareness-raising and educational tools. Furthermore, given the broad geographic project outreach, the different national and regional specificities and context had to be taken into account, while articulating efforts within the diverse and multidisciplinary group of people in the MARLISCO partnership. The latter was particularly taken into account during the development of the educational pack in order to accommodate the needs of the teachers in the various European countries.

Insights in the effectiveness of a few of the aforementioned outreach and educational tools are included in MARLISCO's relevant report (Hartley et al, 2015b):

Results from the survey designed to provide a snapshot of visitor perceptions at the European-wide exhibition indicate that the majority of visitors to the exhibition reported being extremely concerned about the issue. Visitors also made many pledges to take actions to reduce marine litter and be part of

the solution – of the 1842 visitors surveyed at the exhibition between 2013 and 2015, 88% pledged to avoid using plastic bags in the supermarket, 74% pledged to buy items with less packaging, and 52% pledge to encourage family and friends to make similar changes that will benefit the environment. These findings indicate what the European general public will pledge to do to reduce marine litter when visiting and learning about the issue. However, due to the nature and layout of the different exhibitions across Europe and many locations, there was not always precise control over when visitors would complete the survey (i.e. when they arrived, during the exhibition, or when they were leaving) and it is worth noting that these visitors may have been a selective sample.

When it comes to the e-course that sought to train educators on how to use the Educational Pack, build confidence and intent to integrate marine litter education and the pack itself in their teaching practice, the evaluation survey indicated that the e-course was an excellent tool to build the capacities of educators in applying the educational pack and enable them to integrate marine litter into their teaching. Starting from the contents of the educational pack as basic teaching material the course treats learners as experts that bring in their own ideas to share with others and results in jointly generated outcomes for which the learners feel a high level of ownership. The e-course provides resources, techniques and ideas to facilitate teaching whilst increasing the confidence level of the trainees (Hartley et al, 2015b). This form of training allowed some 190 educators (via two rounds) from across Europe to work together and communicate best practices and ideas. The very high completion rates of the e-course together with the high level of course content satisfaction of the participants, led the MARLISCO consortium to the decision to undertake one more round of the e-course, right before the closure of the project reaching out to some 320 educators in total (from all three rounds) coming from 15 European and non-European countries.

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7 DISTILLING MARLISCO'S LESSONS LEARNED AT THE SCIENCE-SOCIETY NEXUS

MARLISCO was set up to help understand and address some of the barriers that seemed to hinder an effective response from society on the issue of marine litter but also to identify ways to overcome them. Despite the specificities of the marine litter issue, the experiences gained while implementing MARLISCO's wide range of activities on the science-society interface offer useful insights that are applicable to many other societal challenges.

The main lessons learned from MARLISCO interactions among and between different actors across Europe on the science-society interplay are depicted below:

- ✓ Good framing of the issue at stake, on the basis of consolidating the various scientific views and integrating multi-disciplinary perspectives, is key towards providing a solid knowledge basis to feed into all awareness raising, public engagement and empowerment actions. Identification of the knowledge uncertainties and gaps, as well as debunking the most popular 'myths' and misconceptions on the issue, contribute substantially in forming a good starting point.
- ✓ Understanding and assessing the perceptions and views of the involved stakeholders before designing communication and engagement attempts is imperative. This increases considerably the potential of stakeholder engagement and action.
- ✓ The transformation of knowledge into simplified information and/or easily digestible messages should not be warped by the emotional appeals approach favoured very often by communication & media experts. Emotional appeals may attract immediate attention but may undermine the message itself.
- ✓ Given the diversity of stakeholder profiles in terms of motivation and interest as well as responses towards learning and learning styles, there is a need for a pluralistic, diversified approach when designing awareness raising and public engagement tools and mechanisms.
- ✓ Stakeholders are knowledge agents themselves and treating them as such not only fosters trust which is key to mobilizing action but also leads to more creative and dynamic solution identification and problem solving approaches.
- ✓ A solution oriented approach when communicating the problem at stake coupled with concrete showcases of feasible actions has a greater impact in terms of triggering action.
- ✓ To facilitate the transfer of state-of-the art scientific knowledge, interactive, hands-on and experiential activities should be performed in a dynamic mutual learning environment.
- ✓ Activities should take account of local specificities while linking to national and/or regional and international efforts, creating in this way a sense of broader participation, a momentum that fosters citizenship, co-responsibility and empowerment towards taking up individual and collective actions.
- ✓ Great outreach and momentum can be achieved by complementary and/or simultaneous engagement activities targeted to various stakeholders and strata of society, often having an amplification and multiplier effect.

8 CONCLUSION

In conclusion, the overall MARLISCO experience underlines one major factor that is key to any kind of successful endeavour undertaken at the science-society interface or elsewhere, which is the strong motivation and commitment of skilful partners, receptive of mutual learning, gradually yet-surely evolving into a task force with a joint mission to combat marine litter. Having said that it should be noted that considerable time and effort was invested in reaching a common level of understanding about this complex societal problem and how it should be addressed. Factoring into large scale project design, such as MARLISCO, adequate time and appropriate mechanisms for multi-disciplinary partnerships to mature and become fully functional increases the prospects for obtaining maximum performance and cost-effectiveness.