



Municipalities for Sustainable Seas



Marine Litter at UNESCO World Heritage Marine Sites



M. Mannaart, A. Bentley, G. McCord & J.J. Midavaine

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Marine Litter at UNESCO World Heritage Marine Sites

Client: Common Wadden Sea Secretariat, Virchowstrasse 1, D-26382 Wilhelmshaven
T +49 (0)4421 9108 15 | M +49 (0)160 89 40 472
waddensea-secretariat.org | waddensea-worldheritage.org, UNESCO World Heritage Sites

Authors: Michael Mannaart, Arabelle Bentley, Grioghair McCord & Jan Joris Midavaine

Date: 10 March 2019

KIMO International

8 North Ness Business Park,

Lerwick, Shetland

ZE1 0LZ

United Kingdom

Telephone: +44(0) 1595 744807

Mobile: +44 7733 112349

Website: www.kimointernational.org

Twitter: @KIMOInt

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Preface

The world's oceans are of utmost importance to the planet as a whole. The 1972 World Heritage Convention unites nations behind a shared commitment to preserve the world's outstanding heritage for the benefit of present and future generations. It recognizes that the protection of these exceptional places is the duty of the international community as a whole and it ensures that the preservation of these special sites becomes a shared responsibility. The UNESCO World Heritage List includes 49 ocean places – distributed across 37 countries – recognized for their unique marine biodiversity, singular ecosystem, unique geological processes or incomparable beauty of Outstanding Universal Value.

An important threat to these sites is marine litter. But what is the nature and extent of the problem at the sites and what can be done about it? In order to assess this, a literature review on the sources, magnitude and effects of marine litter has been conducted. Subsequently, a survey with managers of the World Heritage marine sites was conducted to assess what the current situation is at site level. In November 2018, the outcomes of this endeavour fed into a workshop among managers and practitioners from World Heritage marine sites to foster a discussion on the issue. Actions are needed. Marine litter has no boundaries and its impact on the natural environment is global in scale.

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Summary

The 1972 UNESCO World Heritage Convention unites 193 nations behind a shared commitment to preserve the world's outstanding heritage for the benefit of present and future generations. The UNESCO World Heritage List includes 49 ocean places – distributed across 37 countries – recognised for their unique marine biodiversity, singular ecosystem, unique geological processes or incomparable beauty. The disappearance of these World Heritage marine sites (WHms) would be an irreversible loss to humanity. These sites are under multiple pressures, of which one specific topic has a global impact: marine litter. But what is the impact of marine litter on WHms and their Outstanding Universal Value? In November 2018, a dedicated workshop was organised to document and share the experiences and good practices from the people in the field, the managers from UNESCO World Heritage marine sites. In order to facilitate the workshop on marine litter in WHms an assessment was made comprising literature research and a survey with the managers from WHms. This assessment focused on the causes, magnitude and nature of marine litter and its effects on WHms and their nature values. The outcomes of both the literature review and the survey are presented below.

Results of the literature review

The world's oceans contain around 150 million tonnes of plastic¹. The sources of this marine litter are land-based, riverine, sea-based and airborne. A plethora of activities spanning the entire value chain lead to the release of plastics into the environment. Deliberate and accidental release, spillage and dumping on land, in rivers, at sea, the oceans and in the air contribute to pollution levels. There is interaction between these different pollution vectors due to overlapping transport pathways and the long lifespan of the material. Since most of the water flows to the seas, high levels of plastic pollution are found there. Although plastic parts can be big or small when released into the environment, all will eventually fragment to the level of so-called nano-litter of a microscopic size. Many sea-dwelling or sea-dependent species suffer from plastic pollution, especially through entanglement and ingestion.

A large number of marine litter monitoring systems have been created in order to assess marine pollution. These monitoring systems can be sub-divided into four main survey types: floating litter, beach litter, benthic litter and riverine litter (in case a river discharges at or near the WHm site). An all-comprising system for marine litter monitoring

¹ World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, 2016

that can be applied globally is not yet developed. A harmonised science-based monitoring and assessment programme has not yet been developed on a global scale. However, the UNEP/IOC “Guidelines on Survey and Monitoring of Marine Litter” could form the basis for a harmonized monitoring system that is applicable in all relevant habitat types of the sites, varying from e.g. ice shoes to sea grass beds, coral reefs, mangroves, mud flats, sandy beaches and rocky beaches.

A considerable number of actions addressing marine litter pollution exist. Since waste has no boundaries and the many sources of marine litter are in every corner of society, a global, integrated waste management approach is needed.

Measures aiming at altering the value chain of production, consumption and waste recycling are key to solve the root causes of the problem. However, development of these measures is relatively recent and their implementation is a very complex and a difficult task due to social, legal and economic issues involved. At national or regional level, measures like environmental labelling and stakeholder engagement programmes aiming at the prevention of pollution (often combined with clean-ups as well) are being implemented. Most of the measures applied are end-of-pipe solutions, aiming at removing marine litter already present in the environment. Examples are cleaning up operations like beach-clean ups, collecting waste from the seabed by fishing vessels or removing waste from the water column. At the local level technical solutions for cleaning up the marine environment are used to prevent litter from entering specific areas or to collect litter on the spot.

Results of the survey

In response to the survey that was sent to 49 World Heritage Marine sites, 49 responses were received reflecting the situation in 46 WHms. The summarised conclusions of the research questions are presented in this section, which reflect the opinions of the management teams of the participating WH marine parks. In case more than one answer has been provided these are presented in order of prevalence.

1. All of the 46 World Heritage marine sites that responded indicate that marine litter is present at their site.
2. Marine litter affects a broad range of organisms in the WH marine sites. This impacts both plants and animals present at several depth levels at sea, on land and in the air.
3. An important topic that was raised is the lack of knowledge about the effects of marine litter on organisms, the Outstanding Universal Value and the local economy. The magnitude, nature and effects of micro-litter and nano-litter are not known either.
4. Marine litter impacts the local economy, it makes sites less economically attractive.

Results of the survey continued:

5. The respondents indicated that they consider the main sources of marine litter at the sites to be shipping, fisheries, local sources, riverine input, and other sources.
6. Of the 49 WHms, 26 indicated that marine litter monitoring is carried out at their site. All systems applied focus on macro-litter. However, monitoring methodology, frequency, habitats monitored, the kind of information collected, the people who conduct the surveys, the format of data storage, the period of data collection and the accessibility of the collected marine litter data differ.
7. Marine litter in sites is addressed by measures such as beach clean-ups, prevention by means of awareness-raising campaigns, mitigation measures and other measures. A minority of the respondents mentioned that at their sites no action is being taken.
8. Marine litter that is collected at sites is disposed of at landfills, by recycling, incineration and other measures.
9. The disposal of the marine litter is in most cases paid for by (in order of prevalence): local authorities, national authorities, external funding and other means of funding. A small percentage (13%) stated that no collection nor disposal is carried out.
10. Key reasons for the littering problem perceived by the managers are a lack of public awareness, carelessness/premeditation, other reasons and a lack of proper dumping sites.
11. Regarding the approaches that might help tackle the littering problem, most of the managers from WHms suggest education and awareness campaigns as a solution, while waste valorisation and enforcement are regarded to be of importance as well. Waste disposal and other approaches were also mentioned.
12. According to the managers from WHms, UNESCO's World Heritage Centre could help reduce the impacts of marine litter in the World Heritage Sites by (in order of prevalence): awareness raising, campaigning and projects, funding, sharing of best practices. Also mentioned were robust waste management and robust monitoring, targeted clean-ups and legislation.

Recommendations

When it comes to addressing marine litter effectively at WH marine sites a two pronged approach is needed: one at the international level and one at the local, the WHm site level.

International approach

Address the sources of marine litter: since this involves the entire global value chain, this needs to be done at international level. A united and aligned approach could be beneficial from a political and financial perspective. Three main actions at the international level are needed for which participation of the international community would be beneficial:

1. *Awareness raising and education* are important instruments to achieve common understanding of the problem of marine litter and the role that society, producers and consumers play.
2. *Promotion of the development of (international) policies and legislation* to prevent the production of plastic waste, by addressing the value chain.
3. *Facilitating the implementation of policies, legislation and funding* to prevent the production of marine litter, its abatement and clean-up are areas where both UNESCO and UNEP can play a role. This should also be linked to the needs of specific networks with local components like the network of World Heritage marine sites.

Develop a standardised marine litter monitoring system as a knowledge base. Such a system needs to:

1. Be applicable at all World Heritage marine sites and thus account for the habitat types present that include: sandy beaches, coral reefs, rocky shores, mangroves, pebble beaches, dunes, seagrass meadows, estuaries, cliffs, mudflats and salt marshes.
2. Include a harmonised categorisation of the marine litter items.
3. Include protocols for the assessment of the water surface, seabed and land-sea interface (e.g. beach, mudflat, mangroves), and when applicable riverine monitoring in case a river empties in or near the WHms.
4. Include protocols for assessing macro litter, micro litter and nano-litter and allow comparison of the state of play of the different WHms.
5. Provide a harmonised system for data storage, data accessibility and data exchange.
6. Provide guidance to the people who carry out the marine litter assessments.

Develop a standardised marine litter monitoring system (continued):

7. Make use of social media and information technology: the application of mobile phone apps for monitoring purposes linked to databases could be very useful and limit the amount of time and knowledge needed to do assessments.

The UNEP/IOC “Guidelines on Survey and Monitoring of Marine Litter” could be useful for the development of a standardised marine litter monitoring system. Contacting the authors of the guidelines about this is recommended as is assigning a group of experts to collate the current monitoring protocols and to develop these into a harmonised system.

Develop standardised protocols to determine the impact of marine litter on:

1. Outstanding Universal Value (beauty, ecology, habitats and geology) of WHms.
2. Socio-economic values of WHms.

It is recommended that research protocols are developed to determine the impact of marine litter on both the OUV and on the socio-economic values of WHms. This must be done in such a way that these protocols can be applied to all WHm sites. When this information is collected it could be useful as a tool for convincing politicians and funding agencies to help support combatting the problem.

Local approach at WH marine site level

Five steps are needed to address the problem of marine litter pollution at marine sites:

1. A holistic assessment that consists of:

- a. Determination of the types, amounts and sizes of the fractions of the marine litter present. Do this by using an accepted methodology (a methodology that is broadly accepted as a neutral methodology. It would be best if one methodology were to be applied throughout the whole network of WH marine sites but this may take a while so a choice has to be made for the meantime).
- b. Determination of the negative impact of the marine litter to the site’s environment, nature values (including Outstanding Universal Value if these apply) and socio-economic values. This is needed to convince decision makers and possible funders that marine litter really is a serious problem for WHms.

- c. Determination of the sources, pathways of transport of the marine litter and the geographical (thus the governance) level that applies.

A holistic assessment continued:

- d. Determination of barriers to addressing the sources of marine litter at the site.
2. **Definition of concrete measures** and the process needed to address the litter effectively in relation to its sources (refer to table 2). If possible try to engage important stakeholders in an early stage of the process to create support.
 3. **Drafting of a plan of action** in which the nature, magnitude and impact of the problem are described and measures and their associated processes needed to solve these. A timeline with milestones and a budget needed for the measures must be included as well. Topics like negotiations and fundraising are likely to be included.
 4. **Implementation of the measures.** The measures need to be implemented, meaning that actions or campaigns need to be started or technical solutions need to be put in place.
 5. **Monitoring of the effects of the measures.** What are the levels of marine litter and its composition at the site? Can a change be observed and if so what is the direction of this? The policy monitoring results may lead to adjustment of measures since this needs to be applied as a feedback loop.

By applying these suggestions a firm basis for further protection of the World Heritage marine sites can be achieved.

However, to be successful, cooperation across all actors, private sector, governments, World Heritage marine managers, individual WHm sites, and support by society at large are needed.

1. Introduction

The 1972 UNESCO World Heritage Convention unites 193 nations behind a shared commitment to preserve the world's outstanding heritage for the benefit of present and future generations. It recognises that the protection of these exceptional places is the duty of the international community as a whole and it ensures that the preservation of these special sites becomes a shared responsibility ².

The UNESCO World Heritage List includes 49 ocean places – distributed across 37 countries – recognised for their unique marine biodiversity, singular ecosystem, unique geological processes or incomparable beauty (see Figure 1). The disappearance of these World Heritage marine sites (WHms) would be an irreversible loss to humanity.

Despite their iconic World Heritage status, none of these iconic sites are immune to the effects of accelerating ocean industrialisation, increasing pressure for coastal development or the serious impacts from climate change. The presence of marine litter in our ocean has been extensively documented, but the impact of marine litter on WHms and their Outstanding Universal Value remains largely unknown.

To address this issue for the first time, in November 2018 a dedicated workshop was organised to document and share the experiences and good practices from the people in the field, managers from the World Heritage marine sites. These local guardians collectively have hundreds of thousands of hours of on-the-ground experience. Some sites have monitored marine litter for decades while others are currently considering setting up a marine litter monitoring protocol. Some sites have a longstanding system of regular beach clean-ups while others have only recently been confronted with a surge in marine litter.

The Wadden Sea is the largest unbroken system of intertidal sand and mud flats in the world. This World Heritage site spans three countries (Germany, the Netherlands and Denmark) and is managed by the Common Wadden Sea Secretariat (CWSS).

² <https://whc.unesco.org/uploads/activities/documents/activity-13-137.pdf>

Regional political support to address marine litter has grown, as evidenced by the 2018 Leeuwarden Ministerial Council Declaration on the Protection of the Wadden Sea which includes the following two actions:

- to substantially reduce the amount of marine litter in the Wadden Sea by the year 2030;
- to gain and exchange knowledge on sources and impacts of marine litter on the Wadden Sea ecosystem and stimulate and support appropriate measures.

In preparation for the workshop, KIMO (Municipalities for Sustainable Seas)³ was commissioned to develop a survey on marine litter in WHms. The survey was conducted in July and August 2018. The University of Oldenburg (Germany) provided expert scientific advice in the survey preparation, while the Common Wadden Sea Secretariat guided the overall process. The survey was shared with the World Heritage marine managers network in collaboration with the World Heritage Marine Programme, and obtained a response rate of 90 percent.

This report describes the background of the problem of marine litter and results of the survey. It aims to provide an inventory of reported impacts of marine litter in WHms and solutions and monitoring tools that are being used across the World Heritage marine managers network.

This final report focuses on the root causes and pathways of marine litter, as well as solutions developed at the local level to minimise or eliminate the impacts of marine litter on the Outstanding Universal Value of WHms. It will provide a decision-making tool for addressing the impacts of marine litter in WHms at the local, regional, national and international level.

³ KIMO (Municipalities for Sustainable Seas) has worked actively on combatting marine pollution since 2001 and was contracted to conduct the assessment and to guide the workshop. Examples of KIMO's activities include the Fishing for Litter Programme and coordination of projects aiming at engaging civil society in addressing marine litter: Green Deals on Fishing for a Clean Sea and Clean Beaches.

Marine Litter at UNESCO World Heritage Marine Sites



Figure 1: The 49 marine sites inscribed on UNESCO’s World Heritage List, refer to annex II for full names. (Source: UNESCO)

2. Aims and objectives

The aims of this assignment were:

- Preparation of an online questionnaire on marine litter by 1th July 2018.
- Processing of survey results and preliminary report by 15th August 2018.
- Full overview by 15th September 2018.
- Draft final report by 15th October 2018.
- Contribution to preparation and delivery of workshop on marine litter in World Heritage sites, 14th-16th November 2018.
- Final report by March 2019.

The main research questions of the survey focused on:

- The extent and the origin of marine litter in WH sites and its effects.
- The monitoring of marine litter in WH sites.
- How marine litter that is present in the WH sites is being addressed.
- How UNESCO's World Heritage Centre could potentially help managers from WHms to reduce the impacts of marine litter in WH sites.

These questions are all addressed in the next chapters.

3. Research methodology

3.1 Introduction

The locations of this research were predefined, comprising the 49 marine sites inscribed on the UNESCO World Heritage List. Therefore, no further definition of geographical distribution nor selection was necessary. As a result, the methodology applied to this research is concerned specifically with the experiences of managers from World Heritage marine sites and information presented in literature. The literature consulted described the root causes of marine litter and its pathways in the natural environment and focused on policies and measures that address the problem. Thus, this research consists of two general parts: (i) literature research and (ii) information collected from managers from World Heritage marine sites by means of an online survey.

3.2 World Heritage Marine Sites and their Outstanding Universal Value

The 49 marine sites on the UNESCO World Heritage List (as of January 2019) stretch from the Tropics to the Arctic. They span 37 countries and include (*inter alia*): coral reefs, mangrove forests, tidal flats, and ice floes. A location map is shown in Figure 1 (<http://unesdoc.unesco.org/images/0024/002468/246839e.pdf>).

A fundamental difference between marine protected areas (MPAs) and World Heritage marine sites is the international oversight that comes with monitoring, evaluation and reporting obligations for the latter. To ensure the characteristics that make up a site's World Heritage status will endure, all sites inscribed on the UNESCO World Heritage List are subject to systematic monitoring and evaluation cycles embedded in the official procedures of the 1972 World Heritage Convention⁴.

The systematic monitoring and evaluation is done against the preservation of the assets for which the site was inscribed on the World Heritage List, collectively known as its Outstanding Universal Value (OUV). OUV is the central premise upon which World Heritage is built. The OUV serves as the reference point against which the state of conservation of a World Heritage site is monitored and evaluated. OUV is the benchmark against which the

⁴ Douvere, F. and B. Adman, T. 2016. Part 1. The 1972 World Heritage Convention for ocean conservation: Past, present and future. In Casier, R., and Douvere, F. (ed.) The Future of the World Heritage Convention for Marine Conservation. Celebrating 10 years of the World Heritage Marine Programme. World Heritage papers 45. UNESCO. Pp. 11-22. <http://unesdoc.unesco.org/images/0024/002468/246839e.pdf>

World Heritage Committee makes its decisions. A detailed description of a site's OUV is adopted by the World Heritage Committee when a site is inscribed on the World Heritage List.

Natural Sites must respond to at least one of the following four criteria of Outstanding Universal Value:

1. Superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.
2. Outstanding examples of major stages in the earth's history, including the record of life, significant on-going processes in the development of landforms or significant geomorphic or physiographic features.
3. Outstanding examples of significant, ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and plant and animal communities,
4. The most important and significant natural habitats for in-situ conservation of biological diversity, including threatened species that are considered of Outstanding Universal Value from the point of view of science or conservation.

A site must also meet requirements for integrity and have adequate management in place to ensure conservation of the site's outstanding features.

3.3. Literature research

The literature research focused primarily on the causes, effects and solutions to the problems caused by marine litter that are of importance to World Heritage Marine Sites. Literature consulted included articles and books on the causes of marine littering of the natural environment, the river-sea interaction of plastic waste, biodegradation of plastics, marine management policies (for example, the EU Marine Strategy Framework Directive) and marine spatial planning. Also examined was literature describing concrete actions to prevent or remove marine litter. This information was needed to describe the background of the problem in general, linking this to the outcomes of the questionnaire that feeds into a chapter on possible solutions and measures to tackle the littering problem at the sites.

3.4 Survey

Assessment of the impacts of marine litter pollution in WHms was conducted through an online survey. The survey comprised a mixture of closed (multiple choice) and open (free text) questions (Annex I). Key research areas of the survey are:

- the extent and the origin of marine litter in WH sites and its impacts (including on the four natural criteria of Outstanding Universal Value).
- the monitoring of marine litter in WH sites.
- how marine litter present in the WH sites is being addressed.
- how UNESCO's World Heritage Centre could potentially help managers from WHms to reduce the impacts of marine litter in WH sites.

As not all WHms were inscribed on the World Heritage List for all four criteria of OUV, a link was added in the survey where respondents could consult the Statement of OUV for their WHms. No cultural criteria of OUV were considered in the survey.

The survey was available both online and in pdf in English, Spanish and French. The survey was shared among the marine managers who are part of the Marine World Heritage Network led by the World Heritage Marine Programme.

4. Marine litter, its challenges and measures to resolve the issue

4.1 Marine litter, its sources and the problems involved

4.1.1. The problem of marine litter

In order to provide measures to address marine litter present in marine nature sites, both the origin and sources of the problem need to be understood. That is the objective of this chapter which provides a non-exhaustive overview of sources mentioned in literature.

For a long period of time people thought that the seas and oceans were endless resources that could not be harmed. As a result, the seas have been used as a dumpsite for garbage, waste, toxic materials and munitions. We now know differently. One of the materials that poses a severe threat to the marine environment is plastic. Plastic is a polymer – it is extremely stable, and does not readily enter into the degradation cycles of the biosphere. Environmental pollution by synthetic polymers, such as waste plastics and water-soluble synthetic polymers in wastewater, has been recognised as a significant problem (Shimao, 2001). Over the past 50 years the global production of plastics has increased twentyfold, reaching 322 million tonnes in 2015, and is expected to double again over the next 20 years (European Commission, 2018).

A considerable portion of this plastic ends up in the environment, and ultimately in the oceans. It is estimated that at least 8 million tonnes of plastics leak into the ocean each year (World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, 2016). This is equivalent to dumping the contents of one garbage truck into the ocean every minute. Estimates suggest that plastic packaging represents the major share of this leaked material. Some of the most current research estimates that there are over 150 million tonnes of plastics in the ocean today. This amount includes approximately 23 million tonnes of (mainly) chemical additives. These additives include flame retardants, plasticisers, pigments, fillers and stabilisers. These substances are used to improve the different properties of the plastic or to reduce its cost (World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, 2016).

If the current behaviour remains as is, the ocean is expected to contain 1 tonne of plastic for every 3 tonnes of fish by 2025, and by 2050, more plastics than fish (by weight). (World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, 2016).

4.1.2 Sources of marine litter

Sources of marine litter are diverse and can be land-based, riverine, sea-based and even airborne. These sources and their pathways into the marine environment are explored in this section. It is interesting to see that the terms pathways and sources often are used in an interchangeable way in literature, which is not correct.

4.1.2.1 Land-based and riverine sources

The majority of the sources of plastic waste are land-based since the production, consumption and dumping in the last part of materials' life cycle predominantly takes place on land. Landfills, inadequate waste management practices, fly-tipping, domestic and industrial effluents, run-off and sewer overflows also play a significant role (Veiga, 2016). Other sources include untreated municipal sewage, construction and demolition, ship-breaking yards, and agricultural activities (Werner, 2013).



Figure 2. A dumpsite with Marabou storks and Sacred Ibises at the Kenya Coast (Photo: M. Mannaart)

Pollution from land-based sources consists of a diversity of objects, including bottles, plastic bags, balloons, cigarette butts, microbeads in cosmetics, plastic pellets from the plastics industry and fibres from clothing because of wear during washing. Wear and tear from tyres, artificial turf and road markings are sources of microplastic pollution (Kole et al., 2017). Paint (dust) from buildings is another, not yet well understood source of nano-litter. Littering on beaches by tourists and litter blown to beaches from villages is another cluster of sources (Veiga, 2016) (Figures 2 and 3). Major pathways for transport of litter include rivers and beaches, the latter also being regarded as a source (Andrady, 2011, Cole et al., 2011).

4.1.2.2 Sea-based and airborne sources

Sea-based sources of litter include waste from shipping and offshore oil and gas drilling platforms (German Advisory Council on Global Change, 2013), legal and illegal dumping at sea, (Werner, 2013), paint particles from ships (Suaria et al., 2016), lost shipping cargo, fisheries (nets and net fragments, ropes) and aquaculture (Veiga, 2016).



Figure 3. A potential source of marine litter: domestic waste at a beach part of a marine nature reserve in Malaysia (Photo: M. Mannaart)

Single use items form a large part of marine litter found on beaches (Roscam Abbing, 2018; Veiga, 2016). Plastics from cosmetic products (scrubs, toothpaste), synthetic garments (fibers), industrial products (cleansers, paints) and industrial plastic production (pellets and powders) (Veiga, 2016) are present. Airborne litter comes from e.g. balloons and plastic litter transported in the bodies of animals. Natural events (like tsunamis, storms, tornadoes and strong sea) can also deposit large amounts of marine litter.

A (non-exhaustive) overview of sources of marine litter and their pathways linked to human functions (based on Waterman, 2008) is presented in Table 1.

4.1.3 Effects of marine litter

It is clear that there is a large amount of plastic in the ocean but what does this plastic marine litter do to the environment? Plastic does not degrade quickly in the marine environment (Roscam Abbing, 2018) and its longevity in the oceans means it is easily moved by currents and winds and can accumulate in vast concentrations in ocean gyres. Five of these vast accumulations of litter have been identified so far; two in the Pacific Ocean, two in the Atlantic Ocean and one in the Indian Ocean (Roscam Abbing, 2018). The plastic caught in these gyres is moved through the action of currents, wind and waves and ends up on the shores of nearby islands and coastal regions. Plastic easily fragments in the marine environment and this affects its buoyancy, causing it to fall through the water column and eventually to the seafloor where it can remain for hundreds of years. It degrades into smaller and smaller fragments - the micro to nano plastics that society is becoming increasingly aware of. When plastic breaks down into tiny particles it can be easily ingested by marine species and can ultimately end up in the human food chain. Its small size means it readily adsorbs harmful chemicals that can penetrate into living tissue, organs and cells (Roscam Abbing, 2018).

Marine plastic pollution causes widespread ecological impacts ranging from entanglement of and ingestion by marine life subsequent with physical harm and potential toxic responses, to forming a vehicle for invasion of exotic species (Roscam Abbing, 2018; Midavaine, 2016; Thomson et al., 2009). The number of species known to have been affected by either entanglement or ingestion of plastic debris has doubled since 1997, from 267 to 557 species, including marine turtles, marine mammals, seabirds, fish and invertebrates (Midavaine, 2016). Marine litter also causes serious economic harm to marine industries and to local authorities, with losses for coastal communities, tourism, fishing and shipping. It affects recreational opportunities and aesthetic value – nobody wants to sit on a litter-covered beach!

Table 1. Overview of land and sea based sources of plastic marine litter per function

Land-based & coastal sources of marine litter	Sea-based sources of marine litter
<i>Sites for living & working</i> • Building and construction sites • Paint particles from buildings • Landfills and fly-tipping • Inadequate waste management • Sewer overflows • Effluents/run-off • Fibres released by washing machines • Particles from cosmetic products	<i>Transfer/distribution centres & related activities</i> • Inadequate waste management at ports • Shipping cargo • Paint particles from ships
<i>Industry</i> • Building and construction material • Paint particles from buildings • Effluents/run-off • Sewer overflows • Pellet loss during plastic production • Ship-breaking	<i>Infrastructure & transport</i> • Inadequate waste management at ports and ships
<i>Recreation & tourism</i> • Inadequate waste management at recreational & tourism sites incl. beaches • Fly-tipping	<i>Water resources management</i> • Dumping at sea
<i>Transfer/distribution centres & related activities</i> • Inadequate waste management (overflowing bins, waste blown away) • Shipping cargo • Paint particles	<i>Energy/mining/extraction & storage</i> • Offshore oil and gas platforms and drilling rigs

Land-based & coastal sources of marine litter	Sea-based sources of marine litter
<i>Infrastructure & transport</i> • Wear and tear from tyres • Inadequate waste management • River transport and flooding	<i>Shipping/fishery</i> • Nets, pieces of nets and ropes • Polystyrene • Other plastic items
<i>Agriculture</i> • Plastic items	<i>Mariculture</i> • Nets and pieces of nets • Pieces of plastic • Other plastic items
<i>Aquaculture</i> • Plastic items • Polystyrene • Mussel pegs	<i>Marine Environment in a broader sense</i> • Natural events: tsunamis, storms et cetera • Plastics present from all other sources mentioned

4.1.4 Pathways of marine litter as starting point for action

The sources of marine litter have been presented in general in the previous section, but in what way can they reach and affect nature values of World Heritage marine sites? This is of major importance in order to define measures to deal with this problem effectively, since it has to be in the sphere of influence of the managers from WHms. An overview of sources and pathways is presented in Table 2 of which the contents is explained in the section below.

At sea, litter from cargo, nets of merchant ships and waste fishnets is lost or deliberately dumped and is transported by currents, tides and wind at sea, washing up at marine nature sites where it can affect biota and habitats. Transport of litter when discarded or lost on land will generally happen in two ways: by means of air or water. Litter, when not too heavy, can be blown away after which it can reach waterbodies like lakes, canals (Figure 4), rivers, lagoons and eventually the open sea. When litter is present on land it can either be buried in the soil or be present on top, after which in both cases it could be washed away and be transported by water towards

the sea. There the tides, currents and wind can transport it further (Figure 5). Over time, plastic will fragment in the natural environment into smaller particles that are much more easily transported.



Figure 4. Litter in a klong (canal) at Bangkok, Thailand that discharges into a main river (Photo: M. Mannaart).

Table 2. Relevant general sources and pathways of marine litter grouped by governance level

International/national level	Regional and local level
Litter already present at sea or the ocean, which is transported by tides, currents and wind. This litter is an accumulation of the waste produced by sources and transported by pathways as presented in the column “regional and local level”. Concentration of this waste can lead to “waste gyres”.	<i>Riverine (transport of) litter</i>
	<i>Beach and wind</i>
	<i>Sites for living & working</i> • Building and construction sites • Paint particles from buildings • Landfills and fly-tipping • Inadequate waste management (including effluent run-off) • Sewer overflows • Effluents/run-off • Fibres released by washing machines • Particles from cosmetic products
	<i>Industry</i> • Building and construction material • Paint particles from buildings • Effluents/run-off • Sewer overflows • Pellet loss during plastic production • Ship-breaking
	<i>Recreation & tourism</i> • Insufficient waste management at recreational & tourism sites including beaches • Fly-tipping

International/national level	Regional and local level
	<i>Transfer/distribution centres & related activities</i> - Inadequate waste management (overflowing bins, waste blown away) - Shipping cargo - Paint particles
	<i>Agriculture</i> Plastic items
	<i>Aquaculture</i> Plastic items
	<i>Transfer/distribution centres & related activities</i> - Inadequate waste management at ports - Shipping cargo - Paint particles from ships
	<i>Infrastructure & transport</i> Inadequate waste management at ports and ships
	<i>Water resources management</i> Dumping at sea
	<i>Fishery</i> - Nets, pieces of nets and ropes - Other plastic items
	<i>Mariculture</i> - Nets and pieces of nets - Pieces of plastic - Other plastic items
	<i>Marine Environment</i> - Natural events: tsunamis, storms et cetera - Plastics present from all other sources mentioned

Rivers are the main pathways for the transport of marine litter from land and especially for its land-sea interaction. Often waste is directly dumped into rivers, but also other sources like sewers and effluents (which contain macro and micro-plastics) discharge into rivers. It has been estimated that 10 rivers are the sources of the input of most of the global marine litter pollution (Schmidt, 2017). Estimated plastic releases from Asian rivers represented 86% of the total global input (Lebreton, 2017). Apart from the fact that rivers can have a regional, national and even an international impact, other sources will have a more local impact. Inadequately managed garbage dumps, local industry (for example ship-breaking), agriculture, mariculture, aquaculture, recreation and tourism all can produce litter with a local and regional impact.

Local sources of marine litter could be the most easily addressed since fewer stakeholders are involved. Sources at a higher governance level will be more difficult to address since more stakeholders and input at governmental levels have to be included in the process. Nonetheless, due to its magnitude, the basis for the ultimate solutions to the vast problem of marine litter involves awareness-raising of the problem and cooperation to address the issue at a global level.



Figure 5. (L) Marine litter washed ashore at a sandy beach that is part of a marine nature reserve in Singapore
(R) Plastic pellets found between seaweed on an island beach off the Norwegian coast (Photos: M. Mannaart)

4.2 Assessing the problem: marine litter monitoring at large

Marine litter is a global problem, but what is the nature and magnitude of the problem locally and how can this be determined? Before remedial action can be taken, the magnitude and nature of the problem at a site must first be determined.

As presented in the previous sections, plastic litter can be found in the air, on land, in rivers and freshwater bodies and at sea. Plastic in the sea is present throughout the ocean profile: at the surface, at the bottom and somewhere in between floating at several depths in the water column. Apart from its presence in the marine water column, it can also wash ashore or be transported from land to shore, affecting beaches and coastlines. That is why systems that measure marine litter will generally be divided into four types:

- 1) Floating litter surveys
- 2) Beach litter surveys
- 3) Benthic litter surveys
- 4) Riverine litter surveys (Figure 6)



Figure 6: Floating litter collection device, applied to collect litter floating in the North Sea channel before drifting to sea, Part of a litter monitoring programme, the Netherlands (photo: M. Mannaart).

However, one system for marine litter monitoring at a global scale is not yet developed. There is an absence of harmonized science-based monitoring and assessment programmes which presents a challenge for data comparison and means that changes in accumulation rates and composition, trends over time and the effectiveness of management systems are also harder to assess. Despite the fact that monitoring of marine litter is currently carried out within several WHms countries, the methods of survey and monitoring used are different, preventing comparisons and harmonisation of data across regions or time-scales.

In order to deal with this problem the Regional Seas Programme of UNEP launched, in cooperation with the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the development of the UNEP/IOC Guidelines on Survey and Monitoring of Marine Litter. These Guidelines include a comparative analysis of information from around the world on existing experience and methods for surveys, monitoring, reporting protocols and assessment of marine litter. An extensive comparison of marine litter monitoring systems that are applied around the globe is presented in the resulting document: UNEP's *Guidelines on Survey and Monitoring of Marine Litter* (Cheshire et al., 2009). The report lists a number of evaluated systems from around the globe, including:

Beach surveys:

- AMDS: Australian Marine Debris Survey
- NMDMP: National Marine Debris Monitoring Program
- NOWPAP-beach: Northwest Pacific Action Plan (NOWPAP) – beach litter survey
- KMMAF: Korean Ministry of Maritime Affairs
- ICC: International Coastal Cleanup
- OSPAR-beach: Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Commission).
- CCALR-beach: Commission for the Conservation of the Antarctic Marine Living Resource CCALR – beach CCAMLR 2008
- WWF: World Wide Fund for Nature.
- CCI: Clean Coast Index.

Floating litter surveys

- Japan-floating
- FAP: Floatables Action Plan

Benthic litter surveys

- NOWPAP-benthic: Northwest Pacific Action Plan (NOWPAP) – seabed litter survey
- NOWPAP-benthic: Marine debris in the Northwest Hawaiian Island

The inclusion of monitoring as part of site management is a positive step; however, implementation of a robust and harmonized system facilitates comparison of data and the realization of common goals to address the problems caused by marine litter.

4.3 General solutions to marine litter

4.3.1 From the international to the national level

Since the sources of marine litter, in particular marine plastic litter, are associated with almost all activities in society, a very broad approach is needed in order to address the plastics value chain at large. Rethinking and improving the functioning of such a complex value chain requires effort and greater cooperation from all its key players, from plastics producers to recyclers, retailers and consumers. It also calls for innovation and a shared vision to drive investment in the right direction (European Commission, 2018). The application of the 3 Rs - Reduce, Reuse, Recycle – is of fundamental importance (Modak, 2017). The waste hierarchy establishes a set of principles based upon sustainability and a set of actions to reduce and manage waste. Key to its implementation is the prevention of littering or ‘turning off the plastics tap’. This approach addresses vast numbers and types of stakeholders in the entire value chain, meaning that instruments are needed that go beyond the national level: waste has no boundaries. Thus, international strategies such as the UN Agenda 2030 Sustainable Development Global Goals, and in Europe the European Union plastics and single use plastics strategies, the waste and waste water directives and the packaging directive, are all of utmost importance to address the plastics value chain and close the loop of reduce, reuse, recycle.

Policy instruments that could be applied to solve the issue can be divided into three main groups: communication, economic and legal instruments (Van den Heuvel, 2001). To achieve the ultimate goal of preventing marine litter in a shorter period of time, it would be necessary to apply more prescriptive instruments, with concurrent and enforced legislation.

Apart from a number of global examples, an interesting example of international legislation with an impact on the national level is the European Marine Strategy Framework Directive in which guidelines are defined to assist countries to develop their own marine strategies to achieve the Directive's goal of good environmental status of the northern seas by 2020. (European Commission, 2008; Vandenbroucke, D. et al, 2012; Mannaart et al, 2011). The Directive itself is a legal instrument linked to economic instruments like funding programmes. These together with communication instruments like webpages, brochures, congresses et cetera are all applied to achieve the Directive's ultimate goal. Another instrument linked to marine policy could be maritime spatial planning in which all kinds of spatial instruments like e.g. zoning could be applied (Mannaart, 2010; Mannaart. M., 2009).

Addressing types of pollution could be included.

4.3.2 National and local initiatives as a part of the solution

4.3.2.1 Policy Instruments

National policies with a local touch: the Dutch Green Deal Approach and the German Round Table

An example of a national policy approach in which both national and local stakeholders participate is the so-called "Green Deal Approach". National governments often define legislation and impose regulations to prevent pollution of all kinds or allocate funds for subsidies to address the issue. Of course, this is important and necessary, but additional environmental and economic benefits can be achieved by making use of the positive energy and initiatives in society. This involves a combination of communication and economic instruments with some legal actions. A network management approach is applied: engage the stakeholders who are either responsible for the pollution or could help prevent it, thus making them part of the Environmental Policy Cycle process (Jann & Wegrich, 2007). An essential aspect of this approach is that there is a shared ownership. The stakeholders are the "owners" of the initiative and therefore responsible for its outcome. A small group of

frontrunners can create a transition in society, of which awareness and the will to take responsibility are key elements. About 180 Green Deals have been launched in the Netherlands so far of which 3 address the marine environment including (since 2014) the Green Deal Ship Generated Waste, the Green Deal Fishing for a Clean Sea and the Green Deal Clean Beaches (refer to text box). Both aim not only at removal of waste from the marine environment but also at prevention. Green Deals are targeted to specific sectors (Mannaart, M. et al, 2017). In 2016, on a larger scale, the “German Round Table on Marine Litter” with 150 stakeholder groups was developed aiming at the same objective (refer to text box). This has proved to be a great success.

Environmental Labels and Awards

When it comes to policy instruments that are linked to economic activity, Environmental Awarding is an option for steering towards a higher level of sustainability. At the regional and municipal level in coastal areas there are e.g. the international Quality Coast Label (Mannaart, M., Salman, A.H.P.M. & C. Della Libera, 2010), the ECO XXI label and the Green Destinations Label. At the level of beaches and marinas there is the international Blue Flag label addressing the environment at that scale and at the level of restaurants and beach pavilions there is e.g. the Green Key label. These kinds of approaches could address regional and local environmental policy and could include policy measures which address plastics as well. Green procurement could be incorporated since municipalities, beach pavilions and restaurants are the applicants. Since the labels often operate at an international level, bench marking is an option. In most cases participation in these programmes is voluntary.

4.3.2.2 Clean up actions and cleaning devices

Collecting Fishing Gear: the Global Ghost Gear Initiative and the Healthy Seas initiative

Among the many initiatives on all continents, two international examples are mentioned here. Both the *Global Ghost Gear Initiative* (GGGI) and the *Healthy Seas, a journey from waste to wear* initiative address derelict fishing gear by either removing fishnets from the seas or collecting fishnets on shore directly from the fishermen. Fishnets are upcycled when possible to include these in the value chain again. Participation in these projects is voluntary.

The German Round Table on marine litter

Description: within the European Union there is the Marine Strategy Framework Directive (MSFD) that aims to: “Promote the sustainable use of the seas and conserve the marine environment”. Linked to the MSFD every country needs to have a National Programme of Measures. As one of those measures in Germany the Round Table Marine Litter was established. It supports the implementation of OSPAR & HELCOM Regional Action Plans on Marine Litter and was established in 2016. Its intention is to enhance dialogue & networking among stakeholders, exchange of know-how and to overcome sectoral approaches.

Structure and procedure: there are 2 working groups, 1 on land-based sources and 1 on sea-based sources. There are 2-3 meetings/year (back to back) and a general assembly. Presentations of activities (national/ regional/ International) and discussion on measures & identification of next steps. There are also subgroups for specific topics (intersessional work) and presentations on projects & activities from members.

Stakeholders: about 150 stakeholder groups are involved, including: the shipping industry, fishing industry, waste management companies, wastewater companies, tourism and education sectors, plastics industry, cosmetic industry, tyre industry, retailers, NGOs, scientific institutes, universities and consultancies, ministries, public authorities and politicians.

Solutions: essential for solutions that come out of the round table are: exchange of knowledge, dialogue and above all cooperation. Solutions include: reports, guidelines, best-practice examples, enhanced waste management in the fishing sector, courses on awareness and interactive workshops.



Figure 7: Stakeholders of the German Round Table on Marine Litter

Beach Cleaning

All over the world beach clean-ups are held. Whether this is to clean beaches solely to remove the litter, to add a social or artistic component or even to recycle the collected waste, many clean-ups are being organised.

Examples are present from every continent, including:

- Papahānaumokuākea, USA (the long-running Marine Debris Program, this an example of a location where the sources of marine litter lie outside the site).
- Aldabra Atoll, Seychelles (Aldabra Clean Up Project in collaboration with Oxford University).
- iSimangaliso, South Africa (clean-up campaigns and job creation; no littering as one of the conditions in all concessions, agreements and permits).
- Sian Ka'an, Mexico (a long-term monitoring and clean-up project with a database of over 10 years and good cooperation with fishing and tourism sectors).
- Komodo National Park, Indonesia (citizen litter monitoring, an example of a site where the source of the pollution lies in its immediate vicinity).
- Tubbataha Reefs Natural Park, Philippines (this is linked to the impact of climate change, more monsoon winds so more litter washing up).
- Galapagos Islands, Ecuador (an example of local community involvement in clean up campaigns and partnering with UN agencies like UNEP to raise global awareness).



Figure 8: Proud participants of a beach clean-up on an island off the Fredrikstad Coast, Norway, 2018 (photo: KIMO)

The Fishing for Litter scheme, and Green Deal Fishing for a Clean Sea, Europe

Description: Fishing for Litter is a cleaning initiative specifically targeting litter removal from the sea. Started as pilot in 2001, since 2004, KIMO, Municipalities for Sustainable Seas, has coordinated this project — an imaginative yet simple initiative that aims to reduce marine litter by involving one of the key stakeholders, the fishing industry, that participates voluntarily. KIMO provides fishing boats with large bags to collect marine litter. When the fishing boats come into port, they can unload the bags of litter. These bags are collected regularly and the rubbish is recycled or disposed of on land. This reduces the volume of debris washing up on the beaches and the amount of time fishers spend untangling their nets.

KIMO's Fishing for Litter projects are currently operating in the UK, the Netherlands, Sweden and the Faroe Islands and have been endorsed by OSPAR as a model for their members to adopt. OSPAR is the mechanism by which 15 Governments and the European Union cooperate to protect the marine environment of the North-East Atlantic. In 2018 the programme was been included as a special kind of waste stream ("passively fished waste") in EU's draft Port Reception Facilities Directive (PRF) that, after adoption, will apply to all EU member states. When adopted as proposed, landing, storing and processing of this kind of litter will be possible in all ports to which the PRF applies. From 2011 to date about 5000 tonnes of marine litter have been collected by the project.

Derived from and linked to the Fishing for Litter scheme, the Green Deal Fishing for a Clean Sea was set-up in the Netherlands in 2014. All stakeholder groups involved in generating and cleaning fishing related waste work jointly together to prevent fishing waste entering the sea and try to process the litter in an as environmentally friendly way as possible. Integrated waste management in ports and the principle "make waste delivery as easy possible to the fishers" are key to this project. National and local governments, ports, waste processors and NGOs, but above all fishers and fisheries associations work together for a sustainable sea. By this bottom up approach, joint cooperation and open communication are key to making this initiative a success.



Figure 9. (l) Fishing for Litter in Scotland and (r) meeting of the contracting parties of the Green Deal Fishing for a Clean Sea in the Netherlands (Photo left: KIMO, photo right: M. Mannaart)

Technical solutions

Apart from social, communication, policy and legal approaches, there are many technical solutions as well. These are often real end-of-pipe solutions. Technical instruments that are applied to prevent litter entering the ocean from the river include barriers like beams that are placed in the water. Another one of these solutions is the Bubble Barrier that is placed on the river bed and releases bubbles that cause litter to drift to a specific location at shore where it is collected. Other technical measures of the many ones available are waste collecting devices like the Waste Shark or Sea Bin, which is a kind of floating drain that collects litter at the water surface and is used in ports and harbours. Many more techniques and devices are available.



Figure 10. Waste collection device with waste guiding boom at left hand side, at the Port of Rotterdam, the Netherlands (Photo: M. Mannaart)

Before implementation of techniques to reduce marine litter, serious thought needs to be given to the possible effects on the natural environment. For example, when considering an action to close off a specific part of a

marine reserve or river in order to prevent litter from entering or leaving the area, the affect of the measure on the migration of organisms should first be considered. Ecological and environmental impact assessments may be needed to first determine the risk to the natural environment.

The next chapter presents the outcomes of the survey that will afterwards be considered within the context of this chapter.

5. Marine litter in World Heritage Marine Sites

5.1 Introduction

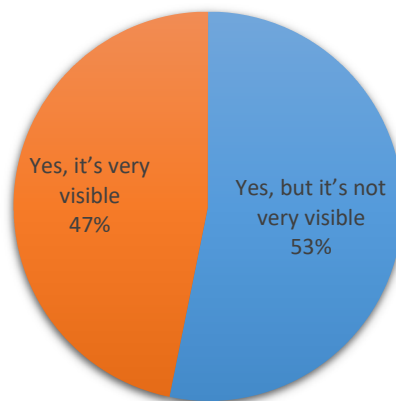
This section presents the outcomes of the online survey that was conducted to assess the impacts of marine litter pollution at the UNESCO World Heritage marine sites. The survey was conducted among marine managers from the 49 World Heritage marine sites. A detailed description of the survey methodology can be found in the previous section. A total of 49 completed surveys were received representing 46 of the 49 World Heritage Marine sites. This is a response rate of 94 percent. For 44 WHms one survey was received and for 2 WHms multiple surveys were received (respectively 3 and 2 responses); these were consolidated into single site responses by WH experts in collaboration with the respective marine managers. The results presented take into account the serial component of two WHms and therefore refer to the number or percentage of responses rather than to number or percentage of WHms involved. The survey question numbers to which each section refers are given at the end of each section title (e.g. Q1, Q2 etc.) The text of the survey is presented in Annex 1 of this document.

5.2 Nature of the problem (Q1-Q5)

5.2.1. Presence of marine litter in WH Marine sites (Q1)

All respondents report the presence of marine litter at their WH marine site. 53% of the respondents report that this is not very visible, while 47% state that it is very visible.

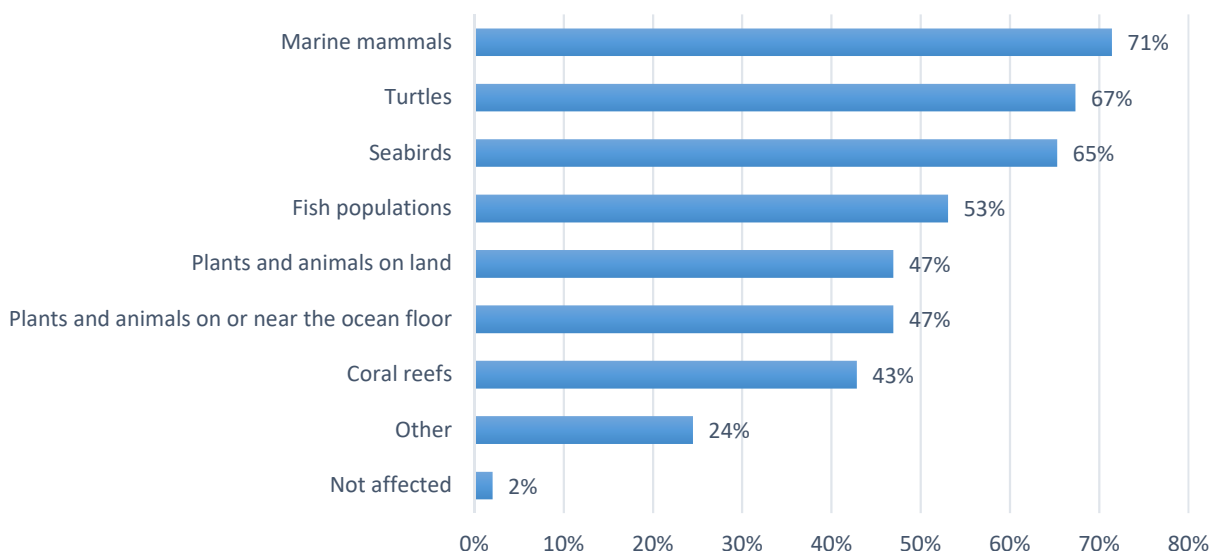
Is marine litter present in your World Heritage Site?



5.2.2. Effects of marine litter on local marine and coastal life (Q2)

The effects of marine litter on local marine and coastal life are broad as indicated by the graph below.

Which local marine and coastal life in or near your World Heritage site is negatively affected by marine litter?



Both plants and animals on land and on/near the ocean floor are being affected by marine litter. Marine mammals, turtles and seabirds are cited most commonly as being detrimentally affected by marine litter. One comment was that the litter was concentrated in certain areas of the site. Six sites indicated that there is a lack of knowledge or that research is needed. More species might be affected but this is currently not known or not studied. The single site that reported no effects of marine litter also indicated this observation might be due to a lack of research. One site indicated that although seals are occasionally found caught in fishing nets, this is probably the result of the animals being caught in active fishing gear and not due to marine litter. This statement also confirms the lack of knowledge/research into detailed marine litter impacts on marine and coastal life. Also recorded in category 'Other' are giant tortoises, Tilapia, lake-based birds, *Lythophyllum byssoides* (coralline algae), mangroves, salt marshes, beaches and coastal dunes. The impacts of marine litter (for example, entanglement of seals) were not addressed in the survey.

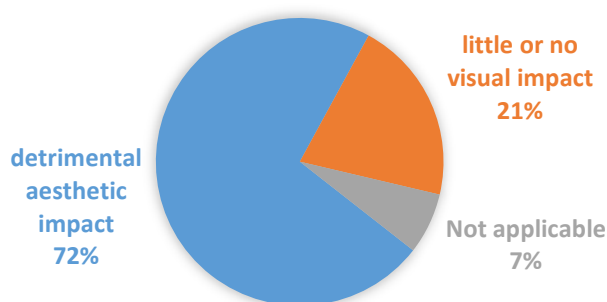
5.2.3. Negative impacts on the attributes of the Outstanding Universal Value (Q3a-d)

For more information on the concept of Outstanding Universal Value and its importance as reference point for the State of Conservation monitoring and evaluation, see section 3.2 (research methodology).

Criterion (vii) - “Beauty”: to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance. Half of the WHMs that participated in the survey are inscribed on the World Heritage List for criterion (vii) (28 of 46 sites). The graph below applies to those 28 WHMs.

Two sites indicated marine litter would affect the aesthetic value if it were not collected and removed. Other sites indicated the criterion is affected in particular areas where marine litter piles up (a specific beach for example), but not the entire property.

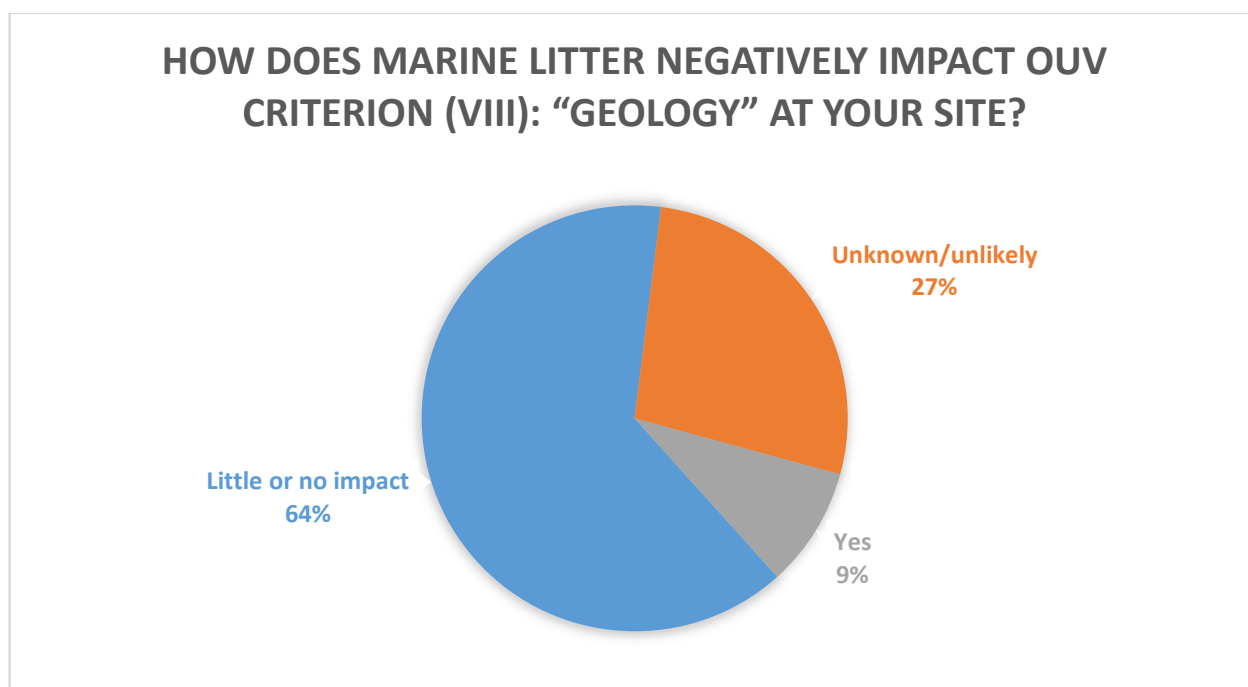
HOW DOES MARINE LITTER NEGATIVELY IMPACT OUV CRITERION (VII): “BEAUTY” AT YOUR SITE?



Ten WHMs for which criterion (vii) does not apply nonetheless completed this question, indicating that marine litter changes the natural scenery, has a visual impact of the scenic and pristine beauty of the coastline, spoils the natural landscape and is not consistent with what is expected of a pristine environment.

Criterion (viii) - “Geology”: to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features. A quarter of the WHMs that participated in the survey are inscribed on the World Heritage List for criterion (viii) (12 of 46 sites). The graph below applies to those 12 sites.

Almost all sites indicate the impact of marine litter on the geological values is very small or unknown at this stage. The site that did report an impact linked this with criterion (vii), although the statement of Outstanding Universal Value for this site is being updated so difficult to check. One site suggested accumulation in canyons and valleys and another one said that marine litter may influence sand dynamics and may have effects on the sedimentation and erosion processes. One respondent mentioned the detrimental impact of marine debris on coral reefs, which is a kind of geological feature.

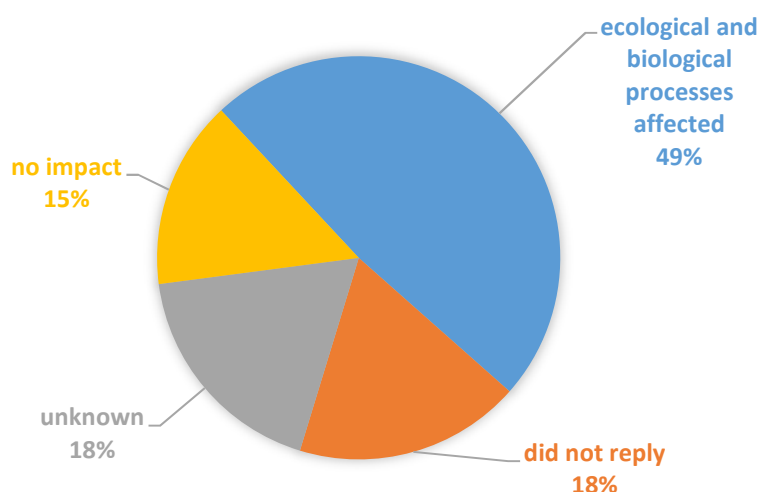


Fifteen WHMs for which criterion (viii) does not apply nonetheless completed this question, indicating that the impact of marine litter on the site's geological values is either minimal, unknown, or difficult to visualize. The relation of marine litter with this criterion is indeed not easy to visualize, although some reports have suggested that marine litter deposits in itself are changing the geology.

Criterion (ix) - "Ecosystems": to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals. Almost two thirds of the WHMs that participated in the survey are inscribed on the World Heritage List for criterion (ix) (31 of 46 sites). The graph below applies to those 31 sites.

For the sites that report an impact, ingestion and entanglement are most frequently cited as examples of impact. Many sites report general impacts on species richness, overall health, productivity, reproductive capacity, reducing the general resilience of the World Heritage site. It is clear from the answers that there is a general lack of data on specific impacts of marine litter on a wider ecosystem. Six sites explicitly mention that the impacts are currently unknown but that one can assume marine litter does impact the WHms ecosystems. The possible impact of microplastics on birds and filter-feeding animals like whales and mantas was also reported, although there is no empirical data available at this stage.

HOW DOES MARINE LITTER NEGATIVELY IMPACT OUV CRITERION (IX): “ECOLOGICAL PROCESSES” AT YOUR SITE?

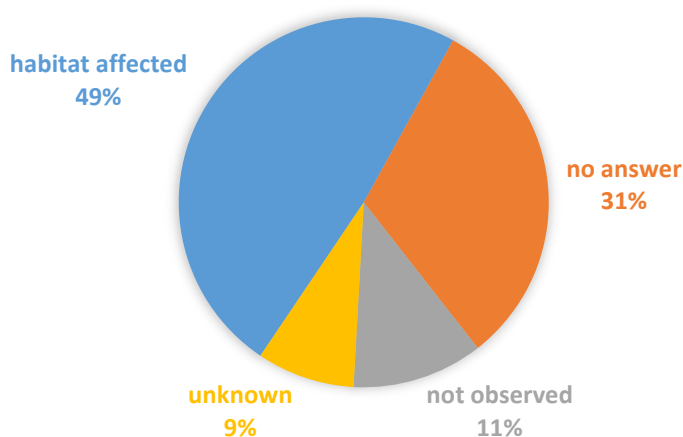


Seven WHms for which criterion (ix) does not apply nonetheless completed this question, which is possibly indicative of their concern of potential impacts of marine litter on ecosystems at their sites. One site highlighted that the accumulation of marine litter in particularly sensitive ecosystems might aggravate the situation. Another site pointed out that floating marine litter objects might be a vector for the introduction of invasive species.

Criterion (x) - “Habitat”: to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point

of view of science or conservation. Almost three quarters of the WHMs that participated in the survey are inscribed on the World Heritage List for criterion (x) (37 of 46 sites). The graph below applies to those 37 sites. Sites approached this question from two perspectives: mortality of threatened species because of marine litter (through entanglement from ghost nets or ingestion) or decrease in available habitat. Sites report that marine litter is trapped in mangrove habitats where it damages the mangrove roots or fills up habitat used by juvenile species. Examples from damage to coral reefs are also reported, through nets and litter that break up coral reefs or that cause damage by being dragged across the reefs because of strong currents. Sites also raised the question of the impact from marine litter, and microplastics in particular, on the feeding mechanism of e.g. Cnidaria or filter feeders like whales and manta rays. Marine litter is also reported to affect the nesting areas of sea turtles, preventing them from laying their eggs or making it more difficult for turtle hatchlings to reach the sea.

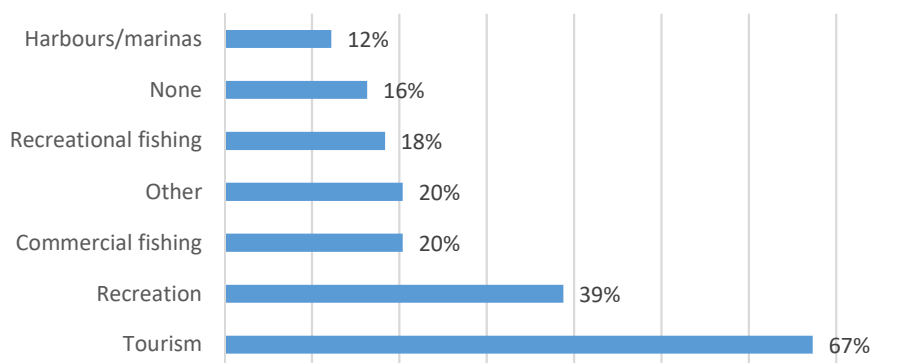
HOW DOES MARINE LITTER NEGATIVELY IMPACT OUV CRITERION (X): "HABITAT" AT YOUR SITE?



Two WHMs for which criterion (x) does not apply nonetheless completed this question. One site indicated its purpose of being inscribed on the World Heritage List was to study the evolution of the site without human interference. With marine litter washing up to the shore this isolation is no longer guaranteed, and one could say that the site is no longer without human interference.

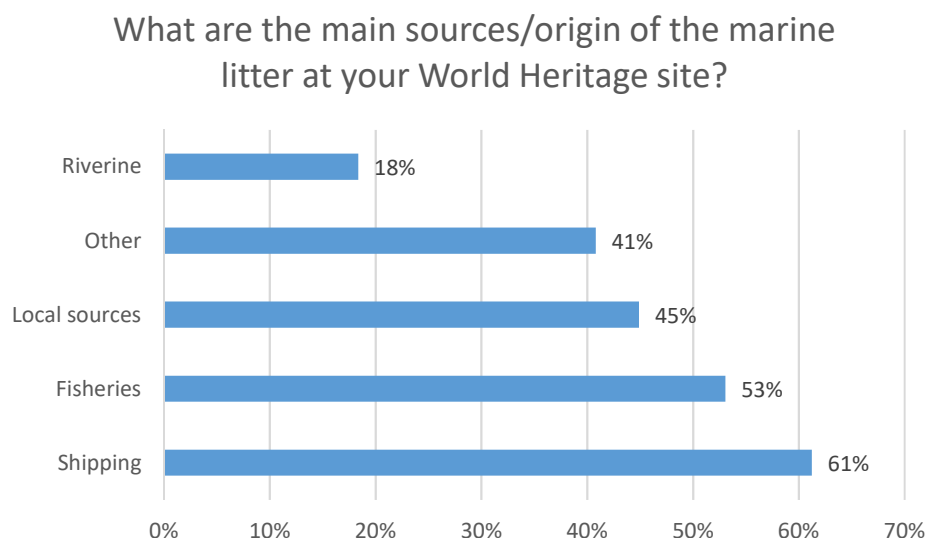
5.2.4. Social/economic impacts in or near World Heritage site (Q4)

Does marine litter have any social/economic impacts in or near your World Heritage site? If so, please specify the sectors that are affected.



The two most important topics mentioned were “Tourism” (67%) and “Recreation” (39%). “Commercial Fishing” and “Other” were both mentioned by 20% of the respondents. Multiple selections were allowed for question 4. Some respondents reported there that the impacts were slight, for example due to the remote nature of their site. Under “Other”, managers reported that there had been little or no research done into social or economic impacts of marine litter at their sites. One site indicated that there was also an impact from a cultural perspective, with marine litter polluting a “sacred” site. Managers also pointed out their own cost for dealing with marine litter, for example dedicating time and human/financial resources to addressing the issue and cleaning up.

5.2.5. Main sources/origin of the marine litter at World Heritage sites (Q5)



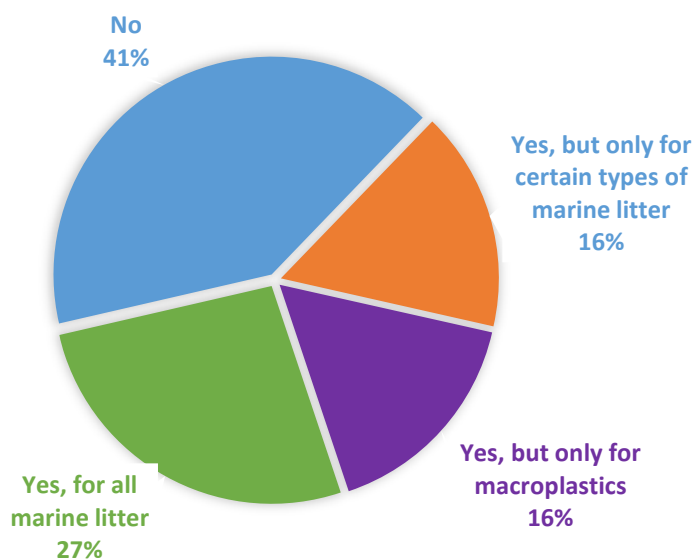
The main sources of origin according to the respondents were: “Shipping” (61%), “Fisheries” (53%), “Local Sources” (45%), “Other” (41%) and “Riverine” (18%). Multiple selections were allowed for question 5. Most common responses in ‘Other’ are local community, neighbouring countries and regions linked through currents, fishing, tourism and natural disasters (cyclones). Q5 also included a sub-question where fifteen managers shared more information about the “local sources” of marine litter. Sites mainly referred to their local context, the villages or households that are located in the WHMs’ vicinity. It was reported that some of these areas have no waste management facilities in place which leads to waste ending up into the sea. Tourists and visitors are also identified as a source of marine litter, including by leaving litter when touring on a leisure boat and when visiting the beach (cigarette butts). Storm water drains and a company were mentioned as sources separately as well. One site also indicated that garbage has been identified from 80 countries around the world.

5.3 Marine Litter Monitoring applied to WH Marine sites (Q6a-Q6h)

5.3.1 Types of monitoring (Q6)

Of the 49 WHMs, 26 indicated (by means of 29 survey answers) that marine litter is monitored. Some kind of marine litter monitoring is carried out in most of the sites. 27% of the respondents mentioned this is done for all marine litter, while both 16% replied this is done both for certain types of marine litter or for macroplastics only. 41% of the respondents indicated that monitoring is being carried out currently. Seven sites provided more information on the types of marine litter that are being monitored: abandoned fishing gear (ghost/drift nets, long lines), macroplastics, and marine litter accumulations on accessible beaches.

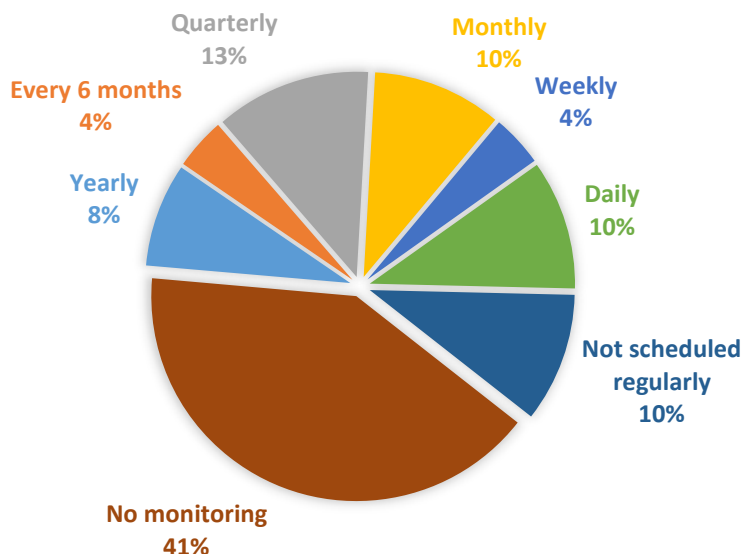
DO YOU CARRY OUT ANY MARINE LITTER MONITORING WORK?



5.3.2 Frequency of monitoring (Q6a)

In case monitoring is carried out the frequency of this varies considerably. The top five of actions include: 41% of the respondents indicates that no marine litter monitoring is carried out at all. In case it is being carried out this is done "Quarterly" (13%), "Monthly" (10%), "Not scheduled regularly" (10%) and "Daily" (10%).

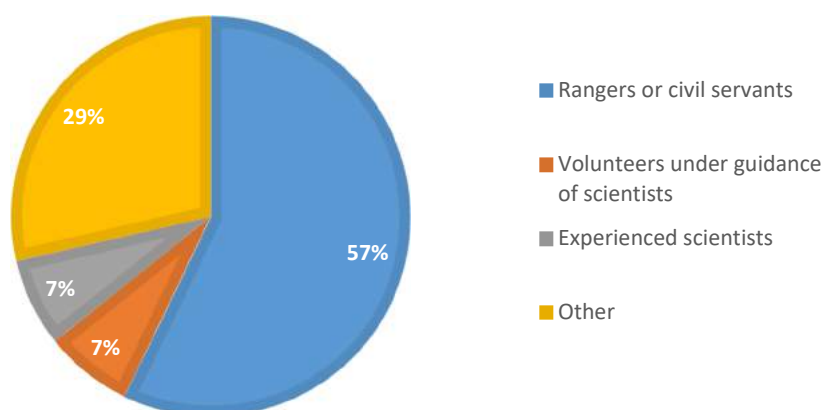
HOW FREQUENTLY DO YOU CONDUCT LITTER MONITORING?



5.3.3 Teams who carry out the monitoring (Q6b)

The visual below applies to the 25 WHMs / 28 survey answers that indicated they monitor marine litter. This question allowed only a single selection but five sites use multiple groups to carry out monitoring and have recorded this in the 'Other' (free text) category. Monitoring is being carried out by four main groups: "Rangers or civil servants" (57%), "Other" (29%), and both 7% for "Experienced scientists" and "Volunteers under guidance of scientists".

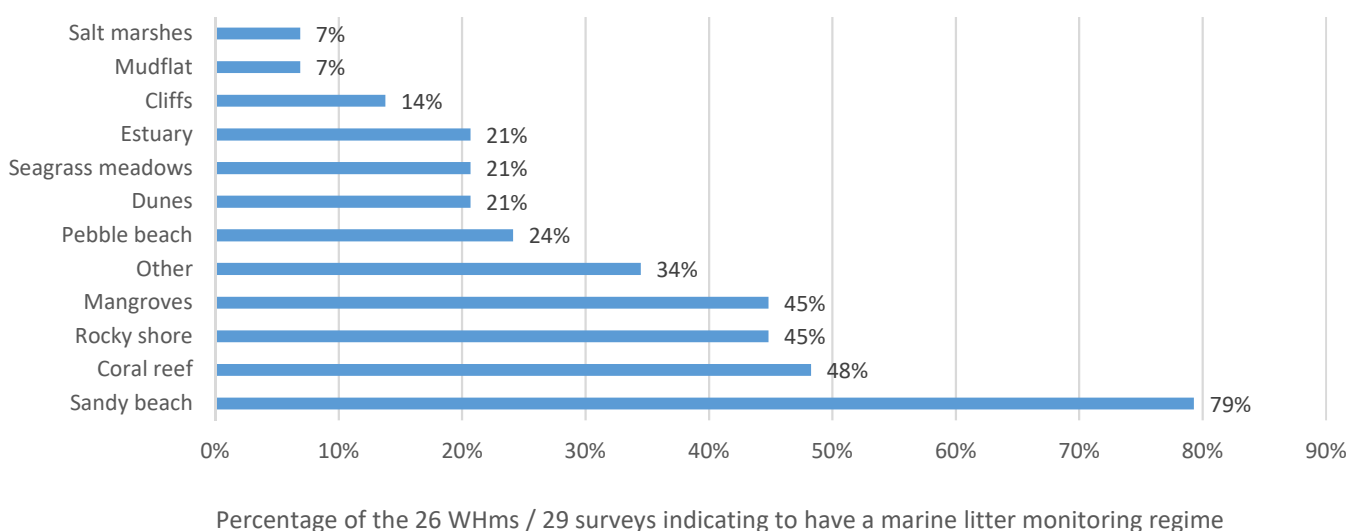
WHO CARRIES OUT THE MONITORING WORK?



5.3.4 Nature of monitoring locations (Q6c)

The nature of monitoring locations within the WHms varies and is as diverse as the habitats present at the sites. The top five of indicated monitoring locations include: “Sandy Beach” (79%), “Coral Reef” (48%), “Rocky Shore” (45%), “Mangroves” (45%) and “Other” (34%).

What is the nature of the monitoring locations within your World Heritage site?



5.3.5 Monitoring system (Q6d)

52% of the respondents answered that a categorised system for litter monitoring is applied at the sites. As presented in section 4.2 on categorised systems for marine litter monitoring listed in literature, the systems applied aim at marine litter present at the water's surface, on the seafloor and at the beach.

DO YOU HAVE A CATEGORISED SYSTEM FOR YOUR LITTER MONITORING?



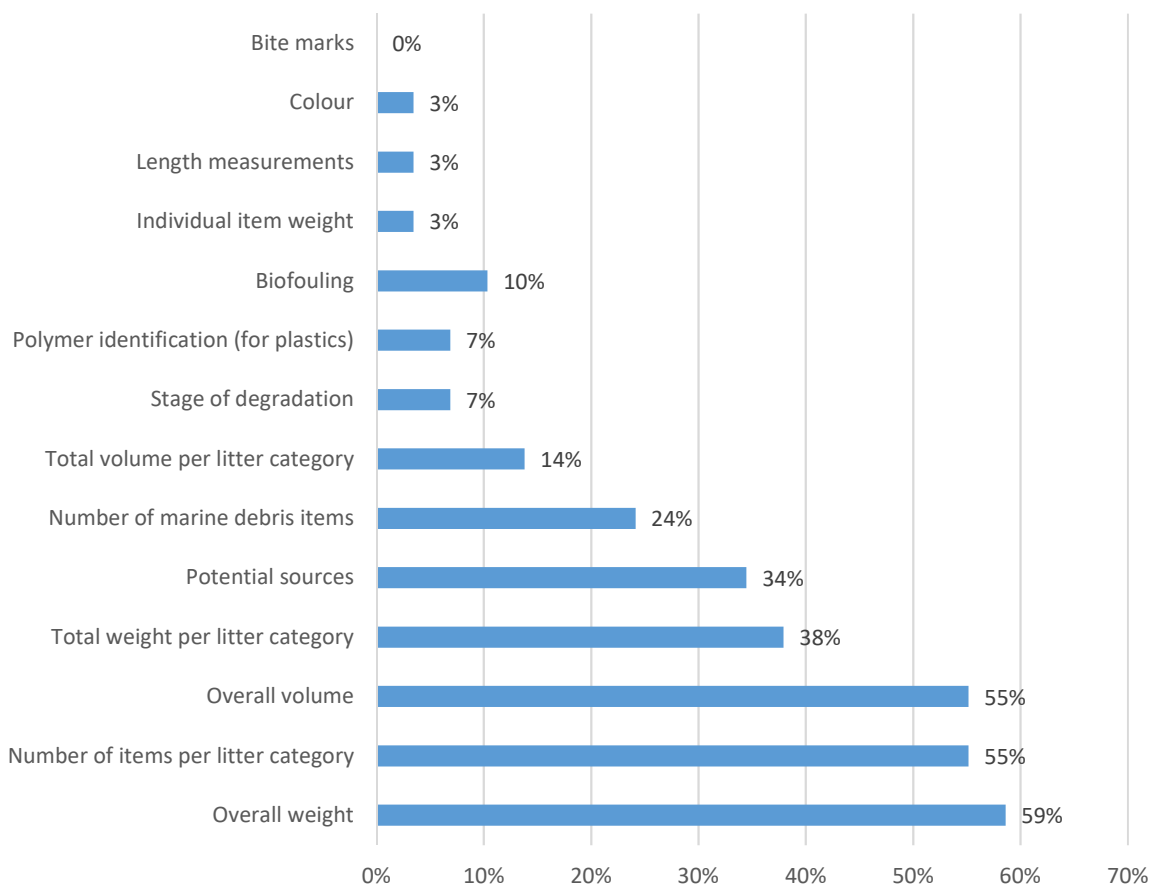
The survey offered the opportunity to provide details of the litter monitoring system in place. The provided systems comprise:

- Self-developed system (5)
- Australian Marine Debris Database (2)
- NOAA Marine Debris Programme (2)
- OSPAR Beach Monitoring System (2)
- Marine Conservation Society Beach Watch scheme (1)
- Ocean Conservancy Formats (1)
- State Developed System (1)

5.3.6 Information recorded (Q6e)

The visual below applies to the 26 WHms / 29 survey answers that indicated that they monitor marine litter. The five most important kinds of information recorded are: "Overall weight" (59%), "Number of items per litter category" (55%), "Overall volume" (55%), "Total weight per litter category" (38%) and "Potential sources" (34%).

Which information do you record during litter monitoring?

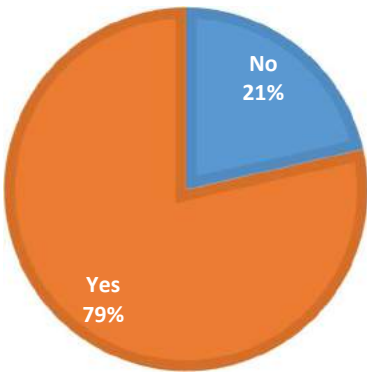


*Percentage of the 26 WHMs / 29 surveys indicating to have a marine litter monitoring regime

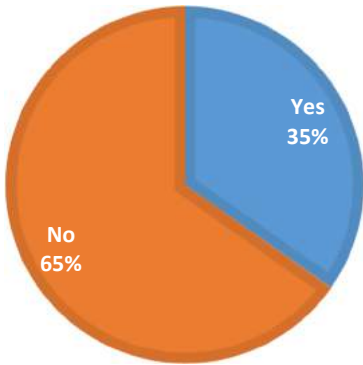
5.3.7 Information stored (Q6f-Q6h)

Of the respondents 79% answered that the marine litter monitoring data is recorded in a database, while 21% did not. Of the data stored 43% of the respondents indicated that this has been stored for 1-5 years, 26% indicated this has been stored from 5 to 10 years, 22% for more than 10 years and 9% for less than one year. Of the data stored 35% is publicly accessible. Examples are: <http://www.ices.dk/marine-data/data-portals/Pages/DATRAS.aspx> and <https://www.tangaroablue.org/database.html>

IS THE MONITORING RECORDED IN A DATABASE?



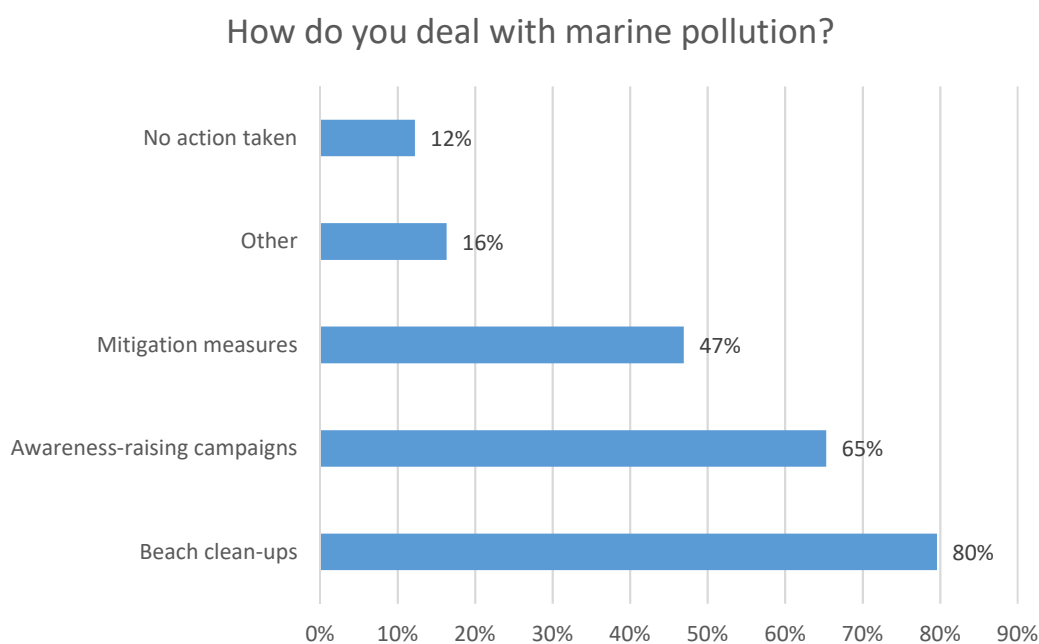
IS THE DATABASE PUBLICLY ACCESSIBLE?



5.4 How marine litter is addressed in the WH Marine sites (Q7-Q12)

5.4.1 How marine litter is dealt with (Q7)

Marine litter in WHms is addressed in a number of ways of which the most commonly five actions include to the respondents: “Beach clean-ups” (80%), “Awareness-raising campaigns” (65%), “Mitigation measures” (47%), “Other” (16%) and “No action taken” (12%).

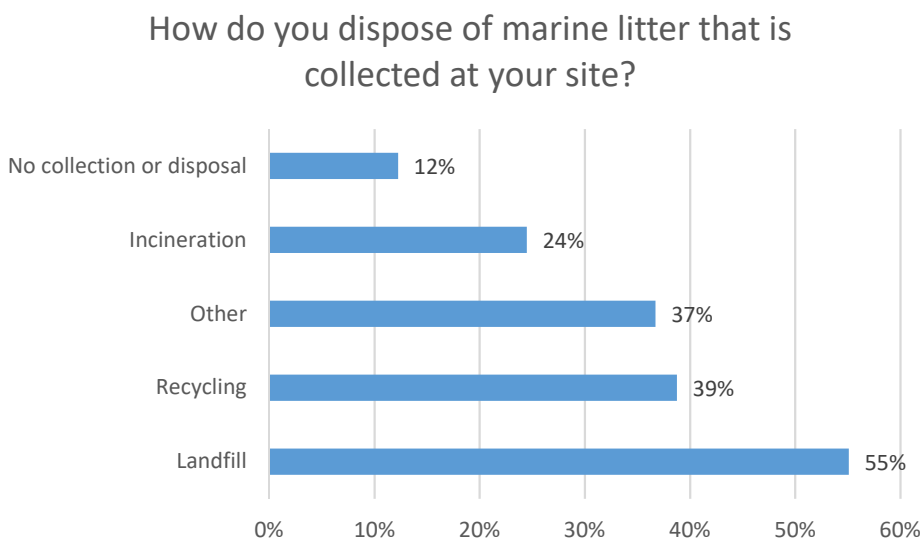


Multiple selections were allowed for question 7. Also recorded in the category ‘Other’ are: encouraging use of re-usable items, encouraging community actions and supporting local communities with waste management facilities, environmental awareness training, asking visitors to report litter to site authorities and oil contingency plans.

5.4.2 Disposal of collected marine litter (Q8)

It is clear that the main way of disposing marine litter is by taking this to a landfill. Luckily the level of recycling is high, 39% of the respondents referred to this. Other means of disposal are used as well (37% of the respondents) and no collection nor disposal applied to 12% of the respondents. Multiple selections were allowed for question 8. Answers included in the category ‘Other’ are: transportation of litter to the mainland where local government or municipal services process the waste, segregation at source and transfer to local

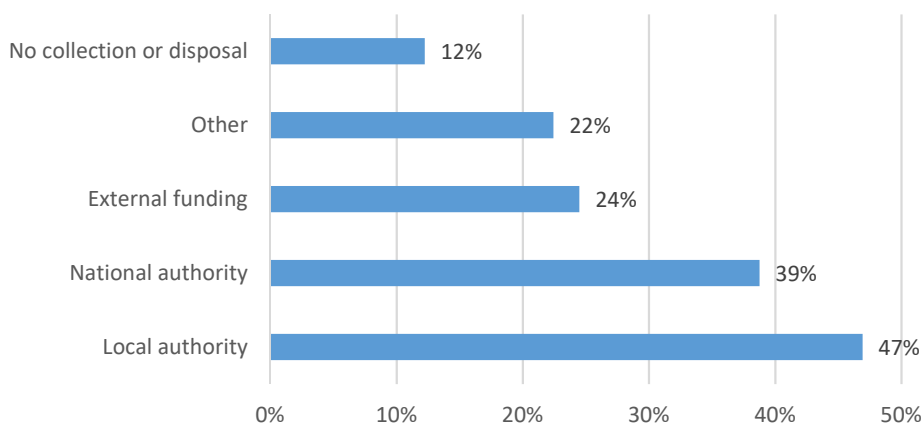
material recovery facility, conversion to biofuel, burning in open air. Some sites also used the “other” category to provide information on future plans to collect / dispose of marine litter.



5.4.3 Funding of waste disposal (Q9)

When it comes to waste disposal 47% of the respondents stated that local authorities pay for this, after which the national authorities take care of this (39%). External funding is of importance in 24% of the cases and other means in 22% of cases. This question allowed multiple responses. For some sites waste disposal is the responsibility of a combination of sources and responders have recorded these in the ‘Other’ (free text) category. Most of these sources are covered by the other categories in this question.

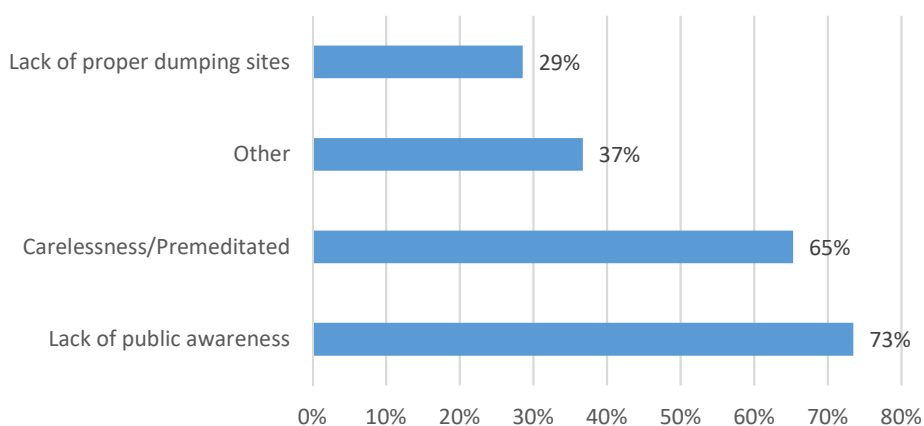
Who pays for the disposal of marine litter at your World Heritage site?



5.4.4 Key reasons for littering (Q10)

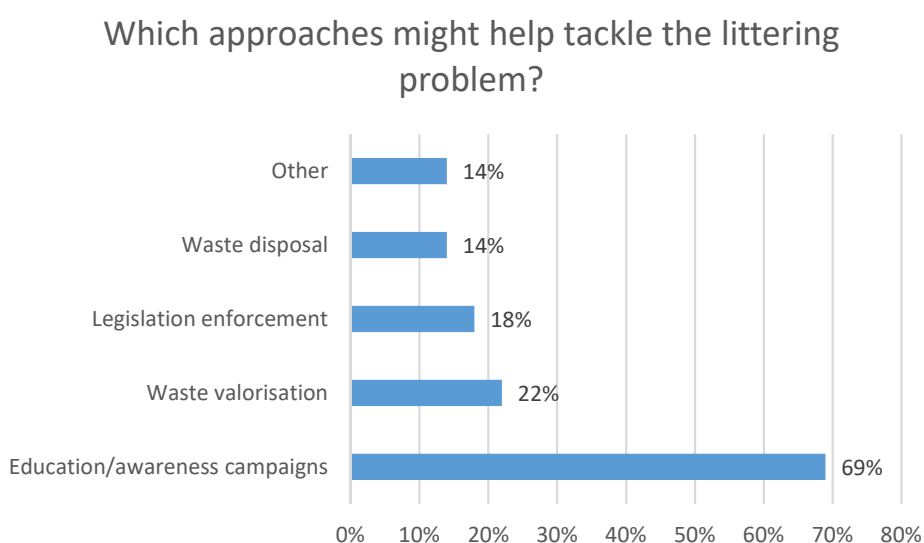
The respondents regarded in 73% of the cases that lack of public awareness is the reason for littering. This is followed at a short distance by carelessness/premeditation (65%). Other reasons were mentioned in 37% of the cases and a lack of proper dumping sites in 29% of the cases. Multiple selections were allowed for question 10. Also recorded in the category 'Other' are: lack of circular economy approach, lack of enforcement, lack of finance for effective waste management, waste management is not a priority for communities living in poverty. Many responses recognized that marine litter is a global issue.

What do you think are the key reasons of the littering problem?



5.4.5 Envisaged approaches to tackle the marine litter problem effectively (Q11)

According to 69% of the managers from WHms education and awareness campaigns are of importance to tackle the litter problem. 22% think that waste valorisation may be a solution and 18% share the opinion that enforcement is a solution. Waste disposal is regarded by 14 percent as a solution, the same percentage that applies to “other” solutions. Free text entry was allowed for question 11 as well. Also recorded in category ‘Other’ was: international convention, incentives, monitoring and sharing of best practices.

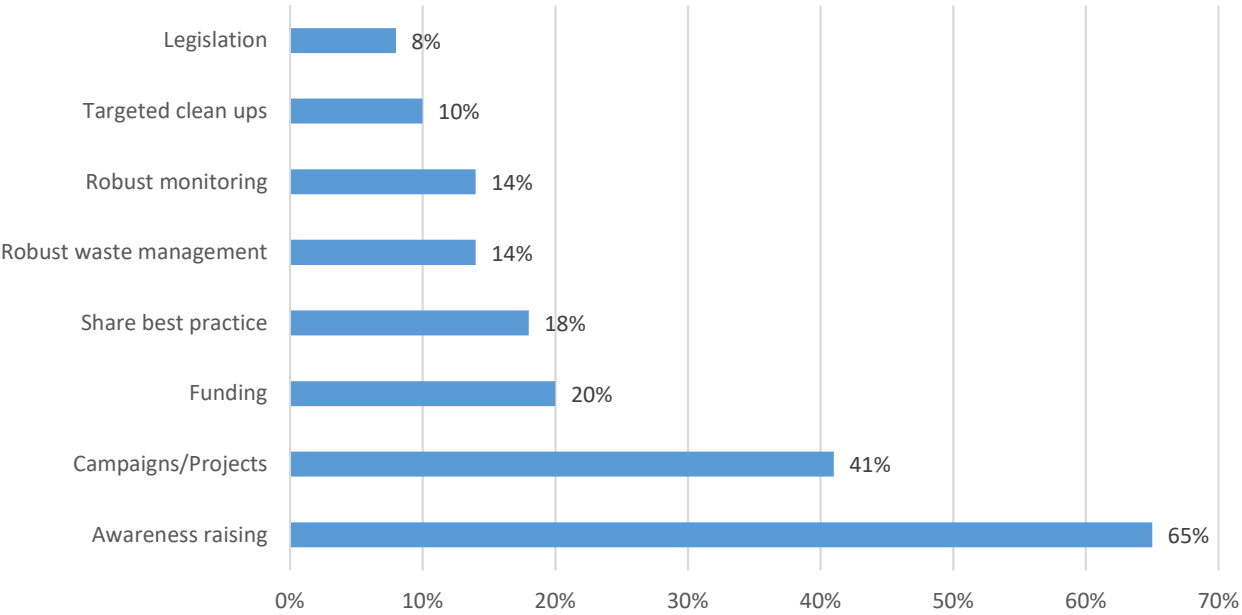


5.4.6 How UNESCO’s World Heritage Centre can help to reduce the impacts of marine litter in WH sites (Q12)

According to the managers from WHms, UNESCO’s World Heritage Centre could support their efforts to combat marine litter pollution by: awareness raising (65%), support with campaigning/projects (41%) and funding (20%). 18% referred to sharing best practices and 14% think that robust waste management could be supported. This percentage applies to robust monitoring as well. 10% mentioned targeted clean ups and 8% of the managers think that the World Heritage Centre could help with legislation.

The graph is qualitative, present to give a broad overview of the responses submitted.

How do you think UNESCO’s World Heritage Centre can help you reduce the impacts of marine litter in your World Heritage site?



6. Conclusions

6.1 Introduction

This chapter presents the conclusions of research, based upon a literature review conducted and the outcomes of a survey that was filled out by managers from WH marine sites.

6.2 Discussion

6.2.1 Literature research

The literature research conducted gives a broad overview of the causes, sources and pathways of marine litter. It does not present in depth research of marine litter present, but is intended to provide an overview that, in conjunction with the outcomes of the survey, is useful to create a framework for action to address the problem practically from WH marine site level and UNESCO World Heritage level.

6.2.2 Survey

The survey was sent to managers of 49 WH marine sites. To facilitate responses from all managers from the WHms the questions were available in English, Spanish and French. This could be a challenge for some sites since those three languages are not the mother tongue of each site. Responses from 46 WH marine sites were received, which is a response level of 94%. This is a good outcome for a general survey. All continents are covered leading to a representative overview of the situation in sites all over the world. The research questions were mainly of a qualitative nature and reflect the opinions of the managers from World Heritage marine sites who participated in the survey. It is based on expert judgement of nature managers. This assessment does not include comparative environmental field research conducted by experts on marine pollution at the sites itself, so the actual situation may differ. Therefore, the outcomes must be regarded as indicative. Nonetheless, it may be assumed that specifically regarding macro-litter, a good indicative picture of the situation has been provided. The assessment does not provide detailed information on pollution levels of micro-litter and nano-litter at the sites. Information on this may be present at sites but the research questions did not focus on this specifically.

6.3 General conclusions

The world's oceans contain around 150 million tonnes of plastic. The sources of this marine litter are land-based, riverine, sea-based and airborne. A plethora of activities spanning the entire value chain lead to the release of plastics into the environment. Deliberate and accidental release, spillage and dumping on land, in rivers, at sea, the oceans and in the air contribute to pollution levels. There is interaction between these different pollution vectors due to overlapping transport pathways and the long lifespan of the material. Since most of the water flows to the seas, high levels of plastic pollution are found there. Although plastic parts can be big or small when released into the environment, all will eventually fragment to the level of so called nano-litter of a microscopic size. Plastics do not degrade but fragment and remain in the environment for a long time. As they break down they can move in the water column, in most cases falling from the surface towards the seafloor. Large parts of plastic can be transported at a different speed than small particles and their respective impact on habitats and organisms differ. Many sea-dwelling or sea-dependent species suffer from plastic pollution, especially through entanglement and ingestion.

A large number of marine litter monitoring systems have been created in order to assess marine pollution. These monitoring systems can be sub-divided into four main survey types: floating litter, beach litter, benthic litter and riverine litter (in case a river discharges at or near the WHm site). An all-comprising system for marine litter monitoring that can be applied globally is not yet developed. A harmonised science-based monitoring and assessment programme has not yet been developed on a global scale. However, the UNEP/IOC "Guidelines on Survey and Monitoring of Marine Litter" could form the basis for a harmonized monitoring system that is applicable in all relevant habitat types of the sites, varying from e.g. ice shoes to sea grass beds, coral reefs, mangroves, mud flats, sandy beaches and rocky beaches. A considerable number of actions addressing marine litter pollution exist. Since waste has no boundaries and the many sources of marine litter are in every corner of society, a global, integrated waste management approach is needed. Measures aiming at altering the value chain of production, consumption and waste recycling are key to solve the root causes of the problem. However, development of these measures is relatively recent and their implementation is a very complex and difficult task due to social, legal and economic issues involved. At national or regional level, measures such as environmental labelling and stakeholder engagement programmes aiming at the prevention of pollution (often

combined with clean-ups as well) are being implemented. Most of the measures applied are end-of-pipe solutions, aiming at removing marine litter already present in the environment. Examples are cleaning up operations like beach-clean ups, collecting waste from the seabed by fishing vessels or removing waste from the water column. At the local level, technical solutions for cleaning up the marine environment are used to prevent litter from entering specific areas or to collect litter on the spot. The literature review shows the necessity of marine litter assessments at site level to determine the magnitude and nature of the problem. The following assessments must be included in any approach to marine litter management at World Heritage marine site level:

- 1) The type(s) and amounts (and sizes) of the marine litter that is present at the WHm site;
- 2) The negative impact of the litter to the site's environment and nature values;
- 3) The sources of marine litter present;
- 4) The pathways of transport of the marine litter;
- 5) The geographical level that applies to both sources and pathways of the plastic litter at the site;
- 6) The presence of (other) barriers to addressing the sources of marine litter at the site.

These assessments should inform the specific measures needed to address marine litter at each particular site allowing a tailor-made marine litter management plan to be created for each WH marine site.

6.4 Conclusions of the survey

The summarized conclusions of the research questions are presented in this section, which reflect the opinions of the management teams of the participating WH marine sites. If multiple answers have been provided these are presented in order of prevalence, with the largest number of respondents first.

Conclusions of the survey:

1. All of the 46 World Heritage marine sites that responded indicate that marine litter is present at their site, while 47% of the respondents indicated that marine litter is very visible. There is broad recognition that marine litter is a serious global issue.
2. Marine Litter affects a broad range of organisms in the WH marine sites. This impacts both plants and animals present at several depth levels at sea, on land and in the air. Only 2% of the respondents indicated that organisms are not affected. An important remark was that there is a lack of knowledge about the impact on organisms.
3. Marine litter has a detrimental effect on the Outstanding Universal Value (OUV) of the Sites, especially the OUV: Beauty, Ecological Processes and Habitat. The only criterion that is almost completely unaffected is Geology. An important topic that was raised is the lack of knowledge about the effects of micro-litter.
4. Marine litter impacts the local economy, it makes sites less economically attractive. It discourages business investment, tourism, recreation and fishing. The magnitude of the socio-economic impact of marine litter at WHms is not yet well understood.
5. The respondents indicated that they consider the main sources of marine litter at the sites to be (from a high to low level of significance): shipping, fisheries, local sources, “other sources” and riverine input.
6. Of the 49 WHms, 26 indicated that marine litter monitoring is carried out at their site using a variety of systems with a variety of monitoring frequencies. All systems applied focus on macro-litter.
7. Where marine litter monitoring is conducted this is mostly done at different frequencies varying from unscheduled to quarterly or even daily. It is clear that there is not a harmonized monitoring methodology applied which makes comparison of amounts of waste difficult between sites and habitats.
8. Most of the monitoring of marine litter at WH marine sites is carried out by rangers or civil servants, “other people”, volunteers under guidance of scientists and experienced scientists. This means that a broad range of people are involved in conducting the surveys. A standardized methodology and the same kind of guidance of the assessors is not yet present in the WHms network.

Conclusions of the survey (continued):

9. The nature of the monitoring locations in the WH marine sites differs significantly. 12 habitat types and the type “other location” were mentioned. The most important monitoring location is “sandy beach” which was mentioned in 79% of the cases. The 12 habitat types mentioned mean that for most habitats another kind of monitoring is needed. The methodology that applies to monitoring of an ice sheet is different than for a mangrove forest or coral reefs. An all-encompassing standardised monitoring methodology is not present.
10. Over half of the respondents who explained that a monitoring system is in place, indicated that a categorised system for litter monitoring is present at their WH marine sites. In general one of 7 categories of methodologies are applied that aim either at the monitoring of the water surface, the seafloor and/or the beach.
11. Across the sites where marine litter is recorded 13 categories of information are recorded.
12. Of the information collected during marine litter monitoring in the majority of the cases this is stored in a database. The length of time which the data has been stored varies from less than a year to over 10 years. In a minority of the sites this data is publically accessible. A larger accessibility of the data could lead to a larger number of people being aware of the problem and to increased support to tackle this.
13. Marine litter in sites is addressed by measures such as: beach clean-ups, prevention by means of awareness-raising campaigns, mitigation measures and other measures. A minority of the respondents mentioned that at sites no action is being taken. Education and awareness raising campaigns and sharing of best practices are key to preventing littering. There is need for robust waste management and recycling strategies to deal with existing (and future) waste that facilitates valorisation of waste. The use of social media is imperative to increase public awareness and education of marine litter and to increase public participation in clean-up activities. Adequate resources and robust strategies are required in order to mitigate the effects of marine litter at these sites.

Conclusions of the survey (continued):

14. incineration. Bearing in mind the importance of the waste hierarchy, improving the reuse and recycling rates are preferable.
15. The disposal of the marine litter is in most cases paid for by (from high to low prevalence): local authorities, national authorities, external funding and other means of funding. In a small part (13%) there is mentioned that no collection nor disposal is carried out. If the full size of the problem were to be explained and addressed as a WHms network, more options to deal with both solutions and funding could be feasible.
16. Key reasons for the littering problem perceived by the managers are: a lack of public awareness, carelessness/premeditation, other reasons and a lack of proper dumping sites.
17. Regarding the approaches that might help tackle the littering problem, most of the managers from WHms refer to (from high to low): education and awareness campaigns as a solution, while waste valorization and enforcement are regarded to be of importance as well. Waste disposal and “other” approaches were also mentioned.
18. According to the managers from WHms UNESCO’s World Heritage Centre could help reduce the impacts of marine litter in the World Heritage Sites by: awareness raising, campaigning and projects, funding, sharing of best practices. Mentioned as well were: robust waste management and robust monitoring, targeted clean-ups and legislation. There is a direct link to 16 and 17.

7. Recommendations for action

7.1 How to address the problem of marine litter at the WH marine sites?

When it comes to addressing marine litter effectively at WH marine sites a two pronged approach is needed. The sources of marine litter are imbedded in society at a global level, to alter this the value chain needs to be addressed. For this an international approach is needed that is of a strategic nature which is for the longer term. Apart from the long term international approach, on the short term the current levels of marine litter at the World Heritage Marine sites need to be addressed. For this, a regional and local approach is needed. The location of the sources of the litter, its pathways of transport and the sphere of influence of the site's management are of importance. Organising clean-ups is probably quite easy, but prevention is often much more difficult. To determine the level and kind of actions needed is always a matter of a tailor-made approach and knowledge of the local, regional and national governance issues.

7.1.1 Approach for action

7.1.1.1.1 The international approach

Address the sources of marine litter: since marine litter is a vast problem, defining and implementing measures at World Heritage marine sites is not going to solve this at the large scale that is needed. For that the magnitude is way too extensive and the root causes need to be addressed. This needs to be done at international level. A united and aligned approach could be beneficial from both a political and financial perspective. Three main actions at the international level are needed in which also the involvement of the UN could be effective:

1. *Awareness raising and education* are important instruments to achieve a common understanding of the problem of marine litter and the roles that society, producers and consumers play. These instruments need to be applied at a global scale to society and enterprises to alter consumption and production patterns, the root causes of the marine litter problem. Although this is beyond the sphere of influence of a manager from a WHms, it can be organised or facilitated by UNESCO and UNEP, since global cooperation alone can tackle the root causes of the problem effectively. Targeted awareness campaigns should be developed during

which social media can play an important role. Important for this is the “couleur nationale”. There needs to be campaigns of an international nature but they have to be tailor-made for the national level regarding language, political and social characteristics.

2. *Promoting the development of (international) policies and legislation* to prevent the production of plastic waste, by addressing the value chain.
3. *Facilitating the implementation of policies, legislation and funding* to prevent the production of marine litter and facilitate its abatement and clean-up are areas where UNESCO and UNEP can play a role. This should also be linked to the needs of specific networks with local components like the network of World Heritage marine sites.

Develop a standardised marine litter monitoring system as a knowledge base. Such a system needs to:

1. Be applicable at all World Heritage marine sites and thus account for the habitat types present that include: sandy beaches, coral reefs, rocky shores, mangroves, pebble beaches, dunes, seagrass meadows, estuaries, cliffs, mudflats and salt marshes.
2. Include a harmonised categorisation of the marine litter items.
3. Include protocols for the assessment of the water surface, seabed and land-sea interface (e.g. beach, mudflat, mangroves) and when applicable riverine monitoring in case a river empties in the WHms.
4. Include protocols for assessing macro litter, micro litter and nano-litter and allows comparison of the state of play of the different WHms.
5. Provide a harmonised system for data storage, data accessibility and data exchange.
6. Provide guidance for the people who carry out the marine litter assessments, both scientists and laymen.
7. Make use of social media and information technology: the application of mobile phone apps for monitoring purposes linked to databases could be very useful and limit the amount of time and knowledge needed to do assessments.

The UNEP/IOC “Guidelines on Survey and Monitoring of Marine Litter” could be useful for the development of a standardised marine litter monitoring system. Contacting the authors of the guidelines about this is

recommended as is assigning a group of experts to collate the current monitoring protocols and to develop these into a harmonised system.

Develop standardised protocols to determine the impact of marine litter on:

1. Outstanding Universal Value (beauty, ecology, habitats and geology) of WHms
2. Socio-economic values of WHms

With regard to the OUV, it must be determined whether a negative impact is caused by the presence, nature and amount of marine litter present at the site and to what extent this affects the:

1. Superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.
2. Outstanding examples of major stages in the earth's history, including the record of life, significant on-going processes in the development of landforms or significant geomorphic or physiographic features.
3. Outstanding examples of significant, ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and plant and animal communities.
4. Most important and significant natural habitats for in-situ conservation of biological diversity, including threatened species that are considered of Outstanding Universal Value from the point of view of science or conservation.
5. The site's integrity and capability to ensure the conservation of its outstanding features.

Questions regarding the impact on OUV need to be addressed such as: are the current levels of the Outstanding Universal Value: beauty, ecology, habitats and geology at the site affected? If so to what extent? Are the functions of ecology, habitats and the geological processes affected by the presence, nature and amount of marine litter at the site? What part of the functions have been hampered and are the functions still at a level able to support the ecosystem, its organisms and geological processes sufficiently?

With regard to the socio-economic values of the WHms questions need to be addressed such as: are the socio-economic values affected by the presence, nature and amount of marine litter at the site? This involves an assessment of the social impact: is local society affected? Are the social and religious values the same as in the past, is the web of social interactions still present and can religious ceremonies still be conducted? With regard to financial impact: are the sources of income of the site and its inhabitants affected. This means e.g. are fewer

visitors attracted to the site, is the local food production associated with the marine environment in decline et cetera.

It is recommended that research protocols for both determining the impact on OUV and the socio-economic values of WHms are developed. This must be done in such a way that these can be applied to all WHms. When this information on the impacts of marine litter pollution on OUV and socio-economic values of WHms is collected it could be useful as a tool for convincing politicians and funding agencies to help support combatting the problem.

7.1.1.1.2 The local approach at World Heritage marine site level

Five steps are needed to address the problem of marine litter pollution of marine sites. These steps should include the following lines of enquiry: are large amounts of marine litter present at the site causing it to be a problem or not? If it is a problem, what kind of litter is present, does it consist of large parts or predominantly small ones? What negative impacts does it have on the environment, habitats and organisms? If it affects the site's nature values, the sources need to be identified and addressed. That can be easy or very difficult depending on their origin and the sources that caused it. What are the pathways of the litter transport? Does it come from a local dumpsite at the nearby village, does it come from a river of national importance or does it come from another country or a gyre at a distance of 1000 kilometres? The geographical scale and level of governance are of great importance to address the problem's sources. A source-based approach may not be feasible when the scale of the problem is too large or governance responsibility for the problem is beyond local influence.

Another important aspect is whether the source can be addressed at all. Even when it lies in the site's vicinity, political, social, economic or environmental barriers could hamper efforts to address the problem effectively. In those cases end-of-pipe solutions like litter removal from beaches or from the water or the application of physical barriers is the last resort.

In summary, the approach to address the litter pollution of a marine site needs to include:

1. **A holistic assessment** that consists of:
 - a. Determination of the types, amounts and sizes of fractions of the marine litter present. Do this by using an accepted methodology (a methodology that is broadly accepted as a neutral methodology). It would be best if a single methodology were to be applied throughout the whole network of WH marine sites. But this may take time to develop so a choice has to be made in the meantime.
 - b. Determination of the negative impact of the marine litter to the site's environment, nature values (including Outstanding Universal Value if these apply) and socio-economic values. This is needed to prove that it is really a serious problem for decision makers and possible funders.
 - c. Determination of the sources, pathways of transport of the marine litter and the geographical (thus the governance) level that applies.
 - d. Determination of the presence of barriers that could hamper addressing the sources of marine litter at the site.
2. **Definition of concrete measures** and the process needed to address the litter effectively in relation to its sources (refer to table 2). If possible, try to engage important stakeholders in an early stage of the process to create support.
3. **Drafting of a plan of action** in which the nature, magnitude and impact of the problem are described and the appropriate measures together with the associated processes needed to solve the problem are identified. A timeline with milestones and a budget needed for the measures must be included as well. Topics like negotiations and fundraising are likely to be included.
4. **Implementation of the measures.** The measures need to be implemented, meaning that actions or campaigns need to be started or technical solutions need to be put in place.

5. **Monitoring of the effects of the measures** what are the levels of marine litter and its composition at the site.

Can a change be observed after the implementation of measures and if so what is the direction of the change? The policy monitoring results may lead to adjustment of measures since this needs to be applied as a feedback loop.

By applying these suggestions a firm basis for further protection of the World Heritage marine sites can be achieved. However, to be successful, cooperation across all actors, private sector, governments, World Heritage marine managers, individual WHMs, and support by society at large are needed.

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Annexes

Annex I. Text of the survey

1. Is marine litter present in your WH site?

- a) Yes, it's very visible
- b) Yes, but it's not very visible
- c) Not sure
- d) No, there is no marine litter present

2. Which local marine and coastal life in or near your World Heritage site is negatively affected by marine litter?

(You can select multiple options - choose all that apply)

- a) Marine mammals
- b) Fish populations
- c) Turtles
- d) Seabirds
- e) Coral reefs
- f) Plants and animals on or near the ocean floor
- g) Plants and animals on land
- h) None – the marine and coastal life at my WH site is not affected by marine litter
- i) Others (please specify)

3. What known negative impacts does marine litter have on the attributes of the Outstanding Universal Value of your site? Please refer to the Statement of OUV for your site which can be found at:

<http://whc.unesco.org/document/168089>

- a) How does marine litter negatively impact OUV Criterion (vii): "Beauty" at your site?

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Criterion (vii): “Beauty”: to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance

b) How does marine litter negatively impact OUV Criterion (viii): “Geology” at your site?

Criterion (viii): “Geology”: to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features

c) How does marine litter negatively impact OUV Criterion (ix): “Ecosystems” at your site?

Criterion (ix): “Ecosystems”: to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals

d) How does marine litter negatively impact OUV Criterion (ix): “Habitat” at your site?

Criterion (ix): “Habitat”: to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation

4. Does marine litter have any social/economic impacts in or near your World Heritage site? If so, please specify the sectors that are affected. (Please select all that apply)

a) Commercial fishing

b) Recreational fishing

c) Harbours/marinas

d) Tourism

e) Recreation

f) None – marine litter does not have any social/economic impacts at my WH site

g) Other (please specify)

5. What are the main sources/origin of the marine litter at your World Heritage site?

Marine Litter at UNESCO World Heritage Marine Sites

- a) Local sources
- b) Shipping
- c) Fisheries
- d) Riverine
- e) Other (please specify)

5a. If you indicated that the marine litter at your site comes from local sources, please tell us more about these local sources

6. Do you carry out any marine litter monitoring work?

- a) Yes, for all marine litter.
- b) Yes, but only for macroplastics (larger than 5mm in diameter)
- c) Yes, but only for microplastics (smaller than 5mm in diameter)
- d) Yes, for macroplastics and microplastics
- e) Yes, but only for certain types of marine litter [please complete Question 6(i) below]
- f) No, currently we do not have any monitoring scheme in place.

6(i) What types of marine litter do you monitor?

6a. If you do conduct litter monitoring of any kind, how frequently?

- a) daily
- b) weekly
- c) biweekly
- d) monthly
- e) quarterly
- f) every 6 months

Marine Litter at UNESCO World Heritage Marine Sites

g) yearly

h) not scheduled regularly

6b. Who carries out the monitoring work?

a) experienced scientists

b) rangers or civil servants

c) volunteers under guidance of scientists

d) volunteers only

e) citizen science

f) other (please specify)

6c. What is the nature of the monitoring locations within your WH site? (Please select all that apply)

a) sandy beach

b) pebble beach

c) rocky shore

d) cliffs

e) mudflat

f) dunes

g) coral reef

h) mangroves

i) seagrass meadows

j) estuary

k) Salt marshes

l) other (please specify)

Marine Litter at UNESCO World Heritage Marine Sites

6d. Do you have a categorised system for your litter monitoring?

(for example, OSPAR system, NOAA Marine Debris Program, National system, self-developed system)

Yes

No

6d (i) If yes, Please give details of the litter monitoring system that you use

(for example OSPAR system, NOAA Marine Debris Program, National system, self-developed system)

6e. Which information do you record during litter monitoring? (Please select all that apply)

a) Number of marine debris items

b) Number of marine debris items per litter category (including litter identification)

c) overall weight

d) total weight per litter category

e) individual item weight

f) overall volume

g) total volume per litter category

h) length measurements

i) colour

j) stage of degradation

k) bite marks

l) (for plastics) polymer identification

m) biofouling

n) potential sources

6f. Is the monitoring recorded in a database?

Marine Litter at UNESCO World Heritage Marine Sites

Yes [please tell us more below]

No

6f(i) What period of time is covered by the database?

a) less than 1 year

b) 1-5 years

c) 5-10 years

d) more than 10 years

6h. Is the database publicly accessible?

Yes

No

6h(i) If you said your database is publicly accessible. Please provide details

7. How do you deal with marine pollution?

(Please select all that apply)

a) beach clean-ups

b) awareness-raising campaigns

c) mitigation measures. (for example, provision of litter bins, anti-littering notices, incentives)

d) No action taken

e) other (please specify)

Please provide best practice examples for monitoring, awareness building and mitigation measures/solutions.

These could be (for example) scientific research, cooperative programmes, awareness campaigns, cooperation with stakeholders/sectors, positive incentives etc)

8. How do you dispose of marine litter that is collected at your site? (Please select all that apply)

a) Incineration

Marine Litter at UNESCO World Heritage Marine Sites

- b) Landfill
- c) Recycling
- d) We do not collect or dispose of marine litter at our site
- e) Other (please specify)

9. Who pays for the disposal of marine litter at your World Heritage site?

(Please select all that apply)

- a) National authority
- b) Local authority
- c) External funding
- d) We do not collect or dispose of marine litter at our site
- e) Other (please specify)

10. What do you think are the key reasons of the littering problem? (Please select all that apply)

- a) Lack of public awareness
- b) Carelessness/Premeditated
- c) Lack of proper dumping sites
- d) Other (please specify)

11. Which approaches do you think might help tackle the issues you identified above? (Please give examples)

12. How do you think UNESCO's World Heritage Centre can help you reduce the impacts of marine litter in your WH site?

END

Annex II. The 49 marine sites inscribed on the World Heritage List (as of 1 January 2019)

Argentina

Peninsula Valdés, 1999

Australia

Great Barrier Reef, 1981

Heard and McDonald islands, 1997

Lord Howe Island Group, 1982

Macquarie Island, 1997

Ningaloo Coast, 2011

Shark Bay, Western Australia, 1991

Bangladesh

The Sundarbans, 1997

Belize

Belize Barrier Reef Reserve System, 1996

Brazil

Brazilian Atlantic Islands: Fernando de Noronha and Atol das Rocas Reserves, 2001

Canada/USA

Kluane/Wrangell-St. Elias/Glacier Bay/Tatshenshini-Alsek, 1979

Columbia

Malpelo Fauna and Flora Sanctuary, 2006

Costa Rica

Area de Conservación Guanacaste, 1999

Cocos Island National Park, 1997

Ecuador

Galapagos Islands, 1978

Finland/Sweden

High Coast / Kvarken Archipelago, 2000

France

Gulf of Porto: Calanche of Piana, Gulf of Girolata, Scandola Reserve, 1983

Lagoons of New Caledonia: Reef Diversity and Associated Ecosystems, 2008

Germany/Netherlands/Denmark

The Wadden Sea, 2009

Iceland

Surtsey, 2008

India

Sundarbans National Park, 1987

Indonesia

Komodo National Park, 1991

Ujung Kulon National Park, 1991

Japan

Ogasawara Islands, 2011

Shiretoko, 2005

Kiribati

Phoenix Islands Protected Area, 2010

Mauritania

Banc d'Arguin National Park, 1989

Mexico

Islands and Protected Areas of the Gulf of California, 2005

Sian Ka'an, 1987

Whale Sanctuary of El Vizcaino, 1993

Archipiélago de Revillagigedo, 2016

New Zealand

New Zealand Sub-Antarctic Islands, 1998

Norway

West Norwegian Fjords – Geirangerfjord and Nærøyfjord, 2005

Palau

Rock Islands Southern Lagoon, 2012

Panama

Coiba National Park and its Special Zone of Marine Protection, 2005

Philippines

Puerto-Princesa Subterranean River National Park, 1999

Tubbataha Reefs Natural Park, 1993

Marine Litter at UNESCO World Heritage Marine Sites

Russian Federation

Natural System of Wrangel Island Reserve, 2004

Seychelles

Aldabra Atoll, 1982

Solomon Islands

East Rennell, 1998

South Africa

iSimangaliso Wetland Park, 1999

Spain

Ibiza, Biodiversity and Culture, 1999

Sudan

Sanganeb Marine National Park and Dungonab Bay – Mukkawar Island Marine National Park. 2016

United Kingdom of Great Britain and Northern Ireland

Gough and Inaccessible Islands, 1995

St. Kilda, 1986

United States of America

Everglades National Park, 1979

Papahānaumokuākea, 2010

Viet Nam

Ha Long Bay, 1994

Yemen

Socotra Archipelago, 2008