Evaluation of ballast water risk assessment

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Indhold

Conclusion

This evaluation of the ballast water risk assessment (RA) for new ferries between Gedser in Denmark and Rostock in Germany takes into account the RA statements below (in italic) and the robustness of these statements based on the amount, quality and use of data, as well as the methodological approach.

The ballast RA consists of a species-specific risk RA supplemented by a corresponding environmental RA. The environmental RA concludes that there is a high risk for survival of ballast water transferred species between the ports of Gedser and Rostock. The species-specific RA identifies low risk for 29 assessment target species, whereas two species cannot be stated as low risk based on available data. The ballast water transfer of these two species is presented as unlikely for one of the species, whereas the second one is assumed to be already established or likely to be soon established in recipient port from nearby populations.

The RA is well written and well-structured, and provides a well-informed conclusion on the basis of available data and assessment criteria. The methodology of the RA is clearly outlined and based on the recommended HELCOM and IMO/MEPC guidelines. However, the RA occasionally fails to provide a level of detail which is considered necessary to accurately assess, whether unacceptable risks are added due to potential transfer of harmful organisms through ballast water. In addition, the RA contains contradictions and mistakes that tarnish some of the statements, as described below.

It is recommended that the comments in this evaluation are carefully considered followed by a decision if the RA should be revised. In particular, two statements are potentially incorrect and could influence the decision of exemption from regulation of ballast water. The two statements concern a low risk assessment for two species and the evaluation of unlikely ballast water transfer for two other species. If exemption is granted it is recommended that it will be on condition of monitoring the species composition in the two port areas. This will help to fill the existing data gaps and to enable an early detection of new potential harmful organisms in the donor port that is not expected to spread by natural means to the recipient port. If such an organism is detected the exemption should be reconsidered.

The recommendations take into account the precaution principle described in the guidelines. According to the guidelines a level of precaution should be incorporated in the RA accounting for the uncertainty, unreliability and inadequacy of information and potential impact of climate change.

Background

The Danish Nature Agency has asked Aarhus University to evaluate a risk assessment (RA) for the new Scandlines ferries between Gedser in Denmark and Rostock in Germany. The RA was carried out by the Danish consultant LiteHauz on behalf of Scandlines Denmark A/S (Litehauz 2012). The RA is part of an application for exemption for ballast water management systems.

Ballast water is used to stabilize ships and thereby increase safety and reduce fuel consumption. The release of ballast water may introduce potential harmful aquatic organisms like non-indigenous and possible invasive species and pathogens to the environment. Therefore, the International Convention for the Control and Management of Ships' Ballast Water and sediments (or in short the Ballast Water Management Convention, BWMC) was adopted by the International Maritime Organization (IMO) in 2004 to prevent and control marine pollution related to ballast water (IMO 2004). The convention will enter into force 12 months after it has been ratified by at least 30 counties representing at least 35% of the world shipping gross tonnage. The minimum number limit of countries has been fulfilled, whereas the requirement for world gross tonnage has not been fully reached yet (June 2012).

The convention presents three ways of acceptable ballast water management:

- Exchange of ballast water at least 200 nautical miles off the coast (in some cases 50 n.m.) with minimum depths of 200 m or in designated areas or if ballast water is loaded and discharged within the same area.
- Treatment of ballast water either physically/mechanically or chemically.
- Exemptions from 1) and 2) based on a risk assessment documenting a low risk scenario.

The exchange of ballast water is an intermediate solution that is only allowed until five years after the convention has come into force. Exemption can only be granted for ships sailing routinely between specific ports/locations and will only last five years. Any change in route or location of release of ballast water causes the exemption to expire and a new RA documenting a low risk scenario has to be performed.

A RA has to follow the guidelines produced by the Marine Environment Protection Committee (MEPC) of IMO, 'Guidelines for risk assessment under regulation A-4 of the BWM Convention' (MEPC 2007). The guidelines underline that the RA has to be based on the best available scientific information and be sufficiently robust to distinguish between unacceptable high risk scenarios and acceptable low risk scenarios for transfer of non-indigenous and potential harmful species. The RA should assign the likelihood and the consequences of the entry, establishment or spread of harmful aquatic organisms, and incorporate a level of precaution to account for uncertainty, unreliability, and inadequacy of information used for the assessment.

Three RA methods are outlined in the guidelines:

- Environmental matching – comparing environmental conditions between donor[a)] and recipient[b)] port/ location.
- Species' biogeographical[c)] risk assessment – comparing species distribution between donor and recipient port/biogeographic region.
- Species-specific risk assessment – evaluating distribution and characteristics of identified target[d)] species.

[a)] Donor: location where ballast water is loaded
[b)] Recipient: location where ballast water is discharged
[c)] Biogeographical region: area defined by biologic and physiographic characteristic within which the animal and plant species show a high degree of similarity and characterized by transitions zones more than sharp boundaries
[d)] Target species: potential harmful organisms.

Evaluation

Introduction

The risk assessment (RA) is about the ferry route between Gedser in Denmark and Rostock/Warnemünde in Germany that has been operated for more than 100 years by Scandlines A/S and their predecessors (*figure 1*). In 1990 the German port was moved from Warnemünde (located at the estuary of the river Warnow) to Rostock two nautical miles up the river. The distance between the two ports is 30 nautical miles crossing Mecklenburg Bight which forms the eastern part of the Belt Sea and the transition to the inner Baltic Sea.

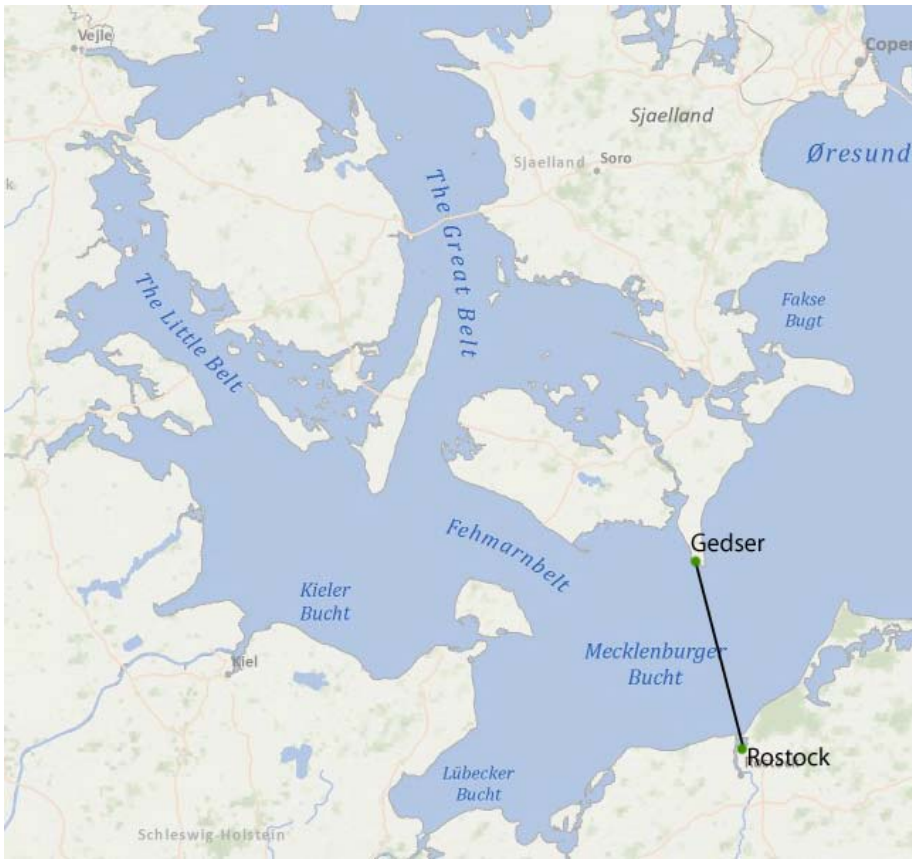

Figure 1. Belt Sea with Gedser-Rostock route (from RA, Litehauz 2012).

From June 2012 the route will be operated with two new ferries sustaining the same number of trips as the old ferries (*table 1*). The capacity of the new ferries is increased by 135 % whereas the need for exchange of ballast water is expected to be reduced by approximately 97 %.

Table 1. Comparison of operation data for the new and old ferries (edited form RA, Litehauz 2012).

Type of operation data (average)	Unit	New vessels	Old vessels
Voyage time (single voyage)	Minutes	~110	~110
No. of voyages to Gedser/to Rostock	Per month	135	135
No. of voyages entailing ballast water operation	Per year	~30	~900
Expected volume discharged per ballast event	m^3/ballasted voyage	~200	~250
Total expected volume discharged in Gedser or Rostock	m^3/5 years	~30,000	~1,140,000

Methodological considerations

The Baltic Sea can be considered as one biogeographical region due to the lack of sharp and absolute boundaries (IMO 2007). Accordingly, the species-specific RA is considered the most effective approach supported by information on the environmental conditions and shipping activities (HELCOM 2008). The subregion Mecklenburg Bight/ Belt Sea of the Baltic Sea was chosen as the biogeographical region for the assessment of the ferry route between Gedser and Rostock.

The surface salinity in Gedser and Rostock varies between 7-28 psu and 7-11 psu, respectively, thereby being within the same salinity range, even though the average salinity in Rostock is significantly lower than in Gedser. The temperature range of Gedser and Rostock is similar, 0 to ~20 °C.

Table 2. Salinity and temperature of Gedser [e)] and Rostock (edited form RA, Litehauz 2012).

Port	Salinity (psu)	Temperature (°C)
Gedser	7-28	0-21
Rostock	7-11	0-19

[e)] The salinity and temperature data for Gedser is obtain at monitoring stations situated 15-24 km from the port, whereas data for Rostock is obtained close to the harbor area. As Gedser is situated relatively exposed to the sea and with no major freshwater supply nearby the salinity and temperature at the monitoring stations is assumed to be representative for Gedser port and the sea just outside.

The similar environmental conditions (salinity and temperature) of the port areas, and the ferry route covering the same biogeographical region justifies the choice of the species-specific RA approach. The RA for the Gedser-Rostock route has largely followed the species-specific and step-by-step methodology recommended by HELCOM describing the environmental conditions in donor and receiving areas and identifying target species based on various available species lists (HELCOM 2008).

Environmental conditions (chapter 4 and 5)

A high risk for survival of ballast water transferred species is assumed in the RA regarding the environmental matching for Gedser and Rostock based on the similarity of salinities and temperature in the two ports. This general statement seems to be well founded despite the data for Gedser was obtained from monitoring stations quite far from the port. However, the RA occasionally fails to provide a level of detail necessary to accurately assess the relevant environmental conditions as documented by the specific comments below.

Biogeographical region (section 4.1)

- Is there a specific reason, why only surface salinity is considered in Table 7? In IMO/MEPC and HELCOM guidelines it is recommended to include seasonal variation of both surface and bottom salinities (HELCOM 2008, MEPC 2007).

Hydrology (section 4.3)

- This section provides only very limited information on flow conditions and flow variability, although such information might be considered important for particle and material drift and dispersal. The authors might

consider consulting publicly available operational data services such as www.myocean.eu. Such services may not be suitable for multi-decadal hind casts, but are useful to obtain 3-dimensional current data (amongst other hydrographic parameters) over the last several years at a high temporal and spatial resolution.

Salinity (section 4.4)

- Yearly salinity ranges at three HELCOM monitoring stations nearest to the port of Gedser are presented. Considering the poor and scattered temporal data coverage at some stations (e.g. station OMBMPM1 does not contain observations after 1997), it is unclear to the reader, if the yearly salinity ranges in table 7 are representative values. It should be clarified, if these ranges are based on (1) a long-term mean or reflect a specific year and (2) a single station or an average over several stations.
- In the text at p. 16 and in table 9 p. 17 the temperature range for Gedser is stated as 7.4-28.2, but in table 12 p. 20 the range is presented as 8.6-28.0. It seems like a correction is needed here.
- In the text at p. 17 and table 9 and 12 the salinity range for Rostock is stated as 6.7-10.6, but at p. 23 and 34 the range is presented as 6-10 instead of 7-11. It seems like a correction is needed here.
- Is there more detailed information on the water depth for the surface values? The statement '< 10 m depth' is a bit vague.
- Is there a specific reason, why only surface salinity ranges were considered in Table 9? According to Gollasch and Leppäkoski (2007) vertical gradients both influence biological communities and provide information about suitable habitats. Therefore, bottom salinity (as well as bottom temperature) would have been another relevant parameter to be included in table 9 and 11.
- Figures demonstrating the seasonal salinity variations for Gedser and Rostock would be helpful for the assessment of tolerance of target species.

Water temperature (section 4.6)

- The authors should be more specific about the period of the temperature ranges in the text and table 11 (see detailed comments for the corresponding salinity section 4.4).
- Figure 7: Figure title, axes labeling and legend should be in English.

Available habitats and bottom composition (section 4.9)

- Figure 9: Focus more on the area of interest and indicate the ports of Gedser and Rostock.

Environmental conditions assessment (chapter 5)

- The following statement seems a little contradictory: 'A scenario where ballast water is transferred between areas of freshwater to marine water is considered low risk. High risk occurs in scenarios where the salinity difference is less than 30 psu.' The first part of this statement implies that the salinity difference between fresh water and marine water is always larger than 30 psu, but such conditions are obviously never found in the area under study. Please clarify or remove the first part of the statement.
- Page 20, 4th paragraph: The statement 'right combination of prevailing currents and ...' is too vague. What is the right combination?
- Page 20, 4th paragraph: Rephrase 'southerly or northerly wind-generated surface currents'. It is unclear whether 'southerly and northerly' refers to wind or surface currents.

- Page 20, 4th paragraph: The assumption on passive particle dispersal is highly speculative, given the lack of any supporting evidence from particle drift modeling. What is the assumption based on? Dispersal models for functional groups of organisms have lately been developed in the project 'Ballast Water Opportunity, BWO' (www.northsearegion.eu).

Biological condition (chapter 6)

The RA presents a comprehensive list of assessment target species considering the available data and generally gives a thorough and relevant description of the listed species.

The RA states low risk for 29 assessment target species between Gedser and Rostock, whereas two species (Gammarus tigrignus and Tubificoides pseudogaster) cannot be assessed as low risk. For these two species it is argued that they do not qualify for high risk, as they do not fulfill all the requirements for high risk as stated in the guidelines (HELCOM 2008, MEPC 2007). The assessment of these two species adding acceptable or unacceptable risk is therefore an open question. The history of more than 100 years of ballast water exchange between the two ports indicates the risk for additional harmful transfer to be acceptable especially when also considering the significant reduced need for ballast water exchange with the new ferries. This is further supported in the RA by the assessment that one of the two species is not likely to be taken up with ballast water and they both have the potential for natural spreading between the ports. However, the inadequate information on the presence of these two potentially harmful species in the port of Gedser, the doubt about the risk for being taken up with ballast water, and the precaution principle stated in guidelines points to an unacceptable risk. Further, two other species (Gracilaria vermicullophyla and Polysiphonia harveyi) could be argued not to be low risk species in contradiction with what is stated in the RA. This will be discussed further in the species-specific comments below that will be supplemented by more general comments.

Species specific comments

- *Gammarus tigrinus*: At p. 35 last paragraph this species is stated not to qualify for high risk based on the argument that it does not fulfill all the requirements for high risk given in the guidelines. This statement is unfortunately not supported before at p. 38 6th paragraph, where it is described that *G. tigrinus* is not likely to be taken up with ballast water, as it rarely occurs at depth deeper than 2 m. This argument seems a bit vague considering the disturbed water and sediment conditions in ports and the fact that the new ferries can take in ballast water from various depths, especially considering the recommendation of the guidelines on precaution.
- *Tubificoides pseudogaster*: As for *G. tigrinus* the statement of not qualifying for high risk at p. 35 is not supported before at p. 38. The main argument is that the species is considered realistic to spread by natural means to the recipient port - an argument that needs to be substantiated.
- *Gracilaria vermicullophyla*: This species is stated as being of low risk as it is not considered likely to occur in the water column and therefore not likely to be taken up with ballast water. However, pieces of thallus may be floating in the water column especially in the disturbed waters of ports and therefore taken up with ballast water. As *G. vermicullophyla* is known as a competitive species of environmental concern, as it can change the habitat (so 'habitat change' can be added to the information in table 17),

this possibility ought to be considered thoroughly. Further, in table 2/26 it is stated that *G. vermicullophyla* is not likely to survive the low salinity range of the Rostock port area. This is contrary to the predominant appearance of *G. vermicullophylla* at estuarine sites, and the recent results of salinity tolerance experiments (Nejrup 2012).

- *Polysiphonia harveyi*: At p. 34 3th paragraph it is stated that the risk of this species '*cannot be assessed as low*', which is also mentioned in p. 35 last paragraph. According to this *P. harveyi* should be mentioned in table 25, and the species should not be noted as of low risk in table 26. These contradictions need to be clarified.
- *Neogobius melanostomus*: According to table 26 this species is not able to survive the higher salinities at Gedser. However, in a recent review of this species environmental tolerances (Kornis et al. 2012) the species originates from a higher salinity environment and is expected to become established in waters below 30 psu. Also, according to a Danish fish expert, Peter Rask Møller from University of Copenhagen, the fish is presently observed around Falster.

General comments

- Despite disagreement with a few of the specific assessments of the establishment status of specific species and their potential of transfer, the overall assessment of additional risk of transfer of target species between the harbors in Gedser and Rostock associated with use of ballast water seems well founded based on the available data.
- According to the report, given the right combination of prevailing wind and current conditions, larvae and plankton may drift passively between the two harbors which are only separated by 50 km. Although this aspect could have been evaluated more thoroughly with the use of existing hydrodynamic tracer models, this agrees well with recent years observations of drift and spread of e.g. *Mnemiopsis leidyi* in the region.
- Salinities are assessed to be different enough to prevent several of the species from the donor harbor from being established in the receiving harbor. Salinity is known to be an important determinant for successful establishment. Our knowledge on the exact salinity tolerances is however often scarce, but the report does a fair job of evaluating the importance of salinity given the available data for the specific species. However, further investigation of salinity and temperature tolerances of some of the uncertain species would be useful for future assessments.
- Most of the target species which are not presently listed in the receiving harbor but with a potential of becoming established, have been observed in the donor harbor for decades. Given that ships have been exchanging much larger amounts of ballast water between the two harbors for more than a century, these target species have had many chances to be spread and established in both harbors. These arguments hold in an historical perspective, but cannot be used as an argument for continued transfer of ballast water if new species without ability to spread by natural means arrive in donor port.

Other comments

Executive summary

- Page 2, 2th paragraph: It is stated that the capacity of the new ferries is increased by 135 %, whereas it on page 21 2th paragraph is written that the capacity is increased by 130 % - this should be unified.
- Page 2, 5th and 6th paragraph: In the 5th paragraph it is stated that the environmental conditions do not differ between the ports of Gedser and

Rostock, whereas in the 6th paragraph it is stated that a species in Gedser is considered unable to survive in Rostock due to the lower salinity. This sounds contradictory, and preferable the statement should instead be that the environmental conditions in Rostock is within the range of Gedser, but a specific species (*M. viridis*) found in Gedser is anyway not considered able to establish in Rostock due to the lower salinity there.

Introduction (chapter 1)

- In 2th paragraph p. 7 is written '*ballast water exchange to be conducted at least 200 nautical miles from the nearest coast and a minimum of 50 metres' depth*'. This is not consistent with the ballast water convention (IMO 2004), as it is here stated that if possible the water exchange should take place at least 50 n.m. from nearest coast if the 200 n.m. demand cannot be fulfilled, but that the depth requirement both for the distance of at least 50 and 200 n.m. is 200 m.

Uncertainty/data reliability (section 3.3)

- This RA lacks a statement about uncertainty and reliability of the environmental data used, especially temperature and salinity. For example, is the temporal coverage of the monitoring data sufficient to provide a representative picture of the seasonal/monthly variations of salinity and temperature? According to the methodology, temperature and salinity variability on monthly to seasonal time scales is an important prerequisite for a geographical similarity analysis (HELCOM 2008, MEPC 2007).

Worst case/precaution principle

- The RA mentions at p. 13 last paragraph that it is worst-case oriented which nicely follows the guidelines recommendation of using the precaution principle. However, the use of worst-case approach it is not well enough documented in the RA. An attempt for worst-case approach is mentioned at p. 21 2nd paragraph as the current schedule of ferry traffic is used for calculation of future ballast water discharge despite a 130 % increase in capacity of the ferries. This is presented as a maximum potential impact, although it is the planned schedule for the new ferries, and that the increased capacity is due to expectations of increased traffic on the ferry route, and that volume discharge is based on a '*realistic scenario*' (same page 3th paragraph). Actually, it is stressed in the guidelines that lack of data or the uncertainty of available data and information has been used as '*high levels of uncertainty in the biogeographical distributions and/or physiological tolerances of a target species may be sufficient in themselves to classify the risk as high*' (MEPC 2007). Therefore, it would be a reasonable expectation that the RA more clearly demonstrated where the worst-case approach was applied.

Historical transfer of ballast water

- The more than 100 years of ballast water transfer between the two ports are in the RA used as an argument for the assumption that species that could establish in the ports would already have done so. This is fair especially in the context of the former significantly higher amount of ballast water discharge. However, this argument cannot be used for new target species and may even not be usable for present target species whose survival is improved due to climate change (see below).

Climate change

- Climate change, especially global warming, may impact the survival of target species. Global warming is likely to improve survival and distribu-

tion of cold-water species living close to their southern distribution and warm-water species living close to their northern distribution. This should be taken into account for projection of future risks also considering the precaution principle and the worst-case approach.

State-of-the art

- As mentioned elsewhere, the RA is thoroughly carried out based on available data and other information following the guidelines and taking into account the relevant species list. However, the RA does not represent state-of-art as there is a lack of data of species from the port areas in question (especially Gedser), not all relevant new literature has been consulted, and present model descriptions of hydrological conditions and dispersal of functional groups have not been applied.

References

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