Prospects for a growing biomarine industry in Sweden
The biomarine industry

In this report, the Maritime cluster of West Sweden presents the results from an analysis of the growth potential of the biomarine industry. The opportunities are multiple—we have a well-developed regional innovation system and stakeholder cooperation facilitated by the Maritime cluster of West Sweden as well as strong marine research and a growing number of entrepreneurs and companies who are ready to take responsibility for developing the seafood value chain. Business leaders and researchers stand united—there is a huge potential to grow the biomarine industry in a long-term sustainable and economically viable way. However, a stronger political commitment, increased financial investments and modernization of laws and regulations are requested.

The marine environment with its rich biodiversity is to a large extent an unexplored treasure and a huge resource that contributes to healthy and sustainable foods. The marine animals and plants are the fundament for the biomarine industry, as being the source of unique substances with applications as pharmaceuticals, biomaterials, feed and fuel. In rural communities along the Swedish coastline, the fisheries and seafood processing industry have traditionally been a main occupation, but this industry has declined both in terms of jobs and economic significance, similar to other regions in Europe. Today, about 75% of the seafood consumed in Sweden is imported. Aquaculture of fish, shellfish and algae with environmentally friendly methods is an opportunity that can contribute both to increased domestic production and economic growth in coastal communities. A national strategy and action plan1 for aquaculture aim to stimulate domestic expansion of this industry. In a benchmarking report from 2017 “Omvärldsanalys”2, we concluded that there are excellent conditions for developing the biomarine industry in western Sweden, where we can exploit the diversity of the biomarine resources with innovative solutions that minimize the impact on the climate and the marine environment in line with the UN sustainable development goals. There a number of committed “blue entrepreneurs” and excellent marine research infrastructure and expertise located in the region, who are willing to contribute to a knowledge-based and sustainable industrial growth.

In this report, we have analyzed the economic growth potential of the biomarine industry by compiling economic data and interviewing more than 20 leading business executives and researchers active in aquaculture production and different steps along the seafood processing value-chain. A questionnaire about the challenges and opportunities for the biomarine industry has been answered by all respondents. The report summarizes what has emerged in the interviews and questionnaires and the conclusions represent the overall view of the blue entrepreneurs and researchers on the potential for the biomarine industry in Sweden. The analysis has been carried out by Bjerke & Co AB in close cooperation with representatives from the Maritime cluster of West Sweden.

Further reading
1 www.jordbruksverket.se
2 www.maritimaklustret.se
The global perspective

For planetary survival in the Anthropocene, a major reordering of global financial and food policies is needed to prioritize both the widespread recovery of capture fisheries and to expand – quickly – sustainable aquaculture.

There have been numerous proposals advanced by agriculture technologists, geographers, and food policy professionals to meet the world’s current and future food needs from agriculture. Nearly all of these analyses regarding the future of global food production consider “food” to be “terrestrial foods”, and their projections rely almost exclusively upon the failed concept of “sustainable intensification” of agriculture. Reforming agriculture is vital; however a scientific consensus has emerged that proposed methods of sustainable intensification of land agriculture will not be able to meet the increased food needs of a projected global population of at least 10 billion by 2050; upwards of 75-150% more food. The only way the lands of Planet Earth could provide this amount of food from agriculture will be to convert the Earth’s last remaining natural, biodiverse, terrestrial ecosystems.

In almost all planning and policy discussions on the future of food production there is little/no recognition that the Earth is 70% ocean and 97% of all water is saltwater; and that with a small footprint compared to agriculture, aquaculture could provide for all of the necessary future animal foods, and a vast amount of plant foods; and that these “ocean foods” are far more efficiently produced and less consumptive of natural resources in comparison with terrestrial foods – an overall more rational investment for the future of food with the enormous benefit of the preservation of the world’s remaining, undeveloped and invaluable terrestrial ecosystems.

Aquaculture production is estimated to comprise only 6% of all human foods today. Aquaculture is an answer to the future of human foods and wellness but there are very few “aquaculture-developed-nations” as the blue revolution has occurred over the last 50 years only in China and the rest of Asia and only very recently in Norway and Egypt. Aquaculture production is not increasing as rapidly as it needs to in order to become an important contributor of food globally in all bioregions, and it is actually decreasing in many areas of Europe and North America primarily due to a serious lack of education in both governments and civil societies.

For planetary survival in the Anthropocene, a major reordering of global financial food and policy systems are needed to prioritize both the widespread recovery of capture fisheries and to expand – quickly – sustainable aquaculture.
A Swedish perspective

Sweden, with its long coastline and its many lakes is not only beautiful, but there is also a fantastic potential to utilize the aquatic environment in a sustainable way and thereby create new industries.

One of the greatest challenges of our time is to increase the production of food to meet the needs of the growing world population, while reducing the ecological footprint, protecting natural resources and ecosystems, and promoting public health and rural development.

A unique opportunity exists in Sweden, if we learn how to wisely make use of the marine environment. Fishing is an important source of income for coastal communities, but the quotas are reduced, and many fishermen can no longer support themselves. Farming on land has been going on for a very long time, but when it comes to food production in the sea, we are still mainly "hunters". A paradigm shift is needed, where we learn to cultivate at sea as well as on land for food production.

I see a tremendous potential for development of a sustainable marine aquaculture industry, especially given that we are currently importing more than 75% of all seafood we eat in Sweden which is not sustainable in the long run. We need to increase the production of seafood and thereby increase Sweden's self-sufficiency of healthy seafoods.

Aquaculture can take place in the sea or in land-based farms, or in a valuable exchange of nutrients between sea and land in circular systems. By farming of extractive "blue catch crops"¹, the excess of nutrients leaking from fed aquaculture systems (i.e. fish or crustaceans such as lobster or shrimp) can be seen as an asset to the farming of these extractive species. The blue catch crops have a net uptake of nutrients from the environment and as such they can mitigate potentially negative effects from fed species in so called integrated multitrophic aquaculture systems (IMTA). The biomass of the blue catch crops can then be used either as food products, as high-quality feed ingredients for the fish and crustaceans or as other valuable bio-products. Nutrients are recycled and used in the most effective way. Different types of IMTA systems are currently being developed by researchers and companies in West Sweden.

Today, farming of blue mussels is the only marine aquaculture industry of major economic importance along the Swedish west coast. I am convinced that marine aquaculture can expand to include many more species and farming systems and become a sustainable and economically viable industry in our region. By working together, entrepreneurs, the existing industry, authorities, politicians and researchers, we can absolutely make this possible.

¹ Blue catch crops are animals and algae that extract nutrition directly from the water or sediments (extractive species). Mussels, oysters, sea squirts and other filters feeders extract particulate matter from the water column. Algae, both macro and microalgae, take up dissolved nutrients directly from the water. Animals living on the seafloor, such as worms, sea cucumbers and sea urchins ingest and extract organic matter from the sediments.

Kristina Snuttan Sundell

Kristina Snuttan Sundell is a professor in Zoophysiology at the Department of Biology and Environmental Science, University of Gothenburg. She has more than 25 years of experience of fish physiology and aquaculture-related research as well as innovation projects together with industry. Sundell is also the director of SWEMARC (Swedish Mariculture Research Center) and as such she is engaged in several committees and platforms for interaction with authorities, decision makers industry and society.

www.swemarc.gu.se
The blue entrepreneurs

Our large companies are key for developing innovations in our biomarine sector. Together with innovative start-ups and SMEs, we can come up with the ideas and products needed for sustainable blue growth and thus meet some of our societal challenges. Along all the steps in the seafood production and processing value-chain, different types of innovation support functions are needed. West Sweden has a well-developed innovation support system with a keen interest in our blue entrepreneurs.

Mikael Holm
CEO Lerøy Sverige
www.leroy.se

“Increased digitalization and automation of complex processes are of great importance in all industries, thus also in the seafood processing industry. This sector is behind when it comes to technology development and there is a great need to increase efforts in these types of investments to be able to meet the future.”

Benjamin Ajo
CEO Insula Sverige
www.insula.no

“We choose to work with inspiration and increased knowledge to get people to eat more fish and seafood. We need to serve more tasty fish for school lunches so that children may learn early in life to appreciate food from the oceans.”
Sweden needs a joint national approach to aquaculture if we are to develop the industry

Vegafish grows tropical vannamei shrimps completely without the use of antibiotics, destruction of mangrove areas or negative socio-economic conditions. Through the use of excess heat from adjacent industries we implement environmentally friendly land-based methods for the cultivation of tropical shrimps in a cold climate.

The cultivation method is based on Biofloc technology which creates a probiotic environment that is the basis of the feed. The culture system is circular which minimizes nutrient leakage to the surrounding environment. Vegafish develops cultivation processes that provide value to consumers in the terms of safe and environmentally sustainable foods and products.

In Sweden, companies within aquaculture need to apply for permits from several different authorities - national, regional and local - such as the Swedish Board of Agriculture, the County Administrative Boards, the National Food Agency and the Municipalities. Applying to several authorities for the same activity creates a lot of unnecessary work. Different authorities will often reach different conclusions, often caused by insufficient competence among the various authorities. Sweden thus has a lot to gain from creating a National Center for Aquaculture where officials and decisionmakers within the field are gathered. The municipalities for example, need to work towards integrating aquaculture into the municipal comprehensive plans. It is hard for municipal officials to take a position on different proposals regarding the location of activities if the politicians do not indicate which areas may be suitable for this type of activity. Several municipalities in Bohuslän have started to work on these issues in a common strategy.

Furthermore, the legislation and interpretation of regulations that govern the possibilities of starting and conducting aquaculture must be modernized to harmonize with research and the development of modern technology. Land-based closed systems designed to minimally affect the environment cannot respond to the same regulatory system as traditional cage cultivation but are today judged on the same basis. This creates a situation where we are not being able to develop sustainable cultivation systems. Current laws and regulations create completely unnecessary problems and slow down the development for modern sustainable businesses. Sweden could have much to gain from collaborating more with Norway and Norwegian companies. Norway has over the years, in a very successful way, developed aquaculture and has made it to a profitable basic industry. However, Sweden must do this without lowering the requirements for animal welfare or weakening the environmental legislation which forms the basis of healthy and sustainable animal husbandry.

1 The Comprehensive Plan shows how the municipality wants land and water areas to be used and provides guidance for decisions by the municipality and other public bodies (Comprehensive Plan for Göteborg, 2009). The plan is adopted by respective City Council which is the municipality’s highest governing body.

2 Bohuslän is a province located at the Swedish West coast.

Matilda Olstorpe
CEO Vegafish

Vegafish is a Swedish foodtech company that grows tropical vannamei shrimps completely without antibiotics, mangrove debris or negative socio-economic conditions.

www.vegafish.com
Prospects for a growing biomarine industry in Sweden

Anders Granhed
CEO Scanfjord Mollösund

Scanfjord farms, packs and sells blue mussels as our primary product. We also purchase oysters and mussels from other producers, that are packed and sold by us. The company provides service to other industries, collaborates with research and perform various types of services with our boats.

www.scanfjord.se

Aquaculture is not a prioritized industry in Sweden today. The society has not yet really understood that the sea and the marine industry are one of the most important industries of the future. It can provide food for an increasing population. Healthy food. While at the same time, the industry has an increasingly important role to play in sustainably protecting our environment. Mussels, oysters, seaweed and other extractive species protect and clean the water from eutrophication caused by, among other things, agriculture. The production of fish also has significantly less environmental impact than the production of red meat such as beef, lamb and pork.

The government is subsidizing the agricultural sector in many ways but nothing goes to aquaculture. Our industry needs to be legally accepted and equated to agriculture. By introducing economic incentives and compensations for the positive environmental impact from mussel farming, the interest for investments in the farming industry may increase. This could for example be a compensation per tonne of nitrogen removed from the sea by aquaculture.

Aquaculture is an industry with great potential for the future. There are strong arguments as well as good opportunities for private investors to get involved. The same applies to the public sector to the greatest extent. I have been involved in aquaculture since 1979 both with mussels and fish. Sustainable and long-term governance with clear rules and regulations and a reasonable measure of supervision and control would make the industry more predictable and also more attractive for capital investments that can accelerate a positive industrial development.

Blue mussels are useful for the environment and create value and jobs in the archipelago

An innovation support system for Blue Growth

Sara Wallin
CEO Almi Väst

“We have invested in several biomarine businesses in West Sweden and we are working towards even more successful companies in this sector. The potential is definitely there and investing in sustainable businesses is in focus with us at Almi.”

www.almi.se/vast

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“We have invested in several biomarine businesses in West Sweden and we are working towards even more successful companies in this sector. The potential is definitely there and investing in sustainable businesses is in focus with us at Almi.”
Prospects for a growing biomarine industry in Sweden

KosterAlg is a vendor of Swedish-grown macroalgae (seaweed). Our customers are the food and cosmetics industries as well as chefs and restaurants. The largest part of the algae is grown in the open sea on the west coast of Sweden, but cultivation also takes place in tanks on land, in clean seawater from the depth of Skagerrak. The production is eco-certified for Sweden and the rest of the EU.

Marine foods will play an increasingly important role in the sustainable production of healthy and nutritious diets for humans. Growing macroalgae needs no irrigation or fertilization, algae grow by taking up nutrients present in the seawater and can counteract eutrophication. The algae also bind carbon dioxide, which could reduce ocean acidification, and furthermore they produce oxygen!

Sweden has good prospects of being successful in terms of sustainable production of marine food. The industry offers great opportunities for investors, both economic and social as well as environmental. However, the government needs to take a more unified and offensive approach in developing aquaculture. Modernization of laws and regulations, simplification of the licensing processes and increased national co-financing and funding of start-up companies are important measures that need to be taken.
Prospects for a growing biomarine industry in Sweden

A way forward with land-based aquaculture

Production of seafood in state-of-the-art, environmentally friendly and closed systems of RAS type (Recycling Aquaculture System) is the way forward for Swedish aquaculture. Sweden has a strong tradition of industrial and environmental expertise and in global comparison, we are definitely in the front of developing the RAS technology. We have the potential to be self-sufficient in salmon within 10 years; today we have an import deficit of almost 40,000 tonnes.

In Norway, there are several RAS fish farms in operation, mainly for the production of salmonid smolt. The fish are then transferred to net pens in the sea for grow-out to marketing size. Around the world, there are several RAS systems for growing fish to consumption size. Currently, a farm is under construction in Florida, which will produce 90,000 tonnes of salmon. Two more RAS farms are planned in Maine with a total of 50,000 tonnes of production capacity. In Asia, there are also nice examples of land-based systems for fish farming.

The water quality in RAS systems is of utmost importance for the quality of the fish, and it is an advantage to have access to clean seawater which also reduces costs. By combining aquaculture with a biogas plant, waste products from fish farming are utilized and are then sent back to run the system in the form of energy (electricity and hot water). We need to construct a full-scale plant on the west coast where we can bring the researchers into the development work. Then we can showcase the importance of research for start-up of companies and increased profitability for the industry.

Sweden needs more entrepreneurs and more educated staff who have the skills to run production facilities. Other important measures are to increase the knowledge within the public sector and authorities who are responsible for permits and legal issues. We need permissions that are reasonable both from an environmental and economic perspective. The state should introduce incentives to stimulate companies to reduce their emissions. Today, this is missing. This could for example be financed through an emission tax.

The demand for seafood will continue to increase. Aquaculture provides environmentally friendly, tasty and healthy food to an ever-growing population. Aquaculture can also contribute to creating more jobs in rural areas.

Bengt Gunnarsson – Cofounder of Smögenlax Aquaculture

Smögenlax is an integrated environmental and marine company aiming to build a RAS salmon farm on the West Coast of Sweden. In the affiliated company Rena Hav (Clean Seas), treatment of process water from the farm and biogas production will provide the RAS with heat and energy.

www.smogenlax.se
In harmony with nature

Sweden has fantastic opportunities to invest in future industry of marine aquaculture for the benefit of both people and the environment as we have access to clean and fresh water in large quantities. We also have a long industrial tradition, now at the forefront of environmental sustainability.

Swedish Algae Factory works in harmony with nature. We grow our own algae, based on a mindset of circular economy, where carbon dioxide, nitrogen and phosphorus emissions are transformed into valuable products. Through the creation of a controlled algal bloom, we prevent harmful emissions of nitrogen and phosphorus to reach our oceans. In the process, we also purify water and produce a nanoporous material that is the shell of the diatoms we grow. This material can be used to improve the efficiency of solar panels, as UV filters in sunscreen and plastic or for absorption and release of chemical substances in various products such as skin care products and batteries. The organic biomass that is inside the shell of the algae can be used to produce more sustainable feed and fertilizer.

The more algal plants we can put into operation, the more environmental and social benefits will be created. We also contribute with sustainable economic growth through the creation of a bio-based circular economic industry.

A heavy investment in marine aquaculture can contribute to a more sustainable food supply and to the production of smart materials, just as in the case of diatoms, which can contribute with great positive effects on the environment.

The Government, the Regions and Municipalities have a lot to gain from investing in this future industry. There is a need for a comprehensive approach to the marine aquaculture industry. A single responsible national authority with increased competence as well as modernized laws and regulations based on modern technology would undoubtedly contribute to facilitating licensing and thus more large investments in this important industry for Sweden and the world.

Sofie Allert
CEO Swedish Algae Factory

The Swedish Algae Factory extracts a super material from diatoms. The nanoporous silica material that constitutes silicon algae shell is naturally designed to absorb visible light effectively, block UV light and absorb and emit chemical substances effectively.

www.swedishalgaefactory.com
Prospects for a growing biomarine industry in Sweden

Technical breakthrough in the production of Swedish oysters

The vision of Ostrea Aquaculture is to become one of Europe’s leading producers of the flat oyster, Ostrea edulis. Our company’s ambition is to produce and sell both spat and consumption-sized oysters.

Since 2008, Ostrea has built up a state-of-the-art hatchery and on-growth facility at Sydkoster in the archipelago of Northern Bohuslän. We have refined the methods for cultivating both micro-algae (food for oyster larvae and juveniles) and oysters. In 2018, the company succeeded in solving a crucial stage in the early phase of production of oyster larvae which means that we can upscale the production volume of the high-prized flat oysters to an industrial scale.

Our business has a positive environmental impact and helps to improve seawater quality. Oysters filter large amounts of phytoplankton out of the water column, thereby counteracting eutrophication in coastal waters by acting as nitrogen traps.

Aquaculture has enormous potential, but more efforts are needed within academia and authorities to provide the industry with the support it needs for the development. The industry is small and needs backing from expertise to solve production and financing problems. Successful aquaculture countries have governmental organizations that directly assist the industry with support. I find that licensing procedures and administration times are often far too complicated and long, which risks delaying or shedding operations in the early stages. The authorities need to improve the handling of aquaculture processes.

Mussels provide nutritious food and feed products

Musselfeed has developed a process that completely separates the valuable mussel meat from the shell. Using a traditional raw material – blue mussels - in a novel form, Musselfeed creates new innovative food and feed products.

Mussels improve the quality of coastal waters. The mussels eat naturally occurring phytoplankton, which uses nitrogen and phosphorus for its growth, nutrients that are in excess in the marine environment. A large part of these nutrients in coastal waters originates from agriculture and other human activities. The mussels are in themselves a nutrient source that also makes great use by returning nutrients to land and thus improving water quality and the environment. The aquaculture industry will grow rapidly. In my opinion, a joint test facility in West Sweden, where knowledge is built through operational testing, would be valuable and contribute to stimulating the industry’s development.

We welcome more investors to our future industry and to our company.
Prospects for a growing biomarine industry in Sweden

Businesses are optimistic about the future

The figure shows the overall assessment the company managers make of the opportunities for their respective companies to grow, increase profitability and employ more staff.

The result shows that there is a strong belief in the company’s own opportunities to grow and increase profitability.

Figure. How do you see the opportunities for you / your company to grow, increase profitability and employ more staff within a 5 year period: (Grade on a 1-7-degree scale, where 1 stands for no opportunities and where 7 stands for very good opportunities)

Strong faith in growth
6,5 out of 7

The companies’ average assessment of the possibility for their own companies to grow over the next 5 years is 6.5 on a scale of 1-7.
Important measures to enable growth

The following two figures present our overall results of the responses from the respondents, both business executives and researchers, given the question—which measures are most important for the industry’s opportunity to develop positively? The questions were included in the questionnaire on challenges and opportunities for the industry and are part of the work with our analysis of the biomarine industry. The most important measures that need to be taken are, according to the respondents; “Simplified regulations and reduced bureaucracy”, “Improved opportunities for obtaining permission for cultivation” and “Measures to increase knowledge about, interest in and demand for marine foods”. Then follows “Development of innovative technical solutions for production” and “Help, primarily from the municipalities, with increased efforts to identify suitable land areas for aquaculture”.

Figure. How much impact would the following options have on you and the industry’s ability to develop successfully? Assess each statement on a scale from 1-7 where 1 stands for no impact and 7 for very large impact.
Access to capital and advice

According to the business executives participating in this analysis, “Access to national and regional funds and grants” together with “EU-funds” and “Private venture capital” are the most important funding sources for their ability to grow. For several of the small or newly started companies, subsidies and advisory support from the innovation system are very important for their ability to develop and grow.

Figure. How much impact would the following options have on you and the industry’s ability to develop successfully? Assess each statement on a scale from 1-7 where 1 stands for no impact and 7 for very large impact. Improved access to capital through:
Conclusions from the analysis

The most important conclusions according to the blue entrepreneurs, the researchers and others who participated in the analysis are:

- The blue entrepreneurs strongly believe in growth and increased profitability for their companies in the next five years as total operating revenue is estimated to increase tenfold.
- Access to national and regional growth funds together with advice from the innovation system are crucial factors for the small start-up companies’ abilities to develop and grow.
- Reduced and simplified bureaucracy for licensing for aquaculture is an important measure for the industry’s growth opportunities.
- Modernization of legislation and regulations is needed to promote novel, more environmentally-friendly cultivation systems and technologies.
- Incentives to stimulate companies to reduce their emissions and by providing compensation for blue catch crops can accelerate a positive environmental development and attract investors to the aquaculture industry.
The economic growth for the next five years was assessed by the individual companies participating in this analysis (with the exception of the large seafood processing industries Insula and Leröy). Growth was calculated as the percentage of change in total operating revenues. The prospects for future growth will to a large extent be affected by a number of important measures and political decisions which are summarized on page 17, conclusions in this publication.

Figure. Estimated economic development of the total of operating income 2018 and 2023 in the West Swedish companies that are part of this study of the biomarine industry (with the exception of Insula and Leröy).
The blue entrepreneurs
Companies within the biomarine industry in Western Sweden

Almi Väst
www.almi.se/vast
Astrid Fiske
www.fiske.zaramis.se/tag/astrid-fiske-ab
Bohus Havsbruk
www.bohushavsbruk.se
Bröderna Samuelsson Fiskexport
www.brodernasamuelsson.se
Catxalot
www.catxalot.se
Everts sjöbod
www.evertssjöbod.se
Fedtts Fisk & Skaldjur
www.fisk.se
Fisk Idag
www.fiskidag.se
GU Ventures
www.ventures.gu.se
Innovatum Startup
www.innovatum.se
Insula Sverige
www.insula.no
Kalvö oston
www.kalvoostron.se
Klädesholmen Seafood
www.klandsholmen.se
KosterAlg
www.kosteralg.se
Lerøy Sverige
www.leroy.se
Marine Taste
www.marinetaste.com
Musselbaren
www.musselbaren.se
Musselfeed
www.musselfeed.com
Orkla Foods Sverige
www.orkla.se
Orust Shellfish
www.orustshellfish.se
Ostrea Aquaculture
www.ostrea.se
RAS 365
www.ras365.online
Restaurang vRÅ
www.restaurangvra.se
Savolax
www.savolax.com
Scandic Pelagic Ellös
www.skagerakpelagic.com
Scanfjord Mollösund
www.scanfjord.se
Smögenlax Aquaculture
www.smogenlax.se
Stadsjord
www.stadsjord.se
Swedish Algae Factory
www.swedishalgafactory.com
Vegafish
www.vegafish.com
West Coast Smolts Sweden
www.smolts.se
Västsvenska skaldjur
www.vastsvenskaskaldjur.se
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