Fanplesstic-sea

Review of existing policies and research related to microplastics

Interreg Baltic Sea Region

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Microplastics

December 2019

About the FanpLESStic-sea project

FanpLESStic-sea – “Initiatives to remove microplastics before they enter the sea” (January 2019-June 2021) is an EU INTERREG funded Baltic Sea Region project aimed at decreasing and removing microplastics in the Baltic Sea, through the delivery of the following outputs:

— A model to map, understand and visualize microplastic pathways that will be applied to the partners’ cities and/or regions;
— Piloting of new technology:
— for filtering out microplastics;
— sustainable drainage solutions as means for removal of microplastics; and
— to remove microplastics from stormwater
— Defining innovative governance frameworks and engaging a large range of players for the implementation of coordinated and cost-efficient measures resulting in locally adapted investment proposals/plans for each partner’s region; and
— Dissemination of project results, including reports on barriers and ways forward, to increase institutional capacity on up-stream and problem-targeted methods to remove microplastics.

FanpLESStic-sea project partners

About this publication

This publication is the output report of the Activity 2.1 of the FanpLESStic-sea project which reviewed the existing research activities and policies on microplastics at global, regional (referring to the Baltic Sea region), EU and national level. National information and data were acquired through a questionnaire whereas a comprehensive literature review was conducted for compiling information at global, regional and EU levels.

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About this document

The FanpLESStic-sea project – "Initiatives to remove microplastics before they enter the sea" started in January 2019. In addition to the project goals such as raising awareness and looking for solutions related to the issue of microplastics, the project will contribute to the implementation of several actions (RL4, RL6 and RL7) of the HELCOM Regional Action Plan on Marine Litter. Additional information on the project, including partnership and envisaged activities, can be found at the FanpLESStic-sea project and HELCOM websites. FanpLESStic-sea is an EU INTERREG funded Baltic Sea Region project aimed at decreasing and removing microplastics in the Baltic Sea, where HELCOM is one of the partners. The envisaged outputs of the project are:

- A model to map, understand and visualize microplastic pathways that will be applied to the partners' cities and/or regions;
- Piloting of new technology i) for filtering out microplastics; ii) sustainable drainage solutions as means for removal of microplastics; and iii) to remove microplastics from stormwater;
- Defining innovative governance frameworks and engaging a large range of players for the implementation of coordinated and cost-efficient measures resulting in locally adapted investment proposals/plans for each partner's region; and
- Dissemination of project results, including reports on barriers and ways forward, to increase institutional capacity on up-stream and problem-targeted methods to remove microplastics.

This report is the output of Activity 2.1 of the project, which aims to review existing research and policies on microplastics. The report is divided into two sections. The first one (Part 1) is a review of existing policies and governance frameworks related to microplastics. The second part (Part 2) is a review of the existing research on microlitter, including microplastics. Both parts have been further divided into the following geographical levels: global, regional (referring to the Balti Sea region), EU and national.

The data for the global, regional and EU levels has been acquired mainly by a literature review type exercise, whereas the data from the national level has been collected via survey. For this purpose, a questionnaire was prepared in SurveyMonkey to collect information on the current regulatory framework and research activities on microplastics in the frame of the FanpLESStic-sea project. The survey (Annex 2) was circulated to the project partners for further distribution to relevant national contacts as well as to the HELCOM Expert Network (EN-Marine Litter) for their voluntary contribution.

Due to the abundance of data (research initiatives and projects) on microplastics globally, this report only highlights the few and most updated research review exercises, such as the comprehensive work done by the Group of Experts on the Scientific Aspects of Marine Protection (GESAMP) on microplastics.

It is also worth mentioning that this report will not introduce the overall issue of microplastics in detail (sources, effects, occurrence, fate etc.) because this kind of work has already been done by many other groups, institutions and countries (UN, GESAMP, EU, IUCN, NGOs, Norway, Sweden and many others) and is not repeated here. Rather, the purpose is to review and make available the existing and ongoing microplastic related research, reports, initiatives and policies in each partner country, on EU level and globally. However, the glossary section defines some important terms that are frequently used in microplastics literature, research and policies and can hence be used as a quick reference and a knowledge bank. Finally, the document concludes with a discussion section aiming at providing food-for-thought on next steps to be taken to address microplastics in the Baltic Sea region.

Summary

Several global-level instruments and multigovernmental agreements exist that are relevant to marine plastics litter and microplastics, but none of the existing frameworks is specifically designed to prevent increasing amounts of plastic pollution and microplastics entering the environment. These are instruments aiming at preventing marine pollution (UNCLOS and IMO's MARPOL, London Convention / Protocol), targeting biodiversity protection (CBD, CMS, FAO, UNFSA) or focused on waste and chemicals (Basel, Rotterdam and Stockholm conventions). Out of these, the new legally-binding amendment to the Basel convention which makes the global plastic waste trade more transparent and regulated is one example. In addition, there are several voluntary measures and action plans that are targeting the issue, such as the Sustainable Development Goals (SDGs), the United Nations Environment Assembly (UNEA) resolutions, FAO guidelines on marking of fishing gear and the marine litter action plans of the G7 and the International Maritime Organization (IMO) among others. However, above-mentioned instruments are related to marine litter and pollution in general and address mainly secondary microplastics that result from the fragmentation of larger plastic items leaving a gap in terms of primary microplastics which none of the current global instruments addresses specifically. Excluding, to some extent, the UNEA resolutions that consider marine plastics litter and microplastics as a package, but still recognizing specific concerns related to microplastics.

At Baltic Sea-level, the most important instrument is the HELCOM Regional Action Plan on Marine Litter that has regional actions which are being followed-up and updated regularly. These include, among others, specific actions targeting microplastics from different sources, including in waste- and stormwater.

The European Union has a wide range of instruments that target the issue of marine plastics litter and microplastics directly and indirectly. These instruments include several Directives and Strategies. Out of the Directives, the most relevant ones are the Marine Strategy Framework Directive (MSFD), the Waste Directive, the Single-Use Plastics Directive (SUP) and the Directive on Port Reception Facilities to tackle sea-based litter. In addition, the European Commission is currently working on regulation concerning intentionally added microplastics. The European Union has also adopted a Circular Economy Package in 2015 which includes a Strategy for Plastics that has specific elements related to preventing marine litter and microplastics pollution. The SUP Directive is a result of such Strategy as well as the restriction proposal by the European Chemicals Agency (ECHA) concerning the use of intentionally added microplastic particles to consumer or professional use products of any kind, which, if adopted, could be an important instrument in addressing the use of microplastics in products in Europe.

The national-level data regarding the regulation, policies and guidance on microplastics was collected through a survey and covered also microplastics in waste- and stormwater. In total, 18 responses from nine countries were received. Based on the results, Sweden is the only Baltic Sea country that currently has a law (ban) concerning "the placing of cosmetic products that are intended to be rinsed off and contain microplastics on the market". Other countries (such as Denmark, Finland and Poland) have also started processes possibly targeting the restriction of the use of intentionally added microplastics in different products, but these are in varying stages. In Denmark, a ministerial order is in hearing on a ban of the use of microplastics in cosmetic products whereas Finland is currently preparing a report on the main sources of microplastics. In Poland, there is a draft act on cosmetic products. Regarding secondary microplastics, there are several existing and planned strategies and laws that address the use of plastic and pollution from plastics in general in Finland, Poland and Russia for example.

Other than laws, bans and strategies, different guidelines exist at least regarding artificial turfs (Denmark and Sweden) and stormwater and road runoff (Finland, Lithuania, Norway, Poland, Russia and Sweden). The guidelines on stormwater are not usually specific to microplastics, rather might mention microplastics as one of the contaminants. However, Sweden is planning to publish specific guidelines regarding microplastics in stormwater. There are also NGO guidelines available that propose ways to reduce microplastics in stormwater in the Baltic Sea region. The issue of microplastics from road dust and tyre wear is also under investigation in several countries in addition to other issues such as microplastics and human health (drinking water). Sweden is also compiling specific guidelines to minimize emissions of microplastics from industrial production of primary microplastics.

In terms of research, the amount of research regarding microplastics has grown dramatically during the past few years. Globally, there is nowadays lot of research on-going on microplastics in water and other ecosystems, wastewater and biota as well as on methodologies for detecting, analyzing and monitoring microplastics. In this report, only few global research compilations are presented. The reports produced by the GESAMP group are to be pointed out, not only did they present available information on microplastics, but they have tried to harmonize microplastics monitoring methodologies. This is an important issue when discussing the sources, impacts and fate of microplastics since the heterogeneity of methodologies used jeopardize the comparison between studies. The global research section provides recommendations from the GESAMP group regarding aspects such as the definition of the size limits/categories, monitoring methodologies and detection methods.

In addition to the work done by the GESAMP group, this section provides findings from the recently published report by the International Union for Conservation of Nature (IUCN) that, among other things, states that the primary microplastics are globally a major source of plastics into the oceans with between 0.8 and 2.5 Mtons/year global releases (central value 1.5 Mtons/year), regionally outweighing that of secondary microplastics from mismanaged wastes. According to IUCN, this is a significant but as-of-yet unrecognized proportion and represents around 50% of the total losses ending up in the ocean. However, the IUCN report counts not only plastic pellets and microplastics in cosmetics as primary microplastics (MPLs) but also tyre particles, road markings, ship coatings and textile fibers which are in other studies and reports (e.g. GESAMP) usually counted as secondary MPLs because they are derived from abrasion. This section also provides a selection of on-going global microplastics monitoring initiatives (from vessels) of which some are based on experimental citizen science and some are more established and well-funded research initiatives that are focusing on collecting more information on the occurrence and accumulation of microplastics in the seas and oceans globally.

At regional level, a comprehensive overview of published research and information of microplastics in the water column and surface, sediments and strandline as well as microplastics in biota from the Baltic Sea region is provided. Two reports were used as a basis for this section: one of the outputs of the HELCOM SPICE project on regional research on microlitter and a compilation of microplastic studies in Nordic Biota (Nordic Council). As already mentioned above, the comparison between studies is not possible due to the different methodologies applied (except for the studies from the surface water that often uses same methodology). For example, in some cases the concentrations of microplastics were reported to be up to 2500 times bigger when using smaller mesh size in the same study. However, it can be observed that most of the studies considered have identified microplastics in their samples regardless of the ecosystem compartment, biota or location where the sampling was conducted.

Regarding biota, the most commonly studied fish species in the Baltic Sea region have been cod, Atlantic and Baltic herring, European sprat and blue mussels, but studies from several other species also exist. It has not always been specified, but the percentage of samples containing microplastics varies between 0 and 34% for different fish species and up to 67% for blue mussels. Some studies include micro fibers in their analysis of microplastics in biota whereas others do not, which complicates the comparison of results from different studies.

The European Commission has funded and produced several reports and studies related to marine litter, but also specifically related to microplastics. The key findings from the most relevant ones are presented. The two reports concerning intentionally added (primary microplastics) and non-intentionally produced (secondary microplastics) provide a good overall image of the situation in Europe. Regarding the intentionally added microplastics, the reports identify cosmetics and personal care products, detergents, paints/coatings/inks, industrial abrasives and agriculture among the most important sources of intentionally added microplastics, whereas tyres, road markings, pre-production plastic pellets and washing of synthetic textiles are all large sources of microplastics emissions into the environment from non-intentional sources. The European Union is also carrying out research related to health risks and recommends targeted actions for sources of microplastics which pose the highest potential risks as well as filling the knowledge gaps related to nanoplastics, a new emerging area of research. Other relevant publications from the European Commission are identified and summarized.

During the last few years, a large amount of national-level microplastics research and reports have been produced. These reports could be roughly divided into four categories of which the first one would be identifying the sources of microplastics (primary and secondary). These kinds of assessments have been carried out in Denmark, Germany, Norway and Sweden, whereas Finland is currently producing one. The second category would be microplastics related to wastewater treatment and treatment plants (WWTPs), which has become an important research topic in many countries (Denmark, Finland, Germany, Norway, Poland, Russia and Sweden). At least 20 different national studies and/or reports concerning microplastics in wastewater were reported, that often investigate the retention potential of the wastewater treatment plants (WWTP) in capturing microparticles and microfibers. Based on the results from different countries, the capability of advanced WWTP using tertiary treatment technologies to capture microplastics and fibers is high (95-99%). However, due to the large volumes of treated wastewater constantly, the WWTP are still considered to be important point sources of microplastics to the environment. Hence, almost without exception, the concentrations of microplastics at the discharge area/water were found to be higher than in reference sites. In addition, the sludge from the WWTPs containing microplastics is often used in agriculture as a fertilizer, and the consequences of microplastics in sludge to the recipient ecosystem are not completely understood.

The third category, which seems to be gaining more interest is microplastic emissions from the car tyre wear/road dust. Studies related this category have already been carried out in Norway, but several new projects have recently been initiated in Denmark, Finland, Germany, Norway and Sweden. Another interesting study focus, which is very much related to this third category is microplastics in stormwater, and there are already few examples of concluded studies (Denmark) and several others on-going.

The last category includes all other, often specific studies such as microplastics in drinking water, from washing machines, in biota or even in snow. In addition, microplastic emissions from artificial turfs is under investigation in many of the project partner countries.

Glossary and definition of terms

Short form / acronym	Term	Definition or use
Common definitions related to marine litter		
ALDFG	Abandoned, Lost or otherwise Discarded Fishing gear	“Abandoned fishing gear” means fishing gear over which that operator/owner has control and that could be retrieved by owner/operator, but that is deliberately left at sea due to force majeure or other unforeseen reasons. “Lost fishing gear” means fishing gear over which the owner/operator has accidentally lost control and that cannot be located and/or retrieved by the owner/operator. “Discarded fishing gear” means fishing gear that is released at sea without any attempt for further control or recovery by the owner/operator (FAO, 2019)
	Hotspot	Hotspots can be defined in various ways. ‘Pollution hotspots’ refer to places where a major pollutant source (e.g. an industrial plant) is present. ‘Biodiversity hotspots’ refer to areas or regions having a high biodiversity (Andersen, Hansen, Mannerla, Korpinen, & Reker, 2013). ‘ALDFG hotspots’ refer to 1) an operation or navigation hazard to their members 2) significant economic loss through the ghost fishing and subsequent mortality of their member target species 3) a risk of entangling marine mammals, birds or turtles occupying the region (Huntington, 2017)
	Marine litter	Any persistent, manufactured, or processed solid material that is discarded, disposed of or abandoned in the marine and coastal environment (UNEP, 1995)
	Marine pollution	The direct or indirect introduction into the marine environment, as a result of human activity, of substances or energy, including human-induced marine underwater noise, which results or is likely to result in deleterious effects such as harm to living resources and marine ecosystems, including loss of biodiversity, hazards to human health, the hindering of marine activities, including fishing, tourism and recreation and other legitimate uses of the sea, impairment of the quality for use of sea water and reduction of amenities or, in general, impairment of the sustainable use of marine goods and services (European Commission, 2008)

POPs	Persistent Organic Pollutants	Organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes (WHO, 1995)
	Pressure	The mechanism (physical, chemical or biological) through which a human activity has a direct or indirect adverse effect on any part of the ecosystem, e.g. physical disturbance to the seabed (OSPAR, 2011)
Size definitions related to marine litter (Source: (GESAMP, 2019)		
	Mega litter	The fraction of marine litter of more than 1m in size (very large size)
	Macro litter	The fraction of marine litter between 2.5 cm and 1 m in size (large size)
	Meso litter	The fraction of marine litter between 5-25 mm in size (medium size)
	Micro litter	Generic term for the fraction of marine litter of less than 5 mm in size (small size). Suggested further division: "Large Micro Particles" (1-5mm) "Small Micro Particles" (<1mm)
MPLs	Microplastics	Generic term for small polymeric (plastic) particles under 5 mm in diameter Possible further division: "Large Microplastics" (1-5mm) "Small Microplastics" (0.02-1mm) "Very small Microplastics" (0.001mm/1µm-0,02mm)
NPLs	Nanoplastics	Generic term for all polymeric particles under 1000nm/1µm/0,001mm
Microplastics specific terms		
	Film (also sheet)	Flat, flexible particle with smooth or angular edges (GESAMP, 2019)
	Foam	Near-spherical or granular plastic particle, which deforms readily under pressure and can be partly elastic, depending on weathering state (GESAMP, 2019)
	Fragment (also flake)	Irregular shaped hard particles having appearance of being broken down from a larger piece of litter (GESAMP, 2019)
	Line	Long fibrous material that has a length substantially longer than its width (GESAMP, 2019)
MBs	Microbeads (also resin beads)	Man-made plastic particles intentionally added to consumer products, typically less than or equal to 5 mm in size that can vary in chemical composition, size, share and density
MFs	Microfibers	Type of microplastics created by fragmentation and degradation of synthetic textiles

PCCP	Personal care and cosmetic product	An article intended to be rubbed, poured, sprinkled, or sprayed on, introduced to, or otherwise applied to, the human body or any part thereof for cleansing, beautifying, promoting attract (Rahman & Z Fahem, 2019)
	Plastic pellets (also nurdles, mermaid tears)	Man-made hard plastic particles with spherical, smooth or granular shape used as a feedstock in the plastic industry, typically between 1-5 mm in size. (modified from (GESAMP, 2019)
PMPLs	Primary microplastics	Primary microplastics are purposefully manufactured in microscopic size to carry out a specific function (e.g. abrasive particles, powders for injection molding or resin pellets for bulk transportation of polymers between manufacturing sites) (GESAMP, 2019), and (HELCOM, 2015)
SMPLs	Secondary microplastics	Secondary microplastics represent the results of wear and tear or fragmentation of larger plastic items, both during use and following loss to the environment (e.g. textile and rope fibers, weathering and fragmentation of larger litter items, vehicle tyre wear, paint flakes) (GESAMP, 2019)
Microplastic research (sampling and analysis) terms		
ATR-FTIR	Attenuated Total Reflection-Fourier Transform-Infrared Spectroscopy	Attenuated total reflection (ATR) is a sampling technique used in conjunction with infrared spectroscopy which enables samples to be examined directly in the solid or liquid state without further preparation. The sample is put in optical contact with a crystal of specific material (diamond, Zin Selenide, Germanium, etc.) with higher refractive index than the sample. This technique allows to analyse massive and rough samples, and it is widely used in microplastic analysis from large microplastic (1 – 5 mm) and smaller microplastics down to 500 – 300 µm (Wikipedia, modified)
	Box corer	The Box corer is a marine geological sampling tool for soft sediments in lakes or oceans. It is deployed from a research vessel with a wire and suitable for any water depth. It is designed for a minimum of disturbance of the sediment surface by bow wave effects which is important for quantitative investigations of the benthic micro- to macrofauna, geochemical processes, sampling of bottom water or sedimentology (Wikipedia)
	Fluorescence-Microscopy	Fluorescence microscopy is an optical microscopy that uses fluorescence and phosphorescence instead of, or in addition to, scattering, reflection, and attenuation or absorption, to study the properties of

		organic or inorganic substances. "Fluorescence microscope" refers to any microscope that uses fluorescence to generate an image, whether it is a simpler set up like an epifluorescence microscope or a more complicated design such as a confocal microscope, which uses optical sectioning to get better resolution of the fluorescence image. It is used for microplastic screening analysis in combination with dyers (e.g. Nile Red). (Wikipedia, modified)
FT-IR (FTIR)	Fourier Transform – Infrared Spectroscopy	Fourier-Transform Infrared spectroscopy (FTIR) is a technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid or gas. An FTIR spectrometer simultaneously collects high-spectral-resolution data over a wide spectral range. Fourier transform (a mathematical process) is required to convert the raw data into the actual spectrum. (Wikipedia, modified)
GC-MS (GC/MS)	Gas Chromatography – Mass Spectrometry	Gas Chromatography–Mass Spectrometry (GC-MS) is an analytical method that combines the features of gas-chromatography and mass spectrometry to identify different substances within a test sample. Applications of GC-MS include drug detection, fire investigation, environmental analysis, explosives investigation, and identification of unknown samples. Recently it has been used also in Microplastic analysis, especially in combination with pyrolysis. (Wikipedia, modified)
	Manta trawl	Usually 1.5 meters wide, made of aluminum with 3 meters long, fine-mesh net; the mouth of the trawl is 60 centimeters wide, with two 45-centimeter floating wings on either side (5Gyres, 2019)
OM	Optical Microscopy	Optical Microscopy (OM), often referred to as the light microscopy, is a type of microscopy that commonly uses visible light and a system of lenses to magnify images of small objects (Wikipedia, modified)
PYR (PY)	Pyrolysis	Thermal decomposition of materials at elevated temperatures in an inert atmosphere that involves a change of chemical composition and is irreversible. This technique is used in combination with GC-MS to separate the compounds generated by pyrolysis. Pyr-GC-MS is at present one of the suitable techniques to analyse microplastics (Wikipedia, modified)
SM	Stereo-Microscopy	The stereo, stereoscopic or dissecting microscopy is an optical microscopy designed for low magnification observation of a sample, typically using light reflected from the surface of an object rather than transmitted

		through it. The stereo-microscope typically uses two separate optical paths with two objectives and eyepieces to provide slightly different viewing angles to the left and right eyes. This arrangement produces a three-dimensional visualization of the sample being examined (Wikipedia, modified)
TD	Thermal Desorption	Thermal desorption is an environmental remediation technology that utilizes heat to increase the volatility of contaminants so that they can be removed (separated) from the solid matrix (typically soil, sludge or filter cake). The volatilized contaminants are then either collected or thermally destroyed. A thermal desorption system therefore has two major components; the desorber itself and the offgas treatment system. Thermal desorption is not incineration (Wikipedia)
TGA	Thermo Gravimetric Analysis	Thermogravimetric Analysis or Thermal Gravimetric Analysis (TGA) is a method of thermal analysis in which the mass of a sample is measured over time as the temperature changes. This measurement provides information about physical phenomena, such as phase transitions, absorption, adsorption and desorption; as well as chemical phenomena including chemisorptions, thermal decomposition, and solid-gas reactions (e.g. oxidation or reduction). (Wikipedia)
	Trawl	A special equipment designed to capture floating plastic on the water's surface while filtering debris through a fine-mesh net (5Gyres, 2019)
	Van Veen grab	The Van Veen Grab Sampler is an instrument to sample sediment in water environments. Usually it is a clamshell bucket made of stainless steel. Up to 20 cm deep samples of roughly 0.1 m2 can be extracted with this instrument. It can be light-weight (roughly 5 kg) and low-tech. The smallest version even fits into hand luggage. The sampler was invented by Johan van Veen (a Dutch engineer) in 1933 (Wikipedia)
Plastic packaging and single-use plastics (EC 1994, 2015 and UNEP 2019)		
	Lightweight plastic carrier bags	Plastic bags with a wall thickness below 50 microns (European Commission, 2015)
	Oxo-degradable plastic carrier bags	Plastic carrier bags made of plastic materials that include additives which catalyse the fragmentation of the plastic material into micro-fragments (European Commission, 2015)
	Packaging	All products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw

		materials to processed goods, from the producer to the user or the consumer. 'Non-returnable' items used for the same purposes shall also be considered to constitute packaging (European Commission, 1994)
	Plastic carrier bag	Carrier bags, with or without handle, made of plastic, which are supplied to consumers at the point of sale of goods or products (European Commission, 2015)
	Recyclable packaging	Packaging, including plastic bags, that can be reprocessed in a production process of the waste materials for the original purpose or for other purposes including organic recycling but excluding energy recovery (UNEP, 2018)
	Reusable packaging	Packaging, including plastic bags, that are conceived and designed to accomplish within its life cycle a minimum number of uses for the same purpose for which it was conceived (UNEP, 2018)
	Single-use plastics or disposable plastics	Commonly used plastic packaging including items intended to be used only once before they are thrown away or recycled, e.g. grocery bags, food packaging, bottles, straws, containers, cups, cutlery, etc. (UNEP, 2018)
	Very lightweight plastic carrier bags	Plastic bags with a wall thickness below 15 microns which are required for hygiene purposes or provided as primary packaging for loose food when this helps to prevent food wastage (European Commission, 2015)
Biodegradable plastics (UNEP 2017)		
	Biodegradable	Material (packaging) in which the waste shall be of such a nature that it is capable of undergoing physical, chemical, thermal or biological decomposition such that most of the finished compost ultimately decomposes into carbon dioxide, biomass and water (UN Environmnet, 2017)
	Biodegradation	Biologically-mediated, natural chemical process in which materials are being transformed completely or partially into natural substances such as water, CO_2/methane, energy and new biomass with the help of microorganisms (bacteria and fungi). The process of biodegradation depends on the environmental conditions as well as on the material or application itself. Consequently, the process and its outcome can vary considerably (adapted from (European Bioplastics, 2019) and (UN Environmnet, 2017)
	Bioplastics	Bioplastics constitute a broad range of materials and products that are bio-based,

		biodegradable/compostable, or both (European Bioplastics, 2019) The amount of bio-based material of the content is not specified in this definition.
	Compostable	Material (packaging) waste that can be recycled through a process of organic recovery comprised of composting and anaerobic digestion (UN Environmnet, 2017)
	Compostable -domestic (C-d)	Capable of being biodegraded at low to moderate temperatures, typically found in a domestic compost system (UN Environmnet, 2017)
	Compostable – industrial (C-i)	Capable of being biodegraded at elevated temperatures under specified conditions and time scales, usually only encountered in an industrial composter (standards apply) (UN Environmnet, 2017)
	Degradation	The partial or complete breakdown of a polymer due to some combination of UV radiation, oxygen attack, biological attack and temperature. This implies alteration of the properties, such as discoloration, surface cracking, and fragmentation (UN Environmnet, 2017)
	Oxo-(bio)degradable / oxo-degradable / oxo-fragmentable plastics	Containing a pro-oxidant that induces degradation under favorable conditions. The underlying technology of oxo-degradability or oxo-fragmentation is based on special additives, which, if incorporated into standard resins, are purported to accelerate the fragmentation of the film products. Oxo-fragmentable materials and products do not biodegrade nor meet accepted industry standards on compostability (such as EN 13432) (European Bioplastics, 2019)
Sustainability		
CSR	Corporate Social Responsibility	A self-regulating business model that helps a company be socially accountable — to itself, its stakeholders, and the public (Investopedia)
DRS	Deposit-Refund System/Scheme	A system that combines a tax on product consumption with a rebate when the product or its packaging is returned for recycling (Walls, 2011)
EPR	Extended Producer Responsibility	An environmental policy approach under which producers accept significant responsibility - financial and/or physical - for the treatment or disposal of post-consumer products. Assigning such responsibility could provide incentives to prevent wastes at the source, promote product design for the

		environment and support the achievement of public recycling and materials management goals (OECD, 2001)
LCA	Life-Cycle-Analysis/Assessment	LCA is the compilation and evaluation of the input, output and the potential environmental impact of a product system throughout its life cycle (ISO 14044 on Life Cycle Assessment). It is sometimes also referred to as life cycle analysis, ecobalance or cradle-to-grave analysis (European Bioplastics, 2019)
Common polymers (Resin codes 1-6)		
01 PET	Polyethylene terephthalate	Resin code 1 – Soft drink and water bottles, strapping, textiles, salad domes, biscuit trays
02 PE-HD	Polyethylene high density	Resin code 2 – Toys, shampoo and milk bottles, cleaning agents, pipes, houseware
03 PVC	Polyvinyl chloride	Resin code 3 – Window frames, profiles, floor and wall covering, pipes, cable insulation, garden hoses, inflatable pools, cosmetic containers, outdoor furniture
04 PE-LD	Polyethylene low density	Resin code 4 – rubbish and reusable shopping bags, cling and shrink wrappings, squeeze bottles, trays and containers, agricultural film
05 PP	Polypropylene	Resin code 5 – Food packaging, sweet and snack wrappers, hinged caps, microwave and lunch containers, pipes, automotive parts, bank notes, rope
06 PS	Polystyrene	Resin code 6 – Eyeglasses frames, utensils, containers, CD cases, plastic water cup, crystal glassware, egg trays
Other Synthetic and Semi-synthetic polymers		
ABS	Acrylonitrile butadiene styrene resin	High impact parts in automobiles, hub caps
AC	Acrylic	Clothing (sweaters and tracksuits), linings for boots and gloves, furnishing fabrics and carpets

Cellophane	Semi-synthetic cellulose-based film	Packaging, food contact packaging, adhesive tape
Cellulose acetate	Semi-synthetic cellulose-based fiber or film	Cigarette filters
EP	Epoxy resin (thermoset)	General-purpose adhesives, industrial coatings, fiber-reinforced plastics
EPS (PSE)	Expanded polystyrene	Cool boxes, floats, cups, clothing and textiles
PA	Nylon, Polyamide 4, 6, 11, 66	Fishing nets and lines, rope
PAN	Polyacrylonitrile, acrylic	Thermal clothing, fire-resistant fabrics, carpets, protective clothing, hair extensions, faux fur, yacht sails
PBS	Poly (butylene succinate)	Films, bags and boxes for both food and cosmetic packaging
PBSA	Polybutylene succinate-co-butylene adipate	Film applications
PBT	Polybutylene terephthalate	Optical fibers
PC	Polycarbonate	Substitute glass in greenhouses, roofing sheets, eyeglasses lenses
PCBs	Polychlorinated biphenols	Coolants and insulating fluids, plasticizers in paints and cements, stabilizing additives in flexible PVC coatings of electrical cables and electronic components, pesticide extenders, reactive flame retardants
PCL	Polycaprolactone	Long-term implants and controlled drug release applications
PE	Polyethylene	Plastic bags, storage containers
PE-LLD	Polyethylene linear low density	Bags, trays, food packaging film
PES	Polyester	Textiles, boats
PGA	Poly (glycolic acid) or Polyglycolide	Biodegradable, thermoplastic polymer used in biomedical applications such as drug delivery or in implantable medical devices
PHA	Polyhydroxylkanoates	Medical applications, packaging
PLA	Poly (lactic acid)	Food and drink containers
PMMA	Poly (methyl) methacrylate	Touch screens for electronic goods
PU (PUR)	Polyurethane	Building insulation, insulation for fridges/freezers, foam mattresses
PTFE	Polytetrafluroethylene	Cable coating in telecommunications
PVA	Polyvinyl alcohol	Papermaking, textiles, variety of coatings
Rayon	Semi-synthetic cellulose-based fiber	Textiles, sanitary products
SBR	Styrene-butadiene rubber	Car tyres
Spandex	Polyether-polyurea	Sportswear, swimwear, under-garments e.g. Elastane, Lycra™
Viscose	The most common form of rayon	Clothing fabrics
Chemical additives and monomer residues		

BPA	Bisphenol A	A monomer used in the manufacture of polycarbonates and epoxy resins
DBP	Dibutyl phthalate	Anti-cracking agents in nail varnish
DEP	Diethyl phthalate	Skin softeners, color and fragrance fixers
DEHP	Di-(2-ethylhexyl) phthalate	Plasticizer in PVC
HBCD	Hexabromocyclododecane	Flame retardant
NP	Nonylphenol	Stabilizer in food packaging and PVC
PBDEs	Polybrominated diphenyl ethers (penta, octa & deca forms)	Flame retardants, nonylphenol stabilizer in PP, PS
Phthalates	Phthalate esters	Plasticiser to improve flexibility and durability
Common organic contaminants absorbed by plastics		
DDT	Dichlorodiphenyltrichloroethane	Insecticide
PAHa	Polycyclic Aromatic Hydrocarbons	Combustion products
PCBs	Polychlorinated Biphenyls	Cooling and insulating fluids, e.g. in transformers

Part 1 - Existing policies, regulatory frameworks and governance strategies related to microplastics

This first part of the report reviews the existing policies and regulatory frameworks that are relevant to microplastics at a global, regional, EU and national level.

Marine plastic litter consists of all (mega, macro, meso, micro, and nano) sized plastics in the marine environment that contribute significantly to marine and coastal pollution[1]. Out of these, microplastics are widely understood as plastic pieces under 5 mm in size (see definitions section). In a similar manner, microplastics are commonly divided into primary and secondary microplastics of which primary microplastics are intentionally manufactured to certain size whereas secondary microplastics are fragmented from bigger plastic items due to different effects such as weathering, UV-radiation or physical fragmentation among others.

Therefore, all instruments and governance frameworks (both legally and non-legally binding) listed below that have relevance to marine plastic litter, also have relevance to at least secondary microplastics and are hence included in this report. However, there are currently no, to our knowledge, binding regulations, instruments or policies addressing solely the issue of primary microplastics at a global level.

Global policies and governance structures with links to microplastics

Marine plastic litter, including microplastics, has been recognized as one of the major environmental concerns of our time by several important global-level actors such as the UN, G20, G7, APEC and others. However, regardless of several decisions, declarations, resolutions and outcome documents, the issue remains largely unsolved. While the debate continues regarding the nature of the problem i.e. if the problem is mostly waste management issue that could be solved by investing more in that or more of a systemic issue that should be addressed through prohibition, regulations, product design, alternative materials and other more upstream solutions, several important global players have started taking the latter approach.

During the recent years, there has been increasing deliberations to address the issue of marine litter and microplastics through some sort of a global approach such as a new (or amended existing) legally binding instrument. While there are some existing conventions and agreements (which are introduced below) that could potentially include or are actively taking steps to include aspects of plastic pollution, none of the existing frameworks is specifically designed to prevent increasing flows of plastic pollution into the environment, including seas and oceans, nor to comprehensively manage the plastic pollution already present in the biosphere[2]. This is also confirmed by the comprehensive review[3] made by the UN Environment in 2017, which among others, identified that:

> *"The long-lasting and transboundary plastic is a source of pollution that is not addressed under a single international legally binding instrument. Global instruments exist to protect biodiversity, manage hazardous chemicals and waste, and prevent pollution of the marine environment from*

[1] (UN Environmnet, 2017)
[2] (IEL, EIA, Massey University, coare, 2018)
[3] (UN Environmnet, 2017)

ocean sources and, to a lesser degree, land-based sources of pollution. Some applicable measures are weakly distributed amongst these global instruments, but the reduction of marine plastic litter and microplastics is not a primary objective of any (UN Environment 2017)".

In addition, the assessment states that international binding agreements with relevance to the issue of marine plastic litter and microplastics vary in scope, objectives, applicable approaches and principles, including reporting and compliance requirements.

The first part of the global-level policy section reviews the existing legally binding and universally accepted instruments (multilateral environmental agreements) addressing marine litter. Then, the report discusses the most important universally recognized non legally binding governance frameworks related to marine plastic litter and microplastics.

Multilateral Environmental Agreements

Based on the request by the second United Nations Environmental Assembly (UNEA-2) and as mentioned above, in 2017 the UN Environment Programme (UNEP) carried out a comprehensive assessment[4] of the existing global regional and sub-regional instruments and policies that have relevance to marine litter. The following section summarizes and highlights the main findings of the relevant parts of report that assessed the effectiveness of the Multilateral Environmental Agreements (MEAs) in addressing marine plastic litter and adds new information where needed.

According to UNEP (2017), these global agreements can be divided into three categories; Pollution, Biodiversity and Chemicals and Waste, and out of these, the most relevant ones based on the UNEP assessment are briefly presented below. According to the assessment, other global instruments applicable to the issue are narrower in their approach. Most importantly, there are no binding agreements at the international level for which the reduction of marine plastic litter and microplastics is a primary objective.

Pollution oriented agreements

United Nations Convention on the Law of the Sea (UNCLOS)

As also stated by UN Environment (2017), UNCLOS[5] is a convention setting out the legal framework within which all activities in the oceans and seas must be carried out. This includes the general obligation to protect and preserve the marine environment as well as the obligation to take all measures necessary to prevent, reduce and control pollution of the marine environment from any source, such as from land-based sources, from vessels and by dumping (articles 194, 207, 210, 211)[6]. In addition to encouraging global and regional cooperation and coordination (such as through HELCOM and other Regional Seas Conventions) for the protection and preservation of the marine environment, UNCLOS has extensive provisions on enforcement in respect of the various pollution sources (articles 213-222)[7]. UNCLOS applies broadly to both sources and activities of pollution.

[4] Same as 4 above
[5] (UNCLOS, 1982)
[6] Articles from UNCLOS (1982) above
[7] Articles from UNCLOS (1982) above

UNCLOS is the only global instrument that imposes a legally binding obligation upon States for the prevention, reduction and control of land-based sources of pollution (article 207), which is also probably the most relevant obligation in terms of preventing marine litter and microplastics:

> *Article 1: States shall adopt laws and regulations to prevent, reduce and control pollution of the marine environment from land-based sources, including rivers, estuaries, pipelines and outfall structures, taking into account internationally agreed rules, standards and recommended practices and procedures.*
>
> *Article 2: States shall take other measures as may be necessary to prevent, reduce and control such pollution.*
>
> *Article 3: States shall endeavor to harmonize their policies in this connection at the appropriate regional level.*
>
> *Article 4: States, acting especially through competent international organizations or diplomatic conference, shall endeavor to establish global and regional rules, standards and recommended practices and procedures to prevent, reduce and control pollution of the marine environment from land-based sources, taking into account characteristic regional features, the economic capacity of developing States and their need for economic development. Such rules, standards and recommended practices and procedures shall be re-examined from time to time as necessary*
>
> *Article 5: Laws, regulations, measures, rules, standards and recommended practices and procedures referred to in paragraphs 1, 2 and 4 shall include those designed to minimize, to the fullest extent possible, the release of toxic, harmful or noxious substances, especially those which are persistent, into the marine environment.*

Other similar and relevant Articles to marine litter and microplastics include Article 210 on preventing pollution by dumping and Article 211 related to pollution from vessels. Both Articles have similar provisions than Article 207 above, including:

> *Article 1 (210): States shall adopt laws and regulations to prevent, reduce and control pollution of the marine environment by dumping.*
>
> *Article 2 (210): States shall take other measures as may be necessary to prevent, reduce and control such pollution.*
>
> *Article 3 (210): Such laws, regulations and measures shall ensure that dumping is not carried out without the permission of the competent authorities of States.*
>
> *Article 1 (211): States, acting through the competent international organization or general diplomatic conference, shall establish international rules and standards to prevent, reduce and control pollution of the marine environment from vessels and promote the adoption, in the same manner, wherever appropriate, of routeing systems designed to minimize the threat of accidents which might cause pollution of the marine environment, including the coastline, and pollution damage to the related interests of coastal States. Such rules and standards shall, in the same manner, be re-examined from time to time as necessary.*

> *Article 2 (211): States shall adopt laws and regulations for the prevention, reduction and control of pollution of the marine environment from vessels flying their flag or of their registry. Such laws and regulations shall at least have the same effect as that of generally accepted international rules and standards established through the competent international organization or general diplomatic conference*

The global rules and standards under Articles 210 and 211 are adopted in the context of the International Maritime Organization (see below under IMO instruments).

Main gaps of the instrument in terms of marine litter and microplastics: UNCLOS does not expressly address marine plastic litter nor microplastics but speaks to different sources of pollution in general.

Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL)

MARPOL[8] is the principal convention of the International Maritime Organization (IMO), the United Nations specialized agency, to address ship-based sources of pollution from international shipping. The most relevant regulations to marine plastic litter and microplastics are covered in its Annex V[9]. The Annex prohibits the discharge of all types of garbage into the sea from ships, except in the cases explicitly permitted under the Annex (such as food waste, cargo residues, cleaning agents/additives that are not harmful to the marine environment).

Garbage includes all kinds of food, domestic and operational waste, all plastics, cargo residues, incinerator ashes, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or periodically.

> According to IMO[10]*, the "MARPOL Annex V seeks to eliminate and reduce the amount of garbage being discharged into the sea from ships. Unless expressly provided otherwise, Annex V applies to all ships, which means all ships of any type whatsoever operating in the marine environment, from merchant ships to fixed or floating platforms to non-commercial ships like pleasure crafts and yachts."*

The regulations for the prevention of pollution by garbage from ships entered into force internationally in 1988. Today, more than 150 countries[11] have signed up to MARPOL Annex V.

MARPOL Annex V recognizes that some sea areas require higher degrees of protection and can be designated as Special Areas under MARPOL. Currently, there are eight Special Areas designated under Annex V: the Mediterranean Sea, **the Baltic Sea**, the Black Sea, the Red Sea, the "Gulfs" areas, the North Sea, the Wider Caribbean region including the Gulf of Mexico and the Caribbean Sea, and the Antarctic area. Out of these, the Black Sea and the Red Sea have not entered into force yet due to no receipt of sufficient notifications on adequate reception facilities.

To assist Governments, ships and port operators in implementing relevant requirements under MAPROL Annex V, the Marine Environment Protection Committee (MEPC) has developed and adopted the

[8] (MARPOL, 1973/1978)
[9] (MARPOL Annex V, 2011)
[10] (IMO, Prevention of Pollution by Garbage from Ships, 2019)
[11] (IMO, 2019)

Guidelines for the implementation of MARPOL Annex V, known as a living document, the latest of which is the MEPC.295(71) Resolution.[12]

Main gaps of the instrument in terms of marine litter and microplastics: the requirement to carry onboard a garbage management plan applies only to vessels 100 GT or more and ships certified to carry 15 persons or more / garbage record book required only for ships 400 GT and ships certified to carry 15 persons or more.

Additionally, the effectiveness of ships to comply with the discharge requirements of MARPOL depends largely upon the availability of adequate port reception facilities.

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (London Convention) and its 1996 Protocol (the London Protocol)

Another important global IMO pollution-oriented instrument that is directly relevant to marine plastic litter and microplastics is the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Convention) and the 1996 Protocol thereto (London Protocol).

According to IMO[13], "*The objective of the London Convention and Protocol is to promote the effective control of all sources of marine pollution. Contracting Parties shall take effective measures to prevent pollution of the marine environment caused by dumping at sea".*

> Article 1 of the **London Convention**[14] is explicit: *"Contracting Parties shall individually and collectively promote the effective control of all sources of pollution of the marine environment, and pledge themselves especially to take all practicable steps to prevent the pollution of the sea by the dumping of waste and other matter that is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea."*
>
> Article 2 of the **London Protocol**[15] adds the pollution from incineration: *Contracting Parties shall individually and collectively protect and preserve the marine environment from all sources of pollution and take effective measures, according to their scientific, technical and economic capabilities, to prevent, reduce and where practicable eliminate pollution caused by dumping or incineration at sea of wastes or other matter. Where appropriate, they shall harmonize their policies in this regard."*

Under the London Protocol there is a general prohibition on the dumping of any waste or other matter at sea, including plastics, but excluding those wastes listed in Annex I ("reverse-listing"). These instruments apply to source reduction but only to dumping activities from vessels, aircraft, platforms or other man-made structures at sea directly into the marine environment by ships[16].

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[12] (IMO, Prevention of Pollution by Garbage from Ships, 2019)
[13] (IMO, Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 2019)
[14] (London Convention, 1972)
[15] (London Protocol, 1996)
[16] (UN Environmnet, 2017) as in 4 above

Main gaps of the instrument in terms of marine litter and microplastics: Limited to intentional disposal of plastics at sea from ocean sources.

IMO Action Plan to Address Marine Plastic Litter from Ships

IMO's Marine Environment Protection Committee (MEPC) recently adopted (on 26 October 2018) the Action Plan to Address Marine Plastic Litter from Ships (Resolution MEPC.310(73)) , to contribute to find a global solution for preventing marine plastic litter entering the oceans through ship-based activities.

Recognizing that more needs to be done to address the environmental and health problems posed by marine plastic litter, IMO Member States agreed actions to be completed by 2025, which relate to all ships, including fishing vessels. The action plan also seeks to address possible gaps in MARPOL such as waste from dredging, which must be fully assessed to ensure it does not contain harmful materials like plastics.

Specific identified measures[17] in the Action Plan include:

- a proposed study on marine plastic litter from ships;
- looking into the availability and adequacy of port reception facilities;
- consideration of making marking of fishing gear mandatory, in cooperation with the Food and Agriculture Organization of the United Nations (FAO);
- promoting reporting the loss of fishing gear;
- facilitating the delivery of retrieved fishing gear to shore facilities;
- reviewing provisions related to the training of fishing vessel personnel and familiarization of seafarers to ensure awareness of the impact of marine plastic litter;
- consideration of the establishment of a compulsory mechanism to declare loss of containers at sea and identify number of losses;
- enhancing public awareness; and
- strengthening international cooperation, in particular FAO and UN Environment.

Further discussions continue in the frame of the MEPC to advance on the implementation of the Action Plan.

Biodiversity and species-oriented agreements

The Convention on Biological Diversity (CBD)

The Convention on Biological Diversity[18] (CBD) is a global convention accepted universally by 196 Parties[19]. The Convention does not directly address pollution of the marine environment since it principally applies to the conservation of biological diversity. However, the CBD adopted a Resolution CBD/COP/DEC/XIII/10[20] on 10 December 2016, addressing impacts of marine debris and anthropogenic underwater noise on marine and coastal biodiversity, including an Operational Paragraph X that:

[17] (IMO, Addressing marine plastic litter from ships – action plan adopted, 2018)
[18] (CBD, 1992)
[19] (CBD, 2019)
[20] (CBD, 2016)

"Urges Parties and encourages other Governments, relevant organizations, industries, other relevant stakeholders, and indigenous peoples and local communities, to take appropriate measures, in accordance with national and international law and within their competencies, to prevent and mitigate the potential adverse impacts of marine debris on marine and coastal biodiversity and habitats, taking into account the voluntary practical guidance contained in the annex to the present decision, and incorporate issues related to marine debris in the mainstreaming of biodiversity into different sectors."

The Decision XIII also includes a specific part and priority actions related to microplastics: *"Assess whether different sources of microplastics and different products and processes that include both primary and secondary microplastics are covered by legislation, and strengthen, as appropriate, the existing legal framework so that the necessary measures are applied, including through regulatory and/or incentive measures to eliminate the production of microplastics that have adverse impacts on marine biodiversity."*

CBD has also published, as an Annex[21] to the above-mentioned decision, a *"Voluntary practical guidance on preventing and mitigating the impacts of marine debris on marine and coastal biodiversity and habitats"* and is actively inviting submissions from its Parties on the implementation of the Decision XIII/10 and its Annex.

Main gaps of the instrument in terms of marine litter and microplastics: Even though the Convention itself is legally binding, the COP Decision XIII/10 is not. However, it is an important indication of the importance of the issue under the CBD. According to UN Environment (2017) the CBD could theoretically include broader legally binding measures that could extend to sources of marine plastic litter and microplastics (but only to the extent that such measures conserve biodiversity).

The Convention on the Conservation of Migratory Species of Wild Animals (CMS)

The Convention on the Conservation of Migratory Species of Wild Animals (CMS) has 128 parties[22] and applies to migratory species. *"CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range."*[23]

During the recent years, the Convention has put more emphasis on marine litter and the Parties have adopted two resolutions (Res.10.4[24] and Res.11.30[25]), that encourage or recommend specific measures for Parties to adopt to address knowledge gaps especially relating to the impacts of debris on marine species, best practice on commercial vessels, and awareness campaigns.

Leading to the 11th Conference of Parties (COP) in 2014, the Convention on Migratory Species (CMS) produced three reports related to marine debris. These reports were: Migratory Species, Marine Debris

[21] (CBD, 2016)
[22] (CMS, 2019)
[23] (CMS, 2019)
[24] (CMS, 2011)
[25] (CMS, 2014)

and its Management (UNEP/CMS/COP11/Inf.27), Marine Debris and Commercial Marine Vessel Best Practices (Inf.28) and Marine Debris Public Awareness and Education Campaigns (Inf.29).

The Contracting Parties also adopted actions plans to, among others, address impacts from marine litter for specific marine species, namely for the Loggerhead Turtle (*Caretta caretta*) in the Pacific and for whales and dolphins.[26]

Main gaps of the instrument in terms of marine litter and microplastics: Even though the CMS has legally binding instruments ("Agreements"), the resolutions are not legally binding in nature. In addition, the action plans are limited to single species.

United Nations Fish Stocks Agreement (UNFSA)

The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (United Nations Fish Stocks Agreement/UNFSA)[27] is mainly concerned with the conservation and management of straddling fish stocks and highly migratory fish stocks in areas beyond national jurisdiction and under national jurisdiction. However, it also includes obligations for States to minimize pollution, waste, discards, and catch by lost or abandoned gear (Article 5(f)). In addition, Article 18 (3d) touches upon the issue of marking of fishing gear by addressing the measures to be taken by a State in respect of vessels flying its flag that shall include:

> *"Requirements for marking of fishing vessels and fishing gear for identification in accordance with uniform and internationally recognizable vessel and gear marking systems, such as the Food and Agriculture Organization of the United Nations Standard Specifications for the Marking and Identification of Fishing Vessels"*[28]*.*

The agreement has been ratified/acceded to by 90 States[29] and the European Union but according to UNEP (2017) it may reach a broader range of States to the extent it is implemented through Regional Fisheries Bodies.

Chemicals and waste-oriented agreements

The Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention)

According to the UNEP assessment, the Stockholm Convention on Persistent Organic Pollutants (POPs)[30] provides for some regulation of the production, use and disposal of additives used in the manufacture of plastics. The application of the Stockholm Convention is limited to those plastics produced with POPs listed under the Convention and may have implications for the recycling and reuse of products that contain regulated chemicals.

[26] (UN Environmnet, 2017) as in 4 above
[27] (UNFSA, 1995)
[28] (UNFSA, 1982)
[29] (United Nations Treaty Collection, 2019)
[30] (Stockholm Convention, 2001)

Main gaps of the instrument in terms of marine litter and microplastics: Scope limited to certain chemicals used in the production of certain plastics.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel Convention)

According to the UNEP Assessment, the Basel Convention[31] provides the most comprehensive approach to the issue of marine plastic litter and microplastics globally since the provisions of the Convention with respect to waste minimization, the environmentally sound management of wastes generated, and the transboundary movement thereof apply to plastic wastes. The Convention has also developed several technical guidelines regarding the identification and environmentally sound management of plastic wastes and their disposal, that provide comprehensive guidance on the matter.

Furthermore, during the Basel Conference of the Parties from 29 April to 10 May 2019 (COP-14), Governments amended the Basel Convention to include plastic waste in a legally-binding framework which will make global trade in plastic waste more transparent and better regulated, whilst also ensuring that its management is safer for human health and the environment. At the same time, a new Partnership on Plastic Waste was established to mobilize business, government, academic and civil society resources, interests and expertise to assist in implementing the new measures, to provide a set of practical supports, including tools, best practices, technical and financial assistance.[32].

Main gaps of the instrument in terms of marine litter and microplastics: The Convention is focused on the transboundary movement of Hazardous Wastes and Their Disposal and through its new Partnership on Plastic waste aims to work with the entire life cycle of plastics. However, the work of the Convention and the Partnership is mainly related to minimizing plastic waste without specifically targeting the consumption or production nor specifically addressing primary microplastics outside their transportation.

As previously mentioned, almost all above-listed instruments are more related to marine litter and pollution in general and hence addressing mainly secondary microplastics that result from the fragmentation of larger plastic items. Even though secondary microplastics are a very important source of microplastics in the sea, **there is a gap in terms of primary microplastics which none of the current global instruments address solely**.

However, according to UN Environment (2017) there are plans to incorporate the issue of microplastics into the negotiation of the post-2020 chemicals agenda of Strategic Approach to International Chemicals Management (SAICM) and the post-2020 biodiversity agenda of the CBD. These linkages would also align with Agenda 2030 for Sustainable Development (see below) and contribute to achieving the Sustainable Development Goals and beyond.

[31] (Basel Convention, 1989)
[32] (BRS, 2019)

The 2030 Agenda for Sustainable Development

Resolution 70/1[33] and the UN Agenda 2030 for Sustainable Development was adopted in 2015 by the United Nations General Assembly with 17 sustainable development goals (SDG), including SDG 14 to conserve and sustainably use the oceans, seas and marine resources. Each SDG includes targets and under the 10 targets for the implementation of SDG 14 ("Life below water"), target 14.1 specifically aims to prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine litter and nutrient pollution.

In addition to Resolution 70/1, the outcome document[34] of the UN Conference to Support the Implementation of SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development, "Our ocean, our future: call for action", States called upon all stakeholders:

> *"To conserve and sustainably use the oceans, seas and marine resources for sustainable development by taking, inter alia, the following actions on an urgent basis, including by building on existing institution and partnerships*" (Paragraph 13): "*To accelerate actions to prevent and significantly reduce marine pollution of all kinds, particularly from land-based activities, including marine debris, plastics and microplastics, nutrient pollution, untreated wastewater, solid waste discharges, hazardous substances, pollution from ships and abandoned, lost or otherwise discarded fishing gear…"* (Paragraph 13(g))

Under the Agenda 2030, several goals and targets were also adopted related to hazardous chemicals and wastes. SDG 3[35] includes the target to substantially reduce the number of deaths and illnesses from inter alia hazardous chemicals (target 3.9). SDG 6[36] includes the target to improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally. SDG 12[37] seeks to achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil to minimize their adverse impacts on human health and the environment (target 12.4).

United Nations Environment Assembly (UNEA)

The United Nations Environment Assembly (UNEA) is often referred to as the world's highest-level decision-making body on the environment. The Environment Assembly meets biennially to set priorities for global environmental policies and develop international environmental law. Through its resolutions and calls for action, the Assembly provides leadership and catalyzes intergovernmental action on the environment.[38]

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[33] (UNGA, 2015)

[34] (UNGA , 2017)

[35] SDG 3: "Ensure healthy lives and promote well-being for all at all ages."

[36] SDG 6: "Ensure availability and sustainable management of water and sanitation for all."

[37] SDG 12: "Ensure sustainable consumption and production patterns"

[38] (UN Environment, 2019)

It is important to highlight that the resolutions from the Assembly are not legally binding and hence are considered as voluntary/soft instruments.

From the very first Environment Assembly (UNEA-1), the issue of marine litter and microplastics has been on its agenda and to date, the Environment Assembly has adopted five resolutions directly linked to marine plastic litter and microplastics and several other related resolutions:

- UNEP/EA/UNEA/1/6 on Marine plastic debris and microplastics (May 2014)[39]
- UNEP/EA.2/Res.11 on Marine plastic litter and microplastics (May 2016)[40]
- UNEP/EA.3/Res.7 on Marine litter and microplastics (December 2017)
- UNEP/EA.4/L.7 on Marine plastic litter and microplastics (March 2019)[41]
- UNEP/EA.4/L.10 on Single-use plastic products pollution (March 2019)
- UNEP/EA.4/L.8 on Environmentally sound management of waste (March 2019)
- UNEP/EA.4/L.9 on Sound management of chemicals and waste (March 2019)

Marine plastic litter and microplastics rose to the global environmental agenda during the UNEA-1 in May 2014, when the Member States adopted a standalone Resolution (EA/UNEA/1/6) on Marine plastic debris and microplastics:

> "*Noting with concern the serious impact which marine litter, including plastics stemming from land and sea-based sources, can have on the marine environment, marine ecosystem services, marine natural resources, fisheries, tourism and the economy, as well as the potential risks to human health.*"

By UNEA-2 in May 2016, the topic already dominated the global environmental discussions leading to accelerated actions and initiatives led by international, regional and national organizations as well as actions taken by the Member States. Thus, during UNEA-2 the Member States adopted a second Resolution (EA.2/11) which among other things requested (OP 21) the Executive Director of UN Environment:

> *"… to undertake an assessment of the effectiveness of relevant international, regional and sub regional governance strategies and approaches to combat marine plastic litter and microplastics, taking into consideration the relevant international, regional and sub regional regulatory frameworks and identifying possible gaps and options for addressing them, including through regional cooperation and coordination...".*

As a follow-up, Resolution EA.3/7 was adopted in 2017 where the importance of *"long-term elimination of discharge of litter and microplastics to the oceans and of avoiding detriment to marine ecosystems and the human activities dependent on them from marine litter and microplastics*" is stressed in its first operative paragraph. In addition, the Resolution establishes an Ad Hoc Open-Ended Expert Group (Ad Hoc group) on Marine Litter and Microplastics to further examine the barriers to and options for combating marine plastic litter and microplastics from all sources, especially land-based sources.

[39] (UNEP, 2014)
[40] (UNEP, 2016)
[41] (UNEP, 2019)

In March 2019, UNEA-4[42] again adopted a resolution for marine litter calling for all relevant stakeholders to participate in the attempts to stop plastic pollution from marine litter and microplastics. Resolution UNEP/EA.4/L.7 also extends the mandate of the Ad Hoc group to gather global data and continue exploring global options to address the issue.

Out of the other resolutions, UNEP/EA.4/L.10 related to single-use plastic products pollution, among other things, encourages "*Member States to develop and implement national or regional actions, as appropriate, to address the environmental impacts of single-use plastic products"[43].*

Similarly, UNEP/EA.4/L.8 regarding environmentally sound management of waste makes several references to plastics litter including directly linked to microplastics; *"Reduce microplastics, including in wastewater treatment plants, and encourage producers to use alternatives for microbeads[44]".*

Finally, Resolution UNEP/EA.4/L.9 on Sound management of chemicals and waste also refers to marine plastic litter and microplastics by "*Noting the initiatives under the Basel Convention and the activities conducted by the Basel and Stockholm Regional Centers to address the pressing issue of marine plastic litter and microplastics[45]".*

The 4th Assembly also adopted a Ministerial declaration which committed to *"Address the damage to our ecosystems caused by the unsustainable use and disposal of plastic products, including by significantly reducing single-use plastic products by 2030, and we will work with the private sector to find affordable and environmentally friendly alternatives[46]".*

G7 Action Plan on Marine Litter

During the G7 summit in Elmau (Germany, 2015)[47], the G7 countries formally agreed on an Action Plan that recognizes the social, economic and environmental impact of the problem. The Plan was then resumed at the G7 Environment Ministerial Meeting in Toyama and in the Ise-Shima G7 Summit in 2016. Within the framework of the 2017 Italian G7 Presidency, the Ministry for Environment, Land and Sea, in collaboration with UN Environment (UNEP) /Mediterranean Action Plan, organized a Workshop on Marine Litter. The event was held in Rome on April 20-21, 2017 to discuss the implementation of the "G7 Action Plan to Combat Marine Litter" with contribution from Regional Seas Conventions.

During the Rome workshop, particular attention was paid to analyzing regional initiatives to facilitate the implementation of the Plan and to studying good practices at regional and national levels, regarding in particular the plastics and fisheries industries, the monitoring systems and the promotion of the recycling culture. Useful input emerged from the discussion for the future implementation of the Plan, that was further discussed in G7 Environment Ministerial Meeting, in Bologna on June 11-12, 2017.

Under the presidency of Canada, marine litter was discussed under the theme of "Working together on climate change, oceans and clean energy", and a Ministerial meeting from September 19 to 21, 2018, in

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[42] (UNEP, 2019)
[43] UNEP/EA.4/L.10 in 40 above
[44] UNEP/EA.4/L.8 in 40 above
[45] UNEP/EA.4/L.9 in 40 above
[46] (UNEP, 2019)
[47] (G7, 2015)

Halifax, Nova Scotia where a G7 Innovation Challenge to address marine plastics litter was launched [48]. The challenge was designed to stimulate innovations, raise awareness of how to address marine plastic litter or facilitate improvements to the management of plastic, especially plastic waste, in developing countries. According to G7, scalable solutions are needed to foster a more sustainable use of plastic products and reduce plastic waste and marine plastic pollution including technological and social innovations in plastics design and production, use, reuse, as well as management of plastic waste.

In 2019, under the presidency of France, a follow-up workshop on marine litter “G7 Action Plan to Combat Marine Litter in Synergy with the Regional Seas Conventions Workshop” was organized in Metz, France from 5 to 6 May 2019. In addition to reaffirming the role of the Regional Seas Conventions such as HELCOM, the workshop highlighted the importance of a stronger collaboration between Regional Seas Programmes and the Fisheries bodies in the context of wider global initiatives on fishery management. This includes the issue of abandoned, lost or otherwise discarded fishing gear (ALDFG), one of the major sources of marine pollution posing a direct threat to marine life and biodiversity in different regions.

FAO – Marking of Fishing Gear

FAO considers the issue of marine litter and microplastics from the perspectives of i) reducing marine litter that originates from the fishing industry, in particular ALDFG; ii) assessing the ecological impact of microplastics on fisheries resources and aquaculture products; and; iii) assessing food safety risks from marine litter, in particular microplastics, on human health.

In July 2018, the Thirty-Third Session of FAO’s Committee on Fisheries (COFI33), endorsed FAO’s Voluntary Guidelines for the Marking of Fishing Gear (VGMFG)[49]. These Voluntary Guidelines include not only a framework for undertaking risk assessment to identify the appropriateness or otherwise of implementing a system for marking fishing gear, but also provisions related to associated measures such as retrieval of lost gear, reporting of ALDFG and disposal of end-of-life gear. The VGMFGs are an important tool in preventing and reducing ALDFG and ghost-fishing, and in combatting illegal, unreported and unregulated fishing (IUUF). The VGMFG compliment FAO’s Code of Conduct for Responsible Fisheries.

According to FAO, the VGMFG should be considered in the context of broader fisheries management measures. A system for the marking of fishing gear, when implemented correctly, should inter alia, provide a simple, pragmatic, affordable and verifiable means of identifying the ownership and position of fishing gear, and its link with the vessel(s) and/or operator(s) undertaking the fishing operations. They are a tool to contribute to sustainable fisheries and to improve the state of the marine environment by combatting, minimizing and eliminating ALDFG and facilitating the identification and recovery of such gear. FAO published the final guidelines[50] in 2019.

In July 2018, COFI33 also supported the development of a comprehensive global strategy to tackle issues relating to ALDFG and to support implementation of the Voluntary Guidelines.

[48] (G7, 2018)
[49] (FAO, 2018)
[50] (FAO, 2019)

The Baltic Sea region

In the Baltic Sea region, the nine coastal countries and the European Union cooperate on environmental management across national borders through the Convention on the Protection of the Marine Environment of the Baltic Sea (Helsinki Convention of 1974, amended in 1992). Even though the recommendations are not legally binding as such, the fact that they are adopted unanimously, and that countries are required to report on their national implementation, diminishes concerns about their lacking legal nature.

While the Convention does not specifically mention plastics, its provisions are applicable to all types of pollution, *de facto* relating to marine litter – including plastics. Thus, Article 3 states that "the Contracting Parties shall individually or jointly take all appropriate legislative, administrative or other relevant measures to prevent and eliminate pollution in order to promote the ecological restoration of the Baltic Sea Area and the preservation of its ecological balance."

Furthermore, according to Article 6, "the Contracting Parties [shall] undertake to prevent and eliminate pollution of the Baltic Sea Area from land-based sources […] in the catchment area of the Baltic Sea."

Shipping as a source of pollution has been specifically regulated by the Convention, in line with the requirements of the International Maritime Organization. Thus, the longest record of HELCOM actions and measures to address discharge of waste – and implicitly, plastics – to the sea is related to shipping.

There is a general prohibition of dumping to the Baltic Sea Area (Article 11). "Dumping" means any deliberate disposal at sea or into the seabed of wastes or other matter from ships, other man-made structures at sea or aircraft, and any deliberate disposal at sea of ships, other man-made structures at sea or aircraft.

The exception is disposal of dredged material, if the criteria specified in Annex V of the Helsinki Convention are met, as well as under specific circumstances when dumping is the only way to ensure safety of human life.

Already in 1973, the Baltic Sea was designated as a special area for discharge of garbage from ships under MARPOL Annex V (in effect from 1 October 1989). Based on this status, the discharge of Annex V waste – which includes plastics – from a ship into the Baltic Sea area is more restrictive than the general provisions of MARPOL Annex V (Maritime Assessment, 2018[51], page 88).

It is mandatory for ships operating in the Baltic Sea to discharge all ship-generated wastes to a port reception facility before leaving port (Regulation 6 of Annex V of the Convention).

The HELCOM No Special Fee Recommendation (HELCOM Recommendation 28E/10[52]) is the first HELCOM recommendation specifically addressing marine litter. It applies to garbage as well as litter caught in fishing nets (based on the amendment from 2007), in addition to other types of waste. According to the "no-special-fee" system, a fee covering the cost of reception, handling and final disposal of ship-generated wastes is levied on the ship, irrespective of whether ship-generated wastes are actually offloaded or not.

[51] (HELCOM, 2018)
[52] (HELCOM, 2007)

The Baltic Sea Action Plan[53], a comprehensive programme devised to achieve good environmental status of the Baltic Sea and adopted by the Baltic Sea countries and the EU in 2007, also addresses marine litter, even if only concisely. The Contracting Parties committed to encourage projects by local governments and local communities to remove litter from the coastal and marine environment, such as beach clean-up operations, "Fishing for litter" initiatives and local litter campaigns, noting the leading role of the voluntary sector in such activities.

Recommendation 29/2 "Marine litter in the Baltic Sea" adopted in 2008 was the first HELCOM recommendation entirely devoted to marine litter, and largely focusing on sampling and reporting of marine litter found on beach[54].

The 2010 Moscow HELCOM Ministerial Meeting[55] includes a commitment of the Contracting Parties to "take further steps to be able to carry out national and coordinated monitoring of marine litter and identify sources of litter". The current HELCOM monitoring guidelines for marine litter on beaches[56] *de facto* supersede this Recommendation, even though a related formal process in HELCOM is yet to be finalized.

But it was only at the Copenhagen HELCOM Ministerial Meeting in 2013[57] that marine litter was recognized as a topic that requires a comprehensive response. HELCOM countries committed to significantly reduce marine litter by 2025, compared to 2015, and to prevent harm to the coastal and marine environment. Furthermore, HELCOM countries decided to develop a regional action plan by 2015 at the latest with the aim of achieving such ambitious objective. The process to develop the action plan started in 2014. Two regional expert workshops and one meeting at an inter-governmental level were conducted to develop the Action Plan. In 2015, a brand new HELCOM Regional Action Plan on Marine Litter was adopted by Contracting Parties as HELCOM Recommendation 36/1[58], containing concrete regional actions and voluntary national actions to reduce the input and presence of marine litter in the Baltic Sea.

The HELCOM Action Plan is only one out of the 18 Regional Seas Conventions and Action Plans (RSCAPs) worldwide. Out of all of them, the Mediterranean one (Barcelona Convention) is the only one having a legally binding action plan in place whereas the others work through voluntary measures. In addition, together with the Mediterranean Action Plan, the Baltic Sea (HELCOM), the North East Atlantic (OSPAR) and the Black Sea are the only regions that reflect the increasing concern over microplastics beyond requiring research into the issue in their action plans[59].

In particular, HELCOM's Action Plan has two important aims:

1) Significantly reduce marine litter by 2025 as compared to 2015 levels and;
2) Prevent harm to the coastal and marine environment

[53] (HELCOM, 2007)
[54] (HELCOM, 2008)
[55] (HELCOM, 2010)
[56] (HELCOM, 2018)
[57] (HELCOM, 2013)
[58] (HELCOM, 2015)
[59] (UN Environmnet, 2017)

There are 30 regional actions in the Plan, touching upon waste management and sewage water systems, as well as the remediation and closure of dumpsites. The plan also deals with most problematic items such as micro particles, polystyrene foam, plastic bags, sanitary litter in sewage as well as bottles and containers.

Additionally, the plan covers sea-based sources through developing best practices for handling waste from fisheries and ships, as well as the collection of ALDFG. Actions addressing education and outreach on marine litter are also included. The Action Plan also calls on the businesses, industry, non-governmental organizations as well as private citizens in the region to jointly address the issue of marine litter.

Among the regional actions related to microplastics, the ones to benefit from the contribution of the FanpLESStic-sea project are:

- Improvement of stormwater management in order to prevent litter, including microlitter, to enter the marine environment from heavy weather events (RL4);
- Establish an overview of the importance of the different sources of primary and secondary microplastics. Evaluate products and processes that include both primary and secondary microplastics, such as fibers from clothing, assess if they are covered or not by legislation, and act, if appropriate, to influence the legal framework, or identify other necessary measures (RL 6); and
- Investigate and promote best available techniques as well as research and develop additional techniques in waste water treatment plants to prevent micro particles entering the marine environment (RL 7).

Regarding these specific actions, several HELCOM countries have taken actions such as carrying out research of the different sources of primary and secondary microplastics. These are further discussed in Part 2 of this report.

Finally, it is to mention the reiterated commitment of HELCOM countries through the Ministerial Declaration 2018[60] of achieving a significant quantitative reduction of marine litter by 2025. In addition to developing baselines, quantitative targets and harmonized monitoring methods for marine litter, the HELCOM Ministers expressed their support to measures aimed at preventing plastics – including micro-plastics – from contaminating the marine and costal environment. Such measures should address the entire lifecycle of products and examine efficient and cost-effective options to reduce plastic and micro-plastic releases from products and processes into the marine environment. The Contracting Parties have also decided to develop appropriate measures to address micro-plastics in riverine inputs, urban wastewater effluents as well as storm water based on an increased knowledge on the scale of the problem.

[60] (HELCOM, 2018)

European Union's Regulatory Framework

The European Union is addressing not only issues related to chemicals and waste but also issues directly related to plastics and marine litter through several regulations and directives as well as different strategies and initiatives.

There are several EU Directives that are relevant to marine plastic pollution and include at least the following under four categories[61] of which the most relevant ones are presented more in detail (in bold) below:

Marine Waters and Water Protection related Directives

- **Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive);**
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy;
- Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC; and
- Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardized methods for monitoring and assessment, and repealing Decision 2010/477/EU.

Waste related Directives

- Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste -> **Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste;**
- Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste;
- Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment;
- Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste; and
- **Directive (EU) 2019/883 of the European Parliament and of the Council of 17 April 2019 on port reception facilities for the delivery of waste from ships, amending Directive 2010/65/EU and repealing Directive 2000/59/EC.**

Plastic related Directives

- **Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment;**
- Commission Directive 2002/72/EC of 6 August 2002 relating to plastic materials and articles intended to come into contact with foodstuffs;
- Commission Regulation (EC) No 2023/2006 of 22 December 2006 on good manufacturing practice for materials and articles intended to come into contact with food;
- European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste;

[61] UNEP (2017) + Research for this report

- Directive (EU) 2015/720 of the European Parliament and of the Council of 29 April 2015 amending Directive 94/62/EC as regards reducing the consumption of lightweight plastic carrier bags; and
- Commission Regulation (EU) No 10/2011 of 14 January 2011 on plastic materials and articles intended to come into contact with food Text with EEA relevance.

Due Diligence by Industry related Directives

- Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH);
- Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment;
- Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products; and
- Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).

Marine Strategy Framework Directive

The Marine Strategy Framework Directive (MSFD)[62] was adopted in 2008 with the aim to achieve or maintain good environmental status (GES) in the marine environment by 2020 as stipulated in its Article 1. To attain this (GES) by 2020, each Member State is required to develop a strategy for its marine waters (marine strategies) based on a roadmap (action plans) outlined in Article 5 of the Directive. The strategies are also to be reviewed and renewed every six years. The MSFD is implemented in all EU marine waters within four marine regions: **the Baltic Sea**, North-East Atlantic Oceans, the Mediterranean Sea and the Black Sea. Based on Article 6 of the Directive, *"Member States shall, where practical and appropriate, use existing regional institutional cooperation structures, including those under Regional Sea Conventions, covering that marine region or subregion"*[63]*.* The implementation of the MSFD is based on eleven qualitative descriptors for determining good environmental status listed in Annex I of the Directive. Descriptor 10 on marine litter requires that *"Properties and quantities of marine litter do not cause harm to the coastal and marine environment."*

Waste Directive

In May 2018, the EU adopted the Directive[64] (EU) 2018/851 on waste amending Directive 2008/98/EC. According to Clean Europe Network (CEN)[65], the new EU litter prevention policy includes a series of concrete measures that have the potential to effect major positive change, with clearly shared responsibilities for different stakeholders such as the EU, national and local governments, producers of the problematic items (private sector), civil society organizations and citizens. The amended Directive also

[62] (European Commission, 2008)
[63] Article 6 of the MSFD above
[64] (European Commission, 2018)
[65] (Clean Europe Network , 2018)

provides the link between the litter generated on land and the litter in the marine environment (see Article 9(l)).

Single-Use Plastics Directive

The Single-Use Plastics (SUP) Directive[66] adopted in 2019 addresses marine litter coming from the 10 single-use plastic products most often found on European beaches, as well as plastic fishing gear and oxo-degradable plastics. It also stimulates the production and use of sustainable alternatives that avoid the generation of marine litter. Measures to point out from the Directive are as follow[67]:

- ***A ban on selected single-use products made of plastic*** *for which alternatives exist on the market: cotton bud sticks, cutlery, plates, straws, stirrers, sticks for balloons, as well as cups, food and beverage containers made of expanded polystyrene and on all products made of oxo-degradable plastic.*
- ***Measures to reduce consumption of food containers and beverage cups made of plastic*** *and specific marking and labelling of certain products.*
- ***Extended Producer Responsibility schemes*** *covering the cost to clean-up litter, applied to products such as tobacco filters and fishing gear.*
- ***A 90% separate collection target for plastic bottles by 2029*** *(77% by 2025) and the introduction of design requirements to connect caps to bottles, as well as target to incorporate 25% of recycled plastic in PET bottles as from 2025 and 30% in all plastic bottles as from 2030.*

According to the EU, microplastics do not fall directly within the scope of the SUP Directive even though they contribute to marine litter and hence the Union is suggesting adopting a comprehensive approach to that specific issue. In addition, the new Directive includes a ban of all products made of oxo-degradable plastics, which can also be interpreted as legislation to address products which rapidly form microplastic.

Directive on Port Reception Facilities to tackle sea-based litter

The revision process of the Directive on Port Reception Facilities (PRF) concluded in 2019 with the adoption of the Directive (EU) 2019/883 on that topic[68]. The Directive aims to protect the marine environment against the negative effects from discharges of waste from ships using ports located in the Union, while ensuring the smooth operation of maritime traffic, by improving the availability of adequate PRF and the delivery of waste to those facilities[69].

In addition to the above presented EU Directives, there are some specific initiatives and strategies that are closely linked to them as well as on marine plastic litter and microplastics, but which do not have a regulatory effect. They are presented below.

Circular Economy Package

In 2015 the European Commission launched a Circular Economy Action Plan entitled: “Closing the loop - An EU action plan for the Circular Economy” which was designed to develop a sustainable, low carbon, resource efficient and competitive economy by focusing certain key areas such as the production (design, processes), consumption and waste management. Under the Circular Economy Package, the Commission

[66] (European Commission, 2019)
[67] (European Commission, 2019)
[68] (European Commission, 2019)
[69] (European Commission, 2018)

agreed to adopt a strategy on plastics in the circular economy, addressing issues such as recyclability, biodegradability, the presence of hazardous substances of concern in certain plastics, and marine litter. The Strategy, adopted in 2018, aims to protect the environment from plastic pollution whilst fostering growth and innovation. The Strategy includes a vision and objectives targeting to have all plastic packaging placed on the EU market reusable or recyclable by 2030[70].

Microplastics as a part of the Plastics Strategy

In 2017 the European Commission commissioned the ECHA to develop a dossier concerning the use of intentionally added microplastic particles to consumer or professional use products of any kind. As response to the request, the ECHA publishes its REACH restriction proposal for intentionally added microplastics in 2019[71]. The proposal restricts the placing on the market of polymers (as defined by Article 3(5) of REACH) as a substance or in a mixture in a concentration equal to or greater than 0.01% w/w when present in a physical form consistent with a 'microplastic'. Microplastics are solid-polymer containing particles, to which additives or other substances may have been added, and where ≥ 1% w/w of particles have (i) all dimensions 1nm ≤ x ≤ 5mm, or (ii), for fibers, a length of 3nm ≤ x ≤ 15mm and length to diameter ratio of >3. Microplastics have diverse applications, including in agriculture, horticulture, cosmetic products, paints, coatings, detergents, maintenance products, medical and pharmaceutical applications. Derogations are proposed for polymers that occur in nature, polymers that meet criteria for minimum (bio)degradability, uses of microplastics at industrial sites as well as certain uses by consumers or professionals that would not inevitably lead to a release of microplastics to the environment. Certain derogated uses are accompanied with requirements to provide additional information on packaging or safety datasheets and to report certain information annually to ECHA. The proposal includes transitional arrangements for specific applications, such that the restriction enters into effect progressively over a period of six years after entry into force. Uses of 'microbeads' (microplastics used as an abrasive) would be prohibited immediately after the entry into force of the restriction.

The restriction proposal was open to public consultation from 20 March to 20 September 2019. According to ECHA, if adopted, the restriction could reduce the amount of microplastics released to the environment in the EU by about 400 thousand tones over 20 years.

In addition to the union-wide process, few (France, Italy, Sweden and UK[72]) EU Member States have already introduced bans or other restrictions on the use of microplastics (microbeads) in certain types of products, largely concerning wash-off cosmetic products.

[70] (European Commission, 2019)
[71] (ECHA, 2019)
[72] (UNEP, 2018)

National level regulatory framework on microplastics

There are multiple countries around the world that are now developing and implementing laws and other regulations to for example prohibit certain plastic items such as bags, cutlery, straws and containers as well as implementing other strategies to tackle the marine pollution from plastics and microplastics. There are also countries that are implementing national laws regarding primary microplastics such as microbeads. According to UNEP (2018), 8 out of 192 countries have passed national level laws or regulations that ban the use, sale, and/or manufacture of microbeads in personal care products. These countries are Canada, France, Italy, New Zealand, Republic of Korea, Sweden, the UK and the US.

From the Baltic Sea Region, Sweden is the only country that is currently implementing a ban that prohibits the provision of a rinse-off cosmetic product that contains plastic particles that are smaller than 5 mm in any dimension on the market. The ban entered into force on 1 July 2018 and cosmetic products released on the market before that date had to be phased out by the end of 2018.

Regulation, guidelines, best practices, voluntary and on-going measures to address microlitter, including microplastics

As part of the FanpLESStic-sea project component 2.1, a survey[73] was sent to the project partners as well as the HELCOM Expert Network on Marine Litter (EN-Marine Litter) to collate information on national-level policies and regulations related to microlitter and microplastics in products and processes as well as sources of microplastics. Five questions from the survey were specifically related to regulations, policies, guidelines and on-going and planned measures. Not many legal frameworks were reported, but different policies, voluntary measures and guidelines were identified. These were often related to plastics in general, or to waste- and stormwater management and were mostly general guidelines without specific reference to microlitter or microplastics. However, on-going and planned measures to address the sources of microplastics pollution as well as products and processes containing microplastics were reported in several countries. The questions relevant to this section of the report are shown below, whereas Table 1 summarizes the answers provided.

Q3	What legal frameworks (legal acts, guidelines, other regulations and communications, including any applicable EU and international legislation) for products and processes (such as production and logistics) that include microplastics exist in your country?
Q4	Is there any guidance available on improvements of stormwater management on a local level in your country to prevent and reduce stormwater related waste (including micro litter and/or microplastics) entering the marine environment?
Q7	Please indicate on-going and planned measures to address sources of primary and secondary microplastics in your country?
Q10	Please indicate on-going and planned measures to address products and processes that include both primary and secondary microplastics.
Q17	Are you aware of the existence of any guidelines on best practices to reduce the input of microlitter and/or microplastics to the sea?

[73] Annex 2 of this document

Table 1. Summary of existing and planned national-level legal frameworks, guidelines and regulations related to microplastics.

Question in the Survey	Country	Focus of the policy/regulation/ guidelines	Description of the Regulation/Policy/Guidelines	Additional information/link
What legal frameworks (legal acts, guidelines, other regulations and communications, including any applicable EU and international legislation) for products and processes (such as production and logistics) that include microplastics exist in your country? (Q3)				
Q3	Denmark	Microplastics in Artificial lawns	In 2018 the Danish EPA sent out a guideline on managing of artificial lawns including the microplastic aspects of the rubber granulates used	https://www2.mst.dk/Udgiv/publikationer/2018/05/978-87-93710-25-2.pdf
Q3	Finland	Plastic-based litter, including microplastics	There is no specific legislation to control microplastics in Finland. To tackle the problems caused by plastic-based litter, Finland has published a "Plastics Roadmap: Reduce, Refuse, Recycle and Replace", including measures such as voluntary commitments (Green Deal agreements), enabling to set ambitious and observable targets and suggest measures to achieve these. The plastics roadmap also includes specific measures for microplastics	https://www.ym.fi/en-US/The_environment/Plastics_Roadmap_for_Finland
Q3	Lithuania	Waste, Pollution, Packaging and packaging waste,	The Ministry of Environment of the Republic Lithuania is the main institution responsible for legislation and administration in the field of waste management. The website of the Ministry provides a comprehensive list of legislation addressed to producers and importers of waste and packaging materials. The legislation concerns the regulation of all waste. No legislation in Lithuania directly limits the amount of microplastics in the environment.	https://am.lrv.lt/lt/veiklos-sritys-1/atliekos/informacija-gamintojams-ir-importuotojams
Q3	Lithuania	Pollution tax	Annex No. 4. Environmental pollution taxes on microplastic sources – plastic and PET (polyethylene terephthalate) packing, car tyres. Types of taxable packaging and tax rates from 2019 onwards: Plastic packaging 521 (Eur/t), PET (polyethylene terephthalate) packaging 579 (Eur/t), Hybrid packaging 579 (Eur/t)	https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.80721/asr
Q3	Lithuania	Obligations of manufacturers and importers of packaged products	*On the responsibility of manufacturers and importers of products covered by the producer responsibility principle*: Manufacturers and importers are responsible for the environmental impact of their products and packaging placed on the internal market throughout their life cycle, from production to safe disposal, including collection, transport, the organization and / or financing of a recycling, recovery and disposal system, the performance of specified product and packaging waste management tasks, the provision of product information, packaging and waste management to users of these products and waste managers, and acceptance, return and return of products; financial responsibility for such activities.	https://am.lrv.lt/lt/veiklos-sritys-1/atliekos/informacija-gamintojams-ir-importuotojams

Q3	Norway	Microplastics from building and operating roads.	Norway has national steering documents from the Ministry of Transportation that the Norwegian Public Roads should minimize emissions of microplastics from building and operating roads. Source Meld. St. 33 (2016–2017) National Transport Plan 2018–2029 (Meld. St. 33 (2016–2017)	National Transport Plan 2018–2029 (English Summary) https://www.regjeringen.no/en/dokumenter/meld.-st.-33-20162017/id2546287/
Q3	Russia	Environmental impact in general	Microplastic pollution is not specifically defined by the Russian law. However, several legal documents include description of measures for reduction of negative environmental impact on water bodies, for instance a Federal Law on Environmental Protection №7 from 10.01.2002 and the Water code of the Russian Federation	http://www.consultant.ru/document/cons_doc_LAW_34823/ http://www.consultant.ru/document/cons_doc_LAW_60683/
Q3	Russia	Environmental impact in general	Resolution of the Government of the Russian Federation of September 28, 2015 No. 1029 "On approval of the criteria for classifying objects that have a negative impact on the environment as objects of categories 1, 2, 3 and 4"	http://www.consultant.ru/document/cons_doc_LAW_186693/
Q3	Sweden	Cosmetic products that are intended to be rinsed off and contain microplastics	Swedish ban on the placing on the market of cosmetic products that are intended to be rinsed off and contain microplastics. Entry into force: July 2018 (Article 4 a § in regulation SFS 1998:944). In some cases, in connection with handling, import and export of chemical products, a ban has been in place in Sweden since 1 July 2018 against providing in the market certain cosmetic products containing plastic particles. More specifically, it applies to products intended to be rinsed off or spit out after they are applied to skin, hair, mucous membranes or teeth if they contain plastic particles added to have a cleaning, scrubbing or polishing effect, § 4a	https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/forordning-1998944-om-forbud-mm-i-vissafall_ sfs-1998-944
Q3	Sweden	Artificial turfs	The Swedish Environmental Protection Agency's guidance regarding the construction, maintenance and management of artificial turfs that relate to the operator's responsibilities and obligations, with a focus on reducing the spread of microplastics. The purpose of this guideline is to guide the operator to prevent negative environmental consequences in the construction and maintenance of artificial turfs where granulates are used as filling material. Many recommendations and conclusions in the guideline can also be used for other types of recreational and sports facilities where granulates, artificial turfs (without granulates), plastic- or rubber surfaces are used, such	http://www.naturvardsverket.se/Stod-i-miljoarbetet/Vagledningar/Plast-och-mikroplast/Konstgrasplaner/#sammanfattning

			as fall protection on playgrounds, running tracks, multisport fields and horseback riding facilities	
Is there any guidance available on improvements of stormwater management on a local level in your country to prevent and reduce stormwater related waste (including micro litter and/or microplastics) entering the marine environment? (Q4)				
Q4	Finland	Stormwater	The stormwaters are regulated in the Land Use and Building Act (maankäyttö- ja rakennuslaki 1999) after the new amendment from 2014 when new chapter (13 a) concerning urban stormwater was added. These acts do not regulate quality of stormwaters. Finland has also published guidance for urban stormwaters (Hulevesiopas 2012), but it has no specific reference to micro or other plastic litter (in Finnish)	https://www.ymparisto.fi/download/noname/%7BE524727D-9C28-494C-84DC-EE3AD26E45F9%7D/115796
Q4	Lithuania	Stormwater	Regulation on surface water management. In order to implement the requirements, the Baltic Sea Environment Commission (Helsinki Commission) 2002 March 6 Recommendation 23/5 on Reducing Emissions from Urban Areas through the Proper Management of Surface Wastewater, in Lithuania as of 1 November 2019. Supplementary requirements for the treatment of surface wastewater and the procedure for the issuance of pollution permits for the general discharge of surface wastewater into the environment by towns and cities have come into force.	https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.295779/asr http://gamta.lt/files/Tvarkos%20apra%C5%A1as.pdf
Q4	Lithuania	Surface water	Water Development Program 2017-2023. Effective from 2017-02-10. In cities with more than 20 thousand inhabitants. It is planned to build new and reconstruct old surface sewage networks and other infrastructure and to enlarge water management companies. In order to achieve the Good Environmental Status under the Marine Strategy Framework Directive (MSFD), the Government of the Republic of Lithuania approved the Program of Water Field Development in 2017-2023 and its action plan to determine the Lithuanian Programme of Measures (PoMs).	https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/4606c421eea211e6be918a531b2126ab?jfwid=-wd7z6lfxo
Q4	Norway	Stormwater – Road runoff	N200 Road building has guidelines on when and how to treat road runoff. Microplastics are mentioned as one of the pollutants. The requirements in N200 are anchored in the Road Act	https://www.vegvesen.no/_attachment/2364236/binary/1269980?fast_title=H%C3%A5ndbok+N200+Vegbygging+%2810+MB%29.pdf
Q4	Poland	Stormwater	General guidelines for rain/stormwater management on a municipal level in Gdansk, Poland (in Polish), not specific to microplastics	http://www.gdmel.pl/do-pobrania-2
Q4	Russia	Stormwater quality	There is no specific guidance available at the moment, but according to the hygienic standard 2.1.5.980-00, there are requirements for overall stormwater quality	http://mhts.artinfo.ru/BIBLIO/SNIPS/Sanpiny/2.1.5.980-00/1.htm

Q4	Russia	Stormwater	Recommendation for the calculation of the systems for collecting, diverting and cleaning surface runoff from residential areas, sites of enterprises and determining the conditions for its release into water bodies	https://meganorm.ru/Data2/1/4293769/4293769496.htm#i758429
Q4	Sweden	Stormwater – Highway runoff pollution	Reducing Highway Runoff Pollution - sustainable design and maintenance of stormwater treatment facilities guidelines	https://trafikverket.ineko.se/se/reducing-highway-runoff-pollution-sustainable-design-and-maintenance-of-stormwater-treatment-facilities
Q4	Not country specific	Stormwater and Sewage	NGO Guidelines: Concrete ways to reduce microplastics in stormwater and waste water (CCB, 2017): • Wetlands should be considered as an end of pipe solution to reduce microplastic entering the streams, rivers and sea; • Monitoring of outgoing water from urban areas stormwater must be developed and implemented; and • All WWTP should establish testing of plastic particle content of outflowing water	https://ccb.se/wp-content/uploads/2018/02/ccb-concrete-ways-to-reduce-microplastics-in-stormwater-and-sewage-final.pdf
Please indicate on-going and planned measures to address sources of primary and secondary microplastics in your country? (Q7)				
Q7	Finland	Microplastics	Finland is running a national survey on the potential sources of MPs in Finland (similar to EU, Norway and Sweden)	n/a
Q7	Finland	Microplastics	Finland's guidance and national indicators related to the implementation of the MSFD are now including targets concerning microplastics. In general, wastewater treatment plants remove a significant part of the waste water micro-plastics	https://www.ympäristo.fi/fi-FI/Meri/Merensuojelu_ja_hoito/Merenhoidon_suunnittelu_ja_yhteistyo
Q7	Lithuania	Stormwater	Employing the investments of EU funds in Lithuania, cities and towns, the development of drinking water, wastewater and surface (rain) wastewater infrastructure and system management is carried out (2000-2020). Including an inventory of surface (storm) wastewater management system in Lithuania, reconstruction and development of surface wastewater management infrastructure according to 2014-2020 Measure 05.1.1-APVA-R-007 "Management of Surface Wastewater Systems" of Priority 5 "Environment, Sustainable Use of Natural Resources and Adaptation to Climate Change" of the Operational Program for Investment of the EU Funds is being implemented.	https://gis.apva.lt/#projects/search

			The project aims to upgrade outdated, worn out and most problematic sections of surface stormwater pipelines and surface stormwater collection infrastructure.	
Q7	Lithuania	Generation of plastics waste	October 22, 2013 Order no. D1-782 Approved National Waste Prevention Program that includes waste prevention objectives and programs for the period 2014-2020 including aims is to reduce the generation of plastic waste, raise public awareness of the environmental impact of lightweight plastic shopping bags and change the perception that plastic is a harmless and cheap material. A ban on the distribution of lightweight plastic carrier bags, except very lightweight plastic carrier bags (wall thickness below 50 µm) at the points of sale of goods or products.	https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.458655/asr
Q7	Lithuania	Sources of microplastics	Lithuania has a deposit-return system for drinks containers returning to the reverse vending machines since 2016, and the return rate has reached 92% in 2018.	https://greennews.ie/lithuania-teach-other-countries-how-to-manage-plastic-waste/
Q7	Sweden	Microplastics	City of Stockholm and City of Gothenburg are developing action plans to address microplastics	
Q7	Sweden	Stormwater	The Swedish Environmental Protection Agency has the responsibility to provide guidance on the issue of stormwater and plans to provide such guidance, also linked to microplastics, during 2019. The Swedish Environmental Protection Agency also handles grant applications for research measures to reduce the spread of microplastic in stormwater. In 2018, the Swedish Environmental Protection Agency distributed a total of SEK 10 million to reduce the spread of microplastics to sea, lakes and watercourses. There has also been grant money available to apply for in 2019 from the Swedish Environmental Protection Agency that concerns microplastics in stormwater. Decisions on grants are planned to be made before the autumn 2019	
Q7	Sweden	Artificial turfs	A proposal (related to government commission (dnr M2015 / 2928 / Ke) to implement a notification requirement for all artificial turfs and areas containing plastic or rubber (such as horse-riding facilities or molded rubber granules in fall protection installations) over 200 m^2 in size. The notification requirement will provide another tool that enables the municipality to set the environmental requirements needed when it comes to the construction and maintenance of current facilities. Since there is a possibility to design precautionary measures based on operational and	

			site-specific conditions, one can also consider already ongoing measures for these facilities	
Q7	Sweden	Microplastics from tyre and road dust	In 2018, the Swedish Government commissioned VTI, the Swedish National Road and Transport Research Institute, to gather and distribute knowledge about emissions of microplastics from tyre and road dust. VTI will put together a compilation of literature on this topic, as well as identify and assess different control measures to reduce these emissions. The commission will be reported to the Government Offices on the 1/12-2020. In addition, The Swedish Transport Administration, Trafikverket, is actively working on the issue of emission of tyre and road wear particles, focusing mainly of measures to increase understanding of emissions, distribution and techniques to treat e.g. runoff pollution	
Q7	Sweden	Microplastics and health risks	The Swedish National Food Agency (Livsmedelsverket) is currently working on a government commission, gathering information and knowledge on health risks with microplastics in drinking water. If necessary, the agency will suggest measures to reduce the exposure to microplastics in drinking water. This work will be finalized in December 2019	
Q7	Denmark	Microplastics in cosmetic products	A ministerial order is in hearing on a ban of the use of microplastics in cosmetic products	https://hoeringsportalen.dk/Hearing/Details/62887
Q7	Russia	Single-use plastics	There are currently several legal initiatives on prohibition of single-use plastic products starting from 2025. Those incentives were announced by Ministry of Natural Resources and Ecology of the Russian Federation	
Q7	Poland	Plastics	The following relevant measures, related to marine litter are included in the Programme of Measures: “Reducing the amount of packaging - action in the light of the Directive on packaging and packaging waste”: • Use of the results of comprehensive guidelines for site selection of ecosystem methodology depositing sediments (ore faucet) in sea and coastal “dumping sites” management in the Baltic Sea area; • Supervising the proper functioning of the port reception facilities for waste and cargo residues; • The introduction of the principle of ‘no special fee’ for collecting waste from ships in ports; • Development of port reception facilities for waste and cargo residues;	

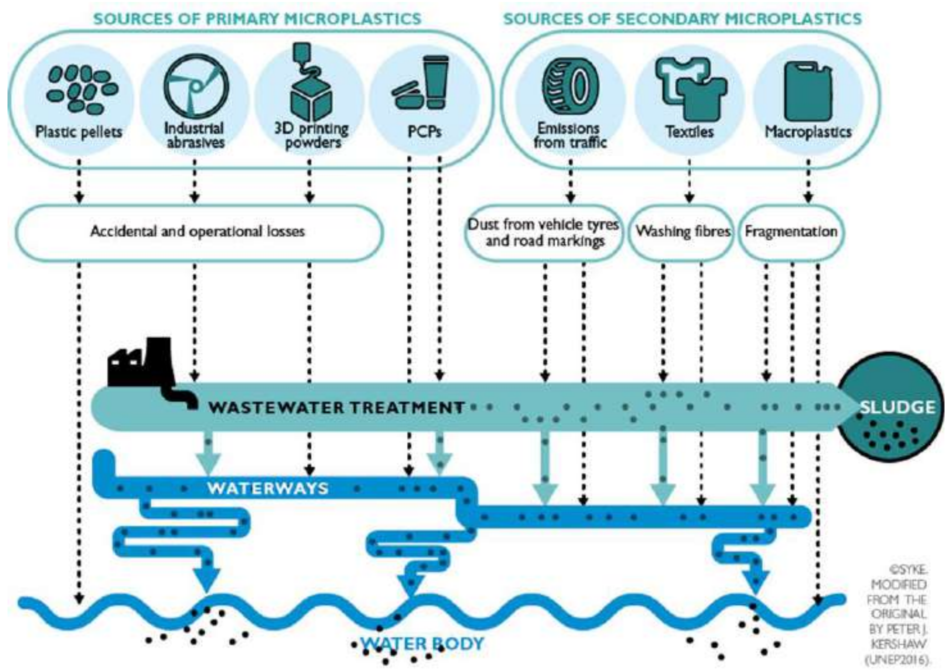
			• Restricting introduction of paraffins and derivatives to the marine water; • Marking of fishing gear - prevent ghost nets; • Reducing the amount of packaging - action in the light of the Directive on packaging and packaging waste; • Study on micro plastic in the marine environment; • Fishing for litter - cleaning of the sea; • Additional beach cleanups	
Please indicate on-going and planned measures to address products and processes that include both primary and secondary microplastics (Q10)				
Q10	Norway	Microplastics	The topic is addressed in the national working groups (marine/ freshwater/terrestrial environment). Final output is/will be a collection guideline	
Q10	Poland	PCCP	Draft act on cosmetic products	Presentation in Polish: http://kongres-kosmetyczny.pl/uploads/article/files/4760128dd7bb0cef22f89b234266933d5b948370.pdf
Q10	Poland	Transportation of industrial goods	Draft act amending the act on the system for monitoring the road transport of goods	http://kongres-kosmetyczny.pl/uploads/article/files/4760128dd7bb0cef22f89b234266933d5b948370.pdf
Q10	Sweden	Microplastics from industrial production of primary plastics	The Swedish EPA is currently in the process of compiling guidelines regarding measures to minimize emissions of microplastics from industrial production of primary plastics. These guidelines will be complemented with other sectors, such as washing of textiles and recycling stations. The guidelines will be completed during 2019	
Are you aware of the existence of any guidelines on best practices to reduce the input of microlitter and/or microplastics to the sea? (Q17)				
Q17	Germany	Microplastics	Measures proposed by the UBA in their report "Kunststoffe in der Umwelt" (in German)	https://www.umweltbundesamt.de/publikationen/kunststoffe-in-der-umwelt
Q17	Sweden	Secondary microplastics	Measures against plastics that may become secondary microplastics: Possibility for municipalities to apply to the Swedish EPA for grants to clean plastic waste from coastal areas (from 1 March 2018)	
Q17	Sweden	Marine litter and microplastics	Implementing the source-to-sea approach: A Guide for Practitioners Guidelines can be applied for marine litter prevention.	https://www.siwi.org/wp-content/uploads/2019/07/Source-to-

				sea-guide_webb.pdf
Q17		Microplastics	NGO Guidelines regarding microplastics in products in different languages (Estonia, Poland, Lithuania, Belarus, Russia) to avoid microplastic pollution in the Baltic	https://ccb.se/plasticfreebaltic/

Part 2 - Research initiatives related to microlitter including microplastics

This section of the report focuses on research initiatives related to microlitter, including microplastics, on the same "levels" as the first section related to the policies and governance; global, regional, EU and national. The global-level research initiatives will showcase the most important, to our knowledge, recent publications on microplastics. These include for example two microplastics assessments (GESAMP, 2015 and 2016) and a recent report (GESAMP, 2019) on efforts to harmonize monitoring methodologies of microplastics. A comprehensive global-level general assessment for marine litter and microplastics was also done by UNEP in 2016, which, among others, identified the main sources of primary and secondary microplastics as demonstrated by Figure 1 below (further edited by SYKE).

Figure 1. Sources of Primary and Secondary microplastics according to SYKE (orig. UNEP, 2016).



The regional-level section will build on the previous work carried out by HELCOM and its partners during the SPICE-project, which among other things identified relevant studies on microplastics in the Baltic Sea area. Since due to information available the SPICE project addressed mainly research of microplastics in water and sediments, this report has served to complement that information with new studies on those matrixes as well as additional data and research on microplastics in biota.

The part describing the microplastics research at EU-level showcases studies related to various already concluded or ongoing EU regulatory processes as well as a research projects funded partly or fully by the EC that are not directly related to its internal processes.

The section on national-level studies is a compilation of responses from the FanpLESStic-sea project Survey that was sent to all FanpLESStic-sea-project partners as well as to the HELCOM Expert Network on Marine Litter (EN-Marine Litter). The survey was open for ten weeks between 15 Abril and 21 July 2019. Eighteen responses from nine countries (all countries in the FanpLESStic-sea partnership and Germany) were received.

Global-level research initiatives related to microplastics

GESAMP

The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (hereafter GESAMP) is an advisory body, established in 1969 and co-sponsored by ten UN agencies, that advises the UN system on the scientific aspects of marine environmental protection[74].

GESAMP has a specific working group (WG40) dedicated to work with the sources, fate and effects of plastics and micro-plastics in the marine environment, and regarding microplastics, GESAMP WG40 has published three important reports:

1) Sources, fate and effects of microplastics in the marine environment: A Global Assessment (Part 1), 2015
2) Sources, fate and effects of microplastics in the marine environment: A Global Assessment (Part 2), 2016
3) Guidelines for the Monitoring and Assessment of Plastic Litter in the Ocean, 2019.

Out of these reports, the first two are comprehensive compilations of all relevant and up to date information on microplastics. The second report complements the first one and adds more information where possible. Together these two assessments draw a good picture of the main types, sources, distribution, fate as well as impacts of microplastics on a global-level using case studies as examples.

Regarding the sources of microplastics, the Part 2 of the GESAMP assessment highlights few key points:

1. *There are primary and secondary sources of microplastics. The distinction is based on whether the particles were originally manufactured to be that size (primary) or whether they have resulted from the breakdown of larger items (secondary).*
2. *Fragmentation and degradation play an essential role in the formation of secondary microplastics, but the processes are poorly understood.*
3. ***There is evidence that microplastics are littered into the environment at all steps in the life cycle of a plastic product from producers to waste management.***
4. ***Microplastics can enter the marine environment via riverine systems, coastlines, directly at sea from vessels and platforms or by wind-induced transport in the atmosphere.***
5. *Methods of defining microplastics, sampling and measurement vary considerably among studies, source sectors and geographical regions making it difficult to synthetize data across studies. (GESAMP, 2016).*

To complement the figure and key points above, an overall picture of the different sources of plastics and microplastics is given in the figure 2 below with the status of the current knowledge of the source. As it can be observed, the knowledge of the sources specifically related to microplastics is between low and medium with the exception of plastic pellets.

[74] (GESAMP, 2019)

Figure 2. Sources of plastics and microplastics by usage sectors (GESMAP, 2016).

Category	Source sector	Description	Entry points	Knowledge
Producers/ Converters	Plastic Producers, Fabricators & Recyclers	Pellets & fragments	Rivers, Coastline, Atmosphere	High
Sectoral consumers	Agriculture	Greenhouse-sheets, pots, pipes, nutrient prills	Rivers, Coastline, Atmosphere	Low
	Fisheries	Fishing gear, packaging	Rivers, Coastline (e.g. ports), Marine	Medium
	Aquaculture	Buoys, lines, nets, PVC pipes	Rivers, Coastline, Marine	Medium
	Construction	EPS, packaging	Rivers, Coastline, Atmosphere	Low
	Terrestrial Transportation	Pellets, tyres, tyre dust	Rivers, Coastline, Atmosphere	Medium
	Shipping/ Offshore industry	Paints, pipes, clothes, miscellaneous, plastic-blasting, cargo	Rivers, Marine	Medium
	Tourism industry	Consumer goods, packaging, microbeads, textile fibres	Rivers, Coastline, Marine	High
	Textile industry	Fibres	Rivers, Coastline, Atmosphere	Low
	Sport	Synthetic turf	Rivers, Coastline, Atmosphere	Low
Individual consumers	Food & drink single-use packaging	Containers, plastic bags, bottles, caps, cups, plates, straws, spoons, etc.	Rivers, Coastline	High
	Cosmetics & personal care products	Microbeads, packaging, toothbrushes, etc.	Rivers, Coastline, Marine	Medium
	Textiles & clothing	Fibres	Rivers, Coastline, Atmosphere, Marine	Medium
Waste management	Solid waste	Unmanaged or poorly managed waste disposal	Rivers, Coastline, Atmosphere	Medium
	Water & wastewater	Microbeads, fragments, fibres	Rivers, Coastline	Medium

The second part of the GESAMP assessment also touches upon the issue of monitoring and harmonization and gives key recommendations and highlights the research gaps and priorities related to microplastics research.

The third identified publication by GESAMP[75] is a first global attempt to harmonize the available operational monitoring methodologies by setting up guidelines for marine plastic litter and microplastics monitoring. The guidelines cover all size of marine plastics, including microplastics, in different environment compartments.

75 (GESAMP, 2019)

The report also provides general recommendations to help designing monitoring programmes bearing in mind the different sampling and analyzing methods as well as their economical requirements. The following recommendations are to be pointed out from the report:

- Marine litter size categories: <5mm to be used as the upper size limit for microplastics for monitoring purposes, based on its common usage in existing national and regional monitoring programmes. Table 2 below (adopted from GESAMP 2016 report) suggests the basic size categories for routine marine litter monitoring.

Table 2. Recommended size categories for routine marine litter monitoring by GESAMP, 2016.

Size	Recommended	Feasible alternative options for operational monitoring research purposes	
		Alternative 1	Alternative 2
Mega	> 1m		
Macro	25mm – 1m		
Meso	5-25mm	1-25mm	1-5mm and 5-25mm
Micro	<5mm	<1mm	>330µm (typical mesh size towed plankton nets)

Green=Recommended, Yellow=Feasible alternative

- Morphological characterization of microplastic litter: to use five general categories (**fragments, foams, films, lines and pellets**) which may be subdivided in finer portions (granules/flakes, EPS/PUR, sheets, fibers /filaments/strands, beads/pellets) with the recognition that subdivisions can be combined for ease of harmonizing and comparing data.
- Sampling methods for microplastics on the **seafloor**:
  i. Use box-corers/corers rather than grabs, when available, to provide more reliable estimates of sampling volume;
  ii. Sample through opportunistic approaches when possible to limit excessive costs in the deep sea;
  iii. Report microplastic abundance as number per sediment dry weight (kg-1).
- Sampling methods for microplastics from the water **surface, water column, and sandy beach** as included in Table 3 (adopted from GESAMP, 2019):

Table 3. Recommended sampling methods/protocols for microplastics from water surface, water column and sandy beaches by GESAMP

Compartment	Recommended/ Feasible Alternative	Method	Comments
Water Surface	R	Net tow	Affordable and litter is restricted to surface
	F	Bulk water pump	Costs involved, and training, but will get good microplastic data
Water Column	R	Underway sampling	Costs involved, and training, but will get good microplastic data
	F	Bulk water pump	Costs involved, and training, but will get good microplastic data

	F	Bongo net	Need vessel with winch, net relatively expensive
Sandy Beach	R	Sieving	Dry or wet sieving two or more size categories

R=Recommended (green), F=Feasible Alternative (yellow)

- Sampling methods for microplastics in **biota:** birds, fish, invertebrates to be used with the feasible alternative of marine animals, corals and epibionts.
- Physio-chemical characterization of microplastics (Table 4): large microplastics (0.3-5 mm) to be characterized by microscopy, and subsequently at least sub-set samples should be confirmed by spectroscopy. In case of small microplastics (0.02-0.3 mm), to identify every plastic-like particle by spectroscopy or alternative novel methods, such as staining with Nile Red (GESAMP, 2019) originally in (Shim, Song, Hong, & Jang, 2016) and (Maes, Jessop, Haupt, & Mayes, 2017). Alternative approach and visualization of different methodologies to analyse microplastics is demonstrated in Figure 7 in the section on research at EU-level.

Table 4. Recommendations for physio-chemical characterization of microplastics by GESAMP

Size	Visual observation (microscopy)	Microscopy and spectroscopy (FTIR, Raman)	Alternatives (FTIR-FPA, Nano-IR, Pyro-GC/MS, SEM-EDS)	Comment
Large micro 0.3-5 mm	R	R	R	Microscopy + spectroscopy
Small micro 0.02-0.3 mm		R	R	
Very small micro 0.001-0.02		F	R	FTIR/Raman Challenging
Nano < 1μm			R	Exploratory

R=Recommended (green), F=Feasible alternative (yellow)

Other relevant recommendations related to monitoring of microplastics include to record basic physical information (shape, size and color) and polymer type (e.g. PET, PE, PP, PS, etc.). Further categorization/classification of microplastics by physical characteristic (e.g. blue fiber, red fragment, and microbeads) is also recommended. Quality assurance and quality control procedure should be strictly applied from plastic sampling in the field to instrumental analysis in the laboratory.

Regarding the associated costs and level of expertise needed for different microplastics monitoring protocols, it can be observed that all stages (sampling, processing, analysis and equipment) are relatively expensive and that sufficient level of expertise is needed to carry out the analysis.

IUCN

The International Union for Conservation of Nature (IUCN) published a report titled "Primary Microplastics in the Oceans: A Global Evaluation of Sources"[76] in 2017, which demonstrated that primary microplastics are globally a major source of plastics into the oceans with between 0.8 and 2.5 Mtons/year global releases (central value 1.5), regionally outweighing that of secondary microplastics from mismanaged wastes. However, the IUCN report counts not only plastic pellets and MPL in cosmetics as primary MPLs but also tyre particles, road markings, ship coatings and textile fibers which are in other studies and reports (e.g. GESAMP) counted as secondary MP because they are derived from abrasion[77]. According to IUCN, this is a significant but as-of-yet unrecognized proportion and represents around 50% of the total losses ending up in the ocean. Whereas the other half of the microplastic loss is trapped in soils when waste water treatment sludge is used as fertilizer and/or when particulates are washed from the road pavement. According to the study, the fate and effect of these microplastics in soils is still largely unknown.

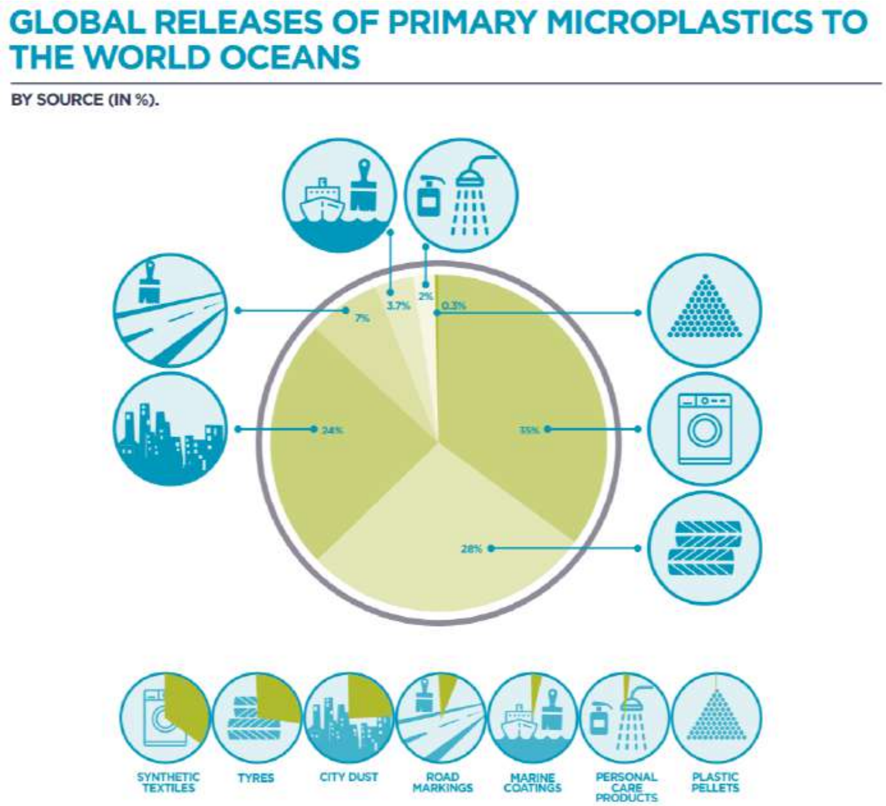
Based on the study results, most of the losses of primary microplastics (98%) are generated from land-based activities compared to only 2% generated from activities at sea. It is suggested that the largest proportion of these particles stem from the laundering of synthetic textiles and from the abrasion of tyres while driving. Additionally, most of the releases to the oceans are occurring from the use of products (49%) or the maintenance of products (28%) (see Figure 3).

Figure 3. Global releases of primary microplastics to the world oceans according to IUCN, 2017.

[76] (Boucher & Friot, 2017)

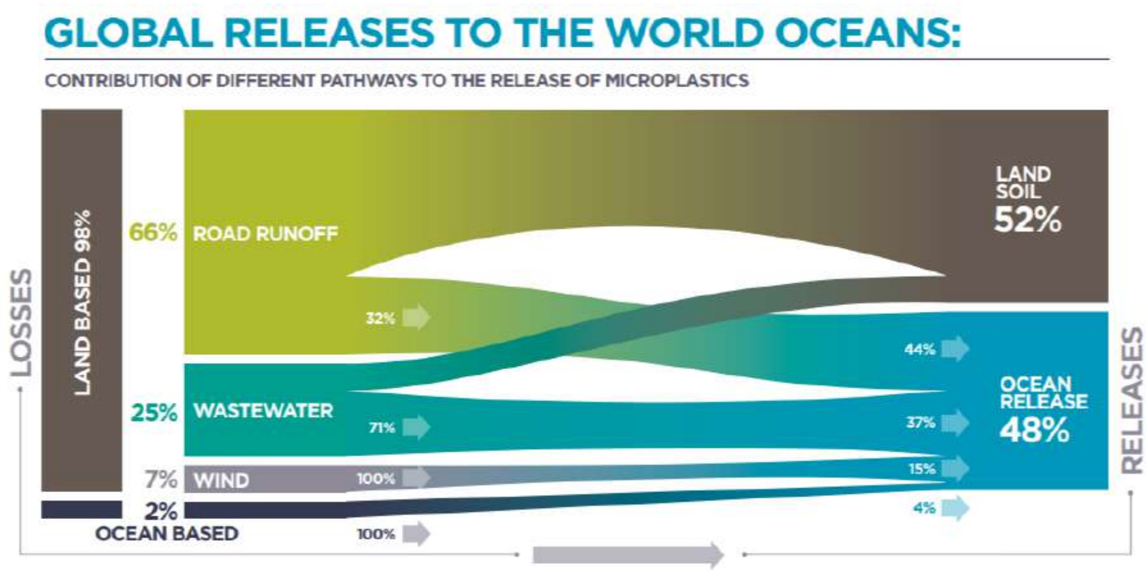
[77] IUCN defines primary microplastics as plastics directly released into the environment in the form of small particulates. They can be a voluntary addition to products such as scrubbing agents in toiletries and cosmetics (e.g. shower gels). They can also originate from the abrasion of large plastic objects during manufacturing, use or maintenance such as the erosion of tyres when driving or of the abrasion of synthetic textiles during washing. Secondary microplastics are microplastics originating from the degradation of larger plastic items into smaller plastic fragments once exposed to marine environment. This happens through photodegradation and other weathering processes of mismanaged waste such as discarded plastic bags or from unintentional losses such as fishing nets.

For GESAMP (also HELCOM) microplastics can be categorised as being of primary or secondary origin. Primary microplastics are purposefully manufactured to carry out a specific function (e.g. abrasive particles, powders for injection moulding, resin pellets for bulk transportation of polymers between manufacturing sites); and secondary microplastics represent the results of wear and tear or fragmentation of larger objects, both during use and following loss to the environment (e.g. textile and rope fibers, weathering and fragmentation of larger litter items, vehicle tyre wear, paint flakes).



The IUCN report also illustrates the pathways and releases of microplastics from land- and ocean-based sources suggesting that while almost all microplastics originate from land, up to half of the emissions would get released to the marine environments. The main sources of microplastic emissions ending up in the ocean would hence be through road runoff (44%), wastewater treatment systems (37%), wind transfer (15%) and ocean-based sources (4%).

Figure 4. Global releases of microplastics to the world oceans according to IUCN, 2017.



Experimental global microplastics research initiatives

This section lists several existing experimental microplastics research initiatives that aim to increase the knowledge of microplastics in the oceans by collecting data from different types of research and other vessels. Some of them are more sophisticated larger-scale projects, that are specifically funded for that purpose, but the list below also includes more citizen science-type initiatives that often feed into larger projects.

5Gyres

5Gyres has been a pioneer NGO in carrying out microplastics research expeditions since its establishment in 2009. Since then they have been organizing expeditions to raise awareness of plastic and microplastics pollution as well as to collect data to support research. Data collected during the 2014 expedition from Bermuda to Iceland contributed to the 5Gyres' first Global Estimate of Plastic Pollution[78]. Research expeditions continue on yearly and relevant information is available on their webpage[79].

5Gyres has also published protocols for microplastics sampling: “High speed trawl protocol”, “Manta trawl protocol”, “Plastic observation protocol” as well as “Plastic beach protocol” (available on their webpage[80]).

By the ocean we unite

By the Ocean we Unite[81] is a Dutch foundation with charitable status (ANBI) that contributes to preventing more plastics from ending up in our oceans through different activities. In addition to activities such as environmental education and documentaries, the foundation conducts microplastics research during their sailing expeditions since 2016.

In 2018, in addition to “Expedition Denmark” and several shorter expeditions in the Netherlands, the foundation expanded the marine sample collection to the Wadden Sea, the North Sea (including the Channel), **the Baltic Sea** as well as included samples from six freshwater samples. Based on the results from the total of 74 samples between 2016 and 2018, the group found plastic items larger than 1 mm in 92% of the surveyed samples (1879 items in total using manta trawl, 300µm mesh size) of which 72% were microplastics (<5 mm). Plastics were further divided into 5 categories: fragments, line, pellets, thin film and foam of which plastic fragments accounted for 60%. Out of the rest, 17% were lines, 9.6% thin films, 9.2% pellets or nurdles, and 4.8% foam.

Plastic Change

A Danish NGO called Plastic Change[82] has a similar initiative, “Expedition Plastic”, that has explored and researched the two northern accumulation zones in the Atlantic and the Pacific Ocean respectively in close collaboration with universities in Denmark and the US. Plastic Change Expedition has also taken samples outside of the accumulation zones (gyros). The global voyage started from Denmark in 2014 and by June 2019 is halfway around the world. By now, practically all the samples – both inside and outside of the plastic “soups” have contained either larger or smaller amounts of microplastic. All the data from

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[78] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0111913
[79] https://www.5gyres.org/expedition
[80] https://www.5gyres.org/trawl-resources
[81] https://www.bytheoceanweunite.org/about-our-research/
[82] https://plasticchange.org/

sampling have been shared with their collaborators around in the US and Denmark (such as the 5 Gyros and Universities) for further analyzing.

Ocean Research Project

Since 2013, the Ocean Research Project (ORP)[83] has conducted multiple research expeditions in the Atlantic, Pacific and Arctic Oceans, collecting samples of plastic trash in the water and mapping out the eastern side of the North Atlantic Gyro (accumulation zone). In 2014, ORP carried out a second expedition to research microplastics pollution in the Pacific Ocean. During 6,800 miles nonstop trip from San Francisco to Yokohama Japan, ORP's crew collected microplastics samples along the entire trans-pacific route[84].

"ORP's research expeditions targeting the North Atlantic and North Pacific Gyres have helped increase the scientific community's understanding of marine pollution from plastic debris. The extensive datasets that ORP collected during its expeditions contributed to the publication of Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea by Dr. Marcus Ericksen[85]" (ORP, 2019 from 77 above).

MICRO-FATE project

"MICRO-FATE" project[86] funded by the Federal Ministry of Education and Research of Germany (BMBF) (2019 – 2021) is conducting an expedition across the Pacific Ocean, from Canada to Singapore were samples are taken at several stations along the passage not only in the North Pacific Garbage Patch, but also at less polluted locations.

The project aims to collect samples from the surface water, the water column and the seabed to find out more about the vertical distribution of the plastic particles and to identify potential gradients regarding concentration, composition, age and coverage with biofilms. Additionally, samples will be examined for organic pollutants to find out whether plastic is a source or a sink of pollutants into the marine environment. Also, the project aims at examining how the polymer structure of the plastic particles changes as a consequence of weathering.

Regarding the vertical distribution mentioned above, a study[87] from California published in June 2019 showed that the deep-sea zone located 180 to 460 meters below the surface, known as the midwater, contained the highest amount of microplastic waste—about four times as much as on the surface suggesting that, in the case of California, more microplastic occurs in the depths relatively clean Monterey Bay than on the surface in the notorious Great Pacific Garbage Patch[88]. Same study also examined two abundant particle feeders, pelagic red crabs and giant larvacean sinker, in this ecosystem (200-600m) and found that the number of microplastic particles contained within a sinker ranged from 3 to 17 (mean 10.7) and from 1 to 15 (median 5) for the red crab respectively. Maybe more interestingly, the dominant polymers throughout the vertical analysis were PET, a material commonly found in single-use beverage and food containers, and PA, a material used to make textiles. The study concludes that one of the largest

[83] http://www.oceanresearchproject.org/
[84] https://www.oceanresearchproject.org/programs/science/marine-debris/
[85] (Eriksen, et al., 2014)
[86] (UFZ, 2019)
[87] (Choy, et al., 2019)
[88] (Nuwer, 2019)

and currently underappreciated reservoirs of marine microplastics may be contained within the water column and animal communities of the deep sea.

There are also other similar expeditions and experimental research projects such as Unplastify[89], Kontik2[90], Mantatrust[91], Eat Less Plastic[92], HelloOcean[93] and most probably many others that are doing similar microplastics research on a smaller scale that are not mentioned here.

Microlitter research in the Baltic Sea

As part of the "Status, Pressures and Impacts, and Social and Economic evaluation in the Baltic Sea marine region" (SPICE)-project[94], co-financed by the EU, HELCOM compiled regional data on microlitter research for the Baltic Sea area, which has been used as a basis for this section. More specifically, the Task 2.1.3 of the SPICE-project, "Development of baselines of marine litter", carried out an analysis of compiled data on microlitter in the Baltic Sea. This data has been further complemented with new studies for the period 2017-2019. A new section regarding microplastics in biota has also been added. The issue of microplastics in biota and consequently in the food chain as well as the uncertainty related to the impacts of it, is currently an emerging issue not only in the Baltic Sea region but globally.

In addition, a new data call for existing policies and research related to microlitter in the Baltic sea region was carried out as part of the FanpLESStic-sea project to gather relevant national-level information and research, which is not always published widely. The data call was mainly designed to gather data on sources of microplastics, microplastics in wastewater and stormwater as well as on availability of data and policies regarding microplastics. These studies are presented in the national-level section below. If relevant (new) data was received regarding microlitter in biota, water column and surface or sediments, it has been added to the table below under the regional-level research.

In 2017, the report[95] from the SPICE project estimated that after 1-2 years there would be significantly more data available for assessing, but the amount of new publications related to microplastics in the Baltic Sea Marine Environment has not significantly grown during the past two years to the best of our knowledge. On the other hand, a good number of national-level reports and studies have been produced related to, among others, sources and impacts of microplastics, microplastics in waste- and stormwater and microplastics emissions from traffic and roads.

All relevant studies are presented in tables below, where the previous data from the SPICE project has been complemented with new studies. A new table is presented for studies concerning microplastics in biota based on a recent report from the Nordic Council[96]. The call during the SPICE-project as well as for the FanpLESStic-sea project was for microlitter, but most of the existing research is for microplastics. Additional research that has been carried out to complement the data from the previous HELCOM work

[89] https://www.unplastify.com/english
[90] http://www.kontiki2.com/
[91] https://www.mantatrust.org/
[92] https://www.eatlessplastic.com/
[93] http://helloocean.org/
[94] http://www.helcom.fi/helcom-at-work/projects/completed-projects/spice/
[95] (HELCOM, 2017)
[96] (Bråte, Buenaventura, & Lusher, 2018)

and the data call for FanpLESStic-sea project, also confirms that there are considerably more studies available when using “microplastic” instead of “microlitter” as a research parameter.

In addition to compiling data on the occurrence of microplastics in the environment, a section to discuss the potential sources of microplastics in the Baltic Sea area can be found below. This information is mainly based on the existing national level assessments that have been carried out in some of the Baltic Sea countries (Denmark, Germany and Sweden) as well as in Norway and were also reported through the survey. A similar section can also be found in the EU-level research section.

A short description of the on-going HELCOM work on the development of a microlitter indicator is also provided at the end of this section.

Summary of the existing microplastics studies from the Baltic Sea Region (previous HELCOM work complemented with the FanpLESStic-sea project research)

Microplastics in water surface, sediments and beaches

According to the SPICE outputs, the earliest sampling for microlitter in the Baltic Sea was done from water surface from the Swedish coast (2007), whereas from sediments came at a later stage (Denmark, 2012). There is also data just outside the Baltic Sea area (near Gothenburg, Sweden) already from 2007. For microlitter on strandline, earliest studies date back to 2014 from Germany, and for microlitter in biota from to 2013 (Denmark). The environmental sampling was done mainly for research purposes, but some pilot monitoring activities are also ongoing in several Baltic Sea countries such as Denmark (biota and sediment), Estonia, Finland, Poland (surface) and Sweden. In Denmark, there are also historical samples from biota that date back all the way to year 1987. In most of the cases, the main objective of the research in different water compartments was to detect (and possibly further analyse) plastic polymers.

The SPICE report also confirms that there is great variability in the methods used for sampling as well as sampling preparation and analyses.

Regarding the water surface and water column, the most commonly used methodologies for collecting samples are the surface nets or trawls (manta trawl). Additionally, different water pumps and other water samplers such as Limnos and Niskin bottles are used. Regarding the sediment, different sampling methods include box corer, Van Veen grab, twin Gemax corer as well as a hand-operated dredge. Also, in the beach/strandline surveys, different sieving methodologies are used.

Common to all these methodologies in different compartments is that mesh/cut-off size varies enormously, which makes the comparison between different studies difficult if not impossible. In some studies, the differences in the number of observed particles have been reported to be 2500 times bigger when using smaller mesh size. The only exception is for water surface studies because most of them used manta trawls.

Detailed analysis of different methods used in different water compartments (surface and column, sediment and beach/strandline) around the Baltic Sea collected during the SPICE project can be found in (HELCOM, 2017).

Microplastics in Biota (fish and invertebrates)

No compilation of microplastics in biota was included in SPICE report, but it briefly summarized that studies on microlitter in fish from field samples had been reported by Denmark, Finland and Sweden where methods for catching fish varied between bottom trawls, seines, line and hook and electronic fishing. Data from these studies have been used both for pilot monitoring and method development. Denmark has also used historical datasets for that purpose. Other organisms besides fish (invertebrates) are analysed, mainly during research projects on exposure (ingestion and impacts). These include mostly laboratory work with some incubation in situ (see the next section below).

However, as also identified by the SPICE -project, in 2017, the Nordic Council of Ministers funded a study called "Micro-and macro-plastics in marine species from Nordic waters"[97] which is a comprehensive summary of existing relevant studies of microplastics in different biota in the Nordic waters. Since, according to the report, most of the studies were made in the North and Baltic Seas, it gives a good overview of the status of knowledge on microplastics in biota (fish and invertebrates) for the Baltic Sea. In the above-mentioned report, a total of seven studies from the Baltic Sea were analysed of which five concerned fish and two invertebrates.

The studied species include Atlantic and Baltic Herring (*Clupea harengus and Clupea harengus membras*), Atlantic cod (*Gadus morhua*), European sprat (*Sprattus sprattus*), European flounder (*Platichthys flesus*), Atlantic mackerel (*Scomber scombrus*), Three-spined sticklebacks (*Gasterosteus aculeatus*), Common dab (*Limanda limanda*) , Whiting (*Merlangius merlangus*), European eelpout (*Zoarces viviparus*), Long-spined bullhead (*Taurulus bubalis*) and Twaite shad (*Alosa fallax*). These species are pelagic or demersal species from coastal and offshore locations. Herring and cod are the most studied species by number and by study location and their percentage of ingestion of microplastics ranged from 0–34% and 1.4–26%. For the Chinese mitten crab the ingestion rate in two studies varied between 9-28% whereas for the blue mussel ingestion rates as high as 67% were reported. However, the study reminds that the comparability between and within studies from the Nordic environment (including Baltic) and other regions is difficult as there is a limited number of studies, a limited number of studies on the same species from different locations and different methods are used. In addition, several other factors are believed to impact the level of plastic ingestion in species, especially for fish which are not easily accounted for.

A MSc Thesis on microplastics in biota from Finland was added to the table below that studied eight fish species; Bleak (*Alburnus alburnus*), Three-spined sticklebacks (*Gasterosteus aculeatus*), Perch (*Perca fluviatilis*), Roach (*Rutilus rutilus*), Minnow (*Phoxinus phoxinus*), Round goby (*Neogobius melanostomus*), Pike (*Esox Lucius*) and White bream (*Blicca bjoerkna*).

To detect microplastics, visual detection was widely used combined with different digestion solutions where the dominant combination was to use 10% KOH and 14% NaClO. To further analyse the samples in the laboratory, a variety of methodologies were applied including FTIR, Raman Analysis as well as light microscope. The most dominant polymers were not always reported, but for example one study reported PE and PA as the most dominant polymers for all four species studied (same species also found in the Nordic Council's study).

[97] (Bråte, et al., 2017)

Microplastics in Baltic biota (Laboratory)

One laboratory study[98] to point out is from Finland, which carried out experiments with different Baltic Sea zooplankton taxa to scan their potential to ingest plastics. All taxa studied (mysid shrimps, copepods, cladocerans, rotifers, polychaete larvae and ciliates) showed ingestion of 10 µm fluorescent polystyrene microspheres. In addition, food web transfer experiments showed the potential of plastic microparticle to transfer via planktonic organisms from one trophic level (mesozooplankton) to a higher one (macrozooplankton).

Another study[99] exposed a range of animals (bivalves, free swimming crustaceans and benthic, deposit-feeding animals), of a coastal community of the northern Baltic Sea to relatively low concentrations of 10 µm microbeads. According to the study, the beads were ingested by all animals in all experimental concentrations (5, 50 and 250 beads mL− 1). Bivalves (*Mytilus trossulus, Macoma balthica*) contained significantly higher amounts of beads compared with the other groups. Free-swimming crustaceans ingested more beads compared with the benthic animals that fed only on the sediment surface.

A recent study[100] on bioturbation and ingestion of MPs showed that the transportation of MPs to the sediment surface by bioturbation by a community of common benthic invertebrates in the northern Baltic Sea (clam *Limecola balthica*, polychaete *Marenzelleria spp.*, gammarid *Monoporeia affinis*) was negligible suggesting that in the Baltic Sea the seafloor may act as a sink for once sedimented MPs, reducing simultaneously the MP exposure of the macrofauna feeding on the sediment surface. The animal ingestion of MPs during the 10-week experiment was minimal. Similar results were obtained by the same research group already in a study[101] from 2017.

Table 5 is based on the data from the Nordic report and complemented with additional research compiled under the FanpLESStic-sea project. Similarly, Tables 6 and 7 below are based on the results from the SPICE project, complemented with the results from the data call and research under the FanpLESStic-sea project.

Table 5. Existing research on microplastics in biota in the Baltic Sea area (fish and invertebrates).

From the Nordic Council of Ministers report[102] and FanpLESStic-sea project research							
Species name	**Baltic Sea sub-region**	**Method in the lab; FTIR (yes/no)**	**Most dominant polymers**	**N**	**% containing MPs; MP presence /individuals**	**MP size Cut-off (µm)**	**Reference and type of reference**
FISH							
Atlantic cod (*Gadus morhua*)	Kattegat	Different digestions and visual; FTIR, but no results given	/	16	% not specified; Mean 0.87±0.1 (SD)	/	Agersnap 2013, BSc Thesis
Atlantic cod (*Gadus morhua*)	Eastern Gotland Basin	10% KOH and 14% NaClO and visual;	/	50	26,0%; Range 0-4	100	Lenz et al. 2015, Report

[98] (Setälä, Fleming-Lehtinen, & Lehtiniemi, 2014)
[99] (Setälä, Norkko, & Lehtiniemi, 2016)
[100] (Näkki, Setälä, & Lehtiniemi, Seafloor sediments as microplastic sinks in the northern Baltic Sea -Negligible upward transport of buried microplastics by bioturbation, 2019)
[101] (Näkki, Setälä, & Lehtiniemi, 2017)
[102] This is an adaptation of an original work by the Nordic Council of Ministers. Responsibility for the views and opinions expressed in the adaptation rests solely with its author(s). The views and opinions in this adaptation have not been approved by the Nordic Council of Ministers.

		Partial Raman Analysis					
Atlantic cod (*Gadus morhua*)	Bornholm Basin	10% KOH and 14% NaClO and visual; Partial Raman Analysis	/	51	15,7%; Range 0-4	100	Lenz et al. 2015, Report
Atlantic cod (*Gadus morhua*)	Bornholm Basin	Visual; FTIR	PE and PA	338	1,4%; Range 0-1	180	Rummel et al. 2016, Scientific paper
Atlantic herring (*Clupea harengus*) European sprat (*Sprattus sprattus*) Plankton samples	Bornholm Basin	150 mL saturated KOH solution (1120 g L− 1) and 150 mL NaClO solution (14% active chlorine) to 700 mL MilliQ water; Visual inspection under a light microscope		814	20% contained plastic particles, of which 95% were characterized as microplastic (<5mm) and of these 93% were fibers Average microplastic concentration in the plankton samples was 0.21±0.15 particles m^{-3}.	100	Beer at al. 2018, Scientific paper, data between 1987 to 2015
Atlantic herring (*Clupea harengus*)	Baltic Sea - Kattegat	10% KOH and 14% NaClO and visual; No FTIR	/	45	27%; Mean 0.36±0.09 (SD)	500	Sørensen et al. 2013, Report
Atlantic mackerel *(Scomber scombrus*)	Baltic Sea	Visual; FTIR	PE and PA	191	17,7%; Range 0-3	180	Rummel et al. 2016, Scientific paper
Baltic herring (*Clupea harengus membras*)	Bornholm Basin	10% KOH and 14% NaClO and visual; Partial Raman Analysis	/	55	7,3%; Range 0–4	100	Lenz et al. 2015, Report
Btlantic herring (*Clupea harengus membra*s)	Eastern Gotland Basin	10% KOH and 14% NaClO and visual; Partial Raman Analysis	/	50	16%; Range 0–4	100	Lenz et al. 2015, Report
Baltic herring (*Clupea harengus*)	Bornholm Basin	Visual; FTIR	PE and PA	58	0%	180	Rummel et al. 2016, Scientific paper
Baltic herring (*Clupea harengus*)	Bornholm Basin		Unknown	299	21,0%; n not known		Beer 2016, MSc thesis
Baltic herring (*Clupea harengus*)	Northern Baltic Sea/Proper	Sodium hydroxide with addition sodium dodecyl sulfate (SDS) was used for digestion	Unknown	164	1,8%		Budimir et al. 2018, Scientific paper

Baltic herring (*Clupea harengus*)	West Coast of the Baltic Sea	Visual (stereo microscope); FTIR/ATR	Synthetic or semi-synthetic (viscose)	130	33,8%; Range: 0-51, mean 7.8 ± 12.2 particles/ind.	1000-5000	Ogonowski et al. 2018; Scientific paper (not peer reviewed)
Bleak *(Alburnus alburnus*)	Southern Finnish coastline (Vaasa to Kotka)	10 ml NaOH, 5 ml SDS (Budimir et al. 2018)	/	147	8,8% (13)	100	Zidbeck, 2018, MSc. Thesis
Common dab (*Limanda limanda*)	Bornholm Basin	Visual; Yes	PE and PA	98	0% MP presence	180	Rummel et al. 2016, Scientific paper
European eelpout (*Zoarces viviparus*) (x 2)	The Sound	Different digestions and visual; FTIR, but no results given	/	30	% not specified; Mean and SD: 1.5±0.8 and 0.3±0.3	/	Agersnap 2013, BSc Thesis
European flounder (*Platichthys flesus*)	Bornholm Basin	Visual; FTIR	PE and PA	299	10,0%; Range 0-1		Rummel et al. 2016, Scientific paper
European sprat (*Sprattus sprattus*)	Bornholm Basin		Unknown	515	18,0%; n not known		Beer 2016, MSc thesis
European sprat (*Sprattus sprattus*)	Northern Baltic Sea/Proper	Sodium hydroxide with addition sodium dodecyl sulfate (SDS) was used for digestion	Unknown	154	0,9%; MP Presence		Budimir et al. 2018, Scientific paper
Minnow *(Phoxinus phoxinus*)	Southern Finnish coastline (Vaasa to Kotka)	10 ml NaOH, 5 ml SDS (Budimir et al. 2018)	/	20	5% (1)	100	Zidbeck, 2018, MSc. Thesis
Perch *(Perca fluviatilis*	Southern Finnish coastline (Vaasa to Kotka)	10 ml NaOH, 5 ml SDS (Budimir et al. 2018)	/	107	8,4% (9)	100	Zidbeck, 2018, MSc. Thesis
Pike *(Esox Lucius)*	Southern Finnish coastline (Vaasa to Kotka)	10 ml NaOH, 5 ml SDS (Budimir et al. 2018)	/	2	0	100	Zidbeck, 2018, MSc. Thesis
Roach *(Rutilus rutilus*) 18.1%,	Southern Finnish coastline (Vaasa to Kotka)	10 ml NaOH, 5 ml SDS (Budimir et al. 2018)	/	91	2,2%	100	Zidbeck, 2018, MSc. Thesis
Round goby *(Neogobius melanostomus)*	Southern Finnish coastline (Vaasa to Kotka)	10 ml NaOH, 5 ml SDS (Budimir et al. 2018)	/	15	0	100	Zidbeck, 2018, MSc. Thesis

Three-spined stickleback *(Gasterosteus aculeatus)*	Southern Finnish coastline (Vaasa to Kotka)	10 ml NaOH, 5 ml SDS (Budimir et al. 2018)	/	120	12,5% (15)	100	Zidbeck, 2018, MSc. Thesis
Three-spined sticklebacks (*Gasterosteus aculeatus*)	Northern Baltic Sea/Proper	Sodium hydroxide with addition sodium dodecyl sulfate (SDS) was used for digestion	Unknown	355	0,0%		Budimir et al. 2018, Scientific paper
Twaite shad (*Alosa fallax*)	Gdansk Basin	Visual; No FTIR	/	/	% not specified; MP presence	/	Skóra et al. 2012, Scientific paper
White bream *(Blicca bjoerkna)*	Southern Finnish coastline (Vaasa to Kotka)	10 ml NaOH, 5 ml SDS (Budimir et al. 2018)	/	1	0	100	Zidbeck, 2018, MSc. Thesis
Whiting (*Merlangius merlangus*)	Kattegat	10% KOH and 14% NaClO and visual; No FTIR	/	46	31%; Mean 0.43±0.11	500	Sørensen et al. 2013, Report
Eight (8) different fish species, results reported also separately in the table	Southern Finnish coastline (Vaasa to Kotka)	10 ml NaOH, 5 ml SDS (Budimir et al. 2018)	/	503	8% (40); between 0 and 12,5% depending on the species; 0-5 particles/fish	100	Zidbeck, 2018, MSc. Thesis

INVERTEBRATES							
Blue mussel (*Mytilus edulis*)	Gulf of Finland and Åland Sea	9 different mussel tissue digestion methods FTIR	Plastics made up 8% of all the analysed microlitter particles (PES most dominant polymer)	450 (50 +200+200)	66% of all studied individuals (WWTP site and Reference site) Mussels that were collected from the reference (200) site contained 2.6 ± 3.5 ML g−1 ww (0.4 ± 0.5 ML individual−1) and 0.26 ± 1.3 MP g−1 ww (0.04 ± 0.19 MP individual−1).	20–100 µm, 100–300 µm, 300 µm:	Railo et al. 2018
Blue mussel (x2) (*Mytilus edulis*)	Svanemøllen Strand and Kalvebod	Different digestions and visual; FTIR, but no results given		30+30	% not specified	/	Agersnap 2013, BSc Thesis
Blue mussel (*Mytilus edulis*)	Kattegat	65% HNO_3 and visual; No FTIR	/	120	67%		Gustafsson 2016, BSc Thesis
Chinese mitten crab (*Eriocheir sinensis*)	Gdansk Bay	Visual; No FTIR		208	9,0%		Wójcik-Fudalewska

							Scientific paper

Table 6. Studies carried out on microlitter/microplastics in water surface and water column (HELCOM FanpLESStic-sea + SPICE Projects).

Green= FanpLESStic-sea research, Blue=SPICE published

Ecosystem compartment	HELCOM Sub-basin	Sampling methods applied	Results	Size fractions considered	Reference
Surface water	Swedish coast, close to the shore; 21 locations (Kattegat, The Sound, Bromholm basin, Western Gotland Basin, Northern Baltic Proper, Åland sea)	Manta trawl	Up to 4 fibers/liter (10 µm); Average of 32 anthropogenic particles /liter (10 µm); 0-8 fibers/m^3 (300 µm); 0-2,5 particles /m^3 (300 µm); 500 x higher concentration of fibers and 2500 of particles when filtering with 10 µm filters compared to 300 µm	≥10 µm; and ≥300 µm	Published, Magnusson & Norén, 2011 Report
Surface water (same as below but more detailed)	The Gulf of Finland: -Turku harbor -Archipelago -Off shore	Manta trawl	particles/$m^{3;}$ 0.73; 0.25±0.07; 0.48	>300 µm	Published, Magnusson 2014
Surface water	North Kattegat and Bay of Mecklenburg	Manta trawl	3.54/m^3 and 1.44/m^3; (the study did not include plastic fibers)	>100 µm	Published, Mintenig 2014; MSc. Thesis
Water column	Baltic Sea; Within the Russian exclusive economic zone	Bulk water sampling (PLEX instrument)	Mean MPs content was the 32.2 (SD 50.4) pcs/m3. Elevated MPs concentrations were observed in subsurface, near-bottom and thermohaline layers compared with intermediate layers.	>174 µm	Published, Zobkov et al. 2019
Water column	North from Gothenburg (just outside Baltic Sea area)	Plankton and zooplankton nets	150 - 2400 particles/m^3 and 102,400 in industrial harbor (80 µm); 0.01-0.14 particles/m^3 (450µm); The plastic fibers concentrated in the 80µm mesh net are much more numerous (up to 1000 and 100,000 times more) than the reported number of plastic particles with 333/450 µm mesh nets	>80µm; >450µm	Published; Norén, 2007; Report

Water surface	Lake Södertälje (rivers upstream and downstream to the Baltic Sea)	Stainless steel pump (up to 60m)	The levels of anthropogenic particles (microplastics, fibers and other anthropogenic particles) >300 µm varied between 0.1 and 1 particles / m^3 (average 0.3) and between 0.7 and 20 (average 8.3) for 50-300 µm (5-160 times higher)	>300 µm and 50-300 µm	Report, Rotander & Kärman, 2019
Surface water	Gulf of Finland	Manta trawl & submersible pump	0.3 -2.1 /m^3 (manta), 0– 3.4 /m^3 (pump 300 µm) and 0– 8.2 /m^3 (pump 100 µm	>333 µm (manta), >100µm & >300µm pump	Published, Setälä et al. 2016
Surface water	Gulf of Finland	Manta trawl	0.3-0.7 particles/m³	300 - 5000µm	Published, Magnusson 2014
Surface water	Gulf of Finland	Pump	0.01-0.65 fibers/L 0.5 9.4 synthetic particles/L	>20 µm, filtered with a sandwich type tower: (20 and 100µm)	Published, Talvitie et al. 2015
Surface water	Danish Seas, South Funen Archipelago	Manta trawl, low-volume bulk sampler	0.07 ± 0.02 particles/m^3; The concentration of microplastics in low-volume bulk samples is not comparable to manta trawl results	>300µm	Published, Tamminga et al. 2018, data from 2015
Surface water	Kattegat / The Sound / Arkona Basin / Baltic Sea	Plankton net 20 µm	300-1300 fibers/m³ 100-7000 particles/m³	>20 µm -	Published, Norén et al 2009
Surface water	Arkona Basin / Bornholm Basin	Manta trawl	0.0-8.0 particles /m³; 0.0-35.0 fibers /m³	300-5000µm	Published, Norén et al. 2015
Surface water		Bulk sampling	710-26 810 particles /m³ 0-1 410 fibers /m³	10 -5000µm	
Water column	Northern Baltic Proper (Landsort Deep)	Vertical tows and bulk sampling	10^2-10^4 particles /m³ (mean)	90 – 5000µm	Published, Gorokhova, 2015; historical zooplankton samples
Water surface – water	Baltic Sea Proper in 2015– 2016	Bulk sampling 10-30-L Niskin bottles	63% contained fibers in concentrations from 0.07 to 2.6 items/L.; 7% (7 samples) contained small films (0.2–3 mm, totally 10 pieces); 40% (38 samples) had flakes	>174 µm	Published, Bagaev et al. 2017
Water surface	Stockholm archipelago and other study close to Visby	Manta trawl and another method with citizen science	Coastal Sweden: 4.2 ×105 /km2, offshore 4.7×104 /km2	335 µm and 80 µm small trawl	Published, Gewert et al. 2017

Table 7. Studies carried out on microlitter/microplastics in sediment (FanpLESStic-sea and SPICE Projects).

Green=FanpLESStic-sea research, Blue=SPICE published research

Ecosystem compartment	HELCOM Sub-basin	Sampling methods applied	Results	Size fractions considered	Reference
Sediments from 1 to 118 meters	North from Gothenburg, Sweden	100 ml box corer	9.6 to 24.2 particles / 100 ml of sediment (38-118 meters); 18.2 to 104.4 particles/100 ml of sediment (1m depth)	≥10µm	Johansson, 2011 BSc. Thesis
Sediment	North from Gothenburg (just outside the Baltic Sea area)	100 ml	2 - 34 particles/100 ml; 332 particles in industrial harbor	2µm	Published, Norén, 2007, Report
Riverine sediments	Rhine river, Germany	Diving bell and bucket chain dredger	MP numbers ranged between 0.26 ± 0.01 and 11.07 ± 0.6 × 10^3 MP kg^{-1} while MP particles <75 µm accounted for a mean numerical proportion ± SD of 96 ± 6%. MP concentrations decreased with sediment depth	11–5033 µm	Published, Mani et al. 2019
Beach and sediments	Swedish west coast	Visual and FTIR	In the pooled samples the concentrations varied between 4 000 and 100 000 particles >300 µm per kg d.w. and worst-case samples on the beaches had up to 70 times higher concentrations.	1-5 mm, 0.5-1 mm and 0.3-0.5mm	Report, Karlsson et al. 2019
Sediment	Lake Södertälje (rivers upstream and downstream to the Baltic Sea)	Core samplers (50cm)	0.1-0.8, average 0.4 MP/g d.w	50µm and >300 µm	Report, Rotander & Kärman, 2019

Sediment	Western Baltic Sea, Belt Sea, Sound, Kattegat	Box corer	Microplastics were found in all samples and in the range of 0.6 – 36 particles per 10-gram dry weight (DW) sediment	38, 1000 and 5000µm	Strand et al. 2013, data from 2012-2013; Conference poster
Sediment	Gulf of Finland, 7 locations along the Pojo bay area	Gemax sediment corer and Grab sampler	Grab sampler: 0-10,33 MP/g d.w (100 µm) and 0-9,16 (20 µm) Sediment corer: 0-0,48 MP/g d.w (100 µm= and 0,04-1,38 (20 µm)	20 and 100 µm (also 100-500 µm)	Tirroniemi, 2019 MSc. Thesis
Sediment	Inner Danish waters: Kattegat, Belt Sea, Sound and western Baltic Sea	HAPS bottom corer with a diameter of 13.5 cm or a Van Veen grab sampler Visual identification using microscopy µFT-IR spectroscopy in the later stage	202-3511 particles per kg dry weight and 300-1340 particles per liter wet sediment. Out of all identified microplastic-like particles 71–100 % were fibers	20-5000 µm 20-38, 38-100, 100-300, 300 1000 and 1000 5000 µm	Strand, Lundsteen & Murphy, 2019
Coastline sediments	Bay of Mecklenburg / Arkona Basin (German Baltic coast)	Samples were scraped off the surface layer with a stainless-steel table spoon either at the drift line or were carefully spooned off the surface of sand ripples under water with the same flat table spoon	0-7 particles and 2-11 fibers /kg (dw)	63µm – 5mm	Published, Stolte et al. 2015
Coastline sediments	Gulf of Finland	GEMAX corer	average conc. 1.7 fibers and 7.2 synthetic particles/kg (ww); black particles excluded here		Published, Talvitie et al. 2015
Sediments from 330m depth	South-Eastern part of the Baltic Sea near the Baltiysk Strait inlet	Hand-operated dredge	Average conc. 34 ± 10 /kg (dw)	>174µm	Published, Zobkov & Esiukova 2017

Shallow coastal and deeper open sea sediments	Polish coast of the Baltic Sea	Van Veen grab, top 0.5 – 2.5 cm of the sample	25 – 53 particles/kg (dw) sediment on open beach; 0–27 particles kg^{-1} (dw) in bottom sediment	≤5mm	Published; Graca et al. 2017
Strandline/beach sediments	Isle of Rügen	Stainless steel frame	Median abundance of 88.10 microplastic particles/kg (dw) or 2862.56 particles per m^2	63µm – 5mm	Published, Hengstmann et al. 2017

Sources of microplastics in the Baltic Sea region

Studies presented in the section above confirm that microplastics have been detected in different ecosystem compartments in the Baltic Sea, but less attention has been given to discuss the potential sources of these microplastics. Based on available information, some general sources can be identified.

The Danish Assessment estimated that the emissions from primary microplastics would be only 1% of the total emissions compared to 99% from secondary sources. From the secondary sources, emissions from tyres account to 60% (4200-6600 t/year and 0.7-1.16kg/per capita/year), followed by unidentified other sources (10%), ship paints and footwear (approx. 7% each), road markings (5%), and textiles 1.8%. An assessment from Norway came up with quite similar estimates regarding emissions from car tyres, personal care and cosmetics products and textiles, but emissions from raw material loss (pellets) were estimated much higher (up to 450 tones/year and 87 grams/person/year). In Germany, the estimates were also in line with the previous estimates with the exception of pellets as well, which was estimated to be much higher, in the range of 0.260-2.6 kg/person/year. The assessment from Sweden identified 17 microplastic sources but was only able to give numerical estimates for 6 categories. In these categories, microplastic emissions from laundry were estimated to be at 3.5-4 tons/year, wear from boat hulls at 480-1360 tons/year, microplastics from personal care products in the waste water effluent water at 1.3 tons/year.

Common to all these studies is a big range of estimated values together with high uncertainty for many sources. See Table 8 below for different estimates from Denmark, EU, Germany, Norway and Sweden (see table 10 in the national-level section for sources).

Table 8. Comparison of estimated microplastics pollution in g per capita (modified from Sundt, Syversen, Skogesal, & Schulze, 2016).

Country and Year	Denmark (2015		EU		Germany (2015)		Norway (2014)	Sweden (2016)	
Population (milj)	5,70				80,69		5,165	10,12	
Estimate / Rnage (grams/capita)	Low	High	Low	High	Low	High	Best Guess	Low	High
Personal care and cosmetics	2	5	8			6	8	0.13*	
Pellets (raw materials)	1	10	112	1122	260	2603	87		
Paints	28	228	55				238	47**	135**
Tyres	737	1158	63		744	1376	871		
Textiles	35	175	53				136	0.35***	4***
Road markings	19	121					62		
Others	143	742				2	210		
Total	965	2439					1612		

* Effluent water average
** Wear from boat hulls
***Laundry

As a follow-up for some of the above-mentioned national and EU assessments, work has been done to identify options for reducing microplastic from these sources. A report entitled “Primary microplastic-pollution: Measures and reduction potentials in Norway” is one of them (Sundt, Syversen, Skogesal, & Schulze, 2016). It assesses measures for sources such as road traffic, paint, textiles, cosmetics/detergents, pellets and waste/recycling. Similar work has been done in the EU, where a reduction potential was assessed for tyres, pre-production plastics, textiles and wastewater treatment processes (Eunomia & ICF, 2018). Regarding textiles for example, both of these reports mention filters in washing machines as one potential measure to reduce microfiber emissions. Other possible effective measures are labeling and better design (eco-design) as well as removing the most polluting fabrics from the market.

Formation of microplastics via fragmentation from macroplastics in the environment

Regarding the formation of secondary microplastics, less data and estimates are available. None of the above-mentioned national assessments provide estimates of the amount of secondary microplastics/year. However, the Norwegian assessment gives a very rough “best guess” of 360 to 1800 tons per year based on the annual consumption of plastics, accumulation and potential fragmentation rate among other parameters. The study concludes “that such rough estimates are of course difficult to prove and speculative, but they give a feeling about the possible range” and also that “it is therefore not possible yet to estimate the contribution from macrolitter to Norwegian emissions of microplastics other than to say that it most likely is substantial”.

The Danish assessment concludes that “a substantial portion of the plastic pieces in the marine environment fragment before they are removed from beaches or before they are covered by sediment, but that there are no model calculations estimating the formation of microplastics based on the occurrence of macroplastics in the environment” and refers to the estimates from Norway included above as best available estimates.

Similarly, the Swedish assessment acknowledges that “to quantify microplastics originating from fragmentation of large plastic items on land or in the sea is particularly complicated since it requires data from a range of factors that are very difficult to control, e.g. the input rate of larger plastic items to the environment, the rate by which these plastic items fragment into microscopic pieces and estimations of how many plastic fragments will reach the sea. A conservative way of handling this task could however be to assume that in time all macroplastic items that are left in the environment will fragment into microscopic plastic particles” but estimates or best guesses are not provided. However, they point out the need for more reliable data on the emission of microplastic particles from several sources, in particular from waste handling.

Similarly, reliable data on littering and on the fragmentation of plastic debris is missing in Germany.

Therefore, it is yet to be seen if the envisaged upcoming assessments, i.a. from Finland and other on-going projects can shed more light on the issue of fragmentation of macroplastics as a source of microplastics in the Baltic Sea.

Status of the HELCOM work on microlitter indicator

In relation to the development of marine litter indicators, the biggest progress has been achieved on beach litter and litter on the seafloor indicators, not only globally, but also in the Baltic Sea, as can be seen in the State of the Baltic Sea Repot (2018)[103], where for the first time a descriptive section on marine litter is included in an HELCOM holistic assessment. However, the same does not apply to microliter indicators. There are several indicators on microlitter under discussion in global forums at the moment: microlitter in the water column, microliter in biota (i.a. fish or invertebrates), and microliter in sediments. Out of these, HELCOM is working on the development of a microliter indicator in the water column, which is a pre-core indicator. There is on-going discussion on whether sediments would be a more appropriate matrix than the water column for this indicator, due to a greater variability in water column measurements. In either matrix, the aim should be to determine the relative contribution of different sources of microlitter. As part of the HELCOM work on indicators towards the third holistic assessment of the Baltic Sea due in 2023, a work plan on marine litter indicators has been developed, and the following aspects identified as relevant to possibly include a descriptive information on microlitter based on data available:

- the harmonized monitoring of microlitter, including a HELCOM guideline, methodology, matrix, definition of components, particle size categories, frequency, application of reference sites, sample treatment, and data collection to build a viable temporal and spatial data set will be critical;

[103] (HELCOM, 2018)

- an important step in harmonization process would be the identification of the institutes currently conducting the microlitter monitoring and organization of a workshop with contact persons from these institutions and other interested parties;
- consideration should also be given to whether the indicator is applied as a pressure or a state indicator, or both. The latter may have implications for monitoring and assessment design (e.g. if open sea waters and sediments are most appropriate sampling matrix or if stormwater entry points, rivers and WWTPS are most significant); and
- the scale of assessment, data reporting needs, and threshold values will subsequently be needed.[104]

EU-level microplastics research

In the framework of the European Strategy for Plastics in a Circular Economy and regarding its different objectives and actions (such as actions to curb microplastics pollution in Annex 1 of the Strategy), the European Commission has commissioned several studies, among which the following outputs are to be pointed out:

- "Intentionally added microplastics in products", 2017
- "Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products", 2018
- "Environmental and Health Risks of Microplastic Pollution, Group of Chief Scientific Advisors, European Commission", 2019

Intentionally added microplastics in products

The report[105] on the intentionally added microplastics came up with a variety of sources for intentionally added microplastics under different categories defining possible emission pathways for each sub-category (see Table 9 below, modified from the original report).

Table 9. Sources of intentionally added microplastics in the EU, 2017

Category	Sub-Category	Emission pathways
Agriculture	Controlled release fertilisers (nutrient prills), crops	Dissolution of polymer coating (encapsulated ingredient/fertiliser is released over time), no evidence that particle shape remains
	Soil enhancement (water retention)	Soil, ground water?
	Dewatering of manure	Soil, ground water?
Construction	Polymer concrete, fiber reinforced concrete (PP, Nylon, PET), Insulation (EPS)	During construction period: emission of product into water, soil after demolition of buildings into environment (water, soil)

[104] (HELCOM, 2019)
[105] (Amec Foster Wheeler Environment & Infrastructure, 2017)

Cosmetics and Personal care products	Rinse off	Waste water, direct human uptake
	Leave on	Solid waste (makeup remover), waste water, direct human uptake
	Superabsorbents	Solid waste (disposable hygienic products)
Detergents		Waste water (solid waste)
Industrial abrasives	Abrasive media	Most likely: recovery for reuse plus filter masks for workers; possible: waste water; direct human uptake (lungs)
Medical applications	Pharmaceuticals (additive in drug formulations, controlled release, nanocapsules)	Direct human uptake, (waste water if not dissolved)
	Dental polymers for cavity filling, sealants, dentures, abrasive in dental polish	Direct human uptake, waste water
Oil and Gas	(Drilling fluids, flocculant)	Unintentional releases in the marine (or terrestrial) environment
Others	Furniture/soft toys (e.g. expanded PS)	Solid waste
	Adhesives and sealants	No evidence that particle shape remains (solid waste)
Paints/Coatings/Inks	Building, Road, Marine	Paint spill during application (-> soil, water); waste water (rinse brush), formation of secondary microplastics
	Paper making (drainage aid; coating)	Waste water, solid waste
	Laser printer inks	Direct human uptake (inhalation); solid waste (no particles, layer)
	Domestic polishing agents (floor)	Waste water, formation of secondary plastics and possibly abrasion
Waste water treatment	Flocculation agents, sewage dewatering	

Non-intentionally added microplastics, 2018

The second report[106] commissioned by the European Commission related to microplastics from other than intentionally added sources found out that (see Figure 5):

> *"Tyres, road markings, pre-production plastic pellets and washing of synthetic textiles are all large sources of microplastics emissions into the environment. Several other sources have been identified but are found to emit less. Artificial turf is relatively small source, however emissions are from a relatively small number of large point sources (pitches) with annual emissions of 1—5 tons*

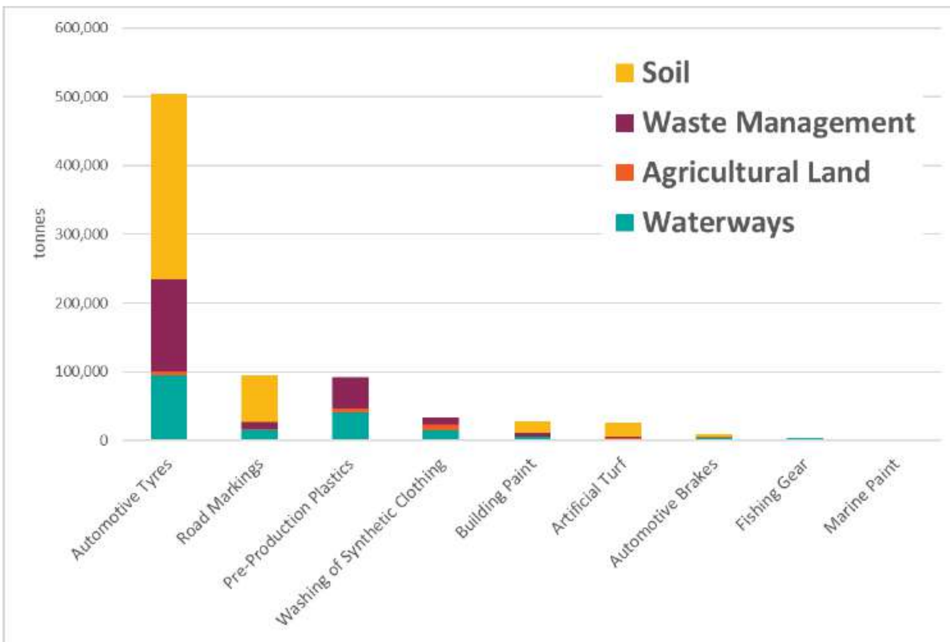
[106] (Eunomia & ICF, 2018)

each, whereas automotive tyre wear emanates from millions of vehicles all throughout Europe's road systems (Eunomia & ICF, 2018)".

Regarding the main sinks, the study concluded that (see Figure 5):

> *"Soil is the largest single sink and is largely comprised of microplastics washed or blown from roads. These also may, over time, be washed into waterways. Waste management includes microplastics collected during road sweeping and the various roadside storm water filtration devices; however, these devices are only effective if regularly emptied. Also included is wastewater treatment sludge destined for incineration or landfill—this accounts for around half of all sludge and in the case of landfill, may also provide a pathway for leaching microplastics to waterways. The other half of the sludge is applied to agricultural land along with any captured microplastics. The effects of this are yet to be established (Eunomia & ICF, 2018)".*

Figure 5. Sources of non-intentionally added microplastics in the EU, 2018.



Environmental and health risks of microplastic pollution, 2019

The report (also called "Option") is based on a SAPEA (2019) report[107] "A Scientific Perspective on Microplastics in Nature and Society" and outlines three policy relevant recommendations for the European Commission on how to approach the risks from the microplastic pollution that are:

- Broaden policy cover to prevent and reduce microplastic pollution related to:
  - Microplastics in water, air and soil;
  - Substance- and context-specificity and uses posing the highest potential risks; and

[107] (Science Advice for Policy by European Academies, 2019)

- Nanoplastics.

The potential actions under this recommendation include measures such as new legal (directives) and voluntary instruments (commercial and social), targeted actions for sources of microplastics which pose the highest potential risks as well as filling the knowledge gaps related to nanoplastics.

- Address wider socio-economic and trade-off implications of microplastic pollution policy actions in terms of:
  - Political and socio-economic feasibility; and
  - A catalyst for other environment and health protection issues.
- Promote global cooperation, high-quality scientific exchange and policy coherence by focusing on:
  - Global Cooperation;
  - Quality and pertinence of scientific studies of microplastics; and
  - International scientific standards and methodologies.

As an input to the above-mentioned report on the environmental and health risks of microplastic pollution, a report entitled "Microplastic Pollution: The Policy Context – background paper"[108] was also produced. The report is a similar work than the product in hand but focuses mainly on the policy context in the European Union providing a more detailed analysis of the different policies and regulations in the EU on marine litter and microplastics. Some of them are not necessarily mentioned in this report and a reader can refer to the report for more in-depth analysis. In addition, the report refers to some global, regional and national level policies.

Finally, the ECHA drafted a report to restrict intentionally added microplastics which contains lot of information regarding microplastics and their use as well as a proposal to restrict them[109]. The report was in agreement with the conclusions of the above-mentioned reports and summarized that 'intentionally added' microplastics have diverse technical functions and are used in various consumer, professional, agricultural and industrial products. The report also concluded that products containing microplastics have different (reasonably foreseeable) conditions of use, including how any wastes that arise during use are disposed. Therefore, releases of microplastics to the environment can occur through various pathways, principally via wastewater and/or municipal solid waste. Certain microplastics are deliberately released directly to the environment i.e. uses in agriculture and horticulture.

The Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans): Ecological Aspects of Microplastics

BASEMAN, PLASTOX, EPHEMARE and WEATHER-MIC projects

The Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans) was established in 2011 as an intergovernmental platform, open to all EU Member States and Associated Countries who invest in marine and maritime research. Within the JPI Oceans, the Ecological Aspects of Microplastics

[108] (SAM, 2018)
[109] (ECHA, 2019)

pilot action funded four projects in 2016 which concluded in 2018[110]: BASEMAN, PLASTOX, EPHEMARE and WEATHER-MIC (a second call was launched in November 2018).

BASEMAN project consisted of two main topics: 1) "the validation and harmonization of analytical methods" which is essential for 2), the "identification and quantification of microplastics (MPs)" and four work packages (WP):

- WP 1: Defining baselines for all relevant identification approaches;
- WP 2: Preparation of standardized test samples for inter-lab comparisons;
- WP 3: Inter-lab and inter-method comparisons. Defining baselines for all relevant identification approaches; and
- WP 4: Sampling methodologies for microplastics in the marine environment: standardization, suitability and intercomparing.

According to the project results baselines for all relevant identification approaches of microplastics have been defined, their strengths and limitations evaluated, and methods and standardized protocols for sampling and monitoring microplastics developed, including best practice guidelines. In addition to several publications[111] such as Baztan, et al. (2017), Fischer & Scholz-Böttcher (2017) and Primpke, Lorenz, Rascher-Friesenhausen, & Gerdts (2017), the project developed three protocols for monitoring microplastics:

1. Standardized protocol for monitoring microplastics in sediments[112]
2. Standardized protocol for monitoring microplastics in seawater[113]
3. Harmonized protocol for monitoring microplastics in biota[114]

These protocols aim at improving MPs sampling, processing and data collection quality while also allowing comparison amongst different studies throughout Europe. For microplastics monitoring the buoyancy of the different polymers is a relevant factor (see Figure 6 from the protocol for monitoring in sediments). Figure 7 below is taken from the protocol for monitoring microplastics in biota and shows current available options for analyzing physio-chemical properties of microplastics whereas Figure 8 is the work scheme of the separation process for isolating microplastics from seawater from the protocol for monitoring microplastics in seawater.

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[110] http://jpi-oceans.eu/news-events/news/final-results-four-jpi-oceans-microplastics-projects-presented

[111] https://www.researchgate.net/project/BASEMAN-JPI-OCEANS-Defining-the-baselines-and-standards-for-microplastics-analyses-in-European-waters-Project-Coordinator-Dr-Gunnar-Gerdts-Alfred-Wegener-Institute-Helmholtz-Centre-for-Polar-and-Mar

[112] (Frias, et al., 2018)

[113] (Gago, Filgueiras, Pedrotti, Caetano, & Frias, 2018)

[114] (Bessa, et al., 2019)

Figure 6. Buoyancy of common polymers (Frias, et al., 2018)

Abbreviation	Polymer	Density (g cm^{-3})	Buoyancy
PS	Polystyrene	0.01 – 1.06	Positive (↑)
PP	Polypropylene	0.85 – 0.92	Positive (↑)
LDPE	Low-density polyethylene	0.89 – 0.93	Positive (↑)
HPDE	High-density polyethylene	0.94 – 0.98	Positive (↑)
Seawater		**1.025**	
PA	Polyamide	1.12 – 1.15	Negative (↓)
PA 6,6	Nylon 6,6	1.13 – 1.15	Negative (↓)
PMMA	Poly methyl methacrylate	1.16 – 1.20	Negative (↓)
PC	Polycarbonate	1.20 – 1.22	Negative (↓)
PU	Polyurethane	1.20 – 1.26	Negative (↓)
PET	Polyethylene terephthalate	1.38 – 1.41	Negative (↓)
PVC	Polyvinyl chloride	1.38 – 1.41	Negative (↓)
PTFE	Polytetrafluoroethylene	2.10 – 2.30	Negative (↓)

Polymer density might vary with additives added during production, and therefore this table is a theoretical model.

Figure 7. Current nondestructive and destructive methodologies available to analyse microplastics (Bessa, et al., 2019)

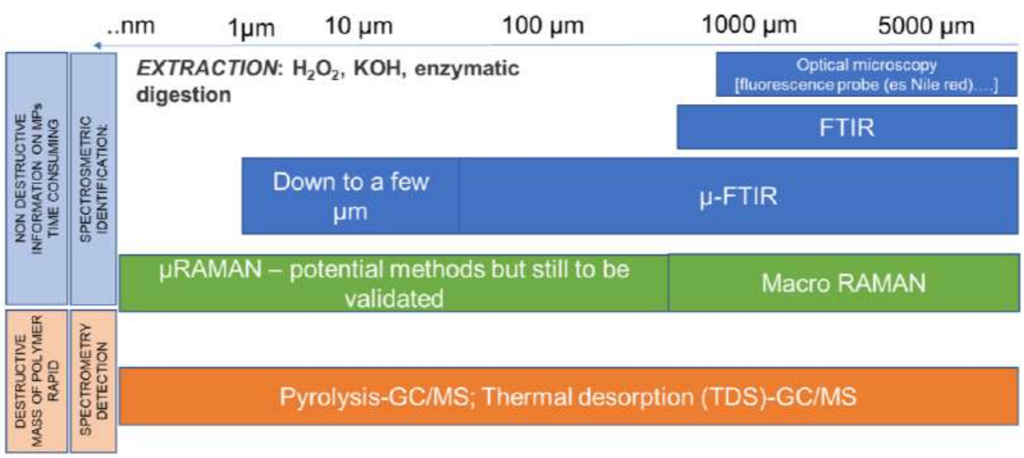
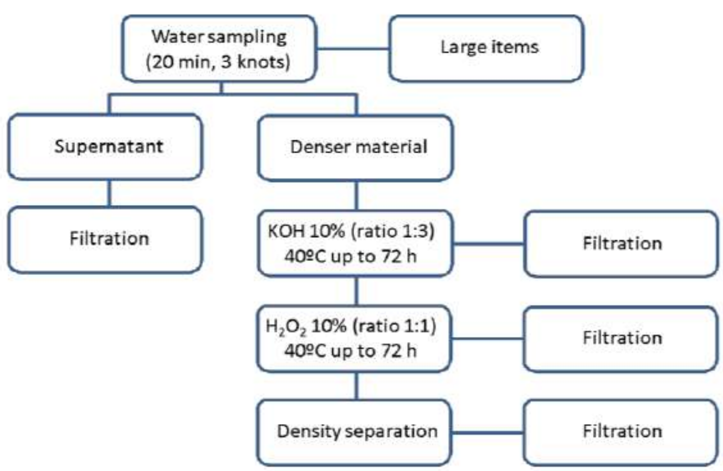


Figure 8. Laboratory processing diagram for water samples (Gago, et al., 2018)



WEATHER-MIC project's aim was to assess how weathering processes influence the transport, fate and toxicity of MPs and their leachates in the marine environment, which was done through seven scientific work packages[115]. The project has also published several scientific articles, posters and reports that can be found from the project web page[116]. Some of them are also directly relevant to the Baltic Sea[117].

The project shows the multiple factors influencing the weathering process by characterization of plastic particles over time, including degradation products. The project also studied effects of weathering on the spatial and temporal distribution of plastic debris, as well as adverse effects and mechanisms by which plastic particles and their degradation products affect biological systems. Moreover, the role of biofilms in aggregation, sedimentation, exposure, uptake and effects of plastic particles in marine organisms were also studied.

PLASTOX project's purpose was to investigate the ingestion, food web transfer, and ecotoxicological impact of microplastics, together with persistent organic pollutants (POPs), metals and plastic additive chemicals associated with them, on key European marine species and ecosystems through field-based observations, laboratory tests, mesocosm and manipulative field experiments to study the ecological effects of microplastics.

The project characterized and quantified microplastic uptake, retention and excretion and potential for trophic transfer. It also determined acute and sub-lethal ecotoxicological effects on key marine species, quantified the adsorption of POPs and metals to microplastics and desorption of plastic additives and assessed the role of POPs and metal adsorption/desorption on microplastic eco-toxicity.

The **EPHEMARE project** had two targets: (1) the uptake, tissue distribution, final fate and effects of microplastics in organisms' representative of pelagic and benthic ecosystems, and (2) the potential role of microplastics as vectors of model persistent pollutants that readily adsorb to their surfaces.

The project demonstrated that microplastic particles are easily ingested, but also easily egested by filter-feeders and predators. While microplastics may act as vectors of pollutants, they do not increase bioavailability and effects of model chemicals compared to natural particulate matter. The project also showed that particles are transferred from preys to predators, but they are egested and do not bio-accumulate in predators. EPHEMARE developed methods based on chronic effects suitable to assess the toxicity of environmental microplastics.

Building on the results from the previous call "Ecological aspects of microplastics in the marine environment" and recent scientific findings, a new joint transnational call was launched to increase the knowledge about the relevant sources of microplastics, analytical methods for identifying smaller micro- and nano- plastics, monitoring their distribution and abundance in marine systems and their effects thereon as well as concepts to reduce inputs of plastic into the marine environment.

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[115] http://jpi-oceans.eu/weather-mic/project-activities
[116] http://jpi-oceans.eu/weather-mic/publications
[117] (Gewert, Ogonowski, Barth, & MacLeod, 2017), (Ogonowski, Wenman, Barth, Hamacher-Barth, & Danielsson, 2018) and http://www.jpi-oceans.eu/sites/jpi-oceans.eu/files/public/WEATHER-MIC/Poster_Samor.pdf

EU marine litter reports

EC Joint Research Centre (JRC)

Other various reports by the EU/EC which do not have microplastics as their focus but are related to the overall issue of marine litter are those by the EC Joint Research Centre (JRC):

- **Guidance on Monitoring of Marine Litter in European Seas - A guidance document within the Common Implementation Strategy for the Marine Strategy Framework Directive (2013)** [118] - The objective of this report was to provide EU Member States with recommendations and information needed to commence the monitoring of the MSFD Descriptor 10, which describes specific protocols and considerations to collect, report and asses data on marine litter, in particular beach litter, floating litter, seafloor litter, litter in biota and microlitter.
- **Identifying Sources of Marine Litter - MSFD GES TG Marine Litter - Thematic Report (2016)** [119] - This report provides a brief overview of the main methods used and outlines one approach for determining sources – a Matrix Score Technique based on likelihoods, which considers the possibility that specific items originate from more than one source. Furthermore, it presents a series of other parameters that can be used to analyse data-sets, with regard to the use, origin and risk of items recorded in the marine or coastal environments. These can further support decision-making when considering preventive measures. Finally, recommendations to help the process of identification of sources are given, from the early stage of data collection and site characterization to bringing in the knowledge of local stakeholders to better determine where litter is coming from and what needs to be done to prevent it.
- **Riverine Litter Monitoring - Options and Recommendations - MSFD GES TG Marine Litter - Thematic Report (2016)** [120] - This technical report compiles the options for monitoring riverine litter and quantifying litter fluxes, focusing on anthropogenic litter. It includes the current scientific and technical background regarding litter in river systems, their flow regime and basic properties. The document provides initial recommendations for monitoring approaches and methodologies and highlights the need for additional scientific knowledge.
- **Harm caused by Marine Litter, MSFD GES TG Marine Litter – Thematic Report (2016)** [121] - This technical report describes the mechanisms of harm caused by marine litter. Further it provides reflections about the evidence for harm from marine litter to biota comprising the underlying aspect of animal welfare while also considering the socioeconomic effects, including the influence of marine litter on ecosystem services. General conclusions highlight that understanding the risks and uncertainties regarding the harm caused by marine litter is closely associated with the precautionary principle.
- **Top Marine Beach Litter Items in Europe - A review and synthesis based on beach litter data (2017)** [122] – This report compiles existing information about top marine beach litter items in

[118] (Joint Research Centre (JRC), 2013)
[119] (Veiga, et al., 2016)
[120] (González, et al., 2016)
[121] (Werner, et al., 2016)
[122] (Addamo, Laroche, & Hanke, 2017)

Europe, including available ranking information, data treatment options, ranking approaches and data analysis.

Other marine litter studies commissioned by the European Commission

Other relevant marine litter studies commissioned by the EC, but not produced by the JRC are presented below:

- **Marine Litter study to support the establishment of an initial quantitative headline reduction target (2013)** [123] - The main scope of this report is to support the development of an EU headline marine litter reduction target that can be used for benchmarking progress towards good environmental status for marine litter.
- **Study to support the development of measures to combat a range of marine litter sources (2016)** [124] - This study investigates litter from sea-based sources and microplastic litter from cosmetic products, reviewing the scale and nature of each of these sources as well as the measures to reduce them.

  Regarding **microplastics**, the study concluded that *whilst cosmetic microplastics are far from the largest microplastic source, they are still significant and contribute up to 4.1% — which was estimated to be between 2,461 and 8,627 tons entering the marine environment from Europe every year*.
- **Assessment of measures to reduce marine litter from single use plastics - final report and annex (2018)** [125]. This report sets out the methodology used to assess the impacts of introducing a range of measures tackling single use plastics (SUP). The outputs of this study were used to underpin the impact assessment carried out by the Commission for the proposal for a 'Directive of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment'.

[123] (Van Acoleyen, et al., 2014)
[124] (Sherrington, Darrah, Hann, Cole, & Crobin, 2016)
[125] (ICF & Eunomia, 2018)

Microplastics research at national level

In addition to the questions related to policies and technologies, the survey that was carried out as part of the FannpLESStic-Sea project, included various questions regarding the ongoing and concluded national-level research on microplastics. There were specific questions regarding the sources of MPLs, MPLs in wastewater and stormwater as well as car tyres as source of MPLs. In addition, there were separate questions regarding the availability of data and information (sources, processes, techniques) on microplastics. The following sections summarize the results from the survey under three sections: data availability, concluded research and on-going research.

In addition, there is a separate table regarding the on-going monitoring activities that were reported through the survey. In the beginning of each section/table, the questions from the survey are included. Additional research/studies to those reported through the questionnaire are included where relevant. The first section shows the answers related to the availability of data. In many cases same answers were reported under several questions and are hence showcased under the most relevant section in this report. Some of the studies/reports are included in both sections (availability of data and concluded studies) and marked with an asterisk (*). In these cases, more information is provided in the latter section.

Availability of national-level data on sources of primary and secondary microplastics, products and processes that include both primary and secondary microplastics and techniques related to wastewater treatment

Table 10. Availability of national-level data on primary and secondary microplastics

Country	Focus of the data	Type of data/resource	Additional information/link
Is there data available on the different sources of primary and secondary microplastics in your country? (Q5)			
Denmark*	Sources of microplastics	Report: "Microplastics: Occurrence, effects and sources of releases to the environment in Denmark" (2015)	https://www2.mst.dk/Udgiv/publications/2015/10/978-87-93352-80-3.pdf
Denmark*	Microplastic in Danish wastewater Sources, occurrences and fate	Report by the Danish Environmental Protection Agency (2017)	https://www2.mst.dk/Udgiv/publications/2017/03/978-87-93529-44-1.pdf
Finland	Sources of microplastics	Presentations from the stakeholder meeting (2019): • Cosmetics • Roads • Artificial surfaces • Snow dumping • WWTPs	https://www.syke.fi/fi-FI/Tutkimus__kehittaminen/Tutkimus_ja_kehittamishankkeet/Hankkeet/RoskatPois_Merenhoidon_toimenpideohjelmaa_tukeva_hanke_meriympariston_roskaantumisen_lahteiden_selvittamiseksi_tilan_maarittamiseksi_ja_roskaantumisen_vahentamiseksi/Sidosryhmaseminaari_1242019/Sidosryhmaseminaari_1242019(49933)

Finland*	WWTPs as sources of microplastics	Doctoral dissertation: Wastewater treatment plants as pathways of microlitter to the aquatic environment (2018).	https://aaltodoc.aalto.fi/handle/123456789/30720?show=full
Germany*	Sources of microplastics relevant to marine protection in Germany	Report funded by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety the project number 31969 (2015)	https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_64_2015_sources_of_microplastics_relevant_to_marine_protection_1.pdf
Lithuania	Microplastics in general	Microplastics: Harmful to Our Health? A web source containing basic knowledge of microplastics with references provided.	https://lt.mapleplainfc.com/36-microplastics-harmful-to-our-health.html
Norway*	Sources of Microplastics	Report regarding the sources of microplastic pollution to the marine environment (2014)	https://www.miljodirektoratet.no/globalassets/publikasjoner/m321/m321.pdf
Norway*	Microplastics in road runoff	NIVA/TØI report has national estimates on microplastics in road runoff; rubber from tyre treads, bitumen from roads and thermoplastic elastomers from road marking paints (2018)	https://www.miljodirektoratet.no/globalassets/publikasjoner/M959/M959.pdf
Poland/ Southern Baltic	Sources and fate of microplastics in marine and beach sediments of the Southern Baltic Sea	A preliminary study from Southern Baltic Sea in Poland (2017)	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5383691/
Sweden*	Microplastics in cosmetic products and other chemical products	Report by KEMI estimated that 0.2-4.4 tons of microplastics per year are emitted to the water environment from cosmetics products that are sold in Sweden (2018)	https://www.kemi.se/global/rapporter/2018/rapport-2-18-mikroplast-i-kosmetiska-produkter-och-andra-kemiska-produkter.pdf
Sweden*	Swedish sources and pathways for microplastics to the marine environment	A review of existing data: In August 2015, the Swedish Government commissioned to the Swedish Environmental Protection Agency, SEPA, to identify important sources of microplastics in Sweden and to take measures to reduce emissions of microplastics to the aquatic environment (2016)	https://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/regeringsuppdrag/2016/mikroplaster/swedish-sources-and-pathways-for-microplastics-to-marine%20environment-ivl-c183.pdf
Sweden*	Sources: Microplastics in the environment	The mapping of different sources has been continued in another Government commission in 2018/2019 (in Swedish). Translation of this document is planned for 2019/2020	https://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/regeringsuppdrag/2019/ru2019-05-28uppdrag-mikroplaster.pdf
Sweden	Sources of microplastics	Study and report by IVL Swedish Environmental Research Institute commissioned by the City of Stockholm related to the development of an	https://www.ivl.se/download/18.14bae12b164a305ba1111945/1537881614762/C334%2

	in the City of Stockholm	action plan against microplastics pollution. Study identified several important sources such as: Tyre wear (largest source) through the pathways; stormwater, sewage sludge and sewage water, Littering (large source), Littering at construction sites (moderately large source), Thermoplastic paint used for road markings (moderately large source). Other large sources showed to be households and commercial washing generating synthetic fibers and microplastics from rubber granulates at artificial turfs. Large uncertainties were reported regarding the results in the report (2018)	0Mikroplast%20i%20Stockholm%20stad.pdf
Sweden	Microplastics from artificial turfs (and other sports facilities and playgrounds)	This study by IVL (Swedish Environmental Research Institute) on commission by the Swedish Environmental Protection Agency investigated artificial turfs and other sports facilities and play grounds as sources of microplastics and proposed measures to prevent microplastics emissions from these sources. The project estimates that transmission from a full-sized field (artificial turfs with granulates) is ca. 500 kg per year. However, the uncertainty in this figure is high and only a limited amount of this is expected to reach the aquatic environment (2019)	https://www.ivl.se/download/18.57581b9b167ee95ab9919a1/1552466299144/C359.pdf
Is there data available on products and processes that include both primary and secondary microplastics? (Q8)			
Estonia, Lithuania Poland, Russia (and Belarus)	Products that are known to contain microplastics.	The first Consumer guidelines were developed within the project "More Baltic-Less Plastic" (Coalition Clean Baltic). Those guidelines contain basic information about cosmetics with microplastic particles	https://ccb.se/plasticfreebaltic/
Please provide information on available techniques in waste water treatment plants to prevent micro particles entering the marine environment you may be aware of? (Q11)			
Finland*	WWTPs	Scientific Publication: Solutions to microplastic pollution -Removal of microplastics from wastewater effluent with advanced wastewater treatment technologies (2017)	https://doi.org/10.1016/j.watres.2017.07.005
Finland	WWTPs	BSc. Thesis, Removing microplastics from wastewater (2019)	http://jultika.oulu.fi/files/nbnfioulu-201901291099.pdf
Germany	Wastewater treatment	Information of the available techniques in waste water treatment plants (BMBF project OEMP)	https://www.siwawi.tu-berlin.de/menue/key_activities/parameter/en/
Global	WWTPs	Scientific publication: Microplastics in wastewater treatment plants: Detection, occurrence and removal. Different techniques used for collecting microplastics from both wastewater and sewage sludge, and their pretreatment and characterization methods are reviewed and analysed.	https://doi.org/10.1016/j.watres.2018.12.050

Norway	Waste- and storm water	A compilation of the Swedish report below including some recommendations on measures to be taken on national level (Norway, 2017)	not publicly available
Poland	Wastewater treatment	Literature review: Effectiveness of removing microplastics from sewage and water (in Polish). In the light of current studies, it seems that the problem is not the removal of microplastics from sewage, but their storage together with sewage sludge, due to inadequate treatment of these compounds during sludge treatment and therefore their re-disposal into the environment. It is suggested that in order to limit this process, plastics which are degraded in the sludge treatment processes should be applied, or sewage sludge should be subjected to prior thermal treatment allowing for the breaking down of micro-particles and their easier degradation	https://pke.gdansk.pl/efektywnosc-usuwania-mikroplastikow-ze-sciekow-i-wod-dr-hab-e-m-siedlecka-prof-ug/
Russia	Wastewater treatment	Guidelines and information of the waste water treatment and wastewater treatment plants	https://vodproektstroy.ru/ochistnye-sooruzheniya/#20
Sweden*	Waste- and storm water	A report concerning techniques to reduce litter in waste water and storm water (Sweden, 2016) The scope and the objective of this project was to compile a report containing information of the best available technology (BAT) to reduce litter in waste water and storm water, as part of the OSPAR regional action plan against Marine litter, Action 42	https://smed.se/vatten/3960

*The study can also be found from the concluded national level studies section below

Concluded national level microplastics research

This section on national-level microplastics studies and research is a compilation of responses from the HELCOM Member States through the survey that was sent to the HELCOM EN-Marine Litter and to the FanpLESStic-sea-project partners. The data from the survey is complemented with additional studies that emanated while conducting this report.

It is to be pointed out that information from a non HELCOM country, Norway, is provided thanks to a project partner from that country being part of the consortium. Most of the studies reported feed into the implementation of the HELCOM Regional Action Plan on Marine Litter. Reported studies and concluded and on-going research are related to different aspects, but sources of microplastics as well as their presence in different matrices (wastewater and sewage sludge, stormwater and stormwater ponds, drinking water, snow, tyres, biota) are the main focuses of research. A short description of the main results or key points is also provided where possible in addition to the direct links to the full information. Data included in Table 11 was collected using the survey questions below:

Q6	Please provide information on research activities related **specifically to the sources of microplastic**s, including from roads and **tyres** in your country.
Q12	Please provide information on research activities in **waste water treatment plants** to prevent micro particles entering the marine environment you may be aware of
Q13	Please provide links to the outputs of **concluded research projects** addressing microlitter and/or microplastics where institutions from your country have participated.
Q14	Please provide links to the outputs of **additional concluded research projects** addressing microlitter and/or microplastics you may be aware of.

Table 11. Compilation of concluded national studies, reports, projects and other research activities.

SOURCES OCCURRENCE AND FATE OF MICROPLASTICS				
Country and Year	**Study Focus**	**Title of the Publication / Project**	**Main output / Key Findings**	**Available/ Reference/ Additional information**
Denmark, 2015	Sources	Microplastics: Occurrence, effects and sources of releases to the environment in Denmark	According to the study, among the most important uses of primary microplastics in products in Denmark are microbeads in cosmetics, various types of microplastics in paint, small plastic particles which are used for "sandblasting” and as "EPS beads for pillows and other purposes”. In addition, primary microplastics are the main raw material for the production of plastic items and rubber granules from recycled tyres are used for artificial turfs and other applications. Emissions from these uses will typically be to sewage (soil is the main release pathway for rubber granules), and some of the microplastics will end up in the aquatic environment, while most will be retained in the sewage sludge, which is partly used for agricultural purposes.	https://www2.mst.dk/Udgiv/publications/2015/10/978-87-93352-80-3.pdf Environmental project No. 1793, 2015

			Regarding stormwater, as only some of the stormwater sewers are equipped with settling lagoons, it is estimated that on average only 10-20% of the microplastics in stormwater is retained. Total quantified emissions from the primary microplastics are estimated to be in the range of 460-1,670 tons/year whereas the total emissions from secondary microplastics are between 5,000 and 12,200 t/year totaling to 5,500-13,900 t/year for total emissions from both primary and secondary microplastics in Denmark. From this amount it is estimated that 2,000-5,600 t/year are discharged to sewage where the main sources are estimated to be tyres and textiles with significant contributions from other sources. The estimations of the ultimate emission to the aquatic environment are at **600-3,100 t/year**.	
Finland, 2016	Sources	Microplastics and Harmful Substances in Urban Runoffs and Landfill Leachates - Possible Emission Sources to Marine Environment	Microplastics were found in all samples in the study. In general, fibers were more prevalent than particles in all the samples. The concentrations of fibers varied from 0.080 and 0.261 fibers/L, whereas the range of particles was between 0.002 and 0.017 particles/L.	BSc. Thesis https://www.theseus.fi/bitstream/handle/10024/114539/Kilponen_Juho.pdf?se%20quence=1
Germany, 2015	Sources	Sources of microplastics relevant to marine protection in Germany	Initial estimates indicate the use of 500 tons of primary microparticles made of polyethylene, which are used annually in Germany in cosmetic products. The use of detergents, disinfectants and blasting agents in Germany is estimated at less than 100 tons per year. For the use of microparticles in plastic waxes, however, about 100,000 tons are expected. The quantities used in the various other applications are currently not specified so that the total amount of primary microparticles in Germany cannot be quantified.	https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_64_2015_sources_of_microplastics_relevant_to_marine_protection_1.pdf
Lithuania, 2014	Sources,	Scale, origin and spatial distribution of marine litter pollution in the Lithuanian coastal zone of the Baltic Sea	The first attempt to investigate the marine litter pollution level of the Lithuanian coastal zone was carried out based on different marine litter monitoring methods and according to the lists of identifiable items. The results have proven that plastic is the dominant type of marine litter. It seems that tourism and fishery related marine litter occurrence do not significantly depend on seasonal variations.	Journal article: http://www.gamtostyrimai.lt/uploads/publications/docs//11761_db3505f016c570653b5f12a38336a274.pdf

Germany, 2019	Sources	Plastics in the Environment	Publication of marine plastics and microplastics in the environment from the German Environment Protection Agency (Umwelt Bundesamt) (in German).	https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/190515_uba_fb_kunststoffe_bf.pdf
Norway, 2014	Sources	Sources of microplastic pollution to the marine environment, 2014	According to the report, a total volume of Norwegian annual emissions from primary sources is estimated at approximately 8.000 tons of microplastics (1.6kg per capita), a significant proportion of which are considered to have the potential to reach water bodies and the ocean. Some of this is also released directly into the sea. For secondary sources, the report is unable to make an estimate. However, the report concludes that both sources are important for the generation of microplastics in the Norwegian oceans.	https://www.miljodirektoratet.no/globalassets/publikasjoner/m321/m321.pdf
Norway, 2014	Occurrence, Distribution and Effects	Microplastics in marine environments: Occurrence, distribution and effects	This report is a comprehensive analysis of the state of knowledge regarding microplastics, that came up with the following recommendations: 1. Standardization: There is an urgent need for the standardization of approaches for the quantitative determination of microplastic pollution. This ranges from the simple definition of a microplastic to how data are reported. Such standardization is essential for the comparison of data and the evaluation of spatial and temporal trends. 2. Monitoring: There is an urgent need to evaluate the extent of microplastic pollution around the coast of Norway and Svalbard, including the direct inputs from marine discharges, such as treated wastewater. Long-term monitoring is required to monitor the load of microplastics in the Norwegian marine environment. 3. Fate of microplastic in the marine environment: We need to know more about what happens to plastic in the ocean. There is a need to identify the main processes that affect microplastics fate and how these processes in fact affect plastics. 4. Direct effects of microplastics: Further studies on the effects of microplastics on marine organisms are required. Understanding whether microplastics can move up the food chain is a key question. 5. Influence of hazardous substances and additives on the effects of microplastic: Studies are required on understanding how additives and POPs in plastic influence toxicity and bioaccumulation/biomagnification.	Norwegian Institute for Water Research REPORT SNO. 6754-2014 http://tema.miljodirektoratet.no/Documents/publikasjoner/M319/M319.pdf

Sweden, 2016	Sources	Swedish sources and pathways for microplastics to the marine environment - A review of existing data	The most important emissions for microplastics were found to be from road wear and abrasion of tyres: approximately 13,000 tons of microplastics are released from tyres every year. However, the data on microplastic content in stormwater from roads is very scarce and it is uncertain how many of these particles are transported to water recipients and how many of them are permanently deposited in the ground close to the road. The yearly load of plastic particles from personal care products, synthetic fibers from laundry and household dust that is discharged to Swedish municipal wastewater was estimated to be 250-2,000 tons. The major part of this is retained in the WWTPs and around 4–30 tons per year are estimated to be released to the water recipient. Most of these particles were >300 µm and the fate of smaller particles is less known, in particular for those <20 µm. The same is true for artificial turfs where the estimated loss was 2,300-3,900 tons per year, but data on the load reaching the sea is lacking. Loss of industrially produced plastic pellets in connection to manufacture and handling was estimated to amount to between 300 and 530 tons per year, but also here the volumes discharged to the sea are unknown.	https://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/regeringsuppdrag/2016/mikroplaster/swedish-sources-and-pathways-for-microplastics-to-marine%20environment-ivl-c183.pdf
Sweden, 2018	Sources	Microplastics in cosmetic products and other chemical products	Swedish Chemical Agency (KEMI) report 2/18 estimated that 0.2-4.4 tons of microplastics per year are emitted to the water environment from cosmetics products that are sold in Sweden.	https://www.kemi.se/global/rapporter/2018/rapport-2-18-mikroplast-i-kosmetiska-produkter-och-andra-kemiska-produkter.pdf
Sweden, 2019	Sources	Mikroplaster i miljön år 2019 Microplastics in the environment	The mapping of different sources has continued in another Government commission in 2018/2019. A translation of this document is planned for 2019/2020.	https://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/regeringsuppdrag/2019/ru2019-05-28uppdrag-mikroplaster.pdf
Sweden, 2018	Impacts of microplastics	Effects of microplastics on organisms and impacts on the environment – Balancing the	Literature review and overview of the current knowledge in the field, focusing on conclusions where a consensus has been reached concerning the sources, fate and effects of MPs. Knowledge gaps and ongoing discussions within relevant research fields regarding the effects of MPs and associated chemicals	https://bioenv.gu.se/digitalAssets/1717/1717688_effects-of-microplastics-on-organisms-bethanie.pdf

		known and unknown	are addressed. The major focus of this report is aquatic ecosystems (marine and freshwater).	
Coalition Clean Baltic (CCB)	Sources, Occurrence, Effects	Plastic Free Baltic Project/ Campaign	In 2017, CCB has implemented a project Plastic Free Baltic, which has significantly contributed to lifting up the agenda of microplastic/marine litter pollution in the Baltic Sea region, including the upstream catchment area. Partners: Lithuania (Lithuanian Fund for Nature), Poland, Latvia, Finland, Russia, Belarus.	https://ccb.se/plasticfreebaltic/
MICROPLASTICS IN WASTEWATER				
Country and Year	**Study Focus**	**Title of the Publication / Project**	**Main output / Key Findings**	**Available/ Reference/ Additional information**
Denmark, 2017	Wastewater	Microplastic in Danish wastewater: Sources, occurrences and fate	According to the Danish study, in the raw wastewater microplastic concentration was quantified to a median of 1.3 10^5 particles/L (size range 20-500 µm) corresponding to 5.9 mg/L, which is equivalent to one per-cent of the total organic matter of the raw wastewater, as it typically holds 320-740 mg COD/L. In treated wastewater microplastic concentration was quantified to a median of 5,800 particles/L (size range 20-500 µm) corresponding to 0.02 mg/L. The variability of microplastic concentrations in raw wastewater between the ten investigated treatment plants was quite large ranging from 13,000 to 442,000 particles/L corresponding to 0.2 to 30 mg/L. The average emission from a Danish WWTP to the aquatic environment from this calculated is 0.3% (with 25th and 75th percentiles of 0.0% and 0.7%) of the microplastic mass coming into the plant. From the results obtained from the analysis of the wastewater samples it is thereby shown that the emission of microplastic from Danish WWTPs to the receiving waters is minor compared to the total load on the plants	https://www2.mst.dk/Udgiv/publications/2017/03/978-87-93529-44-1.pdf
Denmark, 2017	Wastewater	Partnerskab om mikroplast I spildevand (The Partnership for microplastics)	The project ”Partnership for microplastics” has established a partnership for microplastics in Denmark in order to collect existing knowledge and acquire greater knowledge by involving the most relevant stakeholders and scientists in the field. The objective of the project concerns the identification of possible treatment technologies that can remove microplastics. Furthermore, the objective is to identify where knowledge is needed within analytical methods, and also to investigate the occurrence of microplastics in waste water, including storm water	The Environmental Technology Development Program (MUDP)/Danish Technological Institute and COWI https://mst.dk/media/143341/partnerskab-om-mikroplast-i-

			that in the project is treated as a specific category under wastewater.	spildevand-2017.pdf
Denmark, 2018	Wastewater	Quantification of microplastic mass and removal rates at wastewater treatment plants applying Focal Plane Array (FPA)-based Fourier Transform Infrared (FT-IR) imaging	Key Findings: • 98% of MPs are removed from influent wastewater in WWTPs. • The annual MP discharge from WWTPs in Denmark is approx. 0.56 g/(capita year). • MPs are quantified by mass in addition to particle number. • Mass can be estimated using FT-IR imaging.	Simon, M., van Alst, N. & Vollertsen, J, 2008. Water Research https://www.sciencedirect.com/science/article/pii/S0043135418303877
Denmark, 2018	Wastewater	µPLAST i spildevand – renseteknologiers tilbageholdelse af mikroplast	The aim of the study was to evaluate the retention of microplastics by different filter and sedimentation technologies at WWTPs and wet retention ponds. At WWTPs the retention was evaluated by pre-precipitation, pre-filtration and tertiary filtration with disc filters and membrane filters.	The Environmental Technology Development Program (MUDP)-project https://www2.mst.dk/Udgiv/publikationer/2018/10/978-87-93710-92-4.pdf
Finland, 2015	Wastewater	Do wastewater treatment plants act as a potential point source of microplastics? - Preliminary study in the coastal Gulf of Finland, Baltic Sea	The amount of microplastics in the influent was high, but it decreased significantly during the treatment process. The major part of the fibers was removed already in primary sedimentation whereas synthetic particles settled mostly in secondary sedimentation. After the treatment process, an average of 4.9 (±1.4) fibers and 8.6 (±2.5) particles were found per liter of wastewater. The total textile fiber concentration in the samples collected from the surface waters in the Helsinki archipelago varied between 0.01 and 0.65 fibers per liter, while the synthetic particle concentration varied between 0.5 and 9.4 particles per liter. The average fiber concentration was 25 times higher and the particle concentration was three times higher in the effluent compared to the receiving body of water. This indicates that WWTPs may operate as a route for microplastics entering the sea.	Talvitie, J., Heinonen, M., Pääkkönen, J.P., Vahtera, E., Mikola, A., Setälä, O., Vahala, R. (2015). Water Science and Technology, 72, 1495-1504
Finland, Sweden (and Iceland), 2016	Wastewater (biota)	Microlitter in sewage treatment systems -A Nordic perspective on waste water treatment plants as	The study found out that in the Finnish and Swedish Sewage Treatment Plants (STPs) more than 99.7% of the microlitter particles up to 300µm in the influent wastewater were retained and were hence not discharged with the effluent. STPs in both countries were equipped with wastewater chemical and biological treatment. For comparison, the plants in Iceland only had mechanical waste treatment meaning that none or very little microlitter particles	Magnusson, K., Jörundsdóttir, H., Norén, F., Talvitie, J., Setälä, O. (2016) https://norden.diva-portal.org/smash/

		pathways for microscopic anthropogenic particles to marine systems	were retained. Hence the concentration of microplastics was ~1500 particles/m^3 in the effluent compared to 10-40m^3 in treated effluent in Finland and Sweden. The concentration of non-synthetic particles was similar among countries. Even though the average microlitter concentrations were similar, the size of the plants and hence the total amount of the discharge of the microparticles varied a lot between the plants, meaning that the larger total number of microlitter was discharged from larger STPs. The study also detected microplastics and different fibers in biota and sediments from wastewater recipient area in all countries but was not able to trace them to the wastewater effluents with any certainty.	get/diva2:923936/FULLTEXT01.pdf
Finland, 2017	Wastewater	Solutions to microplastic pollution - Removal of microplastics from wastewater effluent with advanced wastewater treatment technologies	The study included membrane bioreactor (MBR) treating primary effluent and different tertiary treatment technologies (disc filter, rapid sand filtration and dissolved air flotation) treating secondary effluent. The MBR removed 99.9% of MPs during the treatment (from 6.9 to 0.005 MP L−1), rapid sand filter 97% (from 0.7 to 0.02 MP L−1), dissolved air flotation 95% (from 2.0 to 0.1 MP L−1) and disc filter 40–98.5% (from 0.5 – 2.0 to 0.03–0.3 MP L−1) of the MPs during the treatment. The study shows that with advanced final-stage wastewater treatment technologies WWTPs can substantially reduce the MP pollution discharged from WWTPs into the aquatic environments.	Talvitie, J., Mikola, A., Koistinen, A., Setälä, O. (2017) Water Research 123: 401-407.
Finland, 2017	Wastewater	How well is microlitter purified from wastewater? – A detailed study on the stepwise removal of microlitter in a tertiary level wastewater treatment plant	The overall retention capacity of studied WWTP was over 99% and was achieved after secondary treatment. Despite of the high removal performance, even an advanced WWTP may constitute a considerable source of microlitter and microplastics into the aquatic environment due to the large volumes of effluent discharged constantly. Approximately 20% of the microlitter removed from the process is recycled back with the reject water, whereas 80% of the microlitter is contained in the dried sludge.	Talvitie, J., Mikola, A., Setälä, O., Heinonen, M., Koistinen, A. (2017) Water Research, 109, 164-172
Finland, 2018	Wastewater (biota)	Application of an enzyme digestion method reveals microlitter in *Mytilus trossulus* at a wastewater discharge area	Microlitter was found in 66% of the mussels. Mussels from the WWTP recipient had higher microlitter content compared to those collected at the reference site. Plastics made up to 8% of all the analysed microlitter particles. The dominating litter types were fibers (~90% of all microlitter), 42% of which were cotton, 17% linen, 17% viscose and 4% polyester.	Railo, S., Talvitie, J., Setälä, O., Koistinen, A., Lehtiniemi, M. (2018). Marine Pollution Bulletin, 130, 206-214

Finland, 2018	Wastewater (biota)	PhD. Thesis, Wastewater treatment plants as pathways of microlitter to the aquatic environment	WWTPs in Finland were found to annually discharge from the 87 largest Finnish WWTPs (90% of total WW) ~ 480 billion microplastic particles into aquatic environments. As vast volumes of wastewaters are constantly discharged into the aquatic environments, the role of WWTPs as pathways may be significant. The results from the wastewater receiving environment also indicate that the WWTPs may influence the microlitter and microplastics abundance and composition detected in biota. Blue mussels collected from the wastewater receiving area had higher microlitter content than those from the reference site.	https://aaltodoc.aalto.fi/handle/123456789/30720
Finland, 2019	Wastewater	Microplastics are vectors for bacteria from wastewater into the aquatic environment	This study investigated bacterial communities of MPs surface biofilms from different stages of municipal wastewater treatment process. The results showed high diversity of bacteria which were strongly attached to MPs. After all treatment steps core bacterial groups remained attached to MPs and escaped wastewater treatment plant (WWTP) with effluent water. Several pathogenic bacteria were identified in samples from all treatment steps and most of them were found in the effluent. These data provide new insights in the possible impacts of MPs pollution on the environment and shed light on the role of WWTPs as important distributors of MPs carrying wastewater bacteria to natural waters.	Final report, available at: https://vvy.etapahtuma.fi/eTaika_Tiedostot/5/Hanke/1520/LOPPURAPORTTI_Abstract_microplastics_VVYreport.pdf
Finland, 2019	Wastewater	Fate of microplastics in Nenäinniemi wastewater treatment plant	The Nenäinniemi WWTP was found to remove 99 % of microplastics and removed microplastics were deposited into drained sludge. The most common polymers encountered were polyethylene (PE), polypropylene (PP) and polyethene terephthalate (PET). Primary treatments removed 91 % of the influent MP concentration. Surprisingly, in the secondary treatment, the MP concentration quadrupled. Disc filtration, however, removed 97 % of the microplastics remaining after the secondary treatment. The total balance of microplastics entering the environment was estimated to be 8.8 million particles/day compared to approximately 1 billion that remained in the sludge.	Ryymin, K. (2019). Master's Thesis, Environmental Science and Technology, University of Jyväskylä https://jyx.jyu.fi/handle/123456789/63366
Germany, 2017	Wastewater	Identification of microplastic in effluents of waste water treatment plants using focal plane array-based micro-Fourier-transform	Key points: • Microplastics (MP) were analysed in effluents from 4 tertiary and 8 secondary WWTPs in Germany. • Micro-FT-IR imaging allowed polymer identification of all MP down to a size of 20 µm. • MPs were determined in all effluents of examined WWTPs.	Mintenig, S., Int-Veen, I., Löder, M., Primpke, S., & Gerdts, G. (2017). Scientific Article

		infrared imaging.	• An installed post-filtration (tertiary treatment) removed 97% of MP. WWTPs may act as MPs source but also as sink since MPs were detected in sewage sludge.	
Norway, 2017	Wastewater	MicroSludge: Mapping microplastics in sludge	Microplastics were found in sludge from different WWTPs around Norway. The overall average plastic abundance was 6077 particles kg-1 (d.w.) (1701 – 19 837) or 1 176 889 particles m-3 (470 270 – 3 394 274). Based on the average microplastic abundance and the present application of sewage sludge in Norway, it was estimated that over 500 billion microplastics are released into the environment via sewage sludge application each year, to agricultural soils, green areas and soil producers. This likely represents a significant source of microplastics to terrestrial and marine systems.	https://www.miljodirektoratet.no/globalassets/publikasjoner/m907/m907.pdf
Poland, 2018	Wastewater	Efficiency of microplastics removal in selected wastewater treatment plants – Preliminary studies	This study found that the content of microplastics in influents was in the range from 19.4 · 10^3 to 552.2 · 10^3 particles per 1 m^3 and in effluents from 28 to 960 particles per 1 m^3. Microlitter particles removed from raw wastewater accumulated in sewage sludge. Total concentration of microplastic particles in the sludge was in the range from 6.7*10^3 to 62.6*10^3 particles per 1 kg d.m. In liquid phase, finer fractions of microplastics were dominant. In sewage sludge larger particles, especially fibers, were effectively cumulated. About 95%–99% removal efficiency of microplastics from influents was stated.	Wiśniowska, Ewa & Moraczewska-Majkut, Katarzyna & Nocoń, Witold. (2018)
Russia, 2014	Wastewater	BASE Project - Implementation of the Baltic Sea Action Plan in Russia – Preliminary study on synthetic microfibers and particles at a municipal waste water treatment plant	The results of this study show that the WWTPs may operate as a point source of microplastic litter into the aquatic environment. However, the reduction of the microplastic load is also remarkable in scale. Due to the preliminary status of this project, results gained in this study are only indicative. In order to evaluate the actual role of WWTPs on the total microplastic load of the marine environment, a more detailed investigation is needed into the amount and types of microplastic litter in wastewaters and in natural waters. Furthermore, extensive studies of other possible sources are needed. At the last sample point, after the purification process, 16 fibers, 7 synthetic particles and 125 black particles were found per liter of wastewater (purification rate 95-97%).	http://www.helcom.fi/Documents/HELCOM%20at%20work/Projects/BASE/Microplastics%20final%20report%20Base_final.pdf
Sweden, 2014	Wastewater	Microscopic debris in water from wastewater	The number of microlitter particles in incoming water was in the order of 10^4 to 10^5 per m^3. With the flow rates occurring at the time the inflow of particles was in the order of 10^8 microplastics and 10^{10} non-synthetic anthropogenic fibers per hour to the two larger WWTPs, Henriksdal and Ryaverket, and 1*10^6	https://www.ivl.se/download/18.343dc99d14e8bb0f58b51a3/1443173318867/B2208+Mikroskopiska+skr%C3

		treatment plants	microplastics and $10*10^6$ non-synthetic anthropogenic fibers to the smaller Långeviksverket. The majority of the microlitter particles in the incoming water, 70-100 %, were retained in the WWTPs, but the effluent still contained substantial amounts. Larger particles, >300 µm, were retained in the WWTPs to a larger extent than particles <300 µm. This is valid for both microplastics and non-synthetic anthropogenic fibers. Non-synthetic anthropogenic fibers were retained in the WWTPs to a larger extent than microplastics. The number of particles >300 µm in the effluent was substantially reduced after passage through the 15 µm disc filter at Ryaverket compared to the two other WWTPs. However, no such difference for particles <300 µm could be observed.	%A4ppartiklar+i+vatten+fr%C3%A5n+avloppsreningsverk.pdf
Sweden, 2014	Wastewater	Screening of microplastic particles in and down-stream a wastewater treatment plant	WWTP concentration in incoming water was 15,000 microplastic particles per m^3, resulting in an inflow of 3,200,000 particles per hour. Retention in sewage sludge was > 99 %, and 1,770 microplastic particles per hour left the WWTP with the effluent. Microplastic concentration in the recipient of the effluent tube was elevated compared to background levels; 1.1 - 1.8 plastic particles m^{-3} were found in the effluent plume compared to 0.45 m^{-3} in the reference area. Higher particle concentrations were found close to the mouth of the tube compared to 200 m downstream.	https://www.diva-portal.org/smash/get/diva2:773505/FULLTEXT01.pdf
Sweden, 2016	Wastewater	Wastewater treatment in Sweden 2016	Report regarding the wastewater treatment in Sweden, including information on microplastics. Even though WWTPs are not designed to remove microplastics, removal of microplastics is efficient since WWTPs are efficient at separating particles.	https://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-8809-5.pdf?pid=22471
Sweden, 2018	Wastewater engineering	Microplastics in the water and nutrient circle	The content of microplastic particles in influent wastewater after the screen (3 mm) at Sjölunda WWTP was 0.18 mg/L for the size range 10–500 µm, while the content in effluent wastewater was 0.0014 mg/L. The microplastic content in sewage sludge was 420 mg/kg TS, and in the soil that only received mineral fertilizer was 0.30 mg/kg TS. The soil which also received 1-ton TS sludge/ha and year had a microplastic content of 0.32 mg/kg TS, while the soil receiving 3 tones TS sludge/ha and year had a content of 3.4 mg/kg TS. The microplastic concentration in digestate was 6 mg/kg TS.	https://www.svensktvatten.se/contentassets/7be8e202754e4011a400bcff4ed89b1c/mikSVu-rap-8-13.pdf

			The results also show a tendency for more plastic types in soil fertilized with sludge than in soil that has not received sludge. At the same time, the results show that microplastics also occur in soils that have not received sludge.	

MICROPLASTICS IN STORMWATER AND FROM ROAD EMISSIONS				
Country and Year	**Study Focus**	**Title of the Publication / Project**	**Main output / Key Findings**	**Available/ Reference/ Additional information**
Denmark, 2019	Stormwater	Microplastics in a stormwater pond	The study revealed 270 item L^{-1} in the pond water, corresponding to 4.2 µg L^{-1}. The MPs in the pond were highly concentrated in its sediments, reaching 0.4 g kg^{-1}, corresponding to nearly 106 item kg^{-1}. MPs also accumulated in vertebrates from the pond—three-spined sticklebacks and young newts. In terms of particle numbers, this accumulation reached levels nearly as high as in the sediments. The size of the MPs in the pond water and its fauna was quite similar and significantly smaller than the MPs in the sediments. A rough estimate on MPs retention in the pond indicated that MPs were retained at efficiencies similar to that of other particulate materials occurring in the stormwater runoff.	Kristina Borg Olesen*, Diana A. Stephansen, Nikki van Alst and Jes Vollertsen, 2019. https://www.mdpi.com/2073-4441/11/7/1466/pdf-vor
Denmark, 2019	Stormwater	Microplastics in urban and highway stormwater retention ponds	Highlights of the study: • Commercial and industrial areas emitted more MP than residential and highway areas. • PVC, PS, PP, PE and polyester were the most common polymers found. • PVC had the largest particle size and mass. On average, 954 L of stormwater was collected per sample, leading to an approximate contamination of 23.3 items m^{-3} or 987 ng m^{-3}. The concentration per pond ranged from 490 to 22,894 item m^{-3} and 85 to 1143 µg m^{-3}, with a median value between all ponds of 1409.	Fan Liu, Kristina Borg Olesen, Diana A. Stephansen, Nikki van Alst and Jes Vollertsen, 2019. https://www.sciencedirect.com/science/article/pii/S0048969719314226
Norway, 2019	Microplastics in road dust	Microplastics in road dust – characteristics, pathways and measures	The expected main contributors to road dust-associated microplastic particles (RAMP) are rubber compounds in tyre treads, polymers used to strengthen the bitumen used in road pavement and thermoplastic elastomers used in road marking paints, where the former appears to dominate. The major fraction of RAMP is expected to be found in the runoff from the road and road verge generated during	https://www.miljodirektoratet.no/globalassets/publikasjoner/M959/M959.pdf

			rainfall events. However, even if domestic WWTPs are expected to be main recipients of road runoff in urban areas, their presence in the influents or effluents (neither treated water nor sludge) have not been undisputedly documented.	
Sweden, 2016	Stormwater and wastewater	A report concerning techniques to reduce litter in wastewater and storm water	The scope and the objective of this project was to compile a report containing information of the best available technology (BAT) to reduce litter in wastewater and storm water (OSPAR Regional Action Plan against Marine litter, Action 42). WWTPs with mechanical, biological and chemical treatment of the waste water would, based on these studies, retain >97% of microlitter≥300 µm and generally >80% of litter particles ≥20 µm in the sewage sludge.	http://www.smed.se/vatten/3960
Europe 2017-2019	Road run-off	PROPER Micropollutants in Road Run-Off water	This review presents the most relevant literature references on road runoff pollution and was mainly focused on references published since 2000. It aims at identifying the most important pollutants in road runoff – key pollutants – and having an overview of concentrations and pollutants loads in road runoff across Europe.	CEDR Conference of European Directors of Roads http://proper-cedr.eu/Deliverables/D1.1_Report.pdf
MICROPLASTICS IN BIOTA AND ECOSYSTEMS				
Country and Year	**Study Focus**	**Title of the Publication / Project**	**Main output / Key Findings**	**Available/ Reference/ Additional information**
Germany, 2015-2018	Microplastics in the ecosystems	MikrOMIK: Microplastics as vector for microbial populations in the ecosystem of the Baltic Sea	The joint project MikrOMIK was aiming at a comprehensive analysis of microplastics in the Baltic Sea, focusing on the microbial populations colonizing the plastic particles. So far, only rough estimations of the abundance and distribution of microplastics in the Baltic Sea exist, and nothing is known about the interaction between microplastics and microorganisms in this ecosystem. Within the project, methods for the sampling and identification of microplastics from seawater and sediment were evaluated; abundances, sources and sinks of microplastics in the Baltic Sea determined; microplastic sedimentation behavior explored; ingestion and egestion by higher organisms studied; and microbial plastic biofilms, including potential pathogenic members investigated.	Several publications available under the project webpage: https://www.io-warnemuende.de/mikromik-publications.html
Norway (and other Nordic countries), 2017	Microplastics in biota	Micro-and macro-plastics in marine species from Nordic waters	Review of state of knowledge for Nordic marine environment. The study focused on fourteen species; herring (Atlantic and Baltic), Atlantic cod, European sprat, European flounder, Atlantic mackerel, three-spined sticklebacks, common dab, gray gurnard,	https://norden.diva-portal.org/smash/get/diva2:1141513/FULLTEXT02.pdf

			whiting, horse mackerel, haddock, European eelpout, long-spined bullhead and twaite shad. Herring and cod are the most studied species by number and by study location. Percentage ingestion ranged from 0–30%, 13–47% and 0–31% in herring, cod, and mackerel, respectively.	
Norway, 2017-2018	Microplastics in biota	MILKYS: Contaminants in coastal waters of Norway, including microplastics as a contaminant	Microplastics monitoring option for mussels within the MILKYS program which is part of Norway's reporting for OSPAR. The percentage ingestion for those mussels containing particles ranged from 15.0 % to 92.3 % per station. In total, 177 out of 319 individuals contained potential plastic particles (55.5%). The average microplastic load per individual was 1.40 (± 2.27) whereas the average microplastic load per gram w.w. was 2.84 (± 10.84). A total of 445 particles were extracted from the 177 mussels and 81.2% were categorised as small microplastics (<1mm), and the rest were larger (1-5mm).	http://tema.miljodirektoratet.no/Documents/publikasjoner/M1120/M1120.pdf
Norway, 2018	Microplastics in biota	MicroPearl: Occurrence of pearls in mussels (*Mytilus spp.*) from the Norwegian coast	Microplastic occurrence in mussels does not appear to influence pearl production in Norwegian mussels. No significant correlation between number of microplastics detected in mussels and number of pearls detected in mussels was identified. However, any pearl and microplastic relationship should be further investigated since it is unknown if pearls can embed microplastics.	http://tema.miljodirektoratet.no/Documents/publikasjoner/M1173/M1173.pdf
Poland, 2017	Microplastics in water	Microplastic as an emerging contaminant of water - a state of knowledge in Poland	In the recent years the interest in water contamination with microplastics, both in questions of water and animal protection, has increased in Poland. Research published in 2017 indicates that the most common plastic occurred in the Baltic marine and beach sediments is polyester and less frequently poly(vinyl)acetate and poly(ethylene-propylene) are found. Still there is a lack of research on the problem of the occurrence of microplastic particles in freshwater – both surface and groundwaters.	Conference paper: https://www.researchgate.net/publication/330910460_Microplastic_as_an_emerging_contaminant_of_water_-_a_state_of_knowledge_in_Poland
Poland, 2018	Microplastics in water	Microplastics in the southern Baltic coastal waters	The obtained results allowed to determine that in the tested samples of the Polish coast sediments, the dominant type of microplastics were fibers (over 50% of identified objects), and on average 40% were microplastics qualified as plastic fragments. The identified microplastics can be included primarily in the secondary group resulting from the degradation of larger objects.	https://mir.gdynia.pl/mikroplastiki-w-wodach-przybrzeznych-baltyku-poludniowego/
METHODOLOGY DEVELOPMENT, MEASURES AND SPECIFIC STUDIES				
Country and Year	**Study Focus**	**Title of the Publication / Project**	**Main output / Key Findings**	**Available/ Reference/**

				Additional information
Denmark, 2018	Drinking water	Analysis of microplastic particles in Danish drinking water	The results from the visual assessment of filters showed that in average 15.6 MP-like particles > 100 µm were observed per 50 L water sample. In 16 out of the 17 samples, the number were below the limit of detection (29 MP-like particles per 50 L) and in the sample with the highest concentration, 30 MP-like particles per 50 L were observed. Identification by ZnSe discs showed that 3 % of the MP-like particles were verified as MP, whereas the majority consisted of cellulose-like material (76 %), and the rest were poor spectra (10 %), unknown (7 %) or proteinlike (4 %). The types of MP particles detected in the tap water samples were polyethylene terephthalate, polypropylene and polystyrene. Using the Anodisc method, polyethylene terephthalate and polypropylene were also found, as well as acrylonitrile butadiene styrene and polyurethane. However, due to the concentrations of MP below the limit of detection, no conclusions regarding the origin of MP from either tap water or sample contamination can be made. In contrast to previous American and Danish studies of MP in drinking water, this study shows no significant concentrations of MP in Danish tap water. This result is in line with a recent study of Norwegian drinking water from 2018.	Strand, J., Feld, L., Murphy, F., Mackevica, A. & Hartmann, N.B. 2018. Aarhus University, DCE – Danish Centre for Environment and Energy, 34 pp. Scientific Report No. 291. https://dce2.au.dk/pub/SR291.pdf
Finland, 2017	Microfibers from washing of clothes	Release of polyester and cotton fibers from textiles in machine washing	The number and mass of microfibers released from polyester and cotton textiles in the first wash varied in the range 2.1×10^5 to 1.3×10^7 and 0.12 to 0.33% w/w, respectively. Amounts of released microfibers showed a decreasing trend in sequential washes. The annual emission of polyester and cotton microfibers from household washing machines was estimated to be 154,000 (1.0×10^{14}) and 411,000 kg (4.9×10^{14}) in Finland (population 5.5×10^6). Due to the high emission values and sorption capacities, the polyester and cotton microfibers may play an important role in the transport and fate of chemical pollutants in the aquatic environment.	Sillanpää M. and Sainio P. 2017. Environmental Science and Pollution Research, 24, 19313-19321
Finland, 2017	Microplastics in snow	Pure as snow? Snow as a route for microplastics and other waste from urban areas to sea	This study divided the microplastics into two size categories (1–4mm and 0,3–1mm). Microplastics were found in all nine samples of snow. The amounts were 160 – 7120 for the larger size category and 510 – 10540 to the smaller size category. These numbers correspond to 11-21 g/m^3 of water on average. Depending on the winter, the total leakage of microplastics from snow is estimated to be in the range of **2-17 tons/year** from one snow reception site	MSc. Thesis, https://helda.helsinki.fi/bitstream/handle/10138/299030/Pro%20gradu_Pikkarainen.pdf?sequence=2&isAllowed=y

			at sea. No other reception sites on land were considered.	
Lithuania 2011	Phthalates	Phthalates (plasticizers) in surface water	The aim of the research was to apply and optimize the solid phase extraction (SPE) and gas chromatographic – mass spectrometric (GC–MS) method for the analysis of phthalates in surface water and validate the method. The determined concentrations of phthalates may be regarded as a concentrated pollution. The study also indicated that the contaminants are diluted into the flow of the river, and presumably water biota is not affected by toxicity; however, of major concern is the fact that the Venta river of the Baltic Sea basin is contaminated with environmental estrogens.	Keriene, Maruška and Sitonytė (2011) http://mokslozurnalai.lmaleidykla.lt/publ/0235-7216/2011/4/204-209.pdf
Norway, 2016	Measures	Primary microplastic-pollution: Measures and reduction potentials in Norway	This report assessed about fifty potential measures to reduce microplastic pollution to the environment and concludes that the most cost efficient and feasible specific sector-wise measures would be: 1. Better road cleaning to collect dust from car tyres and road paint 2. Dust and spill control during painting work on boats, ships and constructions 3. Improved design and production methods of synthetic textiles, as well as introducing lint filters on washing machines 4. Follow up voluntary industry commitments to phase out microplastics in cosmetics and raw material (pellets and dust) loss from plastic industry 5. Better construction of artificial football pitches to avoid loss of rubber granulate 6. Include the obligation to monitor and avoid microplastic emissions in all industry permits.	https://www.miljodirektoratet.no/globalassets/publikasjoner/M545/M545.pdf
Norway, 2017	Methodology development	Testing of methodology for measuring microplastics in blue mussels (*Mytilus spp*) and sediments, and recommendations for future monitoring of microplastics (R&D-project)	Method development and assessment of microplastics in marine sediments and blue mussels. Differences in microplastic values within biota from locations around the Norwegian coast. Plastics were found in 76.6 % of individual blue mussels (*Mytilus spp.*), with at least one individual containing microplastics from all thirteen sites. The overall average plastic load was 1.84 particles/individual (range 0 – 14.67). Particles from blue mussels consisted of fibers (85 %), fragments (11 %) and films and foams (4 %). Most of the particles were blue in colour (39 %) and the most common polymers were semi-synthetic fibers composed of chemically altered cellulose.	https://www.researchgate.net/publication/321724113_Testing_of_methodology_for_measuring_microplastics_in_blue_mussels_Mytilus_spp_and_sediments_and_recommendations_for_future_monitoring_of_microplastics_R_D-project
Sweden, 2017	Measures	Reporting of government assignments on sources of	This report is a follow-up report to the one above and aims to propose concrete actions to reduce microplastics leaking into the oceans.	https://www.naturvardsverket.se/Documents/publikationer6400/978-91-

		microplastics and proposals for measures for reduced emissions in Sweden	According to the report, there is lack of enough scientific knowledge to make accurate conclusions about how microplastics from the sources identified by the first report (road and tyres, artificial turf pitches, industrial production and management of primary plastics, washing of synthetics, boat hull paint and littering) are transported to the ocean, lakes and waterways in Sweden and the environmental impact they cause even though the prevalence of microplastics in the oceans is a fact. The report proposes actions that primarily aim to improve both knowledge and awareness of microplastics through research and development, guidance, dialogue and information.	620-6772-4.pdf?pid=20662
Sweden, 2019	Measures	The Ecodesign Directive as a driver for less microplastic from household laundry	The purpose of this study is to start framing the problem with microplastics emissions from household laundry from a socio-economic perspective. More specifically the study aims to 1) provide a structure for analyzing the performance of policy instruments in the area of microplastics; and 2) demonstrate the potential socio-economic impacts of implementing filter requirements in the Ecodesign Directive.	https://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6867-7.pdf?pid=24053
Sweden, 2018	Sampling methods	Sampling methods for microplastics >300 µm in surface water	In the pump samples zero to eight MPs were found per sample, rendering an arithmetic mean of 0.17 MPs/m^3. In the trawl samples the numbers varied between 9 and 33 MPs, which corresponded to a significantly higher concentration per volume than the pump with an arithmetic mean of 0.32 MPs/m^3. The composition of MPs in the study varied between the replicates but mainly consisted of expanded cellular plastics, films, filaments and fragments. Each pump sample had on average 1.3 films and 0.33 expanded cellular plastics whereas each trawl sample had on average 2.5 films and 9.2 expanded cellular plastics. Per unit of volume most of the particles in the pump samples (40%) consisted of films, whereas the particles in the trawl predominantly consisted of expanded cellular plastics (46%).	http://naturvardsverket.diva-portal.org/smash/get/diva2:1217686/FULLTEXT01.pdf

On-going research related to microplastics

This section provides an overview of the several research initiatives currently ongoing in the FanpLESStic-sea project and other Baltic Sea countries. As it can be observed, an overwhelming amount of new research is currently being produced through several national (and co-national) research initiatives which are also funded from multiple different sources. The two questions below were used to collect this information.

Q15	Please provide links/available information on **on-going research projects** addressing microlitter and/or microplastics with the participation of institutions from your country.
Q16	Please provide links/available information on **additional on-going research projects** addressing microlitter and/or microplastics you may be aware of.

Table 12. On-going microplastics research in FanpLESStic-sea project countries.

Country and implementation period	**Study focus area**	**Name of the project, publication, initiative**	**Description/expected outcomes**	**More information/ partners**
Denmark, 2017-2020	Car tyre wear	Removal of car tyre rubber and other environmentally harmful substances from rain-related discharges (translation from Danish)	In this project, special focus will be on mapping and quantifying the occurrence of car tyre wear (micro rubber) in separate rain/road water.	Miljøstyrelsen (MUDP), Aalborg Universitet, Tårnby Forsyning og Ørestad Vandlaug. http://www.kruger.dk/projekter/udviklingsprojekter/mikroplast.htm
Denmark, 2019-2023	Marine plastics and microplastics	MarinePlastic	MarinePlastic is an interdisciplinary center for cutting-edge research into marine plastic pollution, uniting Danish researchers across institutions and disciplinary expertise. The MarinePlastic project has five work packages: WP1: Regulation and societal actions WP2: Analytical methods WP3: Sources and distribution WP4: Fate and behaviour WP5: Ecological impacts	Aalborg University (AAU), Aarhus University (AU), Technical University in Denmark (DTU), Roskilde University (RUC), National Museum of Denmark Jes Vollertsen or Jakob Strand (jv@civil.aau.dk / jak@bios.au.dk) https://marineplastic.dk
Denmark, Finland, Sweden	Microplastic monitoring	Optimization and harmonization of microspectroscopic methods for identification of	- Further developing two main tracks of optical microspectroscopic techniques that build on vibration spectroscopy: i) Infrared absorption microspectroscopy (FTIR), and ii) Raman scattering microspectroscopy.	Aarhus University (Denmark), Finnish Environment Institute (Finland), Martin Hasellöv from the

		microplastics in marine samples	This includes build-up of a spectral library database search platform. - Developing efficient workflows between normal light microscopy and FTIR and/or RAMAN, and also towards Scanning Electron Microscopy (SEM) - Evaluation of optimized sample pretreatment protocols (published alternatives) on spectroscopic characteristics for three sample matrix types (water, sediment and biota).	Gothenburg University (Sweden)
Denmark, Finland, Sweden, 2018-2019	Monitoring and Sampling	HARMIC	HARMIC-Harmonizing sampling and analysis of microplastic in Nordic seas NCM project between Denmark, Finland and Sweden. The ultimate purpose of the project is to establish guidelines for monitoring of microplastics in the marine environment.	Finnish Environment Institute (SYKE), IVL, Gothenburg, University, Aarhus University Outi Setälä, SYKE
Denmark, Germany, Sweden, 2017-2020	Microplastics	BONUS CLEANWATER	BONUS CLEANWATER is a new research project focusing on reducing the input of micropollutants and microplastic into the Baltic Sea by exploring, developing and comparing new eco-technological approaches. Project Goals: - Develop eco-technological solutions for removing micropollutants and microplastic from contaminated water. - Determine the dominant source, wastewater or stormwater, for various micropollutants and microplastics, Develop testing methods for analysis of xenobiotics and microplastics in storm-, leachate- and wastewater,	Denmark: Aarhus University, Aalborg University, Aquaporin A/S, BIOFOS A/S, Liqtech International A/S Sweden: Lund University, Sweden Water Research, Primozone Production AB, Veolia Water Technologies German Federal Institute of Hydrology, https://www.swedenwaterresearch.se/en/projekt/bonus-cleanwater/
Denmark, Norway, and the Faroe Islands, 2018-2019	Biota (Northern fulmar), monitoring and research	PLACHFUL	Plastic characterisation in Northern fulmar.	Geir Wing Gabrielsen from the Norwegian Polar Institute (NPI), Aarhus University (Denmark), University of the Faroe Islands (the Faroe Islands)
Estonia, Germany, Lithuania, Poland,	Microplastics	BONUS MICROPOLL	The focus of the project is on the multilevel impacts of MP themselves, of associated pollutants and of attached biofilms on the Baltic Sea ecosystem. The potential hazard and impacts of these substances will be determined by i) detecting the recent	TUT (Estonia), IPF (Germany), OW (Germany), KU, (Lithuania), NMFRI, (Poland), IVL

Sweden, 2017-2020			status regarding MP in the Baltic Sea (abundance, composition, sources, sinks), ii) exploring the vector function of MP for associated pollutants and biofilms, and iii) in situ and laboratory experiments, exposing marine organisms from different trophic levels to defined levels and size classes of MP and POPs. The project is divided into s work packages: - WP1: Marine MP sampling and processing. - WP2: Vector function of MP for POPs and biofilms, degradation of MP. - WP3: Impacts of MP on Baltic biota. - WP4: Eco-technological approaches for efficient wastewater treatment. - WP5: Modelling, sources, transport, pattern & fate of MP. - WP6: Policy advice and implementation. - WP7: Management & coordination.	(Sweden), SU (Sweden) https://www.io-warnemuende.de/micropoll-home.html Publications: https://www.io-warnemuende.de/publications-6567.html First year report: https://www.bonusportal.org/projects/blue_baltic_2017-2020/micropoll
Finland, 2016-2020	Microplastics in Finnish waters	MIF; Microplastics in Finnish waters, a consortium between SYKE & University of Eastern Finland UEF (2016-2020).		Consortium leaders: Maiju Lehtiniemi (SYKE), Arto Koistinen (UEF)
Finland, 2017-2019	Sources of marine litter	RoskatPois!	A project supporting MSFD PoM, aiming at assessing the sources of marine litter in Finland, defining the state of marine environment regarding marine litter, setting up a roadmap towards a litter-free marine environment.	Finnish Environment Institute, SYKE, Outi Setälä
Finland, 2017-2020	Microplastic impacts	PhD project	The fate and impacts of microplastics in seafloor habitats.	Msc Pinja Näkki
Finland, 2018-2019	Biodegradability	UBINAM	Bio-based and biodegradable plastic materials in the marine environment.	Finnish Environment Institute, SYKE, Hermanni Kaartokallio,
Finland, 2018-2019	Monitoring	SUMMIT	Implementation of the national marine microlitter monitoring.	Finnish Environment Institute, SYKE, Outi Setälä
Finland, (started 9/2019)	Monitoring		Baltic Sea Monitoring on Microplastic sedimentation processes	University of Turku, Saija Saarni
Finland, 2019-2020	Microplastics in artificial surfaces	TEKONURMI	Assessing the Styrene-butadiene rubber (SBR) infill emissions from football turfs in Finland	SYKE (Outi Setälä, Maiju Lehtiniemi).

Finland, 2019-	WTTPs as pathways for microplastics into the environment	Jätevedenpuhdistamo pienten mikromuovien reittinä ympäristöön	The main objective of the project is to develop a semi-automated analytical method for the detection of small micro-plastics in purified sewage and treated waste sludge.	Markus Sillanpää and Salla Selonen (SYKE): https://vvy.etapahtuma.fi/Hankkeet-selaus-2
Finland, Norway, Sweden, 2017-2020	Microplastic impacts	IMPASSE	IMPASSE –Impacts of MicroPlastics on AgrosystemS and Stream Environments.	SYKE (Finland), Salla Selonen with NIVA (Norway), SLU (Sweden)
Finland	Impact of micro- and nanoplastics	PhD project	Micro- and nanoplastics in natural waters and their impacts on invertebrates	MSc. Daniel Rotko, University of Eastern Finland and SYKE.
Finland	Microplastics in household waters and foodstuff		Survey of microplastics abundance in household waters and foodstuff and piloting suitable tools for analysis.	University of Eastern Finland (UEF), Arto Koistinen
Finland	Microplastics and Pharmaceuticals	PhD project	Characterization and analysis of microplastics in environmental samples and sorption of pharmaceuticals to microplastics.	MSc. Emilia Uurasjärvi
Finland	Microplastics recycling	PhD project	Chemical and toxicological identification and of risks related to recycling of plastics, composites and microplastics.	MSc. Samuel Hartikainen
Germany, 2017-2020	Microplastic sinks and sources	“MicroCatch_Balt - Environment, Sources, Sinks, Solutions" funding line of the German Federal Ministry of Education and Research (BMBF)	Investigation of microplastic sinks and sources from a typical catchment area to the open Baltic Sea. MicroCatch_Balt will cover the key aspects of MP contamination from limnic to marine systems in northern Germany, providing stakeholders with expertise for future monitoring and mitigation strategies.	Leibniz Institute for Baltic Sea Research Warnemünde, Leibniz Institute for Polymer Research Dresden, Forschungszentrum Jülich Institute of Bio- and Geosciences, Johann Heinrich von Thünen-Institut, Federal Research Institute for Rural Areas, Forestry and Fisheries, Fraunhofer Institute for Computer Graphics Rostock https://www.io-warnemuende.de/microcatch-start.html
Germany, 2017-2020	Car tyre abrasion	“RAU - Environment, Sources, Sinks, Solutions" funding line of the German Federal Ministry of	Key areas of work: - Development of a sampling basket for fractional sampling of individual rain events. - Analytical evaluation of environmental samples for tyre abrasion.	Technical University of Berlin, Institute for Civil Engineering, Faculty VI Planning Building Environment, Institute of Civil

		Education and Research (BMBF)	- Measurement of abrasion, quantification of subsets and subsequent qualitative examination. - Further development of the pollution load simulation. Optimise the street cleaning.	Engineering, Chair of Urban Water Management / TUB FG Siwawi https://www.rau.tu-berlin.de/menue/reifenabrieb_in_der_umwelt/parameter/en/
Germany, 2017-2020	Microplastics from textiles	"TextileMission - Environment, Sources, Sinks, Solutions" funding line of the German Federal Ministry of Education and Research (BMBF)	Key questions to be addressed include: - What is the dimension of the problem? - How much plastic can be found where? - What are the main sources of the problem? What are the most important entry paths and causes?	The Association of the German Sporting Goods Industry (BSI), Hochschule Niederrhein - University of Applied Sciences, TU Dresden - Institute of Water Chemistry, VAUDE, WWF Germany, Adidas, Henkel, Miele, Polartec, LLC, http://textilemission.bsi-sport.de/en/
Germany, 2017-2022	Wastewater treatment	Several other microplastics related projects funded by the German Federal Ministry of Education and Research (BMBF) under the Environment, "Sources, Sinks, Solutions" - project	- Reduction of the input of plastic via wastewater into the aquatic environment (REPLAWA). - Microplastic in Inland Waters - Investigation and modelling of the entry and whereabouts in the Danube area as a basis for action planning (MicBin). - Microplastic contamination in the model system Weser - Wadden Sea National Park: a cross-ecosystem approach (PLAWES). - Microplastic in dams and reservoirs: sedimentation, distribution, effects (micro Platas). - Tracking of (sub) microplastics of different identities - Innovative analysis tools for the toxicological and process engineering evaluation (SubµTrack). - Business Models for the Reduction of Plastic Waste along the Value Chain: Paths to Innovative Trends in Retail (Innoredux). - Environmental policy instruments to reduce the plastic pollution of inland waters via drainage systems (InRePlast).	http://www.replawa.de/ www.micbin.de http://www.bayceer.uni-bayreuth.de/PLAWES/ https://www.uni-muenster.de/Mikroplatas/ https://www.wasser.tum.de/submuetrack www.plastik-reduzieren.de

			Development of budget approach and LCA impact assessment methodology for the governance of plastics in the environment (plastic budget).	www.inreplast.de https://www.plastikbudget.de/
Germany, 2018-2020	Wastewater treatment	EmiStop - Identification of industrial plastic emissions by means of innovative detection methods and technology development to prevent the entry to the environment via the wastewater path.	EmiStop develops innovative analytical methods and evaluates selected technologies for industrial wastewater treatment. Optimization strategies are to be developed in order to reduce the entry of microplastics via the sewage path. The optimization strategies include technology development and laboratory and pilot trials.	Technische Universität Darmstadt, Hochschule RheinMain, Institut für Umwelt- und Verfahrenstechnik, inter3, Institut für Ressourcenmanagement, BS-Partikel GmbH http://www.emistop.de/
Germany 2018-2021	Microplastics	Sonderforschungs bereich 1357 Mikroplastik	DFG financed project by the University of Bayreuth. The aim of this CRC initiative is to gain a fundamental understanding of the processes and mechanisms: - That cause biological effects of MP in limnic and terrestrial ecosystems; - That influence migration of the MP particles; and That cause the formation of MP from macroscopic plastics each depending on the physical and chemical properties of the plastics.	https://www.sfb-mikroplastik.uni-bayreuth.de/de/
Latvia	Microplastics in biota		Post doc grant: ”A paleo-ecotoxicology approach to detect the impact of plastic particles on functional and structural diversity of the keystone microcrustacean group Cladocera in freshwaters”	n/a
Latvia	Environmental impact from geosynthetics	EI-GEO ”Environmental impacts of geosynthetics in aquatic systems”	Geosynthetics are widely used in hydraulic engineering in aquatic ecosystems such as in revetment measures for coastal protection or in ballast layers for wind energy plants. While providing various economic and technical benefits, the application of geosynthetics in hydraulic engineering projects has been questioned recently as these materials might degrade during their lifetime and induce a hazardous impact on the aquatic environment in a long term especially as the origin of plastic debris or as source/sink for chemicals such as plasticizers and	http://ei-geo.com/ Program ERA.Net RUS Plus (No RUS_ST2017-212) is supported via grants of national scientific funding agencies of Germany (BMBF), Latvia (VIAA) and Russia (RFBR).

			stabilizers used in the production of geosynthetics to improve their performance.	
Latvia	Microplastics	EU Marine Strategy Framework Directive (MSFD)	Agreement with the Ministry of Environmental Protection and Regional Development of the Republic of Latvia regarding MSFD	
Lithuania, 2019-2021	Innovative materials	No. J05-LVPA-K "Intellect. Joint Science-Business Projects"	Development of Innovative Plastic and Other Additive Composites with Distinctive Physical and Chemical Properties Project coordinator: Joint stock company "Vilkritis" Project partner: Kaunas University of Technology	https://fmed.ktu.edu/projects/development-of-innovative-plastic-and-other-additive-composites-with-distinctive-physical-and-chemical-properties/
Norway, 2018-2019	Wastewater	Mapping of microplastics in wastewater	No definite results yet, but a large fraction of the microplastics appears to be removed during the initial mechanical treatment steps.	NIVA
Norway, 2018-2021	Microplastics from roads and traffic	Occurrence and fate of microplastics from roads and traffic (MicroROAD)	Goal: The main research goal for this PhD-project is to identify, characterize and assess the concentration levels of microplastic particles from roads and traffic, in road run-off, road soil samples, catchment sediments as well as in biota, and measure how efficient different types of water treatment facilities used on road and tunnel wash water run-off are at withholding microplastic particles.	https://www.researchgate.net/project/Occurrence-and-fate-of-microplastics-from-roads-and-traffic-MicroROAD
Norway, 2018-2021	Chemicals in microplastics	NANO-CARRIERS	Micro and nanoplastics as carriers for the spread of chemicals and antibiotic resistance in h aquatic environment.	NIVA
Norway, 2018-2021	Impact/biota	MicroLeach	Long-term effects of plastics and additive chemicals on marine organisms.	NIVA, Sintef Ocean, Queensland Uni, Plymouth Uni, Vrilje Amsterdam Uni
Norway, 2019	Small microplastics	OSPAR-project	To investigate the small sized "unidentifiable" fraction of plastics at an OSPAR monitored beach in Norway.	NIVA and Norwegian NGOs
Norway, 2019	Hot-spots	Deep-dive	To study the characteristic and amounts of plastics and microplastics in hot-spots with plastic pollution that has been accumulated for around 50 years.	NIVA and Norwegian NGOs
Norway, 2019	Microplastics in Agriculture	Plastland	To investigate and understand the use of plastics in Norwegian Agriculture and any impact on agricultural land, including microplastic occurrence in soils and run-offs.	NIVA and local authorities

Norway, Iceland and the Faroe Islands 2019-2020	Biota, monitoring and research	FINplast	Compare plastic ingestion in fish from Iceland, Norway and the Faroe Island and harmonize microplastic methods.	NIVA, University Centre of the Westfjords (Iceland), Evanskyn Environment Faroe Islands
Norway, 2019-2021	Microplastic in sea ice	MicroIS	Microplastic in sea ice.	NP, NILU, NIVA
Poland	Microplastics in drinking water	FanpLESStic-sea project	Gdansk Water Utilities, as part of its participation in the project, will carry out, among others, analyses of microplastics content in drinking water and will verify the level of its removal as a result of the sewage treatment process and using the pilot station built within the framework of the "Interactive Water Management" project. The Company will also implement an educational campaign on microplastics and their harmfulness to the environment and human health and will supervise the implementation of similar campaigns by other project partners.	Gdansk Water Utilities http://www.giwk.pl/projektymiedzynarodowe/projektymiedzynarodowe/fanplesstic-sea.html
Poland	Stormwater	FanpLESStic-sea project	In the frame of the project, Gdansk Water (GW) will build a pilot station to verify the removal potential of microplastics from stormwater using Nature Based Solutions (wetland system). GW will also implement an educational campaign on microplastics and their harmfulness to the environment and human health.	http://gdmel.pl/aktualnosci/artykuly/257-redukcja-mikroplastiku-w-morzu-baltyckim-czyli-o-projekcie-fanplesstic-sea
Russia, 2018-2020	Plastic pollution	More Baltic Less Plastic	The goal of the project is to reduce the amount of plastic litter entering the Baltic Sea from land. Objectives: - Development of methods and tools for marine litter monitoring. - Awareness raising on the marine litter issue among media and locals. Provide recommendations towards a clean coast and sea for local citizens and municipalities. Inspire them to actively participate in solving the problem (reduce, reuse, recycle, rethink, refuse).	Coalition Clean Baltic, Friends of the Baltic, Sennoy district municipality, Lomonosov town municipality, Libraries of Lomonosov town and Peterhof town – South shore of the Gulf of Finland, Izhora local community Center of Youth creativity, Center of youth creativity "Voznecenskiy bridge" https://baltcf.org/project/more-baltic-less-plastic/

				http://ecocentrum.ru/en/news_noplastic_en
Sweden, 2018-2020	Microplastics from traffic	Microplastics from road traffic	Swedish National Road and Transport Research Institute (VTI) was commissioned by the Swedish government to develop and disseminate knowledge of microplastic emissions from road traffic. VTI will also identify and evaluate potentially effective policy instruments and measures in order to limit emissions.	https://www.vti.se/en/research-areas/microplastics-from-road-traffic/
Sweden 2018-2020	Microplastics released from the transport system	Mission to develop and disseminate knowledge about microplastics emissions from the transport system	The Swedish Government instructed the State Road and Transport Research Institute (VTI) to develop and disseminate knowledge about microplastics emissions from the transport system. VTI should also identify and evaluate potentially effective instruments and measures aimed at limiting emissions. VTI will prepare the final report for the assignment by 1 December 2020 to the Government Offices (Ministry of Industry).	VTI https://www.vti.se/sv/sysblocksroot/nyheter/regeringsuppdrag-mikroplaster.pdf
Sweden, 2018-2020	Stormwater	GreenNano3	The goal for GreenNano is to implement and develop innovative methods for sustainable stormwater management, which contributes to attractive cities, cleaner watercourses and better habitats. The work in GreenNanao3 is carried out within five work packages: - WP1: Advanced purification components for stormwater. - WP2: Rainwater treatment with green infrastructure. - WP3: Models for stormwater quality and development of assessment criteria. - WP4: Delay with green infrastructure. - WP5: Business development and total solutions.	https://www.ltu.se/research/subjects/VA-teknik/2.62875?l=en
Sweden, 2019	Microplastics in water and sediment along a gradient from land into the sea		The study is carried out by the University of Gothenburg on behalf of the Swedish Agency for Marine and Water Management. The aim of the study is to investigate the quantities and varieties of microlitter present in water and sediment along a gradient from land into the sea and trying to trace sources and pathways. The study provides a basis for status assessment according to the MSFD. A report is expected before the end of 2019.	http://www.naturvardsverket.se/Miljoarbete-i-samhallet/Miljoarbete-i-Sverige/Forskning/Forskning-for-miljomalen/Pagaendeforskning-

				for-miljomalen/Forskning-om-mikroplast-/
Sweden 2019-2021	Microplastics (sources, dispersal pathways, ecological effects and consequences, and measures helping to reduce them)	Mikroplaster	The Swedish Environmental Protection Agency (EPA) and the Swedish Agency for Marine and Water Management (SwAM) are funding five projects during 2019-2021 related to microplastics of which three are related to sources: - Development of measurement methods and techniques for tracking nanoplastic materials in wastewater and natural waterways. - Sources, sinks and flows of microplastics in the urban environment, creating a model that describes how microplastics are transported, caught up and released, in order to show where measures should be put in place. Development of analysis methods for microplastic for research and environmental monitoring, so that the understanding of the relative importance of different sources and pathways for microplastics is improved.	http://www.swedishepa.se/Guidance/Research/For-applicants-and-reviewers/Closed-Calls1/Call-for-funding-research-in-the-area-of- Microplastics/
Sweden, 2019-2022	Microplastics in stormwater		The Swedish Environmental Protection Agency is distributing grants for three years to implement measures aimed at improving the aquatic environment, including stormwater measures that minimize microplastics and other contamination via stormwater.	https://www.naturvardsverket.se/Stod-i-miljoarbetet/Bidrag/Utslapp-via-dagvatten-2019/
*Coalition Clean Baltic (CCB), 2019-	Marine litter and microplastics	Plastic Free Ocean	In 2019, CCB started implementing the project "Plastic Free Ocean". The project activities will support the implementation of the EU Plastics Strategy and the idea is to address the growing pollution of the Baltic Sea (and through it – the world ocean) by single-use plastic items, primary and secondary microplastics, and associated toxic chemicals through a combination of: - policy-oriented measures - awareness-raising public campaigns - monitoring activities - provision of assistance to identified target groups from the private and municipal sector to switch to plastic-free alternatives.	https://ccb.se/plastic-free-ocean/ Partners: Lithuania "The Lithuanian Fund for Nature", Estonia, Germany, Latvia, Poland and Russia Supported by the Swedish Postcode Foundation

*NGO

On-going monitoring activities

A separate question was also included in the survey to acquire data on monitoring activities related to microlitter and microplastics. Based on the results, it can be observed that there are an increasing number of monitoring initiatives either on-going or planned, but the methodology is not necessarily standardized for these initiatives or is currently being piloted. This was also confirmed under the on-going research projects section that identified projects specifically aiming to provide standardized tools for different monitoring efforts. The issue of monitoring remains as one of the biggest challenges as also identified by GESAMP and others.

Table 13. On-going monitoring activities in the FanpLESStic-sea partner countries.

Q9	Are you aware of any monitoring activities of microlitter and/or microplastics in your country? If so, please provide additional information, including links to compiled data as relevant.	
Country	**Initiative**	**Additional information / data**
Denmark	The project (MarinePlastic) has started in early 2019, therefore no data is available yet. Monitoring activities are scheduled for September 2019 (coastal/fjord sampling) and June 2020 (sampling in Kattegat).	No data available yet
Denmark	The Danish EPA has collected sediment samples from the marine environment. Some of these samples will be analysed for microplastics in late 2019.	No data available yet.
Denmark	The Danish EPA is currently collecting water samples from the marine environment with ferryboxes. These samples will be analysed for microplastics in late 2019.	No data available yet.
Finland	Finland has been running pilot monitoring for several years. Different methodologies and sampling from various matrices with various sampling devices have been conducted to gain experience and learn best ways to conduct a) sampling b) sample treatment protocols c) analyses.	Available data is so variable that it cannot yet be used for detailed assessments, but it provides an overall view of the situation.
Germany	Monitoring measures for microplastics are planned but not initiated yet. An in-going initiative for plastic monitoring in waters is on-going.	https://www.plamowa.net/de/
Norway	There are no standardised long-term monitoring activities in Norway regarding microplastics, but there are monitoring activities that are assessing the feasibility to implement microplastics as a part of their already established monitoring. The yearly Norwegian monitoring program for impact from inorganic and organic contaminants on the coastal environment (MILKYS, sponsored by the Norwegian Environment Agency) is an example, which has included microplastics occurrence in *Mytilus spp*. (marine mussels) for two years to far; 2017 and 2018.	https://www.miljodirektoratet.no/publikasjoner/2018/november-2018/contaminants-in-coastal-waters-of-norway-2017/
Poland	Monitoring of microplastics is carried out in Poland as part of the State Environmental Monitoring (SEM). In the Polish Maritime Areas microplastics monitoring was performed for the first time in 2016 at 6 stations (including 1 station at the Vistula Lagoon as part of complementary water monitoring in the shallow-water zone). Since 2018 (up to 2021),	n/a

	microplastics in sediments and water column are monitored at 6 stations once in each testing year.	
Russia	Microplastic monitoring in the coastal-marine zone of the south of Primorsky Krai.	https://e-koncept.ru/2016/86753.htm
Russia	Not specific to microplastics, but overall monitoring of water bodies in the Water Code of the Russian Federation dated 03.06.2006 (as amended and added, took effect from 01.07.2019) where Chapter 4 is dedicated to the management in the use and protection of water facilities, and, in particular, Article 30 focusses on state monitoring of water bodies	https://legalacts.ru/kodeks/VodniyKodeks-RF/glava-4/statja-30/
Sweden	City of Stockholm, City of Gothenburg, Örebro University and Länsstyrelsen (county administration) Östergötland.	n/a
Sweden	The Swedish Road and Transport Research Institute are measuring microplastics in road dust and storm water runoff and sediment.	Research ongoing, no data available yet.

Discussion

Based on this report it can be observed that there is an increasing amount of information available on microplastics also in the Baltic Sea area. This includes the sources of primary and secondary microplastics, the occurrence in different ecosystem compartments as well as in biota (mainly fish and bivalves). Regarding the sources, there is a relatively good understanding of the sources of primary microplastics as well as certain sources of secondary microplastics, such as from road emissions and from washing off synthetic fibers. However, the fragmentation process of (other) larger plastic items and more importantly the contribution of it to the total amount of microplastics in the environment seems to be known in theory, but poorly understood in practice.

There are also a lot of studies concentrated on detecting and possibly identifying the plastic particles and fibers in different water ecosystem compartments, biota and wastewater. It also appears there is fairly good understanding of microplastics in wastewater, what is not the case for other issues, such as microplastics emission from stormwater.

In terms of policy measures, there is no global approach specifically addressing microplastics, even though the issue is partially included in the scope of several international schemes. Nationally, policy initiatives focus on the designing of measures to address mainly larger plastic items (from reduction of production and use of plastic items, to improvement of their management once turned into waste) and at a lesser extent specific type of microplastics, such as those present in cosmetics. However, it seems to be a tendency to increase and further specify national measures and initiatives.

Despite the advances done regarding monitoring of microplastics, it seems that both researchers and policymakers are struggling to come up with harmonized monitoring protocols for the different ecosystem compartments.

Proposals on where further research could focused on is on (i) harmonization of monitoring methodologies; (ii); further advance on the quantification of the input of the identified sources of primary and secondary microplastics; (iii) development of technologies to prevent microplastics leakage, both primary and secondary microplastics; and (iv) assessment of the effectiveness of measures to reduce the input of microplastics to the different ecosystem compartments.

<u>Key observations</u>

- Microplastics are not directly addressed through any global instrument even though several of the existing multilateral environmental agreements cover important aspects related to marine litter of which the Basel Convention is probably the most relevant;
- In the Baltic Sea level, microplastics are addressed through the HELCOM Action Plan on Marine Litter;
- At EU-level, marine litter and microplastics are addressed through several Directives, and EU is currently working on regulating the use of added primary microplastics;
- Global-level research exist on sources, occurrence and fate of microplastics, and the global community is working towards harmonizing monitoring methodologies for microplastics. The smaller the particles considered, the more challenging, time consuming and expensive the monitoring is, suggesting that intermediate solution is needed;

- EU-level research on marine litter and microplastics is comprehensive and has identified the main sources of primary and secondary microplastics in EU while the work towards indicators and monitoring is still on-going;
- Regional-level research provides strong evidence of the occurrence of microplastics in water, sediments, beach and biota in the Baltic Sea area, but due to the varying monitoring methodologies applied, the comparison between studies, basins and regions is not possible;
- National-level research provides information of the sources of primary and secondary microplastics, and during the recent years several studies have demonstrated that due to the large volumes involved, the WWTPs are releasing microplastics into the marine environment despite of the advanced and efficient treatment technologies;
- Microplastics in road dust and stormwater is relatively new area of research, but lot of on-going projects are addressing the issue;
- The development of harmonized monitoring methods for microplastics is of high importance in order to better understand the problem.
- There is still lack of knowledge regarding the effects and impacts of microplastics, but on-going research is expected to shed light on the issue at all levels.

Key suggestions

- Support the development of harmonized, cost-efficient, and sufficiently robust monitoring methodologies for microplastics;
- Enough evidence of different sources of microplastics exists to guide the implementation of measures already now (WWTPs, primary microplastics in products and processes);
- Prevent and reduce the secondary sources of microplastics by addressing the products in earlier phase of their life-cycle before they become microplastics or more importantly before they become marine litter;
- Address the known sources of primary microplastics through best available techniques and regulation;
- Focus the research on the secondary sources that are less known such as road dust via stormwater, formation process of microplastics via fragmentation from macroplastics and based on the evidence plan measures to address those sources.
- More research is needed regarding the effects and impacts of microplastics on biota.

References

5Gyres. (2019). *Resources*. Retrieved from Trawl for plastic: https://www.5gyres.org/trawl-resources

Addamo, A. M., Laroche, P., & Hanke, G. (2017). *Top Marine Beach Litter Items in Europe, EUR 29249 EN.* European Commission. doi:10.2760/496717

Agersnap, S. (2013). *Mikroplastik i havmiljøet – Metode til kvantificering af mikroplastik i havvand, blåmusling og fisk. .* Aarhus, Denmark.

Amec Foster Wheeler Environment & Infrastructure. (2017). *Intentionally added microplastics in products.* Final report for the European Commission (DG Environment). Retrieved from https://ec.europa.eu/environment/chemicals/reach/pdf/39168%20Intentionally%20added%20 microplastics%20-%20Final%20report%2020171020.pdf

Andersen, J., Hansen, J., Mannerla, M., Korpinen, S., & Reker, J. (2013). *A glossary of terms commonly used in the Marine Strategy Framework Directive.* Aarhus University. DCE – Danish Centre for Environment and Energy. Retrieved from http://www.dmu.dk/Pub/TR16.pdf

Ašmonaitė, G., & Carney Almroth, B. (2018). *Effects of microplastics on organisms and impacts on the environmnet: Balancing the known and unknown.* Göteborgs Universitet. Naturvårdsverket. Retrieved from https://bioenv.gu.se/digitalAssets/1717/1717688_effects-of-microplastics-on-organisms-bethanie.pdf

Bagaev, A., Mizyuk, A., Khatmullina, L., Isachenko, I., & Chubarenko, I. (2017). Anthropogenic fibres in the Baltic Sea water column: Field data, laboratory and numerical testing of their motion. *Science of The Total Environment, 599-600*, 560-571. doi:https://doi.org/10.1016/j.scitotenv.2017.04.185

Balčiūnas, A., & Blažauskas, N. (2014). Scale, origin and spatial distribution of marine litter pollution in the Lithuanian coastal zone of the Baltic Sea. *BALTICA , 27*(Special issue), pp. 39-44. doi:10.5200/baltica.2014.27.14

Basel Convention. (1989, March 22). 1989 Basel Convention On The Control Of Transboundary Movements Of Hazardous Wastes And Their Disposal (entered into force 5 May 1992). *1673 UNTS 57*. Retrieved from http://www.basel.int/Portals/4/Basel Convention/docs/text/BaselConventionText-e.pdf

Baztan, J., Bergmann, M., Booth, A., Broglio, E., Carrasco, A., Chouinard, O., . . . Vanderlinden, J. (2017). Breaking Down the Plastic Age. In *Fate and Impact of Microplastics in Marine Ecosystems.* Amsterdam: MICRO 2016. doi:10.1016/B978-0-12-812271-6.00170-8

Beer, S. (2016). *Microplastic Ingestion by two Baltic Key Species Herring and Sprat, Seasonal and Dedacal Trends.* University . Denmark.

Beer, S., Garm, A., Huwer, B., Dierking, J., & Gissel Nielsen, T. (2018). No increase in marine microplastic concentration over the last three decades – A case study from the Baltic Sea. *Science of The Total Environment, 621*, 1272-1279. doi:https://doi.org/10.1016/j.scitotenv.2017.10.101

Bessa, F., Frias, J., Regoli, F., Kögel, T., Lusher, A., Andrade, J. M., . . . Gerdts, G. (2019). *Harmonized protocol for monitoring microplastics in biota.* JPI-Oceans BASEMAN project. doi:10.13140/RG.2.2.28588.72321/1

Borg Olesen, K., Stephansen, D. A., & van Alst, N. V. (2019). Microplastics in a Stormwater Pond. *Water*. Retrieved from https://www.mdpi.com/2073-4441/11/7/1466/pdf-vor

Boucher, J., & Friot, D. (2017). *Primary Microplastics in the Oceans: A Global Evaluation of Sources.* Gland, Swizerland: IUCN. doi:dx.doi.org/10.2305/IUCN.CH.2017.01.en

Bråte, I. L., Buenaventura, N., & Lusher, A. (2018). *Occurrence of pearls in mussels (Mytilus spp.) from the Norwegian coast.* Norwegian Environment Agency. NIVA. Retrieved from http://tema.miljodirektoratet.no/Documents/publikasjoner/M1173/M1173.pdf

Bråte, I. L., Huwer, B., Thomas, K. V., Eidsvoll, D. P., Halsband, C., Carney, B., & Lusher, A. (2017). *Micro- and macro-plastics in marine species from Nordic waters.* Nordic Council of Minister. Retrieved from https://norden.diva-portal.org/smash/get/diva2:1141513/FULLTEXT02.pdf

BRS. (2019, May 10). Basel Convention press release. Geneva. Retrieved from http://www.brsmeas.org/?tabid=8005

Budimir, S., Setälä, O., & Lehtiniemi, M. (2018). Effective and easy to use extraction method shows low numbers of microplastics in offshore planktivorous fish from the northern Baltic Sea. *Marine Pollution Bulletin, 127*, 586-592. doi:https://doi.org/10.1016/j.marpolbul.2017.12.054

CBD. (1992, June 5). 1992 Convention on Biological Diversity, (entered into force 29 December 1993). *1760 UNTS 79*. Retrieved from https://www.cbd.int/convention/text/default.shtml

CBD. (2016). Addressing impacts of marine debris and anthropogenic underwater noise on marine and coastal biodiversity. *CBD/COP/DEC/XIII/10, 13, (CBD Decision XIII/10).* Conventionon Biological Diversity. Retrieved from https://www.cbd.int/doc/decisions/cop-13/cop-13-dec-10-en.pdf

CBD. (2016). *Marine Debris: Understanding, Preventing and Mitigating the Significant Adverse Impacts on Marine and Coastal Biodiversity.* Technical Series No.83. Secretariat of the Convention on Biological Diversity,, Montreal.

CBD. (2019, July). *List of Parties*. Retrieved from https://www.cbd.int/information/parties.shtml

CCB. (2017). *Concrete ways to reduce microplastics in stormwater and waste water.* Coalition Clean Baltic. Retrieved from https://ccb.se/wp-content/uploads/2018/02/ccb-concrete-ways-to-reduce-microplastics-in-stormwater-and-sewage-final.pdf

Choy, A. C., Robinson, T. O., Erwin, B., Firl, E., Halden, R. U., Hamilton, A. J., . . . van Houtan, K. S. (2019). The vertical distribution and biological transport of marine microplastics across the epipelagic and mesopelagic water column. *Scientific reports, 7843*(9). Retrieved from https://www.nature.com/articles/s41598-019-44117-2

Clean Europe Network . (2018, April 18). *EU Adopts Historic Litter Prevention Policy.* Retrieved from CEN briefing: EU Adopts Historic Litter Prevention Policy:

http://www.cleaneuropenetwork.eu/pdf/ELPA%2006.18_EU%20Adopts%20Historic%20Litter%20Policy-update.pdf

CMS. (2011, November 25). UNEP/CMS/Resolution 10.04. *Marine Debris*. Retrieved from https://www.cms.int/en/document/marine-debris-0

CMS. (2014, December 1). UNEP/CMS/Resolution 11.30. *Management of Marine Debris*. Retrieved from https://www.cms.int/en/document/management-marine-debris-3

CMS. (2019, April). *About CMS*. Retrieved from https://www.cms.int/en/legalinstrument/cms

CMS. (2019, June 1). *Parties and Range States*. Retrieved from https://www.cms.int/en/parties-range-states

ECHA. (2019, March 20). *RAC and SEAC agreed conformity of the intentionally added microplastics restriction proposal*. Retrieved from ECHA/NR/19/13: https://echa.europa.eu/-/rac-and-seac-agreed-conformity-of-the-intentionally-added-microplastics-restriction-proposal

ECHA. (2019, March 20). Restricting the use of intentionally added microplastic particles to consumer or professional use products of any kind. *ANNEX XV Restriction report - Proposal for a restriction*. Helsinki: European Chemical Agency. Retrieved from https://echa.europa.eu/registry-of-restriction-intentions/-/dislist/details/0b0236e18244cd73

Ejhed, H., Fråne, A., Wrange, A.-L., Magnusson, K., & Olshammar, M. (2018). *Mikroplast i Stockholms stad.* Stockholm: IVL Svenska Miljöinstitutet. Retrieved from https://www.ivl.se/download/18.14bae12b164a305ba1111945/1537881614762/C334%20Mikroplast%20i%20Stockholm%20stad.pdf

Eriksen, M., Lebreton, L. C., Carson, H. S., Thiel, M., Moore, C. J., Borerro, J. C., . . . Reisser, J. (2014). Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea. *PLoS ONE, 9*(12), e111913. doi:https://doi.org/10.1371/journal.pone.0111913

Eunomia & ICF. (2018). *Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products.* Final report for DG Environment of the European Commission. Retrieved from https://www.eunomia.co.uk/reports-tools/investigating-options-for-reducing-releases-in-the-aquatic-environment-of-microplastics-emitted-by-products/

European Bioplastics. (2019). *Glossary*. Retrieved from https://www.european-bioplastics.org/glossary/

European Commission. (1994, December 20). European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste.

European Commission. (2008, June 17). Marine Strategy Framework Directive, MSFD. *Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy*.

European Commission. (2015, April 29). Directive (EU) 2015/720 of the European Parliament and of the Council of 29 April 2015 amending Directive 94/62/EC on packaging and packaging waste.

European Commission. (2018). Proposal for a Directive. *Directive of the European Parliament and of the Council on port reception facilities for the delivery of waste from ships, repealing Directive 2000/59/EC and amending Directive 2009/16/EC and Directive 2010/65/EU, COM/2018/033 final - 2018/012 (COD)*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018PC0033

European Commission. (2018, May 30). Waste Directive. *Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste*.

European Commission. (2019, May 19). *Circular Economy: Commission welcomes Council final adoption of new rules on single-use plastics to reduce marine plastic litter.* Retrieved from Press release IP/19/2631: https://europa.eu/rapid/press-release_IP-19-2631_en.htm

European Commission. (2019, March 27). *Circular Economy: Commission welcomes European Parliament adoption of new rules on single–use plastics to reduce marine litter.* Retrieved from STATEMENT/19/1873: https://europa.eu/rapid/press-release_STATEMENT-19-1873_en.htm

European Commission. (2019, April 17). Directive on port reception facilities for the delivery of waste from ships. *Directive (EU) 2019/883 of the European Parliament and of the Council of 17 April 2019 on port reception facilities for the delivery of waste from ships, amending Directive 2010/65/EU and repealing Directive 2000/59/EC.* Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019L0904

European Commission. (2019, August 2). *Our Oceans, Seas and Coasts*. Retrieved from Descriptor 10: Marine Litter: Descriptor 10: Marine Litter

European Commission. (2019, June 5). SUP Directive. *Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment*.

European Union. (2019). *Environmental and Health Risks of Microplastic Pollution.* Group of Chief Scientific Advisors - Scientific Opinion 6/2019, Scientific Advice Mechanism (SAM). Retrieved from https://ec.europa.eu/info/sites/info/files/research_and_innovation/groups/sam/ec_rtd_sam-mnp-opinion_042019.pdf

FAO. (2018). Voluntary Guidelines for Marking of Fishing Gear. *COFI/2018/Inf.30.* Retrieved from http://www.fao.org/3/MX136EN/mx136en.pdf

FAO. (2019). *Voluntary Guidelines on the Marking of Fishing Gear.* Rome. Retrieved from http://www.fao.org/3/ca3546t/ca3546t.pdf

Fernandes, J. N., & Barbosa, A. E. (201x). *PROPER PROJECT - WP1 Prediction of pollutant loads and concentrations in road run off, Task 1.1. Literature review on road runoff pollution on Europe.* Conference of European Directors of Roads (CEDR). Retrieved from http://proper-cedr.eu/Deliverables/D1.1_Report.pdf

Fischer, M., & Scholz-Böttcher, B. (2017). Simultaneous trace identification and quantification of common types of microplastics in environmental samples by pyrolysis-gas chromatography-mass spectrometry. *Environment Science Technology, 51*(9), 5052 – 5060. doi:10.1021/acs.est.6b06362

Frias, J., Pagter, E., Nash, R., O'Connor, I., Carretero, O., Filgueiras, A., . . . Gerdts, G. (2018). *Standardised protocol for monitoring microplastics in sediments.* JPI-Oceans BASEMAN project. doi:10.13140/RG.2.2.36256.89601/1

G7. (2015, June 8). *G7 Information Centre.* Retrieved from Leaders' Declaration: G7 Summit: http://www.g8.utoronto.ca/summit/2015elmau/2015-G7-declaration-en.html

G7. (2018, September 20). *G7 Information Centre.* Retrieved from G7 Innovation Challenge to Address Marine Plastic Litter: http://www.g8.utoronto.ca/environment/2018-environment-oceans-energy-marine-litter.html

Gago, J., Filgueiras, A., Pedrotti, M. L., Caetano, M., & Frias, J. (2018). *Standardised protocol for monitoring microplastics in seawater.* JPI-Oceans BASEMAN project. doi:10.13140/RG.2.2.14181.45282

GESAMP. (2015). *Sources, fate and effects of microplastics in the marine environment: a global assessment.* IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (Kershaw, P. J., ed.). Retrieved from http://www.gesamp.org/publications/reports-and-studies-no-90

GESAMP. (2016). *Sources, fate and effects of microplastics in the marine environment: part two of a global assessment" (Kershaw, P.J., and Rochman, C.M., eds.).* IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection. Retrieved from http://www.gesamp.org/publications/microplastics-in-the-marine-environment-part-2

GESAMP. (2019). *About GESAMP*. Retrieved March 2019, from http://www.gesamp.org/about/history

GESAMP. (2019). *Guidelines or the monitoring and assessment of plastic litter and microplastics in the ocean (Kershaw P.J., Turra A. and Galgani F. editors).* IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP/ISA Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection. Retrieved from http://www.gesamp.org/publications/guidelines-for-the-monitoring-and-assessment-of-plastic-litter-in-the-ocean

Gewert, B., Ogonowski, M., Barth, A., & MacLeod, M. (2017). Abundance and composition of near surface microplastics and plastic debris in the Stockholm Archipelago, Baltic Sea. *Marine Pollution Bulletin, 120*(1-2), 292–302. doi:https://doi.org/10.1016/j.marpolbul.2017.04.062

González, D., Hanke, G., Tweehuysen, G., Bellert, B., Holzhauer, M., Palatinus, A., . . . Oosterbaan, L. (2016). *Riverine Litter Monitoring - Options and Recommendations, JRC Technical Report; EUR 28307.* European Commission. doi:doi:10.2788/461233

Gorokhova, E. (2015). Screening for microplastic particles in plankton samples: How to integrate marine litter assessment into existing monitoring programs? *Marine Pollution Bulletin, 99, Issues 1–2* (1-2), 271-275. doi:https://doi.org/10.1016/j.marpolbul.2015.07.056

Graca, B., Szewc, K., Zakrzewska, D., Dołęga, A., & Szczerbowska-Boruchowska, M. (2017). Sources and fate of microplastics in marine and beach sediments of the Southern Baltic Sea—a preliminary study. *Environmental Science and Pollution Research, 24*(8), 7650-7661. doi:https://doi.org/10.1007/s11356-017-8419-5

Green, N. W., Schøyen, M., Hjermann, D. Ø., Øxnevad, S., Ruus, A., Lusher, A., . . . Bæk, K. (2018). *Contaminants in coastal waters of Norway 2017.* Norwegian Environment Agency (Miljødirektoratet). Norwegian Institute for Water Research (NIVA). Retrieved from http://tema.miljodirektoratet.no/Documents/publikasjoner/M1120/M1120.pdf

Gustafsson, L. (2016). *En undersökning om förekomsten av mikroplast i västsvenska blåmusslor (Mytilus edulis) - Kandidat uppsats (BSc. Thesis).* Högskolan i Halmstad. Retrieved from https://issuu.com/cillidill/docs/en_unders__kning_om_f__rekomsten_av

Hartmann, N., Vollertsen, J., & Hansen, A. A. (2018). *µPLAST i spildevand – renseteknologiers tilbageholdelse af mikroplast, MUDP-rapport.* Danish Miljøstyrelsen. Retrieved from https://www2.mst.dk/Udgiv/publikationer/2018/10/978-87-93710-92-4.pdf

HELCOM. (2007). *Baltic Sea Action Plan. Adopted at HELCOM ministerial meeting in Krakow, Poland on 15 November 2007.* Retrieved from http://www.helcom.fi/Documents/Baltic%20sea%20action%20plan/BSAP_Final.pdf

HELCOM. (2007). *HELCOM recommendation 28E/10, application of the no-special-fee system to ship-generated wastes and marine litter caught in fishing nets in the Baltic Sea area.* Retrieved from http://www.helcom.fi/Recommendations/Rec%2028E-10.pdf

HELCOM. (2008). *HELCOM recommendation 29/2, marine litter within the Baltic Sea region.* Retrieved from http://www.helcom.fi/Recommendations/Rec%2029-2.pdf

HELCOM. (2010). *HELCOM ministerial declaration on the implementation of the HELCOM Baltic Sea Action Plan. 20 May 2010, Moscow.* Retrieved from http://www.helcom.fi/Documents/About%20us/Convention%20and%20commitments/Ministerial%20declarations/HELCOM%20Moscow%20Ministerial%20Declaration%20FINAL.pdf

HELCOM. (2013). *HELCOM Copenhagen ministerial declaration: taking further action to implement the Baltic Sea Action Plan – reaching good environmental status for a healthy Baltic Sea. 3 October 2013, Copenhagen, Denmark.* Retrieved from http://www.helcom.fi/Documents/Ministerial2013/Ministerial%20declaration/2013%20Copenhagen%20Ministerial%20Declaration%20w%20cover.pdf

HELCOM. (2014). *Preliminary study on synthetic microfibers and particles at a municipal waste water treatment plant.* BASE project 2012-2014, Helsinki Region Environmental Services HSY. Retrieved from http://www.helcom.fi/Documents/HELCOM%20at%20work/Projects/BASE/Microplastics%20final%20report%20Base_final.pdf

HELCOM. (2015). *HELCOM recommendation 36/1, regional action plan on marine litter (RAP ML).* Retrieved from http://www.helcom.fi/Recommendations/Rec%2036-1.pdf

HELCOM. (2015). *Regional Action Plan for Marine Litter in the Baltic Sea.* Retrieved from http://www.helcom.fi/Lists/Publications/Regional%20Action%20Plan%20for%20Marine%20Litter.pdf

HELCOM. (2017). *SPICE-project, Task 2.1.3 Development of baselines of marine litter - Report on the analysis of compiled data on microlitter in the Baltic Sea, Author: Outi Setälä.*

HELCOM. (2018). *Declaration of the Ministers of the environment of the Baltic coastal countries and the EU Environment Commissioner, HELCOM Brussels Declaration 2018.* Retrieved from http://www.helcom.fi/Documents/HELCOM%20at%20work/HELCOM%20Brussels%20Ministerial%20Declaration.pdf

HELCOM. (2018). *HELCOM assessment on maritime activities in the Baltic Sea 2018. Baltic Sea environment proceedings no. 152.* Helsinki: Helsinki Commission. Retrieved from http://www.helcom.fi/Lists/Publications/BSEP152.pdf

HELCOM. (2018). *HELCOM guidelines for monitoring beach litter.* Retrieved from http://www.helcom.fi/Documents/Action%20areas/Monitoring%20and%20assessment/Manuals%20and%20Guidelines/Guidelines%20for%20monitoring%20beach%20litter.pdf

HELCOM. (2018). *State of the Baltic Sea – Second HELCOM holistic assessment 2011-2016. Baltic Sea Environment Proceedings 155.* Retrieved from http://www.helcom.fi/baltic-sea-trends/holistic-assessments/state-of-the-baltic-sea-2018/reports-and-materials/

HELCOM. (2019). Future work on HELCOM Indicators. *Decision Document 4-20, HOD 57-2019*.

Hengstmann, E., Tamminga, M., vom Bruch, C., & Fischer, E. (2017). Microplastic in beach sediments of the Isle of Rügen (Baltic Sea) - Implementing a novel glass elutriation column. *Marine Pollution Bulletin, 126*(2018), 263–274. doi:https://doi.org/10.1016/j.marpolbul.2017.11.010

Huntington, T. (2017). *Development of a best practice framework for the management of fishing gear (part 2).* Global Ghost Gear Initiative (GGGI). Retrieved from https://static1.squarespace.com/static/5b987b8689c172e29293593f/t/5bb64b578165f5891b931a6b/1538673498329/wap_gear_bp_framework_part_2_mm_lk-2017.10.23.pdf

ICF & Eunomia. (2018). *Assessment of measures to reduce marine litter from single use plastics, Final report and Annex.* European Commission. Retrieved from https://ec.europa.eu/environment/waste/pdf/Study_sups.pdf

IEL, EIA, Massey University, coare. (2018). *Toward a new global convention with a multi-layered governance approach to address plastic pollution, November 2018.* Position paper.

IMO. (2018, April). *Addressing marine plastic litter from ships – action plan adopted*. Retrieved from http://www.imo.org/en/MediaCentre/PressBriefings/Pages/20-marinelitteractionmecp73.aspx

IMO. (2019). *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*. Retrieved April 2019, from http://www.imo.org/en/OurWork/Environment/LCLP/Pages/default.aspx

IMO. (2019). *Prevention of Pollution by Garbage from Ships*. Retrieved March 2019, from http://www.imo.org/en/OurWork/Environment/PollutionPrevention/Garbage/Pages/Default.aspx

IMO. (2019). *Status of the ratification of the Conventions.* Retrieved from http://www.imo.org/en/About/Conventions/StatusOfConventions/Documents/StatusOfTreaties.pdf

IVL Swedish Environmental Research institute. (2016). *Report concerning techniques to reduce litter in waste water and storm water.* Swedish Meteorological and Hydrological Institute. Retrieved from https://admin-sm.transfers.se/app/uploads/2016/10/SMED-Report_-193-2016-BAT-Microlitter.pdf

Johansson, A. (2011). *Mikroskopiska antropogena partiklar i marina sediment. (Microscopic antropogenic particles in marine sediments) (in Swedish).* BSc Thesis no 548, Göteborg University , Department of marine ecology. Retrieved from https://studylibsv.com/doc/773128/mikroskopiska-antropogena-partiklar-i-marina-sediment

Joint Research Centre (JRC). (2013). *Guidance on Monitoring of Marine Litter in European Seas, A guidance document within the Common Implementation Strategy for the Marine Strategy Framework Directive.* European Commission. doi:doi:10.2788/99475

Karlsson, T. M., Ekstrand, E., Threapleton, M., Mattsson, K., Nordberg, K., & Hassellöv, M. (2019). *Undersökning av mikroskräp längs bohuslänska stränder och i sediment.* Göteborgs Universitet, Institutionen för marina vetenskaper. Retrieved from http://naturvardsverket.diva-portal.org/smash/get/diva2:1306886/FULLTEXT01.pdf

Karlsson, T., Kärrman, A., Rotander, A., & Hassellöv, M. (2018). *Provtagningsmetoder för mikroplast >300 µm i ytvatten - En jämförelsestudie mellan pump och trål.* Göteborgs Universitet & Örebro Universitet. Naturvårdsverket & Havs- och Vattenmyndigheten. Retrieved from http://naturvardsverket.diva-portal.org/smash/get/diva2:1217686/FULLTEXT01.pdf

KEMI, Kemikalieinspektionen. (2018). *Mikroplast i kosmetiska produkter och andra kemiska produkter, Rapport från ett regeringsuppdrag.* RAPPORT 2/18. Retrieved from https://www.kemi.se/global/rapporter/2018/rapport-2-18-mikroplast-i-kosmetiska-produkter-och-andra-kemiska-produkter.pdf

Kerienė, I., Maruška, A., & Sitonytė, J. (2011). Solid phase extraction and gas chromatographic – mass spectrometric analysis of phthalates in surface water: method development and validation. *Chemija, 22*(4), pp. 204-209. Retrieved from http://mokslozurnalai.lmaleidykla.lt/publ/0235-7216/2011/4/204-209.pdf

Kilponen, J. (2016). *Microplastics and Harmful Substances in Urban Runoffs and Landfill Leachates, Bachelor`s Thesis in Environmental Engineering.* Faculty of Technology. Lahti university of Applied Sciences. Retrieved from https://www.theseus.fi/bitstream/handle/10024/114539/Kilponen_Juho.pdf?se%20quence=1

Krång, A.-S., Olshammar, M., Edlund, D., Hållén, J., Stenfors, E., & Winberg von Friesen, L. (2019). *Sammanställning av kunskap och åtgärdsförslag för att minska spridning av mikroplast från* *konstgräsplaner och andra utomhusanläggningar för idrott och lek.* IVL Svenska Miljöinstitutet. Naturvårdsverket. Retrieved from https://www.ivl.se/download/18.57581b9b167ee95ab9919a1/1552466299144/C359.pdf

Kruglova, A., Talvitie, J., Gonzales-Martinez, A., Mikola, A., & Vahala, R. (2019). *Microplastics are vectors for bacteria from wastewater into the.* Aalto University, Department of Built Environment.

Lassen, C., Foss Hansen, S., Magnusson, K., Norén, F., Bloch Hartmann, N. I., Jensen, P. R., . . . Brinch, A. (2015). *Microplastics - Occurrence, effects and sources of releases to the environment in Denmark, Environmental project No. 1793.* The Danish Environmental Protection Agency. Retrieved from https://www2.mst.dk/Udgiv/publications/2015/10/978-87-93352-80-3.pdf

Lenz, R., Enders, K., Beer, S., Sørensen, K. T., & Stedmon, C. A. (2015). *Analysis of microplastic in the stomachs of herring and cod from the North Sea and Baltic Sea.* DTU Aqua, National Institute of Aquatic Resources. Retrieved from https://naturstyrelsen.dk/media/194047/microplastreportnst_dtuaqua.pdf

Liu, F., Borg Olesen, K., Reimer Borregaard, A., & Vollersten, J. (2019). Microplastics in urban and highway stormwater retention ponds. *Science of The Total Environment, 671*, 992-1000. doi:https://doi.org/10.1016/j.scitotenv.2019.03.416

Ljung, E., Borg Olesen, K., Andersson, P.-G., Fältström, E., Vollertsen, J., Bertil Wittgren, H., & Hagman, M. (2018). *Microplastics in the water and nutrient-cycle.* Bromma: Svenskt Vatten Utveckling. Retrieved from https://www.svensktvatten.se/contentassets/7be8e202754e4011a400bcff4ed89b1c/mikSVu-rap-8-13.pdf

Løkkegaard, H., Woldum Tordrup, S., Køcks, M., Lassen, C., & Warming, M. (2017). *Partnerskab om mikroplast i spildevand.* Danish Miljøstyrelsen. Retrieved from https://mst.dk/media/143341/partnerskab-om-mikroplast-i-spildevand-2017.pdf

London Convention. (1972, November 13). Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (entered into force 30 August 1975). *1046 UNTS 120*.

London Protocol. (1996, November 7). 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, opened for signature (entered into force 24 March 2006) . *36 ILM 1 (1997)* .

Lusher, A., Bråte, I. L., Hurley, R., Iversen, K., & Olsen, M. (2017). *Testing of methodology for measuring microplastics in blue mussels (Mytilus spp) and sediments, and recommendations for future monitoring of microplastics (R & D-project).* Norwegian Environment Agency (Miljødirektoratet). Norwegian Institute for Water Research (NIVA). Retrieved from https://www.researchgate.net/publication/321724113_Testing_of_methodology_for_measuring_microplastics_in_blue_mussels_Mytilus_spp_and_sediments_and_recommendations_for_future_monitoring_of_microplastics_R_D-project

Lusher, A., Hurley, R., Vogelsang, C., Nizzetto, L., & Olsen, M. (2012). *Mapping microplastics in sludge.* Miljødirektoratet. Norwegian Institute for Water Research (NIVA). Retrieved from https://www.miljodirektoratet.no/globalassets/publikasjoner/m907/m907.pdf

Maes, T., Jessop, R. W., Haupt, K., & Mayes, A. G. (2017). A rapid-screening approach to detect and quantify microplastics based on fluorescent tagging with Nile Red. *Scientific Reports, 7*(1), 44501. doi:10.1038/srep44501

Magnusson, K. (2014). *Microlitter and other microscopic anthropogenic particles in the sea around Rauma and Turku, Finland.* IVL reports, Report no. U4645, IVL.

Magnusson, K., & Norén, F. (2011). *Mikroskopiskt skräp i havet metodutveckling för miljöövervakning.* N-research. Retrieved from http://www.n-research.se/pdf/Magnusson%20och%20Nor%C3%A9n%202011%20Rapport%20om%20mikroskr%C3%A4p%20i%20Svenska%20vatten.pdf

Magnusson, K., & Norén, F. (2014). *Screening of microplastic particles in and down-stream a wastewater treatment plant.* IVL Swedish Environmental Research Institute. Retrieved from https://www.diva-portal.org/smash/get/diva2:773505/FULLTEXT01.pdf

Magnusson, K., & Wahlberg, C. (2014). *Mikroskopiska skräppartiklar i vatten från avloppsreningsverk.* Svenska Miljöinstiutet (IVL). Retrieved from https://www.ivl.se/download/18.343dc99d14e8bb0f58b51a3/1443173318867/B2208+Mikroskopiska+skr%C3%A4ppartiklar+i+vatten+fr%C3%A5n+avloppsreningsverk.pdf

Magnusson, K., Eliasson, K., Fråne, A., Haikonen, K., Hultén, J., Olshammar, M., . . . Voisin, A. (2016). *Swedish sources and pathways for microplastics to the marine environment - A review of existing data.* IVL Swedish Environmental Research Institute. Retrieved from https://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/regeringsuppdrag/2016/mikroplaster/swedish-sources-and-pathways-for-microplastics-to-marine%20environment-ivl-c183.pdf

Magnusson, K., Jörundsdóttir, H., Norén, F., Talvitie, J., & Setälä, O. (2016). *Microlitter in sewage treatment systems -A Nordic perspective on waste water treatment plants as pathways for microscopic anthropogenic particles to marine systems.* Nordic Council. TemaNord. Retrieved from https://norden.diva-portal.org/smash/get/diva2:923936/FULLTEXT01.pdf

Mani, T., Primpke, S., Lorenz, C., Gerdts, G., & Burkhardt-Holm, P. (2019). Microplastic Pollution in Benthic Midstream Sediments of the Rhine River. *Environment Science Technology, 53*(10), 6053-6062. doi:10.1021/acs.est.9b01363

MARPOL. (1973/1978). Protocol relating to the International Convention for the Prevention of Pollution from Ships of 2 November 1973, as amended on 17 February 1978 (entered into force 2 October 1983). *340 UNTS 184 ('MARPOL 73/78')*. Retrieved from https://treaties.un.org/doc/Publication/UNTS/Volume 1340/volume-1340-I-22484-English.pdf

MARPOL Annex V. (2011, July 15). 2011 Regulations for the Prevention of Pollution by Garbage from Ships (entered into force 1 January 2013). *Resolution MEPC.201(62)*. Retrieved from http://www.imo.org/en/OurWork/Environment/PollutionPrevention/Garbage/Documents/2014 revision/RESOLUTION MEPC.201(62) Revised MARPOL Annex V.pdf

Mathews, R. E., Tengberg, A., Sjödin, J., & Liss-Lymer, B. (2019). *Implementing the source-to-sea approach: A guide for practitioners.* Stockholm: SIWI. Retrieved from https://www.siwi.org/wp-content/uploads/2019/07/Source-to-sea-guide_webb.pdf

Mintenig, S. (2014). *Microplastic in plankton of the North- and Baltic Sea , Master thesis.* Universität Oldenburg.

Mintenig, S., Int-Veen, I., Löder, M., Primpke, S., & Gerdts, G. (2017). Identification of microplastic in effluents of waste water treatment plants using focal plane array-based micro-Fourier-transform infrared imaging. *Water Research, 108*, 365-372. doi:https://doi.org/10.1016/j.watres.2016.11.015

Näkki, P., Setälä, O., & Lehtiniemi, M. (2017). Bioturbation transports secondary microplastics to deeper layers in soft marine sediments of the northern Baltic Sea. *Marine Pollution Bulletin, 119*(1), 255-261. doi:10.1016/j.marpolbul.2017.03.065

Näkki, P., Setälä, O., & Lehtiniemi, M. (2019). Seafloor sediments as microplastic sinks in the northern Baltic Sea -Negligible upward transport of buried microplastics by bioturbation. *Environmental Pollution, 249*, 74-81. doi:10.1016/j.envpol.2019.02.099

Naturvårdsverket. (2016). *Wastewater treatment in Sweden 2016.* Swedish Environmental Protection Agency. Retrieved from https://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-8809-5.pdf?pid=22471

Naturvårdsverket. (2017). *Mikroplaster - Redovisning av regeringsuppdrag om källor till mikroplaster och förslag på åtgärder för minskade utsläpp i Sverige.* Naturvårdsverket. Retrieved from https://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6772-4.pdf?pid=20662

Naturvårdsverket. (2019). *Mikroplaster i miljön år 2019.* Swedish Environment Protection Agency. Retrieved from https://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/regeringsuppdrag/2019/ru2019-05-28uppdrag-mikroplaster.pdf

Nerland, I. L., Halsband, C., Allan, I., & Thomas, K. V. (2014). *Microplastics in marine environments: Occurrence, distribution and effects.* Miljødirektoratet. Norwegian Institute for Water Research (NIVA). Retrieved from http://tema.miljodirektoratet.no/Documents/publikasjoner/M319/M319.pdf

Norén, F. (2007). Small plastic particles in Coastal Swedish waters. *ResearchGate*. Retrieved from https://www.researchgate.net/publication/284312290_Small_plastic_particles_in_Coastal_Swedish_waters

Norén, F., Johansson, U., & Ekendahl, S. (2009). *Mikroskopiska antropogena partiklar i svenska hav. Projekt rapport.* Lysekil: N-research.

Norén, K., Haikonen, K., & Norén, F. (2015.). *Marint mikroskräp längs Skånes kust.* IVL-rapport 2015: C 139. (in Swedish), Svenska Miljöinstitutet. Retrieved from http://www.ivl.se/download/18.422aa27a15260b0160f3cb/1454412386965/C139.pdf

Nuwer, R. (2019). The Deep Ocean Harbors a Mountain of Microplastic Pollution. *Scientific American*. Retrieved from https://www.scientificamerican.com/article/the-deep-ocean-harbors-a-mountain-of-microplastic-pollution/

Ogonowski, M., Wenman, V., Barth, A., Hamacher-Barth, E., & Danielsson, S. (2018). Hydrophobic organic contaminants are not linked to microplastic uptake in Baltic Sea herring. *bioRxiv*. doi:https://doi.org/10.1101/363127

OSPAR. (2011). IGC-COBAM Summary Record 11/4/1-E. OSPAR Commission.

Pikkarainen, K. (2017). *Pure as snow? Snow as a route for microplastics and other waste from urban areas to sea, Master's Thesis.* University of Finland, Faculty of Biological and Environmental Sciences, Department of Environmental Sciences. Retrieved from https://helda.helsinki.fi/bitstream/handle/10138/299030/Pro%20gradu_Pikkarainen.pdf?sequence=2&isAllowed=y

Połeć, M., Kmiecik, E., Aleksander-Kwaterczak, U., & Wątor, K. (2018). Microplastic as an emerging contaminant of water - a state of knowledge in Poland. Retrieved from https://www.researchgate.net/publication/330910460_Microplastic_as_an_emerging_contaminant_of_water_-_a_state_of_knowledge_in_Poland

Primpke, S., Lorenz, C., Rascher-Friesenhausen, R., & Gerdts, G. (2017). An automated approach for microplastics analysis using focal plane array (FPA) FTIR microscopy and image analysis. *Analytical Methods, 9*(9), 1499-1511. doi:10.1039/C6AY02476A

Rahman, S., & Z Fahem, A. (2019). Cosmetovigilance: A Paradigm Shift. *Terminology and Concept, 16*, 2-4. doi:10.21276/jpds.2019.16.01.02

Railo, S., Talvitie, J., Setälä, O., Koistinen, A., & Lehtiniemi, M. (2018). Application of an enzyme digestion method reveals microlitter in Mytilus trossulus at a wastewater discharge area. *Marine Pollution Bulletin, 130*, 206-214. doi:https://doi.org/10.1016/j.marpolbul.2018.03.022

Rotander, A., & Kärrman, A. (2019). *Microplastics in Södertälje - From Lake Mälaren to the Baltic Sea.* Örebro University, MTM Research Centre, School of Science and Technology. Naturvårdsverkrt. Retrieved from http://naturvardsverket.diva-portal.org/smash/get/diva2:1317939/FULLTEXT01.pdf

Ruiz, M., & Stankiewicz, M. (2019). Five Years Since the 2013 HELCOM Ministerial Declaration. In *The Handbook of Environmental Chemistry.* Springer, Berlin, Heidelberg. doi:https://doi.org/10.1007/698_2019_378

Rummel, C. D., Löder, M. G., Fricke, N. F., Lang, T., Griebeler, E.-M., Janke, M., & Gerdts, G. (2016). Plastic ingestion by pelagic and demersal fish from the North Sea and Baltic Sea. *Marine Pollution Bulletin, 102*(1), 134–141. doi:https://doi.org/10.1016/j.marpolbul.2015.11.043

Ryymin, K. (2019). *Mikromuovien prosessikohtalo Nenäinniemen.* Pro gradu -tutkielma, Jyväskylän yliopisto, Bio- ja ympäristötieteiden laitos. Retrieved from https://jyx.jyu.fi/bitstream/handle/123456789/63366/URN%3aNBN%3afi%3ajyu-201904032054.pdf?sequence=1&isAllowed=y

SAM. (2018). *Microplastic Pollution: The Policy Context - Background Paper.* European Union. The Scientific Advice Mechanism Unit of the European Commission. Retrieved from https://ec.europa.eu/research/sam/pdf/topics/microplastic_pollution_policy-context.pdf

Science Advice for Policy by European Academies. (2019). *A Scientific Perspective on Microplastics in Nature and Society.* Berlin: SAPEA. doi:https://doi.org/10.26356/microplastics

Setälä, O., Fleming-Lehtinen, V., & Lehtiniemi, M. (2014). Ingestion and transfer of microplastics in the planktonic food web. *Environmental Pollution, 185*, 77–83. doi:10.1016/j.envpol.2013.10.013

Setälä, O., Magnusson, K., M, L., & Norén, F. (2016). Distribution and abundance of surface water microlitter in the Baltic Sea: A comparison of two sampling methods. *Marine Pollution Bulletin, 110*(1), 177– 183. doi:https://doi.org/10.1016/j.marpolbul.2016.06.065

Setälä, O., Norkko, J., & Lehtiniemi, M. (2016). Feeding type affects microplastic ingestion in a coastal invertebrate community. *Marine Pollution Bulletin, 102*(1), 95-101. doi:https://doi.org/10.1016/j.marpolbul.2015.11.053

Sherrington, C., Darrah, C., Hann, S., Cole, G., & Crobin, M. (2016). *Study to support the development of measures to combat a range of marine litter sources.* Eunomia. Retrieved from https://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/pdf/MSFD%20Measures%20to%20Combat%20Marine%20Litter.pdf

Shim, W. J., Song, Y. K., Hong, S. H., & Jang, M. (2016). Identification and quantification of microplastics using Nile Red staining. *Marine Pollution Bulletin, 113*, 469-476. doi:https://doi.org/10.1016/j.marpolbul.2016.10.049

Sillanpää, M., & Sainio, P. (2017). Release of polyester and cotton fibers from textiles in machine washings. *Environmental Science and Pollution Research, 24*(23), 19313-19321.

Simon, M., van Alst, N., & Vollersten, J. (2018). Quantification of microplastic mass and removal rates at wastewater treatment plants applying Focal Plane Array (FPA)-based Fourier Transform Infrared (FT-IR) imaging. *Water Research, 142*, 1-9. doi:https://doi.org/10.1016/j.watres.2018.05.019

Skóra, M., Sapota, M., Skóra, K., & Pawelec, A. (2012). Diet of the twaite shad Alosa fallax (Lacépède, 1803) (Clupeidae) in the Gulf of Gdansk, the Baltic Sea. *Oceanological and Hydrobiological Studies, 41*(3), 24-32. doi:https://doi.org/10.2478/s13545-012-0024-0

Sørensen, T. K., Stedmon, C., Enders, K., & Henriksen, O. (2013). *Analyse af marint affald i sild og hvilling fra det nordlige Storebælt.* Institut for Akvatiske Ressourcer. DTU Aqua. Retrieved from https://www.cbd.int/doc/meetings/mar/mcbem-2014-03/other/mcbem-2014-03-020-en.pdf

Soutukorva Swanberg, Å., Nordzell, H., & Hasselström, L. (2019). *The Ecodesign Directive as a driver for less microplastic from household laundry.* Swedish Environmental Protection Agency. Retrieved from https://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6867-7.pdf?pid=24053

Stockholm Convention. (2001, May 22). 2001 Stockholm Convention on Persistent Organic Pollutants (entered into force 17 May 2004). *2256 UNTS 119*. Retrieved from https://treaties.un.org/doc/Treaties/2001/05/20010522 12-55 PM/Ch_XXVII_15p.pdf

Stolte, A., Forster, S., Gerdts, G., & Schubert, H. (2015). Microplastic concentrations in beach sediments along the German Baltic coast. *Marine Pollution Bulletin, 99*(1-2), 216–229. doi:https://doi.org/10.1016/j.marpolbul.2015.07.022

Strand, J., Feld, L., Murphy, F., Mackevica, A., & Hartmann, N. B. (2018). *Analysis of microplastic particles in Danish drinking water.* Aarhus University, DCE – Danish Centre for Environment and Energy.

Strand, J., Lasse, P., Shashoua, Y., & Andersen, J. H. (2013). ICES Annual Science Conference. *Microplastic particles in sediments from Danish waters - poster.* Retrieved from https://pure.au.dk/portal/files/56618475/JAK_Microplastic_poster_20sep13jak_3a.pdf

Strand, J., Lundsteen, S., & Murphy, F. (2019). *Microplastic-like particles in seabed sediments from inner Danish waters 2015. Scientific Report No. 320.* Aarhus University. DCE – Danish Centre for Environment and Energy,. Retrieved from http://dce2.au.dk/pub/SR320.pdf

Sun, J., Dai, X., Wan, Q., van Loosdrecht, M. C., & Ni, B.-J. (2019). Microplastics in wastewater treatment plants: Detection, occurrence and removal. *Water Research, 152*, 21-37. doi:https://doi.org/10.1016/j.watres.2018.12.050

Sundt, P., Schulze, P.-E., & Syversen, F. (2014). *Sources of microplastics-pollution to the marine environmnet.* Norwegian Environment Agency (Miljødirektoaret). mepex. Retrieved from https://www.miljodirektoratet.no/globalassets/publikasjoner/m321/m321.pdf

Sundt, P., Syversen, F., Skogesal, O., & Schulze, P.-E. (2016). *Primary microplastic-pollution: Measures and reduction potentials in Norway.* Norwegian Environment Agency (Miljødirektoratet). mepex. Retrieved from https://www.miljodirektoratet.no/globalassets/publikasjoner/M545/M545.pdf

Talvitie, J. (2018). *Wastewater treatment plants as pathways of microlitter to the aquatic environment.* Department of Built Environment. Aalto University. Retrieved from https://aaltodoc.aalto.fi/handle/123456789/30720

Talvitie, J., Heinonen, M., Pääkkönen, J., Vahtera, E., Mikola, A., Setälä, O., & Vahala, R. (2015). Do wastewater treatment plants act as a potential point source of microplastics? -Preliminary study in the coastal Gulf of Finland, Baltic Sea. *Water Science Technology, 72*(9), 1495-1504. doi:https://doi.org/10.2166/wst.2015.360

Talvitie, J., Mikola, A., Koistinen, A., & Setälä, O. (2017). Solutions to microplastic pollution -Removal of microplastics from wastewater effluent with advanced wastewater treatment technologies. *Water Research, 123*, 401-407. doi:https://doi.org/10.1016/j.watres.2017.07.005

Talvitie, J., Mikola, A., Setälä, O., Heinonen, M., & Koistinen, A. (2017). How well is microlitter purified from wastewater? - A detailed study on the stepwise removal of microlitter in a tertiary level wastewater treatment plant. *Water Resources, 109*, 164-172. doi:https://doi.org/10.1016/j.watres.2016.11.046

Tamminga, M., Hengstmann, E., & Fischer, E. K. (2018). Microplastic analysis in the South Funen Archipelago, Baltic Sea, implementing manta trawling and bulk sampling. *Marine Pollution Bulletin, 128*, 601-608. doi:https://doi.org/10.1016/j.marpolbul.2018.01.066

Tirroniemi, J. T. (2019). *Microplastics in northern Baltic Sea bottom sediments: distribution and method development.* Department of Environmental Sciences, Faculty of biological and environmental sciences. Helsinki: University of Helsinki. Retrieved from https://helda.helsinki.fi/handle/10138/303693?show=full

UFZ. (2019, May 21). *Press Release - MICRO-FATE project starts with Pacific Ocean expedition*. Retrieved from Occurrence and fate of microplastic in the marine environment: https://www.ufz.de/index.php?en=36336&webc_pm=23/2019

UN Environment. (2019, May). *UN Environment Assembly and Governing Council*. Retrieved from http://web.unep.org/environmentassembly/un-environment-assembly-and-governing-council

UN Environmnet. (2017). *Combating marine plastic litter and microplastics: An assessment of the effectiveness of relevant international, regional and subregional governance strategies and approaches.* Nairobi: United Nationes Environment Programme (UNEP).

UN Environmnet. (2017). *Exploring the potential for adopting alternative materials to reduce marine plastic litter.* Retrieved from https://www.unenvironment.org/resources/report/exploring-potential-adopting-alternative-materials-reduce-marine-plastic-litter

UNCLOS. (1982). United Nations Convention on the Law of the Sea . *Law of the Sea 1833 UNTS 3 (entered into force 16 November 1994)*. Retrieved from https://www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf

UNEP. (1995). Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (adopted in Washington DC, 1995). UNEP.

UNEP. (2014). UNEA-1. *Resolutions and decisions adopted by theUnited Nations Environment Assembly of the United Nations Environment Programme at its first session on 27 June 2014*, (p. 21). Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/17285/K1402364.pdf?sequence=3&isAllowed=y

UNEP. (2015). *Biodegradable Plastics and Marine Litter. Misconceptions, concerns and impacts on marine environments.* Nairobi: United Nations Environment Programme (UNEP). Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/7468/-Biodegradable_Plastics_and_Marine_Litter_Misconceptions,_concerns_and_impacts_on_marine_environments-2015BiodegradablePlasticsAndMarineLitter.pdf.pdf?sequence=3

UNEP. (2016). *Marine Litter Legislation: A Toolkit for Policymakers.* Nairobi: United Nations Enviroenment Programme (UNEP). Retrieved from https://wedocs.unep.org/handle/20.500.11822/8630

UNEP. (2016). *Marine plastic debris and microplastics – Global lessons and research to inspire action and guide policy change.* Nairobi: United Nations Environment Programme.

UNEP. (2016). United Nations Environment Assembly of the United Nations Environment Programme Second session Nairobi, 23–27 May 2016. *UNEP/EA.2/Res.11 Marine plastic litter and microplastics.* Retrieved from Resolutions and Decisions: UNEA 2:

http://wedocs.unep.org/bitstream/handle/20.500.11822/11186/K1607228_UNEPEA2_RES11E.pdf?sequence=1&isAllowed=y

UNEP. (2018). *Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations.* Nairobi: United Nations Environment Programme. Retrieved from https://www.unenvironment.org/resources/publication/legal-limits-single-use-plastics-and-microplastics-global-review-national

UNEP. (2018). *SINGLE-USE PLASTICS: A Roadmap for Sustainability.* Nairobi: United Nations Environment. Retrieved from https://wedocs.unep.org/handle/20.500.11822/25496

UNEP. (2019). *Resolutions and decisions adopted by the United Nations Environment Assembly of the United Nations Environment Programme at its fourth session (UNEA-4)*. Retrieved from http://web.unep.org/environmentassembly/ministerial-declaration-resolutions-and-decision-unea-4

UNEP. (2019). United Nations Environment Assembly of the United Nations Environment Programme Fourth session Nairobi, 11–15 March 2019. *UNEP/EA.4/Res.6 Marine plastic litter and microplastics.* Retrieved from http://wedocs.unep.org/bitstream/handle/20.500.11822/28471/English.pdf?sequence=3&isAllowed=y

UNFSA. (1982, December 10). Article 18 of the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.

UNFSA. (1995, December 4). 1995 The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. *United Nations Fish Stocks Agreement 2167 UNTS 3 (entered into force 11 November 2001)*. Retrieved from https://treaties.un.org/doc/Treaties/1995/08/19950804 08-25 AM/Ch_XXI_07p.pdf

UNGA . (2017). Our ocean, our future: call for action (adopted by the General Assembly on 6 July 2017). *A/RES/71/312.* Retrieved from https://undocs.org/A/RES/71/312

UNGA. (2015). Transforming our world: the 2030 Agenda for Sustainable Development. *A/Res/70/1.* Retrieved from https://undocs.org/A/RES/70/1

United Nations Treaty Collection. (2019, August 2). *Law of the Seas*. Retrieved from UNFSA: https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXI-7&chapter=21&clang=_en

Van Acoleyen, M., Laureysens, I., Lambert, S., Raport, L., Van Sluis, C., Kater, B., . . . (EUCC), F. M. (2014). *Marine Litter study to support the establishment of an initial quantitative headline reduction target - SFRA0025.* European Union. doi:10.2779/40799

Veiga, J., Fleet, D. K., Nilsson, P., Vlachogianni, T., Werner, S., Galgani, F., . . . Cronin, R. (2016). *Identifying Sources of Marine Litter. MSFD GES TG Marine Litter, JRC Technical report; EUR 28317 EN.* European Commission. doi:doi:10.2788/690366

Vogelsang, C., Lusher, A. L., Dadkhah, M. E., Sundvor, I., Umar, M., Ranneklev, S. B., . . . Meland, S. (2019). *Microplastics in road dust – characteristics, pathways and measures.* Norwegian Environment Agency (Miljødirektoratet). Norwegian Institute for Water Research (NIVA). Retrieved from https://www.miljodirektoratet.no/globalassets/publikasjoner/M959/M959.pdf

Vollertsen, J., & Hansen, A. A. (2017). *Microplastic in Danish watewater - Sources, occurrences and fate.* The Danish Environmental Protection Agency. Retrieved from https://www2.mst.dk/Udgiv/publications/2017/03/978-87-93529-44-1.pdf

Walls, M. (2011). Deposit-Refund Systems in Practice and Theory. *Resources for the Future Discussion Paper No. 11-47*, 15. doi:https://dx.doi.org/10.2139/ssrn.1980142

Werner, S., Budziak, A., van Franeker, J., Galgani, F., Hanke, G., Maes, T., . . . Vlachogianni, T. (2016). *Harm caused by Marine Litter. MSFD GES TG Marine Litter, JRC Technical report; EUR 28317 EN.* Thematic Report. doi:doi:10.2788/690366

Wiśniowska, E., Moraczewska-Majkut, K., & Nocoń, W. (2018). Efficiency of microplastics removal in selected wastewater treatment plants – Preliminary studie. *Desalination and water treatment, 134*, 316-323. doi:10.5004/dwt.2018.23418

Wójcik-Fudalewska, D., Normant-Saremba, M., & Anastácio, P. (2016). Occurrence of plastic debris in the stomach of the invasive crab Eriocheir sinensis. *Marine Pollution Bulletin, 113*(1), 306–311. doi:https://doi.org/10.1016/j.marpolbul.2016.09.059

Zidbeck, E. (2018). *Microplastic ingestion by coastal fish in Finland.* Master's thesis, University of Helsinki, Faculty of Biological and Environmental, Department of Environmental Science. Retrieved from https://helda.helsinki.fi/bitstream/handle/10138/301374/Zidbeck_Erika_Pro_gradu_2018.pdf?sequence=2&isAllowed=y

Zobkov, M., & Esiukova, E. (2016). Microplastics in Baltic bottom sediments: Quantification procedures and first results. *Marine Pollution Bulletin, 114*(2), 724–732. doi:https://doi.org/10.1016/j.marpolbul.2016.10.060

Zobkov, M., Esiukova, E. E., ZyubincI, A. Y., & Samusevc, I. G. (2018). Microplastic content variation in water column: The observations employing a novel sampling tool in stratified Baltic Sea. *Marine Pollution Bulletin, 138*, 193-205. doi:https://doi.org/10.1016/j.marpolbul.2018.11.047

ANNEXES

Annex 1 - List of partners identified through the survey

Country	Institution	Additional information (if provided)
Denmark	Aalborg University, Civil Engineering Department	Thomas Manns Vej 23, 9220 Aalborg Øst, Denmark https://www.civil.aau.dk/ civil@civil.aau.dk
	DTU – Aqua	Kemitorvet Building 202, 2800 Kgs, Lyngby Denmark https://www.aqua.dtu.dk/ aqua@aqua.dtut.dk
	DTU Environment	Bygning 115, Bygningstorvet, 2800 Kongens Lyngby Denmark https://www.env.dtu.dk/english info@env.dtu.dk
	National Museum	Ny Vestergade 10 Prinses Palæ DK-1471 København K, Denmark
	Roskilde University	Universitetsvej 1, 11.2, DK-4000 Roskilde, Denmark https://forskning.ruc.dk/en/organisations/institut-for-naturvidenskab-og-milj%C3%B8
	Aarhus University	Frederiksborgvej 399, building B1.25, 4000 Roskilde, Denmark http://bios.au.dk/en/
	The Velux Foundations	TOBAKSVEJEN 10, 2860 SØBORG, DK https://veluxfoundations.dk/da info@veluxfoundations.dk
Finland	University of Eastern Finland	
	Aalto University	
	Finnish Environment Institute (SYKE)	
	Jyväskylä University	
	University of applied science of Turku	
	LUT University	
	HSY (Viikinmäki WWTP)	
	WSP Finland	
	Kuopion Yliopisto	
	Aquatic environment protection societies (vesiensuojelyydistykset)	
Latvia	Riga Technical University	
	Latvian Institute of Aquatic Ecology	
Lithuania	Siauliai Chamber of Commerce, Industry and Crafts	
	Klaipeda University	
	Lietuvos gamtos fondas	

	VšĮ "Žiedinė ekonomika" UAB ”Portus medicus“	
	Social reTEX namai (VšĮ “Resursai tvariai plėtrai”)	
	VšĮ ,”Gamtos ateitis“	
Poland	National Marine Fisheries Research Institute	
	The Polish Association of Cosmetic and Detergent Industry	
	Basell Orlen Polyolefins	
	PlasticsEurope Polska Foundation	
	Gdansk Waters Company	
	Gdansk Water Utilities	
	Polish Ecological Club (Polski Klub Ekologiczny),	
	CCB	
Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring	
	Northern (Arctic) Federal University named after M.V. Lomonosov	
	VNIRO Russian Federal Research Institute of Fisheries and Oceanography	
	Lomonosov Moscow State University	
	Pacific Geographical Institute Far-Eastern Branch	
	Maritime State University named after Admiral G.I. Nevelskoy	
	Non-profit fund for environmental development "Without rivers as without hands"	
	Far-Eastern Federal University	
	P.P. Shirshov Institute of Oceanology (Russian Academy of Sciences)	
	The Atlantic Branch of the P.P. Shirshov Institute of Oceanology	
	Association "Maritime Heritage: explore and preserve"	
	Institute of Lake Science RAS	
	Russian State Hydrometeorological University	Department of Ecology and Bioresources
	Environmental organization Friends of the Baltic / International organization Coalition Clean Baltic	
	Ecocentrum	
	Ecological and Biological Center "Krestovsky Island"	

	St Petersburg University	
	Maritime State University. adm. G.I. Nevelskogo, Department - Institute for the Protection of the Sea	
Sweden	The Swedish EPA	
	The Swedish National Road and Transport Research Institute, VTI	
	The Swedish Chemicals Agency, KEMI	
	The Swedish National Food Agency, Livsmedelsverket	
	Swedish Environmental Research Institute, IVL	
	The Swedish Transport Administration, Trafikverket	
	Lulea University of technology	www.lulea.se
	The Water Research School	www.waterresearchschool.lu.se
	Swedish University of Agricultural Sciences	www.slu.se
	University of Gothenburg	www.gu.se
	Chalmers University of technology	www.chalmers.se
	The Swedish Waste Management Association	
	The Swedish Agency for Marine and Water Management, Havs- och Vattenmyndigheten	
	Research Institutes of Sweden, RISE	
	The Swedish Water & Wastewater Association, SWWA	
	Håll Sverige rent	
	Beställargrupp konstgräs	https://bekogr.se/projekt/
Norway	Norwegian Institute for Water Research (NIVA)	
	NINA	
	NILU	
	HI (former IMR + NIFES)	
	NTNU	
	MEPEX Consult AS	
	COWI As	
	UiO	
	UiT	
	Polar Institutt	
	Aquaplan-niva	
	Norwegian Polar Institute	
	NTNU	
	UiO	
	UiB	
	NORCE	

	IMR	
	Norwegian Institute of Bioeconomy	
	Research (NIBIO)	
	Multiconsult	
	Eurofins Norway	
	GRID Arendal	
	Norwegian Public Roads Administration	
	Oslo municipality	
	SINTEF Oceans	
Germany	Alfred Wegener Institute (AWI)	
	Bundesanstalt für Materialforschung und –prüfung (BAM)	
	Deutsche Bundesstiftung Umwelt (DBU)	
	DVGW-Technologiezentrum Wasser (TZW)	
	Forschungszentrum Jülich	
	Goethe Universität Frankfurt am Main	
	Helmholtz Zentrum für Umweltforschung (UFZ)	
	Institut für Chemie und Biologie des Meeres (ICBM)	
	Institut für Ostseeforschung Warnemünde (IOW)	
	Leibniz-Institut für Polymerforschung Dresden	
	Technische Universität Berlin	
	Technische Universität München (TUM)	
	Umweltbundesamt (UBA)	
	Universität Bayeuth	
	Universität Heidelberg	
	Universität Münster	
	Universität Rostock	
	Universität Tübingen	

Annex 2 - FanpLESStic-sea: Survey on Microplastic Policies and Research in the HELCOM region

Information regarding the Survey

FanpLESStic-sea is an EU INTERREG Baltic Sea Region project aimed at decreasing and removing microplastics in the Baltic Sea, where HELCOM is partner.

FanpLESStic-sea envisaged outputs are:

- A model to map, understand and visualize microplastic pathways that will be applied to the partners' cities and/or regions;
- Piloting of new technology i) for filtering out microplastics; ii) sustainable drainage solutions as means for removal of microplastics; and iii) to remove microplastics from stormwater;
- Defining innovative governance frameworks and engaging a large range of players for the implementation of coordinated and cost-efficient measures resulting in locally adapted investment proposals/plans for each partner's region; and
- Dissemination of project results, including reports on barriers and ways forward, to increase institutional capacity on up-stream and problem-targeted methods to remove microplastics.

This questionnaire, prepared in the frame of the FanpLESStic-sea project, aims at collecting information on the current regulatory framework and research activities on microplastics at global, European and national level.

Based on the voluntary reporting through this survey and resulting evaluations, the intention is to draft a report on the review of existing research and policies on microplastics with a focus on the Baltic Sea region.

Please respond to all questions from the national perspective and please also provide a web link or additional information to the comment field to support your answer. Linked and other relevant material can be provided in national language. You are kindly invited to complete the survey by **30 June 2019**.

Please consider already available information in the follow up of the implementation of the Regional Action Plan on Marine Litter and the report on the analysis of compiled data on microlitter in the Baltic Sea (conducted as part of the SPICE project co-funded by the EU) to avoid duplication of information.

If you have any questions, please do not hesitate to contact Marta Ruiz (marta.ruiz@helcom.fi) and/or Aaron Vuola (aaron.vuola@helcom.fi) at the HELCOM Secretariat.

Thank you for your valuable time to complete the survey!

1. HELCOM country

2. Contact person for national responses (name and organization) for possible follow-up questions

3. What legal frameworks (legal acts, guidelines, other regulations and communications, including any applicable EU and international legislation) for products and processes (such as production and logistics) that include microplastics exist in your country?[126] Please provide web link / reference. Additional information can also be provided.

4. Is there any guidance available on improvements of stormwater management on a local level in your country to prevent and reduce stormwater related waste (including micro litter and/or microplastics) entering the marine environment?[127]

5. Is there data available on the different sources of primary and secondary microplastics in your country?[128]

6. Please provide information on research activities related specifically to the sources of microplastics, including from roads and tyres in your country.

7. Please indicate on-going and planned measures to address sources of primary and secondary microplastics in your country[129]

8. Is there data available on products and processes that include both primary and secondary microplastics?[130]

9. Are you aware of any monitoring activities of microlitter and/or microplastics in your country? If so, please provide additional information, including links to compiled data as relevant.

10. Please indicate on-going and planned measures to address products and processes that include

[126] This question is linked to Actions RL6 in the Regional Action Plan on Marine Litter (HELCOM Recommendation 36/1).
[127] This question is linked to Actions RL4 in the Regional Action Plan on Marine Litter (HELCOM Recommendation 36/1).
[128] This question is linked to Actions RL6 in the Regional Action Plan on Marine Litter (HELCOM Recommendation 36/1).
[129] This question is linked to Actions RL6 in the Regional Action Plan on Marine Litter (HELCOM Recommendation 36/1).
[130] This question is linked to Actions RL6 in the Regional Action Plan on Marine Litter (HELCOM Recommendation 36/1).

both primary and secondary microplastics[131]

11. Please provide information on available techniques in waste water treatment plants to prevent micro particles entering the marine environment you may be aware of[132].

12. Please provide information on research activities in waste water treatment plants to prevent micro particles entering the marine environment you may be aware of[133].

13. Please provide links to the outputs of concluded research projects addressing microlitter and/or microplastics where institutions from your country have participated.

14. Please provide links to the outputs of additional concluded research projects addressing microlitter and/or microplastics you may be aware of.

15. Please provide links/available information on on-going research projects addressing microlitter and/or microplastis with the participation of institutions from your country.

16. Please provide links/available information on additional on-going research projects addressing microlitter and/or microplastis you may be aware of.

17. Are you aware of the existence of any guidelines on best practices to reduce the input of microlitter and/or microplastics to the sea?

18. Please list organizations/institutions/foundations etc. within both public and private sector, that are working on microliter and/or microplastics in your country that you are aware of.

[131] This question is linked to Actions RL6 in the Regional Action Plan on Marine Litter (HELCOM Recommendation 36/1).
[132] This question is linked to Actions RL7 in the Regional Action Plan on Marine Litter (HELCOM Recommendation 36/1).
[133] This question is linked to Actions RL7 in the Regional Action Plan on Marine Litter (HELCOM Recommendation 36/1).