Note on Same Risk Area

Ballast Water Management

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Note on Same Risk Area

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Sources must be acknowledged.
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### Abbreviations and acronyms

<table>
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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ALIENS 2</td>
<td>Study on biological survey protocols and target species selection</td>
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<tr>
<td>BALSAM</td>
<td>Baltic Sea Pilot Project: Testing new concepts for integrated environmental monitoring of the Baltic Sea</td>
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<td>BLG</td>
<td>Bulk, liquid and gases</td>
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<td>BWM</td>
<td>Ballast water management</td>
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<td>BWMC</td>
<td>Ballast Water Management Convention</td>
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<td>BWMS</td>
<td>Ballast water management system</td>
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<td>CONF</td>
<td>Conference</td>
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<tr>
<td>DLRA</td>
<td>Detailed-level risk assessment</td>
</tr>
<tr>
<td>EEZ</td>
<td>Exclusive Economic Zone</td>
</tr>
<tr>
<td>GETM_ERSEM</td>
<td>General Estuarine Transport model coupled with an European Regional Seas Ecosystem Model</td>
</tr>
<tr>
<td>GT</td>
<td>Gross tonnage</td>
</tr>
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<td>HELCOM</td>
<td>Helsinki Commission</td>
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<td>IMO</td>
<td>International Maritime Organisation</td>
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<tr>
<td>INTERREG</td>
<td>Interregional cooperation across Europe</td>
</tr>
<tr>
<td>IOPP</td>
<td>International Oil Pollution Prevention</td>
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<tr>
<td>MEPC</td>
<td>Marine Environment Protection Committee</td>
</tr>
<tr>
<td>OSPAR</td>
<td>The Convention for the Protection of the Marine Environment of the North-East Atlantic</td>
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<tr>
<td>PA</td>
<td>Precautionary approach</td>
</tr>
<tr>
<td>Pax</td>
<td>Passenger vessel</td>
</tr>
<tr>
<td>PP</td>
<td>Precautionary principle</td>
</tr>
<tr>
<td>Propagule pressure</td>
<td>An estimate of the absolute number of individual species involved in any one release event (propagule size) and the number of discrete release events (propagule number)</td>
</tr>
<tr>
<td>Ro-Pax</td>
<td>Roll-on/Roll-off passenger vessel</td>
</tr>
<tr>
<td>Ro-Ro</td>
<td>Roll-on/Roll-off vessel</td>
</tr>
<tr>
<td>ROV</td>
<td>Remotely operated vehicle</td>
</tr>
<tr>
<td>RSS</td>
<td>Regular Shipping Service (comprise e.g. Pax, Ro-Pax and Ro-Ro vessels)</td>
</tr>
<tr>
<td>USCG</td>
<td>United States Coast Guard</td>
</tr>
<tr>
<td>CEARA</td>
<td>Centre of Expertise for Aquatic Risk Assessment</td>
</tr>
<tr>
<td>QBRAT</td>
<td>Quantitative Biological Risk Assessment Tool</td>
</tr>
<tr>
<td>RAP</td>
<td>Rapid assessment process</td>
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<tr>
<td>SLRA</td>
<td>Screening-level risk assessment</td>
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Foreword

In January 2014, the Danish Partnership for Ballast Water agreed to commission a study on “Same Risk Area” in connection with the implementation of the Ballast Water Management Convention (BWMC). The Danish Partnership for Ballast Water comprises the Danish Nature Agency and the Danish Maritime Authority, both holding legal responsibilities for ballast water regulation in Denmark, and the Danish Shipowners’ Association. The study’s main objectives were to:

- Present background information on the risk assessment (RA) required under the BWMC
- Discuss the concept of risk management versus identification of hazards and hereunder the application of the precautionary principle
- Identify feasible candidate risk management methods which take into account the use of biological risk in defining a risk area
- Present administrative scenarios on the implementation of the identified methods

The study was carried out by LITEHAUZ Maritime Environmental Consultancy in Holte, Denmark. The primary participants were Dr Frank Stuer-Lauridsen and Mr Svend Boes Overgaard. The Partnership appointed a steering committee comprising Ms Clea Henrichsen (Danish Maritime Authority), Mr Peter W. Olsen (Danish Shipowners’ Association) and Mr Ulrik Christian Berggreen (Danish Nature Agency). The study was initiated in February and a draft note was available in early April 2014.
Executive Summary

Introduction
Invasive species have become an increasing problem following the growth in trade and overseas transport during the 2nd half of the 20th century. As a consequence the International Convention for the Control and Management of Ships’ Ballast Water and Sediments was adopted in 2004 with the aim to eliminate the introduction of ecologically and economically unwelcomed aquatic invasive species. The primary mechanism used for controlling invasive species is avoiding the introduction in the first place through disinfecting a ship’s ballast water with an onboard ballast water management system.

However, a ship on voyage between specified ports may be granted an exemption under the Convention’s regulation A-4 provided that the risk of spreading invasive species is acceptable. Ports, which could be considered for exemptions, may be quite close, as e.g. Elsinore and Helsingborg, or they be situated in the same area of a region. A mechanism for identifying a “same risk area”, i.e. an area with an acceptably similar risk profile for the ports, would presumably allow for a reduction in the administrative burden and reduce the cost of implementing the BWMC for the short sea shipping operating in the area.

This study aim to identify and assess feasible candidate risk management methods, which take into account the use of biological risk in defining a risk area. It also discusses the concept of risk management versus identification of hazard, hereunder the application of the precautionary principle. Based on the findings from evaluation of available risk assessments, protocols and other risk assessment models mechanisms for implementation are presented.

Review of available protocols and risk assessments
The two risk assessment approaches of relevance comprise the “Environmental matching risk assessment” and the “Species-specific risk assessment”. The Environmental matching risk assessment compares the environment in the respective ports of call and the Species-specific risk assessment evaluates the successful survival of species when transferred by ballast water based on three main components: use of target species, simple assessment and an exposure element with a probability component and a propagule pressure component.

The most commonly applied risk assessment approach is environmental matching of port conditions (18 out of 19 assessed). Matching of environmental conditions is typically based on salinity and to some degree also on temperature. Salinity is generally considered the most reliable parameter to assess whether a harmful species will survive in the recipient environment. The use of environmental matching is in an intra-regional context therefore considered key to the concept of a “same risk area”, as similar conditions in a port-pair are an indication of the ports sharing the same risk profile.

In 15 out of the 19 risk assessments a species-specific approach is also taken. The majority of the species-specific risk assessments include the use of target species, although not all criteria for target species selection as addressed in the IMO Guidelines For Risk Assessment Under Regulation A-4 Of The Ballast Water Management Convention (G7) are applied.

The non-biological exposure components of G7 are rarely applied in the risk assessments, e.g. volume of ballast water and frequency of discharge. Also, none of the risk assessments weigh in the
risk according to the economical impacts. Since these are key elements in assessing the acceptability of a risk, the inclusion of the exposure component and an element of economic impact assessment should be considered for risk evaluation.

**Taking a hazard approach versus a risk approach**
The omission of the exposure component in the typical current risk assessments produce the unfortunate situation that any identified hazard is set to occur at 100%, i.e. it will always happen. Such hazard-based assessments therefore spearhead a zero risk approach. This is not in line with the G7, which clearly states that even though low risk scenarios exist, zero risk is not obtainable, and such risk should be managed by determining the acceptable level of risk in each instance.

**The use of the precautionary approach and the precautionary principle**
The approach in G7 is precautionary and involves considering the availability and quality of the data when indicating potential risk. With the limited biological data available it is common in the reviewed risk assessments and protocols to include an element of precaution based on G7.

However, in several risk assessments the EU precautionary principle is invoked as means to determine that the level of uncertainty leads to unacceptable risk. The precautionary principle is invoked primarily with reference to lack of predictability on the exposure component, but also by qualifying all aquatic non-indigenous organisms as harmful in the absence of information to the opposite. Thus, the current pilot risk assessment approach invariably predicts unacceptable risk when encountering uncertainty or absent data, which would lead to rejection of exemption despite neither of the approaches advocate zero tolerance towards risk. The EU precautionary principle in fact points out specifically that there is a “...distinction between reliance on the precautionary principle and the search for zero risk, which in reality is rarely to be found”.

**Feasible candidate risk management methods**
When discussing the concept of a “same risk area” the issue of natural dispersal is of key relevance, as species moving by their own means, by water currents and by wind may expand the area of risk. Ports in close proximity may therefore share the same risk from natural causes. A number of methodologies exist, which takes natural dispersal and biological risk into account when defining a risk area. These include:

The ESA/Brockmann Consult DUE Innovator II BWE risk assessment model is developed for assessing the impacts of ballast water exchange and takes drift (dispersion by natural water movement) into consideration, thus recognising the importance of hydrodynamics. The DHI Hydrodynamic Model is a quantitative stochastic transport model of the North Sea and part of the Baltic Sea. A NIOZ lead consortium developed the GETM-ERSEM model, which is able to describe biological and physical-chemical processes and their interactions in both the water column and on the bottom.

Modelling dispersion of species through of their pelagic stage(s) and determining the probability of a species ending in a particular position from a certain start position can be described as connectivity, and this is used for modelling biological risk, e.g. in DHI. Although the connectivity concept is still in its infancy and needs to be developed further to allow for risk categorisation of coastal waters also, it allows for combining hydrodynamically sound analysis with biological characteristics of propagules. It may therefore ultimately be used to assess natural dispersal potential of invasive species for given characteristics (transport distances), as well as location and separation of high- and low-risk areas, i.e. to identify whether two locations or ports may be considered a “Same risk area”.

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Administrative scenarios
Based on the risk assessments, protocols and connectivity concept it is proposed to develop and apply a tiered approach with three levels to meet the requirements for being granted an exemption. The approach seeks to reduce uncertainty for stakeholders and to reduce the risk of applications being rejected. The proposed tiers are compatible with the Joint Harmonized Procedures and comprise:

- Desktop screening risk assessment (pilot RA)
- Same risk area concept (in development)
- Detailed risk assessment (full Joint Harmonized Procedures assessment)

The first screening level risk assessment could be based on available biological and environmental information, i.e. a desktop study, which as minimum would identify no-feasible high-risk applications. The IMO G3 guidelines (Resolution MEPC.123(53)) includes a number of parameters which could also act as potential “show stoppers”. These include:

- In areas identified by the Port State in connection with warnings provided by ports concerning ballast uptake and any other port contingency arrangements in the event of emergency situations;
- at locations nearby protected areas (e.g. Natura 2000);
- in areas close to aquaculture;
- at locations nearby sewage outfalls;
- in areas with known frequent large phytoplankton blooms;
- ports with a history of high number of discharge events;
- port connected to freshwater bodies though inland water transportation with a known history of introduction of harmful species (e.g. the Ponto-Caspian); and
- when high volume/frequency of ballast water operations are conducted.

The second tier makes use of the “Same risk area” concept. Today, the most detailed invasive species data are available from HELCOM databases, but new survey data will enter the Decision Support Tool’s database over time allowing the “same risk area” concept to be developed and applied. In “same risk areas” high risk ports would not be included until information on invasive species is obtained e.g. through a baseline survey. This will work as an incentive to provide port baseline surveys. The modelling of the dispersal potential using a connectivity model can identify the ports or locations to may be considered to be within same risk area.

The third tier, the detailed risk assessment, would require full application of the Joint Harmonized Procedures including the appertaining port survey protocol as agreed by HELCOM and OSPAR.
1. **Background**

The International Convention for the Control and Management of Ships’ Ballast Water and Sediments was adopted in 2004 by the UN’s IMO and is aimed at reducing the impact of invasive species of the seas with the wording “prevent, minimize and ultimately eliminate the transfer of Harmful Aquatic Organisms and Pathogens through ships’ Ballast Water and Sediments”. The unwelcome effects of transplanting species between their native regions and other regions with similar biogeographic characteristics had become increasingly evident following the growth in trade and overseas transport which occurred over the second half of the 20th century. The spectacular cases of invasion by the zebra mussel, green mussel, comb jelly, mitten crab and many other species, and the tragic consequences of the ballast water-mediated cholera transfer to Peru in 1991, had prompted a number of countries to call for action during the 1980s and 1990s. Several national and international research and development programmes had by then emerged to increase understanding of the mechanisms involved and address the possible methods of abatement.

The impact was in some cases ecologically and economically quite severe, and one thing was immediately clear: once an aquatic invasive species was established in a new environment it was impossible to reverse the situation. Sometimes these invasive species are only kept at bay by active control measures, and it would therefore be cheaper and more manageable for societies to avoid the introduction in the first place.

The focus of the Convention is therefore to establish mechanisms to prevent or at least reduce the risk of such transfers. The management tools are ballast water exchange (D-1) and later a more stringent discharge criteria inevitably requiring a disinfection of the water (D-2). However, ship(s) on voyage(s) between specified ports may be granted an exemption under regulation A-4, if it is decided that a low risk is acceptable. Many of the specified ports, which could be considered for exemptions, are either quite close, e.g. Elsinore and Helsingborg, or at least in the same biogeographic region or area within the region. Thus, it is possible that a number of ports in an area have the same risk or a sufficiently identical risk to be at acceptable risk levels to warrant a further investigation of this issue by the authorities. A mechanism for identifying a “same risk area”, i.e. those ports in an area with an acceptably similar risk profile, would presumably allow for a reduction in administrative work and perhaps ease the burden of the BWMC on the short sea shipping sector.

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**Box 1. The comb jelly**

One of the worst marine species invasions occurred in the early 1980s when the North American comb jelly (*Mnemiopsis leidyi*) was introduced into the Black Sea through ballast water. It rapidly took hold and by 1989 an estimated 1 billion tonnes of the alien species was consuming vast quantities of fish eggs and larvae, as well as the zooplankton that commercially important fish feed on. By 1992, the annual losses caused by decreases in commercial catches of marketable fish were estimated to be at least USD 240 million.

Although a mechanism to identify “same risk area” may only be in its infancy, the regulation of an event relying on biological processes and local hydrology should address the key characteristics affecting the frequency of the event. A number of models and simple management tools which attempt to do so are addressed in Chapter 3.

Management of risk assessments is to be governed by eight principles regarding the nature and performance of risk assessment under The IMO risk assessment guidelines (G7). Two principles are mentioned here, which are key to the subject of this note:

- **Risk Management** – That low-risk scenarios may exist, but zero risk is not obtainable, and as such, risk should be managed by determining the acceptable level of risk in each instance.

- **Precautionary** – That risk assessments incorporate a level of precaution when making assumptions and making recommendations, to account for uncertainty, unreliability and inadequacy of information. The absence of, or uncertainty in, any information should therefore be considered an indicator of potential risk.

These issues are discussed in Chapter 2.

Obviously, the BWMC cannot regulate domestic traffic for sovereign states, but in its implementation, consideration should be given to the actual and concrete management of the risk associated with invasive species reflecting an area’s risk boundaries rather than countries’ borders.

The BWMC does not distinguish between primary and secondary “transfers”, whereas a number of initiatives and scholars do identify primary and secondary introductions (e.g. GloBallast user guide for BWRA, 2003; Gollasch and Leppäkoski, 1999; Behrens et al., 2005; David et al., 2007). The primary transfer occurs from one biogeographic region of the world to another, and secondary transfers occur within a region or local area following the primary introduction. Since the BWMC is an instrument agreed on by states it relates to the transfers occurring between states, and thus by definition regulates only the ballast water crossing international borders. This means that since some countries are large and others are small, one may observe obscure implementation scenarios where the risk of invasive species is strongly regulated concerning short distance transport between ports in neighbouring small countries where the risk is more likely to be comparable, while transport over longer distances within larger countries may be unregulated despite the likelihood of a higher risk level.

While not disregarding the potential occurrence of undesired species in these areas, examples of such regulated low-risk and unregulated high-risk transfers between states may be found in the mix of small and large states along the West African coast, the Persian Gulf, the northern coast of South America or the Baltic Sea. In these areas, a vessel must treat ballast water associated with international short sea shipping activities from even very short distances, while ballast water from a vessel alongside may be discharged untreated after considerably longer domestic travels. The mechanism to assess a possible “same risk area” would be key to a simple and a risk-relevant management of invasive species associated with short sea shipping in such areas.
**Box 2. Regulated and unregulated regional voyages**

You are obliged to meet the D-2 standard following the 4 km journey between Elsinore in Denmark and Helsingborg in Sweden, where intense shipping traffic has taken place for 100+ years, but not if you travel 1400 km from Swedish Luleå to Helsingborg or for that matter the 600 km from Danish Esbjerg in the North Sea to Elsinore in The Sound. Even without a G7 risk assessment at hand it is likely that the risk associated with the 4 km crossing of The Sound may indeed pose the lowest risk; yet, this is the only journey requiring a risk assessment.

**Terminology**

Aquatic species introduced into a region in which they are not native has been described by many different terms in the scientific literature, e.g. alien species, non-indigenous species, introduced species, etc. The BWMC applies the term ‘*harmful aquatic organisms and pathogens*’, covering all species which create hazards to the environment, human health, property or resources, impair biological diversity or interfere with other legitimate uses of such areas. For convenience, the terms *harmful organisms or harmful species* are used in this study.
2. Perspective

This section focuses on risk, giving a brief introduction to the IMO risk assessment guideline G7 and reviews existing RA protocols and developed RAs in the context of the G7 criteria used for seeking exemptions under Regulation A-4.

Risk is generally accepted as the product of the hazard of a given event and the frequency with which it occurs. Since it is rather difficult to change the hazard embedded in something, management of the risk most often involves reducing the frequency to an acceptable level. This section also reflects on the concepts of risk management versus hazard elimination approaches, as well as the use of the precautionary principle and the consequences and future prospects regarding lack of data for conducting accurate and up-to-date RAs.

2.1 Introduction to the G7 risk assessment guidelines

The G7 guidelines (Resolution MEPC.162(56), 2007) establish three types of RAs which can be used either separately or in combination for the granting of exemptions under Regulation A-4. These are known as the:

- Environmental matching risk assessment
- Species’ biogeographical risk assessment
- Species-specific risk assessment

The latter species-specific RA is the most commonly applied in currently available RAs and a further elaboration on its different components is shown below in 2.1.3.

2.1.1 Environmental matching risk assessment

The environmental matching RA compares environmental conditions between donor and recipient ports on parameters such as salinity and temperature to determine the likelihood of survival and establishment of species transferred between the locations.

2.1.2 Species’ biogeographical risk assessment

The species’ biogeographical RA assesses the distributions of non-indigenous, cryptogenic and harmful native species that presently exist in the donor and recipient ports and biogeographic regions. Overlapping species in the donor and recipient ports and regions are a direct indication that environmental conditions are sufficiently similar to allow a shared fauna and flora.

2.1.3 Species-specific risk assessment

The species-specific RA approach is to be used for assessing voyages within one biogeographical region. It determines the likelihood of successful transfer of a species from a donor to a recipient port and estimates the potential to survive or complete its life cycle in the recipient environment. The RAs use information on life history and physiological tolerances, as well as environmental conditions.

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1 As of April 2014.
2 The D-1 and D-2 criteria are in fact doing exactly this, reducing the hazard of deballasting, since in this case it is very difficult to reduce the frequency.
The G7 species-specific RA has the following main components:

- Use of target species
- Simple assessment
- Exposure assessment
  - Probability assessment
  - Assessment of propagule pressure

The main components are described below:

*Use of target species*

The species of concern for the species-specific RA is the so-called target species that are to be defined for a specific port, state or biogeographic region. The target species are selected based on criteria that identify the species that have the ability to invade and become harmful to, impair or damage the environment, human health, property or resources.

*Simple assessment*

The simple assessment comprises a basic evaluation of whether a target species is present in the donor port but not in a recipient port and takes into account salinity and temperature tolerances and required habitat type of the target species.

*Exposure assessment*

The probability assessment component takes into account the likelihood of the target species surviving the ballast water operation stages of uptake, transfer and discharge and whether the species are able to establish a self-maintaining population in the recipient port.

The propagule pressure component is an estimate of the number of organisms and the frequency with which they are introduced over the entire period of the exemption, based on the vessel’s ballast water operations, i.e. total volume discharged, volume discharged in any event and number and temporal distribution of discharge events.

A list of the specific criteria as stipulated in the G7 guidelines are given in Appendix A.

*Determination of risk in G7*

The risk qualification is aligned with the three main components of the species-specific RA and the risk scenario is determined to be either an unacceptably high risk or an acceptably low risk. There is no medium risk level in G7. In order for the risk of transfer of harmful species to be deemed unacceptably high at least one target species should satisfy all of the following:

- Likely to cause harm;
- Present in the donor port or biogeographic region;
- Likely to be transferred to the recipient port through ballast water; and
- Likely to survive in the recipient port.

*2.2 Evaluation of existing risk assessment protocols and risk assessments*

This section describes and establishes an overview of currently developed RA protocols and provides a consolidated view of a number of applied RAs used for assessing the risk of successful transfer of harmful species in the context of the BWMC.

Though a number of RA protocols exist this study focuses in more detail on four specific protocols, as these are fairly progressed and represents official interpretations of management of risk with regard to the BWMC.
The four RA protocols chosen for this evaluation are:

- The HELCOM/OSPAR Decision Support Tool
- The GloBallast programme
- The Australian Ballast Water Management Information System
- The Canadian Risk Assessment Framework

The evaluation also reviews a total of 15 additional RAs, either in the form of proposals for RA protocols or actual RAs. A consolidated evaluation is given for these below. A complete list of the evaluated protocols and RAs is provided in Appendix B.

2.2.1 Evaluation methodology

As the majority of the applied RAs use a species-specific approach, the evaluation takes the form of a comparative analysis of the RA methodology mirrored against the criteria stipulated in the G7 species-specific RA.

The application of environmental matching is of key importance when considering the concept of a “same risk area” as well as two additional parameters, namely (1) natural dispersal of species, i.e. are the assessed species evaluated with regard to their ability to spread naturally, and (2) the use of the precautionary principle. These issues are also considered in the evaluation.

2.2.2 HELCOM/OSPAR Joint Harmonised Procedures

The Decision Support Tool to be applied under the HELCOM/OSPAR Joint Harmonised Procedures for the granting of exemptions under Regulation A-4 (HELCOM/OSPAR, 2013) is a web-based interface used to determine the level of risk in ballast water discharge from one port to another based on an algorithm. The tool consists of two main RA components: Environmental matching and a Species-specific approach using target species. The input to the tool comprises:

- Harbour profiles (statistical information about environment, size and some business parameters of harbours)
- In situ measurements (abundance and biomass of species) detected in the harbours
- Lists of target species (optionally defined for different regions)

The key input to the environmental matching component is salinity together with a number of additional inputs including water and air temperature, cloud cover, sea state, wind speed and direction and turbidity. Of these parameters the environmental part of the algorithm takes into consideration only salinity, where the salinity difference needs to be more than 30 PSU to result in low risk. An arbitrary condition is also included, which is number or target species present, i.e. if more than one target species is identified a difference in salinity of more than 30 PSU is required.

The algorithm, which assesses the risk of successful transfer of target species (species-specific RA), compares the presence and abundance of target species in the donor and recipient port environments and evaluates the salinity tolerances of the target species with regard to the recipient conditions. In its basic (and current) form, the algorithm comprises the simple assessment of G7 and does not consider other biological parameters related to a specific species, though it allows for further expert assessment in case a medium risk is identified. The decision process flow chart is included in Appendix C.

The risk outputs of the algorithm are either low, medium or high, where only the medium risk determination allows for further assessment. The elaboration on medium risk may take into account e.g. local conditions in the ports and salinity tolerance, temperature and behaviour as well as dispersal ability and mobility of the species. Negative impacts on related species in other ecosystems are also considered relevant to include in the medium risk assessment.
In general, the algorithm does not take into consideration exposure elements to determine the risk e.g. in the form of other biological-specific properties such as substrate and other specific habitat requirements, environmental conditions to complete a full life cycle and potential for natural dispersal or propagule pressure.  

The issue of natural dispersal is currently being discussed by the Ballast Water Exemption Scientific Expert Group as to whether there should be a decision point on natural spread included in the algorithm, and whether sufficient information is available to allow for the evaluation to be done automatically. The issue of natural dispersal is of key relevance when discussing the concept of a “same risk area”. This holds true especially for ports in close proximity to each other, which is the case for many short sea shipping routes.

2.2.3  GloBallast programme

During the early 2000s, a number of initial, first-pass ballast water risk assessments were conducted on ports in six pilot countries following the Global Ballast Water Management Programme (GloBallast) risk assessment methodology. The GloBallast programme was initiated to assist countries in implementing ballast water management guidelines and prepare for the implementation of the Convention. One of the core activities was to try a standardised method of ballast water RAs using existing data and a semiquantitative analysis, which did not include subjective risk-perception in the assessment (Anil et al., 2004).

The applied RA methodology consists of both an environmental matching and a species-specific approach component. As the programme is closely related to IMO, the RA methodology comprises all the key components of the G7 species-specific RA: target species, the simple assessment and exposure.

One of main objectives of the RA programme is to establish whether a port state should apply a uniform management regime for all vessels calling at a port or use a selective approach where those trading routes or vessels are identified, which have a significant chance of introducing unwanted aquatic species. The selective approach is believed to reduce the number of ships subject to ballast water controls and compliance monitoring, and by placing fewer restrictions on ‘low risk’ vessels more time and funds would be available for vessels coming from high-risk locations.

Though this is not the intent of the programme, the selective approach is somewhat similar to concept of a “same risk area” on a general level, as the methodology makes it possible to identify locations of the same low risk (though not necessary from same area) and manage these in a similar manner.

2.2.4  Australian Ballast Water Management

Within the draft version of the Biosecurity Regulation 2013A (2013), an exemption may be granted for one or more discharges of ballast water from a vessel if a risk assessment has been conducted showing that the risk associated with the proposed discharge or discharges is acceptable (subsection 280(2)). The RA should take into account the IMO G7 guideline, and though no specific details are given for the scope of the RA, the draft version prepares the ground for taking into consideration both the hazard and risk component of the G7.

Current legislation considers all untreated ballast water from outside Australian territorial waters as a priori high risk and discharges are prohibited, except when (1) fresh potable water sourced from a

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3 Information on the ship’s ballast water operations are to be included as part of the data input, but it is not used in the decision tree.
5 Only the Indian ballast water risk assessment is referenced. The methodology applied is also applicable for the other ballast water risk assessment conducted and published under the Monograph series 8 and 10-14.
municipal water supply is used, (2) if ballast water has been exchanged in mid-ocean (95% exchange) or (3) if ballast water was taken up inside Australia’s territorial seas. In these instances the ballast water is considered low risk (DAFF, 2013). As of now all ballast-water-carrying ships heading for an Australian port and planning to exchange or discharge ballast water have to apply for an exemption using the risk assessment procedure provided by AQIS (Australian Quarantine and Inspection Service).  

The exemptions may be applied for as a preapproved exemption (domestic vessels only) or as a case-by-case exemption (international vessels and domestic vessels on high-risk voyages) following application of an online risk assessment tool. Australia’s risk assessment protocol follows the G7 guidelines and comprises a combination of all three risk assessment methods: environmental matching, species’ biogeographical, and the species-specific risk assessment. It takes into consideration the salinity and temperature of the ports and a wide range of biological factors such as planktonic stages, survival of target species in ballast water tanks and their life cycle, as well as journey duration, the salinity and volume of ballast water, and numbers of discharges (Heyer et al., 2008). The RA consequently comprises all components, the use of target species, simple assessment and the exposure component of the species-specific RA.

The RA protocol does not consider risk in the context of a “same risk area” as the Australian RA for domestic vessels (preapproved RA), but uses actual target species’ presence identified from a continuous survey scheme as well as the probability of donor port infection of the so-called trigger species which are either not established in Australian waters or are established but not widespread.

2.2.5 Canadian Risk Assessment Framework

The Canadian Centre of Expertise for Aquatic Risk Assessment (CEARA) has developed a three-tiered biological risk assessment process for assessing the potential for introduction, spread and establishment of aquatic species. The three stages are:

1) Rapid assessment process (RAP) to assess a species within a few days using minimal information;
2) Screening-level risk assessment (SLRA) to assess and prioritize a species in about a week using additional information that is readily available; and,
3) Detailed-level risk assessment (DLRA) to assess a species within several months using detailed information (Mandrak et al., 2011).

The RA framework includes all components of the G7 species-specific RA as well as an elaboration on ecological impacts.

CEARA has also developed a Quantitative Biological Risk Assessment Tool (QBRAT), which calculates risks, based solely on the probability of success and failure of arrival, survival, establishment and spread of a harmful species. The program does not calculate risks based on any environmental or biological parameters, only quantified probabilities associated with the four actions, which are given by the user.

Establishing uncertainty is a key element in Canadian risk framework and three common methods for dealing with uncertainty and its distribution are outlined: sensitivity analysis, Monte Carlo simulation and the use of actual data for model calibration. The decision to progress from a RAP or an SLRA to a DLRA is to be based on the need to reduce or improve the ability to quantify uncertainties and to manage risk according to the level sought. However, it should be considered

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7 Harmful non-native or species that are known to be established in Australian waters and have a ballast water-mediated invasion history have yet to reach the full extent of the potential range in Australia.
whether the benefits of the ensuing marginal decrease in uncertainty justify the corresponding time and costs of increasing risk assessment level. The Canadian RA framework suggests that the Precautionary Principle⁹ should not be applied during the scientific assessments but be incorporated during administrative risk management decision-making when appropriate (Mandrak et al., 2011).

2.2.6 Evaluation of RAs and summary of results
In addition to the four main RA protocols studied, 15 RAs were also evaluated for (19 in total) with regard to a number of principles. An overview on which the assessment was done can be seen in Figure 1.

Ten RAs applied a risk assessment approach; seven, a hazard approach; one, semi-hazard; and one, unknown. The majority (11) applied semi-quantitative methods to evaluate risk e.g. in the form of risk levels low, medium and high. The rest applied either a qualitative or a quantitative method. Five stated precautions as an element of the risk assessment and three actively used the precautionary principle. Inclusion of a species’ ability to disperse naturally was included in seven of the RAs.

2.2.7 Risk assessments with an environmental matching approach
The most commonly used RA approaches are environmental matching of port conditions (18 used this and one was unknown). Matching of environmental conditions is typically done on salinity and to some degree also temperature differences. It is in general considered that sufficient data on salinity and temperature are available to assess similarities or differences in the environmental conditions in the ports. The use of salinity is the only parameter common to all RAs conducted in the past, and salinity is in general considered the most reliable parameter used to assess whether a harmful species will survive in the recipient environment. Temperature is considered a less reliable decisional parameter as the temperature in the Baltic Sea and the North Sea has a high degree of variability over the duration of a year i.e. species are tolerant to a wide range of temperatures (David et al., 2013). The greater annual temperature difference tolerated, compared to annual

⁹ As defined by UNEP (1992): Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing actions.
salinity difference that the species need to tolerate, is used as a supporting argument for choosing salinity over temperature as a reliable assessment parameter (HELCOM, 2010b).

The use of environmental matching in an intraregional context is key to the concept of a “same risk area” as similar conditions in a port-pair are an indication of the ports sharing the same risk profile. The application of this approach will aid in scoping the boundaries of a “same risk area”.

2.2.8 Risk assessments with a species-specific approach

A species-specific approach was taken in 15 out of 19 assessments, all in connection with an environmental matching of port conditions.

The majority of the species-specific RAs include the use of target species, though not all criteria for target species selection as addressed in G7 are applied. However, key components are included, such as evidence of prior introduction and demonstrated impacts. The simple assessment component is commonly applied. The exposure components which comprise assessment of survival probability and propagule pressure are typically not considered, though a few consider voyage duration as a parameter to quantify risk (Gollasch and Leppäkoski, 2007; MacIsaac et al., 2002). A small quantity of harmful organisms present in the discharged BW may end up having critical consequences.

The arguments for not including exposure range from lack of quantifiable data to the assumption that these components are not considered reliable as risk quantifiers. For example, the recent Baltic Sea Case study by David et al. (2013) concludes that the quantification of risk with regard to species survival on uptake, transfer and discharge is not robust or reliable enough to be used as a quantifying factor as e.g. some species may reproduce in ballast tanks. A different study concludes that the quantity of discharged BW relates to risk (Gollasch et al., 2011).

With the limited biological data available it is common for the reviewed protocols and RAs to be conducted with an element of precaution (e.g. Hayes and Hewitt, 2000, Litehauz, 2011, and GloBallast risk assessments). The precautionary principle is also applied in a number of RAs, primarily with reference to lack of data on the exposure component (e.g. David and Gollasch, 2010, Gollasch et al., 2011, and David et al., 2013), but also on target species selection by qualifying all aquatic non-indigenous organisms as harmful (Gollasch et al., 2011). The exposure components are not included in the determination of risk, and it is considered that when a species is present in a ballast water donor port, it becomes discharged alive in a recipient port and causes harm in the receiving environment. When data are not considered reliable or when there is a lack of information on species abundance the precautionary principle is also considered and should lead to a determination of high risk (David et al., 2013).

2.3 Management of risk

The BWMC targets the prevention, minimization and ultimate elimination of the transfer of harmful aquatic organisms and pathogens. Within the context of exemptions under Regulation A-4 of the BWMC, the approach to do so is the application of a risk assessment.

One should bear in mind that G7 guidelines of the BWMC identify and manage risk and the G7 guideline points to the fact that an “acceptable level” of risk should be determined in each instance. By using “acceptable”, the determination of the level of accepted risk becomes subjective and related to the port state’s assessment and perception of risk. This will for some Port States be different with regard to specific species, e.g. a species may be considered a target species in the HOLAS list and in German waters but not in Danish waters. The acceptable level of risk is ultimately to be defined by the port state. It should be kept in mind that it is possible within the
scope of the BWMC for Port States to agree on whether a specific port pair may be exempted as long as the arrangement does not have an impact on other Port States’ water.

A number of discussion points may be raised from the arguments presented, when uncertainty has resulted in the use of the precautionary principle or when classifying a risk as high due to a lack of data.

2.3.1 Taking a hazard approach versus a risk approach

One discussion point is the lack of the exposure component in the risk assessment, i.e. the exposure to an identified hazard is set at 100%, meaning it will always happen. Though only the simple assessment is called for in G7 which does not include any exposure considerations, including the additional criteria (6.4.9 to 6.4.11) will result in a complete risk assessment, i.e. the hazards are identified and described, the vulnerability and potential impacts are evaluated and the likelihood of such an occurrence is determined.

The hazard assessments take in principle a zero-risk approach, which is not in line with the G7 guidelines. The G7 is clear on the issue of a zero-risk approach stating that even though low-risk scenarios exist zero risk is not obtainable, and such risk should be managed by determining the acceptable level of risk in each instance (Section 5.2.5, MEPC.162(56), 2007).

2.3.2 The use of the precautionary principle

In several developed RAs the precautionary principle (PP) is being used as a means to determine that the level of uncertainty is too high and an exemption cannot be granted or a specific RA approach or component cannot be used. The application of the PP is not a part of the IMO G7 guidelines, which speaks only of precautionary in its definition of the RA principles to apply:

“Precautionary - That risk assessments incorporate a level of precaution when making assumptions, and making recommendations, to account for uncertainty, unreliability and inadequacy of information. The absence of, or uncertainty in, any information should therefore be considered an indicator of potential risk.”

There is a distinction between the precautionary approach (PA) sought in G7 and the PP understood in the context of EU environmental management. The PA calls for adjusting the risk level, taking into account the quality of the data used. In a EU context the PP is rarely used on existing risks, and is used only on new risks from applications entering the market. It is a

### The Precautionary principle in the EU

The precautionary principle (PP) in a EU context originates from the EU Maastricht Treaty, article 174:

“Community policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Community. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as priority be rectified at source and that the polluter should pay.”

The PP is only outlined in the treaty and not defined, however according to the European Commission (EC, 2000) the prerequisites on when to apply the PP are in the circumstances where:

1. scientific evidence is “insufficient, inconclusive or uncertain”, and
2. there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the chosen level of protection.

The prerequisites for use of the PP are considered in part to be founded on the risk assessment where the four RA components; hazard identification, hazard characterization, evaluation of exposure and risk characterization are completed.

No elaboration on the “chosen level of protection” is found in EC legal texts other than a clarification of equality of zero risk and the use of the PP, stating that there is a “distinction between reliance on the precautionary principle and the search for zero risk, which in reality is rarely to be found” (EC, 2000).

The use of the PP is in principle a measure used by administrations. The field of action when invoking the PP is ascribed intrinsic values by the Commission and should adhere to the following principles:

- Be proportional
- Be non-discriminating
- Be consistent
- Include an examination of costs and benefits
- Be subject to review in the light of new data
- Assign responsibility for producing the scientific evidence
provisional method of handling uncertainty with regard to risk until scientific certainty has been established to a level accepted by the member states. (See text box for background information on the PP in a EU context).

In a perfect scenario, all data are available at any given time in order to conduct a risk assessment with zero uncertainty. This is in principle not possible for obvious reasons, though a frequent monitoring of all substrates and the water column in a port will go a long way to reach this objective. The requirement for validity of data, i.e. how old may the data be to be used for a RA, governs the frequency of survey. However, the representativeness may still be challenged due to the fact that there continues to be a risk of introduction of new harmful species, as well as of secondary transfer of harmful species already introduced into the region in the transitional period until the D-2 standard is fully applied. Hull fouling also acts as a vector for transfer of harmful species and as long as this issue is not regulated all traffic will potentially contribute to the introduction of new species.

In summary, we will never have enough data and enough updated data to totally eliminate the element of uncertainty. Applying the PP argument will consequently mean that we will always consider any hazard uncertain and therefore risky. Taking this position means a zero-tolerance approach.

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10 Here we have not considered the fact that, even when following the HELCOM/OSPAR protocol, the probability still exists that harmful species are present that have just not been sampled, thus adding to the uncertainty of the survey’s representativeness of the composition of harmful species present at the BW uptake location.

11 Certain categories of vessels will continue to discharge untreated ballast water and a vessel will not need to comply with the D-2 standard until its IOPP certificate is to be renewed.
3. Methodologies that may address “same risk area”

Risk assessments are reviewed in the context of using the hydrodynamics or biological properties of species. It was mentioned previously that the lack of information on biologically relevant hydrodynamic connection as well the estimation of the exposure in terms of number of ballasting events, the volume, the time and the position are important.

3.1 Methodology concepts

As species may disperse naturally by their own means e.g. by swimming, or disperse with currents or drift by the wind, the distance between uptake and discharge locations, as well as hydrodynamics should be considered. The G7 guidelines do not specifically mention natural dispersal as an assessment factor, however; the OSPAR/HELCOM Scientific Expert Group is contemplating how and if this may be included in the web-based RA tool.

The issue of natural dispersal is of key relevance when discussing the concept of a “same risk area”. This holds true especially for ports in close proximity to each other, which is the case for many short sea shipping routes. At least three models have been brought forward with this issue (Meer 2012):

The ESA/Brockmann Consult DUE Innovator II BWE risk assessment model was developed for assessing the impacts of ballast water exchange and recognises the importance of hydrodynamics in its risk index on drift. This model underlines the Joint HELCOM/OSPAR Decision Support Tool although here it is modified to a new purpose, as the developers mention amongst possible future improvements: “Add data for the decision knot ‘Do species have the ability to naturally spread?’ and implement it in the web application”. The ability to understand a species’ ability for natural spreading is paramount in any “same risk area” thinking.

The DHI Hydrodynamic Model is a quantitative stochastic transport model of the North Sea and part of the Baltic Sea. In its original form this is not a suitable model, but it can be used to model the dispersion of species through their pelagic stage(s) by determining the probability of encountering particles in a particular position originating from a certain start position during an optional time interval. One may determine the probability of a particle’s end position after a time interval or vice versa can calculate the probability of a particle’s point of origin before it ends in the specified position after a time interval. Depending on coastal dynamics and on the grid size, particles can be located close to or in ports, and the model can be connected to ecological models from DHI describing characteristics of the particle (or species) such as lifetime, and can be overlapped with similar dispersion maps for other species of concern. In this case, the model addresses the biological connectivity or different areas and becomes relevant for a “same risk area” consideration.

GETM_ERSEM is able to describe biological and physical-chemical processes and their interactions in both the water column and on the bottom of the sea. This model is suitable for modelling the ecology of the North Sea and could be used for describing the biotic determinants for a comprehensive ballast water risk assessment. Currently, the model does not determine risk and does not compare biological conditions between two areas, but may be developed to do so.
The connectivity model to assess whether two locations or ports may be considered a "same risk area" may provide a simple but hydrodynamically sound analysis when coupled with the biological characteristics of propagules. Currently the model allows for the identification of the natural dispersal of invasive species for given characteristics (transport distances) as well as the location and separation of high- and low-risk areas. Although the connectivity method is still in its infancy and needs to be developed further to allow for risk categorisation also of coastal waters, it is a potential future tool for granting exemptions, e.g. in the case of transfer of ballast water within low-risk areas or from one low-risk area to another low-risk area (provided the Target Species share biological characteristics). Further research and tests of applicability are warranted. Though the model in its current form is less reliable to predict the probability in waters close to land, it seems a viable way to pre-assess two ports located within same high-risk dispersal area.

The connectivity model seems a viable method to determine the potential of two locations as being connected with respect to natural dispersal of species and a method to consider in the Joint HELCOM/OSPAR Decision Support Tool.

3.2 The omission of non-biological data in RA

The protocols, procedures and guidance documents for RA all include assessment of the frequency and volume of the ballasting. However, few of the conducted RAs include “shipping measures” or weight the risk according to the economic impacts. Regarding the former, several studies conclude that no clear correlation can be found, and recently Ruiz et al. (2013) pointed to a fundamental gap in knowledge, since they found no correlation between the invasive species in 16 U.S. bays and shipping intensity. Also, a recent study concludes that the shipping measures are poor descriptors of risk and leave these out of the RA (David et al., 2013) with reference to a precautionary approach.

Nevertheless, the more ballast water is discharged in a port, the higher is the risk of introduction of a non-indigenous species, if the environmental conditions allow. It is also clear, however, that since an organism also has to survive and become established, the detailed train of actions are not yet available. It should be mentioned that the discrete risk found comparing a small ballasting operation with a large one, i.e. the shipping measures, may never be statistically reflected in large-scale epidemiological studies where all the accumulated risks are observed only after a biological selection for survival has taken place.

Socioeconomic risks from environmental factors are normally evaluated in light of the potential or perceived impact they impose. Though these form a part of the G7 RA, they are not included in the HELCOM/OSPAR Joint Harmonised Procedures in the decision process when assessing risk. Since it is a key element in assessing the acceptability of a risk, the inclusion of an element of economic impact assessment should be considered for location-specific evaluation.
4. Administrative implementation

In implementing the BWMC exemptions regulation A-4 and the Joint HELCOM/OSPAR RA a number of regulatory and industry challenges are known. Setting aside the scientific uncertainties as mentioned in this study, we have previously pointed to two (Litehauz, in press): (1) the availability of existing data and ownership of new data, and (2) the uncertainty related to the option to revoke an exemption. A catalogue of options to avail the transition phase put forward considerations on the lower and perhaps acceptable risks associated with local transport in a limited area.

The concept of a same risk area rests upon the assumption that the risks from invasive species as identified e.g. through black lists or species characteristics, may be similar, comparable or acceptable in coherent water bodies, as modelled through their connectivity or a related modelling approach. Since the models are still under development their use in RA may yet only be through a pilot scale approach.

This study presents a few future scenarios for possible implementation of mechanisms that may address the above.

4.1 A screening for exemption potential

In the OSPAR and HELCOM areas, the recommended administrative procedure for considering exemptions will rest on a risk assessment. The current Joint HELCOM/OSPAR RA model is a one-level RA entry approach utilising a significant amount of location-specific survey data by which a low level of uncertainty is sought in the assessment of risk. Therefore, the barrier for entering an exemption process is high, due to the initial need for survey data when engaging in the RA process, as it has to be provided (at a cost borne by the applicant if no data is available) without any assurance of the outcome of the risk assessment.

From an administrative point of view, this challenge may be met by taking a more pragmatic tiered approach on the identification of risks considered (e.g. illustrated by the Canadian model). A tiered approach would allow for including a lower level RA as a preliminary starting point to identify the associated risks and potential impacts of granting an exemption. The approach would lower the uncertainty for the applicant by ruling out high-risk routes as well as assisting administrative bodies to focus on port pairs with the highest exemption potential. A tiered approach is often used when conducting environmental assessments, screening and environmental impact assessments, and it could be developed in such a way that it is still in line with the G7 guidelines. A tiered approach with three levels would comprise:

1. Desktop screening risk assessment (pilot RA)
2. Same risk area concept
3. Detailed risk assessment (full RA)

A screening assessment could be based on available biological and environmental information, i.e. a desktop study and take its point of origin in a qualitative – and if data allows also a quantitative –
assessment ensuring that strong high-risk scenarios are identified. Should the assessment lead to a judgment of medium risk or high risk based on few species, a modelling of species dispersal is carried out to determine whether the locations and port pairs could be considered to be within the "same risk area". The full RA follows the normal G7 and HELCOM/OSPAR Joint Harmonised Procedures.

The point of departure for the qualitative approach for the Baltic Sea could be the area division used in the HELCOM List of Non-Indigenous and Cryptogenic Species in the Baltic Sea - Version 2 (HELCOM, 2010c), which includes known distributions of species of interest divided into 10 larger areas or the HELCOM HOLAS divisions of 63 sub-basins. For the North Sea, such an area division is not available and other means of defining areas on a qualitative basis should be developed should this approach be considered.

A number of prerequisites could be applied for the pre-screening entry level, which would govern the need for recourse to a full risk assessment, should less uncertainty be deemed necessary. A number of parameters are listed below which may be taken into consideration as determinants for a higher-level RA entry. These could be considered to be applied in the form of a scoring system. The parameters are based partly on the IMO G3 guidelines (Resolution MEPC.123(53), 2005) as well as other obvious situations and events of ballast water operations, which could lead to a higher-risk scenario:

- in areas identified by the Port State in connection with warnings provided by ports concerning ballast uptake and any other port contingency arrangements in the event of emergency situations
- at locations nearby protected areas (e.g. Natura 2000)
- in areas that are close to aquaculture
- at locations near sewage outfalls
- in areas with known frequent large phytoplankton blooms
- ports with a history of a high number of discharge events
- ports connected to freshwater bodies though inland water transportation, with a known history of introduction of harmful species (e.g. the Ponto-Caspian)
- where high volume or frequency of ballast water operations are conducted

The detailed RA would be represented by the HELCOM/OSPAR Joint Harmonised Procedures and result in the lowest level of uncertainty.

**Scenario example 1**

An operator in the Baltic Sea is contemplating applying for exemption under Regulation A-4 for a route connecting ports A and B. A screening assessment is done using a combination of a qualitative and a quantitative approach. First, the uptake and discharge locations are assessed as to whether they fall into any of the categories listed as determinants for a full RA.

Second, the dispersal potential is modelled using a connectivity model (e.g. DHI model) to identify whether the ports or locations may be considered to be outside the same risk area and consequently invasive species may spread between ports with shipping as a vector.

The conclusion is to not proceed to a full RA.

The qualitative approach could act as a stand-alone method, or it may be coupled with a qualitative assessment in the form of e.g. hydrodynamic and biological modelling of dispersal potential, such as the DHI connectivity model either for individual known species or on a more general level (e.g. as...
particle dispersal and settling modelling). In a pre-screening it is important that lack of data does not automatically force a high-risk conclusion. Only data-based deductions are presented, and obviously therefore high risk is reported when it is certain e.g. when target species differ between ports. For such areas there is no reason to continue to a more detailed level including surveys.

4.2 Same risk area concept

Today the most detailed invasive species data are available from HELCOM databases, but new survey data will enter the Decision Support Tool’s database over time. Based on currently existing or future data the “same risk area” concept is developed and applied, where data from surveys or existing databases e.g. the HOLAS sub basins, are accepted as indications of a same risk area.

This would require that certain localized high-risk locations are identified and excluded from the “same risk area”, i.e. big ports or known invasive species hotspots, and that a connectivity modelling had been carried out showing that for the species of interest the area is indeed connected through water hydrodynamics and biological parameters.

Having done that the short sea traffic and line traffic would continue be free to take up and discharge ballast water within the boundaries of the “same risk area”.

The high-risk ports would not be included in the “same risk area” until information on invasive species is obtained e.g. through a baseline survey. This will work as an incentive to provide port baseline surveys to establish whether the port can be categorized as a low-risk port within the “same risk area”.

Scenario example 2

An operator in the Baltic Sea is contemplating to apply for exemption under Regulation A-4 for a route connecting ports A and B. The data from databases or surveys show differing species composition, i.e. not low risk. However, the modelling of the dispersal potential using a connectivity model (e.g. DHI model) can identify that the ports or locations may be considered to be within the same risk area.

As the ports are considered to be within “same risk area” no treatment of ballast water discharge is required.

Over time a more precise picture may emerge on the size and distribution of “same risk areas” to allow more ports to be included or excluded.
5. References


Biosecurity Regulation 2013A, 2013, Biosecurity Regulation 2013A; Managing the discharge of ballast water and sediment


HELCOM, 2010c, HELCOM List of Non-Indigenous And Cryptogenic Species In The Baltic Sea (Version 2)

HELCOM/OSPAR, 2013a, Terms of Reference for Ballast Water Exemption Scientific Expert Group, ANNEX 2.

Heyer K., 2012, Compiling and testing of biological risk assessments for the invasion of alien species with ballast water, Helsinki Commission, Maritime Group Eleventh Meeting, Copenhagen, Denmark, 6-8 November 2012.


## Appendix A – Applicable Criteria for a Species-Specific Risk Assessment

<table>
<thead>
<tr>
<th>Section</th>
<th>Criteria</th>
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<tbody>
<tr>
<td><strong>Selection of target species</strong></td>
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<tr>
<td>6.4.3 -</td>
<td>• Evidence of prior introduction</td>
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<tr>
<td>6.4.3 -</td>
<td>• Demonstrated impacts on environment, economy, human health, property or resources</td>
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<tr>
<td>6.4.3 -</td>
<td>• Strength and type of ecological interactions, e.g. ecological engineers</td>
</tr>
<tr>
<td>6.4.3 -</td>
<td>• Current distribution within biogeographic region and in other biogeographic regions</td>
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<tr>
<td>6.4.3 -</td>
<td>• Relationship with ballast water as a vector</td>
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</tbody>
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**Simple assessment - minimum data**

<table>
<thead>
<tr>
<th>Section</th>
<th>Criteria</th>
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<tbody>
<tr>
<td>6.4.7.1</td>
<td>Biogeographic region of donor and recipient port(s)</td>
</tr>
<tr>
<td>6.4.7.2</td>
<td>The presence of all non-indigenous species (including cryptogenic species) and native species in the donor port(s), port region and biogeographic region, not present in the recipient port, to allow identification of target species</td>
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<tr>
<td>6.4.7.3</td>
<td>The presence of all target species in the recipient port(s), port region and biogeographic region</td>
</tr>
<tr>
<td>6.4.7.4</td>
<td>Difference between target species in the donor and recipient ports, port region and biogeographic region</td>
</tr>
<tr>
<td>6.4.7.5</td>
<td>Life history information on the target species and physiological tolerances</td>
</tr>
<tr>
<td>6.4.7.6</td>
<td>Habitat type required by the target species and availability of habitat type in the recipient port</td>
</tr>
</tbody>
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**Exposure assessment - Probability component**

<table>
<thead>
<tr>
<th>Section</th>
<th>Criteria</th>
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<tbody>
<tr>
<td>6.4.9</td>
<td>Likelihood of target species surviving on uptake, transfer and discharge</td>
</tr>
<tr>
<td>6.4.10</td>
<td>Likelihood of establishment of population:</td>
</tr>
<tr>
<td></td>
<td>• Seasonal variations of all life cycle occurrences</td>
</tr>
<tr>
<td>6.4.11.1</td>
<td>• Physiological tolerances of all life stages to temperature and salinity</td>
</tr>
<tr>
<td>6.4.11.2</td>
<td>• Assessment of habitats to complete life cycle</td>
</tr>
<tr>
<td>6.4.11.3</td>
<td>• Comparisons of known physiological tolerances for other conditions</td>
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</tbody>
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**Exposure assessment - Propagule pressure component**

<table>
<thead>
<tr>
<th>Section</th>
<th>Criteria</th>
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<tbody>
<tr>
<td></td>
<td>• The total volume of water discharged</td>
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<tr>
<td></td>
<td>• The volume of water discharged in any event (voyage)</td>
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<tr>
<td></td>
<td>• The total number of discharge events</td>
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<tr>
<td></td>
<td>• The temporal distribution of discharge events</td>
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Appendix B – Evaluation of Protocols and Risk Assessments

See separate attachment.
Appendix C – HELCOM/OSPAR Decision Process Flow Chart