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Maritime Transport and Maritime Spatial Planning

Cross-border case study

ABSTRACT

Title: Maritime transport and Maritime Spatial Planning

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Abstract: The general aim of this study is to examine the role of the maritime transport in Maritime Spatial Planning (MSP). The target group are planners, stakeholders, decision makers.

The study outlines and maps the marine space contemporary and potential requirements related to expected developments of maritime transport and ports in the Plan4Blue project area.

The case also looks at how MSP can support sustainable development of maritime transport.

During the publishing of this report both the Estonian and Finnish MSP processes were ongoing. According to directive 2014/89/EU national maritime spatial plans shall be established as soon as possible, and at the latest by 31 March 2021.

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CONTENTS

1. BACKGROUND

International Maritime Organization (IMO) is the intergovernmental organization tasked to regulate global maritime transport. “IMO is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine and atmospheric pollution by ships. Its main role is to create a regulatory framework for the shipping industry that is fair and effective, universally adopted and implemented. IMO measures cover all aspects of international shipping to ensure that the sector remains safe, environmentally sound, energy efficient and secure” (IMO, 2019).

The aim of EU regulation is to safeguard free movement of goods and people within the EU. Most of the actions on community level concerning maritime transport have been taken as a response by the member states to the changes in the international maritime environment. Such changes have mainly been caused by marine accidents and oil spills. A good example of EU regulation is the Port State Control Directive which targets substandard ships (EUR-Lex, 2009). In 2014 EU established a framework for maritime spatial planning (MSP)” aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources” (EUR-Lex, 2014). According to the framework Member States shall establish a maritime spatial plan, which is a tool for long-term planning of marine space.

MSP follows all the relevant existing regulations and conventions. In Estonia MSP itself is regulated by Planning act and in Finland by Land Use and Building Act. There will be one marine plan for the whole Estonian marine area, where internal waters and EEZ are part of this area while in Finland eight coastal Regional Councils will conduct actual planning which results in 3 MSPs. In Estonia MSP is in principle a legally binding document while in Finland it is treated more as a strategic document.

Maritime transport is one of the key activities in the sea space. Navigation rules are agreed and set by IMO and most of the agreed regulations are ratified and integrated into national laws by the states around the Baltic Sea. One of the principles mentioned in the United Nations Convention on the Law of the Sea (UNCLOS) are “innocent passage” and “transit passage”. Innocent passage is a right of free passage through territorial waters which exists only as long as the foreign vessel respects coastal state regulations and do not interfere with or threaten the tranquillity of the coastal state. (Smith, 1976 via Burke et al., 1983). Transit passage is solely for the purpose of continuous and expeditious transit of the strait between one part of the high seas or an exclusive economic zone and another part of the high seas or an exclusive economic zone. (UNCLOS, 1982) IMO has also highlighted the Baltic Sea as a Particularly Sensitive Sea Area (PSSA) within which certain specific measures are to be taken, including traffic management and the stricter application of requirements in respect of discharges and equipment (Kopti et al., 2016).

MSP does not foresee considerable spatial changes to maritime transport in the project area. Estonian MSP reflects the shipping lanes published in the navigation information and determines marine traffic areas based on the traffic density and main driving directions. Marine traffic areas have been designated in cooperation with the Estonian Maritime Administration by assessing AIS data. (Rahandusministeerium, Hendrikson&KO, 2019). In Finland existing navigation and port information is taken into account and maritime transport is tackled as one of the main sectors in MSP.

The shipping routes are transnational by nature, which means that efficient, effective, sustainable and safe planning requires cross-border cooperation. Baltic Sea is one of the most intensively trafficked areas in the world with a sensitive and vulnerable ecosystem and occasionally rough weather conditions, which makes its coordinated planning essential (Baltic LINes, 2016). Furthermore, European "Blue Growth" agenda is expected to encourage even more activities to take up space and resources in the limited and sensitive sea area. MSP could play a crucial role in managing shipping when considering the new developments (unmanned and autonomous shipping, offshore wind farms, etc.), larger ships, increased trade volumes and new policy guidelines.

So far, the Estonian and Finnish maritime sectors have not experienced any spatial conflicts with other interests in the planning context. Shipping industry is dependent on many variables: economic fluctuations, standards, guidelines and regulations, technological developments and climate change. Artificial structures and other new uses in the sea may raise the discussion about the potential increase of navigational risk, and may push the development of risk management plans.

Information used in this report is based on the literature review and stakeholder workshops. Workshop participants were a mix of academia, industry and government representatives, whose daily work is connected with maritime transport.

1.1 Objective of the report

Plan4Blue maritime transport case aims to outline and map the marine space contemporary and potential requirements related to expected developments of maritime transport and ports in the project area.

The case also looks at how MSP can support sustainable development of maritime transport. Shipping induced environmental pressures are analysed together with the stakeholders.

The objective is to explore issues that are most vital to the maritime transport - safety, continued operation, business success and efficiency of sustainable eco-socio-technical maritime transportation system. The aim of MSP in the Gulf of Finland region is to allocate the necessary marine space for effective and efficient development of maritime transport and other Blue Economy sectors concerned.

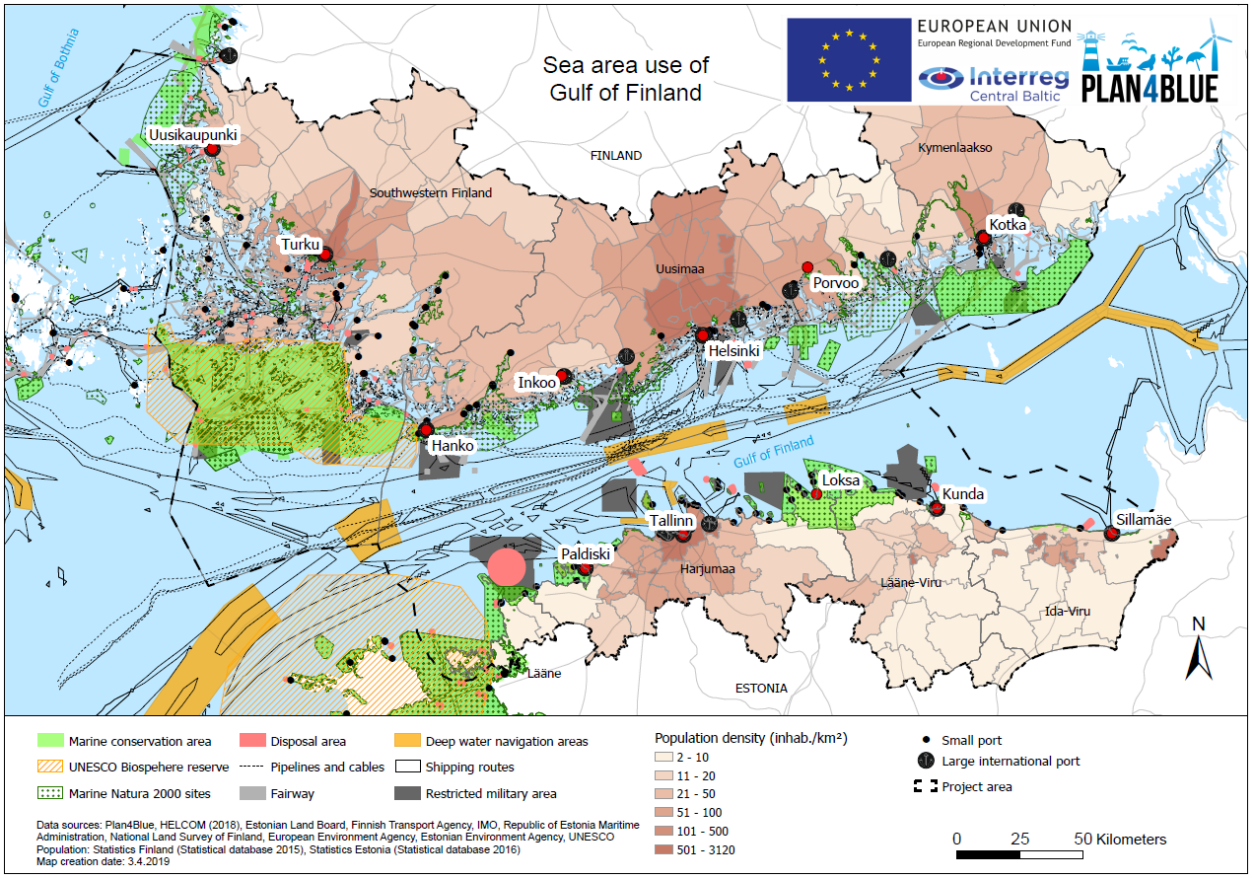
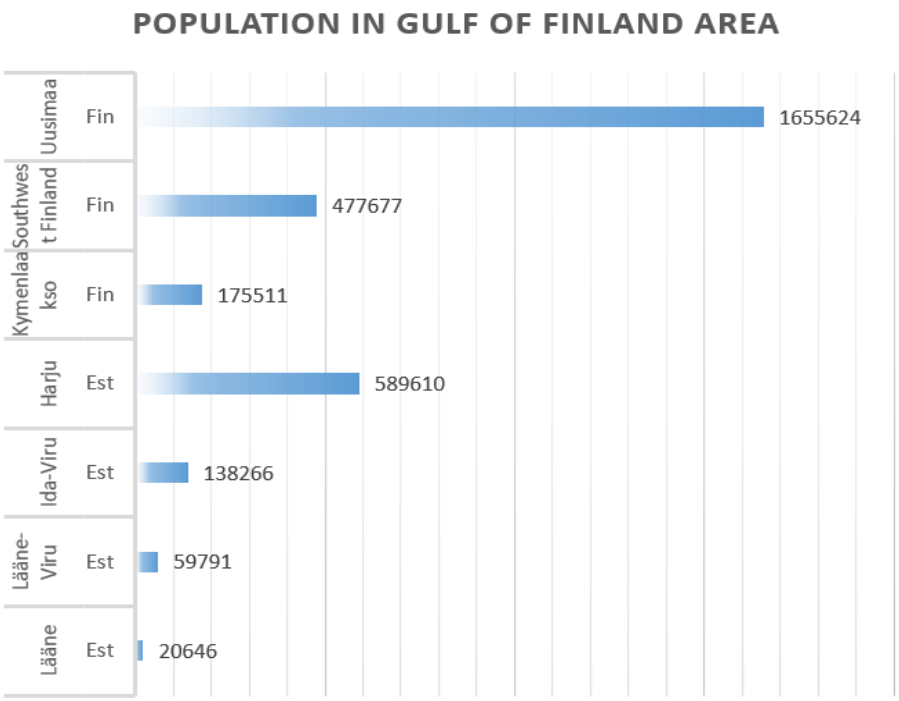


Figure 1. Sea area use and population density in the Gulf of Finland area.

The Gulf of Finland sea area is characterized by sensitive environment, heavy maritime traffic and the multi-use of marine space (Figure 1). According to IMO, the Baltic Sea Area has some of the densest maritime traffic in the world. The Baltic Sea was designated as a Particularly Sensitive Sea Area (PSSA) at IMO Marine Environment Protection Committee's 53rd session in July 2005.

The population in the coastal areas around Gulf of Finland area is 3,1 million (compared to total population of 1,3 million in Estonia and 5.5 million in Finland), 74% of which is on the Finnish side and 26 % on the Estonian side (Table 1). Nearly half (~46%) of the total combined population lives in the coastal areas.

Table 1. Number of people living in the coastal areas around Gulf of Finland.



2. MARITIME TRANSPORT IN ESTONIA AND FINLAND

Finland is highly dependent on maritime transport, as 90 % of exports and 80 % of imports are shipped (Liikenne- ja viestintäministeriö, 2014). In 2016, 48,4 million tons of good were exported through Finnish harbours and 46,5 million tons of goods imported, while passenger traffic totalled close to 19 million persons, nearly half of these from Helsinki to Tallinn (Finnish Transport Agency, 2017). In all, the maritime cluster offers some 43 500 jobs. The Finnish fleet consists of more than 1200 ships, out of which 118 are merchant vessels. These in turn handle about 30 percent of total exports. International shipping routes serve more than 18 million passengers annually (Liikenne- ja viestintäministeriö, 2014).

“In 2018, approximately 10.7 million passengers used the services of Estonian ports in international sea traffic, which is less than in 2017 (10.9 million in 2017). The drop was mainly due to a decrease in the number of passengers travelling between Estonia and Finland, where the number of passengers transported reached 8.9 million. Between Estonia and Sweden, 1.3 million sea passengers were transported, i.e. slightly less than the year before. In the cruise season from April to October, 652,790 cruise passengers arrived by sea to Estonia, i.e. a tenth more than the year before” (Statistics Estonia, 2019a).

60% of Estonia’s export and import is done by sea and most of the transit is carried out through harbours (Estonian Ministry of Economic Affairs and Communications, 2010). According to Statistics Estonia, in 2018, compared to 2017, the number of passengers on the main scheduled domestic ship lines increased by 3% (to 2.5 million), the number of international traffic passengers served by Estonian ports decreased by 1% (6.9 million), the freight volume of ports in tonnes increased by around 3%. (Statistics Estonia, 2019; Statistics Estonia, 2019a). There are currently 27 cargo harbours in Estonia. The bigger cargo harbours are Muuga (1157 foreign vessels in 2017), Paldiski North Harbour (993), Paldiski South Harbour (844), Sillamäe (703) (Rahandusministeerium, Hendrikson&KO, 2019). Estonian state fleet is 325 vessels (Vitismann, 2018) and in total there are 358 ships in the ship register in 2017 (Estonian Maritime Administration, 2018).

Statistics Estonia (2019a) states that “in 2018, Estonian ports handled 35.9 million tonnes of cargo, which is 1.1 million tonnes more than in 2017. 24.5 million tonnes of goods were loaded (4% increase from 2017) and 11.4 million tonnes of goods were unloaded (1% increase from 2017) in Estonian ports in 2018. Transit goods were loaded and unloaded in ports in the amount of 19.1 million tonnes (7 % increase from 2017). 14 million tonnes of transit cargo were loaded and 5.1 million tonnes unloaded in Estonian ports. The most frequently handled group of transit goods in Estonian ports were refined petroleum products (12 million tonnes), the transport of which increased by 6% in a year. The loading and unloading of chemicals and chemical products as transit goods amounted to 6 million tonnes, which is a fifth more than the year before. Sea container transportation through ports increased by 5% compared to the previous year.”

According to the Estonian Maritime Information System (via Statistics Estonia, 2019a), in 2018, the largest number of ships arriving in Estonian ports from foreign ports (9,322) were general cargo vessels (incl. Ro-Ro passenger ships), in addition 944 liquid bulk carriers, 295 container ships, 159 dry bulk carriers, 117 specialised carriers and 340 cruise ships arrived in Estonian ports from foreign ports.

As in Estonia, short sea shipping prevails in Finland. Although the Finnish ports are capable of handling all types of cargo, a majority of all cargo handled by the ports is bulk cargo. Dry bulk is typically delivered by RoRo and RoPax vessels. This is due to the need to deliver the cargo domestically by trucks and due to the trade routes focusing on southern Baltic sea, Baltic states and Sweden. Container traffic mainly arrives to Finland from South Baltic, especially from Lübeck (Fridel, 2015). Regular and comprehensive passenger traffic between Tallinn and Helsinki and partly between Helsinki and Turku and Stockholm is a special feature for the Finnish maritime sector, that also serves cargo traffic and benefits both. (Helsingin satama, 2012). About a quarter of all bulk cargo is transported with passenger vessels operating between Finland and Estonia and Finland and Sweden (Liikenne- ja viestintäministeriö, 2014). Apart from passengers the Helsinki-Tallinn route carries considerable amount of cargo, 2.8 million tons, rising to 4 million tons by 2022 (Helsingin satama, 2012).

Although Finland currently has about 50 harbours used in international shipping, about 80 % of transnational cargo is guided through the ten biggest ports. Four of these are located within the project area (ports of Turku, Hanko, Helsinki and Sköldvik). Outside of container traffic Finnish ports handle products from timber and metal industry. Growth in mining industry may in the future have a major influence on shipping, but this scenario includes great uncertainties. Crude oil and petroleum products form a major part of bulk cargo both in Southern Finland and the Gulf of Finland as a whole. (Liikenne- ja viestintäministeriö, 2014).

Finland and Estonia are sole countries in the world where all harbours freeze over during a normal winter season. Functioning of the infrastructure in winter is to be secured by stressing the need for adequate ice breaking capacity. Tough ice conditions in the winter require specialised fleet, which slows down the rate of change of the fleet serving Finnish ports (Fridel, 2015).

At the moment, many ports in Southern Finland are upgrading their infrastructure and increasing the draft of their fairways. The main ports also have a readiness to expand and adjust their services to suit any rising needs. Therefore, although changes in the operating environment of the ports are ongoing, it seems that the current port network is well suited to meet foreseeable future demands. Improvements in harbour logistics and infrastructure and in road network and introduction of new service models are ways to increase the competitiveness of the ports further and to maintain current customer relations.

It is to be noted that recent upgrading of the Russian deep-water terminals of Primorsk and Ust-Luga has over the past few years had a major impact on the cargo volumes in the Baltic sea area, as well as on the share of different cargo types and on the balance in transport volumes between eastern and western Baltic. In all, some 40 % of all cargo transported by sea was liquid cargo in 2014 and a vast majority of this crude oil and petroleum products. Over the previous decade the total volume of seaborne cargo transport rose by a fifth. It is seen that this trend will prevail in the coming years (Fridel, 2015). Russia is a major player in container traffic, too, and this strongly impacts the economy and quantity of container traffic in Finnish ports especially through Russia-bound transit traffic. Growth in transportation to Russia not only increases traffic to Finnish ports, but also brings empty containers available for export, thus lowering export costs. Numerous uncertainties on the future of Russian transport exist however, outside economics and trade politics including development of Russian ports both in the Baltic sea and Black sea regions (Venäläinen, 2018).

Overall there is a global trend for the increase in cargo transport, which can be noticed in Estonia and Finland. Maritime sector continues to be very important sector for both Estonia and Finland. In addition, fishing vessels account for a significant part of maritime traffic, especially trawling traffic between the ports and fishing areas. Recreational traffic and leisure boating increases during the summer season, which adds pressure to the coastal areas. (Rahandusministeerium, Hendrikson&KO, 2019).

2.1 Estonian and Finnish strategies related to shipping

2.1.1 Estonian strategies

National Spatial Plan "Estonia 2030+" states that Estonia is open to the sea. International passenger ship services have clustered in the capital. The Old City Harbour in Tallinn handles more than eight million passengers annually (2011) but is ready to receive 1.5 times more. Regular connections by passenger ships could be organized also out of the harbours of Paldiski, Sillamäe and Kunda. Planning is under way for routes between Kunda and Kotka and between Tartu and Pskov. On the Kunda–Kotka route, the ship does not need to sail through the territorial waters of Russia, as it did on the Sillamäe–Kotka route, which made the travel time too long and eventually unprofitable. (Estonian Ministry of the Interior, 2013)

One of the drivers of Estonia's development is international freight transport. Providing transit and logistics services is a great export opportunity for Estonia. A location on the east coast of the Baltic Sea provides opportunities to channel both west-east and north-south trade flows. Efficient utilisation of marine space and connecting ports to other infrastructure is one of the main factors in improving Estonia's international competitiveness, enabling it to participate in trade between Russia, Asia and Europe. The cargo ports (particularly Muuga) with their railway

and road connections in the Tallinn area are an important transit and logistics hub. The high-potential harbours of Paldiski and Sillamäe need to be involved in international transport more than currently. The capacities of the harbours of Muuga and Sillamäe are yet to be fully exploited. A number of harbours with a good export potential remain untouched by international transit flows, some ports could improve the competitiveness of the local economies and export or import goods important for those regions (Pärnu, Virtsu, Roomassaare, Kunda). (Estonian Ministry of the Interior, 2013)

Estonian Marine Policy 2012–2020: a long-term planning basis for the marine sector. The goal of the development plan is to use and maintain Estonia's marine resources as much as possible and contribute to the development of the marine sector. For that purpose, the development of marine business should be supported, mainly accompanied by the improved safety of vessel traffic and other marine-related activities, the protection of marine and coastal environment and marine cultural heritage (Estonian Ministry of Economic Affairs and Communications, 2019).

National Transport Development Plan 2014-2020 describes the plans for both international passenger and carriage of goods. Economic efficiency and environmental soundness have become the most important aspects for planning the development of the transport sector. It is stated that overall simplification of port-related formalities is an important initiative (Estonian Ministry of Economic Affairs and Communications, 2019a).

Programme of measures of the Estonian marine strategy 2016-2020. Obligation stemming from European Unions' Marine Strategy Framework Directive (MSFD, 2008/56/EC), all member states have to establish and implement the programme of measures to achieve or maintain good environmental status of the marine areas by 2020. The composed programme of measures covers the whole Estonian marine area, including internal waters, territorial sea and exclusive economic zone. Some measures directly linked to shipping are: ratification and implementation of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWMC), and participating in the regional information system; creating the readiness to use liquefied natural gas (LNG) as ship fuel; managing environmental risks concerning bunkering at sea (Estonian Ministry of Environment, 2012).

Internal Security Strategy for 2015–2020. Marine-related instruments are ensuring sea rescue capability and responding to marine pollution (Estonian Ministry of the Interior, 2018).

Estonian Environmental Strategy 2030. Marine related goals: preservation, addition and development of the existing network of protected areas; formulation of measures to exclude non-indigenous species and avoid the spread of new potentially invasive non-indigenous species (Estonian Ministry of Environment, 2007).

2.1.2 Finnish strategies

Finland's maritime strategy 2014–2022, prepared by the Ministry of Transport and communications, transport policy department (Liikenne- ja viestintäministeriö, 2014) aims to serve the Finnish economy, business life and employment, while taking into account the new environmental norms. The strategy observes both the current state and future challenges of the sector and outlines a vision for 2030. The main themes addressed in the strategy are international competitiveness in the form of fairway dues and winter and environmental technology and in skills and know-how of the maritime cluster. The strategy also acknowledges recreational activities and tourism, which depend on high-quality maritime services and safe and clean water. The Finnish know-how is also seen as an export asset, especially as regarding sustainable logistics concepts.

A major issue discussed in the maritime strategy is the level of national fairway dues, which has an impact on the competitiveness of the Finnish economy and that of the Finnish ports compared to the Nordic and Baltic countries and Russia. Another factor impacting the operating costs is the sulphur directive, which raises operating costs and may lead to re-routing of transport of goods.

In relation to this the overall service level, competitiveness and attractiveness of maritime traffic in itself and in relation to other transport modes are themes to be focused on in the future, according to the strategy. Developing of the logistics and services of the industry for example by utilizing knowledge and technology to the fullest is seen as a key strategy in maintaining the competitiveness of the industry. Depending on the type of cargo, many maritime transportations can be re-routed with relative ease. Integrating harbour functions deeper into the logistics network by new types of service provision is a means to find new business operations and to anchor the old customers to certain ports.

Developing of maritime infrastructure has a limited role in the strategy. These needs are shortly referred to in relation to energy efficiency of maritime transport, where the characteristics of ports and shipping lanes play a role, alongside with engine technology, travel speed and energy sources used. Drive for energy efficiency and reduction of sulphur emissions also may have an impact on vessel size and through that on the demands for shipping lines. However, demands specific to Gulf of Finland such as the need for hull modifications (fortification) against ice conditions and customer demand impacting on the types of freight slow down the rate of change of the fleet. As a specific means to support the competitiveness of Finnish economy the need to deepen the shipping line to Vuosaari harbour in Helsinki is mentioned.

It is seen that the global economy and the political and economic development in Russia alongside with port infrastructure development especially in Russia have a major impact on the maritime transport and with it to the investments made in developing the maritime infrastructure. The nature of transportation network in Finland and its geographical location seem to slow down the changes expected in other parts of the world, such as strong increase in container traffic and the growth of vessel size. The current port network is adequate for current and foreseeable needs and should major changes occur in the future, these would mainly be due to changes in trade routes and would mainly impact the relative importance of individual harbours, rather than driving port infrastructure developments on currently unoccupied sites.

2.2 Spatial background information

Geographic information is vital in spatial decision-making and planning. Maps have a central function in providing visual interpretation of data. Visualisation of the MSP background information, scenarios and spatial plans on maps are much more effective in communicating the information than narratives (Nylén et al. 2017). Maps help in assessing a large set of background information and help to guide the decision-making process.

Regional datasets of Gulf of Finland were obtained from HELCOM Map and Data Service – an open access server specialised in datasets on human activities and marine use which are free for downloading. Datasets used in the following maps are compared and contrasted with an aim to discover spatial relationships and networks.

Common uses of spatial data involve comparing natural features with human activity. This set of maps is intended to present maritime transport case core activities on the sea and related pressures. Accordingly, following example layout themes are selected to present current maritime transport status of the Plan4Blue project area in 2019:

- oil spills, shipping routes, economic zone and territorial water (Figure 2)
- oil spills, shipping routes and environmental damage unit (Figure 3)
- beach litter, shipping routes and nature protection areas (Figure 4)
- maritime traffic (commercial shipping and recreational boating) and environmental vulnerability profile (Figure 5)
- noise pollution and shipping routes (Figure 6)
- commercial shipping and fishing routes (Figure 7)
- commercial shipping and fishing routes overlap areas and accidents (Figure 8)

The maps presented in this report have been produced for illustration purposes only. They are partly hypothetical and do not represent the real situation or established view of the researchers, planners or stakeholders involved in the Plan4Blue project.

Table 2. Datasets used in layout themes.

MAP LAYOUT THEME	Description of the main layer	Data type	Source	Comment	Other related datasets available
oil spills	oil spills distribution	vector, point shapefile .shp	Observed during aerial surveillance flights by HELCOM Contracting Parties	Further information: http://www.helcom.fi/baltic-sea-	Oil slicks and spills, Radioactive substances Cesium 137 (seawater, fish, herring, flatfish), Risk of oil spills from ship

			during 1998-2015	trends/maritime/illegal-spills/	acitivies (grounding, collision,
environmental damage	environmental damage risk by oil, all ship types	vector grid .shp, 2 x 2 km resolution	produced by COWI (www.cowi.dk) for the BRISK project	Damage risk data vary depending from the ship sizes (small, large), type of cause (chemical, oil)	Environmental vulnerability (summer, fall, winter, spring), polluting ship accidents, physical disturbance or damage to seabed
noise pollution	input of continuous anthropogenic sound	raster grid .rst	produced for the BIAS project	dataset represent modelled acoustic data collected in one year (2014)	pressure related datas: Baltic Sea Impact Index (BSII), Baltic Sea Pressure Index (BSPI)
marine litter	categorized sum value of beach litter items in relation to a 100 m strip of beach	vector, point shapefile .shp	provided by HELCOM contracting parties in response to data call for State of the Baltic sea report	no underwater litter from seafloor	Sandy beaches as point, sandy beaches as polyline
ships routes and density	IMO registered ships operating in the Baltic Sea	raster .rst	based on HELCOM AIS (Automatic Identification System) data	datas from difffirent ships types and year (2006-2016) are available	Shipping density 2011-2015, Vessel storage capacity, IMO ships routening guide, NOx emissions from ships, AIS passage line crossing by ship type, Risk of oil spills on collisions/ fixed objects on route (2020)
maritime accidents	all accidents, which took place in territorial seas or EEZ are reported	vector, point shapefile .shp	collected by HELCOM Contracting Parties	dataset contains the ship accidents in the Baltic Sea during the period 1989 to 2017	Polluting ship accidents, AIS passage line crossing by ship type, Depth contours
environmental vulnerability					
Administrative boundaries	Economic zone, Territorial waters	vector, line shapefile .shp			Marine background: MSP areas, Coastline, Depth contours, Depth relief map, Baltic Sea Bathymetry Database, Baltic Sea

	Pollution Load Compilation sub basins
Protection areas	

Background map datasets selection is oriented from Maritime Activities in the Baltic Sea report (HELCOM, 2018). In the report, the following shipping and environment interactions are observed: ship emissions, sewage, oil discharges, chemicals discharges, ballast water, marine litter, underwater sound, anti-fouling systems.

Transforming spatial analysis results into meaningful implications for MSP facilitates work of planners, authorities and stakeholders across sectoral borders (Nylén et al. 2019). Spatial analysis used in following map examples are distance analysis (buffer), overlay analysis, grouping and reclassifying. Results are hypothetical conclusions based on existing data.

Background maps use data of human activities (oil spills, noise pollution, recreational boating, beach litter), shipping (oil spills damage, AIS shipping and fishing density, protection areas, shipping accidents), and background data (economic zones, territorial waters). Plan4Blue project team provided environmental vulnerability profile (Herkül et al. 2017), background data (protection area, ports, project area) (Nylén & Tolvanen 2017), and currently presented new analysis results (routes overlap, port profile analysis, vulnerability proportional distribution analysis).

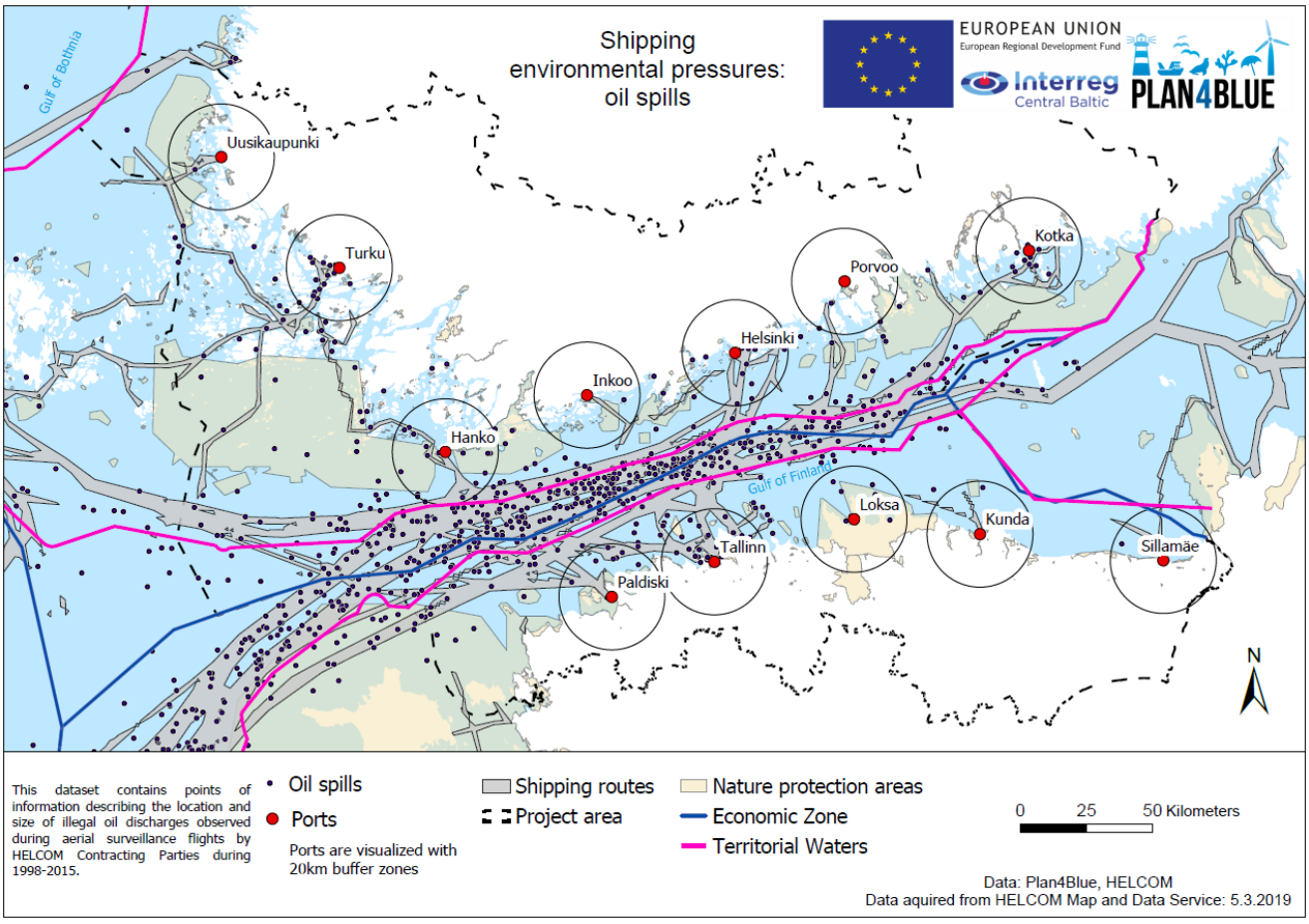


Figure 2. Map presentation of oil spills, main shipping routes, economic zone and territorial water.

Oil spills (Figure 2) are presented in relation to main shipping routes (IMO registered all ship types), administrative boundaries, and protection areas (Table 2). Dataset contains points of information describing the location of illegal oil discharges observed during aerial surveillance by HELCOM Contracting Parties during 1998-2015. Majority of oil spills occur on the main shipping routes both on Finland and Estonian side. Main oil spills

concentration is located in territorial waters. However, the number of spills has dropped significantly, from around 400–600 observed spills during the early 1990s to the 80 spills in 2015. Nowadays ports reception of oil is covered with environmental fees to shipping and there is no economic reason to discharge oil to the sea. It is therefore likely that these spills are (at least partly) the result of action by uninformed mariners from other sea areas who are simply not aware of the rules and practices in the Baltic Sea (HELCOM, 2018).

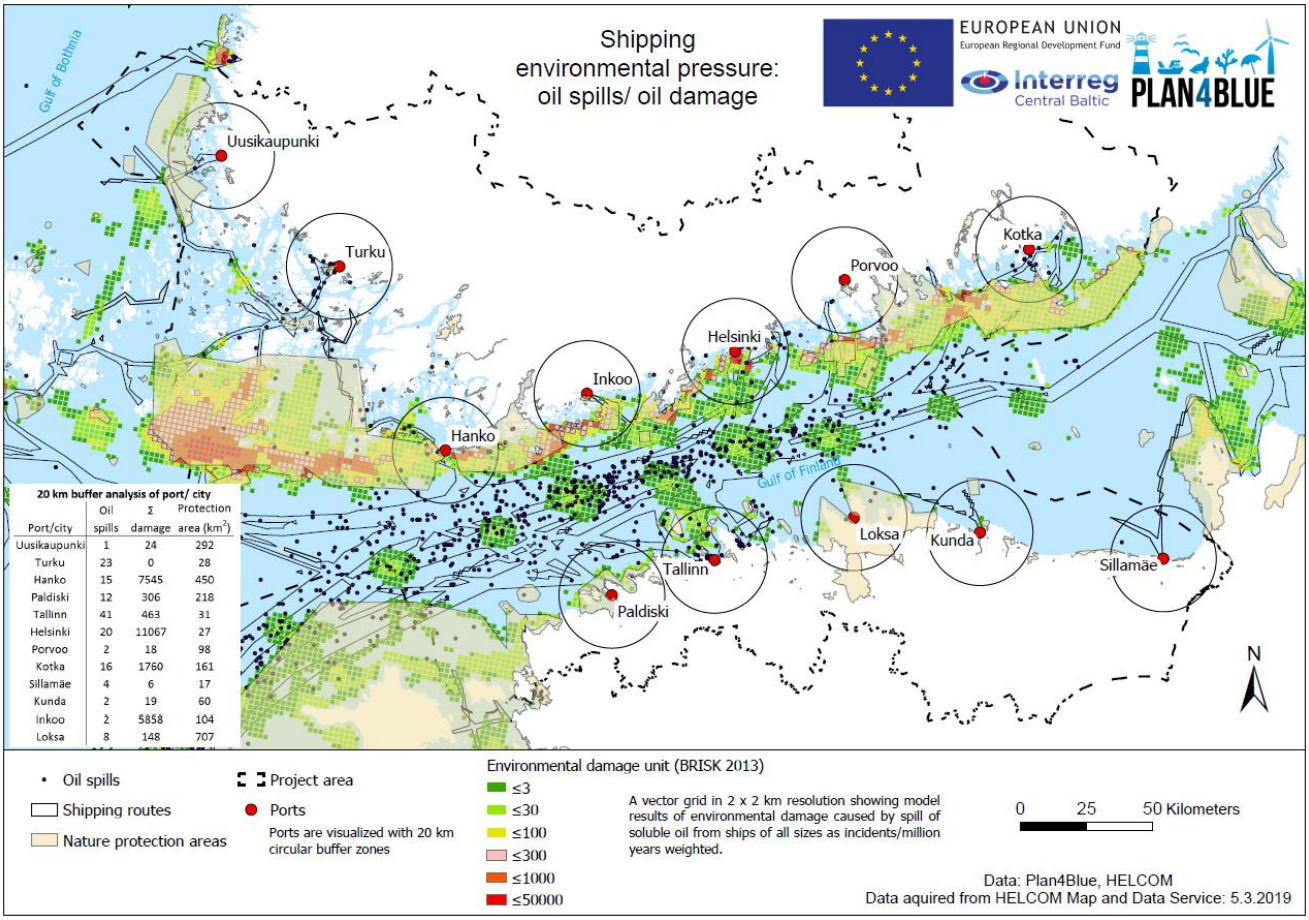


Figure 3. Map presentation of oil spills, damage value, protection areas.

Oil spills damage to natural environment is presented on the second oil spills layer, where one can observe oil spill locations, protection areas and modeled damage value (risk) for the environment (Figure 3). Additionally, area in distance of 20 km from selected ports is compared. Helsinki, Hanko and Inkoo ports are situated at the riskiest area in means of possible damage. Turku has 0 value in means of damage. Most oil spills are detected around Tallinn (n=41). From Finnish side most oil spills are detected around Turku (n=23) and Helsinki (n=20). In Estonia, Loksa area has most coverage of protection zone (707 km^2), and accordingly Hanko in Finland (450 km^2).

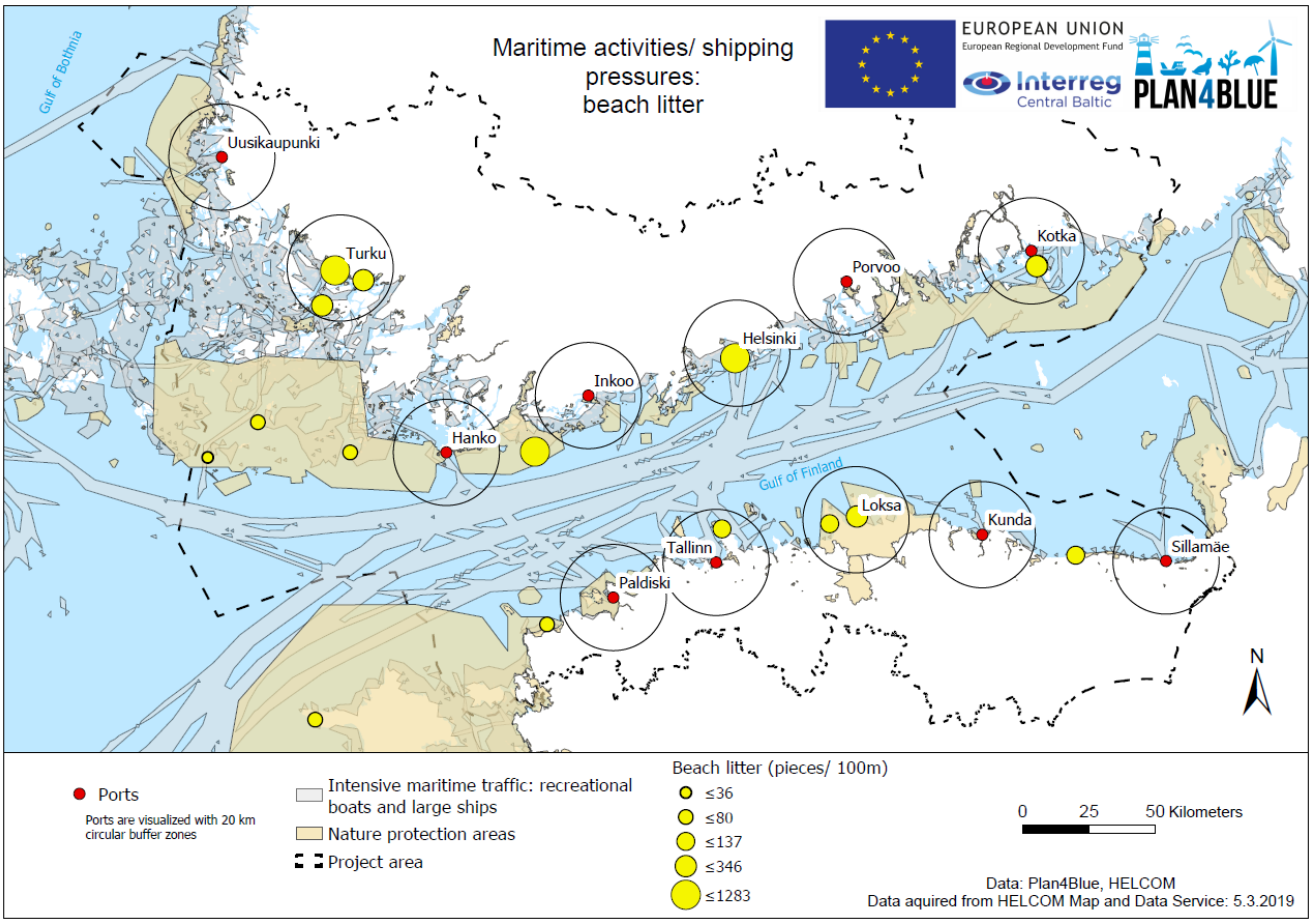


Figure 4. Map presentation of beach litter in the study area.

Spatial distribution of marine beach litter along the coastline in the basins of the Gulf of Finland is presented on Figure 4. Marine litter from ships is challenging to map, as it can be transported long distances by water currents. Large part of the total amount of the litter is deposited on the seafloor (Galgani et al. 2015). Floating litter accumulates on the shore and at that moment it is impossible to link to the source. HELCOM provides beach litter data, which is collected as solid littler from the beach line.

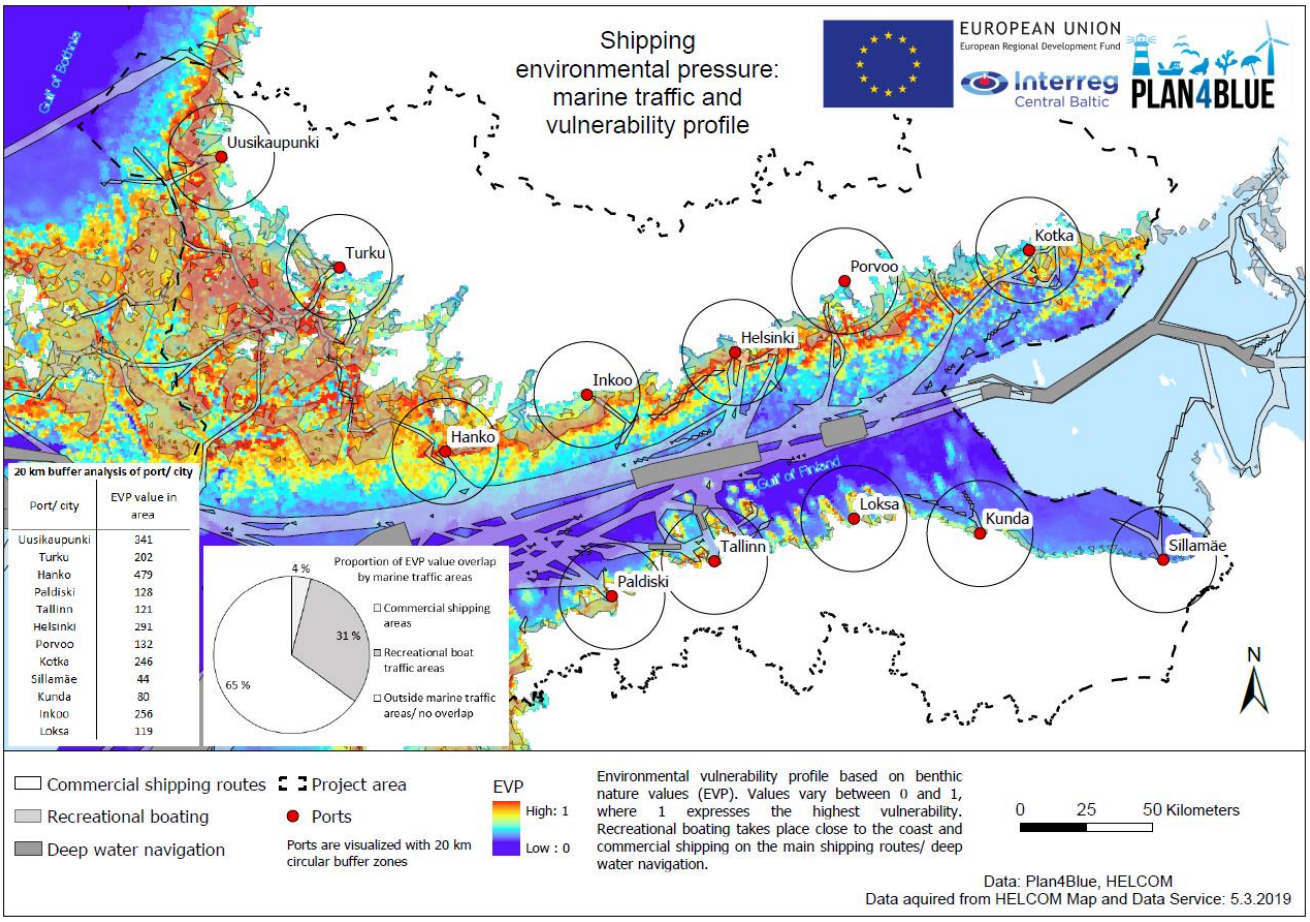


Figure 5. Map presentation of environmental vulnerability profile and marine transport pathways.

Plan4Blue project team has developed special dataset presenting environmental vulnerability based on benthic values. It is seen that coastal area is the most vulnerable and as it goes deeper vulnerability profile reduces sharply to low values. During the workshop the relation of recreational/small boating and high vulnerability profile values were discussed. Map presentation also emphasizes the result that in the whole project area, 31% of the most vulnerable area is located where recreational boating is performed the most (Figure 5).

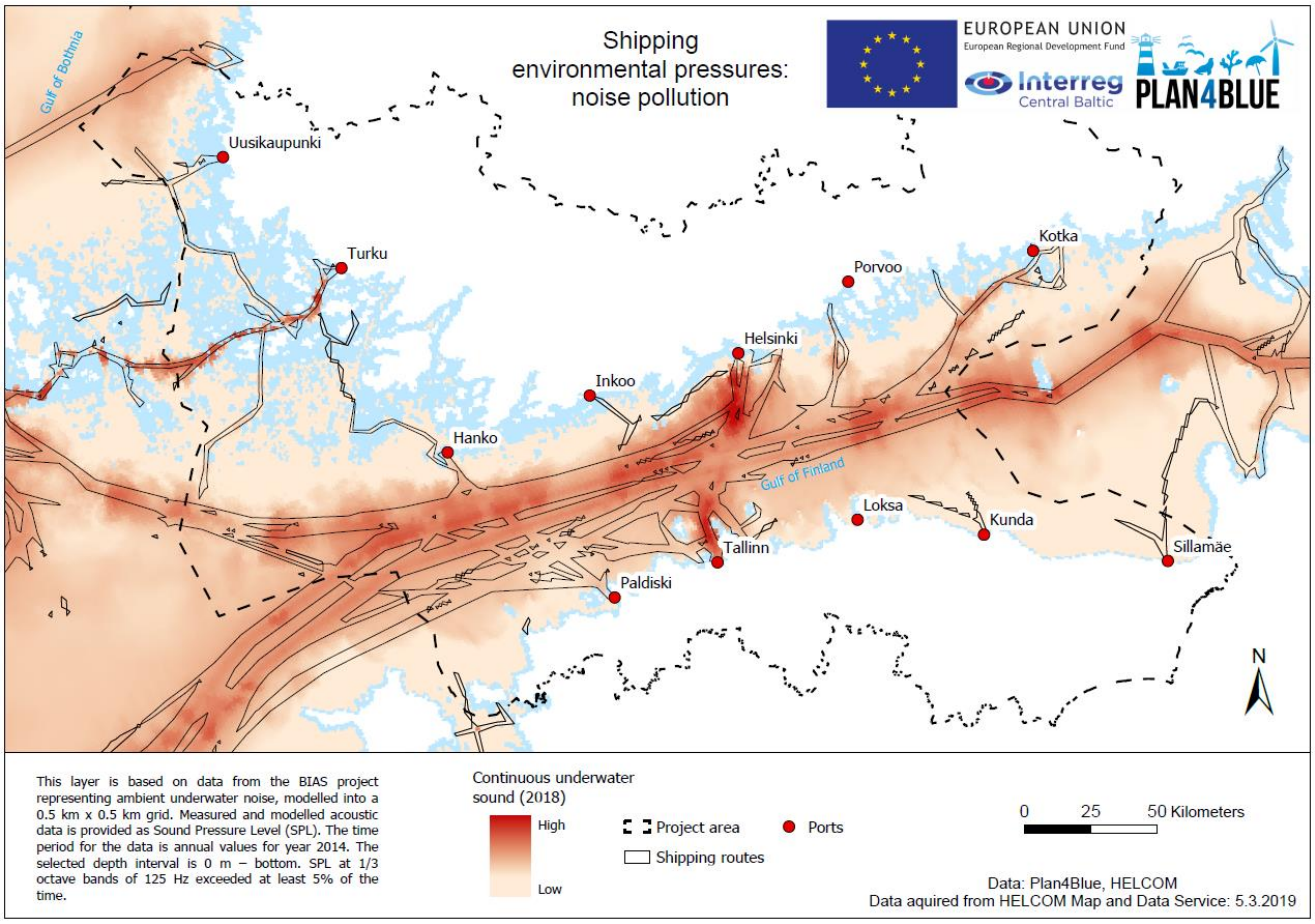


Figure 6. Noise pollution and shipping routes.

Sound pollution in project area is visualized in Figure 6. Underwater sound can affect natural environment by changing animal behavior. The primary sound pollution source in marine area is associated with ships propellers, hull form, on-board machinery and operational aspects (HELCOM, 2018).

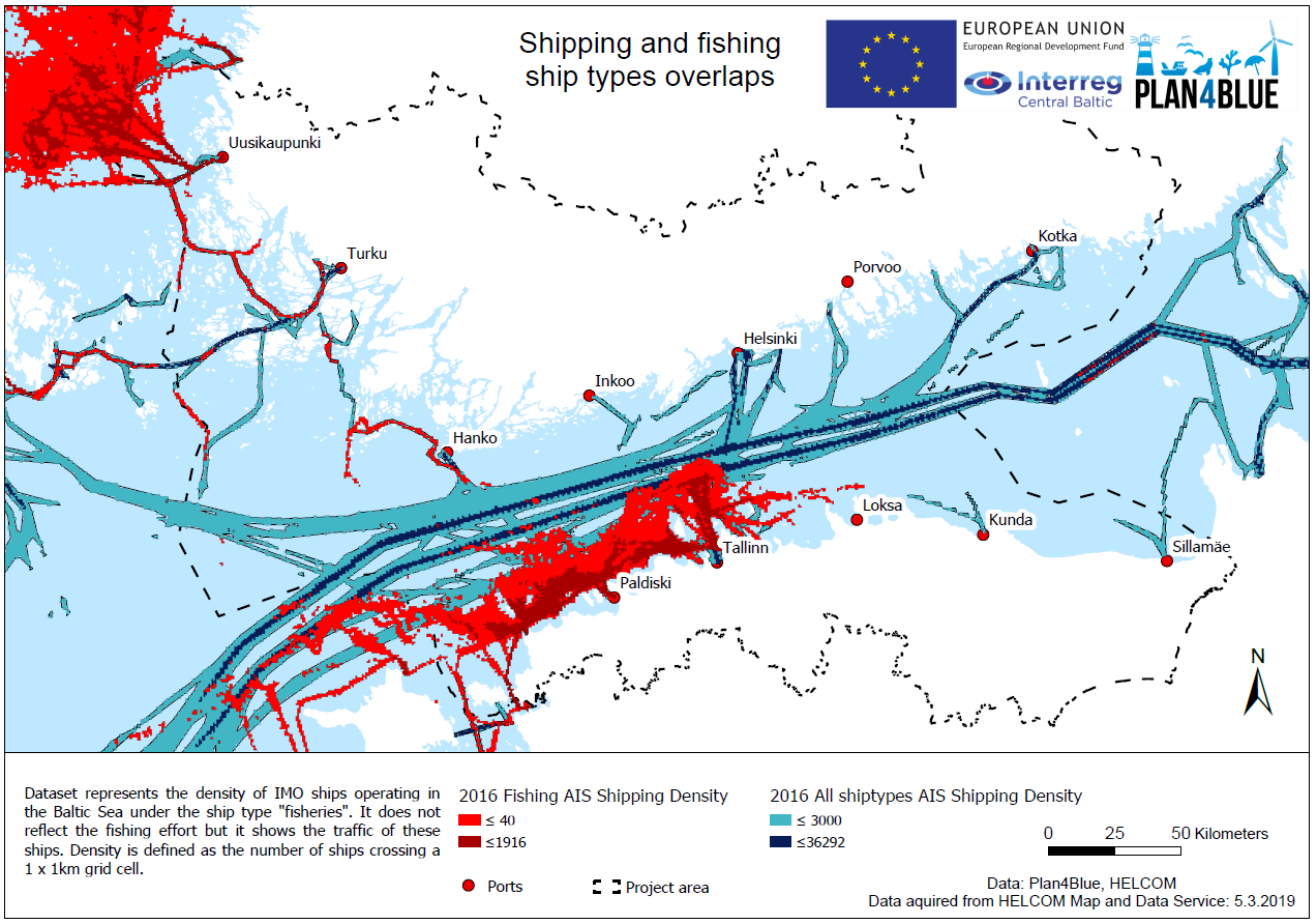


Figure 7. Commercial shipping and fishing routes.

HELCOM AIS (Automatic Identification System) registers all shipping movement. For workshop purposes traffic statistic was visualized in commercial shipping and fishing categories (Figure 7). Overlap of the two sectors is analyzed in relation to shipping accidents (Figure 8).

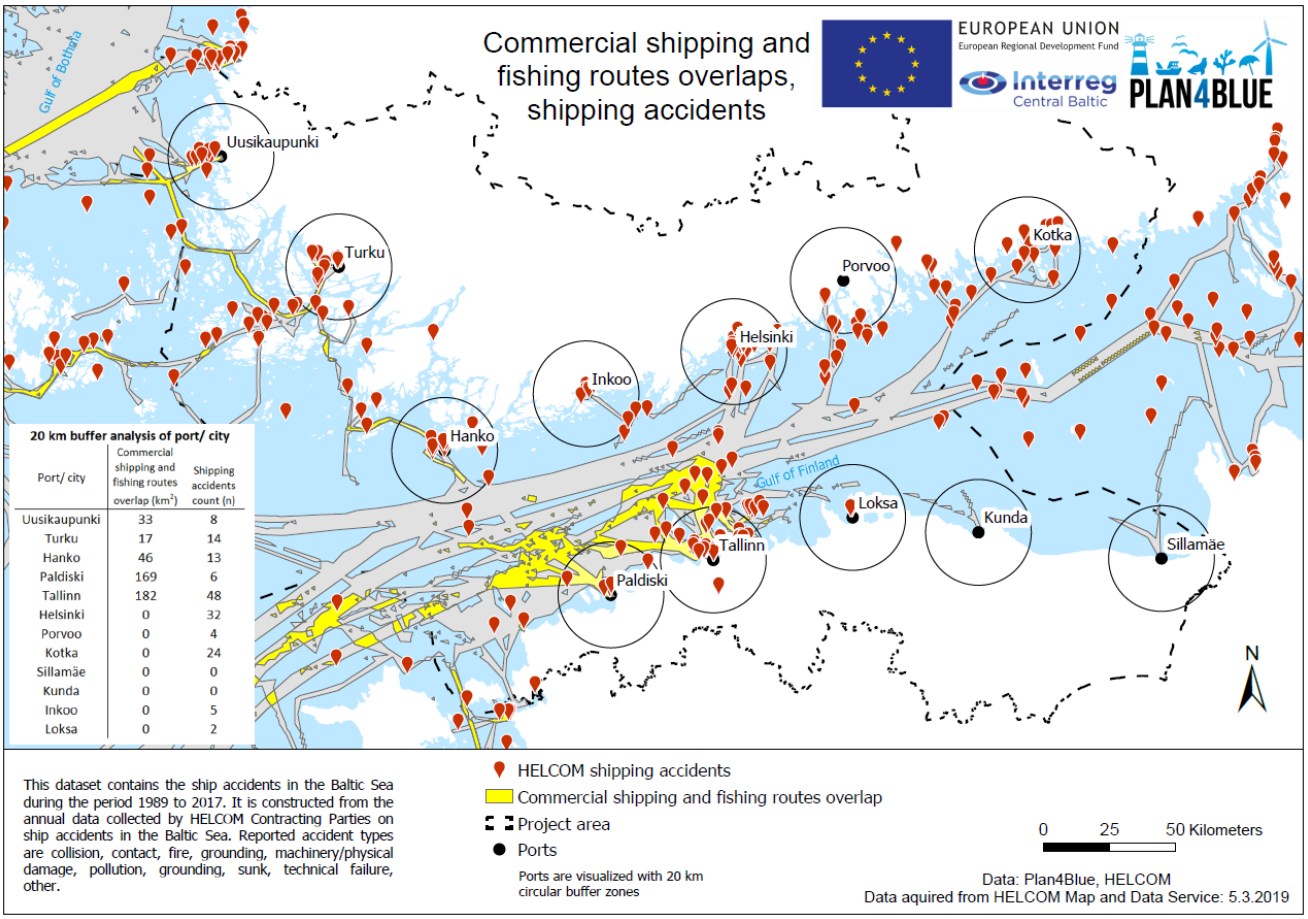


Figure 8. Commercial shipping and fishing routes overlap areas and accidents.

This dataset presents the ship accidents and overlaps of intensive shipping and fishing routes. Main overlaps are in Tallinn, Paldiski, Hanko, Uusikaupunki, Turku. In Finland, fishing ship activities are located on the eastern coast and in Estonia on the northern coast. Sea area is deeper in these locations which concentrates the fishing activities in certain points (e.g. trawling cannot be done near the Gulf of Finland coast, as it has more shallow water sea floor. Moreover, notable overlap areas e.g. in Paldiski and Tallinn coasts have notable difference in means of accident history. One could observe that lot of overlap does not necessarily mean lot of accidents. Accidents data contains all types of collision accidents (e.g. including collision with fixed structures, grounding etc).

Overlaps map presented in Figure 8 has been produced for illustration purposes only. It is hypothetical and do not represent the real situation or established view of the researchers, planners or stakeholders involved in the Plan4Blue project.

2.3 Developments in Maritime Transport

This chapter is based on a literature review with an aim to research on economic, technological, environmental and safety and security developments. The chapter also touches on port developments looking at bigger Finnish and Estonian ports in the project area.

The Review of Maritime Transport 2018, an annual United Nations publication issued by the United Nations Conference on Trade and Development (UNCTAD), has highlighted seven key trends that are currently redefining the maritime transport landscape and shaping the sector's outlook. The Review of Maritime Transport (2018) highlights these seven global key trends as follows:

1) geopolitical, economic uncertainty and trade policy risks are causing negative impact on maritime transport
2) major implications to maritime transport from continued unfolding of digitalization and e-commerce and the implementation of the Belt and Road Initiative
3) overly optimistic carriers competing for market share may order excessive new capacity, thereby leading to worsened shipping market conditions, which will upset the supply and demand balance and have repercussions on freight-rate levels and volatility, transport costs and earnings
4) effects of cooperative arrangements and mergers, liner shipping consolidation through mergers and alliances has been on the rise in recent years in response to lower demand levels and oversupplied shipping capacity dominated by mega container ships. This may impact global competition and smaller companies.
5) alliance restructuring and larger vessel deployment are also redefining the relationship between ports and container shipping lines
6) value of shipping is not only determined by scale but also on the ability of the sector to use technological innovations
7) environmental performance of international shipping is remaining high on the agenda.

2.3.1 Economic developments

Since historic times the Baltic Sea has been an important route for maritime trade (Helcom, 2018a). The Baltic Blue Growth Agenda has showed that out of all maritime sectors, shipping is still by far the greatest generator of gross value added in the region (Beyer, Schultz-Zehden et al. 2017). Shipping sector is highly dependent on the global and regional economic development. Changes in the economic development have a direct effect on the transport demand and, thus, on the well-being of the commercial shipping market (BalticLINes, 2016).

Over 80 per cent of global trade by volume and more than 70 per cent of its value is being carried on board ships and handled by seaports worldwide, so the importance of maritime transport for trade and development cannot be overemphasized. Uncertainty and various positive and negative risk factors are shaping the world economic and merchandise trade outlook. As an example of recent positive development there is are Economic Partnership Agreement concluded between the European Union and Japan in July 2017 and the Comprehensive Economic and Trade Agreement (CETA) between the EU and Canada which provisionally entered into force in September 2017 (UNCTAD, 2017). The agreement with Japan contains obligations to maintain open and non-discriminatory access to international maritime services as well as access to ports and port services (European Commission, 2017). European companies will have more opportunities to provide specialized maritime services like dredging, moving empty containers, or shipping certain cargo within Canada (European Commission, 2017). In the longer term, growing cross-border electronic commerce (e-commerce) could also support demand for container shipping. Negative risk factors include the continued rebalancing of the Chinese economy towards domestic demand, the emerging trade policy direction of the United States of America, as well as uncertainties associated with the decision of the United Kingdom of Great Britain and Northern Ireland to leave the European Union (UNCTAD, 2017).

The economic impacts originate from two sources: the use of marine waters and the state of the marine environment. Human activities that are dependent on the sea bring substantial economic benefits, both in terms of their effect on the national economy and employment and more broadly on citizens' well-being (HELCOM, 2017).

2.3.2 Technological developments

Due to environmental pressures and technological advancements several changes are expected. An ongoing trend is the increase in vessel size and the related growth of shipping companies. While transport volumes increase, the shipping fleet mainly only grows in terms of the size of the vessels. This is connected to the practice of slow steaming, that was originally picked up in response to rising fuel costs and oversupply of tonnage due to global economic downturn. Now also hailed as a way to reduce emissions from shipping, largest vessels capable

of carrying more than 18 000 TEU are from the start designed for slow steaming, while balancing between carrying capacity and reasonable draft of 15 meters or less. These vessels typically sail on the Asia to Europe route ending in ports in Belgium or in the Netherlands, while smaller vessels serve the route forward to Gdansk, Poland (Fridel, 2015). Container transport is on the rise on short sea routes from Middle Europe, too, but according to Port of Helsinki will only grow **moderately**. On shorter routes bulk cargo transport prevails.

The increase in vessel size also applies to cruise ships, which frequently visit the ports of Helsinki and Tallinn and lately also Kotka (HaminaKotka harbours in Mussalo and Kantasatama). Following the increase in vessel size, HELCOM data suggests that the number of ports stay the same in the BSR but existing medium and large ports are likely to grow by more than 50% in the next ten years to cope with larger ships.

The European Commission is seeing to strengthen e-navigation and pave the way for autonomous shipping as one of the strategic action fields for shipping by 2030 (Beyer, Schultz-Zehden et al. 2017). We are at the beginning of the development of autonomous shipping, which could change the sea use patterns (Trauthwein, 2018). In order to promote autonomous traffic around the globe, the One Sea – Autonomous Maritime Ecosystem has introduced roadmaps towards an autonomous maritime future (World Maritime News, 2017a). The Finnish collaboration gathers together the leading marine experts and is a strategic combination of top research, state-of-the-art information technology and business (One Sea Autonomous Maritime Ecosystem, 2018). The work began in 2016 to enable fully remote-controlled vessels in the Baltic Sea by 2020 and to achieve autonomous commercial maritime traffic by 2025 (World Maritime News, 2017a).

At first, short sea shipping will use autonomous ships. This also implies increased competitiveness to move transport from the road to the sea, where the gains are increased efficiency and reduction of emissions (Trauthwein, 2018). However, the current international shipping law states that ocean-going vessels must be properly crewed and therefore fully autonomous, unmanned ships are not allowed in international waters (The Maritime Executive, 2017).

In 2017 IMO began discussions that could allow unmanned ships to operate across oceans (Matthews, 2017). The first test area for projects related to autonomous shipping has been opened in Finland - the Jaakonmeri Test Area (outside of project area). The test area is the first one in the world to be globally open to anyone wishing to test autonomous maritime traffic, vessels, or related technologies (World Maritime News, 2017). There is also a pressure to look for alternative fuels to comply with the stricter environmental standards and to become independent from the oil market (Baltic LINes, 2016).

For years there has been a discussion on the possibility to build a tunnel to connect Helsinki and Tallinn. Mobility between Helsinki and Tallinn has increased throughout the 2000's. According to a study by KPMG commissioned by the City of Helsinki and based on data from Statistics Finland, commuters from Tallinn to Helsinki in 2012 exceeded those from other large Finnish cities including Turku, Tampere and cities of Eastern Finland (FinEst Link Project, 2019). The total cost estimate of the tunnel project has been estimated at 9-13 billion euros. If the project received 40% of public funding of the total costs, the project could be economically sustainable. After project initiation, financial negotiations and project planning the construction of the tunnel could start in 2025 at the earliest, and the railway tunnel could be operational in the 2030's. A 90 km long railway tunnel would cut the travel time between Helsinki-and Tallinn down to 30 minutes. (FinEst Link Project, 2019a) The significantly shorter travel time is expected to change the transport patterns in the Gulf of Finland and possibly reduce passenger transport with ships.

2.3.3 Environmental developments

A number of policies are in place to reduce shipping-induced environmental pressures. Shipping is global by nature; therefore, the key regulatory framework is coming from International Maritime Organization (IMO). Environmental protection of the Baltic Sea also results from HELCOM, EU and different national, regional and local policies.

The increasing environmental performance standards may pose a challenge to the shipping industry as IMO regulations are transferred to the EU directives and national level regulations. The IMO has adopted regulations on air emissions concerning energy efficiency and greenhouse gas emissions (GHG), nitrogen oxides (NOX), sulphur oxides (SOX) as well as water emissions, such as the antifouling convention or regulations concerning invasive species. Regional legislation mainly comes in the form of the Baltic Sea Action Plan, which aims to restore the good ecological status of the Baltic Sea by 2021 (Abhold, 2015).

The EU agreed in 2015 to lower the limit of sulphur content in the fuel of vessels operating in the Baltic sea to 0,1 %. It is actually possible that to an extent the tightening sulphur regulations mitigate the modal shift from land to sea or change the ports of call; in Finland the south-western Port of Hanko has seen some growth during last few years that can be attributed to this. The directive may also direct cargo traffic flows towards land-based connections through Sweden and the Baltic states, supporting sea traffic between Helsinki and Tallinn but less so between Helsinki and Stockholm, as this line is optimized for passenger needs; the Turku-Stockholm-connection is seen more suitable for westbound cargo (Fridel, 2015).

The Baltic Sea is ecologically unique and very sensitive marine ecosystem. Environmental standards and requirements for the shipping sector are increasing. The IMO's Marine Environment Protection Committee adopted a strategy requiring the shipping industry to reduce its total GHG emissions by 50% by 2050 (compared to 2008), as well as cutting carbon dioxide emissions "per transport work" by at least 40% by 2030 (IMO, 2018). To follow these cuts new vessels and technologies are needed.

As an example of innovative means to reach these goals, Norwegian tourist vessel owner and operator The Fjords has taken delivery of a new 42-meter-long carbon fibre all-electric catamaran offering completely emission-free transport. The vessel has a unique charging solution: 40-meter-long, 5-meter-wide floating glass fibre dock housing a 2.4 MWh battery pack. This charges steadily throughout the day via connection to the local grid network, which does not have the capacity to charge the vessel directly. The solution allows the vessel to stably, efficiently and cost-effectively ‘refill’ in just 20 minutes. The dock also stores consumables, fuel for sister vessels, and allows black water to be offloaded for treatment on land. (MarineLink, 2018)

Climate change can have a strong impact on shipping traffic as well as port development in the Baltic Sea. Changes in global shipping routes due to climate change can have an effect to the shipping in Baltic Sea (Baltic LINes, 2016). Gulf of Finland ports could possibly also benefit from ice-free conditions due to climate change.

2.3.4 Safety and security developments

The new spatial demands (e.g. offshore wind energy parks and its related infrastructure, marine protected areas) and expected increase in leisure traffic will demand more sea space which can increase the risk of shipping accidents (Baltic LINes, 2016). It is necessary to follow the international standards set, monitor trends and take this information in careful consideration when planning the marine areas.

Maritime industry may be one of the oldest in the world, but modern shipping relies on modern Information and Communication Technology (ICT) to compete and thrive in the global transport industry. Maritime industry is relying on ICT for cargo documents, port arrangements, crew management and all the other services that ships need to operate efficiently and competitively, ICT is widely used onboard in engineering systems and cargo control and monitoring. ICT is not only used for commercial effectiveness, but for the safety of those onboard, the wider society and the environment (Patraiko, 2016).

Unfortunately, cybersecurity on board vessels and at major ports has stayed behind compared with office-based computer systems and competing industries throughout the world. It is necessary for the maritime industry to adopt a proactive response to the growing cybersecurity threat (Belmont, 2015). The consequences of a cyber-attack could be wide-ranging. For example, ship collisions could result from hacking of e-navigation. The Maritime Safety Committee (MSC) adopted Resolution MSC.428(98) on Maritime Cyber Risk Management in Safety Management Systems in 2017. Based on the recommendations in MSC-FAL.1/Circ.3, Guidelines on maritime cyber risk management, the resolution confirms that existing risk management practices should be used to address the operational risks arising from the increased dependence on cyber enabled systems. IMO Resolution MSC.428(98) encourages IMO member states to ensure that cyber risks are addressed in safety management systems no later than the first annual verification of a company’s Document of Compliance after 1 January 2021. (Gard, 2017).

2.3.5 Port developments

The developments in shipping industry (e.g. new types of vessels, new ways of handling cargo, etc.) are heavily interlinked with port developments. Ports are important locations for trading goods, servicing passengers and

supporting tourism. The maritime ports related marine space contemporary use and potential requirements are outlined and mapped considering the actual development plans of significant Estonian and Finnish maritime ports in the project area. From Estonian side the following significant ports are included in the case study: Port of Tallinn harbours (Old City, Muuga, Paldiski, Paljassaare) and Port of Sillamäe. From Finnish side four international ports are located within the project area: ports of Turku, Hanko, Helsinki and Sköldvik. (Liikenne- ja viestintäministeriö, 2014).

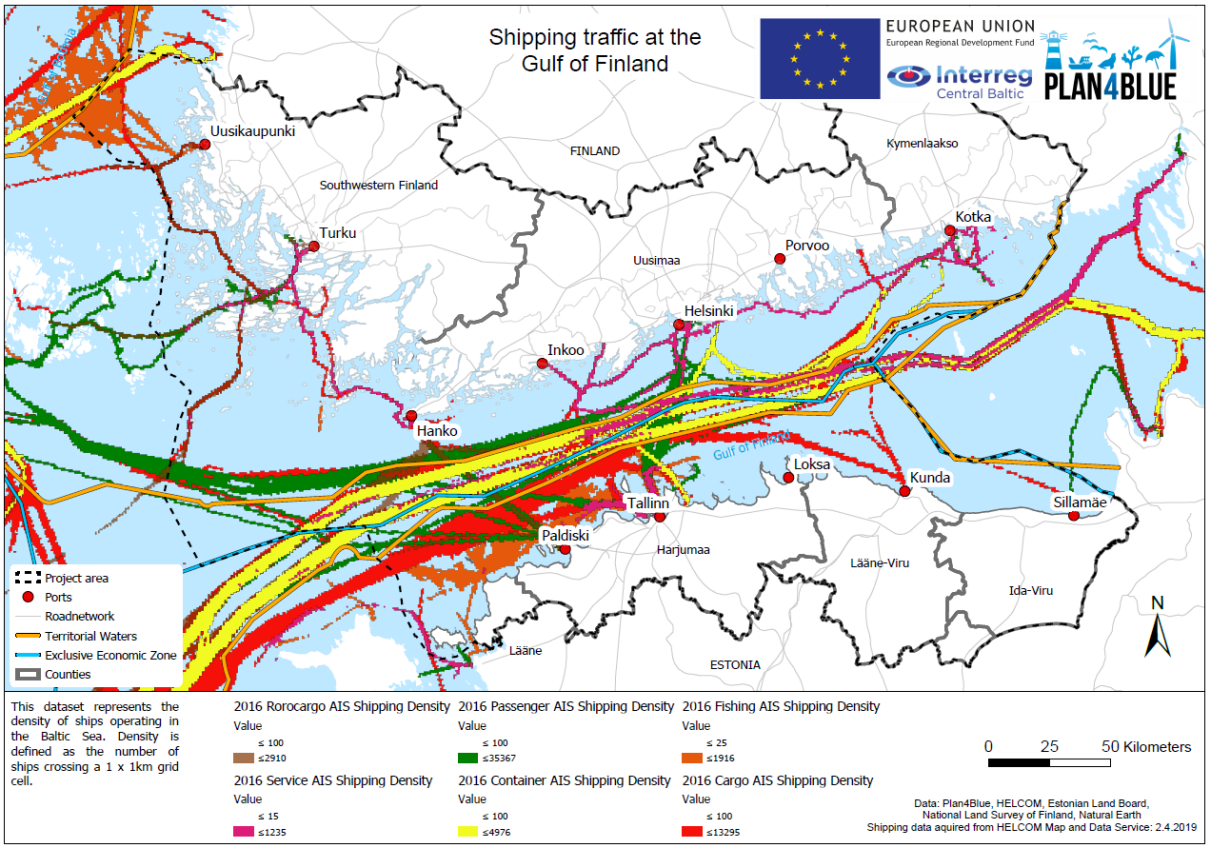


Figure 9. Shipping traffic at the Gulf of Finland.

Port of Tallinn

Port of Tallinn (2019) is a partly state-owned company which got listed at Tallinn Stock Exchange in 2018. Port of Tallinn is the biggest port authority in Estonia. The activities of Port of Tallinn are mainly cargo and its handling activities; passengers and activities related to serving them; real estate development; shipping. Port of Tallinn operates as a landlord type of port with no cargo handling operations of its own.

Port of Tallinn consists of five constituent harbours:

- Old City Harbour (+ Old City Marina)
- Muuga Harbour
- Paldiski South Harbour
- Paljassaare Harbour
- Saaremaa Harbour

Port of Tallinn also owns Muuga and Paldiski South Harbour Industrial and Logistics Parks.

Old City Harbour

Old City Harbour is one of the biggest and busiest passenger harbours in the Baltic region and the biggest passenger harbour in Estonia. Regular traffic is performed round the year from Tallinn to Helsinki, Stockholm, St. Petersburg. Passenger service is available at two passenger terminals: A and D. As of today, the Old City Harbour terminals are handling predominantly ro-ro cargo (rolling stock) (Port of Tallinn, 2019).

Table 3. Old City Harbour (Port of Tallinn, 2019)

General data	
Territory	56 ha
Aquatory	94.0 ha
Number of berths	24
Total length of berths	4986 m
Max. depth	11 m
Max. length of a vessel	340 m
Max. width of a vessel	42 m
Terminals	2 passenger terminals (incl. ro-ro facilities)
Covered warehouse area	5 000 m²

The development plans of the Port of Tallinn envisage the Old City Harbour being converted fully into a passenger port and therefore gradually moving cargo handling out of Old City Harbour to Muuga and Paldiski South Harbours. The territory released from under the cargo handling are closely associated with urban environment creation (connecting the port to the city) and real estate development (Port of Tallinn, 2019).

Most of the development plans for the years 2018-2023 concentrate on opening the port to the public, making it more comfortable for passengers and others users. These plans do not have big impact on sea space. In 2018-2023 it is planned to reconstruct the D-Terminal, build a movable pedestrian bridge to connect A and D Terminals, create Smart Port (traffic management system in port and automatic check-in for passengers with vehicles), install equipment to the quay to provide on-shore electricity power, install automatic mooring equipment, construct of D-terminal parking garage, development of new cruise terminal (Port of Tallinn, 2019).

Old City Harbour 2030+: a long-term comprehensive detailed development plan integrating the port area (closed area), areas of port-city-related activities (semi-public area) and areas of urban development (public areas) into united functional system comprising a human-centred and integrated approach combining commercial, socio-economic, spatial and environmental aspects giving maximum financial and spatial value to the seaside area. Real estate development will cover approx. 16 ha of land in Old City Harbour and a possible extension by land reclamation. The total volume of built-up gross area will be up to 400 000 m² commercial and residential premises (Port of Tallinn, 2019).

Muuga Harbour

Muuga Harbour is the biggest and deepest modern cargo port in Estonia. Water depth extends to 18 meters, which allows to service all ships passing through the Danish Straits. The cargo volume handled accounts for around 50% of the total cargo volume of Port of Tallinn and approximately 40% of the transit cargo volume passing through Estonia. In terms of land availability for extension, Muuga Harbour possesses the greatest development potential in the whole region (Port of Tallinn, 2019).

Table 4. Muuga Harbour (Port of Tallinn, 2019)

General data		Terminals	Storage area:
Territory	566.8 ha	6 liquid bulk terminals	Warehouse area: 230 000 m²
Aquatory	682.0 ha	general cargo terminals (incl. reefer complex)	Open storage area: 695 000 m²
Number of berths	29	container terminal	Reefer warehouse area: 13 500 m²
Total length of berths	6879 m	ro-ro terminal	Oil tank capacity: 1 550 150 m³
Max. depth	18 m	dry bulk terminals	Grain silo: 300 000 t
Max.length of a vessel	300 m	grain terminal	Fertilizer terminal: 192 000 t
Max. width of a vessel	48 m	fertilizer terminal	

Muuga Harbour 2018-2023: According to the development plans of Muuga Harbour, the harbour area is extended eastwards towards the area in-between the existing container and coal terminals (Port of Tallinn, 2019).

According to Port of Tallinn (2019) other development plans of Muuga Harbour include:

• New LNG bunker terminal nearby the quay No 33 is going to be constructed by Vopak in the eastern part of the Muuga Harbor to supply the vessels running on LNG-fuel and the gas grid;

• Development of a food production and logistics complex in the eastern part of Muuga Harbor;

• Implementation of the Smart Port application for heavy traffic vehicles to make the harbor services for the ro-ro ships more efficient;

• Development of ro-ro cargo handling facilities in order to increase the volume of ro-ro cargo in Muuga Harbor;

• Development of a woodchip production/logistics centre;

• Single Window system development for railways - cargo related documentation data input and exchange with a tracking solution of the cargo from a single window;

• Connecting the Muuga Harbor with Rail Baltica's Freight terminal to ensure the railway connection via both the Russian and the European rails' width (respectively 1520 mm and 1435 mm) to the terminals of Muuga Harbour.

Paldiski South Harbour

Paldiski South Harbour is Port of Tallinn´s second cargo harbour 45 km west of Tallinn. The core activity of the harbour is focused on the handling of Estonian export and import cargo and transit cargo. Mainly Ro-Ro cargo, scrap metal, timber, peat and oil products are handled there (Port of Tallinn, 2019).

Table 5. Paldiski South Harbour (Port of Tallinn, 2018)

General data		Terminals:
Territory	118.7 ha	Passenger Terminal

Aquatory	147.0 ha	2 Liquid bulk terminals
Number of berths	10	2 Car terminals
Total length of quays	1850 m	Ro-Ro Terminal
Max. depth	14.5 m	General Cargo Terminal
Max. length of a vessel	230 m	Timber Terminal
Max. width of a vessel	35 m	Dry Bulk Terminal
Warehouse area	15,000 m²	2 Scrap Metal Terminals
Open storage area	540,000 m²	Wood Pellets Terminal
Oil tank capacity	397,900 m³	Peat Terminal

Port of Tallinn (2019) has acquired new land units to develop the port infrastructure and processing-production (industrial park) facilities. In 2009, the berths No. 8 (230 m) and 9 (160 m) were built and as a result of such land reclamation, a 2.7 ha plot of new land was created. This helps to increase the ports processing capacity and volumes. In the harbour extension process new entrance gate will be set up.

According to Port of Tallinn (2019), Paldiski South Harbour has the following long-term development plans:

- Berth No. 6a: in the case that the volume of new passenger vehicles will exceed 300,000 and/or the Ro-Ro volumes 1.6 million tons, the Harbour has planned the construction of an additional berth for the processing of Ro-Ro volumes and passenger vehicles. The length of the new berth is planned to be 260 m and the land reclaimed from the sea will give the harbour about 10 ha of new added territory.

- Breakwater construction (EU co-financed project): the continuous enlargement of the harbour and its activities demands further attention to maritime safety and better navigational and manoeuvring conditions for the vessels. Meanwhile, the construction of the breakwater provides direct opportunity to increase the cargo processing volumes at the berths better protected against the weather conditions and will provide better risk management for extensive environmental damage in case of a potential marine casualty.

Paljassaare Harbour

Paljassaare harbour is primarily a cargo port with handling capacity of some 3 million tonnes per year, which makes it considerably smaller than Paldiski and Muuga harbours. Due to its geographical location Paljassaare Harbour is one of the most sheltered harbours in Estonia in terms of winds and waves. Vessels enter and leave the harbour through a canal (length of canal 800 m, width 90-150m, depth 9.0m). (Port of Tallinn, 2018)

Table 6. Paljassaare Harbour (Port of Tallinn, 2018)

General data		Terminals:
Territory	32.8 ha	oil terminal
Aquatory	33.0 ha	cooking oil terminal
Number of berths	11	timber terminal
Total length of berths	1850 m	coal terminal

Max. depth	9 m	general cargo terminals (incl. reefer terminal)
Max. length of a vessel	190 m	dry bulk terminal
Max. width of a vessel	30 m	

Port of Tallinn does not see perspective in operating Paljassaare port and plans to close it. (Port of Tallinn, 2019)

Port of Sillamäe

The closest EU port to Russia, located 25 km from EU-Russia boarder (Narva – Ivangorod). Sillamäe is a multi-functional private landlord deep-sea port operating all year round. Sillamäe port has a Free Zone.

New berths for handling cargo with a total length of 850 metres were opened in 2014. In the long term the port sees its expansion through the construction of new berths, bringing rail branch lines to the berths area, as well as the construction of new warehouses with capacity-building and diversification of machinery park. Port of Sillamäe (2019) states on its website that it is available for developing different terminals, distribution and manufacturing facilities.

Port infrastructure expansion plans include 100 ha additional storage areas for bulk, ro-ro and container cargo; expansion of Sillamäe Railway Station up to 18 tracks, incl. 6 tracks 1500 m long each; construction of railway tracks onto quays. (Port of Sillamäe, 2018)

2.3.5.2. Finnish ports

Ports are presented according their location from west to east.

Port of Uusikaupunki

Port of Uusikaupunki has four berths and a maximum draft of 8,5 meters and mainly serves RoRo traffic. Annually it handles 1,7 tons of cargo (Port of Uusikaupunki, 2018).

Port of Naantali

Port of Naantali handles 7 million tons of cargo annually (2016), including little over 3,5 million tons of liquid bulk to Naantali oil refinery. The amount of utilised cargo was 1,9 million tons, carried by 130 000 trucks. The port has a maximum draft of 13 meters, more than 1000 meters of pier and close to 100 000m2 of storage space (Port of Naantali, 2018).

Port of Turku

Port of Turku focuses on passenger traffic and transport of processed goods. It serves over 3 million passengers annually on the route to Stockholm. A new passenger vessel will be introduced on the route in 2020 and with it the passenger flow is expected to increase. In 2016, 2,5 million tons of cargo was transported, a vast majority of it by passenger ferries and Ro-Ro vessels. This totalled to well over 100 000 trucks (Port of Turku, 2018).

Port of Parainen is a small port handling 0,6 tons of cargo annually.

Port of Hanko

Port of Hanko, originally established as a winter port in 1847 and still the southernmost harbour in Finland is currently expanding its facilities. It has fairway with a 13-meter draught. The harbour mainly handles RoRo traffic and cargo, vehicles being the main import segment. In all, the harbour handles some 4 million tons of cargo annually (Port of Hanko, 2018).

Port of Helsinki

Port of Helsinki was visited by close to 12 million passengers in 2017. In all, the port handles over 14 million tons of cargo, including more than 490 000 TEUs and 570 000 trucks and trailers annually (Port of Helsinki, 2017). The port consists of four main harbours: mostly passenger harbours of Katajanokka, Eteläsatama and Länsisatama in the vicinity of Helsinki city centre and the main cargo harbour Vuosaari 18 kilometres east to the city. In addition to this, Port of Helsinki controls cruise ship pier in Hernesaari, old coal pier in the city and smaller harbours of Kantvik and Loviisa outside the city region.

Vuosaari harbour has a fairway of 11 meters and there are plans to deepen it to 13 meters in order to accommodate growing container traffic (Helsingin satama, 2012). The harbour has 170 000 m2 of warehouse space (Port of Helsinki 2018). The harbour is the second busiest container port in Finland after HaminaKotka harbour in Mussalo.

As said, passenger traffic mainly takes place between Helsinki and Tallinn, the number of passengers being over 9 million in 2017 (Port of Helsinki, 2017). Passenger traffic between Helsinki and Stockholm is stable at around 2,5 million passengers and 0,6 million tons of cargo annually (Helsingin satama, 2012). Cruise traffic to St. Petersburg is in decline, being 210 000 passengers in 2017, down from over 280 000 the previous year (Port of Helsinki, 2017). The number of international cruise passengers climbed to over 470 000 in 2017 (Port of Helsinki, 2017).

Port of Kantvik mainly serves industrial clients (raw material producers) but also transfers bulk cargo. It serves 200 vessels annually, total amount of cargo being 0,85 million tons. Draft of the harbour is 9,2 meters and the length of the main pier 110 m (Kantvik shipping, 2018). Port of Loviisa handles bulk and loose bulk cargo. The harbour has a draft of 9,5 meters and 44 000 m2 of warehouse space (Port of Loviisa, 2018).

The Port of Helsinki sees that the current harbour areas are suited to meet the needs of near future (up to the year 2030). Increasing demand for capacity is an issue but can be dealt with within the current harbours. This however requires investments in both land and seaways, especially in order to fit the growing traffic volume into Länsisatama (western harbour) and to allow larger vessels to reach the port in Vuosaari. Considering the Vuosaari harbour, the amount of cargo traffic is expected to rise considerably during the next few years.

Port of Sköldvik

Port of Sköldvik is an important harbour for petroleum products. The harbour has a draft of 15,3 meters and the annual amount of cargo shipped is over 20 million tons, most of which is crude oil (import) and processed oil products (export). In addition to this some 4 million tons of products are shipped to other Finnish ports. It serves the Neste oil refinery and other businesses operating in the area (Finnish Transport Agency, 2017).

Port of HaminaKotka

Port of HaminaKotka has a deepest draft of 15,3 meters and is capable of handling all types of cargo, including containers and project shipments. The harbour offers regular container liner traffic to key European ports as well as regular RoRo traffic serving the car and forestry industries. It also benefits from good connections to Russia via rail and the E18 motorway.

In total, the port handles 13,5 million tons of cargo annually. The main cargo port of Mussalo has 2800 meters of quays and 150 hectares of logistics and industrial areas. (Port of HaminaKotka, 2017, Port of HaminaKotka, 2017a). The needs and importance of the port are taken into account in the strategic transport plan for Kymenlaakso region towards 2035. By this time the total amount of cargo is expected to rise to 18 million tons annually (Kymenlaakson liitto, 2015). The main terminal in Mussalo is suited for expansion by land reclamation (Port of HaminaKotka, 2017).

As for the smaller ports in the project area, Inkoo harbour west of Helsinki is a private dry bulk port that handles 1 million ton of cargo annually. It has a draft of 10/13 meters and is kept open all year. It also houses open and indoor storage space (Inkoo Shipping, 2018).

3. MARITIME TRANSPORT IN MARITIME SPATIAL PLANNING

In Estonia the shipping areas (currently existing shipping routes) are priority areas and whenever they intersect with some other activity, close cooperation must be conducted with Estonian Maritime Administration. So far, there has been no need to designate new shipping routes in the Estonian MSP planning process. Planners look at how the space on sea might become more available/dry out if shipping increases/becomes autonomous or develops in some other possible way in the future. Planners work with shipping scenarios. In the planning process GIS analyses are conducted – suitable depths, environmental conditions, socioeconomic characteristics (distance from shore, availability of suitable ports etc.) and public discussions. The Estonian Maritime Administration puts down the specific conditions for shipping routes to be met. Navigational and safety considerations are a priority. The first draft MSP in Estonia has been released in April 2019, final plan should be approved in August 2020.

In Finland the first round of MSP is still in progress and therefore it is still not clearly defined how maritime transport will be handled in MSP. However, maritime traffic is one of the sectors that are to be focused on in MSP in accordance with the Finnish Land Use and Building Act. Currently the Finnish coastal regional councils are finishing the process of collecting background material and conducting scenario studies for the plan preparation. This is done through project activities, consultancy services and by revising material compiled for the needs of regional planning. Based on these, drafts for planning targets and planning solutions will be made by the coastal regional councils during autumn 2019.

Concerning maritime spatial planning, it is important to acknowledge the operation logic of cargo and passenger transport and foreseeable changes in global trade. These tend to favour certain ports and certain modes of transport. However, ports are independent actors and the port network somewhat fixed. As ports specialise and engage in global competition over clients, changes in cargo volumes can be rapid and hard to forecast, and reflect on terrestrial traffic flows. On the other hand, developments in hinterland connections may play a part in the status of ports – an example would be the impact of improved rail network connections in the Baltics, which promote cargo flows to Estonia.

The flows of maritime traffic on open seas are somewhat uncontrollable through traditional planning methods outside of traffic separation zones, as vessels typically enjoy “freedom of navigation”. Fairways leading to ports are typically more fixed because of draft requirements, especially so in Finland, due to a relatively shallow archipelago. However, although maritime traffic does not follow fixed fairways, the vessels in the Baltic sea area operate in a constant 24/48 circulation with designated time slots for moorings. Therefore, if obstructions to maritime traffic such as off-shore wind parks are to be planned, it must be seen that they pose no threat to the safety of shipping.

The safety margins of fairways are linked to the size of vessels that use them, and it’s foreseeable that the margins needed are growing. Maritime traffic along the Gulf of Finland is heavy and this needs to be taken into account in maritime spatial planning. Concerning whole of northern Baltic Sea, functioning of the port network in times of crises can be thought of.

4. CONCLUSION

In this chapter the conclusions of this case study are formulated as key messages to maritime spatial planning. The key messages aim to be a useful tool for planners to take maritime traffic into account in the planning process. The conclusions are based on the information collected and produced in this case study as well as the stakeholder input in the workshops.

The case study found 4 key messages for MSP (written on bold). Each key message is also described and justified below by bullet points, which were drafted in co-operation with stakeholders during the case workshops in Turku, Finland (4.-5.09.2018) and in Tallinn, Estonia (13.-14.03.2019). Both workshops attracted participants from the governmental institutions, industry representatives, unions, academia.

4.1 Key messages to MSP

Maritime industry is a cornerstone of FIN-EST economy and both a heavily controlled and self-motivated industry, which can´t be easily controlled by the means of spatial planning.

- Maritime transport is clearly the biggest means of trade in both countries
- Maritime sector is heavily guided by the regulations proposed by IMO, and most if not, all changes connected to maritime safety and environmental impact of shipping originates from this source. The long duration of IMO processes provides stability and predictability for the industry – if also some inertia.
- Rules and regulation such as IMO and PARISMOU are also readily followed by the operators. Partly this is due to the fact that the Baltic sea is protected from sub-standard shipping, as short sea shipping prevails.
- Baltic Ports organization and informal co-operation between ports help to maintain and develop harbour technology to meet new standards.
- Constructions at sea (e.g. off-shore wind) cannot pose threat to the safety of shipping. It is also to be noted that shipping in the Baltic sea area is highly scheduled activity and re-routing of shipping lines may be impossible or costly.
- The safety margins of fairways are linked to the size of vessels that use them, and it's foreseeable that the margins needed are growing. Also, autonomous shipping requires bigger margins.
- MSP can offer maritime traffic related recommendations such as avoiding sensitive areas. In practice though, MSP cannot restrict maritime traffic as far as rules and regulations mentioned above are followed.

Changes in maritime transport are driven by changes in operation logic and demographic and technological changes, which mainly take place within the existing harbour network. The functioning of maritime transport requires ensuring that the existing routes and ports are taken as a priority in MSP.

- The operation logic of cargo and passenger transport and foreseeable changes in global trade tend to favour certain ports and certain modes of transport
- As ports specialize and engage in global competition, changes in cargo volumes of individual ports can be rapid and hard to forecast, and reflect both on maritime and terrestrial traffic flows. Developments in port network follow demographic changes, as goods are usually delivered close to consumption hotspots
- Changes in energy demand and sources will affect maritime transport as ships seek to find suitable fuel bunkering terminals and clean modes of onshore power.
- Opening of the arctic ocean sees new trade route options

- Gentrification and growth of Russian ports increases the number of sea routes and traffic in the Gulf of Finland. However, while the amount of goods transported by maritime transport is growing, growing vessel size may balance out the congestion at sea.

Maritime transport is the cleanest mode of transport per unit per mile and mainly operates in environmentally less vulnerable deep-water areas. Leisure boating should receive more attention in MSP, as it tends to operate in shallow water areas that are more sensitive to environmental impacts.

- Maritime transport is dependent of fixed infrastructure but enjoys freedom of navigation. The port network itself is somewhat fixed, only relative weight of different ports changes in time. Most vessel traffic already follows the main shipping routes and utilizes deep water areas where the impact to marine life is milder than in the coastal areas. On the Finnish coast the archipelago naturally limits approach traffic to few deep-water routes. In contrast, leisure boating favours coastal waters and archipelago areas, and may have bigger impact on vulnerable marine environments.

- Leisure boating is projected to increase in Estonia especially, and the marina network is growing. The versatile Finnish coastline and large archipelago especially favour leisure boating.

- Leisure boats and leisure traffic are not well regulated or tracked. In Tallinn bay traffic zones for leisure boats have been established.

Future ’Black swans’ require flexible and enabling MSP.

- Major changes in trade routes and modes of traffic such as in air and rail traffic might shift the balance between ports and change the environmental pressure map of the industry.

- Concerning whole of northern Baltic Sea, functioning of the port network in times of crises can be thought of. A working maritime traffic is a basis for working port network.

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