DEVELOPMENT OF A MANDATORY CODE FOR SHIPS OPERATING IN POLAR WATERS

Environmental aspects of emissions and discharges from shipping during regular operation in polar areas

Submitted by Norway

SUMMARY

Executive summary: This document contains the report of an analysis performed on regular operational emissions and discharges from shipping in polar areas – in particular the environmental aspects

Strategic direction: 5.2

High-level action: 5.2.1

Planned output: 5.2.1.19

Action to be taken: Paragraph 6

Related documents: MEPC 60/21/1 and DE 54/13/7

1 At MEPC 60, the Committee briefly discussed a submission from Norway on the environmental aspects of polar shipping and decided to refer the document to DE 54. Based on the comments received at MEPC 60, Norway has revised document MEPC 60/21/1 and submitted it to this session of the Sub-Committee (DE 54/13/7).

2 As a follow up to the recommendations on issues to be further considered in these documents referred to above, Norway has carried out a high level assessment of whether regular operational discharges from ships pose a particular environmental threat in polar waters compared to other areas.

3 The considerations presented in the study are based on review of existing studies and assessment programmes. Of particular relevance and importance has been the broad range of scientific and industry based knowledge compiled as part of the Arctic Council's different environmental assessment programmes. In addition, a wide range of knowledge on polar and sub-polar conditions with regard to human activities, shipping and environmental vulnerability were available as part of the Norwegian governmental integrated management plan for the marine environment of the Barents Sea and areas off Lofoten. Another initiative that has extensively gathered and evaluated knowledge with regards to shipping/petroleum activities and polar marine environmental vulnerability is the Barents 2020 HSE standard
harmonization project. In this project, during the course of more than two years, Russian and Norwegian experts jointly worked together to identify common industry HSE standards for operations in the transboundary polar waters north of Norway and Russia.

4 Other relevant polar literature has been examined; however, the information used as basis for the polar environmental considerations in this study has a clear weight towards the Arctic. While Antarctica is mostly a continent surrounded by sea, the Arctic is mostly a sea surrounded by continents, with a higher level and variety of anthropogenic activity, both at sea and on nearby land masses. The availability of recent environmental assessments focusing on shipping and polar environment, has thus been significantly higher for the Arctic and sub-arctic waters. Several of the conditions and challenges are however comparable with those in Antarctic waters.

5 Even if the report points out some possible measures to be considered in the development of the Polar Code the aim of the analysis was to get a better understanding of the potential impact from regular shipping operations in polar waters. The complete report of the study is found in the annex and Norway hopes this study will to assist the Sub-Committee in its deliberation and development of the Polar Code.

Action requested of the Sub-Committee

6 The Sub-Committee is requested to note the information and the outcome of the analysis and take action as deemed appropriate.
ANNEX

REPORT ON REGULAR OPERATIONAL EMISSIONS AND DISCHARGES FROM SHIPPING IN POLAR AREAS – PARTICULAR ENVIRONMENTAL ASPECTS
Report

Regular operational emissions and discharges from shipping in polar areas - particular environmental aspects

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CONCLUSIVE SUMMARY

On behalf of the Norwegian Maritime Directorate and as part of a process for developing international regulative instruments for shipping in polar waters, Det Norske Veritas AS (DNV) has carried out a high level assessment of whether regular operational discharges from ships pose a particular environmental threat in polar waters compared to other areas.

The issue of environmental vulnerability is complex and not uniform throughout the polar waters, thus these areas as others have their sensitive and less sensitive periods, regions and natural resources. There are also important differences between the Arctic and Antarctic waters in physical conditions, geo-political status, current legislation and impact from shipping. However, certain common particular “polar” conditions can be summarized of relevance for vulnerability for pollution from shipping, such as the temperature and light conditions, remoteness, snow and ice conditions and certain characteristics of the natural resources. In addition, the relatively low level of human disturbance is usually perceived as a particular condition in polar areas of value for protection *in itself*, even if a certain type of added human footprint does not necessarily represent a threat *per se*.

Shipping activities in polar waters are limited compared to other regions, however significantly higher and more diverse in the Arctic compared to Antarctica, but increasing in both areas. The main regulative framework for regular discharges to air and water is the provisions under IMO, primarily MARPOL 73/78, however other specific regional, national and local regulations exists. Antarctica is subject to stricter pollution provisions for several discharge types compared to the Arctic waters, including a ban on the use and carriage of heavy grade oils. Impacts from ships such as noise and other disturbance are generally not regulated.

Even if certain aspects of regular discharges can be seen as a greater problem in other areas than polar waters, such as health hazards from poorly treated sewage affecting beaches and amenities, or eutrophication of enclosed water bodies highly polluted by additional sources, other aspects were identified in this study to represent a particular polar challenge:

- Certain aspects of air pollution from ships, such as the deposition of soot and black carbon on ice, the effects on arctic haze and on acidification in certain regions were identified to pose a particular pollution challenge caused by shipping in polar areas, especially in the Arctic.

- The provisions for allowed discharge of oily water from oil cargo tank wash operations should be carefully considered with regard to the applicability in Arctic waters. Moreover, the current IMO provisions allowing such oily water discharge in the Arctic do not reflect the current oil tanker practices for handling of such waste, which is typically delivered to shore, at least in Norwegian waters where most of the oil tanker activity is located.

- As a potentially relative large source of operational oil discharge, however still not effectively regulated and of unknown exact magnitude, stern tube leakage should be addressed as a particular environmental aspect in the polar environment as well as in other areas. Of particular importance under ice operation is the potential for especially high leakage rates, and the proximity to ice with regards to deposition of oil.
- Potential negative disturbance impacts from shipping on populations of polar species can be seen as a potential particular environmental aspect in Polar areas, especially due to the aggregation of marine mammals in certain biologically key areas at certain times of the year.

- Potential negative impacts from poorly developed waste reception facilities and waste management logistics in polar waters can be seen as posing a particular polar environmental challenge.

- Even though not considered as a regular and “planned” discharge as such, the issue of accidental loss of containers may cause particular challenges in polar areas, due to insufficiencies with regard to emergency preparedness, warning and response. Remoteness and lack of infrastructure reduce the chances for proper handling of stranded dangerous containers and goods.

Of particular importance with regards to the polar environments’ ability to adapt in general, is the considerably changed pattern and rate of variation expected in polar waters due to human forced climate changes, a factor in itself that may trigger stricter protection in polar areas.

In addition, although not necessarily identified by this study as particular polar environmental aspects from regular operational emissions and discharges, the following issues were identified:

- Even if sewage in general was not found to represent a particular threat towards the polar environment, an area of possible concern in both polar areas and other areas may be the variety of potential other occurring chemicals in the effluents, in particular with regard to the currently unregulated grey water.

- The provision allowing discharge of certain garbage fractions in parts of Arctic waters can be considered as unsuitable, even if not identified by this study as representing a specific threat to the polar environment compared to other areas.

- Of importance in polar areas with regard to the spread of alien species via ballast water is the effective implementation of the IMO Ballast Water Convention in all areas, and in addition potential future provisions for controlling the spread of organisms via ship’s hull and rudder.

- Of importance in polar areas with regard to the effects of anti-fouling compounds is the effective implementation of the IMO Anti-fouling System Convention.

- Potential negative impacts from collisions between marine mammals and ships were not identified as a particular threat towards the polar ecosystems, however collisions represent an animal welfare problem on an individual level that should be addressed, especially if shipping and marine mammals are concentrated in the same areas (for example in ice corridors), increasing the risk of collisions.

Examples of measures to address the above challenges have been briefly summarized, ranging from potential additional regulatory measures, such as stricter air emission standards; to technology options for reducing emissions and disturbance, operational measures such as re-routing and application of industry best practice standards, such as “Zero Discharge” of garbage.
INTRODUCTION

New recommendatory guidelines for ships operating in polar waters were adopted by the International Maritime Organization (IMO) in Resolution A.1024 (26) in December 2009. A correspondence group was subsequently established within IMO to further develop a draft International mandatory Code of safety for ships operating in polar waters (Polar Code), which would cover the full range of design, construction, equipment, operational, training, search and rescue and environmental protection matters relevant to ships operating in the inhospitable waters surrounding the poles.

In connection with the processes of developing international regulative instruments for shipping in polar waters, the Norwegian Maritime Directorate has given Det Norske Veritas AS (DNV) the assignment of preparing a high level analysis of the potential specific threats in polar waters from regular operational discharges from ships.

This report describes the relevant allowed regular discharges in Arctic and Antarctic waters as can be expected under the current regulative framework. Further on, in light of the analysis, potential relevant additional measures are compiled.

APPROACH

The considerations presented in this study are based on review of existing studies and assessment programs. Of particular relevance and importance has been the broad range of scientific and industry based knowledge compiled as part of the Arctic Council’s different environmental assessment programs. In addition, a wide range of knowledge on polar and sub-polar conditions with regard to human activities, shipping and environmental vulnerability were available as part of the Norwegian governmental integrated management plan for the marine environment of the Barents Sea and areas off Lofoten. An other initiative that has extensively gathered and evaluated knowledge with regards to shipping/petroleum activities and polar marine environmental vulnerability is the Barents 2020 HSE standard harmonization project. In this project, during the course of more than two years, Russian and Norwegian experts jointly worked together to identify common industry HSE standards for operations in the transboundary polar waters north of Norway and Russia.

DNV has been involved in connection with the above initiatives, due to experience and competency within environmental and safety risk management for shipping and oil and gas activities in general, and under polar conditions specifically. Of particular relevance is DNV’s participation in the working group on regular operational discharges under the Barents 2020 project, and the several assessments DNV has undertaken with regards to regular operational emissions and discharges from shipping in Norwegian waters on behalf of Norwegian Authorities.

Other relevant polar literature has been examined, however, the information used as basis for the polar environmental considerations in this study has a clear weight towards the Arctic. While Antarctica is mostly a continent surrounded by sea, the Arctic is mostly a sea surrounded by continents, with a higher level and variety of anthropogenic activity, both at sea and on nearby
land masses. The availability of recent environmental assessments focusing on shipping and polar environment, has thus been significantly higher for the Arctic and sub-arctic waters. Several of the conditions and challenges are however comparable with those in Antarctic waters.

This study is not exhaustive with regards to the selection of studies and knowledge on environmental threat from pollution from shipping in polar areas. Thus other studies may conclude differently with regard to the vulnerability aspects. The study displays however to our best judgement what can be reasonably summarized as particularly challenging in polar areas compared to other areas when it comes to regular operational emissions, discharges and impacts. The study does not evaluate the aspects of accidental spills from ships.

3 POLAR WATERS DEFINITION AND GENERAL DESCRIPTION

The definition of polar waters applied in this report mainly follows the definition applied in IMO Resolution A.1024 (26) (the IMO polar shipping guidelines), see Figure 3-1.
Figure 3-1 Extent of Arctic (above) and Antarctic (below) waters as applied in this report

The polar waters show similarities with regard to several environmental conditions, however the differences and heterogeneity is evident both between the Arctic and the Antarctic, and within the respective polar areas. Ocean climate, ice conditions and the presence and distribution of natural resources (fish, seabirds, marine mammals etc.) vary both spatially and temporarily. The significant variability is reflected in the way the polar waters are categorized within the UN Large Marine Ecosystem (LME) concept. LMEs are relatively large ocean regions that have been delineated according to continuities in their physical and biological characteristics, facilitating applicable management and governance strategies. While Antarctic waters naturally can be seen as one LME, the Arctic waters are divided in about 10 different LMEs (ref /1/).

Thus, the issue of environmental vulnerability will not be uniform throughout the polar areas. However, certain common particular “polar” conditions have been identified with regard to the potential threat from pollution from shipping, as described in Section 5 of this report.

The Antarctic area is special compared to the Arctic in having no internationally agreed coastal state jurisdiction. The Antarctic Treaty System (ATS) functions on the basis of shared responsibility for the Area. The Arctic is not covered by a treaty that deals with the region as a whole. In addition, the political issues and potential future development scenarios of relevance for shipping are very different between the areas.
4 SHIP TRAFFIC AND ASSOCIATED REGULAR EMISSIONS/DISCHARGES IN POLAR AREAS

4.1 Traffic pattern and volume

The volume of shipping in polar waters is low compared to other regions, however it is expected to increase; in the Arctic considerably, especially due to developing oil and gas exploration, and in connection with potential increase in shipping through the Northern Sea Route if reduced ice covers allows for it. The increase in Antarctica is mainly due to the rapid increase in tourism and associated traffic of passenger- and cruise vessels.

A recent and extensive status report for Arctic shipping has been given in the “Arctic Marine Shipping Assessment (AMSA) 2009” (ref /2/) by the PAME (Protection of the Arctic Marine Environment) working group of the Arctic Council. This assessment identifies the main traffic pattern and volume, ship emissions, environmental aspects and scenarios for traffic development in the Arctic. Several thousand vessels are operating the Arctic waters each year; however this applies to a wider definition of the Arctic than shown in Figure 3-1. Fishing vessels and different types of cargo ships dominates, however practically all main ship types are registered in the area. It is referred to the AMSA report for further details on arctic ship traffic pattern, volume and future scenarios.

A similar shipping assessment does not exist for Antarctica. Over the past decade shipping traffic has increased significantly in Antarctic waters, both in terms of the overall numbers and the types and sizes of vessels (ref /3/), but it is by order of magnitude not comparable to Arctic shipping in terms of volume and diversity of vessel types and size categories. However, according to the Antarctic and Southern Ocean Coalition (ASOC) (ref /4/), tourism doubles every 5th year, representing the major source for increased shipping activity. From a base of about 4 700 tourists in the 1990/91 summer, annual numbers have increased to about 46 000 in 2007/2008 (in comparison, about 60 000 passengers visited the Norwegian Arctic archipelago of Svalbard with cruise ships in 2008, (ref /5/). The largest increase in recent years in Antarctica has been on ships carrying more than 500 passengers. The ships operating in Antarctic waters annually include around 40 licensed fishing vessels, at least 16 illegal fishing vessels, more than 50 tourism vessels, about half a dozen vessels engaged in whaling or anti-whaling protests, and numerous research and resupply vessels associated with the 30 National Antarctic Programs active in the region (ref /6/).

4.2 Regular operational discharges and their regulation in polar waters

The relevant regular and “planned” operational discharges in focus for this study and permitted under current regulations in polar waters are listed in Table 1 below. Even though the general framework for controlling the regular discharges is the provisions under IMO (mainly MARPOL 73/78), examples are given of specific local/regional regulations.

While the Antarctic waters are designated as a Special Area under MARPOL Annex I (oil), Noxious Liquid Substances (Annex II)1 and Garbage (V), with stricter requirements for discharges to water from ships, no such Special Areas has been designated for Arctic waters. In

1 Currently regulates more than 700 noxious liquid substances, however not included within the scope of this study.
Addition, a general ban on the use and carriage of heavy grade oils was introduced in Antarctic waters by IMO in 2009, mainly targeting the risk for accidental oil spills, however indirectly also relevant for several operational discharge aspects. A ban on heavy grade oils is also enforced by Norwegian legislation in waters encompassed by the national nature reserve areas of Svalbard.

Most of the provisions of the IMO MARPOL are established under the different applying national and regional legislation and standards. In Antarctica, the basic provisions are reflected in the Madrid Protocol to the Antarctic Treaty. However, not all nations and parties in polar waters are necessarily signatory to all of the IMO provisions. Other, both stricter, equal or less strict national/regional regulations may apply in certain polar waters; however this study concentrates on analysing polar aspects of what could be perceived as the baseline level of discharges permitted under the international IMO provisions.

A special challenge in Antarctic waters is the lack of control by port state jurisdiction; enforcement of shipping regulations is primarily dependent on flag States. The forty-seven Antarctic Treaty Parties have joint responsibility for protection of the Antarctic marine and terrestrial environments; however, reaching consensus issues make the development and application of appropriate measures complex.

### Table 1  Regular operational discharges and their regulation in polar waters.

<table>
<thead>
<tr>
<th>Emission/discharge/impact type</th>
<th>Regulation in Arctic waters</th>
<th>Regulation in Antarctic waters</th>
</tr>
</thead>
</table>
| **NOx (engine exhaust)** | IMO MARPOL 73/78 revised Annex VI and NOx Technical Code 2008: - Limits for NOx-emissions according to the “NOx-curve”. Tier II-level (from 2011) requires 15-20% reduction for new ships, compared to current Tier I-level.  
*Note: Alaskan and Canadian polar waters are not included in the new U.S./Canadian Emission Control Area (ECA) under MARPOL, with stricter requirements.* | As Arctic |
| **SOx (engine exhaust)** | IMO MARPOL 73/78 revised Annex VI:  
- Current global sulphur cap in fuel down from 4,5% to 3,5 % from 2012, and down to 0,5% from 2020 (possibly 2025).  
*Note: Alaskan and Canadian polar waters are not included in the new U.S./Canadian Emission Control Area (ECA) under MARPOL, with stricter requirements.* | As Arctic  
*Note: Reduced SOx emissions can be expected due to the ban on use of heavy grade oils in Antarctica.* |
| **Particles/soot (engine exhaust)** | Not specifically regulated with limits by revised Annex VI, however indirectly covered by the sulphur provisions.  
*Note: Alaskan and Canadian polar waters are not included in the new U.S./Canadian Emission Control Area (ECA) under MARPOL, with stricter requirements.* | As Arctic  
*Note: Reduced particle/soot emissions can be expected due to the ban on use of heavy grade oils in Antarctica.* |
| **Volatile Organic Compounds (VOC) from oil cargo operations** | Not specifically regulated with limits by revised Annex VI.  
*Note: Annex VI gives the individual Party opportunities for design of ports and terminals in which VOC emissions are regulated.* | As Arctic |

2 The table is not exhaustive with regards to distinct local/national regulations. However, the presented “parachute” regulations represents the general picture of regulative provisions throughout the polar waters as a whole, which in most cases is equivalent to the described IMO provisions.
<table>
<thead>
<tr>
<th>Emission/discharge/impact type</th>
<th>Regulation in Arctic waters</th>
<th>Regulation in Antarctic waters</th>
</tr>
</thead>
</table>
| **Ozone depleting substances** | IMO MARPOL 73/78 revised Annex VI:  
- Prohibits any deliberate emission of ozone depleting substances. New installations which contain ozone-depleting substances shall be prohibited on all ships, except new installations containing HCFSs which are allowed until 1 January 2020 | As Arctic |
| **Oily bilge water**  
(oil from the machinery spaces) | IMO MARPOL 73/78 Annex I:  
- Maximum 15 ppm oil in separated bilge water to sea, requirements to separator equipment, etc. | IMO MARPOL 73/78 Annex I  
Antarctic Special Area requirements:  
- Any discharge of oil or oily mixtures is prohibited |
| **Oily slop water**  
(oil from the cargo areas of oil tankers) | IMO MARPOL 73/78 Annex I:  
- Maximum 1 / 30 000 of last loaded cargo and not more than 30 litres per nm, minimum 50 nautical miles ashore. | IMO MARPOL 73/78 Annex I  
Special Area requirements:  
- Any discharge of oil or oily mixtures is prohibited |
| **Stern tube oil leakage** | Not specifically regulated by IMO.  
*Note: Stern tube oil leakage is getting increased attention, see for example information provided by Canada to IMO (ref /7/).* | As Arctic |
| **Sewage (black water)** | IMO MARPOL 73/78 Annex IV (applying to ships of 400 gross tonnage or more, and ships less than 400 gross tonnage that are certified to carry more than 15 persons):  
- Discharge of sewage within 3 miles of the nearest land is prohibited, unless the ship operates an approved sewage treatment plant.  
- Discharges of sewage within 3 to 12 miles is prohibited, unless broken down, diluted, and disinfected by an approved system prior to discharge.  
- Untreated sewage can be discharged outside 12 miles, however only at a moderate rate *en route* > 4 knots.  
*Note: In Canadian Arctic waters (not internal marine waters), provisions apply allowing untreated sewage to be discharged also within 12 miles. However as the authorization in Canadian Arctic waters is specifically for sewage and not treated sewage, the use of marine sanitation devices, in particular those that would have residual disinfectant in the effluent, should be cautioned as the effluent may be considered to be ‘waste’ under other Canadian Arctic provisions.  
*Note: In Alaskan arctic waters, special requirements apply for passenger vessels >500 passengers, including particular effluent standards for marine sanitation devices, sampling regimes, etc. In general, discharge of untreated sewage is not allowed for certain Alaskan cruise ship operations. | As Arctic |
| **Grey water** | The discharge of grey water is not regulated by IMO.  
*Note: The grey water may typically contain substances for which the discharge is regulated by other national/local provisions.* | As Arctic |

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3 For the last 50 years mineral oil lubricated white metal stern tube bearing systems have been a commercial standard for ships. This system contains and consumes mineral oil. The stern tube arrangement for large merchant ships may contain as much as 3000 litres of mineral based oil; a typical stern tube arrangement may contain ~ 1500 litres. During different stress impacts on the propeller and stern tube, there will be a potential for leakage between the sea and the interior ship via slips in the stern tube/hull penetration zone (including the lubrication zone). To avoid sea water to enter the system, the stern tube lubrication arrangement is loaded with excess pressure, thus under physical conditions with tension and bending of the stern tube, marginal slips will occur and oil may seep out.
### Emission/discharge/impact type

<table>
<thead>
<tr>
<th>Emission/discharge/impact type</th>
<th>Regulation in Arctic waters</th>
<th>Regulation in Antarctic waters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garbage</td>
<td>- IMO MARPOL 73/78 Annex V: Certain waste categories allowed released to sea at certain distances from shore. Plastics, oily wastes and other specified hazardous waste is not allowed released to the sea. Note: Stricter national/local provisions may typically apply, such as for example around Svalbard and in Canadian Arctic waters, where garbage is not allowed released to sea, and according to Russian regulation of traffic along the Northern Sea Route, where garbage is not allowed released to the sea.</td>
<td>- MO MARPOL 73/78 Annex V Special Area requirements: Discharge of garbage to sea is not permitted</td>
</tr>
<tr>
<td>Alien species</td>
<td>- IMO International Convention for the Control and Management of Ships' Ballast Water and Sediments (expected in force from 2016): Discharge of ballast water shall be treated by an approved treatment system can be discharged, and according to an approved ballast water management plan. Note: No regulative instrument has yet been designed for controlling the unwanted spread of alien species through ship’s hull and rudder.</td>
<td>As Arctic</td>
</tr>
<tr>
<td>Anti-fouling compounds</td>
<td>- IMO International Convention on the Control of Harmful Anti-fouling Systems on Ships. Prohibits and regulates the use of harmful organotins in anti-fouling paints used on ships and will establish a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.</td>
<td>As Arctic</td>
</tr>
<tr>
<td>Noise and disturbance</td>
<td>Noise from ship engines, seismic activity and ice breaking activities, in addition to general disturbance aspects and collisions with ships are generally not regulated in Polar waters.</td>
<td>As Arctic</td>
</tr>
</tbody>
</table>
5 REGULAR DISCHARGES FROM SHIPPING IN A POLAR ENVIRONMENTAL CONDITIONS PERSPECTIVE

5.1 Particular aspects of polar environmental conditions and vulnerability

The general level of pollution in polar areas is low due to the low level of human activity (ref /8/). However, the polar environment is yet negatively impacted by human activities, where special attention has been given to the various effects of global warming and the long range transport of pollutants by air and sea from diffuse global and regional sources (ref /8/, /9/, /10/, /11/, /12/, /13/) the latter most evident in the Arctic region (ref /12/). In addition, environmental issues predominantly in focus in polar areas are overharvesting, disturbance and waste generation from tourism and research, radioactive waste and acute oil spills from shipping. Only a few areas are heavily affected by local industrial activity, especially in the Russian part of the Barents region, with examples of quite heavy pollution.

When discussing the environmental vulnerability of the polar waters, it is important to acknowledge that the areas are not uniform with respect to ecosystem composition and physical conditions (ref /1/). There are large spatial and temporal variations between and within different areas and sub-areas (see also Section 3). Polar waters have its sensitive and less sensitive areas and periods, as one will find in other regions. The normal ecosystem situation is constant natural variation; however the different components may in varying degree be sensitive to different man-induced changes. Thus, vulnerability evaluations cannot be performed universally but need to be addressed for particular activities and areas at a more limited and focused scale.

For example, as illustrated with respect to sea ice coverage in the Barents Sea - there are significant spatial differences (see Figure 5-1). In the Arctic, there will be gradients between areas with seasonal ice and multi-year ice with different characteristics. In the Antarctic sea, there is relatively little multi-year ice. Ice coverage is closely linked to biological composition of the ecosystem and various ecosystem functions, and thus has significant influence on vulnerability, and hence the discussion of mitigation measures.

![Figure 5-1 Ice coverage in the Barents Sea. Based on data from Arctic and Antarctic Research Institute (St. Petersburg) (ref /14/).](image)

Sub-areas with uniform ice conditions:
- i. Spitsbergen / Svalbard
- ii. Norwegian
- iii. Franz Josef Land
- iv. Northeast Barents Sea
- v. Novozemelsky
- vi. Kola
- vii. Pechora Sea
- viii. White Sea

Sub-area II is generally ice free.
Sub-areas I, III, IV, VII and VIII usually have ice every winter.
Sub-areas V and VI are in-between
The issue of environmental vulnerability of the polar areas is high on both the political and the scientific agenda. The polar areas is frequently referred to as a fragile and vulnerable environment, however there is insufficient scientific information available to give a general and unified judgement on whether and in which way it is any more or less fragile than other parts of the world. The environmental risks associated with human activities will depend on how the ecosystem responds and on its capacity to adapt. However of particular importance with regards to the polar environments’ ability to adapt in general, is the considerably changed pattern and rate of variation expected in polar waters due to human forced climate changes, a factor in itself that may trigger stricter protection in polar areas. Better information on the responses of individuals, populations and communities to stressors is in general required for ecological risk assessments as the basis determining whether provisions developed primarily with a view to other areas can be used in the polar areas with confidence.

Still, based on a review of selected assessments of polar environmental issues, as listed in Section 7, certain common particular polar conditions can be summarized of relevance for vulnerability for pollution from shipping.

5.1.1 Temperature and light

Temperature and light conditions are at the extreme in Polar waters, and they are important issues especially with regard to accidents and oil spill preparedness and response during winter time. For regular operational discharges and emissions they are not considered of primary importance. Generally and maybe of particular relevance to littoral components is that oil may have a slower degradation rate in cold climates indicating longer recovery time than in warmer climates., as may be the case for other substances and chemicals as well.

One important issue with regard to vulnerability on a general level is that ecosystem compounds which are already stressed for some reason may have a far higher vulnerability to additional stress or change. This is for example clearly expressed by the Arctic Monitoring and Assessment Program (ref /10/), with regard to the onshore ecosystems and aspects of acidification and toxic heavy metals in the region of the smelters in Arctic North West Russia; “In the Arctic, the cumulative effects of acidifying emissions and the deposition of toxic heavy metals can be disastrous for ecosystems which are already subject to extreme climatic conditions”.

5.1.2 Remoteness

Remoteness of major parts of the polar areas with regard to relevant resources and infrastructure (or lack of such) can be seen as on of the more important particular condition in the areas with regard to environmental regulation compared to other areas. This, as well, is of special importance with regard to accident and spill preparedness and response, but also with regard to regular operationally generated wastes. In order to ensure the full implementation of sound environmental regulations the associated infrastructure must be in place and functional. Current legislation requires ship owners to stockpile several waste types onboard, including plastics and oily wastes, for delivery to adequate reception facilities on shore. A lack of reception facilities and/or infrastructure may lead to higher probability of unauthorized dumping. In addition, wastes that are delivered to shore may create local pollution problems ashore, if the waste handling chain in polar ports and surrounding areas is not adequate. Finally, lack of options for delivery may
lead to more waste being incinerated onboard, with resulting air emissions like soot and potentially hazardous substances.

5.1.3 Natural recourses

Organisms in the polar seas are used to extreme conditions with significant natural variations in the short and longer term. Important physical factors include low temperatures in some areas, seasonal variation in light conditions, ice coverage and ice melting, and ocean fronts between warmer and colder water.

The polar ecosystems may be characterised as a relatively simple food-web system with short food-chains and few species (but with many sub species) that are high in abundance, compared with other ecosystem areas (sub-arctic, temporal, etc.). Many species tend to grow slower, live longer, have low reproduction rate, and are key in the energy transfer in the system – compared to other ecosystem-regions (with higher diversity). For certain key species, large natural fluctuations in number of individuals over time are observed, but also caused by humans (due to direct and indirect overharvesting, etc), making the populations more vulnerable when in a reduced state. Such systems are normally considered sensitive (Ref /15/).

The large number of individuals within each species is often considered as robustness rather than a vulnerability, as no single “normal” incident may affect a large part of the population. An important characteristic with the Polar ecosystem is however the seasonal variation in abundance (as well as many physical, chemical environmental parameters). High number of individuals of many species tends to migrate and concentrate in limited areas at certain parts of the year to feed and/or reproduce. Such “biomass” accumulation may highly influence on the evaluation of vulnerability, and many of these areas are regarded as having international importance. During the periods when polar species migrates and gather in and around concentrated areas, they may be more vulnerable to potential environmental stresses.

Areas with ice have different ecosystem communities than open sea areas. Various ice algae and ice fauna occur, in/under ice or adjacent to ice. Along the ice edge, the gradients between open sea and ice create life conditions for particular ice edge communities, linked to the continuous “new” growth associated with the edge of retreating ice.

Arctic species, which are reliant on feathers and fur to insulate against the cold, are especially vulnerable to contamination from oil that will compromise their insulating layers, leaving them exposed and at risk of hypothermia and death.

5.1.4 Ice and snow

As for the other mentioned polar conditions, ice and snow is first of all of particular importance in terms of influencing the probability for - and consequences from - accidental oil spills. However, they are also of significant importance with regards to pollution in general. Trapping of pollution in ice makes the pollution longer-lasting than otherwise. Oil trapped in ice may be transported over long distances. In addition, deposition of black carbon/soot from air emissions may lead to accelerated melting of ice, since solar radiation energy will be more efficiently absorbed by darker surfaces. In polar areas where the ice cover and dynamics are currently believed to be highly affected by global warming processes, this additional aspect of accelerated melting by deposition of air pollution has got special attention. Such deposition in the Arctic
mainly origins from long and medium range transport of pollutants from other places on the northern hemisphere (both natural and anthropogenic sources) but also from local Arctic sources, such as shipping (see Section 5.2.1).

According to PAME (ref /2/), it is projected that the main change in sea ice will be decreasing ice coverage in the summer along the coastal Arctic seas with the formation of first-year ice occurring later in the fall. Even with a warmer climate, the Arctic Ocean will still remain ice-covered for most of the year. As climate and sea ice conditions continue to change, the timing and movements of the animals’ activity will also be modified, making predictions of the potential interactions between shipping and animals increasingly complex.

5.1.5 Low anthropogenic footprint

Although not necessarily a factor identified in terms of increasing the actual threat from ship emissions and discharges, the general low level of human disturbance and waste in the first place is typically perceived as a condition requiring the strictest environmental protection measures in polar areas. The attribute of being relatively pure and pristine compared to most other parts of the world, can bee seen as a particular quality in itself, even if the polar areas don’t turn out to be threatened per se by a certain type of human footprint.

Even if not touched much upon in this report, and scientifically difficult to measure in terms of threat and vulnerability, the perception of polar areas as “pure and pristine” is likely to significantly govern policy decisions in polar areas for the future, more or less dependent of increased scientific knowledge about vulnerability.

5.2 Vulnerability considerations for the specific regular discharges

Even though not considered the most evident particular polar environmental challenge from shipping (which is major acute oil spills), certain problems caused by regular operational discharges are frequently highlighted by the reviewed assessments (see Section 7).

Very few studies however have specifically studied the actual effects of regular discharges in polar waters and/or whether the impacts are of particular concern in polar waters compared to other areas. Thus when discussing the need for updating the legislative framework for the various types of regular discharges and impacts, the question often remains unanswered whether there is actually a general need for updating the framework rather than a specific polar need for updating. The below sections summarize the existing knowledge about the different relevant regular discharge and impact types in light of particular polar vulnerability considerations.

5.2.1 Emissions to air

Exhaust emissions from shipping on a local and regional scale are in focus primarily due to the negative impacts on terrestrial ecosystems, forestry and crops through processes such as acidification, eutrophication and the creation of ground level ozone. Ground level ozone, together with particles/soot and other exhaust emission components also pose negative impacts on human health, primarily by causing respiratory disorders. In some enclosed marine ecosystems, such as the Baltic Sea suffering from man-made nutrient surplus and high levels of pollution, the additional deposition of airborne nitrogen and sulphur from ship emissions directly to sea is also considered significant (ref /16/).
Thus, traditionally the concerns related to exhaust emissions from ships have been more evident in other areas than in polar waters; typically in areas with dense human populations and vulnerable terrestrial ecosystems (primarily vegetation and freshwater systems) in combination with high level of additive emissions and exceeded critical levels of pollution from land based transport and industry. Examples of heavily impacted areas include those around the North Sea and Baltic Sea (both seas currently designated by IMO as an emission control area for sulphur).

However, this study has found support for a potential need for addressing certain aspects of air pollution from ships particularly in polar areas. An overview of the basis for the below considerations can be found in ref /2/, /10/, /11/, /17/ and /18/:

- Deposition of soot and black carbon (BC) from operation of ships may potentially play a significant role in accelerated melting of ice, because such light absorbing aerosols can decrease the surface albedo (reflectivity) of ice and snow; especially evident in proximity to high traffic areas/corridors. In polar areas where the ice cover and dynamics currently is believed to be highly affected by global warming processes, this additional aspect of accelerated melting by deposition of air pollutants on ice has got special attention.

- The increase in ship traffic is likely to contribute to phenomena like Arctic haze, where sulphate and other aerosols; black carbon and soot etc from ship exhaust may affect local/regional climate forcing processes by influencing solar radiation in air masses. Tropospheric ozone formed by ship generated NOx is also of relevance for such processes. The main source for such haze is however air pollutants transported to the Arctic from sources (industry and forest fires) further south. Even though the effects in terms of regional warming/cooling are complicated with feedbacks between aerosols, clouds, radiation, snow and ice cover, and vertical and horizontal transport processes; the contribution from shipping, especially taking into account the most optimistic scenarios for traffic development, should be considered as significant and of special importance in polar areas which are otherwise highly affected by global warming processes. Note however that the environmental and climate effects of these mechanisms in the Arctic are only beginning to be understood.

- Certain arctic areas experiencing high levels of air pollution and acidification effects from land based industry, such as on the Kola Peninsula and in limited areas of northern Norway, Finland and around Norilsk in the Taymir region of Russia, may be vulnerable for additive emissions of sulphur and nitrogen from shipping. Even though today’s SO2 emissions from shipping are only marginal compared to the emissions from the Russian smelters, the contribution to NOx emissions from shipping is quite much higher. Moreover, considering the highest estimates for increases in emissions in connection with the oil and gas activity and increased use of the Northern Sea Route, shipping may contribute to extended periods where the critical loads for acidification and pollution in coastal areas are exceeded. Note that this study has not found support for considering this aspect as a general polar particular challenge, but rather a local Arctic problem in certain areas with high background concentrations and vulnerability to increased nitrogen/sulphur load.

Assessments indicating whether the above aspects are similarly evident in Antarctic waters have not been available for this study. However, they may be of less importance due to far less ship traffic and expected rise in such, practically non-existing significant additive local industry
sources and far less impact from long range atmospheric transport of air pollutants from natural (e.g. forest fires) sources and industry sources (ref /12/). In addition, aspects such as acidification effects on terrestrial ecosystems are far less relevant in Antarctica compared to the Arctic. Moreover, the ban on use of heavy grade oils in Antarctica will contribute to less emission of relevant air pollutants such as sulphur and soot/black carbon.

Certain aspects of air pollution from ships, such as the deposition of soot and black carbon on ice, the effects on arctic haze and on acidification in certain regions have been identified by this study to pose a particular pollution challenge caused by shipping in polar areas, especially in the Arctic.

5.2.2 Oil

The degree of oil pollution in the Arctic marine environment is low, with natural seeps being the largest source of input (ref /8/). Several of the assessment programs examined as part of this study have concluded that the most severe threat posed by shipping to the Polar environment acute oil spills, given the particular polar conditions described in Section 5.1. However no studies specifically addressing the vulnerability in polar waters from legal operational discharges of oil were found.

Legal operational discharges of oil according to the provisions given by MARPOL can be divided in two types; oil from the machinery spaces (bilge oil) of all ships, and oil from the cargo areas of oil tankers, typically from tank washing operations (slop oil). In Antarctica, no oil discharge to sea is permitted.

The legal quantity of discharge of bilge oil represents very small quantities. For example, DNV calculated that the permitted discharge of oil (15 ppm) through separated bilge water from all ship activities in Norwegian waters during one year, was less than 2 000 litres (ref /19/). The estimate was based on activity based modelling of ship emissions (ref /20/) in one of the areas of the arctic and sub-arctic with heaviest ship traffic – about 34 million registered nautical miles per year altogether, from most ship types and size categories, including large cruise vessels.

Low concentrations of oily water discharges from bilge as allowed by IMO MARPOL in Arctic waters areas have not been identified by this study to induce a particular threat to the environment.

The legal quantity of discharge of slop oil represents higher quantities, ref. the described provisions in Table 1. According to a DNV report (ref /19/), the theoretically allowed yearly quantity of oil from the cargo areas of all oil tankers operating in Norwegian waters, is estimated to about 4 000 m³. However, this volume is by no means considered to be representative for the actual volume. The actual oily water production and handling from cargo tank washings generates considerably less volumes of oily water, as oil tankers are required to have segregated oil and ballast tanks. At least in Norwegian northern waters, holding the main traffic of oil tankers in the area, cargo tank washing operations today typically occurs when changing cargo types and in connection with inspection, normally during terminal stay with delivery of oily slop water ashore (ref /21/, /22/).

No assessments have been available for this study describing the environmental impact of actual oil tank washing operations in the arctic as allowed under IMO MARPOL. However, based on considerations similar to those described in Section 5.1, especially with regards to oil in ice, the
experts of the Barents 2020 project (including industry representatives from both Norway and Russia) (ref /14/) concluded that the current potential allowed oil discharge from slop water under IMO MARPOL was not acceptable as an industry standard for oil tankers operating on behalf of the oil and gas industry in the Barents Sea.

The provisions for allowed discharge of oily water from oil cargo tank wash operations should be carefully considered with regard to the applicability in Arctic waters. Moreover, the current IMO provisions allowing such oily water discharge in the Arctic do not reflect the current oil tanker practices for handling of such waste, which is typically delivered to shore, at least in Norwegian waters where most of the oil tanker activity is located.

In addition, the unregulated leak of lubrication oil from stern tube bearing systems may represent a significant oil quantity compared to the actual legal discharge of bilge oil and slop oil. It is difficult to make an accurate estimate of the leak to sea because the leak rate is dependent on several parameters like propulsion power, age and type of arrangement, wear, operational profile etc. Vessels operating in areas with ice is expected to have a higher leak rate than ships with similar size operating in a less harsh environment (i.e. ice entering propeller flow, causing particular loads). Currently no authorized quantity estimates exists, but assumptions are in the range of 6 litres of oil per ship per day, of course depending on vessel type and size (ref /7/, /23/). Thus, based on considerations similar to those described in Section 5.1, especially with regards to proximity to ice, this study have found support for paying particular attention to stern tube oil leakage in polar waters.

As a potentially relative large source of operational oil discharge, however still not effectively regulated and of unknown exact magnitude, stern tube leakage should be addressed as a particular environmental aspect in the polar environment as well as in other areas. Of particular importance under ice operation is the potential for especially high leakage rates, and the proximity to ice with regards to deposition of oil.

5.2.3 Sewage and grey water

Sewage (black water) generally means human body wastes and the wastes from toilets and other receptacles intended to receive or retain body wastes. As per the general regulations (see Table 1), with some local exemptions, only treated sewage can be discharged within 12 nautical miles from shore. Grey water means wastewater from sinks, baths, showers, laundry, and galleys. The basic provision is that grey water can be discharged anywhere untreated.

The fundamental basis for today’s provisions allowing fractions of sewage and grey water to be discharged to sea is the oceans’ capabilities of assimilating and dealing with sewage through natural bacterial action and dispersion. However, especially due to potential negative health impacts and reduction of amenities, sewage must be treated before effluents are discharged in proximity to land.

Of special relevance with regard to sewage and grey water discharges in polar waters (as well as in other areas), is the major producers of sewage/grey water, i.e. passenger and cruise ships. The 2004 U.S. Commission on Ocean Policy (ref /24/) reported that, while at sea, an average cruise ship can generate a total of 532 000 to 798 000 liters of sewage and 3.8 million liters of grey
water a week. On most cruise ships, the sewage is treated using a marine sanitation device that biologically treats and disinfects the waste prior to discharge. Some cruise ships, especially many of those travelling to Alaska, have installed Advanced Wastewater Treatment systems (AWTs) to treat sewage and often grey water. These AWTs provide higher levels of biological treatment, solids removal, and disinfection as compared to traditional marine sanitation devices. On cruise ships using AWTs, one or more grey water sources are often treated together with sewage. On other cruise ships, grey water is generally not treated, as allowed under current provisions.

Still, even if sewage is regulated and treated, according to the U. S. Environmental Protection Agency (EPA) (ref /25/) significant amounts of poorly treated sewage and highly contaminated raw grey water are frequently discharged into harbours and coastal waters. The EPA have found examples of cruise ship discharges containing concentrations of bacteria (such as fecal coliform), chlorine, nutrients, metals and other pollutants that often far exceed federal effluent and water quality standards and are harmful to human health, the marine environment and amenities such as beaches and swimming areas. A majority of sewage samples taken by the EPA from cruise ships having IMO approved marine sanitation devices (Type II MSDs) violated national effluent limits for both ship and land-based sewage - and often exceeded national water quality criteria at point of discharge. However these results are not necessarily representative anymore at least for Alaskan water, as most vessels operating there have installed AWTs. In other polar waters, such as Antarctica, the share of use of traditional devices is however expected to be higher, with generally older cruise vessels in traffic.

The over-fertilization aspect of sewage discharges have called for special regulations in enclosed water bodies facing eutrophication problems, such as the Baltic Sea. Thus in 2009, the Contracting Parties to the Helsinki Convention agreed on a joint submission to IMO to amend Annex IV of MARPOL 73/78 and to designate the Baltic Sea as a special area for sewage discharges from passenger ships, with proposed stricter measures (ref /26/).

This study has not found support for considering the above sewage related challenges as a particular Polar problem. Sewage in itself is normally not regarded as a particular polar threat, as reflected for example by current legislation in Canada, where specific arctic regulations allows raw sewage to be discharged in arctic waters also within the 12 miles zone, and around Svalbard visited by more than 60 000 cruise ship passengers a year, where normal IMO regulations apply.

However, one area of concern that may be subject to further investigation with regard to potential harmful effects in both polar waters and other areas, is the associated discharge of other substances by the effluents. This is especially relevant with regard to the unregulated grey water from cruise ships, which by the vast variety of sources onboard may contain several chemicals for which the effects and decomposition under different conditions is not necessarily known yet.

Even if sewage in general has not been found to represent a particular threat towards the polar environment, an area of potential concern in both polar areas and other areas may be the variety of other occurring chemicals in the effluents, in particular with regard to the currently unregulated grey water.

5.2.4 Garbage

Except from plastics, oily wastes and specified hazardous substances, different regular waste categories are allowed dumped to sea depending on distance to shore. In Antarctica, only food waste is allowed dumped to sea. Similarly stricter provisions applies in areas of the Arctic waters,
see Table 1. Garbage pollution is generally considered as reducing amenities and causing impacts on ecosystems mainly on an individual level rather than on populations (exemptions may exist in ocean regions where huge amounts of “global” garbage from land based sources and shipping tends to accumulate in concentrated areas due to sea currents). Individuals may eat non-degradable waste or may be trapped by plastics, ropes etc. and die. It is however not identified to be a particular concern with regard to ecosystem vulnerability in the polar areas, compared to other areas. However, the dumping of garbage in nature in general tends not to be acceptable, regardless of representing a threat or not. The Barents 2020 project (ref /14/) concluded that the dumping of garbage in the Barents Sea was not acceptable as an industry standard for ships operating on behalf of the oil and gas industry in the Barents Sea.

The provision allowing discharge of certain garbage fractions in parts of Arctic waters can be considered as unsuitable, even if not identified by this study as representing a specific threat to the Polar environment compared to other areas.

5.2.5 Ballast water

The potential damaging spread of alien species through ballast water is recognized as one of the major threats towards the earth’s marine ecosystems, with potentially devastating consequences in several regions and areas; in polar areas as well as other areas.

The IMO International Convention for the Control and Management of Ships' Ballast Water and Sediments (expected in force from 2016), represents the main international instrument for controlling this hazard, by requiring ballast water treatment by approved equipment. However, this Convention is not adopted by all relevant Parties of the polar waters.

This study has found no evidence for considering the threats from spread of alien species under the IMO Ballast Water Convention any differently in polar waters than in any other areas. In polar areas, as in other areas, the Convention is considered sufficient for controlling the spread of species via ballast water; however it does not control the spread of organisms via fouling on ship’s hull and rudder. The latter aspect is currently addressed by ongoing processes within IMO.

Of importance in polar areas with regard to the spread of alien species via ballast water is the effective implementation of the IMO Ballast Water Convention in all areas, and in addition potential future provisions for controlling the spread of organisms via ship’s hull and rudder.

5.2.6 Anti fouling compounds

The potential damaging effects of poisonous anti-fouling compounds like organotin compounds is considered a world-wide problem, and is thus regulated by the IMO International Convention on the Control of Harmful Anti-fouling Systems on Ships. However, this Convention is not adopted by all relevant Parties of the polar waters

This study has found no evidence for considering the threats from anti-fouling compounds any differently in polar waters than in any other areas.

The particular issue in polar areas with regard to the effects of anti-fouling compounds may be the effective implementation of the IMO Anti-fouling System Convention.
5.2.7 Noise and disturbance

Noise and other disturbance from shipping are in general not regulated in polar areas or in other areas. However, in the various reviewed assessments, the issue is frequently highlighted as a relevant particular challenge in polar waters, especially due to the temporarily and spatially high concentrations of marine mammals in certain areas and the expected rise in ship traffic potentially in the same areas. The following aspects are highlighted:

- Disturbance during critical stages could disrupt the short feeding season for polar species, causing some animals to not get enough food to provide the energy needed for the long migrations they face and for breeding and raising their young.
- Disruption or disturbance of migratory patterns of wildlife, potentially affecting both populations and impact indigenous hunting activity. Icebreakers leave behind open water channels that may disrupt or change the movements of wildlife.
- Underwater noise, for example from ship propulsion and offshore vessels working on dynamic positioning systems (and also various drilling-related activities), is posing negative risk on marine mammals and fish.

Determining when impacts of noise exposure and disturbance from any source become biologically significant to a species is often difficult. For the sake of this report, studies were not available showing significant negative disturbance effects on populations from shipping in polar waters. However, from other mammal disturbance studies (see for example ref /27/), it is known that even if apparently not affecting single individuals exposed to the stressor, disturbance may lead to wider avoidance effects on a population level. For instance, animals may typically be observed close to disturbance factors, leading to the perception that the disturbance is not relevant; however on a population level it has been shown that a significantly smaller proportion of a population is exploiting the optimal feeding areas, preferred migration routes or breeding areas, compared to the situation without the disturbance. Disturbance management should also take into account that changing environmental conditions, particularly evident in Polar waters, may result in a situation where areas that are not frequently used by animals today may become important in the long term.

The most immediate impacts of climate change in the Arctic will be the reduction of summer sea ice, longer open water seasons in the fall and the reduction of the year-round presence of multi-year ice. These changes may have far reaching implications for Arctic ecosystems and will also result in the lengthening of the current shipping season. Shipping in the future may be occurring much later into the fall and possibly earlier in the spring, thereby increasing the possibility of interaction between migrating and calving species and ships.

Potential negative disturbance impacts from shipping on populations of polar species can be seen as a potential particular environmental challenge in polar areas, especially due to the aggregation of marine mammals in certain biological key areas at certain times of the year.

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4 However, according to the Arctic Marine Shipping Assessment 2009 (ref /2/) beluga whales were found to be aware of the icebreaker vessels presence at distances of more than 80 km away, and exhibit strong avoidance response at 35 to 50 km away. However, narwhal whales were found to display only subtle responses to the same disturbance.
5.2.8 Collisions between ships and marine mammals

Ship strikes of whales and other marine mammals could occur in some areas, especially where animals aggregate in and around shipping routes. A particular situation in this respect may occur when whales and other animals apply shipping corridors through ice. However, support has not been found indicating that the level of impacts is of significance, at least not on a population level. However, from an animal welfare perspective it can be considered a problem.

Potential negative impacts from collisions between marine mammals and ships has not been identified by this study as a particular threat towards the polar ecosystems, however it represents an animal welfare problem on an individual level that should be addressed, especially if shipping and marine mammals are concentrated in the same areas (for example in ice corridors), increasing the risk of collisions.

5.2.9 Lost containers

On a global basis, containers and goods lost from ships during bad weather and for other reasons represent a safety problem for other ships and in addition a potential pollution problem, depending on the content. In this study, this aspect is not considered as a regular and “planned” operational discharge as such. It can rather be seen as a type of accidental discharge.

However, in light of the polar conditions mentioned causing particular problems with regards to emergency preparedness, warning and response, the issue of lost containers can be seen as a special concern in polar waters. Remoteness and lack of infrastructure typically reduce the chances for proper handling of stranded dangerous containers and goods, a situation already proven to cause damages to local people and environment.

5.2.10 Onshore waste reception

As stated in Section 5.1.2, the remoteness and lack of infrastructure and facilities for reception of waste should be considered a particular challenge in polar waters. Several waste types stockpiled onboard, including plastics and oily wastes, have to be delivered to adequate onshore reception facilities. A lack of such and associated infrastructure may lead to illegal dumping, local pollution problems ashore or higher level of burning of wastes onboard.

Potential negative impacts from poorly developed waste reception facilities in polar waters can be seen as a particular polar environmental challenge.
6 POTENTIAL ADDITIONAL MEASURES FOR CONTROLLING THE REGULAR DISCHARGES

A brief overview of applicable potential additional regulative measures and options for controlling certain regular discharges/impacts in polar areas is given in Table 2 below. It is underlined that the overview is not intended to be exhaustive with regards to all available measures and options.

Table 2 Applicable additional regulatory measures and alternative technology/operational options for controlling regular discharges/impacts in polar waters

<table>
<thead>
<tr>
<th>Particular regular operational discharge / impact aspect</th>
<th>Potential particular regulative measures</th>
<th>Main technological and/or operational options</th>
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<tbody>
<tr>
<td>Emissions to air</td>
<td>Equivalent regulations in arctic waters as the provisions in Emission Control Areas under MARPOL Revised Annex V1 for SOx and particulate matter, or NOx, or all three types of emissions from ships (NOx down 75% compared to other areas for new engines from 2016; maximum sulphur level in fuel 0.1 % from 2015, or equivalent cleaning of exhaust).</td>
<td>- Change to low sulphur distillate fuels (in addition to reducing sulphur, also reducing soot and related particles + reduced onboard oily waste production and associated burning/shore deliverance of such, reduced need for fuel heating (and hence less air emissions from such) and reduced environmental risk from spills. - Use of exhaust gas scrubbers (mainly targeting SO2 and particles, however an option that still enables the use of heavy grade oils). - Use of exhaust gas selective catalytic reduction SCR (reducing NOx). - Use LNG as fuel (eliminating sulphur, practically eliminating soot/particles, considerably (90%) reducing NOx, considerably reducing production of oily wastes, eliminating risk of bunker oil spills). - Use of energy efficiency measures (reducing all air emissions).</td>
</tr>
<tr>
<td>Oil</td>
<td>Equivalent regulation in Arctic waters as in Antarctic waters with regard to discharge of oil from the cargo area of oil tankers, i.e. Special Area provisions for oil from Cargo areas of oil tankers under MARPOL Annex I, (no oil to sea). No common regulative framework currently effectively addresses oil leakage from the stern tube.</td>
<td>- Application of tank washing operation procedures delivering all oil contaminated cargo tank wash water to adequate reception facilities ashore. - Today it is possible to reduce or even eliminate the effect of both operational and accidental stern tube oil leaks to sea either by replacing conventional mineral oil with biodegradable oil/lubricants or to use water lubricated stern tube bearings instead of the traditional mineral oil based systems.</td>
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</table>

5 The legal discharge of oil from bilge has not been considered a particular polar environmental threat, however if MARPOL Annex I Special Area provisions as in Antarctica were to apply, no discharge of oil from the machinery spaces (bilge) would have been allowed. However, under normal (other than Antarctica) Special Area provisions, discharge of oil from the machinery spaces is allowed as in other areas, however with the difference that also ships smaller than 10 000 gross tonnage have to be equipped with 15 ppm alarm and automatic stopping device as an additional control mechanism for the discharge of separated bilge water.
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<th>Particular regular operational discharge / impact aspect</th>
<th>Potential particular regulative measures</th>
<th>Main technological and/or operational options</th>
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<tbody>
<tr>
<td>Sewage and grey water</td>
<td>A particular need for additional regulative measures for the discharge of sewage in polar waters compared to other areas was not identified. However, establishment of general regulative measures with regard to certain aspects of grey water discharge may be of relevance, both in polar waters and in other areas.</td>
<td>- Use of Advanced Wastewater Treatment systems (AWTs) for better treatment of both sewage and grey water. - Establishing of standards or best management practices for design, operation, maintenance and training that will decrease or eliminate the contaminants and volume of untreated grey water and treated grey water effluent.</td>
</tr>
<tr>
<td>Garbage</td>
<td>A particular need for additional regulative measures in Arctic waters for the discharge of in-other-areas legal waste categories was not identified from an ecosystem vulnerability perspective (note that in Antarctic waters, as a special area under Annex V, and in many parts of the Arctic waters, garbage is not allowed discharged to sea). The regulation allowing garbage discharged to sea is outdated compared to several national/local stricter regulations. It is further not aligned with what could be expected as the industry standard in these areas (i.e. zero discharge), and unsuitable in terms of current public and political expectations on how garbage and waste should be handled in general. The issue of lacking or inadequate onshore waste management facilities and logistics may need to be addressed in future legislation, applicable to all kinds of waste categories.</td>
<td>- Waste minimization, segregation and recycling. - Application of industry best practice standards equivalent to “zero discharge”. - Design options for higher onboard waste storage capacity, due to lack of onshore reception facilities</td>
</tr>
<tr>
<td>Alien species</td>
<td>Effective implementation of the IMO Ballast Water Convention in all Polar Areas, as well as potential future control mechanisms for the spread of species via ships hull and rudder.</td>
<td>- Installation of approved ballast water treatment systems</td>
</tr>
<tr>
<td>Anti fouling compounds</td>
<td>Effective implementation of the IMO Anti-fouling System Convention in all Polar Areas</td>
<td>- Use of legal anti-fouling coatings</td>
</tr>
</tbody>
</table>
| Noise, disturbance and ship collisions | General regulations currently don’t exist that control noise and disturbance from ships towards mammals, birds and fish. However it has been focused by several initiatives, especially with regard to noise: - In 2008, the IMO’s Marine Environment Protection Committee (MEPC) formed a correspondence group working on ways to minimize negative noise effects from shipping on the marine environment. This group aims to develop non-mandatory technical guidelines for ship-quieting technologies, as well as potential navigation and operational practices for all IMO member states (however not specifically for polar areas). - General standards for noise effects from the oil and gas industry are given in International Finance Corporation/ World Bank Group Environmental, Health, and Safety Guidelines: Offshore Oil and Gas Development (2007); targeting seismic acquisition, drilling and production (and maritime traffic); | - Rerouting to avoid some areas in sensitive periods. Plan potential future shipping lanes in the Arctic so as to avoid important areas and migration routes whith temporarily and spatially high aggregation of animals. - Lower speed - Alternative engine-, propulsion- and hull designs/configurations to make ships more silent (ref for example Class Societies’ silent class notations)
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<tr>
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<th>Potential particular regulative measures</th>
<th>Main technological and/or operational options</th>
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<tr>
<td>identification of sensitive areas and times of year, identification of fishing areas, and specific measures listed to avoid or reduce possible negative effects. In addition a current initiative addressing noise is ongoing by the International Association of Oil &amp; Gas Producers.</td>
<td></td>
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</tr>
</tbody>
</table>
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