Joint HELCOM/OSPAR Task Group on Ballast Water Management Convention Exemptions
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Background

The last meeting of the HELCOM Heads of Delegation (par. 3.90, Outcome of HOD 48-2015) welcomed the offer by Lithuania and Estonia to contribute to the next round of HELCOM-OSPAR JHP revisions with new proposals regarding BWMC A-4 Risk assessment Target Species criteria and the Baltic Sea Target Species list.

HELCOM Workshop on IMO BWMC target species, criteria and revision process (WS TS 1-2015) was held on 26 August 2015 at the premises of the Ministry of the Environment in Tallinn, Estonia, on HELCOM input for further future revision needs of the JHP covering:

— BWMC A-4 Risk assessment Target Species criteria;

— BWMC A-4 Risk assessment Target Species;

— how to formalize a procedure and responsibilities to update the A-4 target species list.

The workshop aimed to prepare joint HELCOM document on the above topics for submission to the next meeting of the TG BALLAST 6-2015.

The Estonian and Lithuanian proposal regarding BWMC A-4 Risk assessment Target Species criteria and the Baltic Sea Target Species list considered by the WS TS 1-2015 is attached as Annex 1.

Action required

The Meeting is invited to take note of the information.

Annex 1

Draft

Submitted to HELCOM Workshop on IMO BWMC target species, criteria and revision process
(Tallinn, Estonia; 26 August 2015)

Proposal for IMO Ballast Water Management Convention A-4 Target Species selection criteria

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Contents

1 Introduction

The purpose of this document is to contribute to the control of the spread of harmful aquatic organisms and pathogens into the Baltic Sea. The document defines the criteria for granting exemptions for ballast water management in accordance with the Regulation A-4 *Exemptions* of the International convention for the control and management of ships' ballast water and sediments (BWMC; IMO 2004). The BWMC Regulation A-4 indicates that those exemptions can only be granted when they are:

- "granted to a ship or ships on a voyage or voyages between specified ports or locations; or to a ship which operates exclusively between specified ports or locations;
- effective for a period of no more than five years subject to intermediate review;
- granted to ships that do not mix Ballast Water or Sediments other than between the ports or locations specified in paragraph 1.1.".

The 48th meeting of the Heads of Delegation endorsed the revisions of the HELCOM-OSPAR Joint Harmonized Procedure for BWMC A-4 exemptions (JHP) as included in the document 3-19 of the meeting (paragraphs 3.84, Outcome of HOD 48-2015; HELCOM 2015a). According to the outcome (point 3.90) of the meeting "The Meeting welcomed the offer by Lithuania and Estonia to contribute to the next round of HELCOM-OSPAR JHP revisions with new proposals regarding BWMC A-4 Risk assessment Target Species criteria and the Baltic Sea Target Species list" (HELCOM 2015a), Lithuania and Estonia were asked to provide a contribution to the Target Species criteria which adresses major concerns of these two countries on the previously proposed document (HELCOM 2015b). For this purpose, a one-week meeting (3-7. August 2015) was convened in Pärnu (Estonia) with attendance of Sergej Olenin (Klaipeda University, Lithuania), Dan Minchin (Klaipeda University, Lithuania and Marine Organism Investigations, Ireland) and Henn Ojaveer (Tartu University, Estonia), all having 20+ years of experience and competence in the field of marine bioinvasions. Prior to the meeting, several underlying key publications were consulted. These included, amongst others global maritime shipping and ballast water management issues (David and Gollasch 2015), life in ballast tanks (Gollasch et al. 2002), IMO Risk Assessment Guidelines (IMO 2007), guidance on port biological baseline surveys (GloBallast 2014), needs and requirements for marine non-indigenous species monitoring (Olenin et al. 2011; Lehtiniemi et al. 2015), biopollution assessment and classification of non-indigenous species based on impacts (Olenin et al. 2007; Ojaveer et al. 2015), impacts of non-indigenous species in the Baltic Sea (Zaiko et al. 2011;

Ojaveer and Kotta 2015) and risk assessment for exemptions for ballast water management in the Baltic Sea (David et al. 2013).

The following key principles, referred to by IMO (2007), were adhered to in the development of the proposed target species criteria:

1. **Effectiveness -** That risk assessments accurately measures the risks to the extent necessary to achieve an appropriate level of protection.
2. **Transparency –** That the reasoning and evidence supporting the action recommended by risk assessments, and areas of uncertainty (and their possible consequences to those recommendations), are clearly documented and made available to decision-makers.
3. **Consistency –** That risk assessments achieve a uniform high level of performance, using a common process and methodology.
4. **Comprehensiveness –** That the full range of values, including economic, environmental, social and cultural, are considered when assessing risks and making recommendations.
5. **Risk Management –** Although low risk scenarios may exist, a zero risk is not obtainable, and as such risk should be managed by determining the acceptable level of risk in each instance.
6. **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.
7. **Science based –** That risk assessments are based on the best available information that has been collected and analysed using scientific methods.
8. **Continuous improvement –** Any risk model should be periodically reviewed and updated to account for improved understanding.

Disclaimer: the particular process produced here is for general use under consequences derived from the output of the system as a responsibility of those that use the process for implementation of BWMC exemptions. Best scientific expert knowledge available at the time of writing was consulted.

2 Definitions and abbreviations

All definitions used in this document correspond to those of IMO (2004, 2007). Other definitions are given below:

Term	Abbreviation (if any)	Definition
Non-indigenous species	NIS	Species, subspecies or lower taxa introduced outside of their natural range (past or present) and outside of their natural dispersal potential. This includes any part, gamete or propagule of such species that might survive and subsequently reproduce. Their presence in the given region is due to intentional or unintentional introduction resulting from human activities. Natural shifts in distribution ranges (e.g. due to climate change or dispersal by ocean currents) do not qualify a species as a NIS. However, secondary introductions of NIS from the area(s) of their first arrival could occur without human involvement due to spread by natural means.
Cryptogenic species	CS	Species of unknown origin which cannot be ascribed as being native or non-indigenous. Such species also can demonstrate harmful characteristics and should be included in assessments.
Invasive alien species	IAS	a subset of established NIS, which have spread, are spreading or have demonstrated their potential to spread elsewhere and have an adverse effect on one or more of the following: biological diversity, ecosystem function, socio-economic values or human health in invaded regions (Olenin et al. 2010).
Harmful aquatic organisms and pathogens	HAOP	aquatic organisms or pathogens which, if introduced into the sea including estuaries, or into fresh water courses, may create hazards to the environment, human health, property or resources, impair biological diversity or interfere with other legitimate uses of such areas (IMO 2004).
Large Marine Ecosystem	LME	Extensive areas of ocean space of 200,000 km^2 or more, characterized by distinct hydrographic regimes, submarine topography, productivity, and trophically dependent populations, adjacent to the continents in coastal waters where primary productivity is generally higher than in open ocean areas. Additional large aquatic regions, not covered by the LME system (NOAA, 2015), such as Caspian Sea or the Laurentian Great Lakes of North America, may be included to complete the geographical coverage.
Primary introduction		The primary introduction is the first arrival of a NIS or CS to a recipient region (e.g. port) within the LME.
Secondary introduction		Subsequent spread after primary introduction of a NIS/CS to other recipient regions within or outside the LME.

Established species		A NIS or CS known to form a reproducing population in a wild.
Pest		Harmful organisms living in places where they are unwanted and have a detectable environmental and/or economic impact or impact on human health. Pests may be native, non-native or cryptogenic species.
Target species	TS	Species identified for a specific port, State or biogeographic region by a Party according to the Target species criteria indicating that they have a potential for an unacceptable risk to impair human health, property, resources, the environment and/or social-cultural values.

3 Biological invasions in the Baltic Sea

Harmful aquatic organisms and pathogens may be both of native and non-native origin. Native pest species usually are well known and measures to control their spread and/or mitigate their impacts are available. On the contrary, the harmfulness of newly introduced NIS or CS is difficult to predict, therefore the precautionary principle is applied, aiming at the prevention of primary introduction and secondary spread of such species.

The total number of recorded NIS and CS is 245 in the North Sea and 118 in the Baltic (AquaNIS 2015). The North Sea and Baltic Sea share large number of common NIS and CS: 58% (69 species) recorded in the Baltic Sea are known also from the North Sea (Ojaveer et al., in prep.). However, the number of species which first appeared in the North Sea (i.e. primary introductions) that were later recorded in the Baltic Sea is twice as great as that in the opposite pathway (41 *versus* 20, while 8 species appeared to have arrived in both seas at about the same time). The time lag between primary introduction to one regional sea and its subsequent secondary spread to another takes from five to fifty years (AquaNIS 2015). This depends on the species life form (planktonic or benthic), biological traits, environmental tolerance limits and the availability of pathways for spread. The secondary spread within the Baltic Sea varies from 30 to 480 km/year (Leppäkoski and Olenin 2000). Secondary spread is due to natural dispersal of organisms which may also be facilitated by human-associated mechanisms, including ballast water. In the Baltic Sea, 66 species are known to form viable populations and should be considered to be established (please note that in the current work, we consider three species of *Marenzelleria* as *Marenzelleria* spp., and therefore have 64 taxa listed in Table 1 under Section 6.1). A large proportion of the species (about 54 %) have a very limited distribution being currently established in one or two countries/country areas while 12% (8) of the established species are widespread and are established in at least 9 countries/country areas (Ojaveer et al., in prep.).

The level of certainty (direct evidence, very likely, possibly, unknown) in affiliating the responsible pathway for a given invasion requires special attention. It appears that only in 9% of cases of the Baltic Sea invasions (47 invasion events) we know the invasion pathway with the highest confidence, i.e., there is a direct evidence. In 15% cases, the pathway could be assigned with relatively high confidence (very likely), while in the majority of cases (60%) we only know possible pathways (Ojaveer et al., in prep.).

4 The proposed framework of the adaptive system

The proposed framework consists of the following major components: monitoring, an information system, criteria for the selection of TS, port-to-port risk assessment, administration decision and review (see Figure 1). The components form an adaptive system on granting A-4 exemptions for the BWMC, which ensures that all key principles defined in the IMO Guidelines for risk assessment (IMO 2007) are taken into account and the system is subject to a constant development and improvement as experience on granting exemptions evolves. Details of each of the components are described in sections 5, 6 and 7 below.

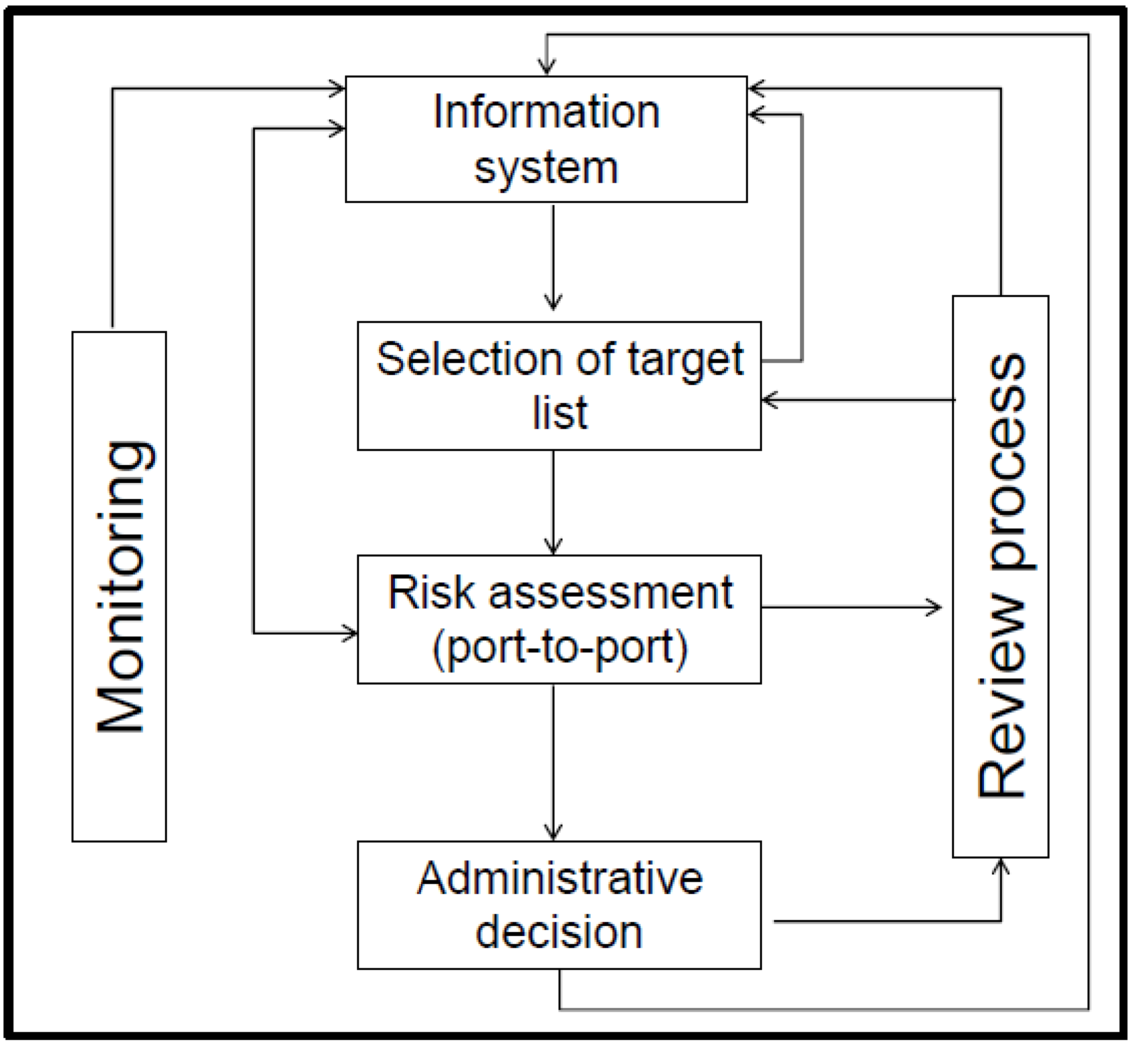

Figure 1. The proposed framework for the adaptive system on granting A-4 exemptions for the BWMC.

5 Selection of target species

5.1 Intitial list of species

The first requirement is to define the spatial context. This depends on the purpose of the risk assessment procedure (i.e. ports situated within one LME or in two different LMEs). Assessments are greatly dependent upon reliable data and its availability which may need to be drawn from a LME or a sea region within an LME. Both native pests as well as NIS and CS should be considered.

The list of potentially harmful native species should contain harmful aquatic organisms and pathogens (HAOP), harmful algal bloom species (HAB), aquaculture pests/parasites/diseases and some of these species may be available from World Health Organization (WHO), World Trade Organization (WTO) and World Organization of Animal Health (OIE) sources.

The list of non-indigenous and cryptogenic species should be obtained from continuously updated and verified sources, such as the Information system on Aquatic Non-Indigenous and Cryptogenic Species (AquaNIS; www.corpi.ku.lt/databases/aquanis) or similar reliable information system.

The compilation of the initial list of species is the first action in the overall procedure (see Figure 2)

5.2 Target species criteria

Species that are defined as TS are a small subset of the native species, NIS and CS occurring within a defined region. To enter on a TS list the species must have some level of impact, and have invasive properties, depending upon the level of perceived level of impact. Such species may be termed 'invasive alien species', IAS (Olenin et al. 2010). Included amongst TS are those native species that have mass expansions that result in some level of impact that may be termed 'blooms' or outbreak periods. There is a general term in the BWMC to cover all of these species termed HAOP (IMO, 2004).

The proposed criteria for the selection of the TS are given below. These follow the IMO (2007) risk assessment requirements and involve yes/no answer (Figure 2).

1. Is there actual evidence of the species being found in ballast water and/or sediments?

2. Is there a potential for an unacceptable risk for the species to become entrained in ballast tanks?
    a. Species has pelagic life-history stage
    b. Species performs diurnal vertical migrations
    c. Species has a pelagic host
    d. Species is present in sediments in shallow water ports (BW uptake areas)

If the answer is 'yes' to at least one of the above points, the species screening procedure should continue.

3. Is there a potential for unacceptable risk for the species to be spread further within the selected assessment area?
    a. The species is already established in all colonisable regions/countries in particular LME
    b. The species is unable to colonise further areas based on the known physiological tolerance limits

<u>If the answer is 'yes' to at least one of the above points, the species screening procedure should continue</u>.

4. Has the species been documented as having an impact upon human health in the selected LME?
    a. Mortality
    b. Illness
    c. Pain
    d. Irritation

Both poisonous and venomous species should be included. Poisonous organisms are capable of producing poison that gains entry to human body via the gastrointestinal tract, the respiratory tract, or via absorption through intact body layers. Venomous organisms are capable of producing poison, usually injected through intact skin by bite or sting. Also organisms that accumulate toxins of natural or anthropogenic origin and may be consumed by humans should be included.

5. Is there a potential for unacceptable risk for the species to impact upon human health in the selected LME?
    a. Based on global evidence [follow the structure from previous point]
    b. Insufficient evidence to rule out unacceptable risk - see point 6.5.7 in IMO (2007)

6. Has the species been documented as having an impact upon economy in the selected LME?
    a. Damage to property
    b. Decline of employment
    c. Decline of income

It should include considerations of decline of ecosystem services: water quality, commercial stocks, beaches, aquaculture.

7. Is there a potential for unacceptable risk for the species to impact upon economy in the selected LME?
    a. Based on global evidence [follow the structure from previous point]
    b. Insufficient evidence to rule out unacceptable risk - see point 6.5.7 in IMO 2007b

8. Has the species been documented as having an impact upon ecology in the selected LME?
    a. Biodiversity
        i. Genetic
        ii. Species (incl. protected and rare species)
        iii. Habitats (incl. protected and rare habitats)
    b. Ecosystem functioning

9. Is there a potential for unacceptable risk for the species to impact upon ecology in the given LME?
    a. Based on global evidence [follow the structure from previous point]
    b. Insufficient evidence to rule out unacceptable risk - see point 6.5.7 in IMO 2007b.

10. Has the species been documented as having an impact upon cultural and social values in the given LME?
    a. Degradation of culturally and nationally important places, incl. change in seascape
    b. Decline of nationally/culturally important individuals
    c. Degradation of amenity
    d. Impact on human activities (diving, swimming, sailing, fishing)

11. Is there a potential for unacceptable risk for the species to impact upon cultural and social values in the selected LME?
    a. Based on global evidence [follow the structure from previous point]
    b. Insufficient evidence to rule out unacceptable risk - see point 6.5.7 in IMO 2007b.

5.3 Target species selection: the procedure

The preparation of a TS list requires the following categories of information:

i) Pathway of spread (see questions 1-2 in 5.2 above and on Figure 2 below)
ii) Ecology of the species in the given LME (see question 3 in 5.2 above and on Figure 2 below)
iii) Impacts (see questions 4-11 in 5.2 above and on Figure 2 below).

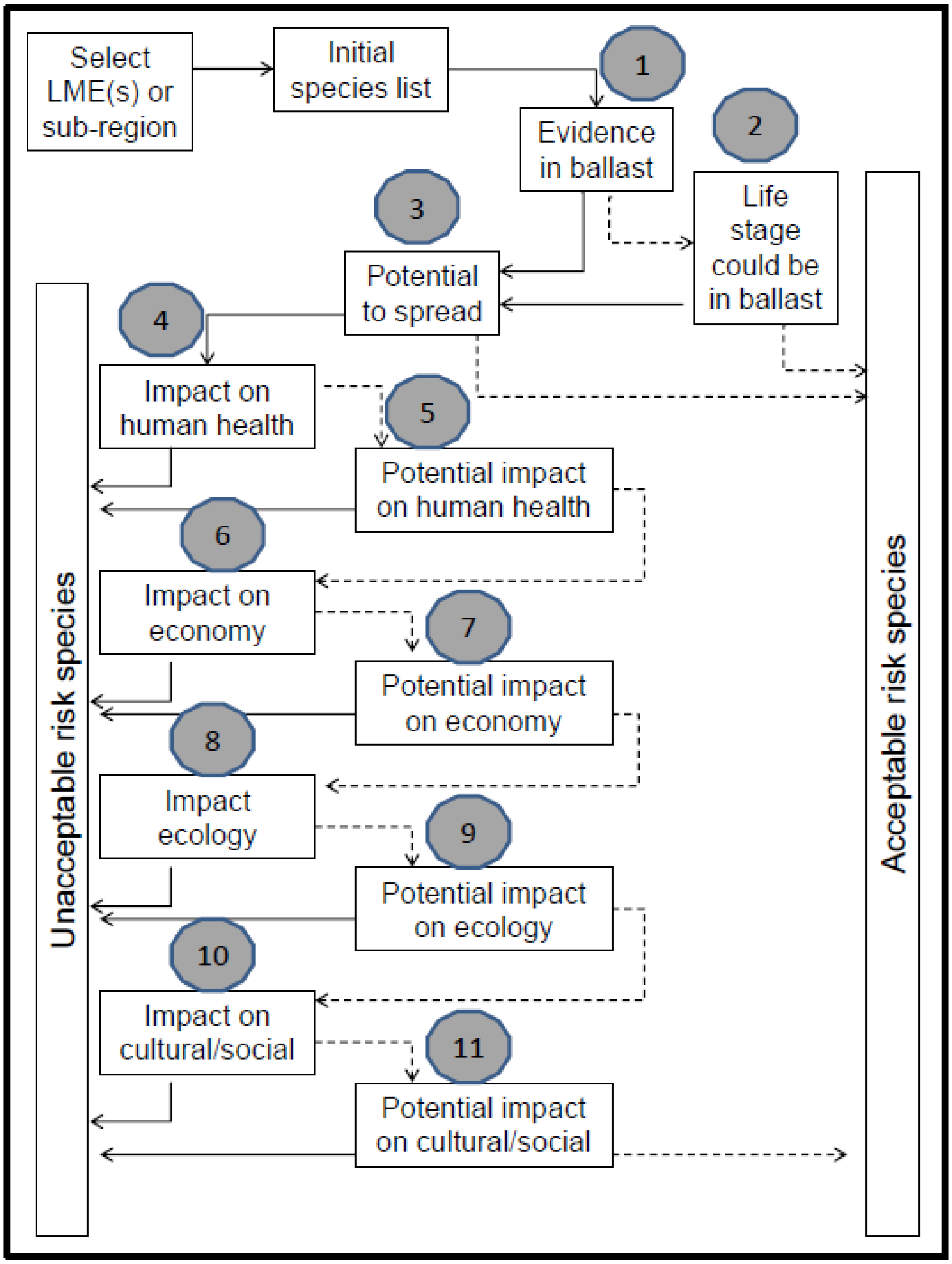

Figure 2. Schematic diagram of the flow procedure for selecting the list of TS that pose an unacceptable risk. Numbers denote the selection criteria (see point 5.3 above). Solid line corresponds to the progress in the procedure where the answer to a particular question is 'YES' while the dotted line corresponds to a 'NO' answer.

6 Testing the system

The proposed system was tested at two levels: LME-level and the port-to-port level. The test case for the LME level was NIS/CS of the LME number 23 (the Baltic Sea). The port-to-port test was performed for both intra LME level (the Baltic Sea) as well as between two LME's (Celtic seas and the Baltic Sea).

6.1 Preliminary list of NIS/CS target species for the LME 23 (Baltic Sea)

The proposed framework was tested for its utility in selecting the list of species that pose a potentially unacceptable risk based on the recently updated Baltic Sea NIS/CS data on 64 established taxa (AquaNIS 2015) t this constitutes a reservoir of species that might be transmitted by ships' ballast water and ballast sediments for consideration when assessing different ports within the Baltic Sea. From the initial analysis of the 64 taxa a little more than half (36 taxa) should be included into the TS list. This is because these pose either a direct or potentially unacceptable risk. Five species were removed as these were unlikely to have a life history stage that could be entrained while ballasting (Step 2; Question: *Is there a potential for an unacceptable risk for the species to become entrained in ballast tanks?*). Twelve species were removed at Step 3 (Question: *Is there a potential for unacceptable risk for the species to be spread further by ballast water [major sub-regions/countries] within the selected assessment area?*), and eleven species that did not pose an unacceptable risk for the different impact stages were removed (Step 11). The results are displayed in Table 1 below.

Table 1. Preliminary Baltic Sea NIS/CS TS list for the internal-LME shipping activities. Taxa posing potentially unacceptable risk are shaded. For the numbers of each risk assessment criterion see section 5.3 above.

No	Species	Unacceptable risk (RA criteria no.)	Acceptable risk (RA criteria no.)	Reference for the decision
1	*Acartia (Acanthacartia) tonsa*		3a	AquaNIS 2015
2	*Alitta succinea*		11	Expert judgement
3	*Alkmaria romijni*		11	Expert judgement
4	*Amphibalanus improvisus*		3a	AquaNIS 2015
5	*Anguillicoloides crassus*		3a	AquaNIS 2015
6	*Boccardiella ligerica*		11	Expert judgement
7	*Bonnemaisonia hamifera*	9a		TBD
8	*Carassius gibelio*	9a,b		Zaiko et al 2011; Lusk et al. 2004; Vetemaa et al. 2005
9	*Cercopagis (Cercopagis) pengoi*	6c; 8a,b		Ojaveer, Kotta 2015
10	*Chaetoceros cf. lorenzianus*	8b		TBD

11	*Chaetogammarus warpachowskyi*	9b		Zaiko et al 2011
12	*Chara connivens*	9a		Ojaveer, Kotta 2015
13	*Chelicorophium curvispinum*	8a; 9a		Ojaveer, Kotta 2015; Grabowski et al. 2007
14	*Cordylophora caspia*		3a	AquaNIS 2015
15	*Dasya baillouviana*	8a; 9a		Zaiko et al 2011
16	*Dikerogammarus haemobaphes*	9b		Grabowski et al. 2007; Zaiko et al. 2011
17	*Dikerogammarus villosus*	8a; 9a		Grabowski et al. 2006, 2007; Van der Velde et al. 2000
18	*Dreissena polymorpha*	7a; 8a,b		Ojaveer, Kotta 2015; Zaiko et al. 2011
19	*Elodea canadensis*		3b	TBD
20	*Ensis directus*	9a; 11a		Gollasch et al. 2015
21	*Evadne anonyx*	9a		Zaiko et al. 2011
22	*Ficopomatus enigmaticus*	7a; 9a		Schwindt, Obenat 2005; Jenner et al., 1998
23	*Fucus evanescens*	9a		Zaiko et al 2011
24	*Gammarus tigrinus*	8a		Grabowski et al. 2007; Ojaveer, Kotta 2015
25	*Gmelinoides fasciatus*	8a		TBD
26	*Gracilaria vermiculophylla*	8a		TBD
27	*Hemimysis anomala*	9a		Dick et al., 2013; Ketelaaars et al., 1999; Zaiko et al. 2011
28	*Karenia mikimotoi*		3a	AquaNIS 2015
29	*Laonome sp.*	8a,b		Kotta et al. 2015
30	*Limnomysis benedeni*	8a		Zaiko et al. 2011
31	*Lithoglyphus naticoides*		2	AquaNIS 2015
32	*Marenzelleria spp.*		3a	AquaNIS 2015
33	*Mnemiopsis leidyi*	7a; 9a		Oguz et al. 2008
34	*Mya arenaria*		3a	AquaNIS 2015
35	*Mytilopsis leucophaeata*	9a		Zaiko et al. 2011
36	*Neogobius melanostomus*	8a,b; 9a		Ustups et al. 2015; Ojaveer et al., 2015
37	*Obesogammarus crassus*	8a		Grabowski et al. 2006; Zaiko et al. 2011
38	*Oncorhynchus mykiss*		2	AquaNIS 2015
39	*Orchestia cavimana*		2	AquaNIS 2015
40	*Palaemon elegans*	9a,b		Katajisto et al. 2013; Zaiko et al. 2011

41	*Paramysis (Mesomysis) intermedia*	9a		TBD
42	*Paramysis (Serrapalpisis) lacustris*	8a		Zaiko et al. 2011
43	*Paranais frici*		11	Expert judgement
44	*Paratenuisentis ambiguus*	7b; 9b		TBD
45	*Penilia avirostris*		11	Expert judgement
46	*Perccottus glenii*	9a		Zaiko et al. 2011
47	*Petricolaria pholadiformis*		11	Expert judgement
48	*Platorchestia platensis*		2	AquaNIS 2015
49	*Pontogammarus robustoides*	8a		Grabowski et al. 2007; Ojaveer, Kotta 2015
50	*Potamopyrgus antipodarum*		3a	AquaNIS 2015
51	*Potamothrix bedoti*		11	Expert opinion
52	*Potamothrix heuscheri*		11	Expert opinion
53	*Potamothrix vejdovskyi*		11	Expert opinion
54	*Prorocentrum minimum*		3a	AquaNIS 2015
55	*Pseudodactylogyrus anguillae*	7a; 8a		Buchmann et al. 1987
56	*Pseudodactylogyrus bini*	7a; 9a		Buchmann et al. 1987
57	*Rangia cuneata*	9b		Janas et al. 2014
58	*Rhithropanopeus harrisii*	8a,b		Forsström et al. 2015, Nurkse et al. 2015, Aarnio et al. 2015
59	*Sargassum muticum*		3b	TBD
60	*Telmatogeton japonicus*		2	AquaNIS 2015
61	*Teredo navalis*	6a		TBD
62	*Thalassiosira punctigera*		3b	TBD
63	*Tubificoides pseudogaster*		11	Expert judgement
64	*Victorella pavida*		11	Expert judgement

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6.2 Port-to-port comparisons

6.2.1 Setting the scene

Transmission of NIS and CS are considered in this exercise. Further consideration of the spread of native species that include HAOP species needs to embrace viruses, bacteria, parasites and impacting inconspicuous biota. For example, some viruses such as noroviruses, might be transmitted by aerosol from spray. Since the port surveys have not been fully undertaken in the selected ports at the level of Hewitt *et al.,* (2004), or the New Zealand baseline surveys (Morrisey et al., 2007), the ports compared in this study include what is known from the port region and in the vicinity of the port itself. Port surveys may be conducted at different levels according to the finances available to undertake such work (Globallast, 2014), ranging from a rapid assessment of TS to complete accounts of native to non-native biota.

In addition, hydrographic surveys can provide information on which to assess some of the risks identified from port matching and species physiological tolerances (IMO, 2007). National surveys that include biosecurity sampling for phytoplankton and young-fish surveys, as well as other forms of environmental monitoring, may help to supplement species information beyond the immediate area of a port.

In this exercise, we examine the transmissions of TS between two ports within the Baltic Sea LME 23, Klaipeda in Lithuania and Tallinn in Estonia. The second exercise examines the risk of TS transmissions between Klaipeda in Lithuania and Cork Harbour, Ireland within Celtic seas LME 24 of the OSPAR region.

<u>Klaipeda port vicinity</u>
This shallow water port is situated in the narrows of a coastal Lagoon, The Curonian Lagoon, and the open coast. The Lagoon is influenced by freshwater discharges from the Nemunas River and more saline water from the coastal region. Salinities range from 3.5 to 5.5 psu and temperatures and water temperatures of 0.5 to 26° C. There is ice cover from December to April. The tidal range is ~0.1m.

<u>Tallinn Port vicinity</u>
This shallow water port lies on the south side of the Gulf of Finland and normally has ice cover from December to April and water temperatures range from 0.5 to 26° C. Salinities range from 4.6 to 6 psu. The tidal range is in the order of 0.1m but wind surges can create a range of 0.5m. The port is sheltered by a peninsula and islands.

<u>Cork Harbour</u>
This is a large natural sheltered bay and the principal port on the south coast of Ireland. It has a cool temperate climate with sea temperatures ranging from 5 to 19° C; sea-ice does not form in winter.

There are occasional deluges of freshwater from the River Lee and the channel is regularly dredged to provide ship access to Cork City. There is a shallow berth in Ringaskiddy and deep-water berths at Cobh and Whitegate. The tidal range within the harbour is up to 4.1m. Seawater enters to the east of the harbor mouth, circulates within the harbour and is discharged on the western side.

6.2.2 Within the Baltic Sea LME

Ballast water transmissions of TS between Tallinn and Klaipeda

T The port and vicinity regions of Tallinn, Estonia are compared with Klaipeda, Lithuania. The results indicate a preponderance of species within the Klaipeda region. Tallinn has fifteen recognized species, all recorded from the Klaipeda region. Klaipeda has twenty-one species, six of which are not present in Tallinn (Table 2). The crustaceans in this study will have arrived as a legacy from the stocking of lakes and rivers during the 1960s from the Ponto-Caspian region and will have spread downstream to the Curonian lagoon (the mysid, *Hemimysis anomala*, and gammarids *Obesogammarus crassus, Pontogammarus robustoides* and *Chelicorophium curvispinum*). All of these have some impact, in particular *H. anomala* which in shallows is nocturnal in behavior. None of the species is known to have an impact on human health but some have recognized impacts at the economic and ecological levels. The bivalve *Dreissena polymorpha,* an ecosystem engineer, is recognized as having economic and ecological impacts within the Baltic Sea LME and elsewhere. Impacts have not been reported in the Klaipeda port region but do occur nearby within the Curonian Lagoon, most probably as the species is at the lower limit of its physiological range; nevertheless its possible arrival in Tallinn should be flagged. The mud-crab *Rhithropanopeaus harrisii* can occur in abundance and this has not been reported from the port of Tallinn and its vicinity, although it has appeared recently in local abundance elsewhere in Estonia and in Finland. There is no known risk, based on current information, of an unwanted species arriving in Klaipeda port and vicinity from Tallinn port (Table 2).

Table 2. TS that might have some risk of transmission.

Species	Species shared	Recorded in Klaipeda Possible risk fo Tallinn	Recorded in Talinn Possible risk for Klaipeda	Species impact	Reference
Acartia tonsa	X				
Anguillicola crassus	X				
Amphibalanus improvisus	X				
Carassius gibelo	X				
Cercopagis pengoi	X				
Chelicorophium curvispinum		X		7a, 9a	Haas et al., 2002; Van den Brink et al., 1993
Cordylophora caspia	X				
Cordylophora caspia	X				
Dreissena polymorpha		X		7a, 8a, 8b	Ojaveer & Kotta, 2015; Zaiko et al., 2009
Eriocheir sinensis	X				
Gammarus tigrinus	X				
Hemimysis anomala		X		9a	Dick *et al.,* 2013; Ketelaaars et al., 1999
Marenzelleria neglecta	X				
Mya arenaria	X				
Neogobius melanostomus	X				
Obesogammarus crassus		X		8a	Grabowski et al., 2006;
Palaemon elegans	X				
Pontogammarus robustoides		X		8a	Zaiko & Olenin, 2004; Ponomareva, 1975;
Potamopyrgus antipodarum	X				
Prorocentrum minimum	X				
Rhithropanopeus harrisii		X		8a, 8b	Aarnio et al. 2015; Forsström et al. 2015; Nurkse et al. 2015

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6.2.3 Between the Baltic and Celtic seas LME's

<u>Ballast water transmissions of TS between Klaipeda and Cork Harbour</u>

In Cork Harbour, there are thirty-four species that might be of concern to other ports spanning a wide range of salinities, and greater salinities than in the vicinity of Klaipeda (Table 3). All thirty-four species were evaluated according to the flow chart (Figure 2). The process illustrated in Table 4 revealed five species that are considered to be TS for the Klaipeda Port and vicinity. In the Klaipeda region, there are thirteen TS that might be of concern for Cork Harbour (Table 5). These five TS are added to the thirteen species, known from Klaipeda port and vicinity for the next assessment stage. Of note are two species of dinoglagellate that have cyst 'beds' in Cork Harbour and these might endure the lower salinities within the Klaipeda region. Both *Alexandrium minutum* and *A. tamarense* produce paralytic shellfish toxins that can result in serious illness in humans (Table 5). The tube worm *Ficopomatus enigmaticus* can survive in low salinities but might not reproduce under Klaipeda conditions. This species has economic and ecological impacts in many regions with sheltered conditions around the world. In exchange, the goby *Neogobius melanostomus* carries a particular risk; it is not present in Ireland. All indications suggest this species has been transmitted to some ports in the Baltic Sea by shipping and is a likely candidate for further transmission; conditions in Cork Harbour are suitable for establishment of this fish. The mud-crab *Rhithropanopeus harrisii* is also a species that could readily become transmitted in ships' ballast water to Cork Harbour and survive. The crab *Eriocheir sinensis* would appear to be a casual species in Klaipeda port and vicinity and so may not be able to develop significant propagule pressure to be of risk to Cork Harbour. This species poses a particular risk for other northern European ports. *Marenzellaria* spp. might already be present in Cork Harbour as there are extensive mud flats where this species could occur. A worm of this genus has been found in another Irish estuary.

While ballast water is a risk for the transmissions of the selected TS, many of these can also be transmitted by hull fouling. Transmissions by hull fouling are significant and management of ballast water alone will not be able to prevent the spread of species to other LMEs.

Table 3. Non-indigenous and cryptogenic species known from Cork harbour and its vicinity. Records also includes species occurring in the Port of Klaipeda which are native to Cork Harbour or have been found elsewhere in Irish waters.

Species		References	Comment
Acartia tonsa	X	Lenane et al., 2006;	Recorded elsewhere near Cork Harbour
Alexandrium minutum	**X**	Touzet et al., 2007; Cosgrove et al., 2010	PSP toxins present seasonally
Alexandrium tamarense	**X**	Touzet et al., 2008; Cosgrove et al., 2010	PSP toxins present seasonally
Amphibalanus improvisus	**X**	Minchin, 2004	causing extensive fouling to boats
Anguillicoloides crassus	x	Evans & Mathews, 1999	Almost certainly present in Harbour
Bonamia ostreae	**X**	McArdle et al., 1991.	Still present in Harbour
Bonnemaisonia hamifera	**X**	Cullinane, 1973	No recent record
Calyptraea chinensis	**X**	Minchin & Nunn, 2006	Localised
Caprella mutica	**X**	Minchin, 2007	widely distributed about Ireland
Chelicorophium curvispinum		Lucy et al., 2004	Established in Irish freshwaters
Codium fragile fragile	**X**	Cullinane, 1973; Parkes, 1975;	widely distributed about Ireland
Colpomenia peregrina	**X**	Cullinane, 1973, Minchin 1991.	Locally established
Cordylophora caspia	**X**	Oliver, 2005	Known from within Lagoon area in Harbour
Corophium insidiosum	**X**	Oliver, 2005	Locally present
Corella eumyota	**X**	Minchin, 2007	Locally established
Crassostrea gigas (angulata)	**Extinct**	Wilkins, 1989; Minchin & Sheehan, 1998	Once introduced and on-grown but did not recuit
Crassostrea gigas	**X**	Minchin & Sheehan, 1998	Actively cultivated and some recruitment
Crassostrea virginica	**Extinct**	Wilkins, 1989	Once introduced and on-grown but did not recuit
Cryptonemia hibernica	**X**	Cullinane & Whelan, 1980, 1981; Cullinane et al., 1984	widely distributed in Cork Harbour
Dreissena polymorpha		Minchin et al., 2002	Established in Irish freshwaters
Elminius modestus	**X**	Minchin, 2007; O'Riordan, 1996	Extensively distributed within the Harbour
Eriocheir sinensis		Minchin, 2006	Casual records on Irish south coast
Ficopomatus enigmaticus	**X**	Kilty & Guiry, 1973; Minchin & Sheehan, 1998	Highly localised
Gammarus tigrinus		Minchin et al., 2013	Established in Irish freshwaters
Hemimysis anomala		Minchin & Boelens, Dick et al., 2012	Established in Irish freshwaters
Herrmannella duggani	**X**	Holmes and Minchin 1991	no recent rcords
Karenia mikimotoi	**X**	Ottway et al., 1979; Minchin & Sheehan, 1998, Raine et al., 2001	Blooms occur along the coastline
Labrynthula zosterae	x	Whelan & Cullinane, 1987	No recent records.
Limnoria quadripunctata	**X**	De Grave & Holmes, 1998	Record from elsewhere in Ireland
Marenzellaria spp.	**?**	Minchin 2007	Record from elsewhere in Ireland
Monocorophium sextonae	**X**	Costello, 1993, Minchin 2007	Locally extensive on wooden piles
Mercenaria mercenaria	**?**	Gibson, 1970	May no longer be present
Mya arenaria	**X**	Ryan, 1993	No recent living records
Myicola ostreae	**X**	Holmes & Minchin, 1995	No recent records, last record in 2003
Mytilicola intestinalis	**X**	Grainger, 1951; Crowley, 1972	Widely distributed within the Harbour
Mytilicola orientalis	**X**	Holmes & Minchin, 1995	May not be established
Palaemon elegans	**X**	Fahy et al., 1998	Native to Ireland
Potamopyrgus antipodarum	**?**	Minchin, 2007	Status unclear, probably present
Ruditapes semidecussata	**X**	Minchin & Sheehan, 1998	Culivated but no evidence of recruitment
Spartina anglica	**X**	Cummins, 1930; Curtis & Sheehy-Skeffington, 1998	Extensive stands still present
Styela clava	**X**	Minchin & Nunn 2006; Guiry & Guiry, 1973; Parker et al., 1999	Widely distributed, common but not abundant
Teredo navalis	**?**	Nichols, 1900, Minchin, 2004	No recent living records

Table 4. Assessment using the flow chart and additional questions to determine the TS of risk of transmission to Klaipeda Port, Lithuania from Cork Harbour, Ireland. Species in bold known to be established in Cork Harbour.

Species	in ballast?	be in ballast?	Can it spread?	on health?	on health?	on economy?	on economy?	on ecology?	on ecology?	on social?	on social?	survive 3.5-5.5psu	endure 3.5-5.5 psu	in Klaipeda?	**Target species**	with hull fouling
Acartia tonsa		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	Yes	Yes	No	No
Alexandrium minutum		Yes	Yes	Yes		Yes		No	Yes	?	?	N/A	Yes	No	Yes	No
Alexandrium tamarense	Yes	Yes	Yes	Yes		Yes		No	Yes	?	?	N/A	Yes	No	Yes	No
Amphibalanus improvisus		Yes	Yes	No	No	No	Yes	No	Yes	No	No	N/A	Yes	Yes	No	Yes
Anguillicoloides crassus		Yes	Yes	No	No	Yes		Yes		No	No	Yes		Yes	No	No
Bonamia ostreae		Yes	Yes	No	No	Yes		Yes		No	No	No		No	No	Yes
Bonnemaisonia hamifera		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	No	No	No	Yes
Calyptraea chinensis	No	No										N/A		No	No	No
Caprella mutica		Yes	Yes	No	No	No	Yes	Yes		No	No	N/A	No	No	No	Yes
Codium fragile fragile		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	No	No	No	Yes
Colpomenia peregrina		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	No	No	No	Yes
Cordylophora caspia		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	Yes	Yes	No	Yes
Corella eumyota		Yes	Yes	No	No	No	Yes	Yes		No	No	N/A	No	No	No	Yes
Corophium insidiosum		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	unknown	No	Yes	Yes
Crassostrea gigas		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	No	No	No	Yes
Cryptonemia hibernica		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	No	No	No	Yes
Elminius modestus		Yes	Yes	No	No	No	Yes	No	Yes	No	No	N/A	No	No	No	Yes
Ficopomatus enigmaticus		Yes	Yes	No	No	No	Yes	No	Yes	No	Yes	N/A	Yes	No	Yes	Yes
Herrmannella duggani		Yes	Yes	No	No	Yes		Yes		No	No	No		No	No	Yes
Karenia mikimotoi		Yes	Yes	No	No	Yes		Yes		No	No	N/A	No	No	No	No
Labrynthula zosterae		Yes	Yes	No	No	No	No	No	Yes	No	Yes	No	No	No	No	No
Limnoria quadripunctata		Yes	Yes	No	No	No	Yes	No	No	No	No	N/A	No	No	No	Yes
Mercenaria mercenaria		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	No	No	No	No
Monocorophium sextonae		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	?	No	No	Yes
Mya arenaria		Yes	Yes	Yes								N/A	Yes	Yes	No	Yes
Myicola ostreae		Yes	Yes	No	No	No	No	No	Yes	No	No	No		No	No	Yes
Mytilicola intestinalis		Yes	Yes	No	No	No	No	No	Yes	No	No	No	Yes	No	Yes	Yes
Mytilicola orientalis		Yes	Yes	No	No	No	No	No	Yes	No	No	No	No	No	No	Yes
Palaemon elegans		Yes	Yes	No	No	No	No	No	No	No	No	N/A	Yes	Yes	No	No
Potamopyrgus antipodarum		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	Yes	Yes	No	No
Ruditapes semideccusata		Yes	Yes	No	No	No	No	No	Yes	No	No	N/A	No	No	No	No
Spartina anglica		No		No	No	No	No	Yes		No	No	N/A	Yes	Yes	No	No
Styela clava		Yes	Yes	No	Yes	No	Yes	No	Yes	No	No	N/A	No	No	No	Yes
Teredo navalis		Yes	Yes	No	No	Yes		No	Yes	No	No	N/A	No	No	No	Yes

Table 5. TS that might have some risk of transmission.

Species	Species shared	Recorded in Cork Harbour Possible risk for Klaipeda	Recorded in Klaipeda Possible risk for Cork	Species impact	References
Acartia tonsa	X				
Alexandrium minutum		X		5b, 6a	McCoy et al., 2014; Anderson et al., 2012
Alexandrium tamarense		X		5b , 9a	Tian et al., 2001; Touzet et al., 2010; Anderson et al., 2012
Amphibalanus improvisus	X				
Cercopagis pengoi			X	6c, 8a, 8b	Kotta et al., 2006; Laxson et al, 2003
Chelicorophium curvispinum			X	8a, 9a	Haas et al., 2002; Van den Brink et al., 1993
Cordylophora caspia	X				
Cordylophora caspia			X	8a, 10a	Jenner et al., 1998; Markowski, 1959; Zaiko et al., 2007
Corophium insidiosum		X		8a	Kevrekidis, 2004
Dreissena polymorpha			X	7a, 8a, 8b	Ojaveer & Kotta, 2015; Zaiko et al., 2014
Eriocheir sinensis			X		Ojaveer et al., 2007;
Ficopomatus enigmaticus		X		**7a, 9a,11a**	Schwindt & Obenat, 2005; Jenner et al., 1998
Gammarus tigrinus			X	8a	Kotta et al., 2013; Packalén et al., 2008
Hemimysis anomala			X	9a	Dick *et al.,* 2013; Ketelaaars et al., 1999
Marenzelleria neglecta			X	**9a, 9b**	Kotta & Ólafsson, 2003
Mya arenaria	X				
Mytilicola intestinalis		X		**9a**	Blateau et al, 1992; Korringa, 1951
Neogobius melanostomus			X	8a, 8b	Corkum et al., 2004; Ojaveer et al., 2015
Obesogammarus crassus			X	8a	Grabowski et al., 2006
Palaemon elegans	X				
Pontogammarus robustoides			X	8a	Zaiko & Olenin, 2004; Ponomareva, 1975;
Potamopyrgus antipodarum	X				
Prorocentrum minimum			X	**9a**	Gallegos & Bergstrom, 2005; Tango et al., 2005
Rhithropanopeus harrisii			X	8a, 8b	Zaitsev & Öztürk, 2001; Roche et al., 2009; Kotta & Ojaveer, 2012
Spartina anglica	X				

<u>Assessing the TS</u>

The selection process developed in the port-to-port exercises provides a basis for making a rational decision as to which species are likely to be transmitted and are of concern when transmitted in ships' ballast water and/or sediments. There are specific difficulties in part of the evaluation regarding which species can be carried in ballast water, especially should there be ballasting in busy shallow-water ports where dredging and other forms of disturbance (e.g. propeller wash) may occur. This is because disturbed sediments can become entrained in the ballasting process along with life history stages that are epibenthic or burrowing.

A further difficulty is the apportionment of overall risk from a particular TS. This is presently not defined to a precise level, possibly leading to blurred decisions in borderline cases where information is either wanting or where the impact is not sufficiently great to warrant a regulation. Nevertheless, we consider human health to be of higher priority than social and cultural impacts and that economy and ecology impact risks lie somewhere in-between, but all have the potential to overlap according to the specific circumstances of a species and port region (Figure 3).

To date, there have been few port surveys worldwide and much of the information needed for species assessments must come from wider regions surrounding selected ports so as to include other survey activities and monitoring activities. It is expected that as a result of future port surveys further TS will emerge for consideration. In the meantime, a precautionary approach is warranted. Accordingly, the exercises developed in this account should be seen as a preliminary attempt to show how a process for selecting TS might operate.

The proposed risk assessment framework was also tested in case of two Baltic ports: Port of Tallinn and Port of Klaipeda, for which NIS/CS recent data are readily available. For the initial species list, NIS/CS in the relevant sub-system/area were considered. Table 2 below indicates that there are only a few species of concern for shipping between these two ports.

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7 Other elements of the proposed system

7.1 Information system

The information system is a key element of the overall procedure for granting exemptions from BWMC requirements. The information system has to ensure meeting the key principles of the risk assessment as outlined by IMO (2007). As indicated by the Globallast Program (GloBallast 2014): "the systematic archiving of biological records, particularly of NIS, not only for future reference, but also for the benefit of the international community engaged in preventative NIS programmes is of crucial importance Such programmes are heavily dependent on reliable, up-to-date information on the status of NIS in different regions, in order to assess the risks associated with different routes and vectors, to develop suitable management measures and to identify priorities for risk mitigation. Suitable data archives should be created at national level and it is strongly recommended that national databases be made available for inclusion in archives at regional and international levels".

Taking the above considerations into account the information system should include the following principal elements and inputs (see Figure 1):

- ✓ Information on NIS, CS and HAOP's (as output of port biological surveys, NIS/CS monitoring; see also point 7.2 below);
- ✓ TS lists;
- ✓ Port-to-port risk assessment outputs;
- ✓ An administrative decision;
- ✓ Review process outputs.

Specifically, a global information system on NIS/CS should include (but not limited to):

- valid taxonomy of NIS and CS, including notes on availability of molecular data;
- biological traits and environmental tolerance limits of NIS and CS;
- documented evidences of species being found in ballast water, on ship hulls and other vessel vectors of introduction;
- standardized impacts on human health, economy, biodiversity, ecosystem functioning, and socio-cultural values;
- introduction event records at the level of particular countries, country regions and ports;
- information on species labelled as unacceptable risk species world-wide.

It is well known that there are deficiencies and contradictions among online NIS information resources that may hamper NIS risk assessments as well as the prioritization of management options and implementation of invasive species policies (Hulme and Weser, 2011). Scientifically validated, continuously updated and maintained databases are the most reliable source for undertaking control measures (Genovesi, 2001). Data management issues and long-term maintenance are both fundamental to providing an effective, pragmatic and accurate information system (Olenin et al., 2014). As indicated by the GloBallast Programme (GloBallast 2014), one of the information systems recently gaining momentum is AquaNIS, which already contains data on aquatic NIS and CS, introduced to marine, brackish and coastal freshwater environments of Europe, neighboring and overseas regions. The geographical component of AquaNIS is arranged in a hierarchical order ranging from oceans, ocean sub-regions, Large Marine Ecosystems (LMEs), sub-regions of LMEs to smaller entities, including ports, from which a user can make a selection (Olenin et al. 2014).

The global information system on non-indigenous and cryptogenic species should be designed to assemble, store and disseminate comprehensive data. Needless to say that such information system must be freely available online. Of crucial importance is that the system is constantly updated by accommodating and validating information from:

- port biological surveys, performed according to the guidelines (e.g. HELCOM 2013; GloBallast 2014); this includes data on species occurrences, abundance and environmental conditions in ports;
- specialized NIS monitoring on national and regional (e.g. HELCOM) level;
- other sources of information on NIS/CS and HAOP, such as regular national reports to expert groups (e.g. Working Group on Introductions and Transfers of Marine Organisms and Working Group on Ballast and Other Ship Vectors of the International Council for the Exploration of the Sea (ICES WGITMO, WGBOSV), specialized data mining results, scientifically validated public science findings;
- outcomes of the TS selection process worldwide (i.e. all species which at least once were identified as posing unacceptable risk should be recorded);
- results of administrative decisions on granted / rejected / withdrawn exemptions on port-to-port basis, including all background information (e.g. why such decision was made).

The decision support tool should provide an interface to a risk assessment for translocation of TS in ballast water between two ports as is described by HELCOM (2013). The background data for the tool should be readily available from the global information system on NIS and CS.

7.2 Monitoring

Monitoring for NIS/CS seldom takes place apart from a few baseline surveys. However, there are several practical suggestions and monitoring guidelines for both NIS/CS as well as port biological sampling (Olenin et al. 2011; HELCOM/OSPAR 2014; GloBallast 2014; Lehtiniemi et al. 2015). In addition to the sampling gear/device, an important consideration is sampling frequency, which should be dictated by the reproduction cycle of a particular organism to be surveyed, and which in turn defines the certainty/uncertainty of the outcome. Recently, sampling frequencies for different taxonomic groups have been suggested (Lehtiniemi et al. 2015; see below).

Table 6. Suggested sampling frequency requirements for monitoring of presence–absence and population dynamics (abundance and/or biomass) of NIS of different taxonomic groups and varying life cycle lengths (Lehtiniemi et al. 2015).

Organism group	Presence/ absence	Population dynamics
Pathogens and other disease agents	Seasonal	Variable
Phytoplankton	Seasonal	Frequent, depending on biosecurity requirements
Zooplankton	Seasonal	Monthly (bi-weekly)
Benthic vegetation	Seasonal/ annual	Seasonal/annual
Zoobenthos	Annual	Annual
Fish	Annual	Annual at specific times (*e.g.* reproduction)

Results of various monitoring activities form one of the key inputs into the information system block of the proposed adaptive system (see section 7.1 above).

7.3 Review process

Review of risk assessment (incl. withdrawal of the granted exemptions) is the required part of the system (IMO 2007). This might include, amongst other, the following considerations:

- Emergency situation in HAB's and HAOP's: in case of arrival/development and/or bloom events;
- Relationship with hull fouling and other vectors (incl. aquaculture);
- Climate variability and change: potentially effective within the period of two exemptions;
- Extreme weather events: short-term rapid changes in hydrological conditions altering the risk assessment conditions;
- Port alteration: port reconstructions and potential changes in location of BW discharge/uptake areas;
- Updates of monitoring: new findings/evidences of native and non-native species of concern;
- Horizon scanning.

As a result of the review process, the TS list should be updated.

7.4 Administrative decision

The administrative decision is the executive part of the system and should be performed by the relevant management body, based on the scientific advice generated for management through application of the risk assessment procedure. It should provide feedback into the system (information system component) on how the advice has been used (i.e., exemptions granted and justifications/argumentation in case of departure from the advice).

8 Weighing the risk

When finally selecting the species to be included into the TS list, further considerations should be given on prioritizing the degree of risk. Undoubtedly, species having shown or potentially posing risk to human health should be treated as a 'high risk' species and included into the TS list (see 'not acceptable' risk for human health on Figure 3). The borderline between 'not acceptable' and 'acceptable' risk for the other two major categories of impact (i.e. economy/ecology and socio-cultural) should be further discussed and agreed upon, which should be included into the decision tree (Steps 6-11, Figure 2). Also, evidence of impact in a given LME/region and potential impact (Steps 6, 8, 10, and 7, 9, 11, respectively; see section 5.2 and Figure 2 above) need potentially to be given different loading in the evaluation process.

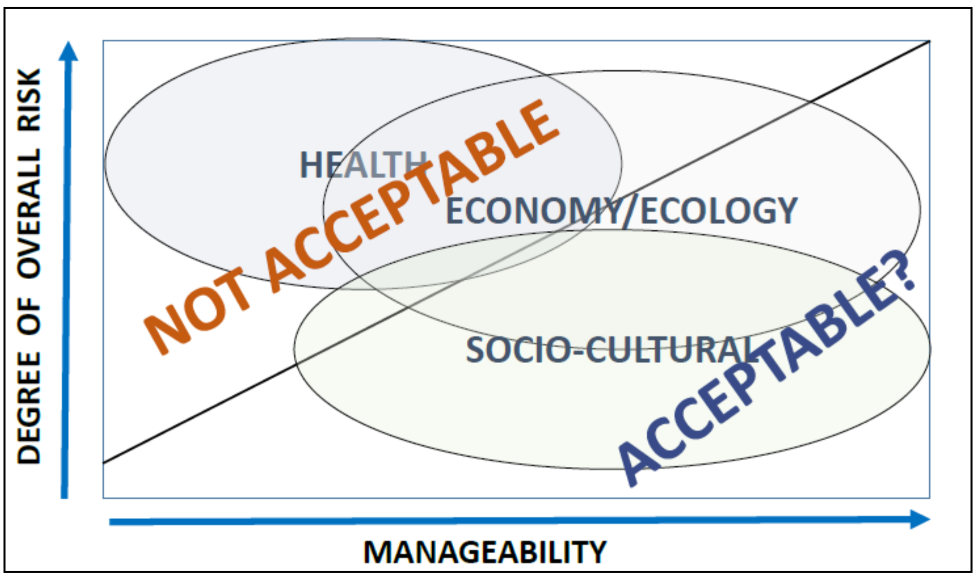

Figure 3. The conceptual diagram on the relationship between the degree of overall risk and manageability.

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