

Biopollution level index

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Key message

There is no area in the Baltic Sea which is not impacted by non-indigenous species (NIS). Conversely, no areas of the highest biopollution level ('massive impacts') were found either.

Estuaries and bays were found to be more impacted by NIS than open coasts or offshore area

Description of the indicator

The number of non-indigenous species (NIS) introduced in the Baltic Sea due to human activities is increasing. Some of them may spread in large quantities and occupy large areas. Such invasive NIS may cause local elimination of sensitive and/or rare species, alteration of native communities, modification of habitats, changes in food web functioning. Adverse effects of invasive NIS at such a level that lower the environmental quality are termed "biological pollution" or "biopollution". Invasive species may also hamper the economic use of the sea or even represent a risk for human health. Economic impacts range from financial losses in fisheries to expenses for cleaning intake or outflow pipes of industries and structures from fouling. Public health impacts may arise from the introduction of microbes or toxic algae.

The Biopollution level index was developed by Olenin et al. (2007) and a Baltic wide use of the index was published by Zaiko et al. (2011). Increasing biopollution indicates additional stress for the ecosystem. It is a signal of failed management concerning introductions of

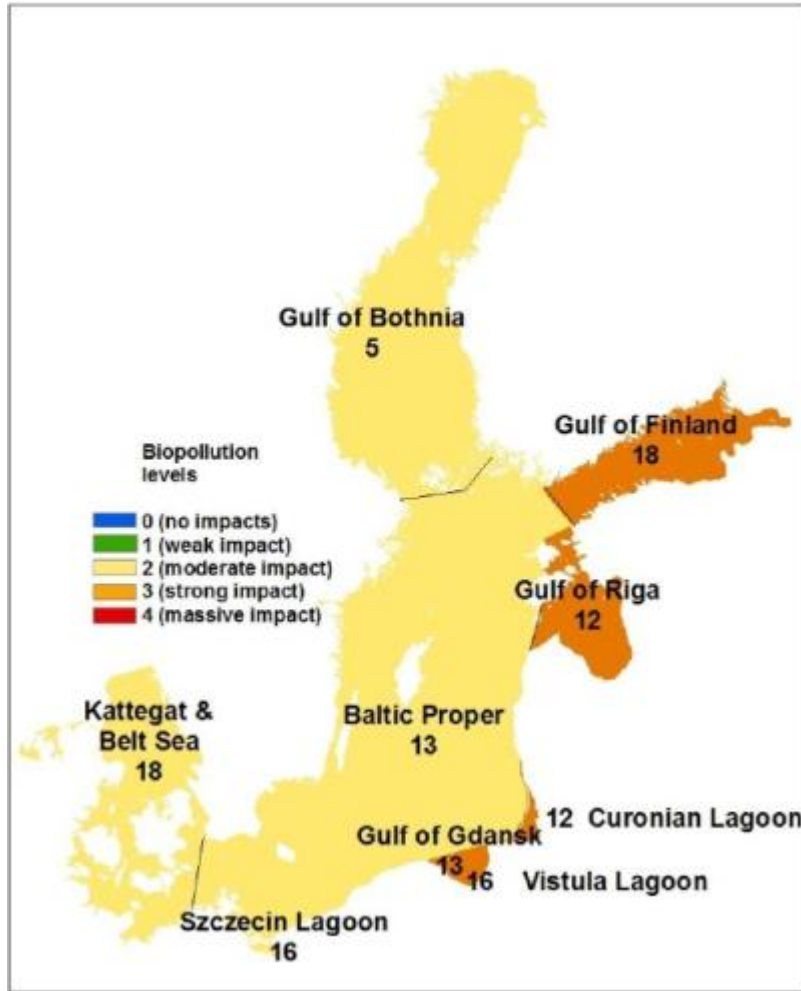


Figure 1. Biopollution level in the assessed sub-regions in the Baltic Sea. Numbers indicate the number of impacting non-indigenous species in an assessment unit (with BPL>0). BPL may get values from 0 to 4. Modified from Zaiko et al. 2011.

Policy relevance

Since the early 1990's when the Marine Protection Committee (MEPC) of the International Maritime Organisation (IMO) put the issue of non-indigenous species (NIS) on the agenda, the problem has become more and more important for marine environmental protection. In 2004 the Ballast water Convention was adopted by the IMO. The convention requires ballast water management procedures to minimize the proliferation of non-indigenous species via ballast water and sediment. Once entered into force every ship has to treat its ballast waters unless exemption is given based on risk analysis.

In order to minimize adverse effects of introductions and transfers of marine organisms for aquaculture ICES drafted the 'ICES Code of Practice on the Introductions and Transfers of Marine Organisms'. The Code of practice summarizes measures and procedures to be taken into account when planning the

introduction of NIS for aquaculture purposes. On the European level the EC Council Regulation No 708/2007 concerning the use of non-indigenous and locally absent species in aquaculture is based on the ICES Code of Practice.

With the maritime activities segment of the Baltic Sea Action Plan HELCOM expresses the strategic goal to have maritime activities carried out in an environmental friendly way and that one of the management objectives is to reach “No introductions of alien species from ships”. In order to prepare the implementation of the Ballast Water Convention a road map has been established with the ultimate goal to ratify the BWM Convention by the HELCOM Contracting States preferably by 2010, but in all cases not later than 2013.

The EU Marine Strategy Framework Directive in order to maintain or achieve good environmental status in the marine environment established a framework for Member states. The good environmental status shall be determined on the basis of qualitative descriptors. One of the qualitative descriptors concerns non-indigenous species stating 'Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem.'

Biopollution Level index has been reviewed by the EU MSFD good environmental status task group 2 on non-indigenous species and is seen as a straight-forward and practical way of assessing impacts of the NIS and their potential to become invasive. BPL index is also viewed as a practical solution for the Ballast Water Management efforts to distinguish between species which pose a threat on regional voyages and which should therefore be taken into account in Risk Assessments done for IMO BWM Convention when considering if a certain ship route may get an exemption from ballast water treatment procedures.

What is the impact of alien species?

Current status in the Baltic Sea

The assessment was performed for nine Baltic sub-regions. It revealed that documented ecological impact is only known for 43 NIS, which is less than 50% of the species registered in the sea. The assessment was made for multicellular species only. The highest biopollution (BPL = 3, strong impact) occurred in coastal lagoons, inlets and gulfs, and the moderate biopollution (BPL = 2) was found in the open sea areas (**Figure 1**). None of the Baltic sub-regions got low impact classifications (BPL = 0 or 1) indicating that invasive species with recognized impacts are established in all sub-regions.

The most widely distributed species, observed nearly all around the Baltic Sea, were *Marenzelleria* spp., *Potamopyrgus antipodarum*, *Eriocheir sinensis*, *Cercopagis pengoi*, *Mya arenaria* and *Balanus improvisus*. However, their magnitude of impact (BPL) differed between the sub-regions (**Figure 2**). For seven species (*Neogobius melanostomus*, *Obesogammarus crassus*, *Pontogammarus robustoides*, *Dreissena polymorpha*, *Gammarus tigrinus*, *Balanus improvisus* and *Cercopagis pengoi*) high biopollution level (BPL = 3) was defined in one or more analyzed sub-regions. None of the analyzed species, and consequently none of the assessment areas, got the maximum biopollution level (BPL = 4).

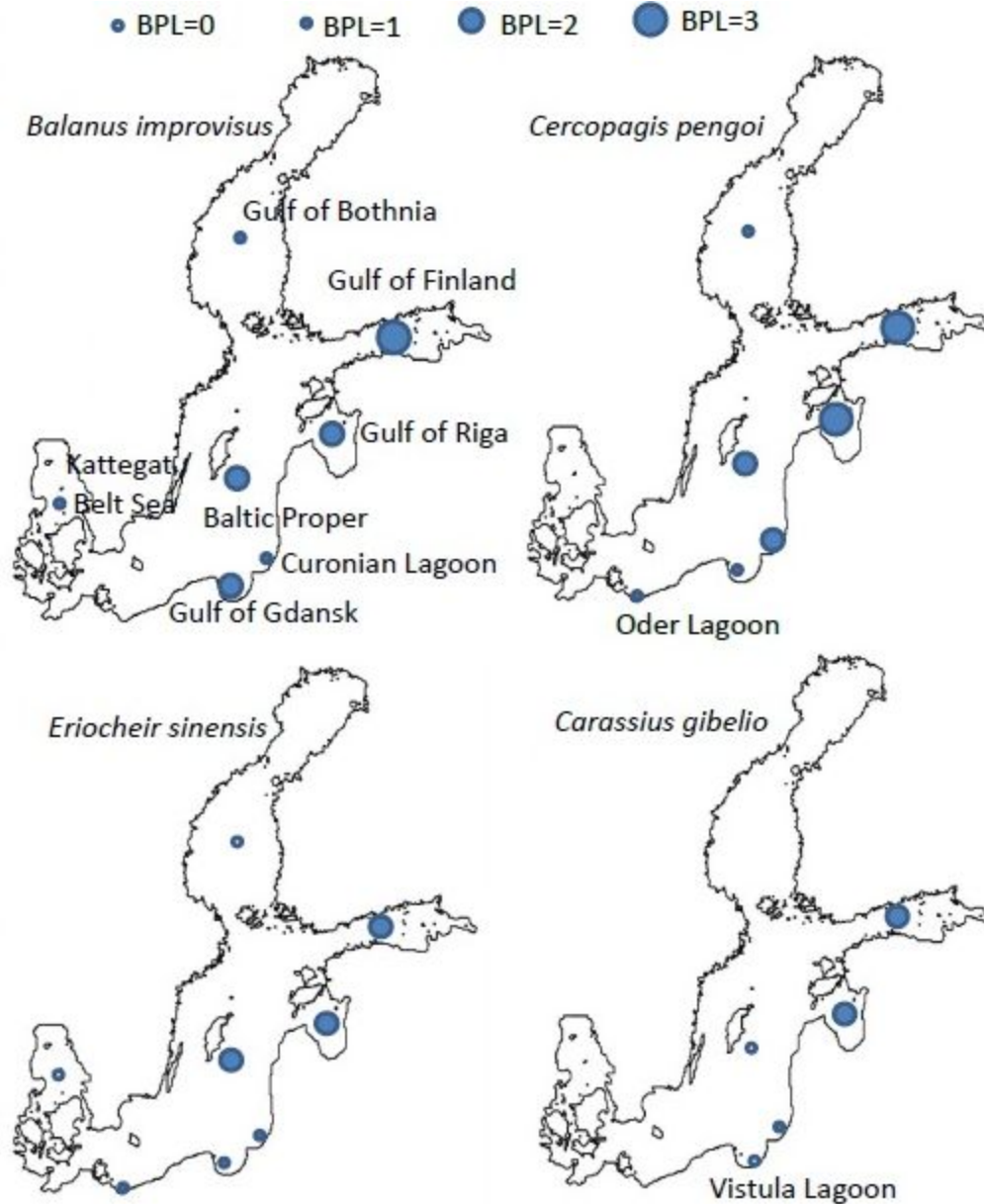


Figure 2. Biopollution level for some of the assessed non-indigenous species, which are either widely spread in the assessment area, the Baltic Sea, or have strong impacts in some of the sub-regions of the sea.

What does the Biopollution index do?

Background

Due to the fact that only a minority of non-indigenous species (NIS) are invasive i.e. have a potential to cause negative impacts on the environment, the plain high numbers of introduced species do not provide sufficient basis for the assessment of biopollution i.e. adverse environmental effects of NIS.

Invasive NIS cause adverse environmental and economic effects only after attaining a critical level of abundance and only when occupying a sufficiently large area. To classify the level of bioinvasion impacts an integrative method, the “Biopollution level index” (BPL), was proposed for aquatic ecosystems (Olenin et al. 2007). The index is based on a classification of the abundance and distribution range of alien species and the magnitude of their impacts on native communities, habitats and ecosystem functioning. It ranges from BPL = 0 (“no impact”) to BPL = 4 (“massive impact”). In this regard, NIS which cause high biopollution effects are most important, not only in terms of assessing the current and changing status of the ecosystems (requirements from the WFD and MSFD), but also in terms of the marine management perspective in order to facilitate strong move towards implementation of the ecosystem based approach.

Hence, the NIS need to be analysed and classified according to the magnitude of their impacts on the environment and biodiversity. In this regard, NIS which cause most harm on the environment and/or humans are most important, not only in terms of assessing the current and changing status of the ecosystems (requirements from the WFD and MSFD), but also in terms of the marine management perspective in order to facilitate strong move towards implementation of the ecosystem based approach.

The BPL method has been tested in the Baltic Sea with all known multicellular non-indigenous species recorded (Zaiko et al. 2011) as well as for a specific case of the dinoflagellate (*Prorocentrum minimum*) (Olenina et al. 2010).

The method to assess the impacts

The assessment is performed on 4 levels;

1. abundance and distribution (ADR)
2. impacts on communities
3. impacts on habitats
4. impacts on ecosystem functioning

and should be delivered on a defined aquatic area - assessment unit (e.g. a coastal lagoon, offshore sand bank, or even entire sub-basins) and for a defined period of time. After ADR is estimated, it is related to the magnitude of bioinvasion impacts, in order to reach the biopollution level index ranging from 0 to 4:

(0) no impact

(1) weak impact

(2) moderate impact

(3) strong impact

(4) massive impact.

The overall biopollution level is the highest species-specific biopollution level in an assessment unit, i.e. applying the 'one-out-all-out' principle and the pre-cautionary principle to the assessment.

The method, definitions and examples are given in detail in Olenin et al. 2007, Zaiko et al. 2011 and the HELCOM Baltic Sea Environment Fact Sheet on [Impacts of invasive phytoplankton species on the Baltic Sea ecosystem in 1980-2008](#). The index is structured according to **Figure 3**.

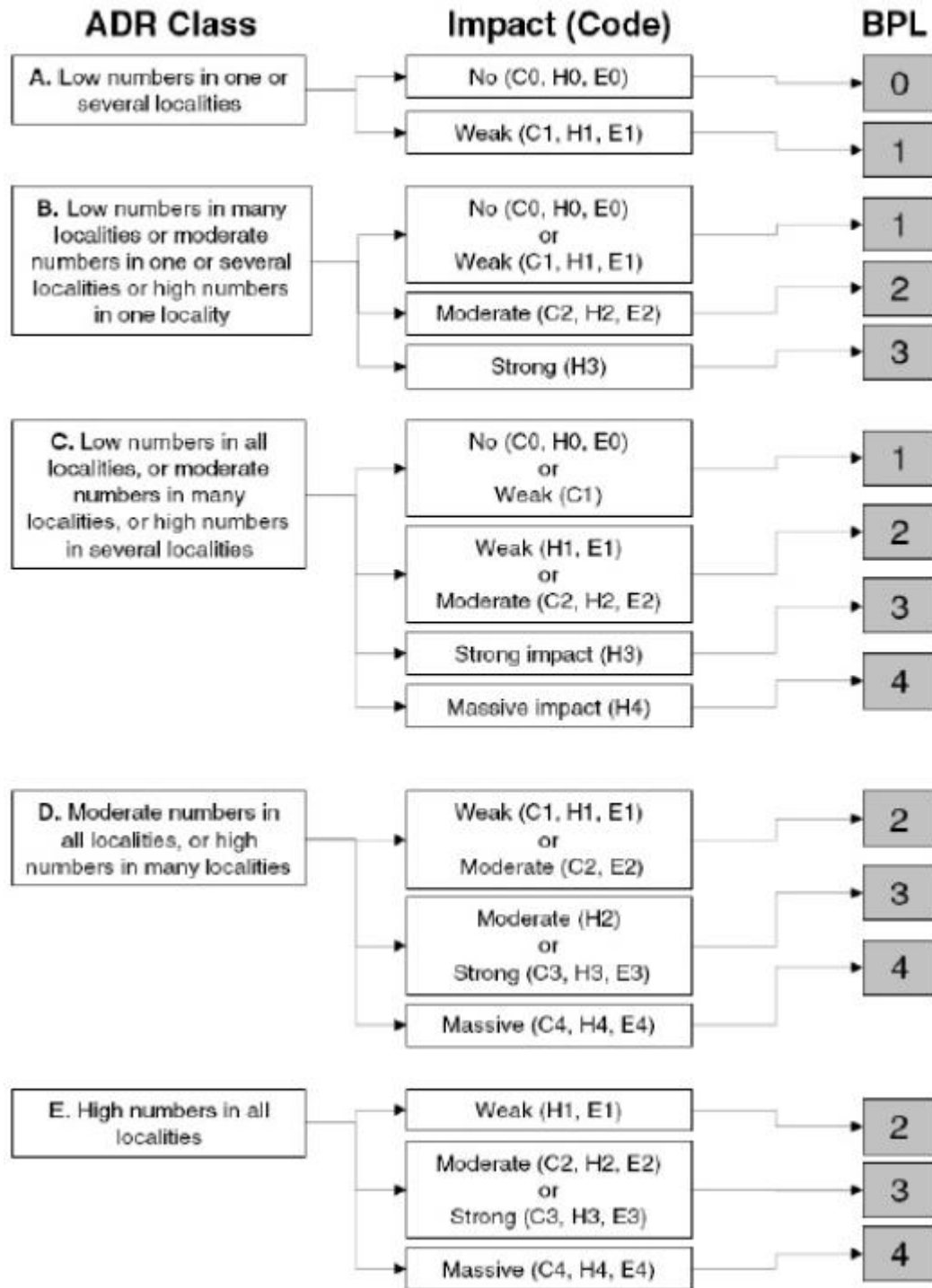


Figure 3. The scheme for assessment of biopollution level (BPL) index where ADR is abundance, distribution and range of NIS and impact codes (range from 0 = no impact to 4 = massive impact) are C on communities, H on habitats, E on ecosystem functioning. Source: Olenin et al. 2007.

Good environmental status (GES) and the biopollution level index

A problem related to non-indigenous species is that once an aquatic organism has been introduced and established in a new environment it is nearly impossible to eradicate it. The consequence is defining an area as “bad” status, depending on the presence of invasive species, means that the area likely will stay in a bad status without a possibility of improvement.

Given these conditions, the goal is always to minimize human mediated introductions of non-indigenous species (see the core indicator ‘Trends in arrival of new NIS’) and the description of GES for non-indigenous species should be 'no new introductions' as defined in the HELCOM management objective. Similarly, for the indicator in question the description of GES should be 'No new non-indigenous species with known impacts'. This means that the assessment is made for certain assessment periods including only those species which have been introduced during that period and species whose impacts have changed after the previous assessment. Some NIS are known not to cause any impacts for a long time but when environmental conditions change they suddenly become invasive and cause adverse impacts. Hence, updates of the assessment should be made for the new NIS but also for the formerly established species.

Metadata

Data source: All established multicellular non-indigenous species in an assessment area are taken into account independently on their arrival into the Baltic Sea. For indicator calculation, see above.

There is no monitoring on NIS in the Baltic Sea but data is available on species abundance and distribution as well as on impacts of the most harmful species, which is stored e.g. in the online Biological Invasion Impact / Biopollution Assessment System (BINPAS) (Narščius et al. 2011) and Baltic Sea Alien Species database as well as in published literature. Proven information provided by other sources such as research institutes may be taken into account.

Particular species BPL assessment reports can be viewed and downloaded from BINPAS (<http://www.corpi.ku.lt/databases/index.php/binpas/>).

Geographic coverage: Available data covers the whole Baltic Sea. Gaps in needed data depend on the size of the assessment units. If the assessment is done for a small area, it is possible that some data for abundance and distribution are lacking. This information is an obligatory prerequisite for the assessment. In case there is no information available on NIS impacts from the considered assessment unit, the knowledge from other environmentally similar domains could be applied. However in this case, the certainty level of the overall assessment will be low.

Temporal coverage: The initial assessment covered 20 years period 1990-2010.

Determination of GES: See above

Strengths and weaknesses of data :

- *strengths: harmonized targets, calculation is made easy through the online BINPAS system.*

- *weaknesses: differences in national data sets' resolution, gaps in knowledge on impacts of certain species, reliance on expert judgement*

Further work required: The descriptions of different abundance-distribution-range classes as well as impact classes should be made more clear and developed further in order to minimize the subjectivity of the assessments (differences between index calculations made by different experts).

Link to the data set

<http://www.corpi.ku.lt/databases/binpas>

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