MEECE Knowledge Transfer Unit
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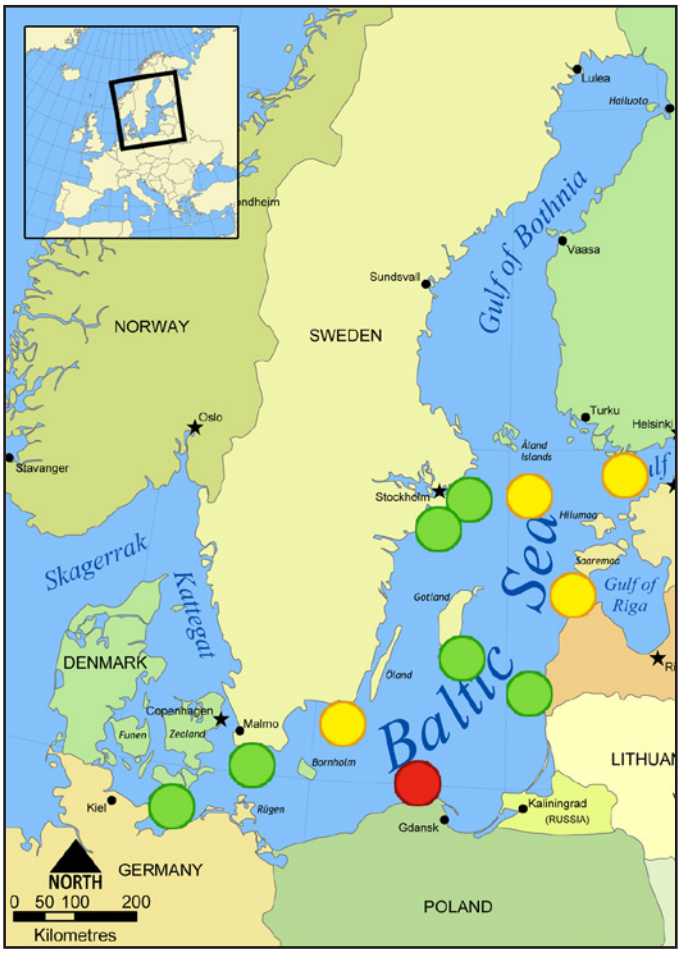
Detecting alien algae invasions: the case of the Baltic

Algae are important members of marine ecosystems, and form the base of marine food webs. However, invasion of non-native algae through the transfer of ship ballast water or by other human activities such as aquaculture, are posing an increasing problem to sensitive European marine ecosystems. These species can expand rapidly in regions outside of their natural habitat and affect the indigenous populations as well as the economic activites and human health.

These "alien" algae compete with native algae, limiting their growth and harming other animals and fish that depend on the native algae for food with resultant economic impacts. Some species of invasive algae are known to produce chemicals that can be toxic to humans and marine mammals. They form extensive "red tides" that decrease water clarity, harm aquatic plants and reduce the aesthetic quality of coastal waters and shorelines.

Marine phytoplankton bloom filling much of the Baltic Sea. Credits: ESA

Despite the increasing importance of invasive species, few methods for evaluating their abundance and impact are available and only little research has been carried out in this area.



Assessing biopollution

A method to assess biopollution assessment level (BPL) has been developed to categorize and rank the degree of disturbance caused by invasive alien species. BPL can identify areas where the impacts from alien algae are the greatest on native species, marine communities, habitats and the wider ecosystem. This knowledge can in turn help steer policy decisions to avoid environmental damages and economic losses.

In the case of the Baltic Sea, BPL have been used to assess a microscopic invasive algae called *Prorocentrum minimum* which has become established over the past two decades. As shown in the map, its impacts range from moderate to massive across the sea, impacting all regions. The only area currently free of this potentially toxic planktonic algae is the Gulf of Bothnia, the northernmost, coldest and nearly freshwater part of the Baltic.

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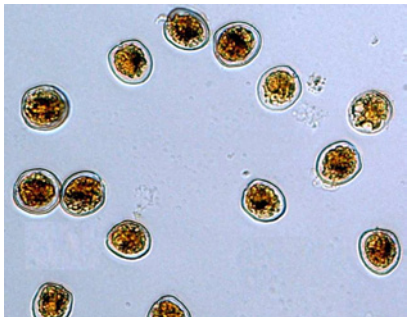
Potential impacts of *P. minimum*

The algae can increase in abundance rapidly over short periods (days). During intense blooms, *P. minimum* is associated with harmful impacts on fish, aquaculture shellfish and aquatic vegetation losses. It can also reduce the concentration of oxygen in the water.

This toxic species produces venerupin (hepatotoxin) which has caused shellfish poisoning resulting in gastrointestinal illnesses in humans. Although responsible for a number of deaths in both Japan and the Gulf of Mexico, no such incidents have occurred in the Baltic.



Example of *Prorocentrum minimum* from the Baltic Sea.

Application of the BPL

There is increasing understanding of the need to take into account the effects of these invasive species in environmental quality assessments. Whilst potentially posing a significant threat to marine ecosystems the impacts of alien invasive species, particularly phytoplankton, remains un-quantified. The BPL approach provides an efficient tool, using already existing data, to assess and monitor the potential threat of invasive species across European regional seas.

The toxic impact on shellfish following harmful algal blooms is a growing global concern. Sudden algal blooms can poison fish, shellfish and marine life, posing a threat both to the general public's health and fisherman's livelihoods.

Recommendations for management

- While only one species was identified as causing serious ecosystem level changes, the BPL framework allows for the inclusion of additional species. This should prove useful for determining acceptable community threshold levels for future invasions, and to track the impacts of invasive species in the Baltic Sea and other areas. As such, it holds the potential to work as a predictive tool for future phytoplankton blooms, and as a first step to evaluate the socio-economic impacts of such prediction on fisheries and tourism.
- Modelling efforts and direct field and laboratory studies should be conducted to predict whether toxin production could occur in the Baltic Sea. Policy guidelines for monitoring and regulating the shellfish industry following blooms should also be considered.
- Future monitoring for alien phytoplankton species should be based on more frequent observations at temporal scales, so as not to miss blooms that can develop very quickly, preferably using molecular probe or automatic plankton recorder methods.
- The BPL approach could be applied to other European regional seas and be used as part of a European early warning system for the monitoring and management of algal blooms.

Further information

For further details about this work please contact Irina Olenina (irina.olenina@corpi.ku.lt)
BINPAS (Biological Invasion Impact / Biopollution Assessment System) also provides further information on this topic | http://www.corpi.ku.lt/databases/index.php/binpas/

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