Joint HELCOM/OSPAR Task Group on Ballast Water Management Convention Exemptions
Ninth Meeting
Gothenburg, Sweden, 13-14 December 2018

Document title	Target species selection criteria for risk assessment based exemptions of ballast water management requirements in the Baltic Sea
Code	3 – 4
Category	INF
Agenda Item	3 - Updates to the Joint HELCOM/OSPAR Harmonized Procedure (JHP) on the Granting of BWM Convention Exemptions
Submission date	28.11.2018
Submitted by	HELCOM Secretariat
Reference	

Background

The COMPLETE project (Completing management options in the Baltic Sea Region to reduce risk of invasive species introduction by shipping, 2017-2020), funded by the Interreg Baltic Sea Region Programme, with partners from Estonia, Finland, Germany, Latvia, Lithuania, Poland, and Sweden, addresses with its WP3 on “Ballast water risk assessment and management systems” issues with relevance for HELCOM/OSPAR TG Ballast.

This document provides the project output 3.1 “Advanced target species (TS) selection criteria”. The output presents a review and update of the TS selection criteria based on international expertise. The proposed selection of TS is based on all pertinent prioritized and ranked values (potential to pose threat to human health, impact on economy, and environment) and on the IMO Guidelines G7 (2007) on risk assessment under regulation A-4. Transparency (expert judgments are open for public scrutiny), consistency (universal applicability of the TS selection criteria and procedure) and precautionary approach (taking into account that information on aquatic organisms ecophysiology, pathways of introduction, environmental and economic impacts is often uncertain and incomplete) are considered. Finally, a proposal for the process of updating the TS list is elaborated.

Action required

The Meeting is invited to <u>take note</u> of the study report and <u>act</u> as appropriate.

Target species selection criteria for risk assessment based exemptions of ballast water management requirements in the Baltic Sea

Gollasch, S., David, M., Hegele-Drywa, J., Heitmüller, S., Helavuori, M., Karjalainen, M., Lehtiniemi, M., Normant-Saremba, M., Ojaveer, H., Olenin, S., Ruiz, M., Sala Perez, M., Strake, S., Broeg, K.

List of contents

1. Introduction

The IMO risk assessment (RA) describes three different ballast water management (BWM) RA methods, “environmental matching”, “species’ biogeographical” and “species-specific” RA. The environmental matching RA between the areas of ballast water origin and discharge considers non-biological parameters as surrogates for the species survival potential in the new environment. The species’ biogeographical RA identifies species with overlapping distribution in the donor and recipient ports and biogeographic regions which is taken as direct indications of the similarity of the environmental conditions and hence species survival in the new environment.

The species-specific RA is focused on life history information and physiological tolerances to identify species’ physiological limits estimating its potential to survive or complete its life cycle in the new environment and it considers target species (TS). An unacceptable risk is indicated if at least one TS is present in the donor port/region, but not in the recipient port, which is likely to survive in the recipient port.

First European considerations of TS were conducted already in 1999 (Gollasch & Leppäkoski 1999) and this approach was updated in 2006 (Leppäkoski & Gollasch 2006). These approaches were based on expert opinion and prepared before the IMO Guidelines for risk assessment under regulation A-4 of the BWM Convention (G7) was adopted in 2007 and are therefore considered as outdated. In 2013, the Helsinki Commission (HELCOM) and the Oslo Paris Commission (OSPAR) adopted the Joint HELCOM/OSPAR Guidelines on the granting of exemptions under the International Convention for the Control and Management of Ships’ Ballast Water and Sediments, Regulation A-4 (JHP), which contains a list of TS for these regional seas as Annex 2 of the document (HELCOM 2013).

More recently, the TS list for the Baltic Sea was revised and adopted by the Heads of Delegation of HELCOM in June 2015 (HELCOM 2015a). It was noted that the majority of the HELCOM countries are ready to use this TS list, which contains 41 species, for the purpose of BWM exemptions according to the IMO Ballast Water Management Convention (BWMC) A-4. It was further noted that this list is a living document (HELCOM 2015b). Likewise, the TS list for the North-East Atlantic was agreed in 2015 (OSPAR 2015).

The JHP is currently under a revision process which is envisaged to be conducted during 2020-2021. As part of this process the TS selection criteria were amended and adopted by the HELCOM/OSPAR TG BALLAST in 2016 (see Outcome of HELCOM/OSPAR TG Ballast 7-2016, Annex 3).

According to IMO TS are species that meet specific criteria indicating that they may impair or damage the environment, human health, property or resources and are defined for a specific port, State or biogeographic region (IMO 2007).

Species-related risk focuses, e.g., on the evaluation of the potential invasiveness of each selected species considering also the harm that it may cause in the recipient environment. In the context of IMO BWMC these species are termed harmful aquatic organisms and pathogens (HAOP). The term HAOP is defined as any 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).

As a result HAOP include all potentially harmful non-indigenous, cryptogenic and impacting native aquatic species and pathogens (David et al. 2013, Gollasch et al. 2015). Also Olenin et al. (2016) consider including also impacting native aquatic species, e.g., species causing harmful algal blooms, aquaculture pests, parasites and disease agents. Therefore, and in line with the precautionary principle, all HAOP are potential TS.

Based upon the IMO definition in the G7 Guidelines (IMO 2007), at least all following criteria need to be considered when identifying TS (David and Gollasch 2018):

- evidence of prior introduction(s), i.e., the species showed its capability to become introduced outside its native range (see 2.1.);
- impact and its severeness, i.e. (see 2.2);
  - potential impact on environment, economy, human health, property or resources;
  - strength and type of ecological interactions, i.e., severeness of its impact;
- current distribution within the native biogeographic region and in other biogeographic regions (see 2.3); and
- relationship with ballast water as a transport vector, i.e., when the species was already found in a ballast tank or if the life cycle of the species includes a larval phase or planktonic adult which makes a ballast water transport likely (see 2.4).

In addition, numerous attempts were undertaken to identify typical characteristics of the ‘perfect’ invasive species, which could be assumed as TS. It was discussed that species with high environmental tolerances and those with high reproduction rates may have a high invasion potential (Safriel and Ritte 1980, 1983; Kareiva 1999; Hewitt 2003; Rewicz et al. 2014) and should therefore also be considered as candidates for TS according to the IMO criteria.

2. Identification criteria of target species (TS)

For the identification of TS, IMO does not distinguish between TS which were already introduced or which one wants to avoid to become introduced in the future. Even though there are limits given in BWMC D-2 for indicator microbes, David and Gollasch (2018) consider pathogens, more than limited in D-2 and other species and/or strains than specified in D-2, as by default being unwanted TS because no ballast water recipient port/region would accept to have harmful pathogens discharged in their waters.

Therefore, the TS selection process should consider *all potentially harmful non-indigenous, cryptogenic and native species, i.e., Harmful Aquatic Organisms (HAO), in potential donor ports/areas.*

Species, which were identified as TS elsewhere or which were included in a control or eradication programme anywhere worldwide, show higher potential to become TS also in the Baltic so that they are recommended to be considered with priority. The reasoning is that in case others try to control or eradicate a species it is because of its strong negative impact.

A problem with the TS selection is possible subjectivity in their identification process. It is likely that the assessment whether or not a species should become a TS results in a degree of uncertainty, e.g., it is possible that species identified as harmful in some environments may not be harmful in others and vice versa. This would result in species being categorized as TS in one region but not in another. Further, different scientists in the same region may classify the same species differently, i.e. as TS or not. To solve this problem, the following TS identification criteria were developed. The criteria are fully in line with the Guidelines G7 and we also considered the TS selection approach as set out in the amended Joint Harmonised Procedure (JHP) for the Contracting Parties of OSPAR and HELCOM for granting of BWM exemptions (HELCOM 2016). We note that the Guidelines G7 TS identification criteria are more specific compared to JHP.

According to JHP, there are two main general questions which should be addressed before a species is considered for inclusion in the target species list:

a. Is there a potential for a species to be primarily introduced or secondarily spread via ballast water or sediments as the major vector, and

b. Is the species present only in part(s) of the region but not the entire region in self-sustaining populations?

In addition to these general aspects, “any impact” on human health, environment or economy triggers the inclusion of the species into the TS list. However, “any impact” is not further specified in the revised TS selection criteria.

The next chapters describe the TS selection criteria suggested by the COMPLETE project based on current knowledge, IMO Guidelines G7, and discussions between partners of the project. This report ends with a chapter discussing the relative importance of these selection criteria.

2.1 Evidence of prior introduction(s)

When considering all HAOP in the donor port/area, those species who managed to become introduced to areas outside their native ranges are potentially classified as TS as their potential to spread has already been documented.

- Baltic Sea example: The donor port contains the ctenophore *Beroe ovata*. This species is known to have been introduced to several regions world-wide and it was found in 2011 in the Danish Belt Sea. Another example may be *Balanus glandula*, which is known since 2015 to occur in Belgium as first European record.

2.2 Impact and its severeness

Concerning the impact of species it is suggested to differentiate within each impact category (human health, environment and economy) between acceptable and non-acceptable impact. Impact on health and measurable economic impact should always be considered as unacceptable. Accordingly, all human pathogens (more than limited in BWMC D-2 and other species and/or strains than specified in D-2) and species with documented measurable economic impact are TS no matter how strong the impact is. The potential environmental impact of the species can be evaluated by applying the impact categorization concepts as defined in Olenin et al. (2007), which were also used in the Ballast water management for Adriatic Sea protection (BALMAS) project (Garaventa et al. 2014, Magaletti et al. 2018). The Olenin et al. (2007) biopollution assessment concept uses abundance and distribution information of non-indigenous species and includes an index that classifies impacts on native species, communities, habitats and ecosystem functioning. This concept enables impact assessments from the absence of any measurable impacts up to major shifts and even catastrophic perturbations in native community structure, habitat properties and ecosystem functioning.

Olenin et al. (2007) developed five impact categories, i.e., none, weak, moderate, strong and massive. Based on the above mentioned differentiation between acceptable and unacceptable impact, we recommend defining one threshold based on the categorization of Olenin et al. (2007). This would also be in line with the recent JHP impact categories (y/n). According to this categorization, a low impact is characterized by:

- local displacement of native species, but no extinction. Change in ranking of native species, but dominant species remain the same. Type-specific communities are present;
- alteration of a habitat(s), but no reduction of spatial extent of a habitat(s);

- measurable, but weak changes with no loss or addition of new ecosystem function(s); or
- measurable, but weak changes with no loss or addition of resources.

We see already species in this impact category as critical and following the precautionary principle their introduction should be avoided and therefore suggest to define the threshold acceptable-unacceptable between the “No impact” and “Low impact” category (table 1).

With reference to environmental impacts, these can occur at different levels (species level, habitat level, ecosystem functioning level). The impact on resource users was added during BALMAS to complete the assessment of impacts species may cause and to reflect the IMO definition, i.e., impacting on the environment, human health, property or resources.

Species where no impact information is available should be included to the TS for precaution.

Table 1. HAOP environmental impact categories (modified after Olenin et al. 2007)

Impact category	**Impact on species**	**Impact on habitat**	**Impact on eco-system functioning**	**Impact on resource users**
Acceptable	No displacement of native species, although NIS may be present. Status of native species according to quantitative parameters in the community remains unchanged	No habitat alteration	No measurable effect	No measurable effect
THRESHOLD				
Unacceptable	Local displacement of native species, but no extinction. Change in ranking of native species, but dominant species remain the same. Type-specific communities are present	Alteration of a habitat(s), but no reduction of spatial extent of a habitat(s)	Measurable, but weak changes with no loss or addition of new ecosystem function(s)	Measurable, but weak changes with no loss or addition of resources
	Large scale displacement of native species causes decline in abundance and reduction of their distribution range within the assessment unit; and/or type-specific communities are changed noticeably due to shifts in community dominant species	Alteration and reduction of spatial extent of a habitat(s)	Moderate modification of ecosystem performance and/or addition of a new, or reduction of existing, functional group(s) in part of the assessment unit	Moderate modification of resources and/or addition of a new, or reduction of existing, resources in part of the assessment unit
	Population extinctions within the ecosystem. Former community dominant species still present but their relative abundance is severely reduced; NIS are dominant. Loss of type-specific community within an ecological group	Alteration or loss of habitat(s), severe reduction of spatial extent of habitat(s)	Severe shifts in ecosystem functioning. Reorganisation of the food web as a result of addition or reduction of functional groups within trophic levels	Severe shifts in resources with income loss for resource users

2.3 Current distribution

A simple assessment may be conducted to determine whether a HAOP is present in the donor port, but not in the recipient port, which has to be based upon port baseline surveys. In addition, the HAOP distribution within its native biogeographic region and in other biogeographic regions has to be evaluated. As a consequence, species with a wide biogeographical or habitat distribution or which are known as HAOP in other biogeographic regions is considered as potential TS.

The current distribution of species has an influence on the species impacts. By simple logic, only widely distributed species may result in the highest impact category. This means that, e.g., a species cannot cause large scale displacements or extinctions of species when it is itself not widely distributed. Nevertheless, a small-scale distributed species with local impact may be of unacceptable consequence should it overlap in distribution with a rare or endangered species with a restricted distribution. In such a case even a HAOP with a small-scale distribution may cause a strong impact as it may lead to an extinction of a rare or endangered species.

Further, locally distributed species may cause a strong impact on, e.g., resource users. This was documented by the fouling species *Ficopomatus enigmaticus* which clogged water intake pipes in a small area in the Port of Emden (Germany), which showed elevated water temperatures due discharge of heated power plant effluents (Kühl, 1977). After some adaption time, this species spread further resulting in a larger distribution area and in an even stronger impact.

2.4 Relationship with ballast water as a transport vector

A positive confirmation of the relationship with ballast water is given when the species was already found in a ballast tank or if the life cycle of the species includes a larval phase or planktonic adult which makes a ballast water transport likely. Several ballast water sampling studies were previously conducted in Europe and the diversity of living organisms (including native, cryptogenic and non-indigenous species) found included viruses, bacteria, human pathogens, fungi, protozoa, algae (unicellular phytoplankton algae and macroalgae), invertebrates and fish. Data on aquatic species found in ballast tanks are compiled in AquaNIS (2015). The dominant groups were crustaceans, molluscs and polychaetes, as well as algae. In total, more than 1,000 species were identified. The majority of these species were small and therefore better enabled to withstand the physical forces caused by the vessel ballast water pumps during the ballasting processes. However, fish with a body length up to 15 cm were found alive within ballast tanks (Gollasch et al. 2002, 2015, David et al 2015).

Many aquatic species have a planktonic or spreading phase in their life cycle so that all those species would have a relationship with ballast water and could become TS. The spreading stage duration is neglected here as TS qualifier to implement the precautionary principle. This is because a shorter spreading stage phase does not disqualify a species from being TS in case of shorter voyages, i.e., when the voyage is shorter than the spreading stage duration. One of the shortest spreading stage durations was found to last only minutes, e.g., for the hydrocoral *Allopora californica* (Shanks 2009). Other species have short-lived spreading stages in the range of a few hours up to a day with *Didemnum* spp. being an example (Olsen 1983, Daley & Scavia, 2008, Gittenberger 2010). Short-lived larvae are also known from certain sponges, e.g. 8-70 hours for *Sigmadocia caerulea* (Maldonado & Young 1999). Pelagic durations of more than 200 days (Kempf 1981) or even a year were observed for several mollusks (Strathmann & Strathmann 2007). Thorson (1946) observed in his study area Öresund that 63% of species had long-lived planktonic larvae, 6% had short-lived (<1 week) planktonic larvae and 31% had non-planktonic larvae. Similar results were found during a study in North America (Grantham et al 2003). Tardent (1979) studied the larval duration of 195 species belonging to Polychaeta, Echinodermata, Mollusca and Decapoda. He noted that for 80 % of these species the larval duration is between a few days and six weeks, which was also found by Shanks (2009). Therefore, even spreading stage phases of a few hours do not guarantee that this species cannot be transported into the recipient port when the voyage is short or when reproduction inside a ballast tank is possible. Further; species may spread by fragmentation or form of resting stages, no matter how long the larval duration is, thereby surviving also longer vessel voyages. In conclusion, the only species not to be categorized as TS are only those which:

- lack a planktonic phase completely[1];
- are bottom living, but live so deep in the sediment that they cannot be stirred up into water column and then pumped on board of a vessel[2]; or
- are in all life stages too big to be pumped on board (e.g., larger fish, turtles).

  - ➢ Baltic Sea example:
    An example of a species too big in all life stages to be pumped on board are sharks, e.g., the ovoviviparous *Mustelus asterias* (starry smooth-hound), which 1,4 m long and it is occasionally found in the western Baltic. For this species even the young are about 30 cm long at birth. Even bigger are *Lamna nasus*, a species of mackerel sharks also found in the Baltic. Most egg-laying sharks have eggs of 5-10 cm length which are too big to be pumped on board.

2.5 Target species selection guide

Considering the Guidelines G7 in detail, Olenin et al. (2016) developed a questionnaire to identify TS, which may be used as guidance. The questionnaire addresses mainly the relationship with ballast water and impact. The questions include:

Relationship with ballast water

- Is there actual evidence of the species being found in ballast water and/or sediments?
- Is there a risk for the species of becoming entrained in ballast tanks?
  - o Species has pelagic life-history stage, including resting stages;
  - o Species performs diurnal vertical migration;
  - o Species has a pelagic host;
  - o Species is present in sediments in shallow water ports (ballast water uptake areas).

Impact

- Has the species been documented as having an impact upon human health (mortality, illness, poisoning, toxicity, pain, irritation)?
- Is there a potential for the species to impact upon human health or is there insufficient evidence to rule out impact?
- Has the species been documented as having an impact upon economy?
  - o Damage to property;
  - o Decline of employment;
  - o Decline of income.

[1] *Several marine gastropods are direct developers, characterized by a larval stage that has very low dispersal potential, others like many tunicates have a very short larvae phase of a few hours only. However, both groups of species mentioned here can theoretically be pumped on board.*

[2] *A sediment-dwelling organism (infauna). Among the deepest burrowers are the ghost shrimps – Thalassinidea – which go as deep as 3 metres into the sea bottom sediment. This means that adults are unlikely pumped on board. However, during reproduction larvae are released, which have a free-swimming stage up to months making ballast water transport possible.*

- Is there a potential for the species to impact upon economy or is there insufficient evidence to rule out an impact?
- Has the species been documented as having an unacceptable impact upon environment (native communities, habitats, ecosystem functioning)?
- Is there a potential for the species to cause unacceptable impact upon environment or is there insufficient evidence to rule out unacceptable impact?

To address all IMO TS selection criteria as outlined above, this guide would need to be expanded to also address the following points:

Prior introduction

- Was the species found anywhere outside its native range?

Current distribution

- Has the species a wide biogeographical distribution?
- Has the species a wide habitat distribution?

2.6 Theoretical case study for illustration purposes

As an example and to document how the TS selection may be worked out we created a theoretical list of species (table 2). Target species are marked in **bold**.

	TS selection criteria				Other information	
Species list	Relation with BW	Unacceptable impact?[3]	Prior introduction elsewhere?	Wide distribution?[4]	Categorized as TS elsewhere?	Control/eradication elsewhere?
Non-harmful native species (e.g. *Acartia bifilosa*)	X					
Harmful native species (e.g., HAB)	**X**	**X**	**X**	**X**		
Harmful native species (e.g., stinging jellyfish)	X					
Cryptogenic species (e.g., *Amphibalanus improvisus*)	**X**	**X**	**X**	**X**		
Non-indigenous species (e.g., *Neogobius melanostomus*)	**X**	**X**	**X**			
Non-indigenous species (e.g., *Undaria pinnatifida*)	**X**	**X**	**X**	**X**	**X**	**X**
Pathogen	**X**	**X**	**X**	**X**		

[3] Expert judgement based on both previous evidence (if needed, also elsewhere) and best available science/expertise.
[4] Distribution wider than single defined locations but in whole biogeographic areas.

2.7 Selection criteria importance

The overall principle to follow is to consider what is acceptable to the ballast water recipient port, i.e., under which circumstances an exemption can be granted so that no ballast water management is needed between a donor and recipient port.

The above mentioned TS selection criteria are partly connected with each other and therefore have to be assessed in a step by step process. For example, a strongly negatively impacting species, which has no larval or spreading phase, will not be seen as TS as it cannot be transported by ballast water.

We therefore propose the following order of assessment:

1. relation with ballast water and
2. unacceptable impact

The criteria

3. prior introduction elsewhere, and
4. current distribution

are of secondary importance as these would alone not identify a TS. As an example, a wide spread species, which occurs in low numbers may cause no impact and is therefore not seen as TS. Other parameters, such as eradication or control programmes, may also be considered (see table 2, "other information"). Species characteristics like wide salinity tolerance and species reproduction strategy are risk assessment related, but not TS criteria related.

3. Acknowledgements

This report was prepared within the project COMPLETE - Completing management options in the Baltic Sea region to reduce risk of invasive species introduction by shipping. The project is co-financed by the European Union's funding Programme Interreg Baltic Sea Region (European Regional Development Fund).

4. Literature

AquaNIS. Editorial Board, 2015. Information system on Aquatic Non-Indigenous and Cryptogenic Species. World Wide Web electronic publication. www.corpi.ku.lt/databases/aquanis. Version 2.36+. Accessed 2018-11-23.

Bonsdorff, E. 1981. Notes on the occurrence of Polychaeta (Annelida) in the archipelago of Aland, SW Finland. Memoranda Society Fauna Flora Fennica 57, 141–146.

Daley, B.A., Scavia, D. 2008. An integrated assessment of the continued spread and potential impacts of the colonial ascidian, Didemnum sp. A, in U.S. waters. NOAA Technical Memorandum NOS NCCOS 78: 61 pp.

David M., Gollasch S. 2018. Risk assessment for ballast water management – learning from the Adriatic Sea case study. Marine Pollution Bulletin, Special Issue. (in press)

David M., Gollasch S., Leppäkoski E. 2013. Risk assessment for exemptions from ballast water management – The Baltic Sea case study. Marine Pollution Bulletin 75, 205–217.

David M., Gollasch S., Leppäkoski E., Hewitt C. 2015. Risk assessment in ballast water management. In David M, Gollasch S (eds) Global Maritime Transport and Ballast Water Management – Issues and Solutions. Invading Nature. Springer Series in Invasion Ecology 8, Springer Science + Business Media, Dordrecht, The Netherlands. 306 pp.

Garaventa F., Magaletti E., Castriota L., Silvestri C., Tornambè A., Falautano M., Maggio T., Gollasch S., Muha T.P., Mozetič P., Pigozzi S., David M. 2014. Review and comment general categorization criteria and selection of a promising EWS approach for the Adriatic. Report. BALMAS project. WP 6.3. 16 pp.

Gittenberger, A. 2010. Risk analysis of the colonial sea-squirt Didemnum vexillum Kott, 2002 in the Dutch Wadden Sea, a UNESCO World Heritage Site. The Invasive Alien Species Team of the Dutch Ministry of Agriculture, Nature & Food Quality, Wageningen, The Netherlands. 32 pp.

Gollasch S., Lenz J., Dammer M., Andres H.G. 2000a. Survival of tropical ballast water organisms during a cruise from the Indian Ocean to the North Sea. J Plankton Res 22:923–937.

Gollasch S., Leppäkoski E. 1999. Initial risk assessment of alien species in Nordic coastal waters. Nord 1999: 8. Nordic Council of Ministers, Copenhagen. 244 pp.

Gollasch S., Minchin, D., David M. 2015. The Transfer of Harmful Aquatic Organisms and Pathogens with Ballast Water and their Impacts. In David M, Gollasch S (eds) Global Maritime Transport and Ballast Water Management – Issues and Solutions. Invading Nature. Springer Series in Invasion Ecology 8, Springer Science + Business Media, Dordrecht, The Netherlands. 306 pp.

Gollasch S., Rosenthal H., Botnen H., Hamer J., Laing I., Leppäkoski E., MacDonald E., Minchin D., Nauke M., Olenin S., Utting S., Voight M., Wallentinus I. 2000b. Fluctuations of zooplankton taxa in ballast water during short-term and long-term ocean-going voyages. Int Rev Hydrobiol 85(5–6):597–608.

Grantham, B. A., Eckert, G. L., Shanks, A. L. 2003. Dispersal potential of marine invertebrates in diverse habitats. Ecological Applications, 13(1) Supplement, 108-116

HELCOM 2013. Joint HELCOM/OSPAR Guidelines on the granting of exemptions under the International Convention for the Control and Management of Ships' Ballast Water and Sediments, Regulation A-4, document adopted as part of the 2013 HELCOM Ministerial Declaration.

HELCOM 2015a. Revised Target Species List for BWMC A-4 exemptions in the Baltic. Baltic Marine Environment Protection Commission (HELCOM), Heads of Delegation Meeting, Tallinn, Estonia, 10-11 June 2015 (HOD 48-2015), document 3-20.

HELCOM 2015b. Outcome of the 48th meeting of Heads of Delegation (HELCOM HOD). Baltic Marine Environment Protection Commission (HELCOM), Heads of Delegation Meeting, Tallinn, Estonia, 10-11 June 2015 (HOD 48-2015).

HELCOM/OSPAR TG BALLAST 2016. Annex 3 of the Outcome of the Seventh Meeting of the Joint HELCOM/OSPAR Task Group on Ballast Water Management Convention Exemptions, Brussels, Belgium, 29-30 November 2016.

Hewitt C.L. 2003. Marine biosecurity issues in the world oceans: global activities and Australian directions. Ocean Yearb. 17:193–212

IMO (2007) Guidelines for risk assessment under regulation A-4 of the BWM Convention (G7). Marine Environment Protection Committee, Resolution MEPC.162(56), 13 July 2007. International Maritime Organization, London

Kareiva P. 1999. Developing a predictive ecology for non-indigenous species and ecological invasions. Ecology 77:1651–1652

Kempf, S.C. 1981. Long-lived larvae of the gastropod Aplysia juliana: Do they disperse and metamorphose or jst slowly fade away? Mar. Ecol. Prog. Ser. 6, 61-65.

Kühl H. 1977. *Mercierella enigmatica* (Polychaeta: Serpulidae) an der deutschen Nordseeküste. Veröff. Inst. Meeresforsch. Bremerh. 16, 99–104.

Leppäkoski L., Gollasch S. 2006. Risk Assessment of Ballast Water Mediated Species Introductions – a Baltic Sea Approach. Report prepared for HELCOM, Helsinki, Finland. 111 pp.

Magaletti E., Garaventa F., David M., Castriota L., Kraus R., Luna Gian M., Silvestri C., Forte C., Bastianini M., Falautano M., Maggio T., Rak G., Gollasch S. 2018. Developing and testing an Early Warning System for Non Indigenous Species and Ballast Water Management. J Sea Res 123 (Special Issue Ballast Water Management), 100-111.

Maldonado, M. Young, C.M. 1999. Effects of the duration of larval life on postlarval stages of the demosponge *Sigmadocia caerulea*. Journal of Experimental Marine Biology and Ecology, 232, *9-21.*

McCollin T., Shanks A.M., Dunn J. 2008. Changes in zooplankton abundance and diversity after ballast water exchange in regional seas. Mar Pollut Bull 56:834–844.

Olenin S., Gollasch S., Jonushas S., Rimkute I. 2000. En-route investigations of plankton in ballast water on a ships' voyage from the Baltic Sea to the open Atlantic coast of Europe. Int Rev Hydrobiol 85:577–596.

Olenin S, Minchin D, Daunys D (2007) Assessment of biopollution in aquatic ecosystems. Marine Pollution Bulletin 55, 379–394.

Olenin S., Ojaveer H., Minchin D., Boelens R. 2016. Assessing exemptions under the ballast water management convention: preclude the Trojan horse. Marine Pollution Bulletin 103, 84–92.

Olson, R. R. 1983. Ascidian-Prochloron symbiosis: the role of larval photoadaptations in midday larval release and settlement. Biological Bulletin 165, 221-240.

OSPAR 2015. OSPAR Target Species List (OSPAR Agreement 2015-01).

Reise K., Gollasch S., Wolff W.J. 1999. Introduced marine species of the North Sea coasts. Helgoländer Meeresunters. 52, 219-234.

Rewicz T., Grabowski M., MacNeil C., Bącela-Spychalska K. 2014. The profile of a 'perfect' invader – the case of killer shrimp, *Dikerogammarus villosus*. Aquatic Invasions 9(3)

Safriel U.N., Ritte U. 1980. Criteria for the identification of potential colonizers. Biol J Linn Soc 13:287–297

Safriel U.N., Ritte U. 1983. Universal correlates of colonizing ability. In: Swingland IR, Greenwood PJ (eds) The ecology of animal movement. Clarendon, Oxford, pp 215–239

Shanks, A. L. 2009. Pelagic larval duration and dispersal distance revisited. Biol. Bull. 216, 373–385

Strathmann, M. F., Strathmann, R. R. 2007. An Extraordinarily Long Larval Duration of 4.5 Years from Hatching to Metamorphosis for Teleplanic Veligers of Fusitriton oregonensis. Biol. Bull. 213: 152–159.

Tardent, P. 1979. Meeresbiologie. Eine Einführung: Georg Thieme Verlag, Stittgart, Germany. 381 pp.

Thorson, G. 1946. Reproduction and development of Danish marine bottom invertebrates, with special reference to the planktonic larvae in the sound (Øresund). Meddelelser fra Kommissionen for Danmarks Fiskeri-og Havundersøgelser, Serie Plankton 4, 1–523.

Annex 1: Process of applying the target species selection criteria for risk assessment based exemptions of ballast water management requirements in the Baltic Sea

The following is based on the target species (TS) selection criteria background report. For practical application, a step-wise approach was chosen to explain how species are evaluated whether or not they are considered target species for the Joint HELCOM/OSPAR Guidelines on the granting of exemptions under the International Convention for the Control and Management of Ships' Ballast Water and Sediments, Regulation A-4 (JHP) risk assessment.

The species to be considered here are species already included in the TS list and species detected in port surveys according to the JHP in the ports for which the exemption may apply.

Step 1

Species already on the HELCOM TS list need to be checked against the updated TS selection criteria for the purpose of risk assessment (RA) for Ballast Water Management (BWM) exemptions. Only those species which meet the criteria as listed below in Step 3 and more detailed in the TS selection criteria background report should remain on this list. The HELCOM TS list is periodically re-evaluated by the expert group established under HELCOM Maritime (the process of re-evaluating the HELCOM TS list was agreed by TG Ballast).

Step 2

List all species found during the current JHP port surveys and if available additional data from other surveys in the same port or adjacent habitats e.g. by using data from AquaNIS of both/all ports involved in an exemption application. All species which are on the HELCOM TS list, when found in the ports to be considered, are identified as TS for the risk assessment for exemptions.

Step 3

Species found during the port surveys which have not been documented before should be evaluated based on the TS selection criteria. At least **all** following criteria need to be considered:

1. Relationship with ballast water as a transport vector, i.e., when the species was already found in a ballast tank or if the life cycle of the species includes a larval phase or planktonic adult which makes a ballast water transport likely;

2. Impact on human health, economy and/or environment and its severeness, i.e., does the species may cause unacceptable high impact (TS selection criteria background document); in case the impact is not known, the species will automatically appear as TS;

3. Evidence of prior introduction(s), i.e., the species showed its capability to become introduced outside its native range; and

4. Current distribution within the native biogeographic region and in other biogeographic regions.

We recommend performing the evaluation in a transparent format, i.e., develop a species evaluation sheet that the reader can see which criterion applies and which not. This may be done in table format and with references where available. This process could be performed by the expert group established under HELCOM Maritime.

In summary, TS are species that

- Criterion 1
  - have a relationship with ballast water; and
- Criterion 2
  - have been assessed to cause human health impact; and/or
  - have been assessed of having potential to cause measurable economic impact; and/or
  - have been assessed having potential to cause unacceptable environmental impact.

Criteria 3 and 4 are supporting criteria for the impact assessment in 2.

Further detailed information can be found in the TS selection criteria background document.