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CRUISE SHIP GENERATED WASTE IN THE BALTIC SEA
-
A STUDY FROM THE PORTS' POINT OF VIEW ON A POSSIBLE UPDATED WASTE MANAGEMENT SYSTEM

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Tiivistelmä – Referat) Abstract

The Baltic Sea is a popular cruising area during the summer months (April till September) with international cruise lines. During these months cruising ports of the Baltic Sea handle the cruise ship generated waste. As the cruising business has been rapidly growing the waste streams has become larger. Present laws and regulations prevent most discharges into the Baltic sea. According to these regulations a ship has to discharge all waste at the port of call produced on board since last port of call. Thus, ports have different waste management strengths and weaknesses. Therefore, it is here argued that an updated collaboration among the ports where individual ports would be specialized in specific types of waste handlings ought to benefit the environmental work of the port and the cruise lines and thus also the environment.

The thesis will through experts' ideas and opinions from each port study whether an updated waste management can be introduced in the ports of the study. The individual ports are Port of Helsinki, Port of Tallinn, Ports of Stockholm and Copenhagen Malmö Port. Cruise ship generated waste has been study to some extent around the world, but there are only a few studies in the Baltic Sea area.

Secondary data and semi structured thematic professional interviews was used to find answers on the research questions. Secondary data in form of waste streams quantities from cruise ships 2010–2014 in the ports of the study was gathered. The gathered data enabled comparisons among the ports and shows in what way the fractions are divided among them. The interviews were held at each port with one to three participants at the time. In total 12 persons were interviewed at nine occasions. The transcribed material was analysed through thematising.

The research shows cruise ship generated waste fractions are unevenly distributed among the ports in the Baltic Sea. Hence, this also means the ports are already specialized in receiving special types of waste fractions. The ports are receiving sorted waste and different fractions are being handled. The ports have a close cooperation regarding cruise ships but the study shows the ports are open for new sustainable solutions.

This thesis opens up the discussion on cruise ship generated waste in the Baltic Sea. The study shows there is little research done on this matter and further studies are needed. The waste management of all parties involved are important in order to act environmentally friendly and harm the surrounding areas the least. This research provides the Baltic Sea cruising ports with one possible solution on an updated waste handling management in the area.

Avainsanat – Nyckelord) Keywords
Cruise ship, Baltic Sea, MARPOL Annex V, Directive 2000/59/EC, Port Reception Facilities, waste management

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Tiivistelmä – Referat) Abstract

Under sommarmånaderna från april till september är Östersjön ett populärt område för kryssningsindustrin med dess internationella kryssningsfartyg. Under dessa månader är det hamnarna i Östersjön som tar hand om avfallen från kryssningsfartygen. I och med att kryssningsindustrin har växt har även avfallsmängden blivit större. Idag finns det lagar och förordningar som förhindrar de flesta utsläppen till sjöss. Enligt dessa förordningar är ett fartyg skyldigt att lämna allt det avfall i hamnen som har producerats ombord sedan föregående hamn. Hamnarna har olika avfallshanteringssystem och därmed också olika styrkor och svagheter. I denna avhandling argumenteras det för ett uppdaterat system som skulle gynna inte bara hamnarna utan också kryssningsfartygen och därmed även miljön. Ett samarbete hamnarna emellan skulle ske så att de enskilda hamnarna skulle vara specialiserade på vissa typer av avfallshantering med tillhörande fraktioner.

Från varje hamn har experters idéer och åsikter analyserats och genom denna avhandling har det undersökts om ett uppdaterat avfallsystem kan introduceras i hamnarna. De enskilda hamnarna är Helsingfors Hamn, Tallinns Hamn, Stockholms Hamnar samt Köpenhamn Malmö Hamn. Det finns knapphändigt med forskning i avfallshantering från kryssningsfartyg i världen, men ytterst lite forskning inom det området har gjorts i Östersjön.

Sekundär data samt semistrukturerade professionella intervjuer användes för att få svar på forskningsfrågorna. Sekundär data i form av avfallsmängder från kryssningsfartyg 2010–2014 från varje hamn samlades in. Den sekundära datan gjorde det möjligt att jämföra hamnarna sinsemellan samt visa hur de olika fraktionerna fördelas mellan dem. Intervjuerna hölls i varje enskild hamn med en till tre deltagare åt gången. Totalt intervjuades tolv personer under nio tillfällen. Det transkriberade materialet analyserades genom tematisering.

Denna avhandling visar att avfall från kryssningsfartyg i Östersjöns hamnar är ojämnt fördelat. Däremot betyder det även att hamnarna redan är specialiserade på mottagandet av särskilda fraktioner. Hamnarna tar emot sorterat avfall och därmed sköter de också de olika fraktionerna. Hamnarna sinsemellan har ett nära samarbete beträffande kryssningstrafiken men denna forskning visar att hamnarna är öppna för nya hållbara lösningar.

Denna avhandling öppnar upp diskussionen kring avfall från kryssningsfartygen i Östersjön. Avhandlingen påvisar att det finns lite forskning inom detta område och att det finns behov för vidare forskning. Det är ytterst viktigt att alla inblandade parter sköter sin avfallshantering så att hela processen fungerar hållbart och påfrestar naturen så lite som möjligt. Denna avhandling ger Östersjöns kryssningshamnar en möjlig lösning på ett uppdaterat avfallssystem i området.

Avainsanat – Nyckelord) Keywords
Kryssningsfartyg, Östersjön, MARPOL bilaga V, Direktiv 2000/59/EC, mottagningsanordningar i hamn, avfallshantering

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Contents

1 Introduction

The cruise ship industry has become a well implemented industry in the Baltic Sea area, and the number of passengers is steadily rising each year. The cruising industry sets pressure not only on the Baltic Sea but on the area as a whole. The countries gain economic benefit from tourists visiting the cities and the wellbeing of the sea is important both for the people living around it and for the tourists visiting the areas. A good waste management in the cruising ports around the Baltic Sea is a crucial part of minimizing the environmental impacts. There is little research on cruise ship generated waste streams and especially little around the Baltic Sea areas.

The amount of passengers cruising the Baltic Sea has arisen by almost 250% from 2000 to 2014 and the cruise ship calls has arisen by 53% (Cruise Baltic Statistics 2014). The cruise ships sail the Baltic Sea in the summer season, around April to September. The cruise ship market in the whole world has grown and as a result also "introduced a unique set of environmental pressures that need to be addressed and investigated, particularly those pertaining to waste management" as Butt (2007: 592) states in his article. For the industry itself the environment and the surroundings are highly important as they are the main attractions for the passengers. The passengers want to see, feel and experience the nature. And alongside visit the cities en route.

This thesis deals with the cruise ship generated waste in the most popular cruising ports in the Baltic Sea. The aim is to go through experts' ideas and opinions from each port to analyse whether an updated waste management could be introduced. The four ports are Port of Helsinki, Ports of Stockholm, Port of Tallinn and Copenhagen Malmö Port. These ports are the most popular ports of call among cruise ships along the Port of Saint Petersburg.

In consumerism the knowledge about and the importance of recycling are simultaneously a bit growing as new innovations regarding environmental protection are created. Also the cruise ship industry is introduced to new solutions and the cooperation between ports and ships is easier than before. The amount of waste that is not recycled, reused or turned into energy is decreasing and more various kinds of waste treatment facilities are growing. Reduction of waste should be prioritized. This research is not handling with the actual production of cruise ship generation waste but the waste management at the ports.

Maritime traffic and environmental protection is a subject close to my heart as a researcher and as an individual. Being a trainee and employee at Port of Helsinki and doing this master thesis in collaboration with the port has broadened my views as a researcher. Growing up in the Finnish archipelago and my father being a seaman the wellbeing of the marine environment has always been a subject of interest. The theoretical approach has taken form throughout my studies at the University of Helsinki. This thesis will show my strengths as a researcher of maritime traffic, port management and environmental protection.

Research questions

The research questions are handling with the cruise ship generated waste from the ports point of view. Cruise ships are important customers for ports and it is important for both parts to act sustainably and following not only laws and regulations but also best practices.

The *main aim* of this research is to study whether it is possible to introduce a new waste handling system for cruise ship generated waste in the ports around the Baltic Sea area. In the proposed system ports would focus on handling specific types of waste produced on cruise ships. The aim is further addressed by the following research questions:

- What quantities of cruise ship generated waste are handled in the Baltic Sea area today? In what way are the fractions handled?
- Are individual ports already specialized in specific types of waste handling management?
- Could the collaboration between the four ports studied in this research be improved to better handle waste from cruise ships? Can certain fractions be discharged in ports specialized in specific types of waste?

The claim is that the waste streams are not evenly distributed although laws and regulations state otherwise. This will be shown through the gathered statistics from each port. The cruise ship is an industry and business like any other and it is searching for the best alternative – the cruise ship will find the best environmental practice while also taking into account economic consequences based on environmental philosophy of each cruise when handling their waste throughout their route in the Baltic Sea. The Baltic Sea is a small area with special

environmental characteristics and a highly popular area for the cruise tourism during the summer. The cruising ports in the area are relatively close to each other. The ships usually cruise during the night and the whole cruise takes about one week. This means that the vessels do not need to hold on to the produced waste for long times.

2 Geography of the maritime industry

2.1 Maritime transportation and logistics

Rodrigue et al. (2009) states in the foreword of their book that "Transportation systems composed of infrastructures, modes and terminals are so embedded in the socio-economic life of individuals, institutions and corporations that they are often invisible to consumers." This does also apply for the maritime transportations of different kinds, and most highly to the cruise ship industry. Consumers, the passengers of cruise ships most likely do not notice the complicated infrastructures, systems and logistics of the ship. When calling at ports the cruise ships needs to be securely moored, off- and on-loaded and handle safely the waste discharging just to name a few things.

The transportability, "the ease of movement of passengers, freight or information", in the maritime transportation is easy. It is argued that "transportation can only exist if it moves people, freight and information around." (Rodrigue et al. 2009: 1–4) Transportation has and will always be one of the most important human activities worldwide. It also eases the access of social welfare, economic developments and political tools. Transportation links places, locations, nodes and people together.

Logistic in transportation means the transportation of materials to the end-user at the right time with minimal transportation costs and negative impacts on safety and the environment (Tapaninen 2013: 34). With minimal logistic costs a company has a strong competitive position. Different transportation ways can be divided into road, rail and water transportation. The water transportation is further discussed and studied for this research.

Maritime transportation is an old way of transporting. The transportation does not only run along oceans and seas but also rivers and lakes. Shipping is a cheap way of transporting, with the exception of channels. Using of channels has a fee but on the other hand it is a faster way than sailing around the coastline. Crossing for example the Kiel Channel saves time for ships coming to the Baltic Sea from the Atlantic as the ship does not have to sail around Denmark. The maritime transportation trends as a whole have changed rapidly during the last decade. According to Gritsenko (2014: 28) there are three main trends in the Baltic maritime transportation to be identified; the intensification of shipping has increased, the structure of transported goods has changed (steady increase of liquid bulk) and the ports have changed and developed.

Goods transported by sea are usually inexpensive materials such as raw materials. Shipping requires little manpower and small energy consumption. Therefore "shipping is a mode that can offer very low rates compared to other modes" (Rodrigue et al. 2009: 132). The environment is the only unstable factor. Today the safety and navigation are well improved. Dominant winds, storms of different kinds, currents and other general weather and natural patterns such as tides still hinder the maritime routes to function undisturbed (Tapaninen 2013: 34–45, Rodrigue et al. 2009: 131–134). Furthermore, weather is still unpredictable despite of all the new technology that is implemented today.

Environmental impacts go hand in hand with logistics. The environmental impacts are usually limited when the logistics are running smoothly. This is managed by minimizing unnecessary transportations, maximizing the shipment loads, and by cutting down the transportation speed and simultaneously minimizing the usage of fuel and production of air emissions. Although accidents are seldom, they can have a significant impact on the environment. Accidents may result in oil spills from the ship itself or from the cargo and also other kinds of leakage into the environment, such as dangerous chemicals. Worth mentioning is also the usage of energy and natural resources, the areas used for the ports, erosion and other health- and environmental hazards produced by the off- and on-loading of goods (Tapaninen 2013: 105). These are the known impacts and the consequences of shipping we accept. Accidents are the impacts we can try to avoid. Thus, the environmental impacts need to be minimized by good environmental knowledge and practices. Therefore the waste management on board ships have been improved in many ways along other environmental improvements.

2.2 Vessel types in the maritime industry

Around the world ships are divided into four broad types; passenger vessels, bulk carriers, general cargo ships and roll-on/roll-off (RORO). Passenger vessels are further divided into two categories: passenger ferries and cruise ships. Passenger ferries transport mainly passengers across short bodies of water. For example ferries running from Helsinki to Tallinn are passenger ferries. Cruise ships on the other hand take passengers on holidays and calls at different ports on the route (Rodrigue et al. 2009: 134–135). According to Cruise Europe definition "A cruise is a voyage of at least 60 hours by seagoing vessel, mainly for pleasure. No cargo/rolling stock will be transported but only passengers with tickets that should include

accommodation and all meals. The Cruise voyage must include at least two visiting ports apart from the starting and ending port." (Cruise Baltic 2015: 14). Visits at many different destinations, the luxury vessels and the luxury life on board and the fact that there is today more money to spend on holidays all have influence on the growing popularity of cruising holidays (Kimara Travel Consulting, Uusimaa Regional Council 2007).

Bulk carriers are the largest vessels afloat and are designed to carry either dry or liquid bulk. General cargo ships are smaller than bulk carriers and designed to carry non-bulk cargos. Today most of them are replaced by container ships as they can be loaded more efficiently and are becoming larger. RORO vessels are designed to allow cars, trucks and trains to be loaded directly on board and are usually larger than the typical ferry. RORO vessel can also be a combination of passenger vessel, e.g. Finnlines. Roll-on/roll-off means that the cargo can be driven on and off the vessel on its own wheels. (Rodrigue et al. 2009: 134–135).

2.3 Port and the city

Different vessels use ports of various kinds and for various reasons. Ports can be described as terminals. Terminals are an important part of the understanding of transportation geography. "All spatial flows, with the exception of personal vehicular and pedestrian trips, involve movements between terminals" (Rodrigue et al. 2009: 164). Both passengers and freights need to go through terminals in order to reach their final destination. Cruise ship passengers need to go through the port terminals to enter the ship and freights need to be consolidated at the port. "The port is the transport hub that connects the land- and sea transport" (Tapaninen 2013: 92).

Just as vessels are different to one another, so are the ports. Usage of the port defines the type of port. RORO-vessels usually visit ports to handle the freight through the stern, containerships ports with cranes and passenger ships ports with passenger terminals and gangways. Today the industrial ports are commonly situated further from the city centre, whereas the passenger ports (Figure 1) still are conveniently situated near city centres with easy connections to other means of conveyances. The cruising ports of this study especially demonstrate this trend, and they are all situated nearby the city centre and with easy access to public transportation.

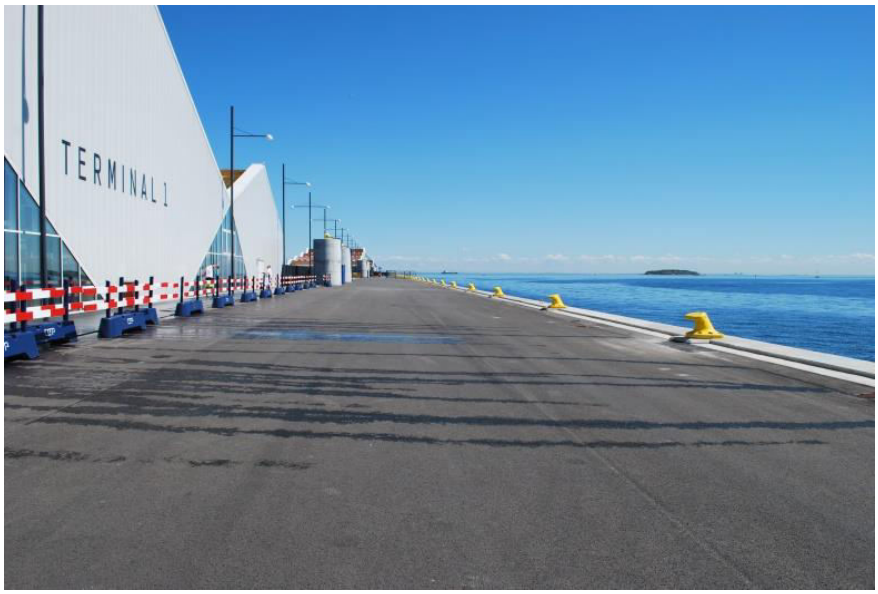

Figure 1. Cruise ship quay in Copenhagen. (Photograph: Irina Svaetichin)

Historically many ports started off as safe harbours for fishing and later on those with convenient locations became transportations hubs. Through urbanization and growing economic welfare ports got an important role in the development of many cities and many cities also owe their origin to the location of the port (Rodrigue et al. 2013). For example in Helsinki the port has a central and important role in the whole city. Helsinki was founded in 1550 to compete for Baltic Sea transport by King Gustav Wasa of Sweden and later the city grew around the port. Regular sea lines running throughout the summer opened in 1837, and passenger traffic running all year around opened in 1972 (Port of Helsinki 2015a). Today the industrial port is situated in the suburbs of the city whereas the passenger traffic is in the city centre. Residential areas near and around the port are highly popular, e.g. Katajanokka and Jätkäsaari. Jätkäsaari and the neighbouring West Harbour are under construction and are meeting both the needs for the maritime transportation and the residential living.

Today the ports have a vital part in the debate about maritime environmental concerns. There are increasing regulations and public debates not only to the shipping industry but to controlling port pollutions (Kunnaala-Hyrkki & Brunila 2015). Furthermore, as ports are often situated close to urban areas they are sites of environmental pollution that can affect cities and citizens nearby (Kunnaala-Hyrkki et al. 2015). Kunnaala-Hyrkki et. al (2015: 16) state further that developing and sharing best practices among the ports of the Baltic Sea, and around the world, will help them “choose the most cost-effective measure for decreasing their

environmental impact". In addition, environmental initiatives by ports can later one become a strong commercial argument and a competitive advantage.

Thus, the cruising business brings many tourists to the cities around the Baltic Sea in the summer. The cruising passengers bring substantial money to the cities and are a vital part of the tourism industry. Turnarounds, when a passenger start and/or finish their cruise, are especially important for the tourism industry of a city. The business has brought half a million Swedish crones in Stockholm 2015 (Ports of Stockholm 2015). The cruising business, tourism industry and the wellbeing of the environment goes hand in hand.

2.4 Background on cruise ship generated waste streams

There is little or no previous research done in the field of waste streams from international cruise lines in the Baltic Sea. Research in this field has mainly been accomplished in the United States of America, Great Britain and parts of Europe. The cruise ship industry is steadily growing with more than 22 million people cruising annually worldwide and 55 new ships to be launched between 2015 and 2020 (CLIA 2015a). According to Cruise Market Watch webpage (2015) there are 298 cruise ships worldwide.

Rising number of people cruising on luxury cruising ships also means growing cruise ship generated waste streams. Today's consumerism simultaneously with the growing ecological footprint and recognition of the shrinking natural capital the recycling and reusing of waste is important. New industries in the recycling field are born and new solutions generated. Therefore, as Butt (2007: 592) states in his article "the growth of this particular market has introduced a unique set of environmental pressures that need to be investigated, particularly those pertaining to waste management." Butt states further, as this research also shows, that the impact of these waste streams will vary due to laws and regulations, port receptions facilities and waste management plans on board the individual cruise ships.

This work took form after the launch of a report commissioned by the Finnish Transport Safety Agency (Trafi) and Ministry of the Environment in Finland year 2014 on the current status in ports of Finland according to the Directive 2000/59/EC on port reception facilities. The report was commissioned due to proposed amendments for the directive. The report covered ports in Finland with international traffic and the current status of how the international regulations are achieved, the feasibility of the current system and what

experiences the different operators in the field have. One of the main findings was that international cooperation among the ports ought to ameliorated and waste handling systems to ought be equal in all ports.

Calculations have shown that waste generated on cruise ships with 2 000–3 000 passengers during one day are around 550 000–800 000 litre of grey water, 100 000–115 000 litre of black water, 13 500–26 000 litre of oily bilge water, 7 000–10 500 kg of solid waste and 60–130 kg of toxic waste (Oceana 2004: 1). As the amount of waste generated on cruise ships are in these dimensions it is highly important that they are not drained to the seas. How the waste is dealt with vary according to the waste management on board and at the home ports and at the ports of call.

For many years the cruise ship industry has been sometimes described to have a negative environmental impact. It has been seen as one of the major pollutants at sea spilling oil and dumping garbage. Historically, ships could legally drain waste into the seas, thus this took a turn when the MARPOL convention was implemented in 1973 by the International Maritime Organization (2015a). In the 1960's advertisements showed how to throw garbage into to sea by making a hole in aluminium can to make it sink to the sea bottom.

Today many of the leading cruise lines have implemented practices and procedures to reduce environmental impact (Sweeting & Wayne 2003). For instance the Royal Caribbean Cruise Line has already since 1992 placed an environmental officer on every cruise ship and repurposes 100% of the offloaded waste from the ships when ending cruises in Florida ports (Royal Caribbean Cruise Line 2015). The wellbeing of the environment itself is vital for the cruise industry as clean oceans is essential for every cruise experience.

Vessels produce waste and accordance to MARPOL 73/78 and the EU Directive 2000/59/EC ports are obligated to maintain adequate port reception facilities to cope with the volume of waste generated by the vessels calling in the ports. Furthermore, also national policies govern the countries waste handlings and therefore the Port of Helsinki, Port of Tallinn, Ports of Stockholm and Copenhagen Malmö Port do operate slightly differently.

According to the EMSA report produced by Ohlenschlager and Gordini (2012) a majority of European ports provide collection of sewage but few ships request the usage of the service as the ships can still legally discharge sewage into the sea. It is believed that the situation is

different in the Baltic Sea as ships can discharge the wastewater with no special fee for example in both the Port of Helsinki and in Ports of Stockholm. The No Special Fee -system is implemented as to encourage ships to deliver all ship generated waste to the port as the vessel nevertheless has to pay a waste fee which is calculated on basis of net or gross tonnage.

In general the shipping industry is seen as a "borderless" industry (Cleanship 2013) and this is one of the basic views for this thesis. Cruise ships, and also all other kinds of vessels, do not usually call only in one port and therefore cannot leave the ship generated waste only in one specific port. Furthermore, the Baltic Sea region is small and the distances are short which enables the cruise ship easily to hold on to some of the waste and discharge it only in the next harbour. Although the No special fee -system, and the other directives, legislations and conventions, enforces the cruise ship to leave all ship generated waste at the calling port this is not the case. The cruise ships attempt to find the best solution for landing of waste. The best solution is an objective concept which is influenced by environmental goals and finances. One reason is of course simply the lack of time as often the cruise ships only stays half a day in one port; there is not enough time to both off-load the waste and to reload supplies.

2.5 The No Special Fee -system

The No Special Fee -system (NSF) was introduced by Helsinki Commission (HELCOM) in 1998 and was set to protect the environment of the Baltic Sea Area. New recommendations have then been established and the definition here and the explanation of the system refer to the HELCOM recommendation 28E/10 (2007) superseding recommendations 19/8, 26/1 and 28/1. The NSF-system encourages ships to deliver waste ashore and thereby avoids undesirable waste streams between ports and thus prevents discharges into the sea. The four ports of this study all have the system implemented.

HELCOMs (2007) definition on the system is "a charging system where the cost of reception, handling and disposal of ship generated wastes, originating from the normal operation of the ship, as well as of marine litter caught in fishing nets, is included in the harbour fee or otherwise charged to the ship irrespective of whether wastes are delivered or not." In other word, ships calling at ports with the NSF-system implemented will pay the same port fee weather the ship leaves waste or not. Passenger ships or other ships calling at the port

regularly during the year can have an authorized certification not the leave the waste in the port. Thus, these ships are obligated to handle their own waste management at the port. Usually cruise ships do not have this certificate as they only call the ports during the summer months and are pleased with the ports waste handling systems. For example in Helsinki mostly passenger ships, such as Tallink Silja, and fast ferries, such as Linda Line, calling daily at the port have the certificate.

Along the system every sea-going ship is obligated to pay for the reception, handling and disposal of oil residues, sewage and garbage at any calling port. The fee covers the waste collection, handling and processing including infrastructure and is usually counted on the basis of a ship's gross tonnage. Moreover, the waste management fee shall not gain financial profit to the port. The fee shall only cover investments in reception facilities, operation of reception facilities, repair and maintenance costs of such facilities and the costs of handling, treatment and final disposal of received wastes. Hence, the system ought not to be economically competitive amongst the ports and as the ships are required to leave the waste generated from last port of call at the next port, the waste streams ought to be evenly distributed.

3 Waste management in ports

The port is responsible for handling the port areas and the infrastructure operationally and financially. This means that the port needs to provide services to ships calling at the port but also for the maintenance of the areas, such as quays and docks. Environmentally the port strives to reduce emissions such as noise, air emission and waste but also to scale down the energy consumption. Additionally, ports produce reports and audits on environmental processes. Handling their own waste, tenants' waste and the waste of the operators are part of the port duties. In general the waste management is a complex problem because of the many aspects (environmental, economic and social) that have to be considered (Zuin et. al 2009). There is little or no research on this topic in the Baltic Sea region. As Kunnaala-Hyrkki et. al (2015: foreword) states "It is widely known that despite the common EU legislation, environmental assessment and management processes in the ports vary greatly within the Baltic Sea region. There is no previous research regarding how environmental issues are handled and monitored in different ports."

The ESPO Green Guide (2012) data shows that the environmental management in the European ports have increased from 1996 to 2012. According to the guide there is a trend to be seen. "the increasing trend for ports to produce an environmental policy, to publish an annual environmental report, and establish activities and procedures to manage their environmental risks such as designating environmental personnel, having an environmental management system, and monitoring environmental performance by the systematic use of environmental performance indicators. The trends demonstrate that a lot has been achieved through voluntary self-regulation within the sector." (ESPO 2012: 13).

According to the EU waste legislation and policy the prevention of producing waste is the most important factor. This is closely linked to manufacturing methods and is also influencing the consumer's demands. The EU Directive 2008/98/EC (2008: 4) states "The first objective of any waste policy should be to minimise the negative effects of the generation and management of waste on human health and the environment. Waste policy should also aim at reducing the use of resources, and favour the practical application of the waste hierarchy." Furthermore, the directive states in particular that waste management shall be carried out without risking the water, air, soil, plants or animals, without causing nuisance through noise or odours or negatively affecting the countryside neither the places of interest. The waste

hierarchy (Figure 2) was first put up in 1997 by the European council. This shows that the minimization and recycling of waste has been on the topic for already two decades.

Port authorities can only manage their own production of waste, not the production of waste on board. The port has a strong influence on the ships leaving waste at the port. They can demand recycling in a certain way and also provide reductions on port fees if waste handling is made in a desirable way. E.g. Ports of Stockholm have a reduction of 5.51 SEK per passenger if the cruise ship generated waste is sorted well. Furthermore, the NSF-system encourages the vessels not to discharge any wastes to the sea as the vessel nevertheless has to pay the waste fee.

Waste should be re-used at first hand and recycled only if it cannot be re-used. To re-use means using products or components for the same purpose for which they were originally conceived (Directive 2008/98/EC). In this phase the waste is not defined as waste per se. Recycled household materials should at least be paper, metal, plastic and glass. These fractions are produced in large quantities on cruise ships as the cruise ship can be seen as a small village.

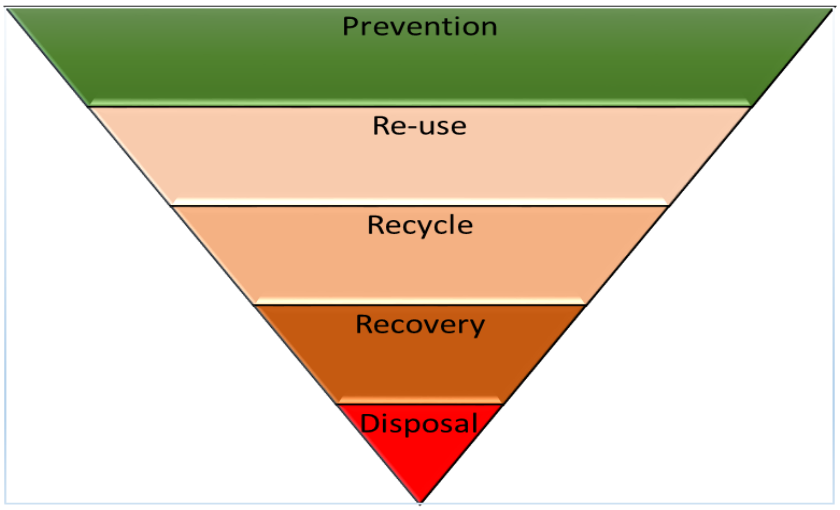

Figure 2. Waste legislation and policy of the EU Member States shall apply as a priority order the following waste management hierarchy (Directive 2008/98/EC). Also applicable on port waste management.

Recovery of waste "means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider

economy" (Directive 2008/98/EC: 10). Waste shall not be mixed with other materials if it does not improve recovery but be collected separately if it is practicable technically, economically and environmentally.

The disposal of waste should always be the last option. In many cases people tend do what is most convenient for them and usually it is easiest to throw all the waste in one place. Prevention, re-use and recycle of products and waste should be as naturally as drinking coffee in the morning. One should not have to think about it but act naturally. In case of disposal the holder of the waste is responsible to carry out a safe disposal operation. The cruise ship is responsible to minimizing the production of waste and the proper sorting on board. A proper sorting on board vessels enables the ports to carry out a good and acceptable disposal. Although port authorities around the Baltic Sea are competitive businesses they do also cooperate with one another to great extent. Especially when talking about environmentally friendly solutions and progresses the port authorities share their knowledge.

3.1 Waste types caused by cruise ship industry

A single cruise ship can be seen as a small village. Cruise ships sailing the Baltic Sea has around 2000–3000 thousand passengers and around 800 workers. Individuals, both passengers and workers, and the different activities on-board produce different types of waste. Cruise ships sailing the Baltic Sea are in general smaller ones as the larger cruise ships cannot call in many of the ports due to shallow waters. A cruise ship produces wastes such as wastewater, oily waste, solid waste, hazardous waste and food waste. According to some calculations an average cruise ship generates a minimum of 1 kg of solid waste, two bottles and two cans per passenger and an amount of 50 ton of black water (sewage) per day (Sweeting & Wayne 2003, Butt 2007). A new type of waste called scrubber waste has also been introduced since the new legislation (Directive 2012/33/EC) on sulphur emissions was introduced as on 1st of January 2015. The new legislation, amending Directive 1999/32/EC states that the sulphur content of the fuel mass cannot be of more than 0.10%. For a satisfactory waste handling the fractions need to be sorted on board the ship. Both passengers and crew members (Figure 3) are sorting the waste.

Figure 3. The waste handling room on board Brilliance of the Seas (6.6.2015). Information on which kind of waste belongs to which barrel is visibly demonstrated for the crew members. (Photograph: Irina Svaetichn)

Wastewater is divided into black and grey water. Black water is sewage and is generated from toilets and medical facilities. Grey water is water from showers, washing machines, and dish washers etcetera. Ships are still allowed to discharge treated wastewaters into to Baltic Sea. According to MEPC 68/10/2 to Annex IV (description on the IMO annexes in chapter 3.2) it is approved that the discharge of sewage within a special area will be prohibited for new passenger ships after 1st of June 2019 and for existing ships after 1st of June 2021. Discharging of sewage will then only be allowed with an approved sewage treatment plant that meets the required nitrogen and phosphorus standards. The discharge of wastewater will be prohibited by all the countries around the Baltic Sea except Russia. That is Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden.

As for today a vessel can discharge black water at a distance of no less than three nautical miles to the nearest land and it has to have a sewage treatment plant in operation. Sewage which is not comminuted or disinfected can be discharged at a distance of more than 12

nautical miles from the nearest land and at four knots. No traces of the wastewater are to be seen in the sea (IMO 2011: 230).

According to CLIA (2015b) the cruise industry has voluntarily entered an agreement to discharge all wastewater ashore in the Baltic Sea area where adequate reception facilities are available. Thus, Robert Ashdown, interviewed by Folke Rydén for his documentary Hotet på havet (2015), says that the cruise ship simply cannot hold on to the wastewaters and only leave it in the calling ports around the Baltic Sea. For the cruise ships to be able to discharge all the wastewaters in the ports they need to spend longer time at berth and as a result to this CLIA would simply have to take away some of the cruise ships sailing the Baltic Sea. It is important to keep in mind that it is still fully legal to discharge treated wastewater into the Baltic Sea and as this is the case many ships probably do. Many sources say that the amount of wastewater discharged into the sea by cruise ships is minimal and others say it is significant. Thus, according to the Prime Minister's Office Publications (2009: 24) the discharged wastewater from vessels accounts only for 0.04% of the total nitrogen load and 0.3% of the total phosphorus load in the Baltic Sea. The problem is however exacerbated locally, especially in the summer months. For this research the amount of discharged water into the sea is not further studied.

The Port of Helsinki and the Ports of Stockholm are receiving all the wastewaters with no special fee, which means that the ships pays the same fee whether leaving the wastewater or not. In the Port of Tallinn and Copenhagen Malmö Port some amounts of discharged wastewater belongs to the NSF-system. Areas not classified as special areas it is generally considered that the oceans are capable of assimilating and dealing with the sewage from ships through the waters natural bacterial action (IMO 2015c). Many of the cruise ships have a wastewater cleaning system on board but usually the treatment only removes bacteria from the water, not the eutrophication substances.

Oily wastes and bilge waters occur on all vessels and goes under MARPOL Annex I. According to statistics it is estimated that a cruise ship generates 8 tonnes of oily bilge water during every a day. The bilge water is passed through a separator where the oil is being separated and stored for later disposal and the water is being discharged (Butt 2007). Other oily wastes generated on board are oily rags. Oily wastes can be processed and reused and in some cases even paid for.

Solid wastes consists of glass, tin, metal, plastic, paper, cardboard, steel, kitchen waste, kitchen grease, food waste, cans, crockeries and electronics. According to Sweeting and Wayne (2003) each cruise ship passenger generates on average of 1 kg of solid waste and disposes of two bottles and two cans each day. Solid waste runs under MARPOL Annex V which in Special Areas cannot be dumped into sea at all. The ship is required to store the wastes on board and commonly the wastes are sorted on the vessel and some even threatened on board. For example cans cardboard and paper can be burned (ashes taken care of), glass can be crushed and cans compacted. See Figure 4.

Figure 4. Examples on how metal cans are compressed and stored on board a cruise ship. (Brilliance of the Seas, 6.6.2015. Photograph: Irina Svaetichin)

Cooking oil is a vast fraction of waste especially on cruise ships. Cooking oil includes all edible oil or animal oil used for cooking. Cooking oil needs to be stored in special boxes and separated from other garbage.

Hazardous wastes are wastes that require special treatments and cannot be mixed with other wastes. According to the Finnish waste act hazardous waste is waste that is flammable or

explosive, contagious or potentially harmful to human health or the environment (Avfallslag 646/2011). It runs under MARPOL Annex III. Hazardous wastes are usually solvents, batteries, fluorescent tubes, mercury vapour and chemicals used in photo-processing. Today many cruise ships do still develop their own photographs for tourists even though a digital option would be much more environmentally friendly. Hazardous waste needs to be labelled in accordance with the EU Directive 2008/98/EC.

International food waste needs to be handled differently from normal catering waste due to risk of spreading diseases amongst humans and animals. A vessel is considered to be in international traffic if it stops at a port outside of EU during its route. Leftovers and other wastes such as wrapping paper that has been in contact with international catering waste are considered international food waste. This waste needs to be disposed of by burial in a landfill or incinerated. (EC No 1774/2002)

Scrubber waste is waste generated from a scrubber which can be installed on ships to reduce the sulphur dioxide emissions. Since January 1st, 2015, EU Member States have to ensure that ships in the North Sea, the English Channel and the Baltic Sea are using fuels with a sulphur content of no more than 0.10% by mass (European Commission 2015a). Fuels with higher sulphur contents are still possible but only if a proper exhaust gas cleaning systems, called scrubber, is in place. As this regulation is valid only since 2015 there are only a few experiences with the reception of scrubber waste in the ports.

Today some vessels have installed a scrubber to meet the required emissions. The scrubber waste is commonly treated as hazardous waste in the port. The problem so far with receiving scrubber waste in ports is that it cannot be discharged into the municipal wastewater system as it is not yet known exactly what amounts of substances it contains. Furthermore, the scrubber sludge is still a new type of waste and the recycling- and discharge processes of the fraction are yet to be discussed. 75 ships had installed scrubbers worldwide by the end of 2014 and according to an estimation over 160 ships have scrubbers on board by the end of 2015 (Rozmarynowska 2015).

Discharging of cruise ship generated waste at the harbour

The waste is being sorted on board the cruise ship into different fractions. Passengers are requested and crew members are required to sort their wastes on board the vessel to make the waste handling smoother and easier when reaching the port. In the Port of Helsinki and in the Ports of Stockholm there are usually waste trucks waiting for the ship to arrive. They receive the waste straight away and pass it forward to the right waste handling treatment facility. In Malmö Copenhagen Port and the Port of Tallinn there are usually different containers ready on the pier where the cruise ship can leave the fractions.

In the ports where the wastewaters are being directly led to the municipal wastewater system both the port and the vessel provide staff with know-how to connect the pipelines from the ship to the municipal lines. During the discharge the connections need to be supervised. Figures 5 a. and b. show the discharge of wastewater directly to the municipal wastewater system. Through the opening in the middle of the figure 5 a. the waste collections are brought in to different containers with the help of workers from Sita Suez Environment. The company is handling the waste in the Port of Helsinki and the Ports of Stockholm.

Figure 5a.

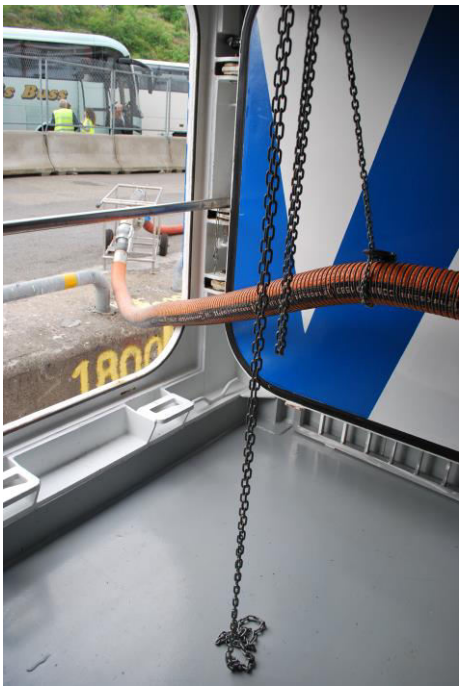

Figure 5b.

Figure 5 a-b. Waste discharging from a cruise vessel in Ports of Stockholm. (Photograph: Irina Svaetichin)

3.2 Laws and regulations

This chapter deals with regulations concerning waste management in ports, mostly on an international level, thus, to a small extent also national legislation. There is an extensive amount of regulations, both internationals and nationals, concerning port management on different levels. As Brunila (2013) states in his research in the Finnish ports there are more than twenty different EU and international regulations affecting the operation.

The International Maritime Organization (IMO) is a specialized agency of the United Nations and the global regulator of shipping. Their slogan is "Safe, secure and efficient shipping on cleans oceans". The Baltic Sea region is designated as a special area in the International Convention for the Prevention of Pollution from Ships (MARPOL). A special area "means a sea area where for recognized technical reasons in relation to its oceanographic and ecological condition and to the particular character of its traffic the adoption of special mandatory methods for the prevention of sea pollution by garbage is required." According to IMO other special areas are the Mediterranean Sea, the Black Sea area, the Red Sea area, the Gulfs Area, the North Sea area, the Antarctic are and the Wider Caribbean Region. The definition of these areas can be found in regulation 5 of Annex V. As of this Annex the Baltic Sea area means "the Baltic Sea proper with the Gulf of Bothnia and the Gulf of Finland and the entrance to the Baltic Sea bounded by the parallel of the Skaw in the Skagerrak at 57°44.8′ N".

The MARPOL convention was first adopted in 1973 at IMO and later on updated by amendments. The MARPOL protocol is one of the major international agreements relevant to cruise ship pollution. The six technical Annexes (Table 1) are produced to prevent and minimize pollution from ships, both accidental pollution and that from routine operations (IMO 2015b). Annex V is implied on the ship. Thus, when the delivery of waste is done at the port, the waste legislation of the country takes force. The MARPOL protocol is in force on the seas, not in the harbours, and refers to what typed of waste can or cannot be discharged to the sea and in what areas. Furthermore, the national laws on garbage in each country are not the same which also results in difficulties on board ships calling at numerous ports as the ship waste handlings remains the same.

According to IMO (2011: 241) garbage is defined as

> *Garbage means all kinds of food wastes, domestic wastes and operational wastes, all plastics, cargo residues, incinerator ashes, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other Annexes to the present Convention.*

Table 1. Description of The MARPOL convention and what year each Annex entered into force. (IMO 2015c)

	Year	**Regulation**	**Description**
Annex I	1983	Regulations for the Prevention of Pollution by Oil	Covers prevention of pollution by oil from operational measures as well as from accidental discharges. 1992 amendments made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003.
Annex II	1983	Regulations for the Control of Pollution by Noxious Substances in Bulk	Details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk. No discharge of residues containing noxious substances is permitted within 12 miles of the nearest land.
Annex III	1992	Prevention of Pollution by Harmful Substances Carried by Sea in Package Form	Contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications.
Annex IV	2003	Prevention of Pollution by Sewage from Ships	Contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land.
Annex V	1988	Prevention of Pollution by Garbage from Ships	Deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of; the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics.
Annex VI	2005	Prevention of Air Pollution from Ships	Sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances. A chapter adopted in 2011 covers mandatory technical and operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships.

The most important regulation for this study is the Annex V on pollution by garbage from ships. According to this Annex all plastics and all other garbage, including paper products, rags, glass, metal, bottles, crockery, dunnage, lining and packing materials are prohibited to be discharged into the sea. The only exemptions to discharging overboard are due to safety reasons or the escape of garbage as a result of damage. The vessels need to have a garbage record-keeping book onboard which shall record all discharge operations, including accidental loss or escape of any garbage and completed incineration at port and at sea. Also the Port Authority of each port has obligations to ensure the provision of port reception facilities without causing undue delay to vessels. (IMO 2011: 241−246).

Resolution (MEPC.201(62)) adopted on 15 July 2011, entered into force on 1 January 2013, with amendments on Annex V. The resolution states that each port undertakes action to ensure adequate facilities at ports and terminals for reception of garbage without causing delays to ships. The discussion on "adequate facilities" has been a heated discussion among ports and shipping companies as sizes and measurements are not defined more than that the facilities need "to take into account the needs of ships operating in these areas". This resolution divides the garbage categories into nine fractions; plastic, food wastes, domestic wastes, cooking oil, incineration ashes, operational wastes, cargo residues, animal carcass(es) and fishing gear. Domestic waste is not divided into subgroups by definition. The resolution states only examples on how to divide domestic wastes; paper product, rags, glass, metal, bottles, crockery, etc. Within the special areas it is allowed to discharge food wastes when on route and no less than 12 nautical miles from the nearest land. The food should be comminuted or ground and it should fit through a screen with openings no greater than 25 mm.

Another international directive that implies on the cruise ship- and port business is the EU Directive 2000/59/EC on port reception facilities (PRF) for ship-generated waste and cargo residues, adopted by the European Community in 2000. By improving the use and availability of PRFs the Directive aims on reducing illegal discharges from ships and thereby enhancing the protection of the marine environment. This directive pursues the same aim as the MARPOL 73/78 Convention with focus on ship operations in European Union ports.

The purpose is set out in Article 1 (2000: 83) as following:

> *The purpose of this Directive is to reduce the discharges of ship-generated waste and cargo residues into the sea, especially illegal discharges, from ships using ports in the Community, by improving the availability and use of port reception facilities for ship-generated waste and cargo residues, thereby enhancing the protection of the marine environment.*

Furthermore, the Directive applies to all ships, irrespective of the flag they fly, and adequate PRFs should be made in all ports in the European Union. The PRFs in each port should therefore meet the needs of its users, from the largest merchant ship to the smallest recreational craft. Each European country is obligated to provide all services and/or other arrangements to fulfill proper and adequate PRFs. The Directive requires all ships to deliver their ship-generated waste to the port reception facilities before leaving the port. The Directive (2000: 82) announces further that "in order to reconcile the interest of the smooth operation of maritime transport with the protection of the environment, *exceptions to this requirement should be possible* taking into account the sufficiency of the dedicated storage capacity on board, the possibility to deliver at another port without risk of discharge at sea and specific delivery requirements adopted in accordance with international law." This leaves room for the ships to keep wastes of particular standards onboard, and the ports with more accurate waste handlings and better recycling methods and opportunities. Garbage that can be recycled and reused should not be defined as waste.

The Directive 2000/59/EC follows the view "polluters pay", and therefore the ship will pay for the use of PRFs. Thus, implementing the view from the environment, the fee system should encourage the ships to leave their ship-generated waste in the port and "charges for using these facilities should be fair, non-discriminatory and transparent." (2000: 82).

According to Finnish waste act (Avfallslag 646/2011 2011) a ship is obligated to leave all ship-generated waste in the port if the PRFs are adequate. Here again the problem stands whether recyclable or reusable waste is defined as waste. In the interest of protecting the environment and the Baltic Sea ship-generated recyclable and reusable waste should be possible to ship to the next harbor which is specialized on certain kinds of recyclable waste. Furthermore, the Finnish waste act, defines waste as a substance or object which the holder has discharged or intends to or is required to discharge. A substance or an object is not waste

if 1) it is ensured that to be reused, 2) it can be directly used as such or at most have undergone such processing as normal to industrial practice, 3) it is produced as an integral part of a production and 4) it fulfills the requirements for production and environment- and health protection for which the substance or object is intended for and the overall assessment does not endanger or harm the environment or health.

The legislation on sulphur dioxide emission, Directive 2012/33/EU amending Directive 1999/32/EC is the end of a long process on sulphur emissions from ships. The basic legislation was developed in 1999, and 2005 SECA areas, sulphur emission control areas, was designated the Baltic Sea, the North Sea and the English Channel, where a sulphur content of the fuels was limited to 1.5%. As of January 1st, 2015, the sulphur content cannot be of more than 0.10%. This new directive will firmly reduce the particulates we breathe daily.

4 Study area and the ports

The research area consists of four popular ports among cruise ship destination in the Baltic Sea. The ports have been chosen on basis of cruise ship calls in each port (Figure 6), Copenhagen Malmö Port, Port of Tallinn, Port of Helsinki and Ports of Stockholm. Figure 7 shows the location of the ports in the Baltic Sea together with monthly density of all kinds of vessels provided with AIS in the area year 2011. Port of Saint Petersburg does not belong to the European Union and is not chosen for the research. Laws and regulations do not apply on the port of Saint Petersburg in the same way as in the rest of the Baltic Sea. Also due to language difficulties the port was not chosen.

It is estimated that 1079 numbers of cruise ships calls and over two million cruise ships passengers arrive in these capitals in 2015 (Cruise Baltic Statistics 2014). According to Helsingin Sanomat (Airaksinen & Mannila 2015) the cruise ship industry will bring Helsinki's entrepreneurs a total of 28 million euros. During the summer 2015 the Port of Helsinki will receive calls from 11 new cruise ships. Usually the amount of new cruise ships calling in Helsinki each year is six or seven. The Baltic Sea area is rising in its popularity and passengers from all over the world are taking holidays on cruise ships in the area.

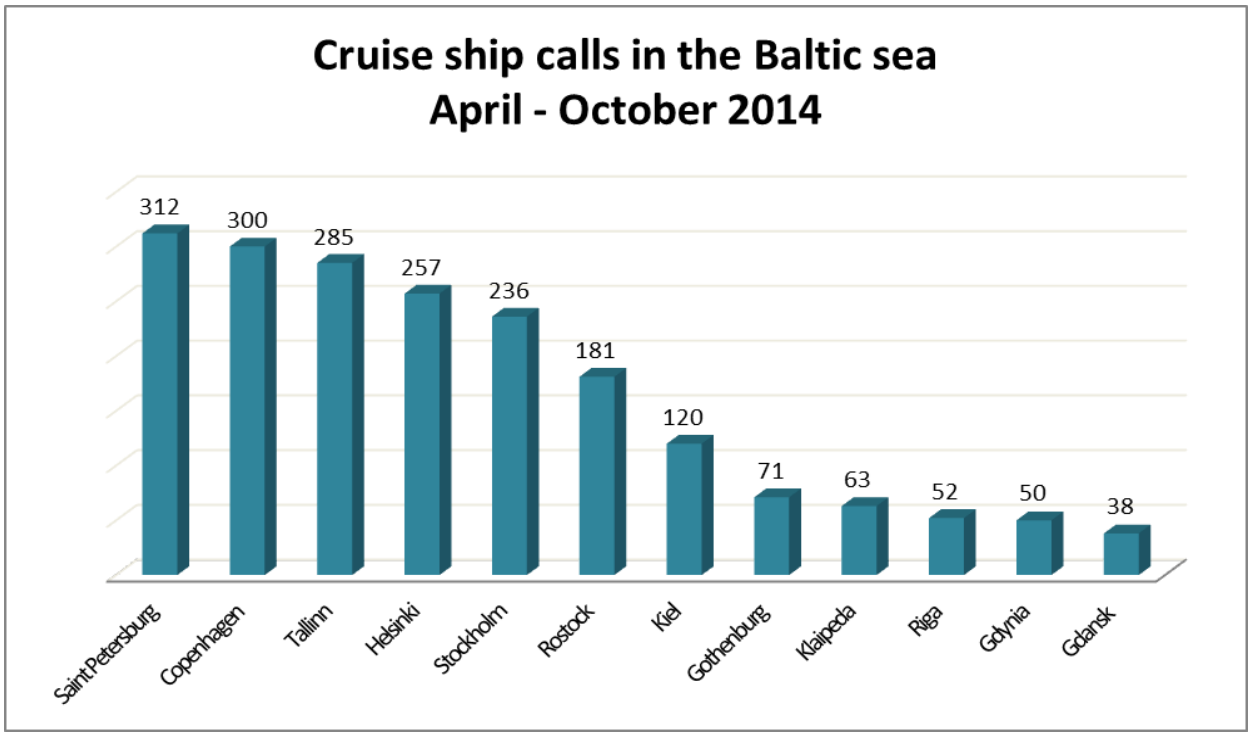

Figure 6. Cruise ship calls in the Baltic Sea 2014. Statistics from Cruise Baltic Statistics (2015), confirmed by each port individually.

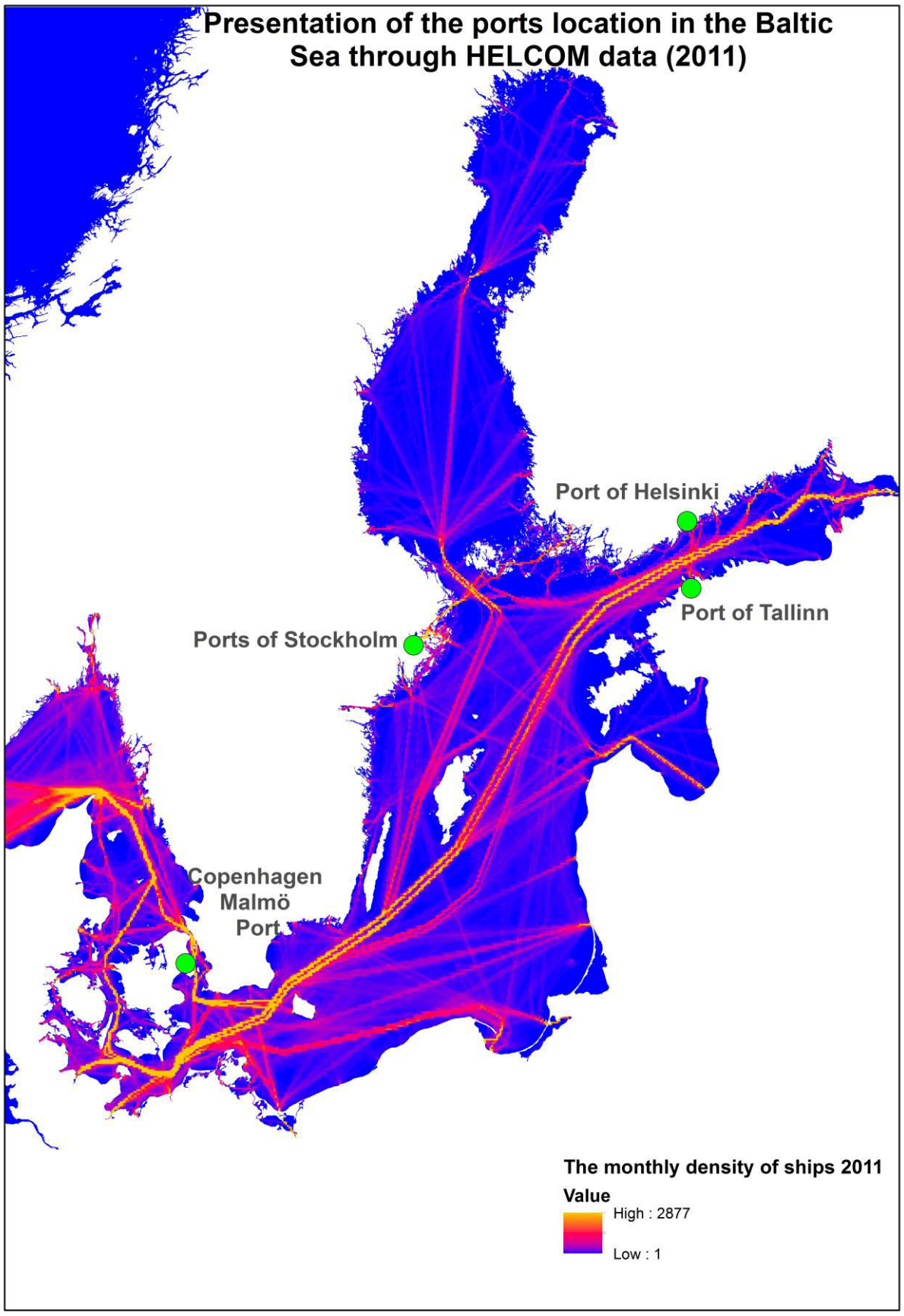

Figure 7. Presentation of the ports together with monthly density of all kinds of ships in the area 2011.

As figures 8 & 9 indicate a steady increase can be seen in both cruise ship passengers and cruise ship calls in each port. The amount of passengers has increased over 250% from year 2000 to year 2014 and the cruise-ship calls have increased by 53% (Cruise Baltic statistics 2014). Due to larger vessels with capacity to take more passengers the amount of passengers has become notably bigger. The slight decline in both the calls and the amount of passenger in 2014 can probably be a result of the stricter emission controls for Baltic Sea transports. Stricter emission controls result in increased fuel costs which further can result in routes being diverted. Thus, the figures show a higher decline in the cruise ship calls than in the cruise ship passengers in each port. The reason to this is the fact that cruise ships are getting larger and the capacity for room for passengers higher, and therefore fewer ships bring more passengers.

The decline in Copenhagen of both cruise ship calls and passengers is not solely a result of the reason stated above. The Copenhagen Malmö port is a popular port for turnaround cruise ships and as this amount declined the count of passengers also declined as turnaround ports count the passengers twice. A turnaround means a port where passengers start and finish their cruise.

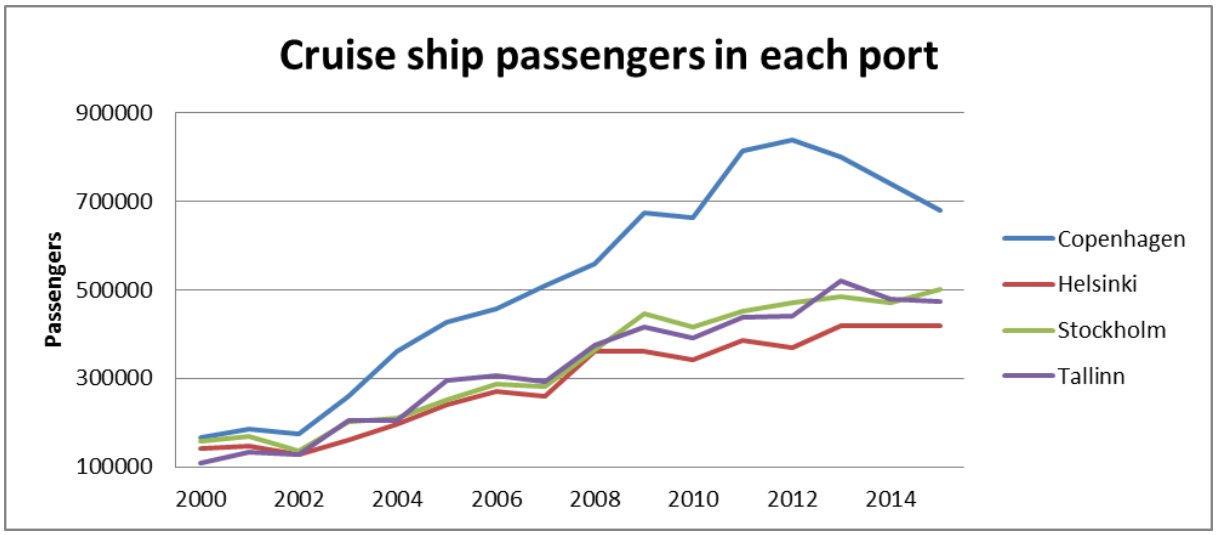

Figure 8. Number of cruise ship passengers in each port 2010–2014.

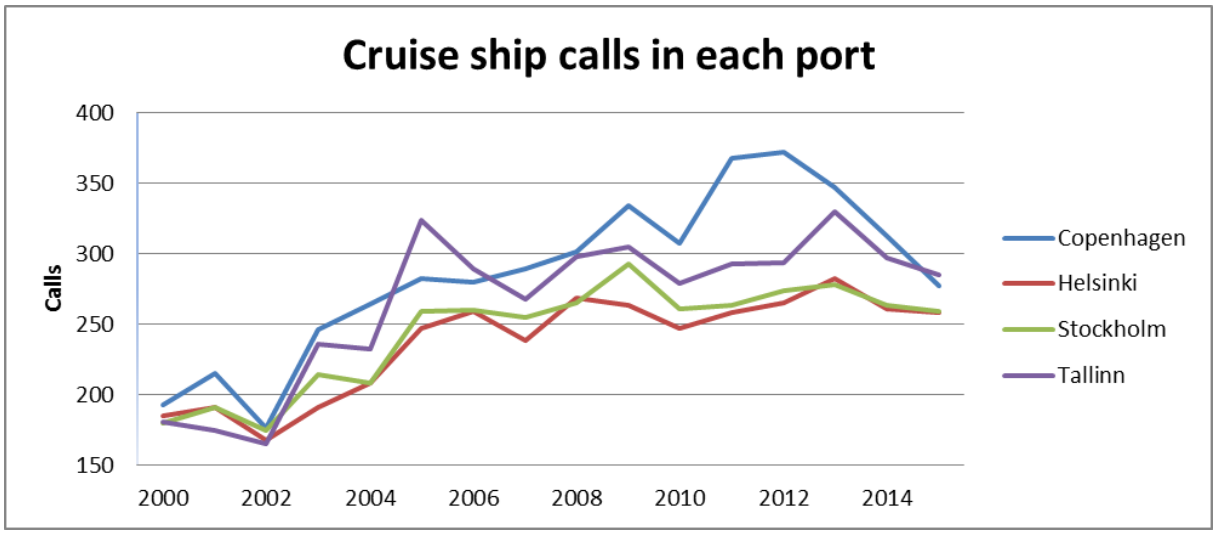

Figure 9. Number of cruise ship calls in each port 2010–2014.

According to HELCOMs survey (2015a) 70% of cruise ship voyages between two ports in 2014 in the Baltic Sea lasted from 8 to 20 hours at sea and the time spent at the ports from 8 to 10 hours. The four ports are strategically close to each other and most of the cruise lines operating in the area are visiting all four ports. All four ports have ISO 9001:2008 Quality Management System and ISO 14001:2004 Environmental Management System certificates. Furthermore all ports are following the MARPOL 73/78 convention, the EU directive 2000/59/EC and have introduced the NSF-system.

Figure 7 shows the location of the four ports of the study and the monthly density of ships in the Baltic Sea year 2011. The data is obtained from HELCOM online Data and Map service (HELCOM 2012). The data represent the average monthly density of ships equipped with an AIS (Automatic Identification System). AIS is an automatic tracking system used on all kinds of ship and Vessel Service Traffic (VST) to obtain and locate data and other useful information of nearby ships. Usage of AIS and VST is helping to avoid collisions of different kinds. The brighter colours on the map show higher density of ships which means that they are the most common shipping routes in the Baltic Sea. As seen from the figure all four ports have a strategic location for the shipping industry in the Baltic Sea.

4.1 The Baltic Sea

The Baltic Sea area is a very sensitive maritime area due to its special features. It is the second largest brackish water basin after the Black Sea and covers the Gulf of Finland, the Gulf of Bothnia, the Gulf of Riga, the Baltic proper and the Belt Sea. The water changes slowly as a result of shallow water, lack of tides, low salinity and the location on a tectonic plate. The Danish Strait is the only connection with the open seas. Due to this harmful substances led to the sea will stay in the Baltic Sea for a long time. This means that the area is highly sensitive to all environmental impacts, especially the ones resulting from human activity. Eutrophication of the Baltic Sea is a severe threat and algal blooming is an annual phenomenon.

Phosphorus and nitrogen are the main eutrophication components in the Baltic Sea and are transported to the sea through the rivers. Finland stands for 10% of the phosphorus emissions to the sea and 11% of the nitrogen emissions. 3 900 tons of phosphorus and 82 000 tons of nitrogen was led to the Baltic Sea from Finland throughout 2008 to 2013. These emissions originate mainly from the agriculture. Phosphorus originates also from fish breeding, forest industry and from places with high population density. Nitrogen on the other hand origins from manufacturing, sparsely populated areas and forest industry. Nitrogen is also led through air emissions to the sea. (Finland's environmental administration 2015).

The Baltic Sea area is one of the busiest shipping areas in the world. Vessels are constantly crossing the sea with passengers or cargo of different types. The Baltic Sea is surrounded by 10 countries and more than 100 ports (Cleanship 2013: 18). Around 2 000 ships are daily operating in the area and it is estimated that by 2017 the transportation of goods by sea will as much as double. It is expected that general cargo and container traffic will triple, and oil transportation increase by 40% (HELCOM maritime 2015). Due to short distances between the Nordic countries, the Baltics and Russia, the sea route is the fastest and cheapest way of transporting goods.

Gritsenko (2014: 80) states that "as the amount of shipment of oil and oil products has gradually increased, vessel traffic on a relatively small Baltic basin has grown proportionately, which has raised the risk of accidents and, as a consequence, damage from discharges, emissions, and other types of pollution. The growing intensity of sea traffic also

leads to an increase in air emissions…" The state of the sea is crucial for the population of the Baltic Sea states because of the well-being of the environment and also because of the economic benefits the area brings the states. Furthermore, Gritsenko argues that the broad knowledge of negative environmental impacts from shipping has put the whole shipping industry under increased pressure to become more environmentally friendly.

The sea is very sensitive for changes and therefore the eutrophication has to be minimalized and due to this the area has stricter regulations than others. For example a small oil spill would have a heavier negative effect on the Baltic Sea than on the Mediterranean Sea. Shipping of oil in the Baltic Sea has increased remarkably since 1990's. Emissions of various kinds are minimal by legislations and they are getting stricter all the time. The area has been granted the status Particular Sensitive Sea Area 2005 by IMO. The pollution from the ships is not the only source to eutrophication of the sea. According to HELCOM (2015b) the main sources to nutrients lead to the sea are riverine inputs, atmospheric depositions of nitrogen to the water surface and direct waterborne discharges to the sea from costal point sources, run-off from diffuse sources in coastal areas and discharges from ships. The eutrophication of the sea is considered to be the most pressing environmental problem and therefore it is high on the agenda on both European Union and HELCOM level (BalticSea2020 2015).

Due to the low salinity in the area the fauna is unique and small compared to other areas. Thus, the species living in the Baltic Sea, which live on the edge of their salinity tolerances, are sensitive to changes and to any emissions of different kinds. Alien species brought to the area through ballast water have only recently been understood to be a threat to the area. Ballast water (which stabilizes and balances the vessel) is brought with ships from different areas in the world and discharged wherever it is needed. The ballast water can contain thousands of organisms of different species, from eggs, cysts, and bacteria and even small fish. The species are introduced in a new environment and although it seems harmless they can cause severe economical, ecological and health problems.

In order to prevent, minimize and later on eliminate the transfers of harmful organism the ballast water management was adopted by IMO in 2004 and expected to enter into force shortly, which requires ships in international traffic to manage their ballast water and sediments to certain standards (HELCOM 2014: 14–16). According to the MEPC 68th session

meeting summaries (2015b), the Ballast Water Management Convention will enter into force one year after. Only 30 states with combined merchant fleets and 35% of the world's gross tonnage have ratified it as of 2015.

Also the climate change affects the sea and can result in changes in the food webs (BalticSea2020 2015). Warmer and longer summer months will most likely result in higher precipitation which will on the other hand cause more surface runoffs and increase input of nutrients to the Baltic Sea and result in stronger eutrophication. Furthermore, warmer sea water affects the distribution and reproduction of species. As a result species will spread further north and appear earlier in the spring. Also species living in cold water will be pushed further north and their living space will be decreased.

4.2 Ports of the study

Copenhagen Malmö Port is the most southern of the ports of this study. Furthermore, the distance from this port to the other ports is longer than between the other three ports. As seen from the map in Figure 7 Port of Helsinki and Port of Tallinn are the closest ones, only 88 km by sea. Thus, the figure illustrates that all the four ports are located fairly close to each other. The time spent on sea from one port to another is no more than one night.

The four ports are situated in or nearby the city centres. The ports have different quays and harbours around the city, but the quays used for cruise ships are mostly situated centre. Port of Helsinki and Ports of Stockholm are quite spread around the city, for example Port of Helsinki's cargo harbour is situated in the outskirt of Helsinki. The four ports are ideal for cruise ship passengers as they arrive in the city centre and the passengers can stroll around easily, both on guided tours or by themselves. The cruise ship passengers in these four cities usually have a day to see the surrounding areas. Saint Petersburg is commonly the main attraction and the cruise ships stays in the port for two to three days. Copenhagen Malmö Port is as the name suggests located in both Copenhagen and Malmö and therefore it is different from the other ports. The two cities are located 26 km opposite to each other and are connected via a toll bridge. They have had a joint harbour since 2001. Most of the cruise ships visiting Copenhagen Malmö Port stop on the Copenhagen side of the port.

The four ports have vast plans for infrastructure improvements. As seen in Table 2 each one is expanding the port areas. Port of Helsinki was granted an exceptional permit for the West Harbour in 2014, in accordance with the original plan. This was seen as a great development progress at the port. Expanding the quays started already in 2011. The terminal will be built to meet the needs for the next generation vessels, e.g. LNG (Liquefied Natural Gas) and shore power. West harbour is also the place where cruise ships take berths and the area is already now and will be even more suitable for big ships. The target is to bring the new terminal into use in 2017 and the whole West Harbours services available in 2018. The West harbour area is also a new and attractive living area. Furthermore, Port of Helsinki is increasing the draught of the Vuosaari harbour route to 13 meter as to meet the future needs of vessels.

Ports of Stockholm's largest improvements are being made at Kapellskär and Värtahamnen. Kapellskär will be rebuilt and expanded with improved logistical areas and environmental improvements, such as facilities for wastewater. The rebuilt port is planned to be ready in 2016. Ports of Stockholm is also able to direct wastewater straight to the municipal wastewater system from all the quays. Värtahamnen is located in the city and is now being developed side by side with the city. The vision is to have an attractive Stockholm for all and through urban development the area will be a modern efficient and environmentally adapted port.

Port of Tallinn is planning on expanding Muuga Harbour. The harbour could expand 1 772 meters in terms of quay line and up to 67 hectares concerning terminals. The depth is counted to be 16 metres (Personal information by Janis Väät 2015). An LNG bunkering terminal will be built at Muuga Harbour. The terminal will create opportunities for receiving LNG arriving by the sea, storing it and for loading tankers and tank trucks (Port of Tallinn 2015b).

Copenhagen Malmö Port has been widely expanding the port areas as to meet the needs for the cruise ships calling at the port. The port has built a new cruise terminal further out to the sea which will reduce the environmental impacts of cruise operations such as reducing noise and emissions for those who live close to the harbour. The quay has permanent facilities to receive wastewater straight to the municipal wastewater system. The port also has plans on expanding the road network, both for rail, road and bus traffic.

Table 2. Presentation of the ports. (Port of Helsinki 2015a, Ports of Stockholm 2015b, Port of Tallinn 2015a, Copenhagen Malmö Port 2015, Väät 2015)

	Infrastructure improvements	Cruise ship improvements	EU level	Environmental policy
Port of Helsinki	Expanding West harbour (2017-2018). Increasing the drought of the Vuosaari route	Service point for cruise ship crew	TWIN-PORT II, M EUR 30 (2015). Core port	Good practices of all parties at the port. All operation promotes recycling and reclamation. Implement investment that spare the environment.
Ports of Stockholm	Rebuilding and expanding Kapellskär (2014-2016). Värtahamnen - port and city developing (until 2016)	Mobile gangway at Nynäshamn & new cruise berth at Frihamnen	Core Port	Working actively, long-sightedly and strategically to create reliable and sustainable transportation.
Port of Tallinn	LNG bunkering terminal by 2017. Expanding Muuga harbour	Micro tunnel, receives sewage up to 1000m³/h	TWIN-PORT II, M EUR 30 (2015)	Operating environmentally friendly and preventing pollution. Assessing all the environmental impacts when planning.
Copenhagen Malmö Port	Road traffic and bus services expanded. New quay	On-board check in	Core Port	Focus on HOW the port should work. Environmental aspects included in analysis of the entire supply chain

The four ports have done improvements for the cruise ship calling at the ports. In the Port of Helsinki (together with the Finnish Seamen's Service and the Finnish Seamen's Mission) some improvements were made for the crew members. They are now provided e.g. with internet access, guided tours and cultural services. In the Ports of Stockholm a new mobile gangway was installed at Nynäshamn and a cruise berth at Frihamnen. These improvements were done as to meet the needs for the growing cruise ship callings at the ports. In the Port of Tallinn a micro tunnel receiving up 1000m³/h of sewage has been installed. In the Copenhagen Malmö Port an on-board check-in has been installed as to make the checking easier and faster. Copenhagen Malmö is the most common port for turn arounds. The ports have together a close collaboration and especially the cruising business throughout the summer brings them even closer to each other as many of the cruise ships visit all these ports on their route.

The ports are all important on EU-level as can be seen from Table 2. Ports of Stockholm, Port of Helsinki and Copenhagen Malmö Port are designed Core Ports by the European Union as to improve Europe's infrastructure network. These three ports belong to the Scandinavian-Mediterranean Corridor. As the name intend it is a network of roads, maritime roads, ports and nodes from Russia through Finland and Sweden all the way through Europe ending in Malta (European Commission 2015b). Port of Helsinki is more over part of the North Sea – Baltic Network together with Port of Tallinn (European Commission 2015a). Port of Helsinki and Port of Tallinn are working in the EU financed TWIN-PORT II project. This project continues from TWIN-PORT I and supports the ports developments towards more efficiently and environmentally friendly operations (Port of Helsinki 2015c). The ports environmental policies differ slightly from each other but the core message is the same. The policies tend to touch the working manners of the port operations and have long-sighted environmentally friendly goals.

5 Data and methods

5.1 Secondary data

Secondary data, information that has been collected by someone else, is used in a majority of human geography dissertations (Flowerdew & Martin 2005: 58). Geographic information for visualization of the produced maps was obtained from HELCOM online Data and Map service (HELCOM 2012). Statistical information over cruise ship generated waste streams in each port was collected for this study. At the beginning of the research the aim was to receive 10–15 -year old statistical information on cruise ship generated waste streams. However, the idea was rather quickly discharged and I only intended to receive up to five-year-old statistics of cruise ship generated waste streams in every port, but it was easiest to receive information regarding only the year 2014. Ports have not been legally forced to separate cruise ship generated waste streams from other waste streams at the harbours. The statistical information trends on the waste streams development within and among the ports will be shown in this study. Furthermore, each port has their own way of collecting and understanding data and all the measurements were not in the same units. It is not the port who primarily gathers the statistics but the waste handling company.

5.2 Semi structured thematic professional interviews

Interviews require good planning and time, especially in the transcription- and analysing phase. Interviews give however the researcher an opportunity to discuss the topic of interest with professionals in the field of research. It is important thus to remember is that the personalized views and feelings towards the topic can shine through the professional face. Even though the interviewee is a professional in the field it can be difficult to maintain a neutral sight toward the topic. Language skills are my asset as I can conduct many of the interviews in the interviewees own mother tongue. In Stockholm and Copenhagen I used Swedish, in Tallinn English and in Helsinki Finnish.

Semi structured interviews gives space for discussion about a particular topic. An interview is not depending upon a rigid set of questions decided beforehand as the interviewer wants to understand the issue in the interviewees' own terms as also Flowerdew and Martin (2005: 119) argues. Not only will the researcher get answers to his or her questions but also get extended information about the particular topic. The questions are open and the emphasis lies

on the interviewee who is able to speak openly about the themes and develop his or hers points of views (Denscombe 2009: 235). The themes and questions are more of an outline and a reminder for me as the interviewer. Furthermore, for this study it gives me an opportunity to obtain privileged information about what only key persons and specialists obtain in the field of waste treatments procedures in harbours.

The interview was structured into five (V) themes and most of the questions were set to lead into a discussion with open answers. The idea was to discuss not only the port's view on the themes but also the interviewee's opinions. The interviewee's opinions and angles on the port's operations are decisive. The themes were set up to cover the waste reception from cruise ships at port, how the port itself is functioning and cooperating with other ports regarding reception and other environmental issues. Through this interview method the interviewee's opinions and ideas are easily brought forward through the chosen themes (Hirsjärvi & Hurme 2000: 48). The five themes were Port Reception Facilities, cruise ship generated waste, cooperation with the other ports, national legislation and sustainable development and the future.

Here, I have interviewed environmental specialists in the ports of Tallinn, Helsinki, Stockholm and Copenhagen. The persons chosen for the interviews are simply on the basis on who is in charge of the environmental aspects and waste handlings of international cruise ships in each port. To some extent the snowball method was also used. Snowballing is "using one contact to help you recruit another contact, who in turn can put you in touch with someone else." (Flowerdew & Martin 2005: 117). I contacted one or two persons per harbour whom then introduced me to other potential interviewees. In both Ports of Stockholm and Malmö Copenhagen Port I held interviews with people who were introduced to me on the spot.

The interviews where held at each port with one, two or three participants at the time. In total 12 persons were interviewd at nine occasions. As the interviews where designed to be in form of discussions and social interaction it was possible to have interviews with multiple persons. In the beginning of each interview I asked a permission to record. One interview lasted from half an hour to an hour and all of the interviews where transcribed as to enable coding and analyzing the discussions.

5.3 Analyzing the data

Analyzing the statistical informations started with converting all the collected statitics into comparable measurements and numbers. This was a step more laborious than expected due to received units in different measurements. Every port and their waste management company have their own way of collecting data. Getting the amount of different fractions of wastes in every port into comparable numbers was challenging.

The amounts were reported in tonnes and kilograms in Helsinki, Stockholm and Copenhagen, whereas in Tallinn it was reported in cubic meters. The units have been converted into tonnes with the help of Tuomo Koponen, Regional sales manager at SUEZ Environment and of Janis Väät, Specialist of environmental management in Port of Tallinn. The comparison is not 100% reliable as there is not an exact calculation of waste fractions into weight. However it will not affect the outcome as the comparison of waste streams is only a way of showing the waste stream flow in the busiest cruise ship ports. Additionally, the comparison shows that the cruise ship generated waste is not evenly distributed.

The statistical information from Port of Tallinn is remarkably higher than the other ports and therefore the reliability is a question. The numbers were double checked and proven right by the employees at the port and are therefore used in this research. The collected data has then been analysed and the outcome is to be shown through figures throughout the thesis. Geoinformatic system (GIS) has been applied in this research through the usage of ArcGis to create statistical maps.

The actual analyse of the interviews was made through thematising the transcribed material. The material was transcribed after each interview. The transcription was not done exactly word by word but the spoken words essential for each theme were transcribed. Words typical for the spoken language were left out. The actual analyse started after all the interviews were conducted and transcribed. The material was reread as to create new ideas and interesting questions (Hirsjärvi & Hurme 2000: 142).

The interviews were then put into themes and classes and the qualitative analysis was made through thematising. With this phase of the analysis the gathered material was put into new daylight through the help of Hirsjärvi and Hurmes (2000: 148) work. Thematising means that multiple times emerging features are noticed and studied at this analysis stage. The themes are anchored in the researcher's interpretation; two interviewees will not express themselves with

the exact same words (Hirsjärvi & Hurme 2000: 173). With the help of these themes the experts' ideas on the cruise ships generated waste streams at the ports will be understood and the answers on the research questions taken forward. The interviewer's effect on the issues is presumed to be minimal as all parts of the process ought to be professionals and behave accordingly. Here, the interview is on no basis personal (Denscombe 2009: 245) and the interviewer is not partial or bias but conducts the interview in respectful and professional manner.

5.4 Issues of validity and reliability

It is important to verify one's own research. The researcher needs to address that the results are real, otherwise there is no need for the reader to put thrust in them (Denscombe 2009: 378). The quality of the semi structured thematic professional interviews was verified at an early stage through putting down a lot of time on framing the interview (Hirsjärvi & Hurme 2000: 184). The frame was done thoughtfully and with some extra help from the Port of Helsinki and the University of Helsinki. The quality of the secondary data ought to be reliable as the numbers where received straight from the source. Hence, the Port of Tallinn's statistical information needed some adjustment and the numbers seem unproportionally large.

Validity refers to accuracy and precision in data (Denscombe 2009: 378). Furthermore it refers to whether or not the used methods are right for studying the research questions presented. This means that a valid research answers the research questions with suitable methods. For this research I have used suitable to answer the research questions. Additionally, the secondary data does to some extent prove the results from the interviews right. Validity on the interviews ought to be strong. The persons interviewed are experts in this field and they cannot really provide a research with the wrong information. External validity on the other hand stands for generalizability of the research (Denscombe 2009: 379). The results of this research can be compared to a similar research in another small area with cruise ships. Especially the methods used here can be applied at similar researches on another geographical area.

The concept of reliability is linked to qualitative research. "Reliability refers to the degree of consistency with which instances are assigned to the same category by different observers or

by the same observer on different occasions." (Silverman 2013: 302). In my research I held interviews at different occasion with different experts in the field of environmental management and cruising business at the ports. This gives my research reliability. Furthermore, the gathered secondary data together with the semi structured interviews reinforces the reliability. Additionally, the interviews "gives a direct access to 'experience'" (Silverman 2013: 201) which further provide my research its reliability.

6 Results

6.1 Distribution of waste among the ports

The distribution of the waste streams among the four ports is unsurprisingly uneven. One of the pre-claims of this study is by this supported. The results are counted out from the gathered waste streams data from each port. The statistics of this research covers only cruise ships. The raw data is to be found in Appendix II.

Figure 10 illustrates the percentage of total discharged garbage and percentage of total amount of passenger throughout the years 2010 to 2014 in Port of Helsinki, Port of Tallinn, Ports of Stockholm and Copenhagen Malmö Port. The following fractions has been counted to the total amount of garbage; food waste, cardboard, glass, metal, mixed domestic waste, hazardous waste and other wastes (mainly wood and cooking oil). If the fractions were to be evenly distributed the percentage number of both figures would be more or less the same, thus, that is not the case. It is assumed that the amount of waste on board cruise ships is directly correlated to the amount of passengers. On the basis of this data the Port of Tallinn is the port which receives the highest quantity of garbage. Port of Helsinki, Ports of Stockholm and Copenhagen Malmö Port receive fairly less garbage compared to the amount of passengers.

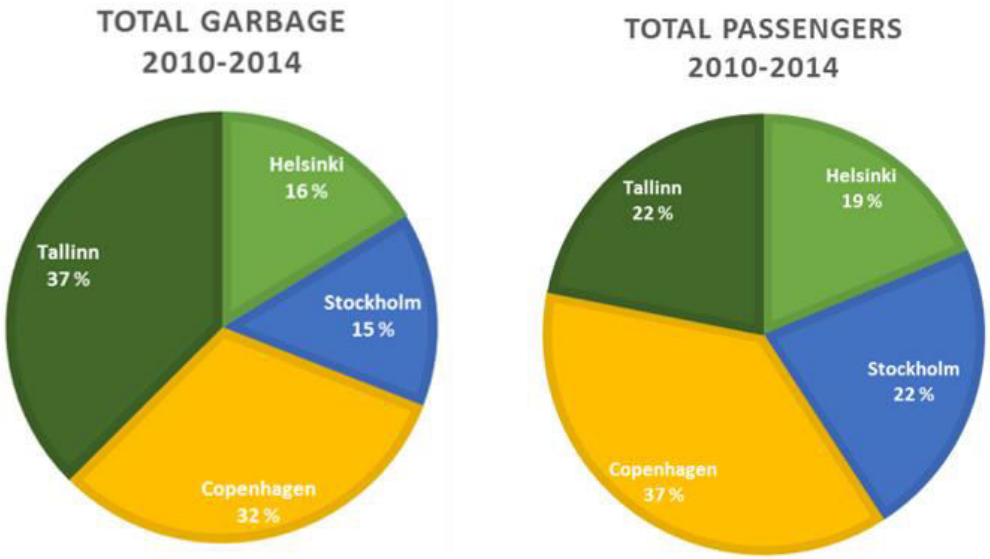

Figure 10. The distribution of total amount of garbage and total amount of passengers in each port 2010–2014.

Discharging of wastewater is the most uneven distributed fraction. Here again, the amount of wastewater produced on board a cruise ship is in direct correlation to the amount of passengers. Figure 11 illustrates the number of passengers and the amount of the received wastewater in each port 2010–2014. In the Port of Helsinki and the Ports of Stockholm the amount of received wastewater is remarkably higher than the number of passengers, in Copenhagen Malmö Port and Port of Tallinn the numbers are the contrary. The decline in Copenhagen Malmö Port can most likely be explained by the restriction put on the amount of discharged wastewater.

This is explained by the efficient wastewater facilities in the Port of Helsinki and the Ports of Stockholm. These ports receive all wastewater without extra charge or other restrictions. Both ports have facilities to connect the pipelines from the cruise ships straight to the municipal wastewater systems. That means that a vessel can discharge wastewater for as long as it is at berth. Copenhagen Malmö Port and Port of Tallinn have already installed improvements in wastewater facilities and there are more to come. There is no exact data on treated discharged wastewater into the Baltic Sea.

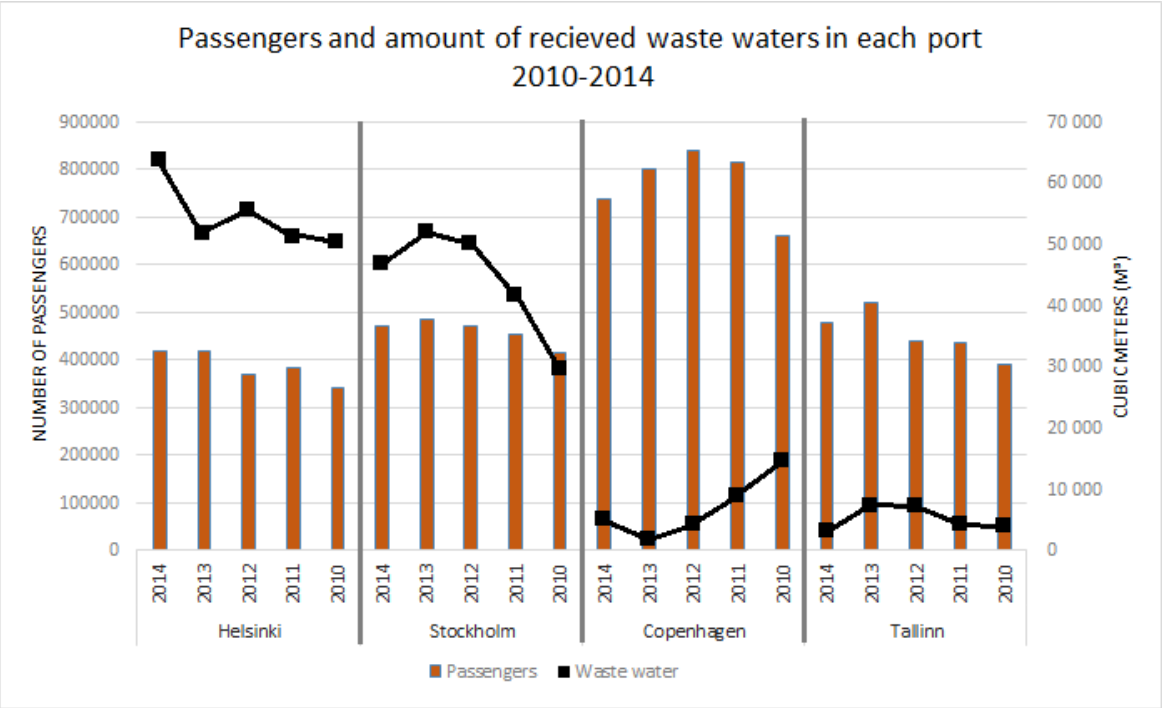

Figure 11. The uneven distribution of discharged wastewater in the ports 2010–2014.

Figure 12 illustrates the distribution of garbage per passenger and wastewater per passenger in each harbour for the past five years, 2010–2014. The analysis was chosen to calculate the amount per passenger as to clearly show the distribution in a comparable manner. As the two maps are in the same scale the analysis can be done by comparing the sizes of the pillars in both maps. Garbage includes the following fractions; food waste, cardboard, glass, metal, mixed domestic wastes and other wastes. Wastewater includes both black and grey water.

The distribution of garbage among Port of Helsinki, Ports of Tallinn and Copenhagen Malmö Port has been more or less equal. Thus, there is to be seen a rise in Helsinki and a decline in Stockholm. Port of Tallinn is the port to receive the most garbage throughout the years. The wastewater distribution among the ports is more unevenly distributed than the garbage. It is clearly shown that the Port of Helsinki is the port that receives the largest amounts of wastewater. Not far behind comes the Ports of Stockholm. The other two ports, Port of Tallinn and Copenhagen Malmö Port receive remarkably less wastewater. Amount of wastewater in the Ports of Stockholm has risen except for 2014, where there is a small decline to be seen. Port of Tallinn receives 42% of all oily wastes throughout 2010 to 2014. The Port of Tallinn is specialized in and has the best facilities to receive and handle oily wastes. The ports daughter company, Green Marine Ltd., can process oily wastes as far as to become a new oil product.

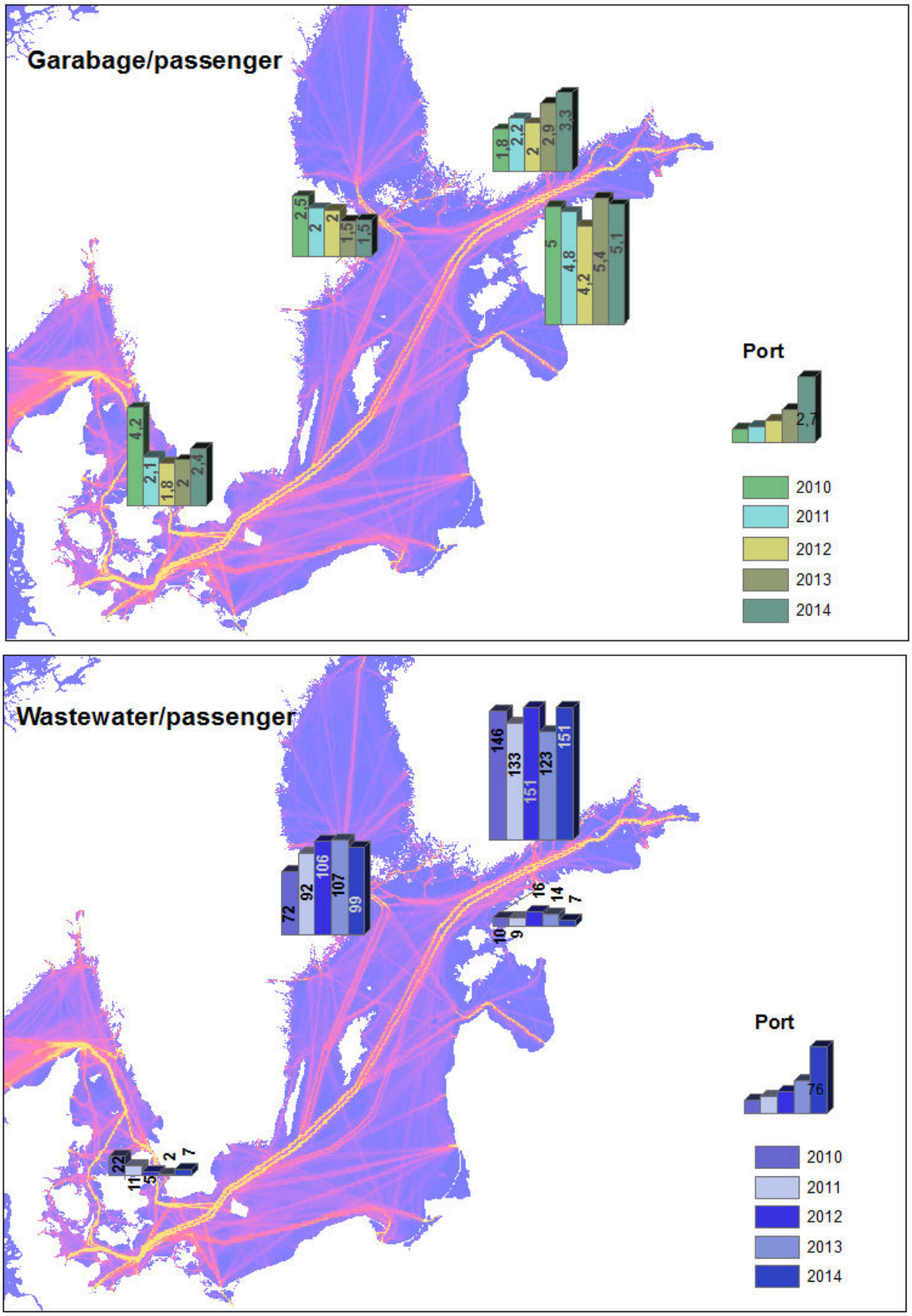

Figure 12. Garbage (kg) per passenger and wastewater (litre) per passenger in the study, 2010–2014.

6.2 Waste management in the ports of the study

The waste management in the four ports of the study differ to some extent although they are basically the same. The national laws on waste management in each country also vary. Table 3 shows the waste management charges in the four ports of the study. As discussed before the ports have implemented the NSF-system and the table presents the basis for the tariff calculation. Table 3 also shows the similarities and differences among the ports. The ports have various possibilities and abilities to handle different waste fractions as the table shows. For example Tallinn cannot receive unlimited amounts of wastewater as their facilities do not have the capacity to handle it, but on the other hand Tallinn has the most developed system for receiving oily waste. The Port of Tallinn has however plans to remove the limit:

> *"We have plans on developing the pipe system in the whole harbour so we can receive more wastewater and taking away our limitations" (Head of Quality and Environmental Management, Tallinn)*

In Copenhagen Malmö Port all the new quays are able to receive wastewater directly into the municipal wastewater system. The old quays do not have this ability and therefore Copenhagen Malmö Port has decided to put limitation on wastewater. The port receives some amounts of black water free of charge whereas grey water always has a fee.

> *"They [the cruise ships] shall not leave water here, which they don't do. They can discharge cleaned water into the sea, but of course we do receive it if they want. Black water is free of charge and grey water they need to pay for. But if they declare everything as black water they can leave it… And some vessels do." (Manager Strategy & Planning, Copenhagen)*

> *"We count the amount of possible generated black water from last port of call. 130 l/person/day, also including members of crew. So if they want to leave more we know that they did not leave black water in last port of call and then they need to pay." (COO Cruise and Ferries, Copenhagen)*

The ports have their own waste management charge. The charge is per gross tonnage in Copenhagen, Tallinn and Stockholm and in Helsinki per 100 net ton. The table shows which fractions belong to this charge or if there are any restrictions. The table does not show separately the recyclable fractions but they are included in the domestic waste instead. The

recyclable wastes received without any extra cost in all the ports are at least paper/cardboard, glass and metal. Cruise ships, and other ships, calling at any port pay beyond this tariff also for vessel charges, mooring and unmooring, water supplies, quay rents, just to name a few. The fees and amounts vary from port to port as the NSF-system does not define amounts per se. Furthermore, each port as an independent business runs on slightly different grounds.

Port of Tallinn and Ports of Stockholm have reductions on the waste fee when the waste is sorted. Additionally the Port of Stockholm has a so called environmentally friendly reduction. A ship is given reductions if it runs on LNG (Liquefied Natural Gas) or has small nitric oxide emissions. Also a ship that gets rebuilt to use LNG will get 1 million Swedish crowns a reward. The Port of Stockholm seems to be one step ahead in tempting shipping companies to become more environmentally friendly. The Port of Helsinki will give reductions to cruise ship discharging wastewater at the port from year 2016 and onwards (Port of Helsinki 2015b).

Tabel 3. The four ports different No special fee - tariff 2015 (Copenhagen Malmö Port 2015, Port of Tallinn 2015a, Port of Helsinki 2012a, Port of Helsinki 2012b, Ports of Stockholm and Nynäshamn 2015)

	Copenhagen	Tallinn	Helsinki	Stockholm
Waste management charges	DKK 3,60/GT (≈0,50€)	0,032 € or 0,029 € / GT	12,65 € / 100 Net (Min 233€, Max 2915€)	SEK 0,53/GT (≈0,06€) (Max. SEK 10 450 ≈1 142€))
Oily wastes	No special fee. 'oily tank washing water' costs DKK 590/m³	No special fee	No special fee (Max 20m³)	No special fee
Wastewater	Only black (130liter/pers/day). Gray water costs DKK 115/m³ (≈82 €)	7 m³ no special fee. The ship pays for the exceeding amounts	No special fee	No special fee
Domestic waste	No special fee	No special fee	No special fee	No special fee
International food waste	No special fee	No special fee	No special fee (Max 7m³/6ton.)	No special fee
Hazardous waste	No special fee	No special fee	On the basis of occured costs	No special fee
Electronics	No special fee	No special fee	On the basis of occured costs	No special fee
Scrubberwaste	On the basis of occured costs	No special fee (Ellen Kaasik, verbal information, 28.5.2015)	On the basis of occured costs	On the basis of occured costs, tariffs by asking the port
Reductions	7th (and following) call 25% reduction	If the cruise ship sort: 0,029€/GT	None	SEK 5.51/pax reduction if sorted. LNG ship SEK 0,05/GT 11th visit reduction (and following)
Passenger fee	DKK 3/pax (≈0,40€)	€ 1,46/pax	€ 0,965/arriving pax € 0,965/departing pax	SEK 31,53/pax (with reducation 26,02/pax (≈2,85€))
Restrictions	Waste fee includes only black water	The waste fee includes only 7m³ waste water	Loading time 4h. Overgoing time: 73,50€/h	

In principle the process goes as follows: the cruise ship fills in a form with the desirable amounts of waste that needs to be discharged. The form itself might differ slightly from port to port but should be more or less the same and the form ought to be based on directions given by IMO. The important part for the port and the vessel is to get a receipt on the actual amount of discharged waste. These receipts are also essential for audits. The receipt of actual discharged amount also gives the port an opportunity the check the amounts on the fractions that have limitations:

> *"We want to see the receipt as fast as possible so that we can check if the ship has left more waste than is included in our price. We want to be able to send the invoice straight away if that is the case." (Harbour Master, Helsinki)*

On the basis of the executed interviews all four ports seem to be quite flexible in the big end when discussing the actual amount being discharged from the cruise vessels. The cruise vessels are bound to send a form to the port which clarifies what kind of waste is being discharged and in what quantities. This needs to be done so the port can order the right kind of containers and trucks to receive the fractions. But as the numbers are usually estimates the actual fractions might fluctuate.

> *"Of course we are flexible. If the ship has already arrived at the quay and they come up with some other fractions and amounts of waste we will come up with a solution to receive it. They [the ship] always notify the amounts in cubic meters which is only estimation. These numbers are just indicative; sometimes there might be large differences. Sometimes the amounts might be less but usually it is more." (Harbour Master, Helsinki)*

The vessels of different kinds calling at harbours are the port's customers and without customers a company cannot run. It is of the port's interest to be sure vessels calling at the ports are running according to laws and regulations, but the port cannot function as a police or an authority. Furthermore, through the interviews a common trend was seen: the waste fee payable by the cruise ships needs to break even with the expenditure on waste management in the ports. At Copenhagen Malmö Port it was stated that unless it breaks even the undergoing expenditures will be added on the next year's fee.

6.3 Sorting, recycling and reusing of cruise ship generated waste

Recycling and reusing of waste is inevitable today. Most of the subgroups to garbage can be reused or recycled as long as the sorting is done properly. Oily wastes can be processed as far as to become a new oil product. The reception and recycling of cruise ship generated waste in the ports of the Baltic Sea is by now well established but still not very long-standing (around ten years). Every port stated that they are recycling over 50% of all cruise ship generated waste. The reception of waste today is a big part of the port activities, especially when talking about cruise ships.

> *"I would say that our waste handling is running pretty smoothly but it is also unbelievable how much it employs people today. Ten years ago we didn't have this* Rumba *going on! But of course it is a good thing. One person is fully employed at this time of the year with this thing." (Harbour Master, Helsinki)*

In both Port of Helsinki and Ports of Stockholm the cruise ship generated waste is being handled through the international waste company Sita Suez Environment. This means that in these two ports a person from the waste handling company is always present when the discharging takes place. This person supervises the whole off-loading process and also helps in taking the waste to the right truck. These fractions are then immediately driven to the waste handling centre. The Harbour Master at the Port of Helsinki describes the cooperation with Sita Suez Environment as very good which also brings good light on the port itself:

> *"We have got some really good feedback on our waste management. Our thing is really working smoothly now and I guess we are quite on the top of this matter. The trucks are waiting at the quay when the vessel arrives and we drive with trucks to help the process. People from the vessel can see with their own eyes to which recycling truck the waste is being handed and so on. A person from one vessel even said we have the best waste management in the whole world!"*

Another important fact is that during this time the Environmental Officer at the cruise ship, and other persons in charge of the waste handling process on board, have a chance to talk directly to persons in charge of the waste handling at the port. This eases the exchange of information and enables a constructive discussion on the whole process.

In all these ports most of the cruise ship generated waste is recycled today. Some fractions still go to landfill, e.g. hazardous waste such as medical waste. Thus, quantities of hazardous waste also go to hazardous waste treatments plants, where the waste is further handled. E.g. in Helsinki the company Ekokem is handling hazardous waste (Ekokem 2016). Cruise ships are known to sort the waste properly on board. Copenhagen Malmö Port is the newest to the recycling process. Until this year the port did not recycle any fractions and did only receive the waste in three fractions; oily wastes, mixed domestic waste and hazardous waste. Today Copenhagen Malmö Port sorts the waste in containers at every quay. When the containers are full the waste handling company arrives to collect the waste.

Copenhagen Malmö Port designed a poster to show what fractions are recyclable and which ones are not. There has been talk about designing a poster that would apply to the whole Baltic Sea region.

> *"It is difficult for the cruise ship crew to know which way a particular port wants the waste to be sorted. Some might want to have six fractions and some ten. So that's way we have tried to make an illustrative poster. If the ports at the Baltic Sea region would have one united poster over the fractions it would make it a lot easier for the crewmembers to sort the waste." (Manager Strategy & Planning, Copenhagen)*

This is one of the good solutions to make the Baltic Sea area a cleaner place. Through innovative solutions and optimizing the sorting of waste in the whole region in the same way the illegal discharging will most likely reduce. All the four ports ought to have the ability to recycle more or less the same fractions, which means this solution would be easy to implement in the region. Likewise the ports can support one another by giving the ship the opportunity to take the recyclable fractions to the port where recycling is possible.

A life cycle assessment (LCA) of waste management throughout the whole chain ought to be done to get a clear and measurable answer on what would be the best practice. Zuin et. al (2009) presents a LCA on ship generated waste at the port of Koper and conclude among other things that the use of disposal in landfill should be avoided, the use of electricity minimalized and that the production of waste on board cruise ships reduced. LCA methodology on waste management should be produced separately at all four ports and on that basis a research on costs and (environmental) benefits should be made to take notice on

what would be the best practice. Is it beneficial to leave certain types of waste in certain ports? Can the LCA have an impact to reduce waste in this manner?

"Waste often has value as resource, and the further application of economic instruments may maximize environmental benefits" (Directive 2008/98/EC: 7). Results of this study regarding cruise ship generated waste does not support this fact. Most of the waste fractions are not bringing economic benefit to the port. Thus, discussions on economic benefits from recycling of oily wastes and metal in the ports were found throughout the interviews.

6.4 Ideas on waste fractions to particular ports

This section will directly answer the main aim of the research whether it is possible to introduce a new waste handling system for cruise ship generated waste in the ports around the Baltic Sea area. The ports of the study function slightly differently and have different strengths when talking about waste handling. For this study I took a look at the waste handling from the port's view. Through the conducted interviews I studied how people working with this matter think and feel about the current waste handling management.

Referring to Zuin et. al (2009: 3037) "an integrated management of ship-generated waste will be achieved through the provisions of adequate reception facilities that encourage the disposal of waste in ports and terminals, through the adoption of recycling or reuse systems, and by removing any incentives for illegal discharges at sea." This can be interpreted in the Baltic Sea as to share the burden of waste management between the closely located ports. The adequate reception facilities do not necessary have to be placed at each one of the ports. This research studies the experts' ideas and opinions of sharing the waste streams from cruise ships in each port of the study.

Cruise ships sailing the Baltic Sea spends usually a day in each port of the journey. The Baltic Sea cruise itself, especially the cruises on the larger cruise vessels, takes around seven days. These cruise ships usually sail the same route throughout the summer. This means that the cruise ships call at the same ports throughout the summer and the journeys themselves are quite short. Bearing this in mind a system where these four ports of the study would collaborate as to receive more of particular waste fractions should be introduced. The

substantial question lays more in the hands of the cruise ships; can they handle the proposed system?

> *"How would the cruise ships react to this, would they be able to carry this out? It would need a lot of logistics and arrangements. Somehow it feels like a really good idea that every port would be specialized at some particular fractions. I can imagine it would be a lot cheaper than the system we have now that every port has a lot of different ways of receiving waste with all its receptions facilities and so on. For the ports view it would be damn good. But would the vessels anyhow leave a lot of other fractions to? Like 'Let's just get rid of these too'" (Environmental Consult, Helsinki)*

> *"I think a system like this could work; If it will be put into action in a good way. If the ports would specialize on some fractions the cooperating would most likely also get stronger." (Deputy Harbour Master, Stockholm)*

Most of the experts interviewed considered this to be a good system. As mentioned above one of the problems is the capacity of the vessels, but another one is the laws and regulations in the area. The regulations more or less force the vessels to leave all its waste in the calling port. Here, I argue that recyclable waste is not necessary defined as waste: if the waste can be reused is it still understood as waste? Therefore waste that can be re-used and recycled ought to be allowed to be shipped to the appropriate port. Disposal of waste is the last option and lowest in the waste hierarchy. According to the Head of Quality and Environmental Management at the Port of Tallinn a similar proposal has been made a few years ago but got rejected.

The cruise ships also need to obtain the information if a new system is to be introduced among the ports. It was noticed throughout the interviews that information discussed with the ship-owners not necessary reach the crew of the cruise ships. In both the Port of Helsinki and the Ports of Stockholm some vessels thought there was a charge for discharging wastewater. So the information from the port through the ship-owner to the vessel will take time. The ports can also make training packages straight to the vessels, with the approval from the ship-owners. This has been discussed in Helsinki:

> *"I've heard that some vessels* (here not discussing only cruise vessels) *do not really know what the best way to do the sorting is. Some kind of training package would be really good. We have discussed this matter in Port of Helsinki and I think this could be a good thing to develop" (Managing Director, Helsinki)*

Notable waste handling strengths in the ports of the study

Strong points to the waste handling were found in all the ports throughout the research. The ports employees know their own strengths and weaknesses but also neighbouring port's strengths and weaknesses. The ports of the study consider Port of Tallinn to be the leading port in handling oily wastes. Green Marine Ltd., which is a daughter company to Port of Tallinn, specializes in oily wastes. Green Marine Ltd. handles all the waste at the port.

> *"We have an oily mobile station which recycles oil. The oil gets separated from the water and when the whole process is done we have a new oil-product and it is not waste anymore" (Specialist of Environmental Management, Tallinn)*

Oily wastes in general are an expensive waste fraction, especially in small units. Larger units contain more oil and the end product gets more valuable. In the Port of Helsinki the discussion on the possibility to ship oily wastes to the Port of Tallinn has already been started. Port of Tallinn has plans on improving their infrastructure and the reception of wastewaters. Building and rebuilding is expensive and will affect the nature. The Head of Quality and Environmental Management mention in the interview that it would be economically and environmentally smarter to share the reception of oily wastes and wastewaters. Port of Helsinki and Ports of Stockholm are receiving wastewaters. Why not cooperate and try to get most of oily wastes to Tallinn and most of wastewaters to Stockholm and Helsinki? Certainly the ports need to have the ability to receive all waste fractions but the ports do not need to have excellent reception facilities for all the fractions.

> *"This is partly a matter which we have already discussed with the Port of Tallinn. Do they really need to invest in new wastewater reception facilities for all the quays? Wouldn't it be better for everyone if Tallinn could focus more on the reception of sludge and other oily wastes? I think this is a really good question. All the ports need to have the ability to receive all fractions but the*

vessels could be encouraged to leave wastes in particular ports. But all the ports should anyhow be able to receive wastewaters." (Managing Director, Helsinki)

Thus, the Managing Director at the Port of Helsinki stated that because of the legislation that today requires adequate reception capacity at the ports this kind of cooperation does not yet work. The Managing Director further argued that it is important all the ports have possibilities to receive wastewaters as to minimize the discharge into the Baltic Sea.

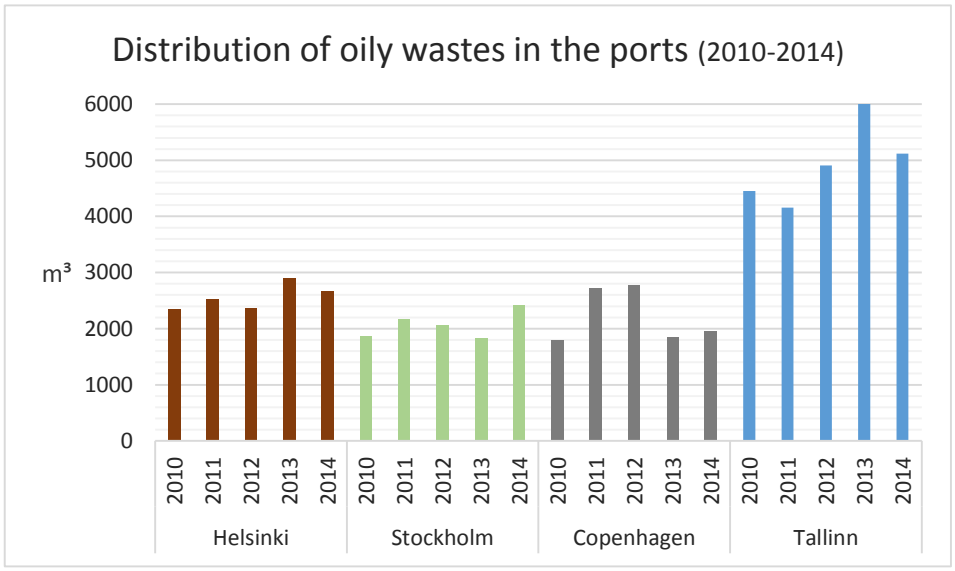

Figure 13. Distribution of oily wastes 2010–2014 in the ports

Figure 13 reveals the distribution of oily wastes in the ports of the study. The figure clearly shows that already today the Port of Tallinn is receiving notably more amounts of oily wastes than the other ports. This supports the idea on leaving the majority amounts of oily wastes to the Port of Tallinn. As seen in Table 3 (chapter 6.2) the Port of Tallinn together with the Ports of Stockholm is the only ports without restriction on the amount of discharging oily wastes.

Both the Port of Helsinki and the Ports of Stockholm have the ability to receive wastewater straight to the municipal wastewater system at all the quays. Port of Tallinn has this ability on a few quays and Copenhagen Malmö Port on their new cruising quays. Copenhagen Malmö Port has a capacity to handle the recyclable waste fractions well as they started the new

system as of year 2015. Today the port receives many more fractions compared to earlier years when the wastes were brought to incineration.

Food waste is a substantial fraction from cruise vessels and therefore only small amounts are recycled in the ports of the study. The main reason is that international food waste needs to be handled differently from domestic food waste (see chapter 3.1). The majority of cruise vessels sailing the Baltic Sea do visit St. Petersburg and therefore the food waste is being classified as an international food waste. The food waste is international whether the vessel takes any provisions from St. Petersburg or not.

> *"It doesn't have anything to do with logical and reasonable thinking… Back in the days we discussed it a lot with the authorities. Before the No special fee system was implemented discharging international food waste was really, really expensive and no one declared any. The cruise vessels that visit our port do of course visit St. Petersburg as it is the main attraction in the Baltic Sea, all the other ports are inside the European Union and I am sure the vessels do not take any provisions from Russia as it is so expensive. So this thing with classifying food waste as international or not is idiotic." (Harbour Master, Helsinki)*

A truck that has been loaded with international food waste also needs to be disinfected afterwards and this is all time consuming. The port is of course the one paying for the total time. In the Port of Helsinki all the food waste received from cruise ship is handled as international food waste. The reasonable way of handling food waste from cruise vessels would be to leave it in the Ports of Stockholm.

> *"We would really much like to receive food waste from the cruise vessels and make biofuel out of it. The busses in local traffic in Stockholm run on biogas! I think the cruise vessels produce a lot of food waste." (Deputy Harbour Master, Stockholm)*

In the Ports of Stockholm they unfortunately tackle with the same problems as in Port of Helsinki and therefore they do not receive any organic waste as a fraction of its own.

> *"I was in contact with the City to see if we somehow could start collecting food waste from vessels, especially from cruise vessels as they ought to produce a lot.*

But there were so much restrictions and a lot of hassle so we felt we could not even try to start anything like this."(Environmental Engineer, Stockholm)

As discussed scrubber waste is a new fraction of waste as a result of the sulphur directive set in January 2015. The Port of Tallinn is the only port to interpret this fraction to belonging to the No Special Fee system and has therefore chosen to receive scrubber waste without extra charges. Scrubber waste is an expensive waste fraction and in the other ports the vessel will be charged for the amount scrubber waste discharged.

6.5 "*The cooperation among the ports is good, but everything can be improved*"

According to the interviews the cooperation between the ports is good and functioning. Nevertheless they all stated that everything can always be improved. The ports get together to discuss matters many times a year in different forums and events.

"Yes, we have good cooperation among all the ports. We meet in different forums, we participate in many cruising networks such as Cruise Europe two times a year, Cruise Baltic three to four times a year, United Baltic Ports one to two times a year. And this is only about the cruises! Beyond this we meet in other contexts. We have decided to cooperate, not compete. If it rains in Tallinn we get drops in Stockholm too." (Manager Cruise and Ferry & Deputy Harbour Master, Stockholm)

The four ports are working together and are also coming up with new ideas and solutions together. If they find new solutions they will share them with the others, especially when talking about environmentally friendly solutions. This outcome complies with the argument by Kunnaala-Hyrkki et. al (2015) that sharing best practices will allow ports to choose to most cost-effective measure for decreasing their environmental impact. It is important to remember that these ports have the same customers, as the Manager Cruise and Ferry & Deputy Harbour Master states in his interview. The Head of Quality and Environmental Management at Tallinn also explained the cooperation as easy going.

"I have all the other ports harbour masters' numbers as speed dial on my phone and we talk almost every week. We have all the same costumers!" (Manager Cruise and Ferry & Deputy Harbour Master, Stockholm)

"We [the ports] are all together in many different organizations through which we meet many times a year. We can all easily call or send an email to each other and ask whatever we want" (Head of Quality and Environmental Management, Tallinn)

Similarly all the persons interviewed argued that although they share a lot of information they are still competitors. The port is a business which needs profit. The environmental section of the ports does not yet bring in a substantial economic benefit, but the experts interviewed believed that in the long term it will. Furthermore, the ports images are highly dependent on their environmental achievements. The environmental discussion of today enlightens that environmentally friendly solutions will be profitable in the long run.

If an updated waste management system is to be introduced in the Baltic Sea it does not only lay in the hands of the ports. The vessels shall act accordingly. It was noticed throughout the interviews that the communication road between the port, ship owner and the vessel itself is sometimes long and slow. Communication with the port and ship owner tends to run smoothly but it takes time before the actual information reaches the vessel. The vessels might not receive the vital information handed out by the port.

"You often discuss different matters with ship owners and other ports but then you notice that it might take over half a year before the information reaches the vessel itself. Within smaller ship owners the information usually reaches the vessels, the problem lays within the bigger companies. Not long ago a captain from a big company still thought they need to pay for all wastewater discharged at the Ports of Stockholm. And I argue that I know this company pretty well…" (Manager Cruise and Ferry & Deputy Harbour Master, Stockholm)

7 Discussion and conclusions

There is little research on the cruise industry as a whole in the Baltic Sea area and especially little on cruise ship generated waste. The cruise ships are responsible for a large amount of the total discharged waste in the ports, although the cruise season mostly lasts only from April to September. This research opens up the discussion on possible improvements to be made to gain better waste handling management in cruising ports around the Baltic Sea which would result as a better environment. The results gained through the research answer the research questions.

The *main aim* of this research was to study whether it is possible to introduce a new waste handling system for cruise ship generated waste in the ports of the Baltic Sea area. In the proposed system ports would focus on handling specific types of waste produced on cruise ships. Throughout my research it is shown that the proposed system could be introduced, if only the ports would introduce this system with a close cooperation. This cooperation would mostly affect cruise ships, as the lines in regular traffic handle their waste on their own. The cooperation needs to be done thoughtfully. One important part is to introduce the system to the cruise ships sailing in the Baltic Sea during the summer months. The cruise ships ought to know the best place to discharge certain fractions of waste. They also need to plan their route and evaluate if they are able to hold on to the waste throughout the route.

Ports are conscious about their environmental image. The ports of this study all show improvements done for a better environment and these ports would most likely apply new environmentally friendly solutions if suggested. The environmental image for ports is important, as also Kunnaala-Hyrkki et. al (2015) argue. The ports have a close cooperation today, but could be even closer and in an even more sustainable way. An updated waste management between the ports may be based on agreements between the ports on the division of labour. As also Tapaninen (2013: 34) argues logistics in transportation means among others minimal negative impact on the environment. Therefore, logistics in a way of cooperation among the ports in a joint waste handling management will result in a better environment.

The main aim of the study was further addressed by three research question. The first question was about what quantities of cruise ship generated waste are handled in the Baltic Sea area today. Furthermore, in what way the fractions are handled. The cruise ship can be seen as a small village. With around 2 000 passengers and 800 workers the quantities of waste

produced is vast. The cruise ships sort their waste and all the four ports of the study handle different waste fractions. This study shows accordingly to Butts (2007: 592) research that due to the growth of the cruising market the impact of the waste streams vary. The impact varies due to laws and regulations, port receptions facilities and waste management plans on board the individual cruise ships. Cruise ships calling at the ports of the study mostly sort their waste and therefore a joint waste handling system among the ports is a possible solution.

Port of Tallinn, Ports of Stockholm and starting in 2016 the Port of Helsinki are all giving special reductions on the waste fee if cruise ships are following their guidelines. Port of Helsinki will give reductions to ships leaving wastewater at the port. This reduction means it will be cheaper to discharge the wastewater at the port than into the sea. Copenhagen Malmö Port gives reductions after a certain numbers of calls at the port. Copenhagen Malmö Port started receiving sorted fractions only in 2015. These reductions can be seen as incentives from the ports as a call for better waste handling by the cruise ships. Copenhagen Malmö Port suggested that cruising ports of the Baltic Sea could have a joint poster about the sorting of the waste fractions and they also suggested that the ports would have the same sorting system.

Throughout the research I noticed that these ports have more or less the same environmental measurements, but, not quite. This fact makes it hard to do comparisons among the ports. A unified legislation for all EU ports would erase this problem, as also Kunnaala-Hyrkki et. al (2015) argues in their research. The ports would all have the same environmental legislation and procedures and therefore also the same measurement systems. This would result in better environmental protection and maintain the ports competitiveness and equality. Furthermore, common environmental legislations ought to support the proposed waste management system.

The second question addressed whether the individual ports are already specialized in specific types of waste handling management. The four ports do clearly have different strengths in their waste handling management. Port of Helsinki and Ports of Stockholm are specialized on receiving wastewaters from ships. Both ports receive unlimited amounts of wastewater straight to the municipal wastewater system at all the quays. Furthermore, it appears that the cruise ships have been content about meeting the waste handling company at the dock when discharging the waste fractions. This gives both parts an opportunity to talk and discuss about possible problems and other issues. Thus, the communication between the port, ship-owner and the vessel was seen as time-consuming by the interviewees. Therefore, matters for future

discussion ought to be held on online-forums where all parts can participate. Port of Tallinn is indisputably specialized in receiving oily wastes. Port of Tallinn's daughter company Green Marine Ltd is specialized in processing oily wastes and is even able to retrain a new oil product from oily wastes. As Copenhagen Malmö Port has only been receiving sorted fractions from summer 2015 onwards a particular waste handling strength was not yet found. Thus, the port is by now doing a lot as to receive well sorted fractions for further recycling. A suggestion is to discharge sorted household waste at Copenhagen Malmö Port.

The final question handled the collaboration between the four studied ports. Could the collaboration be improved to better handle waste from cruise ships and can certain fractions be discharge in ports specialized in specific types of waste? This is where the laws and regulations steps in and make it challenging. According to the regulations a ship needs to discharge the waste produced on board after the last port of call. There are exceptions; the ship is allowed to hold on to the waste if it can prove there is enough storage space on board. These regulations are set as to make the waste distribution even better between the ports and most importantly to reduce dumping waste into the sea. My research clearly shows that this is not the case.

The cruise lines have their own environmental objectives and targets, which vary among the companies. Therefore, the strategy of finding the optimal practices (and also suitable for current economy) for waste handling vary. Furthermore, the cruise lines cannot be quoted as one entity. Zuin et al. (2009: 3037) also argues that "a responsible and integrated management of ship-generated waste will be achieved through the provision of adequate reception facilities that encourage the disposal of waste in ports and terminals, through the adoption of recycling or reuse systems, and by removing any incentives for illegal discharges at sea." Therefore, I argue here, that collaboration between the ports that encourage the cruise ships to leave certain fractions in specific ports which are specialized on that fraction will result in a better waste handling management and through that a better environment. Furthermore my study shows that there already is cooperation among the ports, it is just a matter of putting best practices into operation.

Furthermore, waste should not be defined as waste if it can be reused or recycled. This ought to be the most sustainable solution to the whole Baltic Sea area if the cruise ship is able to hold on to the waste, without discharging it to the sea and only discharging it at the port with

the best reception facilities and high standards of reusing and recycling. The four ports saw this as a good suggestion if only the cruise ship itself has the opportunity to hold on to the particular wastes. Or has enough storage space on board. This is one suggestion for new sustainable solutions.

At a short meeting with Tuomo Koponen from SITA Suez Environment during the summer I was informed of a project where old worn-out cotton clothing can be turned into new fibres for the textile industry. Koponen further argued that in the near future old bed linen from cruise ships can be introduced to this project. The suggestion is that whenever a cruise ship needs to discharge a vast amount of old bed linen and other textiles it would be done in Helsinki. SITA Suez Environment is one of the contributors in the pilot project led by VTT Technical Research Centre of Finland. VTT (2015) states that with this technique the water footprint is reduced by more than 70% and the carbon footprint by 40–50% compared to virgin cotton. New innovations for reusing and recycling are continuously growing, and this is a perfect sign for it.

The interviewees considered my subject to be important and up to date. The interviews seemed to be a good way of gather information. For me as a researcher it was important to visit all the ports and get information straight from the source. Through visiting the ports I got a better understanding of how they work on an individual level and in cooperation with the other ports. One of the interviewees thought it would have been better to send the questions through email and get a joint answer on the questions from one port. But as I was looking for opinions and suggestions on my research questions I am confident that this way of holding interviews in each harbour gave me the best possible answers. Employees have different opinions and suggestions on what needs to be improved and in what way. Furthermore, I was handed reports, leaflets and other important information at each port visit.

7.1 Suggestions for further research

There are many suggestions for further research on the subject and I will here take up the most important ones. As a result from this study many questions concerning waste management in the Baltic Sea ports appeared and it is clear that further research is needed. A study concerning the cruise ship generated waste from the vessels point of view is wanted and needed. What is their point of view? How do they really handle the waste on board? What

would be the best option for the cruise ship to handle the waste? A broad study from the cruise ships point of view with interviews and surveys would be the next step. Also, the prevention of production of waste itself needs to be addressed on board. Probably many packaging options could be reduced and the usage of disposable cups prevented, to name a few. Prevention of waste production could start off with a wide research on what actually is the cause for the waste fractions and from there some suggestions on reduction strategies could be made.

A LCA (Life cycle assessment) over the waste chain from the port to the end-station would give an absolute answer on impacts (e.g. emissions, energy, incineration) deriving from the management. The assessment ought to be done on all different fractions in all four ports. The LCA could be done in the same way as Zuin et. al (2009). Zuin et. al argues that a LCA model would supply decisions makers with both qualitative and quantitative information on different levels. I argue that my research is a good basis for a LCA model over cruise ship generated waste in the cruising ports of the Baltic Sea.

The possible discharging of treated wastewater to the Baltic Sea was a topic of a heated discussion throughout the summer 2015. There were many articles and other news items in the media and also the Port of Helsinki's contrary answer on the topic. The media shed light on the topic and instigated that cruise ships discharge large amounts of wastewater to the sea. Port of Helsinki (2015d) answered in the end of the summer that at least in the Port of Helsinki nearly 80% of all cruise ships discharged wastewater at the port. Furthermore, Port of Helsinki will give reductions to ships leaving wastewater at the port starting next year (2015e). Thus, a research on the actual amount of discharged wastewater into the Baltic Sea from the cruise ships ought to be interesting and important. Furthermore, the research could also contain what kind of substances the wastewater contains. Cruise ships ought to be the vessel type discharging the largest amount of wastewater, if this really is the case. Other vessel types do not have as many passengers and crew members, e.g. cargo ships, and therefore the amount of produced wastewater ought to be minimal.

Could the ships themselves on the other hand do something to reduce the amount of waste being produced on the ship? If we reflect back to Figure 2 on the hierarchy of waste management the prevention of the waste is high. This is something the ports cannot influent so strongly: it is a matter of the cruise company itself. To reduce the waste stream at ports, the

ships need to reduce the production of waste. Can the cruise ship reduce the packing materials of food? What about plastic bottles and drinking glasses? Can the buffets on board produce less food waste? There are probably many solutions and ideas on this matter and a study on these questions ought to be done.

7.2 Concluding remarks

A cruise ship produces waste similarly to a village. The cruise ship is a moving industry and not bound to a special country. In the present day the cruise ship has to discharge waste in each harbour of call, with a few exceptions. According to legislations all the waste produced since the last port of call should be discharged at the port. This legislation ought to force the waste streams to be evenly distributed among the ports. The claim for my thesis shows that this is not the case. Vessels tend to find the easiest and cheapest solution and it is a matter hard to supervise. Additionally, this is not a matter for the port to supervise as they are not the authority. I have argued through the gathered statistics and analysed interviews that special fractions of waste are already discharged in particular ports. Waste management in ports, laws and regulations together with maritime transportation and logistics stands for the theoretical background for my master thesis.

The Baltic Sea is an area with special characteristics and a vulnerable environment. Simultaneously the area is one of the world's busiest shipping zones with around 2 000 ships operating daily. Port of Helsinki, Port of Tallinn, Ports of Stockholm and Copenhagen Malmö Port are the most popular cruising ports together with Saint Petersburg. The ports are close to each other and the sailing distances are no longer than a night between the ports. The cooperation among the ports is good but there is willingness to make suggestions on how it can be even better.

The research is a starting point for possible solutions on a better and updated development of waste management in cruising ports around the Baltic Sea area. The ports of the study do all have good environmental policies and management but an updated system with closer cooperation is needed. The interviewed experts in each harbour stated the ports having a good cooperation today, but everything can always be improved. As the environmental image and environmental expertise among ports are important parts of their business the ports are most likely eager to evaluate new innovative solutions.

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Appendices

Appendix I

List of interviewees

Port of Helsinki

Antti Pulkkinen	Harbour Master
Ari Piispanen	Environmental Consult
Kimmo Mäki	Managing Director

Ports of Stockholm

Anita Krafft	Deputy Harbour Master
Anne Wallinder	Environmental Engineer
Henrik Ahlqvist	Manager Cruise and Ferry & Deputy Harbour Master
Ulrika Persson	Environmental Engineer

Port of Tallinn

Ellen Kaasik	Head of Quality and Environmental Management
Janis Väät	Specialist of Environmental Management

Copenhagen Malmö Port

Annette Berg Nergaard	Administrative Coordinator
Arnt Møller Pedersen	COO Cruise and Ferries
Gert Nørgaard	Manager Strategy & Planning

Appendix II

Interview questions (face to face semi structured thematic expert interviews)

Person(s) interviewed: Status:

Port of: Date & time:

Do all cruise ships leave their waste in the port?

Does any cruise ship have a permit NOT to leave their waste?

Who/what organization is handling the waste?

What substances do you recycle?

Theme I: PRF

1. Do the ships leave ALL their waste in the port?
2. How does the ship inform the port about the waste to be left at the port?
3. Does the port have a "No special fee" system implemented?
    - A good and equal system for ports in the Baltic Sea? Describe difficulties and advantages
4. Have any ship left scrubber waste at the port? If yes, how does the port deal with it?
    - Has there been done research about waste generated from scrubbers?

Theme II: Cruise ship generated waste

1. How much of cruise ship generated waste is being recycled?
2. Is it possible to recycle 100 % of cruise ship generated waste at the port?
3. How does the port deal with international food waste?

Theme III: Cooperation with the other ports (Helsinki, Tallinn, Stockholm and Copenhagen)

1. According to you, what works well and what does not regarding the ports cooperation? How could the cooperation be improved?
2. Could a system be introduced in the Baltic Sea where these four ports would cooperate to full extent and special types of wastes would mainly be recycled in one port? What kind of waste to which port and why?

Theme IV: National legislation on waste

1. Short description of your countries legislations.

2. Does the countries waste legislation match the waste handling process in the port? Do they support each other?

3. Difficulties and advantages with the national legislations and cruise ship generated waste.

Theme V: Sustainable development & future

1. Description of future environmental strategies and developments. Why?

2. What are the ports motives in improving the recycling of ship generated waste?

Further questions:

Why are you recycling?

Appendix III
Secondary data from the ports

		Passenger	Oily wastes		Garbage (ton)							Total garbage (ton)	Sewage (m³)
			Oily wastes (m³)	Oily rags (ton)	Food waste	Cardboard	Glass	Metal	Mixed domestic waste	Other wastes	Hazardous waste		
Helsinki	2010	342000	2343	1,1	28,9	1,0	1,4	0,3	567,4	3,7	0,5	604,2	50200
	2011	385000	2529	0,9	216,8	1,4	0,7	0,7	636,1	0,0	1,6	858,3	51200
	2012	368000	2364	0,3	204,0	1,8	3,6	0,3	536,3	0,0	0,1	746,3	55500
	2013	420000	2891	3,0	429,0	3,0	13,0	1,0	759,0	3,3	1,5	1212,8	51561
	2014	420000	2668	1,7	366,6	87,7	172,1	34,7	716,8	4,1	9,6	1393,2	63 528
Stockholm	2010	415000	1858	23,3		3,7	9,2	93,1	739,1	104,9	82,7	1056,0	29679
	2011	452000	2162	10,2		10,8	10,5	39,5	728,5	68,0	51,4	918,8	41631
	2012	470000	2064	3,5		20,1	0,0	36,9	782,9	64,6	15,2	923,3	49929
	2013	485581	1837	0,2		2,5	62,9	0,1	609,0	7,2	35,2	717,1	51803
	2014	470000	2412			7,4	0,7	5,3	649,7	15,4	34,6	713,1	46641
Copenhag	2010	662000	1790						2753,0		na	2753,0	14631
	2011	815000	2724						1675,0		18,0	1693,0	8905
	2012	840000	2779						1504,0		17,0	1521,0	4180
	2013	800500	1839						1545,0		18,0	1563,0	1690
	2014	739000	1957						1778,0		21,7	1799,7	5058
Tallinn	2010	390000	4453	18,3	204,3	385,0	395,4	97,9	689,0	114,3	65,7	1951,7	3976
	2011	437517	4158	25,8	204,3	331,6	382,2	84,0	730,8	237,6	113,1	2083,6	4076
	2012	440504	4906	22,2	179,1	306,7	242,2	85,5	681,1	190,8	151,2	1836,6	7195
	2013	519319	6020	26,7	314,7	455,0	382,2	104,7	998,3	331,8	198,3	2784,9	7172
	2014	479000	5120	50,7	349,8	349,4	395,4	111,3	696,1	261,1	259,5	2422,6	3216

Appendix IV
Port of Tallinn, statistical information.

	Oily waste (m^3)			Garbage (m^3)								Sewage (m^3)
	Sludge	Bilgewater	Oily rags	Food waste	Plastic	Paper	Glass	Tin	Mixed domestic waste	Other	Hazardous waste	
2010	**2964**	**1489**	**61**	**681**	**1346**	**1426**	**441**	**293**	**2481**	**381**	**219**	**3976**
2011	**2607**	**1551**	**86**	**681**	**1728**	**1228**	**479**	**280**	**2832**	**792**	**377**	**4076**
2012	**2894**	**1625**	**74**	**597**	**1413**	**1136**	**404**	**286**	**2649**	**636**	**504**	**7195**
2013	**3783**	**2238**	**89**	**1049**	**1893**	**1685**	**637**	**349**	**3861**	**1106**	**661**	**7172**
2014	**3194**	**1926**	**169**	**1166**	**1698**	**1294**	**659**	**371**	**3686**	**987**	**865**	**3216**

(2014, orher oily wastes 4 m^3)