Environmental monitoring of Baltic Sea mussel farms

Interreg Baltic Sea Region
Baltic Blue Growth
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Picture 1: Mussel farm in the sheltered Swedish Sankt Anna archipelago

Why is environmental monitoring important?

The Baltic Sea ecosystem is fragile and particularly vulnerable to environmental threats such as eutrophication, pollution and climate change. In fact, eutrophication as well as over-fishing and intensive use from the transport sector have been the main causes of ecosystem deterioration in the Baltic Sea.

Environmental monitoring provides us with the tools to measure short term as well as long term indicators of ecosystem health. It is the scientific basis for understanding the health and functioning of the complex marine environment. To grasp how the ecosystem works and what poses a threat is crucial when evaluating environmental planning and policy, and in particular to gain public support for ecosystem management and restoration. In terms of EU policy and legislation, environmental monitoring is integral to achieve Good Environmental Standard (GES) in accordance with the Marine Strategy Framework Directive and thus fulfilling the environmental pillar of the Integrated Maritime Policy.

For the Baltic Blue Growth project's mussel farms, environmental monitoring is an efficient method to find out what impact mussel farming has on the Baltic Sea ecosystem. It is crucial to ensure that the mussel farm does not have too much of a negative impact on the seabed, creating increased sedimentation that in extreme cases can cause oxygen depletion.

How is it performed at the mussel farms?

As part of the Baltic Blue Growth project, the mussel farm specific environmental monitoring provides a database with indicators for environmental quality in the sediment and waters around the mussel farms. These indicators support a scientifically sound assessment of the impacts of the project mussel farms in the Baltic Sea.

In order to allow for easy comparisons between project farms, data is collected using a standardised sampling scheme. Traditional sampling of water quality variables such as water chemistry, phyto-plankton, sediment and benthic invertebrates will be combined with the results from the latest oceanographic technology to achieve an accurate environmental assessment of the project farms.

The oceanographic instruments record short-term variability of parameters such as how fast the water flows near the seabed, oxygen levels, turbidity (water cloudiness) and amount of phytoplankton over a one-year period. These results provide us information on the environment around the farm in between samplings or when sampling is not possible due to bad weather conditions.

The project farm sampling also includes an experimental evaluation of mussel recruitment and growth to establish how oceanographic processes relate to growth or losses of mussels at the farms. Thereby, it is possible to assess how efficient different cultivations techniques in each basin of the Baltic Sea can be. Combining the various techniques mentioned with cutting-edge modelling, allows for a pan-Baltic assessment of the potentials as well as possible negative impacts of mussel farming

Results from Vormsi farm, Estonia

Although sampling has just started, the team from the University of Tartu has evaluated some first results from the Vormsi pilot farm in Estonia. The team want to find out what positive and negative impacts the mussel farm might have on the water quality so they measured different indicators at the farms and compared these to a reference site. As we can see in figure 1, nitrogen and phosphorous levels are lower at the Vormsi farm than at the reference site. Moreover, the level of chlorophyll, an important measure for water transparency, is lower at the Vormsi farm. Even if these are just first results, the sampling shows decreased nutrient content and increased water transparency at the Vormsi farm, which is good news for the Baltic Sea.

Concerning potential negative impacts, the results from the Vormsi farm show that organic matter in the sediment and oxygen levels are not different from reference area. Of course, these are first results, nevertheless they tell us that currently the mussel farm does not result in local adverse effects to the environment.

Oceanographic instruments are also used to supplement water sampling . These instruments give us a much better temporal view on the environmental conditions by measuring indicators such as oxygen levels at the farms at least once in every 30 minutes. To get solid seasonal data on environmental impacts, all farms are surveyed with oceanographic instruments at least one full yearly cycle.

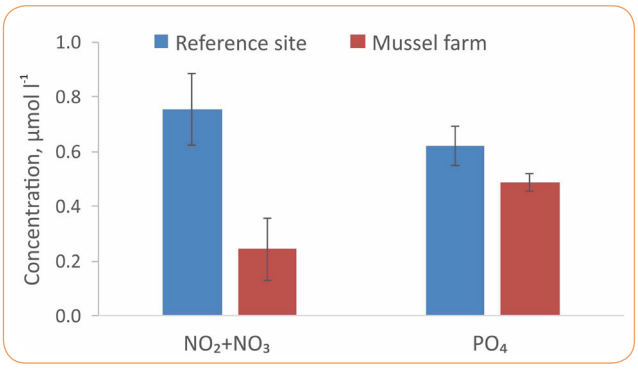


Figure 1: Levels of NO2+3 & PO4 at reference site and Vormsi mussel farm

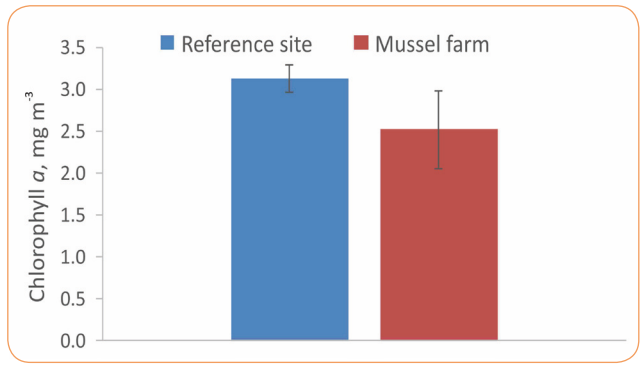


Figure 2: Chlorophyll levels at reference site and Vormsi mussel farm

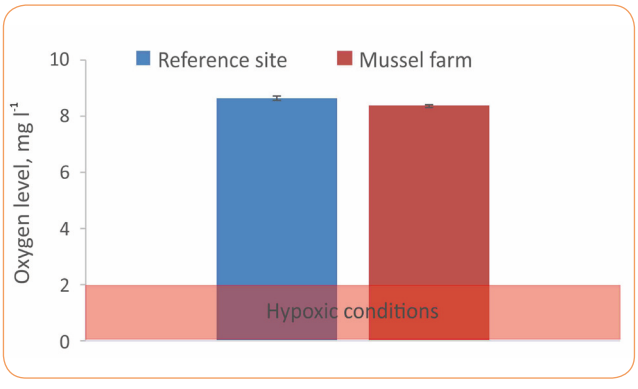


Figure 3 : Oxygen levels near the seabed and amount of organic matter in the sediment.

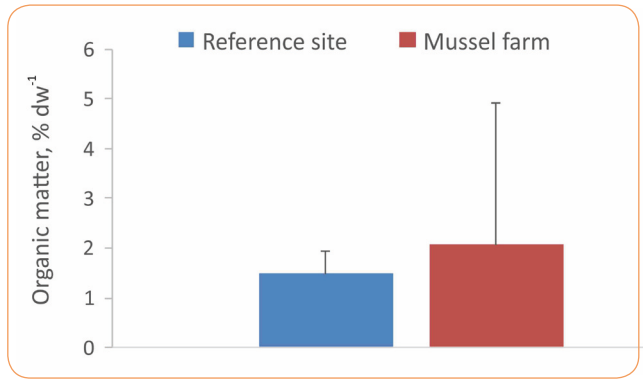


Figure 4: Amount of organic matter in the sediment.

Results from Danish and Swedish mussel farms

For the other Baltic Blue Growth project farms, there is unfortunately no reliable data yet on nutrient uptake and water transparency. However, the oceanographic instruments placed near the sea floor at Sankt Anna, Musholm and Byxelkrok farms clearly show that oxygen levels mostly remain way above the critical threshold for the biota. Any levels below 2 mg/l indicates hypoxia (critically low oxygen levels). Therefore, we expect no negative effects of mussel farms on benthos at farms. The only exception was the Sankt Anna farm, where there was a very short period near to hypoxia (but still over the critical threshold) but this was because of an intrusion of big anoxic water mass into the area and not related to the mussel farming.

The four farms are located in the north and south Baltic Sea and therefore gives us a good indication of the overall impacts of mussel farming. So far, we have seen mostly positive effects, with decreased levels of phosphorous and nitrogen as well as increased water transparency in Vormsi farm. Moreover, the four reference farms all mostly had stable oxygen levels well above the critical threshold of 2 mg/l, indicating a minimal negative impact of the mussel cultivation on the seabed directly below the farm.

Figures 5–7 on the next page illustrate the oxygen levels at the three farms in Denmark and Sweden.

Interview with **Helene Ek Henning**, County Administrative Board, Östergötland, Sweden

Why is environmental monitoring so important?

Mussel farming is a promising measure to reduce eutrophication, in combination with other measures inland. The mussels feed on phytoplankton, and nutrients are removed from the sea when the mussels are harvested. However, intensive mussel farming may also have negative environmental effects on the sea bed below the farm. Both positive and negative impacts need to be thoroughly assessed to determine the overall environmental effect of large-scale mussel farming in the Baltic Sea. So far, only a few studies on the environmental impact of mussel farming have been conducted in the Baltic Sea Region. Therefore, environmental monitoring of the pilot farms is a crucial part of the Baltic Blue Growth project.

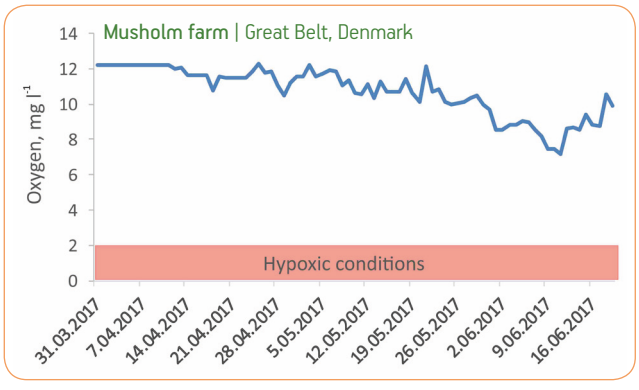
How does environmental monitoring work?

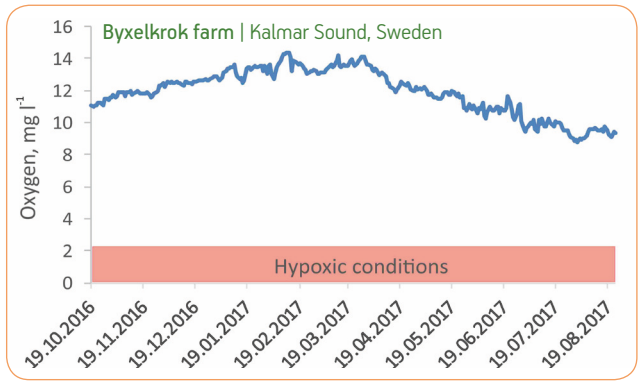
Environmental monitoring is performed in June, August and October 2017 and 2018. We collect samples of water and sediment at the mussel farm and at a reference site (where there is no mussel farm) to see if there are any differences in water quality. The water is analysed for nutrients, phytoplankton and zooplankton as well as oxygen levels and water transparency. The time of sampling is focused to June-October because then the mussel farms are most likely to have an environmental effect on water quality. However, we have also deployed an oceanographic instrument that continuously measure current velocity, dissolved organic carbon, chlorophyll a and underwater light. The sediment is analysed for nutrients, carbon and biological diversity. We also study the recruitment and growth of mussels, and its content

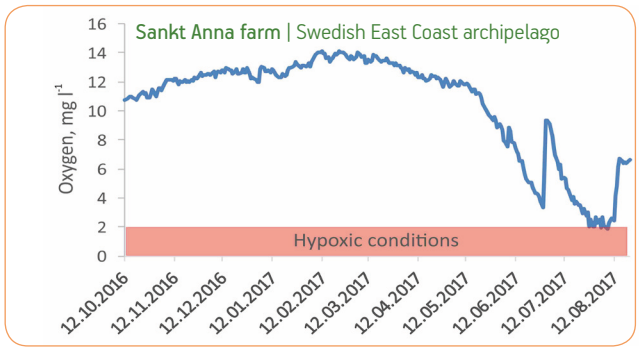
of nutrient and protein. This information is needed to evaluate nutrient removal of mussel farming and the potential for using mussels in animal feed.

Do you have any preliminary results?

We have not yet received all results from this year's environmental monitoring. A comprehensive statistical analysis of the data will be carried out after the last sampling in October. We hope that the oxygen levels above the seabed will not be lowered, because if oxygen is depleted nutrients can be released from the sea bed. We also hope to see that the water is more transparent (i.e. clear) at the mussel farm because of the filter-feeding mussels. The results from Sankt Anna have so far seen promising, but it is too early to draw any conclusions about the total environmental effect of mussel farming.







Figures 5–7: Oxygen levels near the seabed at Musholm, Sankt Anna and Byxelkrok farms in Sweden and Denmark

Picture 2 : Environmental monitoring helps us to find out what impact mussel farming has on the Baltic Sea ecosystem

THE PROJECT

This factsheet has been elaborated by the Baltic Blue Growth project. The aim of Baltic Blue Growth is to advance mussel farming in the Baltic Sea from experimental to full scale to improve the water quality and to create blue growth in the feed industry. 18 partners from 7 countries are participating, with representatives from regional and national authorities, research institutions, private companies. The project is coordinated by Region Östergötland (Sweden) and has a total budget of € 4.7 million. It is a flagship project under the Policy Area "Nutri" of the European Union Strategy for the Baltic Sea Region (EUSBSR).

LEAD PARTNER:
Region Östergötland
Contact: Lena Tasse
Lena.Tasse@regionostergotland.se

QUESTIONS ABOUT ENVIRONMENTAL MONITORING
University Tartu
Contact: Jonne Kotta
jonne.kotta@sea.ee

PROJECT COMMUNICATION:
SUBMARINER Network for Blue Growth EEIG
Contact: Annika Steele
as@submariner-network.eu

www.balticbluegrowth.eu
#BalticBlueGrowth