Trends in arrival of new non-indigenous species

Authors

Manfred Rolke, Monika Michalek, Malin Werner, Maiju Lehtiniemi, Solvita Strake, Alexander Antsulevich & Anastasija Zaiko.

Acknowledged persons

Paulina Brzeska, Elena Gorokhova, Bożenna Kaczmaruk and Sergej Olenin.

Reference to this core indicator report: [Author's name(s)], [Year]. [Title]. HELCOM Core Indicator Report. Online. [Date Viewed], [Web link].

Contents

Key message

- Increasing maritime activity in the Baltic Sea has increased the number of non-indigenous species invaded the Baltic. Since the beginning of 1800s, 118 non-indigenous species have been observed in the Baltic Sea.

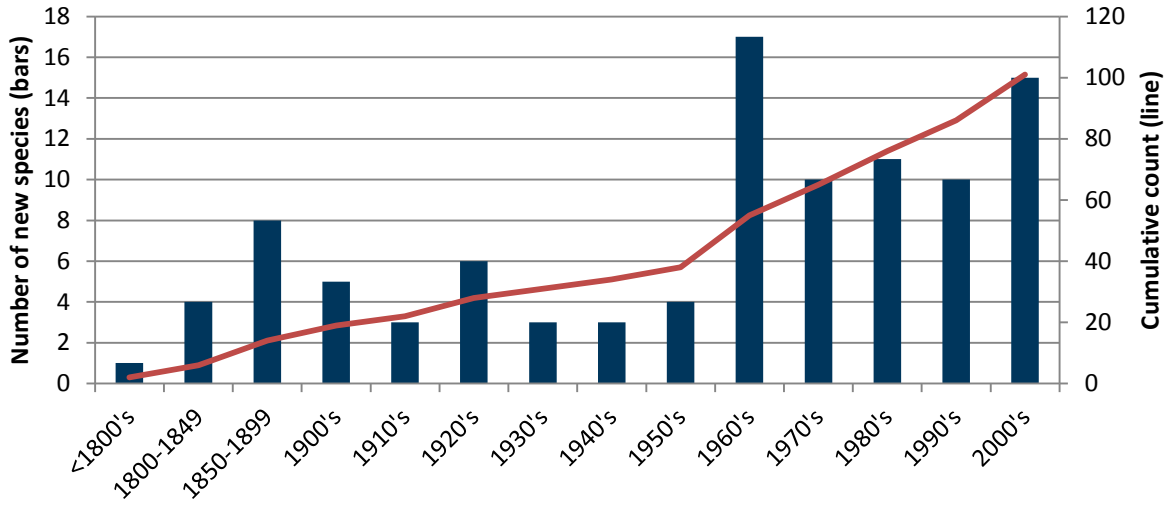


Figure 1. *Number of new observed non-indigenous species in Baltic Sea until 2012. The bars indicate the number of invasions per time period and the line is the cumulative count of the invasions. Note the different time scales before the year 1900 and that not all species were included due to missing information (introduction year).*

Description of the indicator

The indicator follows numbers of non-indigenous species found in Baltic Sea sub-basins within an assessment period of six years. The indicator is based on a baseline study, identifying the number of already arrived non-indigenous species. Every new non-indigenous species (NIS) arriving after the baseline year is counted as a new species. New NIS comprises not only established organisms but all new encountered species even if they will not establish (because species which cannot establish stable populations will also be regarded as failed management).

In the end of the assessment period, the number of new NIS is summed per assessment unit. The assessment period after that will start again from zero and assess the number of NIS arriving during that period.

Policy relevance

The introduction of invasive species into oceanic waters and especially coastal waters can cause severe environmental, economic and public health impacts.

Since the early 90s when the Marine Protection Committee (MEPC) of the International Maritime Organisation (IMO) put the NIS issue on the agenda, the problem got more and more weight in marine environmental protection. In 2004, the Ballast Water Convention was adopted by the IMO. The convention asks for ballast water management procedures to minimize the proliferation of non-indigenous organism with ballast water. Once entered into force every ship has to follow ballast water management procedures.

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 non-indigenous species for

aquaculture purposes. On the European level, the EC Council Regulation No 708/2007 concerning the use of NIS 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 was 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.

In the Baltic Sea Action Plan (in the Roadmap towards harmonised implementation and ratification of the 2004 International Convention for Control and Management of Ships' Ballast Water and Sediments), the CPs agreed to adjust/extend by 2010 the HELCOM monitoring programmes to obtain reliable data on non-indigenous species in the Baltic Sea, including port areas, in order to gather the necessary data to conduct and/or evaluate and consult risk assessments according to the relevant IMO Guidelines. As a first step, species that pose the major ecological harm and those that can be easily identified and monitored should be covered. The evaluation of any adverse ecological impacts caused by non-indigenous species should form an inherent and mandatory part of the HELCOM monitoring system.

The good environmental status (GES) according to the EU Marine Strategy Framework Directive is to be determined on the basis of eleven qualitative descriptors. One of the qualitative descriptors concerns non-indigenous species and describes the GES for this descriptor as "Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem".

How many NIS arrives in 2012-2017?

Current status in the Baltic Sea

Because of the contradictory responses of bivalves to different predominant pressures, it is recommended to use the full size/ biomass spectra instead of concentrating on a ratio of individuals/biomass above specified length/ size as information on the full state of the population and a potential recovery might be lost by ignoring smaller size/biomass classes. See also the section 'Strengths and weaknesses' for discussion of depths and food supply.

Hard-bottom communities: mussels size-frequency and density

Description of the blue mussel indicator

Figure 1 illustrates the temporal development of numbers of new NIS observed in the Baltic Sea until 2012. The number of invasions has steadily increased and there seems to be a jump in the time series after 1950s.

Figure 2 illustrates spatially the total number of species in each assessment unit by 2012. Altogether 118 NIS have been observed in the Baltic Sea by 2012; 90 of them are estimated to be established in the ecosystem. See the HELCOM report 'List of non-indigenous species in the Baltic Sea' and the associated link to the data table for information on the taxonomy, vectors, areas of origin and ratios of NIS and native taxa.

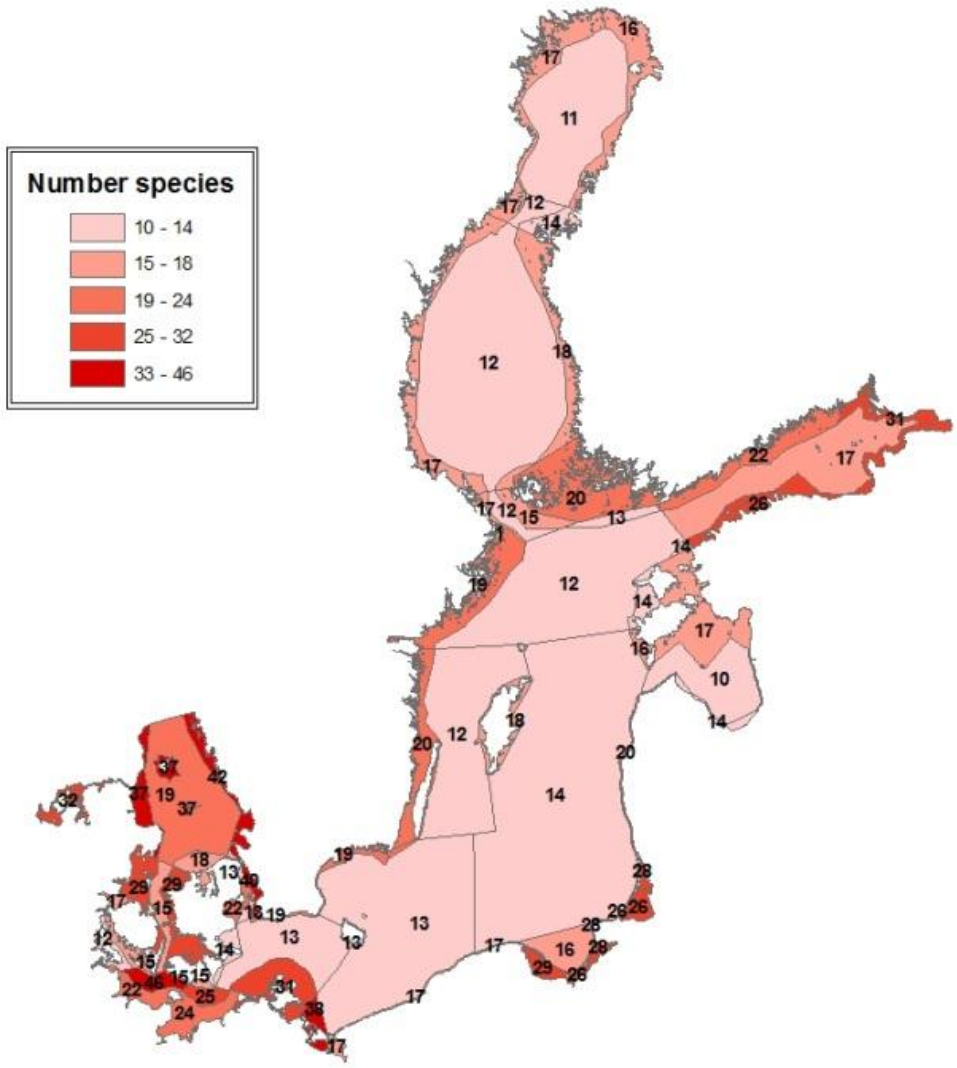


Figure 2. *Total number of non-indigenous species in coastal and offshore areas in the Baltic Sea in 2012.*

Past trends in the arrival of non-indigenous species

The number of new observed NIS increased steadily until the mid-20th century (Figure 1). The trend of new NIS has increased sharply and has not shown signs of decline in 1990s and 2000s (Figure 3). Shipping and stocking have been responsible for the majority of the introductions. The observed number of NIS in Figure 3 includes also secondary invasions (i.e. invasions within the Baltic Sea) why it does not correspond with Figure 1. A synthesis of Figures 1 and 3 suggests that in the 1990s and 2000s both the primary and secondary invasions have increased.

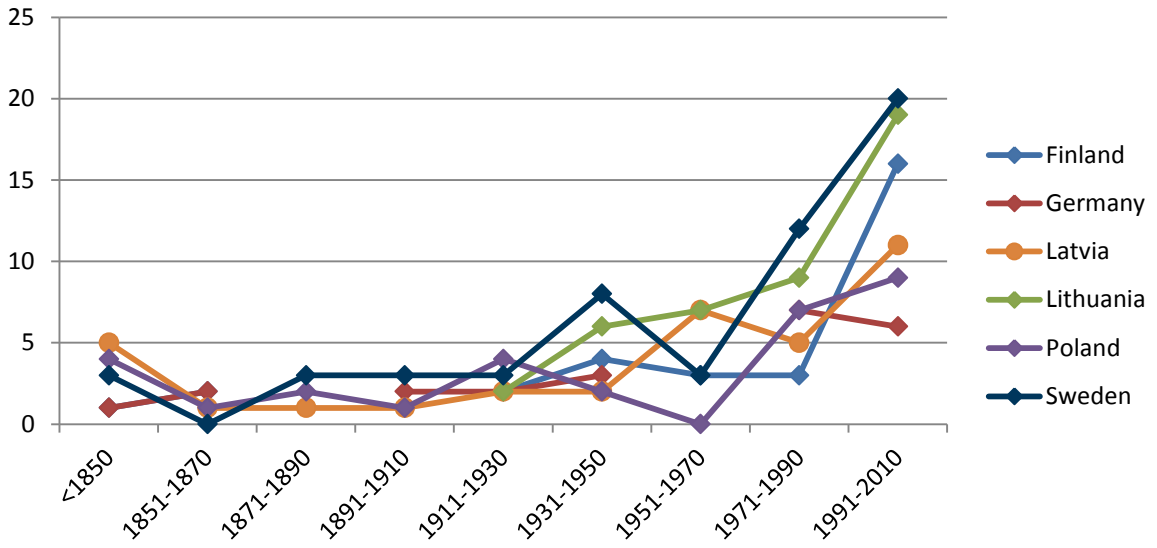


Figure 3. *Rates of detected new non-indigenous species in the Baltic marine area of the Baltic Sea countries for 20-year intervals between 1850 and 2010. [Note that a graph of the primary invasions to the Baltic Sea per recipient country is under preparation.]*

Finland

The number of new NIS in the Finnish marine waters peaks clearly in the period 1990–2010 (Figure 3). Majority of the species have arrived via shipping. In 2011 there were 31 non-indigenous species encountered in the Finnish sea area.

Germany

Altogether 34 organisms are known to be introduced in to the German Baltic Sea and 27 of them are regarded as established (Figure 3, (Gollasch & Nehring 2006). Assuming that the influence of man before the industrial revolution (< 1850) can be regarded as negligible, the natural rate of introductions for this area is one for this time interval and represents a percentage of around 4 % of the present total amount of introductions. In the following time until the 1960s of the last century the number of recognized introductions increased only slightly with an average of two (representing around 8 % of the present total amount). Beginning of the 1970s an appreciable rising of new introductions can be recognized with a maximum of 7 recognized organisms per 20 year time interval (representing 26 % of all introductions).

Latvia

Altogether 35 NIS have been found from the Latvian part of the Baltic Sea (Figure 3). In the 1930-80s majority of new fish species have arrived as potential aquaculture species. Some brackish tolerant species were widely distributed as a food source. After 1990s 11 new species have been found, the majority of the species via shipping.

Lithuania

The number of detected non-indigenous species has increased in Lithuanian marine waters since the early 1920s (Figure 3). There were 43 NIS in the Lithuanian marine waters in 2011. The majority of the species have arrived via shipping.

Poland

Figure 3 shows the rate of introductions of NIS to the Polish marine waters (excluding fish species). Altogether 43 NIS (13 fish species) have been found (based on literature data) from the Polish marine waters. No consistent increase or decrease in the introductions can be seen during the studied time period unless the recent increase during the last four decades can be seen as an indication of a new wave of introductions. Taking into account the latest data from National Monitoring Programmes (2008–2011) only 11 NIS were noted (Polish monitoring stations in the Baltic Sea.

Sweden

Figure 3 shows the rate of introductions of NIS to Sweden, excluding Skagerrak. The introductions have increased greatly during the last four decades. Altogether 55 NIS have been found from the Swedish waters in the Baltic Sea, 19 of them from Kattegat alone.

How the indicator describes the Baltic marine environment

The introduction of invasive non-indigenous species is a severe threat to marine environment. NIS have caused ecological, economic and public health impacts globally. NIS can induce considerable changes in the structure and dynamics of marine ecosystems and may also hamper the economic use of the sea or even represent a risk for human health. Ecological impacts include changes in habitats and communities and alterations in food web functioning, in extreme cases even losses of native species can occur. Economic impacts range from financial losses in fisheries to expenses for industries for cleaning intake or outflow pipes and structures from fouling. Public health impacts may arise from the introduction of microbes or toxic algae.

Only a minority of non-indigenous species (NIS) become invasive i.e. have a potential to cause negative impacts on the environment. Those NIS which cause the most harm on the environment and/or humans are the most important to assess, 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.

Documented ecological impact is known only for 43 NIS (Zaiko et al. 2011), which is less than 50 % of the species registered in the sea. According to the biopollution index (e.g. Zaiko et al. 2011), the highest biopollution (BPL = 3, strong impact) occurs in coastal lagoons, inlets and gulfs, and the moderate biopollution (BPL = 2) in the open sea areas. None of the Baltic sub-regions got classified as ‘low impact’ (BPL = 0 or 1) indicating that invasive species with recognized impacts are established in all areas.

The indicator fact sheet (IFS) ‘Biopollution index’ gives more information of the impacts of NIS and the report ‘HELCOM List of non-indigenous species’ presents the most recent compilation of observed species.

Metadata

Data source

Data originates from the Baltic Sea Alien Species database, European DAISIE database, NOBANIS database, scientific publications, the HELCOM list of non-indigenous species and national experts.

Description of data

Number of species. All neobiota independent of their state of establishment have to be taken into account.

Geographical coverage

The indicator covers the entire Baltic Sea: national coastal and offshore waters divided to sub-basins. There are however wide gaps in the spatial coverage of the current biodiversity monitoring. Currently, the monitoring of coastal and estuarine biodiversity is not structured enough to reliably show the distribution and abundance of several non-indigenous species. As a result of this coarse scale, assessments can be made on a sub-basin scale but, as several NIS occur only in coastal habitats, coastal assessment units can also be assessed separately. Annex 1 shows the map of the assessment units and Annex 2 presents their names and the reporting format.

Existing and recommended monitoring

The baseline status of the indicator has been assessed on the basis of all available information of the introductions and presence (and absence) of NIS.

As the indicator is focusing in shipping as the vector of NIS, it is highly recommended that port surveys will be initiated and data will be used to update this indicator.

Regular monitoring results will also be used to update the information for this indicator.

Temporal coverage

The time series data may overemphasize the recent decades and show too steep increase in the rate of introductions due to improved monitoring of NIS.

The indicator is assessed by a six year assessment period. The data is reported annually to the HELCOM Secretariat to be compiled to the core indicator report.

Methodology and frequency of data collection

Data is mainly compiled from scientific studies, constituting of point observations. The presence of a species has been confirmed by national experts.

Determination of GES boundary

The ultimate goal is to minimize man made introductions of non-indigenous organisms to zero. The boundary between GES and sub-GES is “no new introductions of NIS per assessment unit during a six year assessment period”.

The indicator requires an estimate of the already existing NIS in each area and counts of new introductions. Hence, it is important to distinguish between naturally spreading and anthropogenically introduced species. In reality in some cases it is impossible to distinguish between man-made and natural introductions and therefore all species are first treated as NIS and only species which can be shown to be naturally spreading will be removed from the indicator. The BSAP Roadmap towards harmonised implementation and ratification of the 2004 International Convention for Control and Management of Ships’ Ballast Water and Sediments (HELCOM 2007, p. 99) presents some advice on this matter (see Introduction above).

Systematic studies on NIS introductions have been very scarce in the past, especially in the marine area. Therefore, for the purpose of this indicator, reviews and national databases are taken as a basis for an estimation of the baseline (Germany: Gollasch and Nehring 2006, Poland: http://www.iop.krakow.pl/ias/Baza.aspx, Binpas data, Sweden: http://www.frammandearter.se/index.html).

Strengths and weaknesses of data

Strengths

There is a strong scientific community in the Baltic region studying NIS and a shared database (BSASDB) compiling information from scientific papers and national studies. The approach has good prospects to give an indication of the success of measurements to minimize the man-made introduction of non-indigenous species. It has harmonized targets in the Baltic Sea. It is a simple measurement.

Weaknesses

The current monitoring does not cover littoral areas where NIS are observed only by random studies. The HELCOM protocol to monitor ports may include monitoring of littoral habitats. In addition, there are differences in national data sets, quality problems of old data and geographical and temporal gaps in sampling.

.

References

Carlton, J.T. 1985: Transoceanic and interoceanic dispersal of coastal marine organisms: the biology of ballast water Oceanogr. Mar. Biol. Ann. Rev. 23: 313–371

EC, 2007: Council Regulation (EC) No 708/2007 of 11 June 2007 concerning use of alien and locally absent species in aquaculture. Official Journal of the European Union, 17pp

EC, 2008: Directive 2008/56/EC of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). Official Journal of the European Union, 22pp

Gollasch, S. and S. Nehring, 2006: National checklist for aquatic alien species in Germany. Aquatic Invasions 1 (http://www.reabic.net), 245–269

ICES, 2005: ICES CODE of Practice on the Introductions and Tranfers of Marine Organisms 2005, 30pp

IMO, 2004: International Convention for the Control and Management of Ships' Ballastwater and Sediments, 2004. IMO document BMW/Conf/36, 38pp

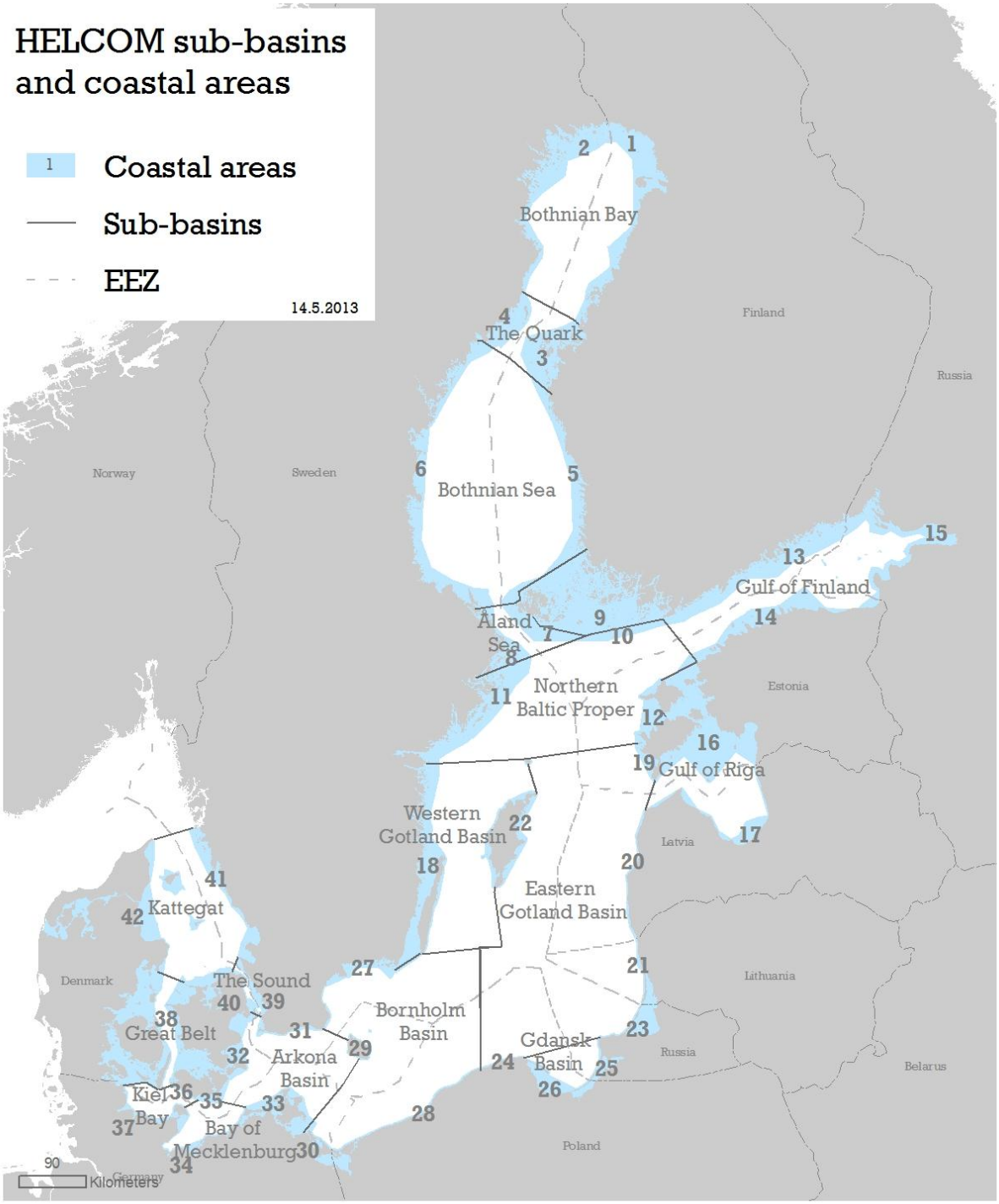
Zaiko, A., Lehtiniemi, M., Narščius, A., Olenin, S. 2011: Assessment of bioinvasion impacts on a regional scale: a comparative approach. Biological Invasions DOI 10.1007/s10530-010-9928-z]

View data

Link to the data set
http://www.helcom.fi/stc/files/shipping/Report%20on%20observed%20non-indigenous%20and%20cryptogenic%20species%20in%20the%20Baltic%20Sea.pdf

Annex 1

Assessment units. See Annex 2 for the names of the units. The assessment can be made either on the level of subbasins (coastal waters included) or separately to coastal assessment units (blue color and numbered) and offshore parts of the subbasins (white area).



Annex 2

Reporting table for the new non-indigenous species. Add columns if necessary. The assessment units (subbasins and coastal areas) refer to the map in Annex 1.

	Species name	**Species #1**	**Species #2**	**Species #3**		
	Taxon					
	Area of origin					
	Sub-basins					
	First observed year					
	Status (established, not established, unknown, disappeared)					
	Characteristics					
	Vector					
	Impact					

Assessment unit (1=present, 0=absent, - =unknown, + = not considered NIS)

Number	Name					
	SUBBASINS					
	Bothnian Bay					
	The Quarck					
	Bothnian Sea					
	Åland Sea					
	Gulf of Finland					
	Northern Baltic Proper					
	Gulf of Riga					
	Western Gotland Basin					
	Eastern Gotland Basin					
	Gdansk Basin					
	Bornholm Basin					
	Arkona Basin					
	Bay of Mecklenburg					
	Kiel Bay					
	Great Belt					
	The Sound					
	Kattegat					
	COASTAL WATERS					
1.	Bothnian Bay Finnish Coastal waters					
2.	Bothnian Bay Swedish Coastal waters					
3.	The Quarck Finnish Coastal waters					
4.	The Quarck Swedish Coastal waters					
5.	Bothnian Sea Finnish Coastal waters					
6.	Bothnian Sea Swedish Coastal waters					
7.	Åland Sea Finnish Coastal waters					
8.	Åland Sea Swedish Coastal waters					
9.	Archipelago Sea Coastal waters					
10.	Northern Baltic Proper Finnish Coastal waters					
11.	Northern Baltic Proper Swedish Coastal waters					

12.	Northern Baltic Proper Estonian Coastal waters					
13.	Gulf of Finland Finnish Coastal waters					
14.	Gulf of Finland Estonian Coastal waters					
15.	Gulf of Finland Russian Coastal waters					
16.	Gulf of Riga Estonian Coastal waters					
17.	Gulf of Riga Latvian Coastal waters					
18.	Western Gotland Basin Swedish Coastal waters					
19.	Eastern Gotland Basin Estonian Coastal waters					
20.	Eastern Gotland Basin Latvian Coastal waters					
21.	Eastern Gotland Basin Lithuanian Coastal waters					
22.	Eastern Gotland Basin Swedish Coastal waters					
23.	Eastern Gotland Basin Russian Coastal waters					
24.	Gdansk Basin Russian Coastal waters					
25.	Gdansk Basin Polish Coastal waters					
26.	Bornholm Basin Swedish Coastal waters					
27.	Bornholm Basin Polish Coastal waters					
28.	Bornholm Basin Danish Coastal waters					
29.	Bornholm Basin German Coastal waters					
30.	Arkona Basin Swedish Coastal waters					
31.	Arkona Basin Danish Coastal waters					
32.	Arkona Basin German Coastal waters					
33.	Mecklenburg Bight German Coastal waters					
34.	Mecklenburg Bight Danish Coastal waters					
35.	Kiel Bight Danish Coastal waters					
36.	Kiel Bight German Coastal waters					
37.	Great Belt Danish Coastal waters					
38.	The Sound Swedish Coastal waters					
39.	The Sound Danish Coastal waters					
40.	Kattegat Swedish Coastal waters					
41.	Kattegat Danish Coastal waters					