Mussel farms in the Baltic Sea

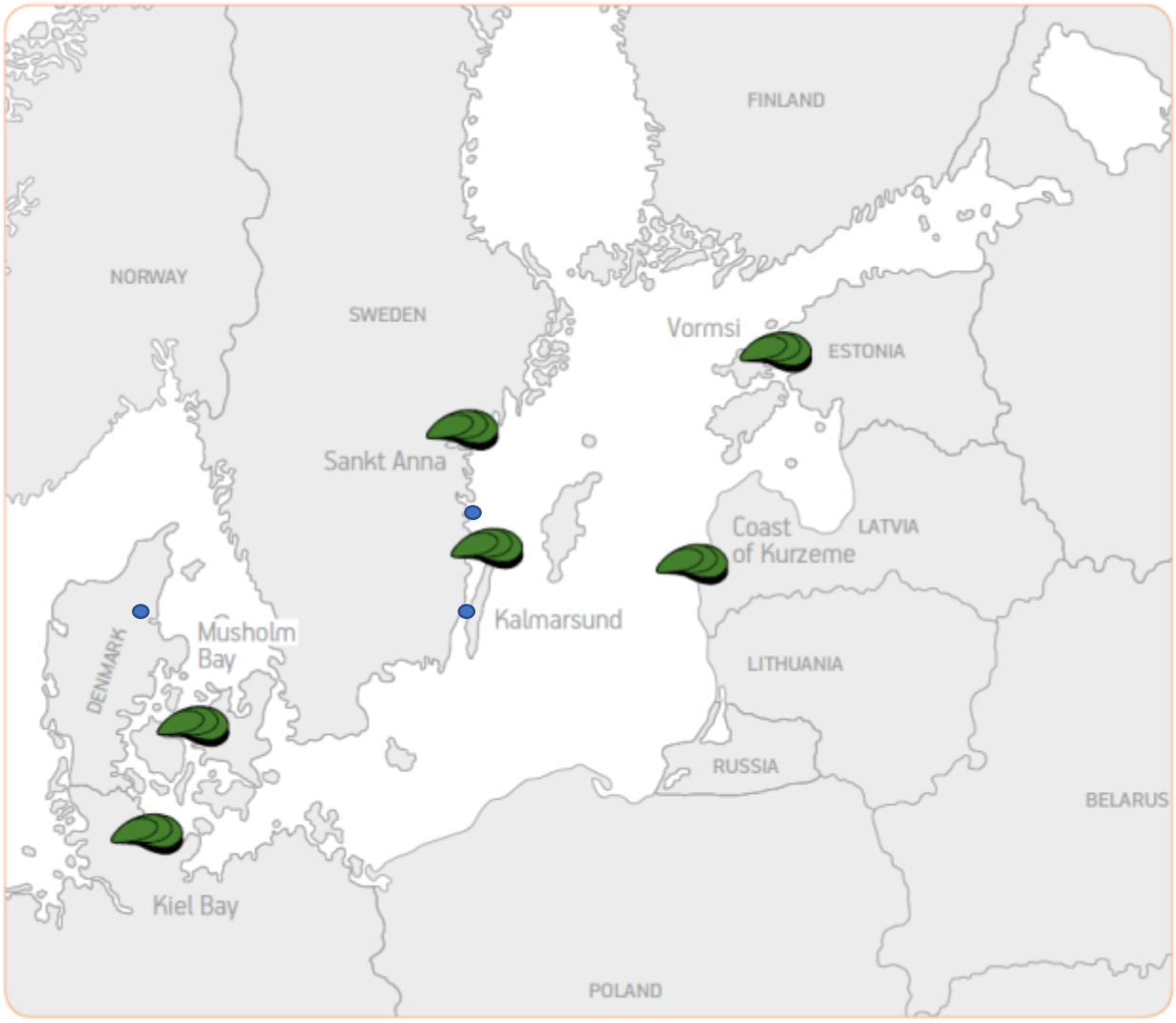

Figure 1: Farmsites used in the project. Green mussels mark the farm-sites for the project farms, from which most information summarized in this report origin. Blue dots mark the farm-sites from which Musholm and Kalmar added some data gained from the parallell.

Lesson learned from the BBG project

Through the Baltic Blue Growth project and the five mussels farm pilots, different lessons have been learned and are provided in this fact sheet. Some areas may be unsuited for mussel production due to predation by (eider ducks), rough weather conditions, strong currents, poor settling and/or poor food availability. So, a suitable area is a prerequisite for successful mussel production. Specific substrates and mesh sizes are not key factors in successful production of small mussels. However, the structure of the mussel farm (anchoring, flexibility, buoys etc.) and logistics (having frequent inspections and adjustments of the farm, the farm being easily accessible, and good and flexible transport to and from the farm) related to it, is very important. These factors must be well investigated and planned before any new start-up of mussel production in the Baltic Sea.

Overview of technologies used

Mussel farming has been practiced in sheltered areas without any major problems caused e.g. by weather influences or ice cover. Most issues that were faced and addressed in the Baltic Blue Growth

project occurred because mussel farming was tested in more exposed locations. Here, storms; currents; waves; ice and weather can cause material to wear or even get ripped off, resulting in new requirements for the design and construction of materials used. One of the biggest challenges is the regularly occurring ice-cover which can even hit the far south of the Baltic Sea. Ice-covers are not per se a problem, but in combination with currents, they can represent a major challenge as when the ice melts and breaks up, it can easily rip out the anchoring and rip off the buoys and lines. The most practical solution to this challenge is to build submerged farms. Such farms are also an opportunity to dramatically increase the size of potential mussel farming sites, as the mussel farms then face less competition for space and cause fewer aesthetic disturbances.

Baltic Blue Growth aims to find solutions to the challenges that come with submerged farms such as setting drill-anchors, calculating the necessary farm specifications and the general lack of experience with the novel techniques. Another problem of mussel farming in some parts of the Baltic Sea is the periodic predation from eider ducks. Different avoidance strategies besides moving the farm to a place where there are no ducks, as well as different technical solutions are currently being tested. By testing different farming techniques, different materials, set-ups and locations, the project provides valuable input in establishing good practices for mussel farming in the Baltic Sea. However, many processes still need to be optimized to increase the biomass production and eutrophication counteracting capacity of mussel farming in the Baltic Sea.

Sankt Anna archipelago, Sweden

This area in the middle archipelago of St. Anna, was chosen based on physical, chemical and social conditions. It is part of a protected natural area and is therefore not affected by conflicts over land/water-ownership. The site has sufficient depth (~20 m), salinity and acceptable current and wind conditions. In addition, the area is not normally affected by ice movements during freezing or spring break-up. The farm was launched in spring 2016. The farm uses submerged long-line technology, 16 long-lines of 150m kept with 350 buoys and with 24 000 m New Zealand fuzzy rope. Ropes that the mussels grow on go from 1,5-10 m depth. So far, the farm technology has worked fine. The mussels are allowed to grow out to full size on the collector ropes and no socking is planned. In the first summer, it seemed like the settling of mussels suffered some competition from cockles *Cerastoderma* sp, but the *Cerastoderma* sp. eventually fell of the ropes and after the first year the mussels totally dominated the biomass on the ropes. Submersion of the longlines for the winters of 2016/2017 and 2017/2018 was considered but not performed. The first winter had only very little ice, but during the second winter there was a thick and long-standing ice-cover over the farm from Jan-Apr. The farm did not suffer from ice damage, presumably due to the high tension of the long lines. So far, the production on the farm has been very successful and it produced more than double the expected yield in mussel biomass. It was harvested in Dec 2017, May 2018 and Sep 2018, with the highest biomass measured in May 2018 after a 2-year growth period. 79 tons were harvested from 16 units over the 24.000m substrate, resulting in 3.2 kg/m harvest. The mussels grew 1-3cm within 14 months.

Basic facts about the farm

- Surface area: 0.5 ha
- Substrate type: lone line (Quality Equipment Ltd.)
- Size: 24,000 m long line
- Growth depth: 2–12 m

Figure 3: Sankt Anna archipelago mussel farm.

Kalmarsund, Sweden

The Kalmarsund farm is located in an exposed area of the Kalmarsound. The estimated harvest for this farm in 2018 in 50 tonnes. Placed in an exposed area at the northern inlet of the Kalmarsound between the Swedish East Coast and the Öland island, this farm uses a submerged net-farm production system which has been designed to withstand ice and o shore conditions. The area was chosen because of its good biological potential for mussel growth, few conflicting uses and interests and the proximity to two larger harbours, making the farm easily accessible. The estimated harvest in 2018 is 50 tonnes, corresponding to a nutrient uptake potential of 500 kg nitrogen (N) and 50 kg phospho-ros (P). The farm is owned and run by the company Bohus Havsbruk according to a contract with Kalmar municipality. The mussels grew 0.5-1 cm in 2 years.

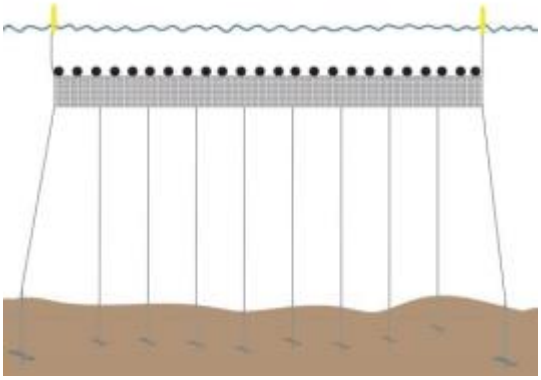

Figure 2: Design of the Byxelkrok farm in Kamarsund.

Basic facts about the farm

- Surface area: 1 ha
- Substrate type: rope net (Shelltech)
- Size: 40,000 m rope
- Growth depth: 3–6 m
- Expected harvest in 2018: approx. 50 tonnes

Musholm Bay, Denmark

The farm in the Musholm Bay is a mussel-farm run by the fish aquaculture company Musholm, thus representing the "Danish model" of fish farms that compensate nutrient outlet from their fish farm by growing and harvesting mussels. The existing mussel farm in the Musholm Bay has been extended with different mesh-size substrates to test maximum nutrient uptake.

The conditions for farming at the site are exposed, with general strong currents, shifting salinity and rough weather. The special interest for the Musholm farm at this stage is to maximise nutrient uptake by testing different mesh-sizes of net substrate and different times of the year to harvest in order to increase the mussel production. Since it is more efficient to harvest the mussels at a smaller size if the aim is to gain a high biomass in a short time, the business potential to use small and thin-shelled mussels in animal feed is also of great interest to the Musholm farm. 13 tons were harvested from the 4 units, over 100m2 substrate in May 2016. The mussels grew around 2.5cm in one year.

Basic facts about the farm

- Surface area: 1 ha
- Substrate type: rope net 10 units of 100m, trawl net 4 units, 5 different mesh sizes – total substrate of 4200 m^2
- Size: 49,000 m rope
- Growth depth: 0–4.5

Coast of Kurzeme, Latvia

The Baltic Blue Growth farm in Latvia is located in the open waters to compare costs and benefits with existing farms in sheltered sites in other parts of the Baltic Sea Region.

Off the port town Pāvilosta on the Latvian coast, the Latvian Institute of Aquatic Ecology is about to establish a test cultivation farm using long lines as a substrate. Located some 5 km off the shore in the open sea, there is rapid water circulation in the area. To protect the cultivation units, the cultivation will thus be submerged in a depth of at least 5 m. The site has a depth of approx. 20 m with a stony bottom with patches of sand. The mussels grew o.5 – 1.5 cm in one year and 1-2 cm in two years.

A special focus with this open water test farm will be on comparing its costs and benefits to those of already existing farms in sheltered sites. It is expected that the costs of deployment will be comparable to other farms, whereas the maintenance costs will most probably be higher, in particular due to the need to deploy navigation signs to warn ships that pass the farm area.

Basic facts about the farm

- Surface area: 1 ha
- Substrate type: 5 parallel submerged longlines
- Rope net (Shelltech)
- Size: 625 m rope
- Growth depth: 5–7

Kiel Bay, Germany

The Kiel farm is operated by the private company Kieler Meeresfarm, which is already running a small-scale commercial mussel cultivation in the Kiel Bay, selling its mussels to locals and restaurants for human consumption. During spring 2017 Kieler Meeresfarm has contracted operators for the Schleswig-Holstein Ministry of Energy, Agriculture, Environment and Rural Areas, that has deployed three new 100 m longlines within the approved farm area, each with 150 units of fuzzy rope substrate. The project mussel farming units at Kiel Bay were finalized in May 2017.

In addition, test substrates consisting of trawl net mesh sizes 50 mm and 100 mm and Swedish bands were launched. Since then, the farm has not encountered any problems. In spring 2018, approximately 5 ton of small blue mussels were harvested, but most of the mussels were discarded since they were not needed for the project activities. All data, including environmental monitoring has been sent to the responsible project partners for further analysis. Mussel meat content

was estimated visually in the field. The harvest was 5 tons from 3 units, over 1500m substrate rope in April 2018, with 3.3 kg/m. The mussels grew up to 10cm in 12-14 months and 3.3kg per meter/year.

Basic facts about the farm

- Surface area: at least 0.32 ha
- Substrate type: long line, fuzzy rope and experimental nets
- Size: at least 1,650 m rope
- Growth depth: 6–12 m

Vormsi island, Estonia

This associated farm was established in May 2015 by the company Estagar (Vormsi Arendus OÜ at the time). The site outside Vormsi Island is visible from the coast, usually without ice and somewhat protected inside the archipelago. Depth is 9-10 m. We have not been collecting info on workhours, cost, vessels, or methods from Vormsi farm to the project, but a lot of biological and oceanographic data. The original farm was designed by Nordshell A/S was made up by in total 126 m coils of trawl net (made from 45 mm mesh) hanging down to 3.5 m depth from a single 50 m longlines. In summer 2016 the mussels measured up to 20 mm. In autumn 2016 the farm suspiciously lost all its buoys at the same time and the line had sunken and had to be recovered from the sea-bottom. The buoys, that were presumed stolen, were replaced again, but after that weights were put on top of each rope, 500g to submerge the farm, and took away all main buoys to reduce curiosity by other persons. In 2017 it was upscaled to more lines with various substrates, net and fuzzy ropes. Maintenance is run by 1 person, visiting the farm once per 1.5 months. So far, the owners only got permission for research. For bigger production, they will need permission from all the involved administrations. The farm is located near shipping lanes, and the sea belongs to government. The mussels grew 1-3cm within 14 months.

Basic facts about the farm

- Surface area: 40 m2
- Substrate type: net strings from trawl nets
- Size: 126 m
- Growth depth: 0–3.5 m

More information about the activities of the Baltic Blue Growth farms can be found in the report 'Report on activities and results from the mussel farms in the Baltic Blue Growth project'. Specific information regarding the nutrient uptake in the farms can be found in the Monitoring Report 'Ecological impacts at the small-scale commercial mussel farms in the Baltic Sea'. Additional information may also be found in the factsheet 'Advice for the Baltic Sea mussel farmer' as well as the other reports and factsheets published on www.balticbluegrowth.eu.

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).

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