The Baltic Sea: Invasive alien species

Alien species are organisms which are introduced outside of their natural range and outside of their natural dispersal potential. This includes any part of such species that might survive and subsequently reproduce. Synonyms for the term alien species are exotic, non-native, allochthonous or non-indigenous species (NIS). Their presence in a given region is due to intentional or unintentional introduction resulting from human activities. In the marine environment, the most common introduction pathway is via ship traffic, where exotic species are for example transported in the ship’s ballast tank or attached to the ship’s hull. As these species are “newcomers” to the invaded areas, their presence may disturb local ecosystems, for example through competition or predation.

Invasive alien species (IAS) are a subset of established NIS which have spread, are spreading or have demonstrated their potential to disperse elsewhere, and have an adverse effect on biological diversity, ecosystem functioning, socio-economic values and/or human health in invaded regions. However, not all alien species necessarily become invasive and there are several examples, where the same alien species may be invasive and non-invasive.

In the Baltic Sea, there are approximately 120 recorded alien species with around 70 of them being established but only a few posing severe problems.

VECTORS activities related to alien species in the Baltic Sea aim to investigate the conditions under which a species becomes invasive. This will be achieved by integrating existing knowledge with novel approaches spanning from genetic techniques and field investigations to modelling efforts, interpreting results in an ecosystem context and contributing to achieve targets set in various policy documents.

The round goby, Neogobius melanostomus, an invasive species in the Gulf of Finland (Photograph: Heli Shpilev).

Species such as Mnemiopsis leidyi, are transported in ballast water (Photograph: Erik Selander).

VECTORS scientists are studying the Chinese mitten crab, Eriocheir sinensis, in the Gulf of Finland.

Drivers of change in the Baltic Sea include eutrophication, fishing, pollution, shipping and renewable energy generation. These activities can result in changes in species distribution, impacts on biodiversity and ecosystem function and a decrease in fishing revenue, resources and tourism.

Regional Seas Case Studies

VECTORS studies three regional seas, the North Sea, Baltic and Western Mediterranean, as research areas for investigating the impacts of human activities and how multiple pressures can have combined and interacting effects for the marine environment, society and economy. Within each of the regional seas several case studies are taking place to allow more targeted investigation of the causes and impacts of these pressures in particular environments. This series of fact sheets provides an overview of each case study and the varying scientific approaches used.
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**Why**

- Alien species may cause significant ecological impacts and substantial socio-economic consequences.
- Successful management, restoration and conservation of the intensively used Baltic Sea ecosystem requires advanced knowledge on how different ecosystem elements respond to the increasing pressure of alien species.
- To fulfil requirements of several international policies, conventions and regulations intended to limit the spread of NIS (e.g. Convention on Biological Diversity, EU Marine Strategy Framework Directive, Ballast Water Management Convention of the International Maritime Organisation).
- To provide an early warning system on alien species and assist in minimising new invasion risks.
- To tackle and manage potential future threats and to identify mitigation strategies to counter future degradation of ecosystem health in the Baltic Sea area.

**Where**

When alien species enter into an aquatic ecosystem, they can disrupt its natural processes; thus, this is a Baltic-wide problem potentially affecting all ecosystem elements. Specifically, coastal areas are primary focal points for human activities, and whilst they are among our ecologically and socio-economically most important ecosystems, they are also the most heavily infested by non-indigenous aquatic species. Because different alien species have different environmental tolerance limits, targeted investigations are carried out in habitats and at spatial scales relevant to a given alien species. VECTORS will, for instance, obtain and provide advanced information on the following alien species:

- Generic information on all alien species at the Baltic Sea scale.
- The amphipod Gammarus tigrinus, the waterflea Cercopagis pengoi and the mud crab Rhithropanopeus harrisii in the Gulf of Riga.
- The comb jelly Mnemiopsis leidyi in the Bornholm Basin.
- The round goby Neogobius melanostomus and the Chinese mitten crab Eriocheir sinensis in the Gulf of Finland.

**How**

VECTORS will integrate several approaches by examining historical data on ecosystem responses to alien species introductions, by conducting novel laboratory and field experiments, and by developing predictive models of species distribution and ecosystem functioning under different scenarios with increasing pressure from human stressors. As such our research will improve understanding of the ecological role of alien species and will have direct relevance to the management of various marine ecosystems. More specifically, the following activities are being carried out by VECTORS:

- Performing systematic reviews on alien ecosystem engineers.
- Analysing long-term trends and spatial patterns of key alien species.
- Conducting novel field and laboratory experiments on ecological interactions of selected alien invertebrates with native biota.
- Carrying out genetic analyses to distinguish between alien and native species and identifying the source regions of alien invasions.
- Identifying cause-effect relationships between the environment and alien biota and predicting species distributions.
- Assembling and storing data in the database called ‘Information system on Aquatic Non-indigenous species, AquaNIS’.

**The future**

It is envisaged, that these major and systematic activities carried out in VECTORS will also be continued in the future. These should include:

- Continuous update of the AquaNIS database with new data to provide an advanced and up-to-date information source for alien species in the region, which can be used both by stakeholders, students and scientists.
- Continuation of the already established close cooperation with important regional stakeholders, such as the International Council for the Exploration of the Sea (ICES) and the Helsinki Commission (HELCOM), but also with the International Maritime Organization (IMO).
- Application for additional funding sources to collect further field and laboratory data on alien species.