AN OVERVIEW OF THE RESULTS OF INITIAL ASESSMENTS OF FINNISH, ESTONIAN & LATVIAN MARINE AREAS

Photo: Peeter Laas

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INTRODUCTION

Environmental awareness is continually increasing among the general public. Besides the land and air-related environmental problems, issues connected to marine environment have become more and more acute. Countries along with the EU are now paying more attention to the state of the marine environment.

A framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive, MSFD) was established by The European Parliament and the Council in 2008. The MSFD sets a target for achieving good environmental status (GES) in European seas by the year 2020.

The main aim of the GES-REG project was to support coherent and coordinated implementation of MSFD in the central and north-eastern sub-regions of the Baltic Sea – in the Gulf of Finland, northern part of the Baltic Proper and Gulf of Riga (Figure 1).

According to MSFD article 8, Member States had the obligation to prepare Initial Assessments (IA) of their marine waters consisting of:

- an analysis of the essential features and characteristics, and current environmental status of marine waters;
- an analysis of the predominant pressures and impacts, including human activity;
- an economic and social analysis (ESA) of the use of marine waters and of the cost of degradation of the marine environment.

The Initial Assessment reports aimed to provide overviews of the countries' marine environmental conditions and pressures affecting them.

As the countries Initial Assessments are based on the already available data and the monitoring and assessment methods differ by countries the environmental statuses are not one on one comparable between the countries. Finland is assessing the environmental statuses by sub-basins whereas Estonia and Latvia have assessed their status by the characteristics of marine environment.

This booklet summarizes the results of the Finnish, Estonian and Latvian Initial Assessment reports and presents results of the pilot studies carried out under the GES-REG project.

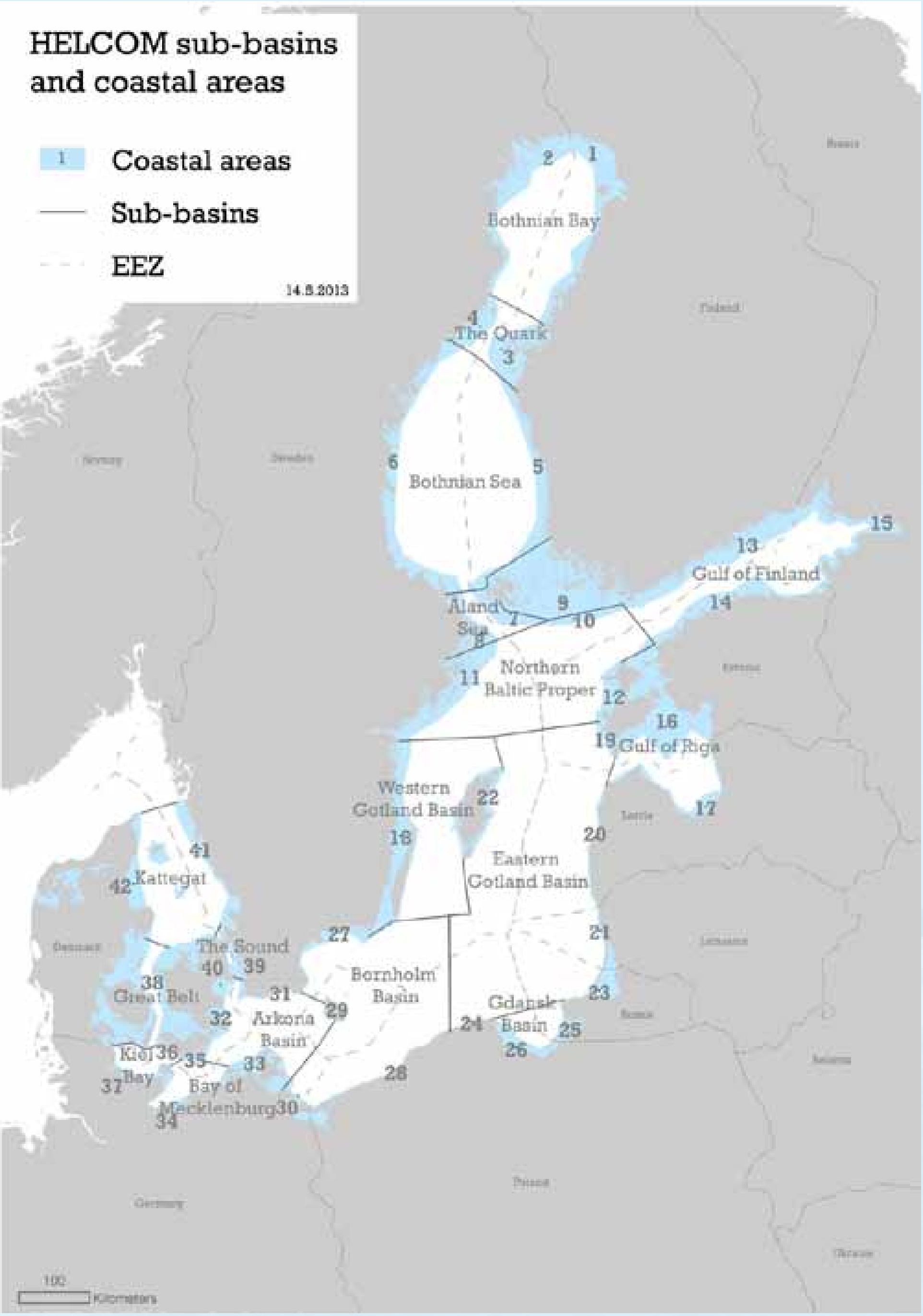

Image 1.
HELCOM costal areas, sub-basins and Member States exclusive economic zones (EEZ).

FINLAND

Marine waters under the jurisdiction of Finland include waters in the Northern Baltic Proper and in two large bays, the Gulf of Finland and the Gulf of Bothnia. The area of Finnish territorial marine waters is 55.800 km^2, combined with the EEZ (exclusive economic zone) of 29.100 km^2, making up roughly 22 % of the Baltic Sea area.

The state of Finnish marine waters is influenced by the processes and factors originating from land as well as from the sea. Analysis of the characteristics of marine environment and human pressures revealed well-known problems such as eutrophication, hazardous substances, introduction of non-indigenous species (NIS), loss of biodiversity and effects of high fishing pressures on fish stocks. According to the Initial Assessment report none of the Finnish territorial marine sub-basins can totally be classified under the category of "good environmental status".

The Gulf of Finland sustains a number of anthropogenic pressures: high input of nutrients, organic matter and hazardous substances, as well as heavy maritime transport. The Gulf of Finland 137Cs-concentrations (originating from Tshernobyl) in its sediments are sometimes 20 times higher than the target set by HELCOM.

A specific problem in the Gulf of Bothnia is caused by acid sulphate soils in areas that are affected by natural land uplifting as well as human activities such as drainage and flood protection. The acid water dissolves metals and this toxic solution is a threat to marine biota.

It became evident from the assessment process that in order to assess the environmental status appropriately according to all 11 descriptors listed in the MSFD, more information and research is needed (field data, monitoring as well as indicator development). Current knowledge is insufficient for evaluating e.g. the acid water combined with dissolved metals; structure and substrata composition of the seabed habitats; NIS; cumulative effects of hazardous substances on biota; marine litter; and underwater noise and their effects on the marine environment.

The initial economic and social analysis of the use of marine waters showed that the Finnish marine environment is a significant source of socio-economic benefits. Fisheries, maritime cluster (industries, shipping, port operations) and tourism and recreation make up the majority of the benefits. An expert assessment on the future of marine-related sectors shows mostly stable or growing trends, indicating increasing economic and social importance but also increasing human induced pressures on the marine environment. Thus more comprehensive management of economic activities is needed in order to reduce or mitigate these pressures.

The value of the ecosystem services, calculated as the potential difference between GES and the situation that might occur in the absence of measures to obtain GES, can be interpreted as the cost of degradation. According to a study about people's willingness to pay for reduced eutrophication, the cost of degradation due to eutrophication in Finland is 200 million euros per year. Since this estimate is based only on people's willingness to pay for reduced eutrophication, the figure is likely an underestimate of the total costs.

In conclusion, according to the Initial Assessment report none of the Finnish marine sub-basins can fully be classified under the category of "good environmental status". The outlined environmental problems are eutrophication, hazardous substances, introduction of non-indigenous species, loss of biodiversity and effects of high fishing pressures on fish stocks. The listed problems are caused mainly by anthropogenic pressures such as high input of nutrients, organic matter and hazardous substances, as well as heavy maritime transport. According to economic and social analysis the future of marine-related sectors shows mostly stable or growing trends and therefore increasing human induced pressures on the marine environment. However, to assess the environmental status appropriately according to all 11 descriptors listed in the MSFD, more information and research is needed.

ESTONIA

Marine waters under the jurisdiction of Estonia include waters in the Gulf of Finland, Gulf of Riga, Northern Baltic Proper and eastern Gotland Basin. The total area of Estonian marine waters is 36 500 km^2, approximately one third of it is the Exclusive Economic Zone (11 300 km^2).

The state of the Estonian marine waters is influenced by the processes and factors originating from land and sea. Analysis of the characteristics of marine environment showed problems already known before (eutrophication of the marine environment, introduction of non-indigenous species, overexploitation of fish stocks). The analysis presented in the Initial Assessment report concluded that the situation in Estonia can be classified under the category of "good environmental status" in several aspects, e.g. the concentration of radio-nuclides is low, the concentration of hazardous substances in most areas does not exceed the limit values, biodiversity is mostly in "good environmental status", the distribution and state of the marine habitat types are also in "good environmental status" in majority of the assessed areas. The analysis also pointed out fields where it is not possible to assess the environmental status due to the lack of data or expertise (structure and substrata composition of the seabed, distribution of underwater noise, effects of marine litter on marine biota and habitats).

The analysis of human induced pressures showed that in most cases the affected areas are local and situated near to the shore while the intensity of human activities is relatively low.

According to economic and social analysis of the use of marine waters the share of employment, tax income and value added in marine sector in Estonia in 2010 was comparing to other sectors two times higher than the national average for one person. The greatest value added was in sectors related to harbours and their operating services, also the biggest number of people was working in those sectors comparing to other marine sectors.

Development analysis of marine related sectors shows stable or even increasing trend of the marine water use up to year 2020. The continuing increase of economy and use trends will influence the marine environment. One of the most important influences on Estonian marine environmental status is eutrophication which originates from agriculture and communal sewage services as well as ports, sea cargo transport and fishing.

The cost of degradation was analysed from the eutrophication point of view. According to people's willingness to pay the cost of degradation due to eutrophication can be estimated to 17 million euros per year. In addition potential costs of degradation due to hazardous substances and non-indigenous species were derived from data provided by neighbouring countries.

In conclusion, the status of Estonian marine waters can be considered “GES” in terms of radio-nuclides, hazardous substances, biodiversity and habitats, however there are some problematic fields (high nutrient level causing eutrophication, introduction of non-indigenous species caused mainly by increasing ship traffic, overexploitation of fish stocks) where the anthropogenic pressure is still quite high and according to economic and social analysis can increase with continuing increase of economy and use trends. In addition there are fields where it is not possible to assess the environmental status due to the lack of data or expertise and therefore further studies and monitoring are needed in those fields.

LATVIA

Latvian marine waters include waters in the Baltic Proper (Eastern Gotland Basin) and Gulf of Riga, and their total area comprises 7.7 % of Baltic Sea. Most (40 %) of Latvian marine waters are rather shallow, 20 – 50 m deep, and only 3 % are deeper than 200 m.

The Initial Assessment was compiled based on existing information incorporated in national, HELCOM and The European Monitoring and Evaluation Programme (EMEP) reports. However, not all existing information was of use due to different assessment units used.

According to the Initial Assessment report, internal processes and external loads such as riverine, point source, atmospheric deposition and sea trans-boundary loads influence the state of Latvian marine waters. There is quite substantial conceptual understanding of these processes, however, very often spatial or temporal availability of information was not sufficient to satisfy assessment requirements. Therefore, analysis of the state characteristics of marine environment was performed only for some descriptors.

The Latvian Initial Assessment analysis showed that eutrophication-related environmental status is considered as "non-GES". At the same time, benthic communities in those areas where data availability enabled analysis showed "GES". This conclusion was supported by the observed near-bottom oxygen conditions. The commercially exploited fish population status is assessed to be "non-GES" for herring while good for sprat and cod populations. Although, generally it was not possible to assess the impact of hazardous substances; the assessed levels of those substances that are regulated by the Community legislation were below threshold values.

According to the Economic and Social Analysis of the use of marine waters the share of employment and value added in the sectors directly related to the use of marine waters was higher comparing to other sectors in 2009 The largest number of employees was in sectors related to marine tourism & recreation. The largest value added and tax revenues were in sectors related to the port operations as in other analysed countries.

Projected development of marine sectors showed stable or increasing (in some cases) trends of the use of marine waters to 2020. The most active increase is projected for the marine shipping and port operations.

The costs of degradation were treated as "foregone benefits" due to reduced provision of ecosystem goods and services (EGS). These indicate a range of 11-57 million euros per year for maintenance of marine biodiversity and habitats and 4-7 million euros per year for environment for tourism and recreation, enjoyment of scenery if transferring values from economic valuation studies in other Baltic Sea countries. However, uncertainty of such estimates is high.

Also the cost of degradation due to eutrophication was estimated. It indicated a range of 50-64 million euros per year (if using 'value transfer method' - the estimates are based on economic evaluation studies conducted in other countries). However, these are high-uncertainty estimates – results from a valuation study covering all the Baltic Sea countries provides significantly lower value - 7 million euros per year for Latvia.

In addition, specific costs to society due to marine litter (beached macroalgae also included) and coastal erosion were estimated. Data were obtained from a survey of coastal municipalities. The results showed that the costs of cleaning beaches from marine litter and algae were around 189 thousand euros in 2010.

Average costs of measures taken for reducing coastal erosion were 50-57 thousand euros per year.

In conclusion, very often spatial or temporal availability of information was not sufficient to satisfy assessment requirements. Therefore, analysis of the state of marine environment was performed only for selected descriptors. The status of Latvian marine waters can be considered "GES" in terms of benthic communities, near-bottom water oxygen conditions and the commercially exploited fish population (sprat and cod). However the eutrophication-related environmental status and population status of herring are considered as "non-GES". Although, generally it was not possible to assess impact of hazardous substances the levels of those substances were below threshold values.

PILOT STUDIES

The project countries' Initial Assessment reports showed that there are fields where it is not possible to assess the marine environmental status due to lack of data or expertise.

In the frame of GES-REG project a few small-scale pilot studies were carried out on marine and beach litter, non-indigenous species and underwater noise to fill in the knowledge gaps.

Hereafter results of the marine litter and non-indigenous species pilot studies are presented.

Marine and beach litter

Studies were carried on different topics related to the marine and coastal litter in different survey areas in the North-Eastern Baltic Sea.

Marine litter which can be divided into micro- and macrolitter consists of a range of materials including plastic, metal, wood, rubber, glass and paper. Although the relative proportions of these materials vary according to the regional sea concerned, plastics are by far the most abundant type of litter in terms of the number of items.

Most plastics are extremely durable materials and are likely to persist in the marine environment for a considerable period, possibly as much as hundreds of years. However, plastics also deteriorate and fragment in the environment as a consequence of exposure to sunlight (photo-degradation) in addition to physical and chemical deterioration, which is likely to result in numerous tiny plastic fragments called micro-plastics.

Micro-plastic particles may be introduced to the Baltic Sea planktonic food web through different mesozooplankton taxa who mistakenly consider it as a food and thus accumulate in planktivorous fish or larger invertebrates.

GES-REG partner Finnish Environment Institute (SYKE) carried out case study on microlitter. In this study they experimentally tested the potential of different zooplankton taxa to ingest microplastics, in order to find information on possible negative impacts in the food web and whether ingested plastic particles would pass through the animals or clog the digestive tract. In addition they did field studies in order to investigate the occurrence and composition of microplastics in the open Gulf of Finland.

Tests showed that all zooplankton-groups studied ingested plastic beads during the incubations. In general the increase of bead concentration increased also the percentage of animals that had ingested beads. Study results of the passage of ingested beads in the digestive tract found that after 12h incubation with beads 67% of all animals had ingested beads. After 12h incubation in particle-free seawater only 3.7% of all individuals contained beads. Thus results indicate that microplastic particles may be transported from the water column into the food web, through different organism groups of mesozooplankton to higher trophic levels, and thus accumulate in planktivorous fish or larger invertebrates.

Microscopical analysis of particles from the 300 µm and the 10µm net filtrations were carried out. The 10µm net filtrations were difficult to study, and the results may be over- as well as underestimates of the amount of debris. To be sure of contents of the smaller fraction, the samples should be re-analyzed with some other method designed for material analysis. From this dataset differences between stations were observed. The highest numbers of marine debris were found at the two easternmost stations of Gulf of Finland and high numbers were also found at the station in the middle of the Gulf of Finland between Tallinn and Helsinki.

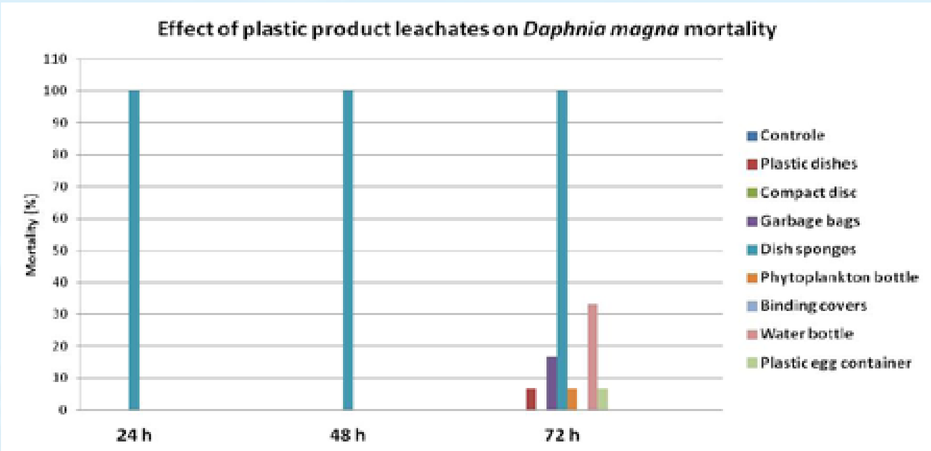

Figure 1.
Effect of 8 different plastic product leachates on Daphnia magna mortality after 72 hours exposure (filtered with GFC/C).

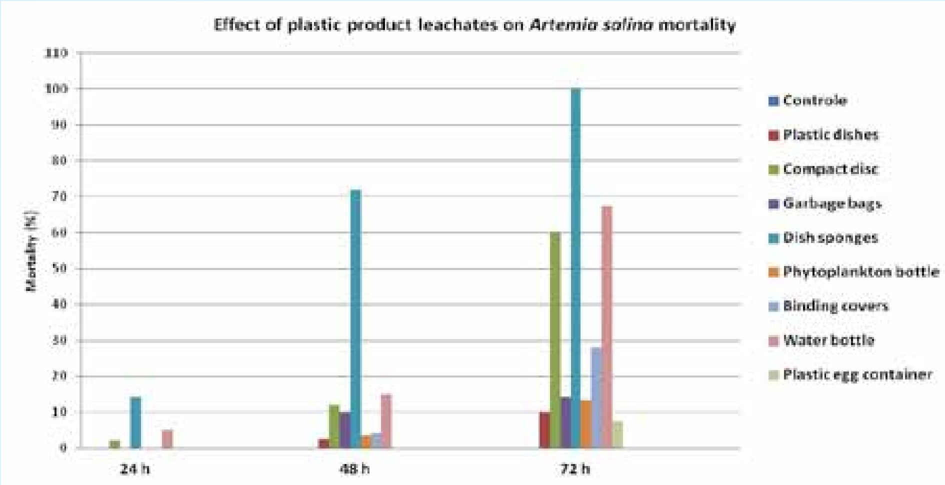

Figure 2.
Effect of 8 different plastic product leachates on Artemia salina mortality after 72 hours exposure (filtered with GF/C).

GES-REG partner Latvian Institute of Aquatic Ecology (LHEI) carried out a pilot study on potential toxicity of microlitter. Tests showed that 60 % of all investigated plastic products caused a negative impact on the test organisms zooplankton Daphnia magna and Artemia salina causing their death (Figure 1 and 2).

The most toxic from all tested plastic products were dish sponges (made from polyurithene - PU), evoking 70 – 100 % mortality after 24 – 72 hours exposure in dish sponge's leachates. The lowest negative impact was caused by leachates from plastic dishes (made from polypropylene - PP), from binding covers (polyvinyle chloride - PVC) and plastic egg containers (polystyrene - PS).

In Estonia coastal macrolitter surveys were performed in three sites in the Gulf of Riga and Gulf of Finland. Studies indicated that the dominating type of litter across all three study areas was plastic/polystyrene making up to 86% of the total amount of litter (Table 1) (image 2).

Item	Häädemeeste	Varbla	Nõva
PLASTIC / POLYSTYRENE	2 558.1 (w/w) / 20.3 pieces 1 339 (d/w)	709,2 / 20.3 pieces	1 546 / 24.9 pieces
PAPER / CARDBOARD	19.5 / 1.1 pieces	23.3 / 1.0 pieces	6.4 (w/w) / 2.9 pieces 4.1 (d/w)
GLASS		140.0 / 0.8 pieces	64.9 / 0.6 pieces
WOOD (MACHINED)		305.1 / 0.3 pieces	364.3 / 3.4 pieces
RUBBER	2.3 / 0.9 pieces	0.3 / 0.3 pieces	58.3 / 1.4 pieces
CLOTH	375.7 / 1.4 pieces	52.1 / 0.5 pieces	1 648.6 (w/w) / 0.6 pieces 1 154.3 (d/w)
METAL	23.1 / 0.9 pieces	4.6 / 0.5 pieces	23.1 / 1.7 pieces
	2 978.8 g (w/w) 1 759.6 g (d/w) 24.6 pieces	1 234.7 g 23.6 pieces	3 711.6 g (w/w) 3 215.1 g (d/w) 35.4 pieces

Table 1.
Results of the coastal litter sampling in three sites at Estonian coast. Litter weight is given in grams either in wet weight (w/w) and/or dry weight (d/w) per 100 m coastline. In case wet and dry weights are similar, no unit is given. Litter number (per 100 m coastline) is indicated in pieces.

Image 2.
Litter from one of the sampling site Häädemeeste
(Photo taken by Estonian Marine Institute, University of Tartu).

Non-indigenous species

Study on the impact of non-indigenous round goby on benthic environment

A pilot study on the impact of round goby (Neogobius melanostomus) (Image 3 and 4) on benthic environment was carried out in the Latvian coastal waters in the eastern part of the Baltic Proper near Pape.

Image 3.
Round goby in his natural environment. (Photo by Juris Aigars).

Image 4.
Round goby on ruler (Photo by Solvita Strāķe).

Round goby is one of the fish species that has successfully invaded different marine habitats in Europe. Habitat occupied by round gobies within their natural distribution range is shallow coastal zones with rocks, gravel and sandy bottom and up to 20m depth. Benthic invertebrates – crustaceans and molluscs – are the most common food items of the round gobies, however also polychaetas, small fish and fish eggs as well as larvae of chironomids can be included in the diet. In Baltic Sea bivalves especially blue mussels (Mytilus trossulus)(Image 4) are the most important food source for adult round gobies. Round gobies are very aggressive and territorial and their predation on early stage native fish is linked to decline of native benthic fish populations. Also a negative correlation between abundance of round goby and flounder (Platichthys flesus) has been documented in the Gulf of Gdansk. Interactions between round gobies and benthic invertebrates change food web dynamics by directly and indirectly affecting energy flow of benthic communities in nearshore areas.

For the pilot study fish were caught, their digestive tracts were analysed and age was determined. In addition the density of round goby in the catch was determined visually. Furthermore soft- and hard bottom macrofauna were sampled and the species distribution and coverage were estimated in the study sites.

Round goby was first found in Pape area during fish monitoring in 2010. At the time of the study in August 2012 it was the third most abundant species in coastal waters of Pape. The total number of caught fish per area is shown in Table 2 (historical data are based on annual coastal fish surveys).

Sampling location	2006	2007	2008	2009	2010	2011	2012	Total
Bernati					5	110		115
Liepaja	8	53	280	254	1323	1125	2381	5424
Pape					46	195	539	780
Total	8	53	280	254	1374	1430	2920	6319

Table 2.
Total number of round goby in scientific surveys using Coastal net series.

The study (end of July and in early August) showed that the number of round gobies increases in correlation with the increase of depth. This can be explained by changes in bottom substrate type, since in deeper areas (deeper than 8 m) the bottom substrate is composed of boulders, shingles and gravel, which is typical habitat for round goby; besides, these boulders and shingles are covered with blue mussel – a prey for round goby. On the contrary, the habitats of the native flounder (Image 5) feature sand to sit and hunt on, that explains the abundance of flounder in shallow areas up to 10 m. However, take into account that results in other seasons might differ. For example, further studies showed that in spring (unpubled data from May 2013) when it is observed the highest spawning intensity of round goby the largest number of fish are found in the shallow part (above 5 m) (Figure 3).

Image 5.
Flounder on blue mussel bed (Photo by Juris Aigars).

Image 6.
Baltic macoma - in the photo we can see clams with siphons and that means that they are in the good shape
(Photo by Rita Poikane).

Round goby is a benthic species therefore it competes for prey items with other benthic fish like flounder and vimba in the coastal waters of Pape. When comparing the frequency of occurrence of prey items in the stomachs of those three species it was found that blue mussel and Baltic macoma (M. balthica) (Image 6) were most common in round gobies' stomachs whereas Polychaeta and Amphypoda dominated in stomachs of flounder and vimba.

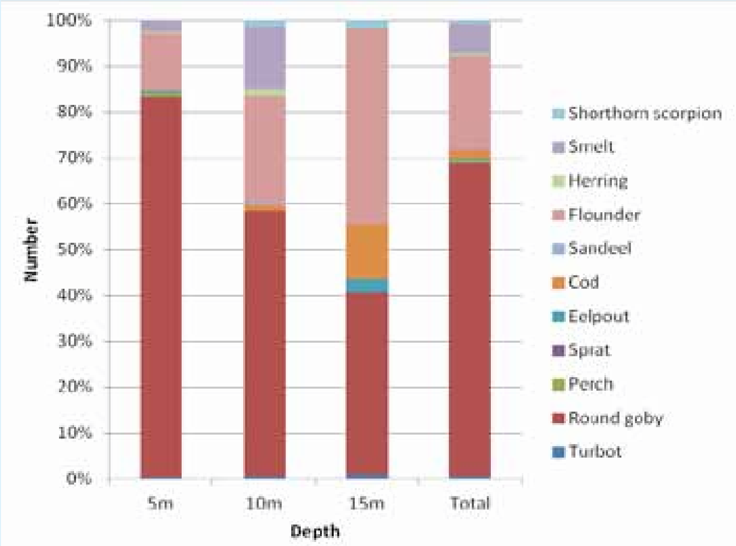

Figure 3.
Percentage of fish caught by Nordic coastal survey nets in 5, 10 and 15 meter depth at littoral of Pape, during end of May (2013).

It suggests that competition for prey items between round goby and other two species is insignificant. But such comparison does not allow to judge about the proportion of each prey item in the stomach. Hence by comparing the relative proportion of different prey items in competing benthic fish stomachs it was found that the keenest competition is for Baltic macoma (Figure 4).

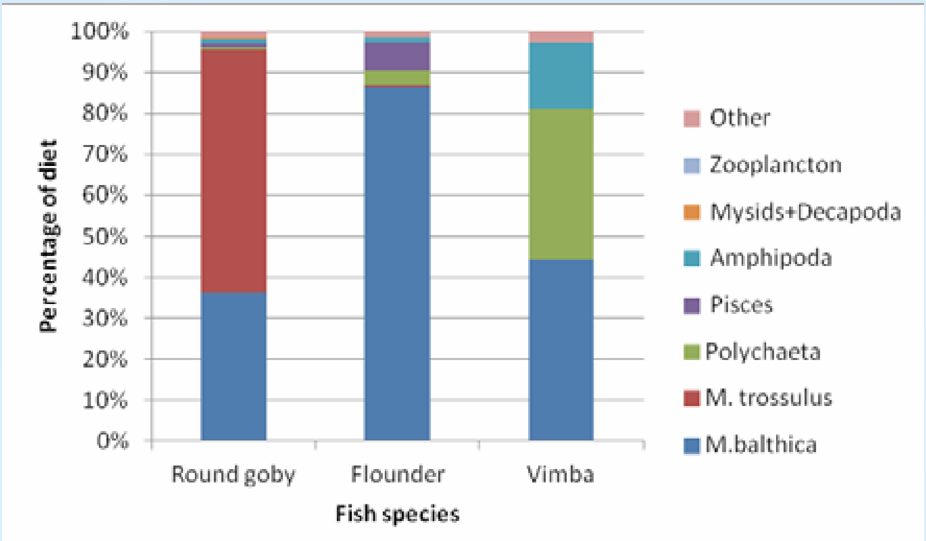

Figure 4.
Relative proportion of different prey items in competing benthic fish stomachs at littoral of Pape, during end of July and in early August.

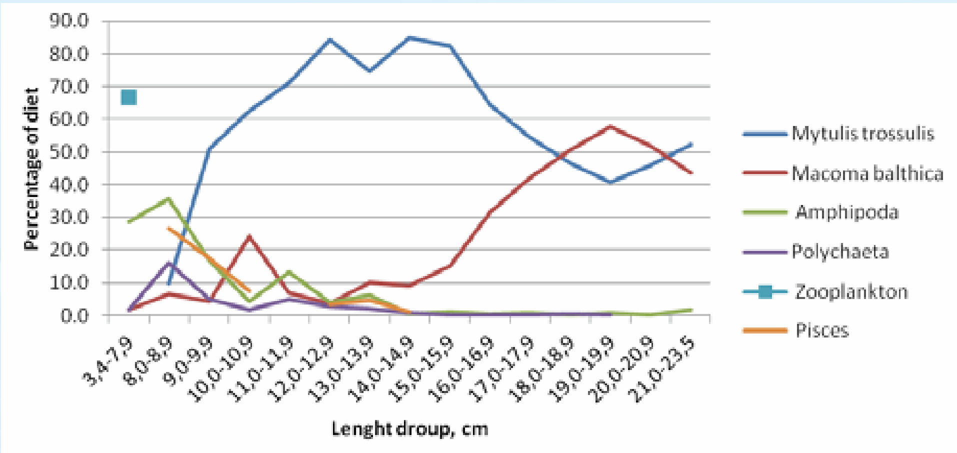

Figure 5.
Relative proportion of different prey items in round gobies digestive tracts.

Altogether these facts suggest that round goby has found an unoccupied feeding niche in coastal area of Pape, and it is not threatened by competition for prey items with other species. On the other hand, the conclusion is not unambiguous because during some stages of development round goby's range of prey items overlaps with those of other species. The study showed that Amphipoda, Polychaeta, fish larva and zooplankton are the main components in round gobies' stomachs with length up to 10 cm and the proportion of bivalves increases sharply with age (Figure 5).

The study provided further evidence that the invasion of round gobies into littoral of Pape has the potential to change trophic interactions of benthic communities. A series of complex interactions between round gobies, blue mussel, and other benthic invertebrates can directly and indirectly affect food resources and energy flow, thereby altering the structure and function of littoral zone communities of Pape and in other coastal areas. Thus it degrades the quality of habitat and has a negative effect on biodiversity.

Port biological survey in Muuga Harbour, Port of Tallinn

The pilot study conducted by the Estonian Marine Institute was aimed at testing, further developing and assisting to finalise the HELCOM port survey guidelines. HELCOM port survey guidelines recommend to apply (in addition to ordinary phytoplantkon, zooplantkon and macrozoobenthos monitoring methods) specific sampling gears to collect epifauna and fouling communities. These are: crab and fish traps (images 7 and 8), and scraping tool (image 9).

Image 7.
Crab and fish trap used in Muuga harbour survey
(Photo taken by Estonian Marine Institute, University of Tartu).

Image 8.
Crab and fish trap used in Muuga harbour survey
(Photo taken by Estonian Marine Institute, University of Tartu).

Image 9.
Scraping tool used in Muuga harbour survey
(Photo taken by Estonian Marine Institute, University of Tartu).

For this purpose biological sampling targeting phytoplantkon, zooplantkon, benthic biota and fish was performed in one of the largest ports in the Baltic Sea – Port of Tallinn (Muuga Harbour). The pilot study was carried out to characterise the composition and biomass/abundance of local community. The survey was performed at three terminals – Ro-Ro and container terminal, grain terminal and oil terminal – in September 2012.

The study did not observe any substantial differences in phytoplankton and mesozooplankton communities between the port area and monitoring stations in nearby small bays at the southern coast of the Gulf of Finland.

Benthic biota was sampled by the Ekman-Birge sampler (image 10) and scraping tool.

As the sampling devices substantially differ in terms of their characteristics, results are presented by the two different samplers employed. In total, 5 different benthic invertebrate and 3 algal species were identified in the samples collected by the Ekman-Birge sampler with a strong domination of Baltic macoma. Cryptogenic species were represented by the cirriped A. improvisus only. In contrast, A. improvisus strongly dominated in samples collected by the scraping tool. The species was present in all

Image 10.
Ekman-Birge sampler
(source: www.oichina.com.cn/en/pro/2013-05-10/1368158000191/)

samples. Also, all the three algal species found in Ekman-Birge sampler were present in samples collected by the scraping tool. However, and in addition, several nectobenthic species were presented: these are Praunus flexuosus and Palaemon adspersus. Also, while Macoma balthica was not found in samples collected by the scraping tool, several gammarids were present. Thus, different sampling devices are useful to employ in parallel to investigate and characterise species composition of benthic biota in port areas.

In total, 9 individuals of fish were found in crab and fish traps with all of them being round goby. Neither other fish species nor any Chinese mitten crab individuals were present in traps.

In conclusion, no new alien species were recorded. The current study should be taken as a baseline against which all future results should be evaluated. Overall, the structure of plankton and benthic communities observed in the pilot study largely correspond to the existing scientific evidence. However, to obtain more comprehensive picture, investigations would be essentially required in spring and summer-time.

SUMMARY

Finnish, Estonian and Latvian Initial Assessment results point out main problems in the countries' marine waters which are eutrophication, hazardous substances, introduction of non-indigenous species (NIS) and effects of high fishing pressures on fish stocks. Those problems are caused mainly by anthropogenic pressures such as high input of nutrients, organic matter and hazardous substances, as well as heavy maritime transport. Assessment on the future of marine- related sectors shows mostly stable or growing trends, indicating increasing economic and social importance but also increasing human induced pressures on the marine environment. Thus more comprehensive management of economic activities is needed in order to reduce or mitigate these pressures.

In addition, there are fields where it is not possible to assess the environmental status due to the lack of data or expertise. Therefore to assess the environmental status appropriately according to all 11 descriptors listed in the MSFD, more information and research is needed (collection of field data, development of monitoring methods and indicators).

In the frame of GES-REG project small-scale pilot studies were carried out on marine and beach litter, non-indigenous species and underwater noise to fill in the knowledge gaps. Most of the pilot studies' results were presented in this booklet.

Study on the toxicity of microlitter on zooplankton indicated the toxic effect of microlitter (micro-plastic) on zooplankton who mistakenly consider it as food and thereby micro-plastic particles may be introduced to the Baltic Sea planktonic food web and thus accumulate in planktivorous fish or larger invertebrates.

Coastal macrolitter surveys indicated that the dominating type of litter across all study areas was plastic/polystyrene making up to 86% of the total amount of litter.

Study on the impact of non-indigenous round goby on benthic environment provided further evidence that the invasion of round gobies has the potential to change trophic interactions of benthic communities.

Port biological survey in the Muuga harbour found no new alien species. The current study should be taken as a baseline against which all future results should be evaluated. Overall, the structure of plankton and benthic communities observed in the pilot study largely correspond to the existing scientific evidence.

The pilot studies can be used as baseline for development of indicators and assessment approaches in the future.

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Finnish Environment Institute

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