



marlin
BALTIC MARINE LITTER

FINAL REPORT OF BALTIC MARINE LITTER PROJECT MARLIN

- LITTER MONITORING AND RAISING AWARENESS

2011-2013



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CENTRAL BALTIC
INTERREG IV A
PROGRAMME
2007-2013



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SUMMARY

Each year millions of tons of waste are dumped into the world's oceans. Slowly but surely the seas are turning into underwater landfills. The root cause of the increased amounts of debris in our oceans is directly related to our modern life style, consumption and production patterns, as well as attitudes and behaviors concerning waste, recycling and littering. Marine litter is an emerging environmental threat to our seas. But in the Baltic Sea marine litter has not been considered a major problem. At the same time the amounts, trends and composition of marine litter has been unknown.

The aim of Baltic Marine Litter Project MARLIN was to increase the knowledge of marine litter in the Baltic Sea by introducing a harmonised monitoring method in combination with opinion building activities to raise awareness of marine litter among the public and policy makers. For the very first time a comprehensive and comparable picture of litter in the Baltic Sea is presented. 23 reference beaches in Sweden, Finland, Estonia and Latvia has been identified and monitored during two years (138 assessments). The amounts of litter range from 75,5 items/100 m at rural beaches to 236,6 items/100 m at urban beaches. Cigarette butts are counted separately and is the most common type of litter with 301,9 cigarette butts/100 m at urban beaches. Plastic accounts for 62% of the litter at urban beaches and 54% at rural beaches. The most common type of litter, except from cigarette butts, is unidentified pieces of plastic, meaning broken down products from larger plastic items or items that doesn't fit under any other category in the protocols used. Other common litter items found at the top 10 list are glass fragments, plastic bottle caps and lids, plastic bags, foamed plastic, food containers and candy wrappers.

Most of the litter is related to our modern take-away lifestyle and composed of plastic. Littering by beach visitors or litter ending up at beaches from nearby cities seems to be the most common source of marine litter. Operational targets aiming at raising awareness and a change in littering behavior is therefore of great importance. The results indicate that litter generated from sea-based sources such as shipping does not seem to end up on shores of the Baltic Sea to the same extent as for example in the North East Atlantic area (ie ropes, fishing gear etc). Since the Baltic Sea lacks strong surface currents and tidal water it might on the other hand be hot spots of sea-bed litter and future studies on benthic and pelagic marine litter is of great interest to fully understand the marine litter situation in the Baltic Sea.

Beach litter monitoring is the most cost-effective tool to understand marine litter and national funding is crucial for long-term monitoring. The monitoring should be harmonised in a regional Baltic Sea context and data shared across borders.

The main outcomes of MARLIN is the implementation of a monitoring method based on UNEP/IOC monitoring guidelines adapted for the Baltic Sea; a structure that involves local stakeholders in the actual monitoring; and an open database and quality control. In combination with opinion building activities MARLIN can provide a good starting point for future national and regional strategies for marine litter in the Baltic Sea such as the Marine Strategy Framework Directive and a HELCOM regional action plan that is supposed to be ready by 2015.

BACKGROUND – MARINE LITTER

MARINE LITTER – OF GLOBAL CONCERN

Each year millions of tons of waste are dumped into the world's oceans.¹ Slowly but surely the seas are turning into underwater landfills. This is waste that nobody owns and that nobody takes responsibility for.

The Marine Strategy Framework Directive (MSFD) defines marine litter as:

*"...any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment...Marine Litter consists of items that have been made or used by people and deliberately discarded or unintentionally lost into the sea and on beaches, including such materials transported into the marine environment from land by rivers, draining or sewage systems or winds."*²



Photo: LE Carlsson

Marine litter is carried over the seas and causes numerous problems. It has social, economic and environmental consequences with impacts on important ecosystem services linked to economic activities such as commercial fishing, aquaculture and shipping. Ecosystem services related to the aesthetic values are at stake with negative impacts on economies relying on coastal tourism as well as costs related to clean up. Plastic litter is suspected to leak hazardous additives when it is slowly degraded into smaller fragments. Eventually it turns into microscopic pieces of litter that has the potential of entering the food chain. And marine litter kills. Marine life such as fish, marine mammals and birds get entangled in litter or mistakes it for food.

THE ROOT CAUSE

The root cause of the increased amounts of debris in our oceans is directly related to our modern lifestyle, consumption and production patterns, as well as attitudes and behaviours concerning waste, recycling and littering. Land-based sources are believed to contribute more widely to the marine litter than offshore sources. Up to 80% of the sources are estimated to be land-based due to; poor waste management in households; inadequate waste infrastructure (such as open landfills); lack of or inadequate water treatment plants; dumping of industrial waste and littering from coastal cities and popular coastal tourism destinations. The debris reaches the sea by winds, tides, rivers and drain-off water. Examples of sea-based sources are; commercial fishing; shipping (transport and cruise), tourism (recreational boating) and offshore operations.³

1 UNEP/Oceans Conservancy/Regional Seas/GPA (2009): *Marine Litter: A Global Challenge*

2 JRC/Ifremer/ICES (2010): *Marine Strategy Framework Directive Task Group 10 Report Marine Litter*.

3 UNEP/Oceans Conservancy/Regional Seas/GPA (2009)

PLASTIC



Studies from all over the world show that 60-80% of the marine waste consists of plastic.⁴ The plastic pose a particular threat because it is durable, floats and can travel long distances. In 2013, The European Commission launched a Green Paper on a European Strategy on plastic waste in the environment. The paper acknowledges the great impact that plastic has on the marine environment. Plastic is assumed to leak harmful substances and hazardous additives. Plastic is slowly degraded into smaller pieces and as such is more likely to be mistaken for food. In the form of microparticles it is able to absorb other persistent toxic substances. Several studies show that these microparticles also enter the food chain. Plastic production has increased dramatically and grew from 1.5 million tonnes (Mt) 1950

to 245 Mt in 2008 and by 2050 it is predicted to have tripled. Consequently plastic waste has also increased dramatically and out of 25 Mt of plastic waste (2008), only 5.3 Mt was recycled.⁵ In the long run our oceans are turning into plastic waste dumps of the planet.

MARINE STRATEGY FRAMEWORK DIRECTIVE

The most important current legislative tool for marine litter in the EU is the Marine Strategy Framework Directive. The aim of this directive is to protect the marine environment more effectively across Europe. It aims to achieve good environmental status of the EU's marine waters by 2020 and to protect the resources upon which marine-related economic and social activities depend. Each Member State is required to develop strategies for their marine waters. These must contain a detailed assessment of the state of the environment, a definition of "good environmental status" at regional level, the establishment of clear environmental targets and monitoring programmes and draw up a programme of cost-effective measures. 11 descriptors are used in order to assess if good environmental status is achieved. Marine litter or descriptor 10 is defined as follows:

Descriptor 10: Properties and quantities of marine litter do not cause harm to the coastal and marine environment.

The distribution of litter is highly variable, which needs to be taken into consideration for monitoring programmes. It is necessary to identify the activity to which it is linked including, where possible, its origin. There is still a need for further development of several indicators, notably those relating to biological impacts and to micro-particles, as well as for the enhanced assessment of their potential toxicity.

10.1. Characteristics of litter in the marine and coastal environment

⁴ UNEP/Oceans Conservancy/Regional Seas/GPA (2009)

⁵ European Commission (2013): *Green Paper On a European Strategy of plastic waste in the environment.*

- Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source (10.1.1)
- Trends in the amount of litter in the water column (including floating at the surface) and deposited on the sea-floor, including analysis of its composition, spatial distribution and, where possible, source (10.1.2)
- Trends in the amount, distribution and, where possible, composition of microparticles (in particular microplastics) (10.1.3)

10.2. Impacts of litter on marine life

- Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis) (10.2.1).⁶

MARINE LITTER IN THE BALTIC SEA AND BALTIC MARINE LITTER PROJECT MARLIN

The Baltic Sea is an enclosed sea with 90 million people, 15 major coastal cities, 10 major rivers, 2000 vessels constantly on the move across the sea⁷ and a well-developed coastal tourism. It can be assumed that litter and waste from various human activities ends up in the sea.

Marine litter is an emerging environmental threat to our seas. But in the Baltic Sea marine litter has not been considered a major problem. Even though litter is a very visual and tangible environmental problem very few steps have been taken to understand the amounts or sources of marine litter in the Baltic Sea.

While other regional seas conventions such as OSPAR (North-East Atlantic) has been monitoring marine litter since 1998⁸ HELCOM launched a report on marine litter in the Baltic Sea 2007 and concluded that “lack of comparable and reliable data is a major gap in marine litter issues in the Baltic Sea”.⁹ Prevention, reduction and control actions on marine litter in the Baltic Sea have been scarce, based on different assessment methods which has yielded incomparable results across years or between countries and without any known reductions in marine litter. This report gave rise to a project idea to introduce a harmonized method for beach litter monitoring. In 2011 the Keep Baltic Tidy network started the Baltic Marine Litter project MARLIN. The project has been financed by the EU Central Baltic INTERREG IVA programme and managed by the Keep Sweden Tidy Foundation.

MARLIN aims to contribute with new knowledge by presenting the first comprehensive and comparable picture of litter in the Baltic Sea, based on results from a harmonized monitoring programme. The project has also focused on activities for raising awareness based on the perspective that one of the most important ways to come to terms with litter and littering is to change people’s attitudes and behaviours. Raising awareness and opinion building activities have also been aiming to put marine litter on the daily agenda among the public and among policy makers.

Beach litter is believed to count for only 15% of the total amount of marine litter.¹⁰ But by monitoring litter on the shores, valuable information on amounts, trends and possible sources can be gained in a cost effective way. At the HELCOM Ministerial Meeting 2013 it was decided that a regional action plan of marine

6 http://ec.europa.eu/environment/water/marine/directive_en.htm referred 7.11.2013

7 HELCOM (2009): *Ensuring safe shipping in the Baltic*

8 www.ospar.org

9 HELCOM (2007): *Assessment of marine litter problem in the Baltic region and priorities of response*

10 UNEP (2005): *Marine Litter – An analytical overview*

litter in the Baltic Sea should be ready at the latest by 2015.¹¹

“We commit to strengthen our efforts... determined to take further measures, initiatives or efforts needed to reach a healthy marine ecosystem supporting a prosperous Baltic Sea region, including addressing pollution of the marine environment by litter.... **We agree to prevent and reduce** marine litter from land- and sea-based sources, causing harmful impacts on coastal and marine habitats and species, and negative impacts on various economic sectors, such as fisheries, shipping or tourism, and to this end decide to develop a regional action plan by 2015 at the latest with the aim of achieving a significant quantitative reduction of marine litter by 2025, compared to 2015, and to prevent harm to the coastal and marine environment.”

Results from the MARLIN project is a good starting point for these important tools for achieving a reduction of marine litter also in the Baltic Sea.

MARLIN FACTS

Lead partner: Keep Sweden Tidy

Partners: Keep the Archipelago Tidy (Finland), Keep the Estonian Sea Tidy, FEE Latvia

Time: 2011-2013

Total budget: 778 000 EUR, partly financed by Central Baltic Interreg IVA Programme

Main outputs:

- A common structure: 23 reference beaches included in the programme with local monitoring teams.
- A common method: Beach litter monitoring method developed from UNEP/Regional Seas¹²
- A common database
- First comparable results of marine litter in the Baltic Sea, a first baseline for marine litter in implementing MSFD
- Concepts for raising awareness and opinion forming¹³
- A joint recommendation from 70 stakeholders around the Baltic Sea on the believed impact from different actors and actions to reduce litter¹⁴



11 HELCOM Copenhagen Ministerial Declaration (2013): *Taking Further Action to Implement the Baltic Sea Action Plan- Reaching Good Environmental Status for a healthy Baltic Sea*

12 UNEP/IOC (2009): *Guidelines on Survey and Monitoring of Marine Litter*

13 Litter free marinas and My Baltic Sea. www.projectmarlin.eu

14 Appendix 4



Photos from activities in Finland, Latvia, Estonia and Sweden.

BEACH LITTER MONITORING

One of the biggest obstacles to resolve the marine litter problem is the lack of information concerning the sources of litter, the movement of litter in the sea, the dynamics of the oceans, trends and other more general information regarding the status of marine litter. This type of information is both necessary and fundamental in order to be able to assess the consequences of marine litter at a local, national and regional level.

Many efforts have been made globally to map the litter situation in marine environments, and the monitoring of beach litter has historically been seen throughout the world as the most common method of assessing the strain placed on the marine environment as a result of litter. However, one problem has been that the results have not been possible to compare due to different monitoring methods.

The lack of a uniform standard led UNEP/IOC to develop harmonized guidelines (2009) regarding monitoring of marine litter. These guidelines were adapted to Baltic Sea conditions by the MARLIN project in cooperation with Statistics Sweden (SCB) in 2011.¹⁵ The aim is that data and materials collected in accordance with these guidelines will be able to support the local and global measures being taken to combat marine litter. The aim is also that monitoring and results will awaken the interest of the general public to the issue of marine litter, since one way to come to terms with the problem of marine litter is to change people's attitudes and behavior. In 2013 the MSFD Technical subgroup on descriptor 10 presented a draft report on monitoring guidance for marine litter in European Seas.¹⁶

THE METHOD – MARLIN BEACH LITTER MONITORING

23 reference beaches has been carefully chosen to comply with the UNEP method. The geographical scope



Figure 1 Map of the 23 reference beaches monitored during MARLIN

is limited to the Central Baltic area (parts of Sweden, Finland and the whole coast of Estonia and Latvia) (fig 1). According to the UNEP method a mix of urban, rural and peri-urban beaches should be chosen¹⁷ in order to gain knowledge on different types of sources (litter on rural beaches are more likely to indicate sea based sources and the litter situation at sea - since very little littering is expected from visitors). In MARLIN beaches have been chosen to represent different usages in the regional context. Beach litter is monitored three times per year (with

no monitoring during winter). Litter items are identified according to the UNEP protocols and results are presented as number of litter items/100m and as litter items/m² which is an addition to the UNEP method. The beach is divided into three overlapping measurement areas (fig 2). In area 3 (1 km stretch) large litter

15 Appendix 1

16 WG-GES (2013): *Monitoring Guidance for Marine Litter in European Seas*

17 UNEP/IOC (2009): *Guidelines on Survey and Monitoring of Marine Litter*

items over 50 cm is collected. In area 2 (100 m stretch) litter sized from 2,5 cm-50 cm is counted. In area 3 (10 m stretch) cigarette butts and snuff is counted.

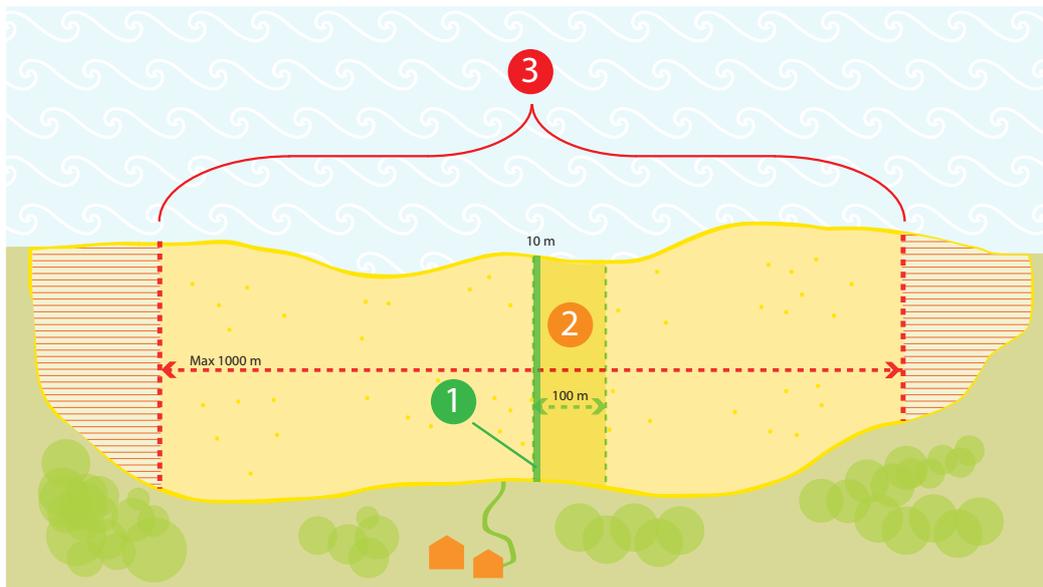


Figure 2 Measurements areas for beach litter monitoring.

THE STRUCTURE OF MARLIN MONITORING PROGRAMME

One of the outcomes of the MARLIN project is the structure which has been developed for conducting the beach litter surveys. In MARLIN local monitoring teams (for ex. landowners, beach management staff, NGOs, schools or volunteers) has been trained by a national coordinator (i.e. project partner) to carry out the assessments (fig 3). The model is simple and very resource efficient and ensures quality with proper guidance and instructions.

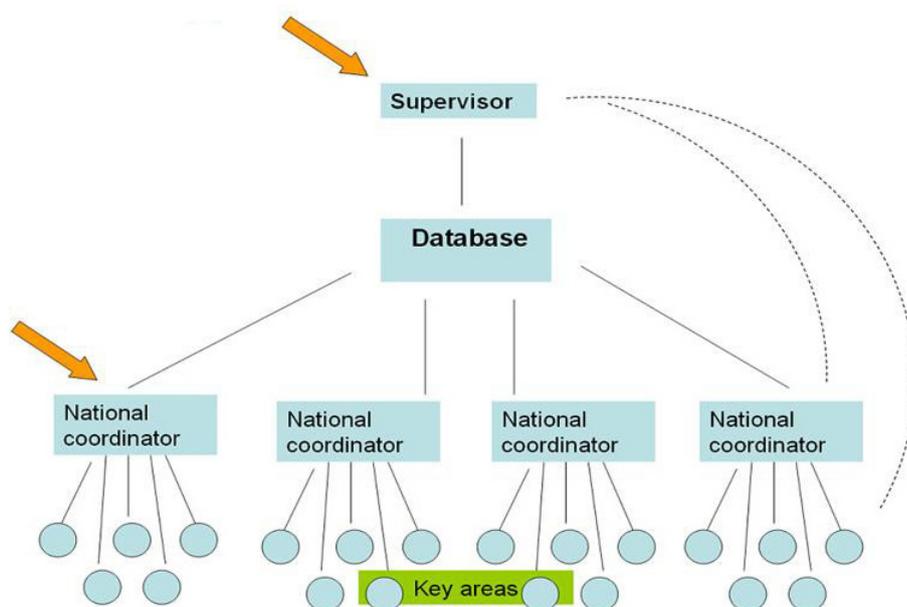


Figure 3 Structure for conducting beach litter surveys.

THE MARLIN DATABASE

Another outcome is a marine litter web-based database, which was partially financed by the project. All beach litter survey results are reported by the national coordinator to the database, which is managed by Keep Sweden Tidy. The main advantages are;

- All of the gathered data is stored in one place
- The database can be accessed via internet, no special software is needed
- Data stored in the database by the national coordinator can be viewed by everyone
- Access to see the data can be given to (local) government representatives and other stakeholders
- Different reports on the data stored can be extracted easily:
 - › country reports and comparison
 - › beach type/characteristic reports and comparison
 - › litter item lists /most common material
 - › seasonal and geographical variations
 - › reports on chosen parameters as pdf or raw data in excel.

Appendix 1 gives a detailed guideline on how to join the monitoring programme and carry out the assessments. Appendix 2 gives further explanation of the MARLIN method versus UNEP/IOC guidelines and an evaluation of the method. Appendix 3 lists the beaches included in this report.

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MAIN RESULTS FROM BEACH LITTER MONITORING

The aim with MARLIN is to present a broad picture of the marine litter situation in the central parts of the Baltic Sea Region. Thus the main focus is not to compare participating countries with each other but to present results based on different beach types, litter composition and seasonal variations with a future possibility to draw further conclusions on for example sources.

Beach litter assessments has been conducted for two years (from spring 2012 until fall 2013) in four different countries within the Central Baltic Region; Sweden, Finland, Estonia and Latvia. Monitoring has been conducted three times a year; spring, summer and autumn. Due to weather conditions winter monitoring has not been conducted. Altogether 23 beaches and 138 assessments are included in this report.

Parameters which have been used are; average amount of litter (items) per 100 meters; total amount of litter per monitoring area and litter amount per 10 square meters. The first two parameters are used in the UNEP method. The additional parameter (litter amount per 10 square meters) was chosen, because it can give a more realistic picture of the litter amount in this region due to extensive archipelago areas in Sweden and Finland where long sandy beaches are quite rare. In this report litter items/100m is used.

In this chapter the main results from the monitoring are presented. The litter amounts presented in the graphs and tables are the combined amounts from monitoring area 2 and 3 (see Fig 2). Monitoring area 2 covers a 100 m stretch and includes litter items ranging from 2,5 cm-50 cm. Monitoring area 3 covers a 1 km stretch and includes litter items which are over 50 cm in size.

LITTER AMOUNTS, BEACH TYPES AND SEASONAL VARIATIONS

In MARLIN different beach types are included in the regional monitoring area; 7 urban beaches, 6 rural beaches and 10 peri-urban beaches. In figure 4 and table 1 litter amounts/100m is presented for all 3 different beach types with seasonal variations during two years of monitoring.

The litter amounts found at the reference beaches range from 75,5 litter items/100 m at rural beaches to 236,6 items/100m at urban beaches.

Litter amounts at rural beaches had a steady decline since the start of the monitoring. A reason for this might be that the first assessment in spring 2012 included the accumulation of "old" litter, while quite small amounts of litter has been accumulated during the time until next assessment. The UNEP method characterize and predicts rural beaches to accumulate more litter from sea-bases sources compared to urban beaches. Typical sea-based sources are related to marine traffic and leisure boating and counts for approximately 20%, which is also supported by these results.

Litter amounts at urban beaches are changing more dramatically between the seasons. During the first year of the project the amounts increased at every assessment. The highest peaks were reached at the spring and fall of 2013. Some of the reasons is that ice melting during spring creates large water flows, which

carries litter, reaching the beach directly or indirectly via the sea. The case is the same at autumn but with heavy rains and winds which carry the litter to the sea or to the beach from urban sources in combination with no cleaning of the beach. The decreased litter amounts during summer is assumed to be related to cleaning activities of the beaches, since they are public beaches with many visitors.

At urban beaches the average number of litter is 236,6 items/100 m and at rural beaches 75,7 items/100 m. This leads to the conclusion that much of the beach litter comes from 1) the beach visitors littering 2) and/or from urban sources with littering streams to the sea that quite soon reach nearby beaches.

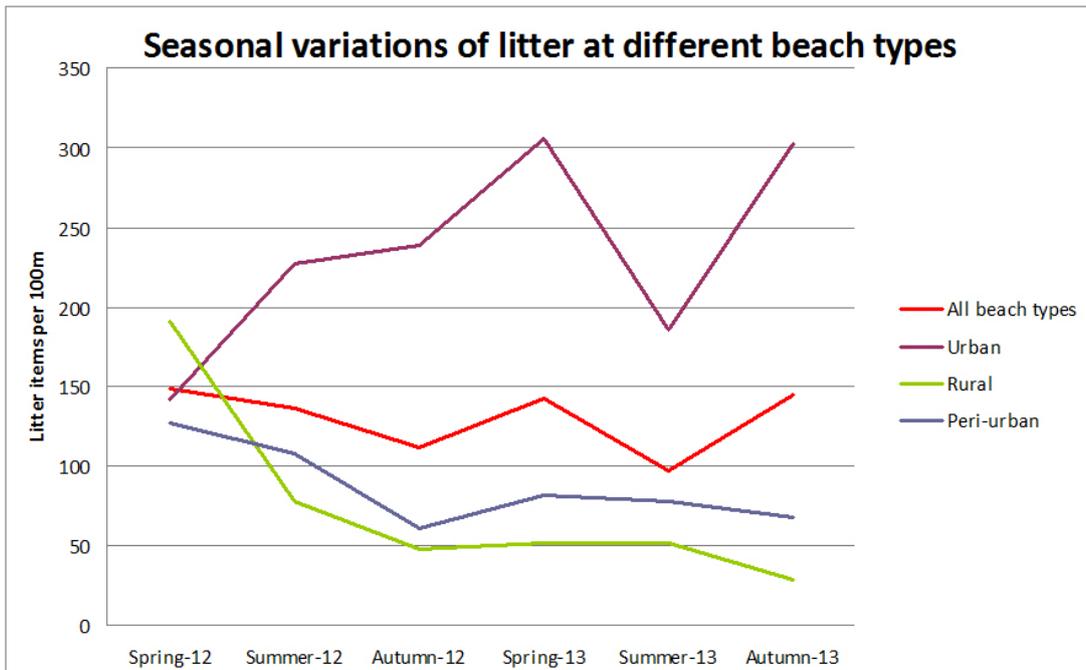


Figure 4 Average litter per 100m, all beach types from spring 2012 to autumn 2013

Table 1: Average litter amount per 100 m

Type	Average litter amount (pieces) per 100 m
All beach types	129,8
Urban	236,6
Peri-urban	87,5
Rural	75,7

PROPORTION OF LITTER MATERIALS

Proportion of litter materials are presented in this chapter. The different beach types are presented separately and combined. The results from MARLIN correspond with the marine litter situation in other seas with plastics being the major problem. 56% of the litter found constitutes of plastic (urban beaches 59%, rural beaches 50% and peri-urban beaches 53%). When adding foamed plastic the total amount of plastic litter is 62% (urban beaches 67%, rural beaches 54% and peri-urban beaches 58%).

In figures 5-8 proportion of litter materials is visualised.

Proportion of litter materials, all beach types combined

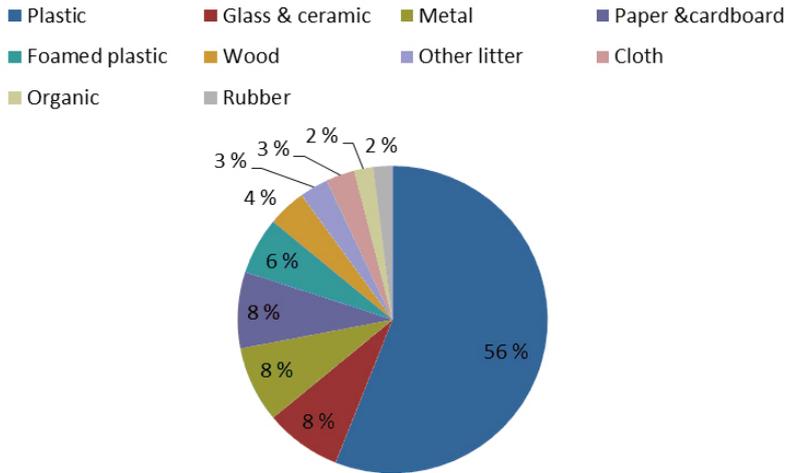


Figure 5 Proportion of litter materials, all beach types combined

Proportion of litter materials, urban beaches

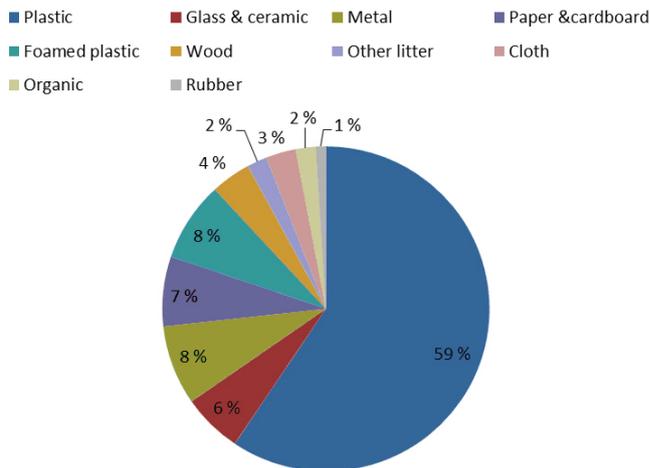


Figure 6 Proportion of litter materials, urban beaches

Proportion of litter materials, rural beaches

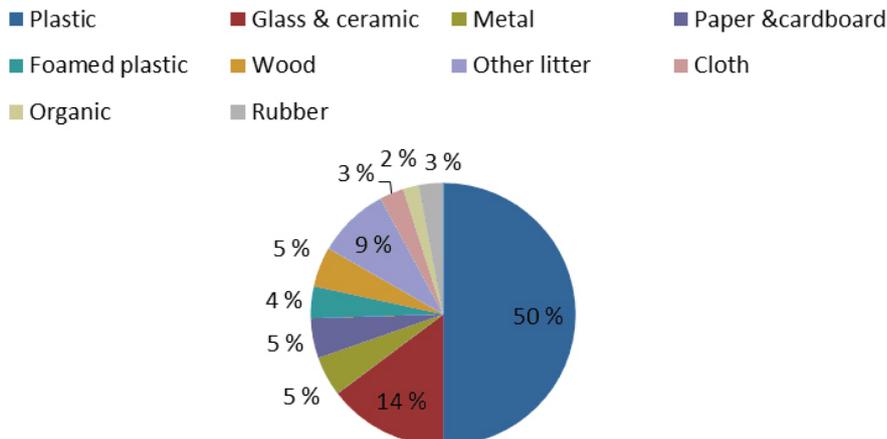


Figure 7 Proportion of litter materials, rural beaches

Proportion of litter materials, peri-urban beaches

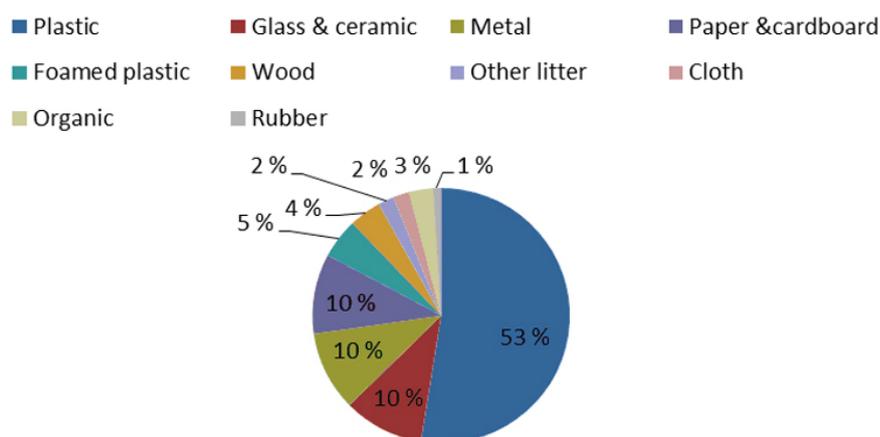


Figure 8 Proportion of litter materials, peri-urban beaches

TOP 10 LITTER ITEMS

Top 10 lists of the litter found are good tools for identifying the sources and therefore useful in developing mitigation strategies. Plastic is commonly found on the reference beaches in MARLIN. Plastic is the most common material found at all of the different beach types. The most common plastic category is “*Plastic, other*” meaning unidentified pieces of plastic or plastic items that doesn’t fit under any other category. “*Plastic, other*” counts for 32,2% at urban beaches, 19% at rural beaches and 15,5,% at peri-urban beaches. When all beach types are calculated together, “*plastic, other*” counts for 25,3% of all litter found.

“*Plastic, other*” is a category which has been used most frequently in the assessments. With the litter that falls under this category, it is difficult to identify what sort of an item/product it was originally. Today, plastic is used in all kinds of products; clothes, consumables, food wrappers, etc. When time goes by, plastic breaks down into smaller and smaller pieces and persists in the marine environment for a long time.

Some differences between urban and rural beaches in the top 10 lists are worth highlighting. At urban beaches many of the items are related to our take away-lifestyle such as bottle caps, plastic bags, plastic food containers and wrappers, and plastic cutlery. But one thing that is notable is that plastic bottles are not found on the top 10 list at urban beaches.

The top 10 list for rural beaches includes less of take away-lifestyle litter and more of “industrial” litter. Plastic ropes constitute 4,8% of all litter found and construction material 3%. Notable is that plastic bottles that were not found at urban beaches are instead found at rural beaches. There is a strong understanding that most of the bottles found at rural beaches are without deposit. This indicates that the refund-system for plastic bottles has positive impact in reducing the litter and that refund system could be expanded to other litter types as well.

Table 2: Top ten litter items – All beach types combined

Material type	Litter type	%
Plastic	Other	25,3
Glass & ceramics	Fragments	5,1
Plastic	Bottle caps and lids	4,8
Plastic	Plastic bags	4,3
Foamed plastic	Foam (insulation and packaging)	4,2
Plastic	Food containers, candy wrappers	3,2
Metal	Bottle caps, lids and pull tabs	2,8
Plastic	Knives, forks, spoons, straws, stirrers	2,4
Wood	Processed timber and pallet crates	2,4
Paper & cardboard	Cups, food trays, food wrappers, cigarette packs, drink containers	2,1

Table 3: Top ten litter items – Urban beaches

Material type	Litter type	%
Plastic	Other	32,2
Plastic	Bottle caps and lids	5,3
Foamed plastic	Foam (insulation and packaging)	5,2
Glass & ceramics	Fragments	3,5
Metal	Bottle caps, lids and pull tabs	3,1
Plastic	Plastic bags	3
Wood	Processed timber and pallet crates	3
Paper & cardboard	Paper (incl. Newspapers and magazines)	2,3
Plastic	Food containers, candy wrappers	2,3
Plastic	Knives, forks, spoons, straws, stirrers	2,2

Table 4: Top ten litter items – Rural beaches

Material type	Litter type	%
Plastic	Other	19
Glass & ceramics	Fragments	8,2
Other litter	Other litter	7,7
Plastic	Plastic bags	7,3
Plastic	Rope	4,8
Plastic	Bottle caps and lids	3,6
Plastic	Bottles < 2l	3,1
Glass & ceramics	Construction material	3
Wood	Processed timber and pallet crates	2,4
Plastic	Food containers, candy wrappers	2,3

Table 5: Top ten litter items – Peri-urban beaches

Material type	Litter type	%
Plastic	Other	15,5
Glass & ceramic	Fragments	6,4
Plastic	Food containers, candy wrappers	5,4
Plastic	Plastic bags	5,4
Plastic	Bottle caps and lids	4,5
Plastic	Knives, forks, spoons, straws, stirrers	3,5
Foamed plastic	Foam (insulation and packaging)	3,4
Plastic	Strapping	2,8
Paper & cardboard	Other	2,8
Metal	Bottle caps, lids and pull tabs	2,8

AVERAGE AMOUNT OF CIGARETTE BUTTS

In the MARLIN method, cigarette butts are counted in a separate monitoring area (area 1) since it is smaller than the size range 2,5 cm-50 cm. Thus this category is not included in the previous results. Cigarette butts are the most numerically frequent form of litter in the world,¹⁸ which is also supported by the results of the MARLIN project. The average number of cigarette butts is 153,3 butts/100 m (urban beaches 301,9 butts/100 meters, peri-urban beaches 111.5/100 m and at rural beaches 49,4/100m).

Cigarette butts include many hazardous substances such as cadmium, arsenic and lead. When cigarette butts end up in the water environment, they start leaking these substances within hours.¹⁹

Table 6: Average amount of cigarette butts per 100 m

Beach type	Average amount of cigarette butts/100 m
All beach types	153,3
Urban	301,9
Peri-urban	111,5
Rural	49,4

LITTER AMOUNTS, DIFFERENT COUNTRIES AND SEASONAL VARIATIONS

In this chapter the average litter amount during the seasons is presented for each country; Sweden, Finland, Estonia and Latvia, figure 9 and table 7. The litter amounts at Finnish beaches are during the whole project higher than in the other countries. This could partly be explained by the different beach types represented in each country. More urban beaches means a higher average of litter per country. Among the Finnish beaches there are 3 urban beaches, in Latvia 3, in Estonia 1 and in Sweden none. The reasons behind the higher amounts of litter found at Finnish beaches are still being studied. Some other possible reasons could be related to sea currents and an extensive archipelago area.

18 Warne, M. St. J.; Warne, M. St. J.; Pablo, F.; Patra, R. (2005). *Variation in, and Causes of, Toxicity of Cigarette Butts to a Cladoceran and Microtox*

19 <http://www.suomenash.fi/en/main+page/>, referred 16.12.2013

Seasonal variations of litter in different countries

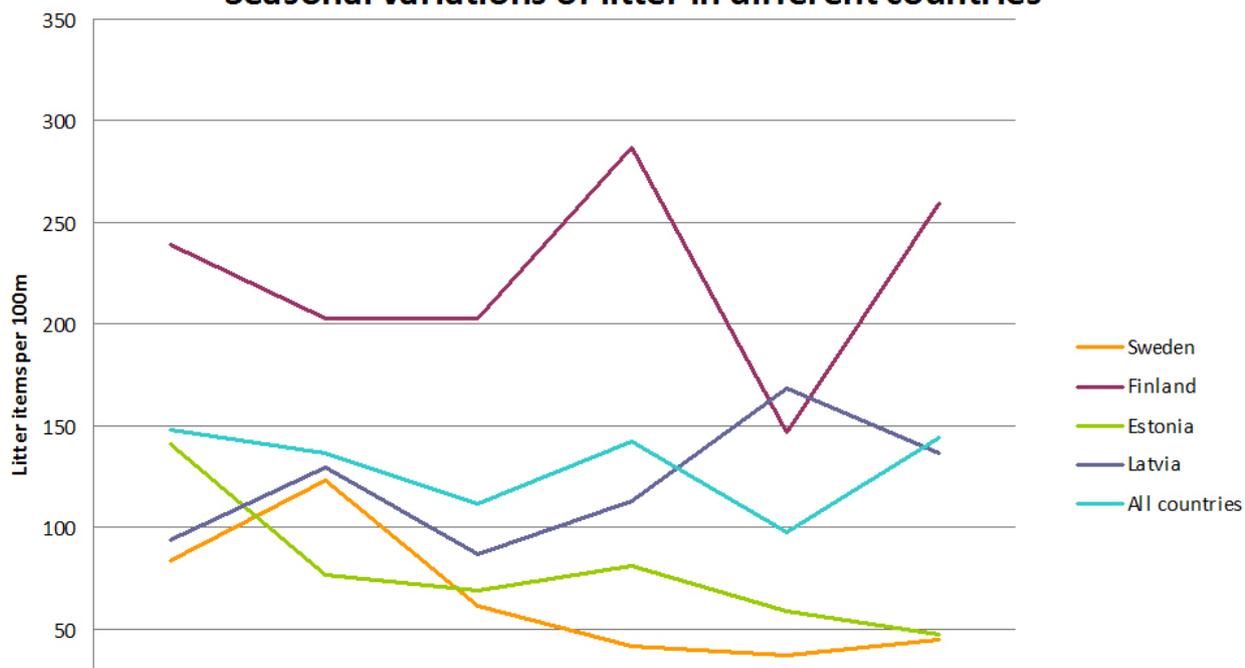


Figure 9 Seasonal variations of litter in different countries.

Table 7: Seasonal variations for different countries
Average amounts litter/100m

	Sweden	Finland	Estonia	Latvia	All countries
Spring	62,8	263,2	111,3	103,3	135,2
Summer	80,2	174,8	67,8	148,8	117,9
Autumn	52,85	231,1	58,2	111,8	113,5

Table 8: Beach types in different countries included in the project

	Sweden	Finland	Estonia	Latvia	All countries
Urban	0	3	1	3	7
Rural	2	2	1	1	6
Peri-urban	3	2	4	1	10

DISCUSSION OF THE MONITORING RESULTS

THE LITTER SITUATION IN CENTRAL BALTIC COMPARED TO OTHER REGIONS

The Central Baltic coast in Sweden and Finland is mainly dominated by archipelago areas. Marine litter that reaches the coast is dispersed over very long distances with thousands of islands (in Stockholm's archipelago 35 000 islands and in Finland's archipelago 50 000 islands). When also considering that only 15% of marine litter is estimated to reach the shore²⁰ – the total amount of litter is probably much greater than the perceived litter. In the Central Baltic area litter items/100 m varies from 75,7 litter items/100m at rural beaches to 236,6 litter items/100m at urban beaches.

Compared to the North East Atlantic the beach litter in Central Baltic area is much lower. An average number of litter items in the OSPAR region is 712 items/100 m. In the northern parts of the Swedish west coast litter amounts increase and up to 1200 items/100 m has been monitored in Skagerrak.²¹ In fact the Skagerrak coast is a hot spot of marine litter and accumulates litter from the whole North-East Atlantic.

Keep Sweden Tidy has been monitoring litter at three urban/semi-urban beaches in Öresund/Kattegatt during 2012 and 2013 and the average number of litter items is 115 items/100 m.²²

The Baltic Sea lacks strong surface currents and tidal water. The water exchange rate is estimated to 30 years. Storms during spring and fall contribute to the main currents in the Baltic Sea which creates a vertical movement of the water (fig 10). As a result of these factors the estimation that 15% of all marine litter reaches the coastline might not correspond to the Baltic Sea and could be a sign of sea bed hot spots in the Baltic Sea that may accumulate great amounts of litter. In two international trawl surveys the amount of sea bed litter in the Baltic Sea was twice as high (0.2 kg litter/km) as in the North Sea (0.098 kg/km).²³

URBAN BEACHES ARE MORE LITTERED THAN RURAL BEACHES

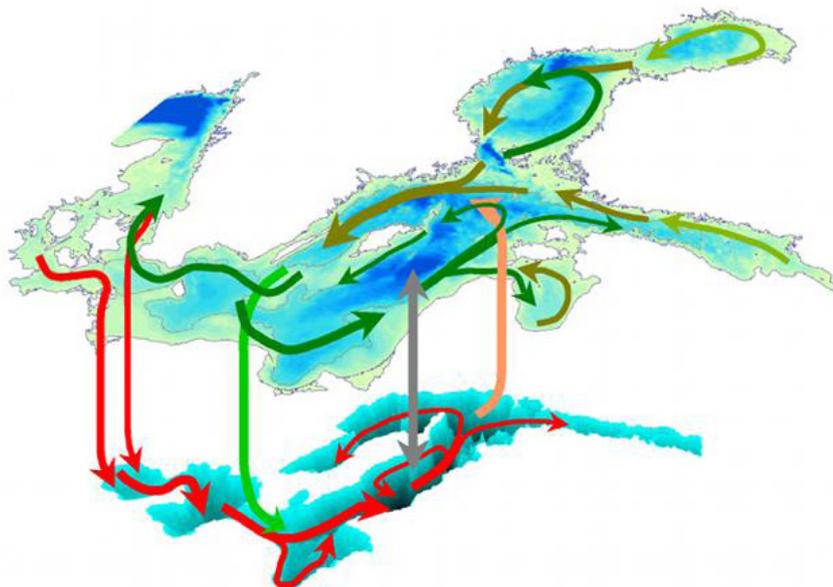


Figure 10 Map of sea currents in the Baltic Sea. Picture Jüri Elken, Springer Verlag

20 UNEP (2005): *Marine Litter – An analytical overview*

21 OSPAR (2009): *Marine Litter in the North-East Atlantic Region, Assessment and priorities for Respons*

22 Keep Sweden Tidy (2013): *Beach litter report for Kattegatt/Öresund*.

23 North Sea International Trawl Survey 2011 and the Baltic International Trawl Study 2011. Havs och Vattenmyndigheten (2012): *God Havsmiljö 2020 Del 1: Inledande bedömning av miljötillstånd och socioekonomisk analys*.

The main conclusion which can be drawn from the two-year monitoring is that urban beaches within the project are more littered than rural beaches or peri-urban beaches. In figure 4 it can be clearly seen how the litter amounts are higher at the urban beaches and the amounts are not declining during the project as it does at rural beaches. This indicates that the litter found at the rural beaches may have been an accumulation of old litter.

A DECREASE OF SEA-BASED SOURCES?

A commonly used figure regarding marine litter is that 80 percent of litter ending up in our oceans comes from land-based sources and 20 percent comes from sea based sources. The MARLIN results indicate low amounts of typical shipping/off shore related litter such as ropes, cords and fishing equipment or packing material of foreign decent. Rural beaches are suspected to receive more of this typical sea-based litter, but rural beaches are quite clean. Ropes made of plastic have been found, but they only compile 4,8% of all litter found. In the OSPAR area two groups of litter items dominate. One is packaging material, mainly of plastic like in the Central Baltic area and the other one is rope/nets/cords i.e. typically sea-based litter.²⁴ The Öresund/Kattegatt beaches that have been monitored by Keep Sweden Tidy indicate a similar trend. The top three litter items are unidentified pieces of plastic, plastic bottle caps and lids and ropes. Cigarettes are the most common litter item with 165 items/100 m.²⁵

It should be acknowledged that HELCOM member states have been implementing measures to improve port reception facilities of waste and to eliminate illegal discharge of waste into the sea since the 1990s. MARPOL Annex V Prevention of pollution by garbage from ships entered into force already 1988. Since 2005 Baltic Sea has been assigned as a particular sensitive sea area by IMO and as such certain measures have been taken to improve for e.g. waste routines. HELCOM also recommends a harmonized no-special-fee system since 2007 i.e. that costs for waste are not separated from the general harbor fees.²⁶

ATTITUDES AND BEHAVIOR RELATED TO LITTERING – A NEGATIVE TREND

The partners in MARLIN are all NGOs with long experience in the field of waste and litter and changing people's attitudes and behavior. Litter seems to be increasing and the attitudes towards littering as a whole have loosened. The "take away"-lifestyle is becoming more and more popular. People are more on-the-go and the consumption of food and drinks which are packed into disposable containers and wrappers increase. Much of the packaging is not disposed in proper ways and ends up in the marine environment. The MARLIN top 10 list indicates mostly food/drink related packaging material such as food and candy wrappers, plastic cutlery, plastic bottles, plastic bottle caps/lids, plastic bags, and plastic cups. More and more people live in cities and a future challenge might be that people perceive the urban environment as something that is not connected to nature and therefore find it more acceptable to litter. Knowledge about urban litter streams into the Baltic Sea will be an important topic for the future.

PLASTIC – THE MAIN PROBLEM

24 OSPAR (2009): *Marine Litter in the North-East Atlantic Region, Assessment and priorities for Responses*

25 Keep Sweden Tidy (2013): *Beach litter report for Kattegatt/Öresund*

26 <http://www.imo.org>, referred 13.11.2013

The monitoring results support the global trend of plastic being the most dominant type of waste in the marine environment. Over 50% of all litter found on the shores in four different countries were plastic (plastic and foamed plastic). The production of plastic is expected to rise from 1.5 million tonnes in 1950 to 735 million tonnes in 2050.²⁷ So it can be expected that the amounts ending up into Baltic Sea will not decrease, unless major mitigation steps are taken. The most common category from MARLIN monitoring results are the small unidentified pieces of plastic which consists of 25,3% of all litter. A beach is in many cases not perceived as being littered due to the small size of the plastic pieces. But these small pieces might be more dangerous to wildlife because it can easily be mistaken for food. The high amount of small pieces also reflects the problem of plastic being durable. If litter is not cleaned up it slowly breaks down into smaller and smaller parts without disappearing.

Plastic has many advantages. It is cheap, light weight, long lasting and can be used for many different products. We will most probably see an increase (rather than a decrease) in its possibilities and range of use. Plastic also has another advantage of being recyclable if handled and disposed correctly. But unfortunately only 21.3% is recycled and almost 48% is land filled within EU.²⁸ The focus should be on rationalizing the production, the use and the disposal of plastics in a sustainable way. This would mean encouraging producers, traders, end-users and waste management to handle plastics and packaging in wise ways.

27 European Commission (2013): *Green Paper On a European Strategy of plastic waste in the environment*

28 European Commission (2013)

CONCLUSIONS AND SUGGESTIONS FOR FUTURE ACTIONS IN THE BALTIC SEA

Based on the results and the experience gained from monitoring beach litter during the project and the progress of implementing the Marine Strategy Framework Directive some recommendations are outlined below. Recommendations for starting up monitoring programmes on marine litter on a regional and local scale as well as identified knowledge gaps and suggestions for future research.

RECOMMENDATIONS FROM MARLIN ON HOW TO PROCEED WITH MARINE LITTER ISSUES IN THE BALTIC SEA REGION

1) Long-term monitoring and national funding

The purpose of marine litter monitoring is to identify trends and potential actions to reduce marine litter. From the information it will not be possible to identify the total amount of litter but with long-term marine litter monitoring it will be possible to identify trends. Since beach litter monitoring often is carried out by NGOs - the support from national authorities with national funding is needed. The EU member states have the responsibility to monitor marine litter according to the MSFD.

2) Beach litter monitoring -The most cost-effective tool to understand marine litter

Even though beach litter only stands for a small proportion of the total amount of marine litter, it is a visible and tangible sign of marine litter pollution. Monitoring beach litter is a primary tool that provides information about marine litter at large. Beach litter is also suggested as a main indicator for marine litter pollution by the MSFD GES Technical subgroup on marine litter²⁹ and it is of great importance to use different beach types in order to understand the sources.

To monitor beach litter is also the easiest and most cost-effective way to understand the sources and trends and to evaluate the effectiveness of management of mitigation strategies. The monitoring teams in MARLIN have been recruited on a grass-route level which is both cost-effective (low costs for labor, travel) and has relevance among those who is doing the monitoring. High expertise is not needed and the equipment used is simple (for example compared to analyses of benthic or pelagic litter).

3) A harmonized method in a local-regional context and sharing of data

Each country should have both national and local data. Many mitigation actions are on the local level (i.e. the sources) and the data for a specific reference beach is important for the local governments. But in order to understand the information and draw conclusions the data needs to be put into a larger context on a regional scale. The sea knows no boundaries – and sources of litter might come far away from home. Different places also have great variations of litter. Therefore the number of reference beaches should be at least 20 within a region with a mix of urban, rural and peri-urban beaches on a national scale.³⁰ The MARLIN project started with 5 reference beaches in each country. The MARLIN database provides a platform to develop a regional action plan for marine litter in the Baltic Sea.

29 JRC/IES (2011): *Marine Litter Technical Recommendation of MSFD Requirements*
30 UNEP/IOC (2009): *Guidelines on Survey and Monitoring of Marine Litter*

4) Marine litter, Marine Strategy Framework Directive and possible targets

Member states have been facing difficulties to set reduction targets on marine litter. The reason is partly due to the lack of knowledge on the present status regarding amounts and composition of marine litter. We strongly suggest a quantitative reduction. Currently the term “significant reductions” is commonly used, but is too vague. But without a known “baseline” it will be useless to set targets. The first step is to start monitoring and include marine litter as a real indicator in order to achieve good environmental status in the Baltic Sea by 2020, as stated in MSFD. In the meanwhile common operational targets can be identified for e.g. prevention measures related to awareness-raising campaigns, improved cleaning and waste infrastructure.

5) The Baltic Sea Strategy and waste management

Marine litter is a mirror of our production and consumption patterns on land. Attitudes related to littering, waste management and cleaning routines are reflected in the sea. Operational targets aiming for a sound waste management on land are important actions to reduce marine litter. A strategy like the Baltic Sea Strategy is an important political and economic tool for a sustainable growth in the Baltic Sea Region.³¹ Unfortunately the strategy is not acknowledging waste management at all and it’s potential for economic growth and sustainable development.

6) Monitoring and raising awareness

The main purpose of monitoring marine litter is to collect data and draw conclusions on trends over seasons and years as well as to identify differences between geographical areas and beach types. From that information conclusions can be drawn on sources and mitigation actions can be identified and evaluated. Therefore it is also a powerful tool to be used in raising awareness, both by communicating the results and also among stakeholders with relevance to the local beach as well as decision makers on national and international level. Local stakeholders should be involved early in order to take action on the most practical aspects to reduce litter (i.e. cleaning routines, number of bins, retailers at the beach, number of toilets etc.). The communication of results become a mitigation action itself and could e.g. be used as an educational programme in schools.



Beach litter monitoring in Estonia.

31 European Commission (2013): *Action plan for the European Union Strategy for the Baltic Sea Region*

7) Monitoring and citizen science

Citizen science – meaning information and observations obtain from the “public” with no real coordination or quality control – can result in a broad and useful knowledge. But we strongly suggest building up a structure in order to ensure quality. In a structured monitoring program a network of national coordinators should agree and use a common method and have close contact with the monitoring teams with at least one workshop per year to ensure quality. These two ways of collecting information seems like the most effective way to both get more information on marine litter and to raise awareness at the same time.

8) No-special-fee-system

Sea-based sources of litter for example from shipping are not dominant on beaches in the MARLIN project. Since the 1990s the HELCOM member states have been implementing measures to improve port reception facilities of waste and HELCOM also recommends a no-special-fee system. In order to successfully introduce this good example also in other regional seas we should evaluate and share the lessons learned in relation to waste handling and attitudes on ships in relation to marine litter and evaluate further if reinforcement of current legislation is needed. It's important that this work continues in the Baltic Sea.

RECOMMENDATIONS FOR MUNICIPALITIES TO PREVENT LITTER AND LITTERING (LOCAL ACTION PLANS)

Municipalities have the responsibility for waste handling and cleaning – but the strategic work to reduce littering is rarely included in the local waste management plans. A strategically approach with the aim to mitigate litter has many positive effects on the local level. Economically, environmentally and socially. The following suggestions for a strategic approach for local governments has been developed by Keep Sweden Tidy together with the Swedish Environmental Protection Agency.³²

- Create an organisation with a responsible person or group to coordinate the work and act as facilitator for cooperation between different departments
- Increase the knowledge of the local litter situation with litter monitoring and data analyses in order to follow trends, suggest mitigation actions and evaluation (i.e. action plan).
- Cooperate! Involve children and students, arrange or participate in anti-litter campaigns and have a continuing dialogue with local business of relevance.
- Communicate your work to the citizens
- Exchange best practices with other municipalities
- Dedicate financial resources for long-term preventative measures
- Political support is strongly suggested
- Include litter issues in the local waste management plan

Examples on actions related to marine litter (on a local level):

- Improved cleaning routines on beaches and operational routines related to bins and waste handling (adapted to number of visitors)
- Provide waste bins and toilets in the archipelago and coastal areas for tourists and boaters

32 Naturvårdsverket (2013): *Strategiskt arbete för minskad nedskräpning. Vägledning för kommuner*

- Cooperate with retailers on public beaches and other well visited coastal areas
- Improvement of waste reception facilities in marinas for leisure boats and fishing boats.
- Restrictions on smoking on public beaches in certain areas
- Participate in national clean-up campaigns
- Join the Eco-school program³³ or other educational programs on sustainability

OTHER RECOMMENDATIONS BASED ON A JOINT EVALUATION FROM ROUND-TABLE DISCUSSIONS AT THE BALTIC MARINE LITTER CONFERENCE IN STOCKHOLM 22-23 OCTOBER 2013



During the final conference of MARLIN around 70 people participated in small round table discussions in order to give a joint evaluation and recommendation on a future strategic approach for marine litter issues in the Baltic Sea. The participants were asked to rank several alternatives under each question. Some of the questions are in line with the current European public consultation on the establishment of a quantitative reduction headline target for marine litter. A summary of the main reflections of the participants can be seen below and the whole report is presented in appendix 4.

Generally about marine litter in the Baltic Sea:

The major problems for the Baltic Sea are believed to be eutrophication (31%), litter (19%) and hazardous substances (15%) and the negative impact of marine litter is probably related to ingestions and entanglement of litter by animals, health risk for humans due to consumption of affected food and costs associated with beach cleaning. The main sources of marine litter are believed to be related to tourism and riverine transport of litter from various land-based sources. Only a small part of the participants estimate that shipping and pleasure craft (6% and 2%) is one of the main sources of marine litter. 60% believes that litter and littering is



Pictures from the MARLIN conference

probably due to our modern lifestyle and throw-away society in combination with laziness and consumers (individuals) are the main contributor to the presence of marine litter (41%).

Recommendations on what different sectors can do to reduce marine litter:

- NGOs – implement awareness-raising campaigns on the sources and impacts of marine litter
- Policy makers – check and improve local waste management services and motivate and inform citizens on sustainable consumption
- Consumers – give greater consideration to the packaging used when making purchasing choices, avoid single use plastic bags and avoid littering

- Plastic industry – extend and improve producers responsibility over the entire product lifecycle
- Waste management sector – exchange ideas and best practices with other waste professionals, municipalities and other stakeholders
- Fisheries sector – cooperate in initiatives to promote fisheries professionals as “Guardians of the Sea”, including monitoring and fishing-for-litter initiatives
- Shipping sector – ensure that there are no disincentives for vessels to bring their litter ashore rather than dumping at sea
- Port authorities – apply a waste fee system aimed at a maximum delivery of waste from ships

In addition it is of interest to mention previous discussions about marine litter in the Baltic Sea. The following suggestions related to measures of marine litter in the Baltic Sea were concluded by the HELCOM group at the International Conference on Prevention and Management of Marine Litter in European Seas 2013.³⁴

Improved waste management / land filling: There are a number of processes already in place to improve waste management and we should use financial tools like regional funds and enforce current legislations (i.e. training of national judges and launching of infringement procedures in order to force member states to expand infrastructure)

Standard monitoring programs: HELCOM should take into account ongoing work in EU and globally.

Education and Outreach on marine litter impacts: To focus more on awareness of public involving stakeholders on all levels.

NEED FOR FUTURE STUDIES BASED ON MARLIN RESULTS

Identify reference beaches from the whole Baltic Sea Area and sharing of data among the countries.

HELCOM has recently agreed to present a regional action plan for marine litter in the Baltic Sea by 2015. We suggest that the method used should be comparable to other international guidelines. The MSFD Technical subgroup on marine litter has recently presented a draft report on monitoring guidance for EU countries. The MARLIN database provides a starting point to develop this work further in the Baltic Sea. Reference beaches should represent a diversity concerning usage and location.

Identify highly affected areas where litter tends to accumulate. Modeling of sea currents and accumulation areas is useful in order to further understand the nature of marine litter and to identify amounts, composition, transport, origin and impacts of marine litter both on the coast and on the sea floor.

Accumulation of litter on the sea floor (benthic litter) should be investigated further, especially in the Baltic Sea. In two international trawl surveys the amount of sea bed litter in the Baltic Sea was twice as high (0.2 kg litter/km) as in the North Sea (0.098 kg/km)³⁵. Modeling of sea currents and information about accumulation areas of other transported material can be of help as well as geomorphological factors. Also diving methods should be developed.

³⁴ <http://www.marine-litter-conference-berlin.info/index.php>, referred 20.11.2013

³⁵ Havs och Vattenmyndigheten (2012): *God Havsmiljö 2020 Del 1: Inledande bedömning av miljötillstånd och socioekonomisk analys.*

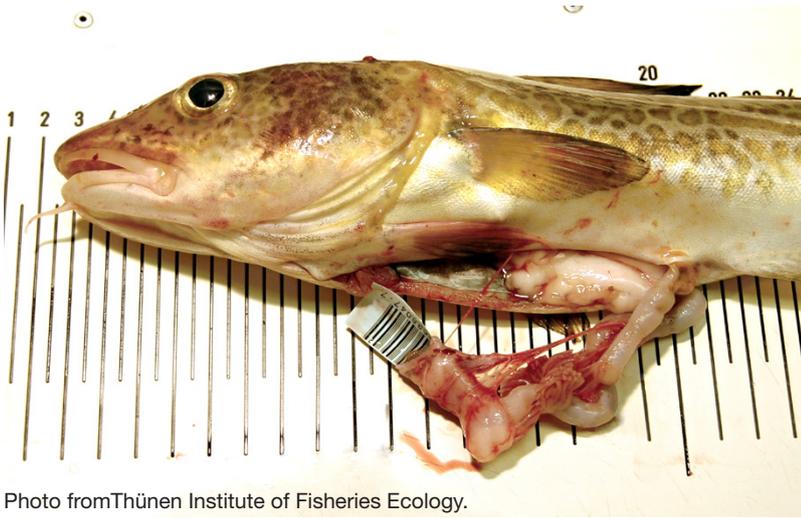


Photo from Thünen Institute of Fisheries Ecology.

Effects on wildlife and ecosystem level needs to be understood further

and suggestions for indicator species needs to be evaluated: OSPAR use the fulmar as an indicator of marine litter but possible species for the Baltic Sea might as well be a fish or a sediment living species (like blue mussels). Fish, bird and marine mammals ingest or get entangled in marine litter – but the effects on ecosystem level is not understood.

The link between macro-litter and micro-litter is not understood: The MARLIN results show that unidentified pieces of small plastic fragments are the most common type of litter. Knowledge on degradation rates for e.g. the age of the unidentified pieces of plastic or number of fouling organisms on the plastic might tell us more about the fate of plastic in the marine environment now and for the future.

The MARLIN results are similar to results from all over the world with plastics being the dominant fraction. Plastic contains harmful substances and hazardous additives and leakage and fate of these chemical compounds into the marine environment are not known. Micro-litter is on the other hand suspected to adsorb persistent organic pollutants and act as a vector of pollutants into the ecosystem. More research is needed.

Sources: The Baltic Sea is an enclosed sea with 90 million people in the drain-off area, 15 major coastal cities and 10 major rivers. The MARLIN top10-list of litter items indicate that typical “littering” is a main source. A special focus on cities (including waste water infrastructure, run-off water and waste infrastructure and littering from the general public) and rivers as sources or transport routes of marine litter is valuable.

Taking the step from attitudes to behavior: The litter on Baltic Sea beaches is mainly from its visitors. The beaches become a source of marine litter but they are probably also recipients of littering in nearby cities. The general attitude that littering is wrong does not necessarily correlate to the actual behavior of littering. Why we litter seems to be more correlated to our modern take away-lifestyle and that our behavior is related to short-term consequences rather than values or attitudes. Behavioral studies on both social and individual level could give all environmental studies interesting and new perspectives on sustainability.

There are no studies on socio-economic effects of Baltic sea marine litter, for example beach litter and aesthetic values in relation to tourism and costs for keeping the beach clean.

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