# AQUACULTURE FRONTIERS



### PART 6: Mariculture, the new promise



Marine aquaculture is probably the fasting growing frontier in the seafood industry. We study efforts led by Norway to build cages sturdy enough to house fish in open seas, and explore emerging species that could become the 'tropical' salmon. We track Japan's progress in farming tuna, and blue ocean opportunities in bivalves and seaweed.



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AQUACULTURE FRONTIERS SERIES

### **REPORT SCOPE**



Marine aquaculture is sometimes referred to as mariculture and encompasses an area with the most exciting growth potential in the aquaculture space.

This report will discuss the future of salmon farming in the sea, the rapid emergence of new tropical marine species, besides the vast growth potential in bivalves such as mussels and oysters.

We ask leading experts how cage designs can be improved to withstand harsher weather found further away from the coast. This includes both firms dedicated to making sea cages, and the efforts of salmon farming companies seeking to earn developmental licenses in Norway.

We take a close look at tropical marine aquaculture and ask leading experts which of these species, from barramundi to pompano, could become the next salmon in terms of volume and profitability. We examine if the recent consolidation phase of the Mediterranean seabass and sea bream industry will start to pay off. We study the exciting prospects for low-trophic species such as mussels and aquatic plants to feed the world's population and grow the share of sustainable aquaculture in the world's food supply.

There's an entire chapter dedicated to companies' efforts to farm bluefin tuna, from the slow evolution of Japanese ranchers to hatchery raised fish. We interview Maruha Nichiro, the world's largest fishing company, plus an innovative company in the US that is solving tuna's high feed conversion ratio. We analyze which countries are doing the most to develop offshore industries, from Saudi Arabia's 2030 plan to US Commerce Secretary Wilbur Ross's strategy to reduce seafood imports.

Our last two chapters zone in on some of the complexities of offshore farming, from property rights to feeding fish offshore.

### ORGANIZATIONS PROFILED

- Innovasea
- Gaelforce Group
- Giliocean
- Badinotti
- EcoSea
- International Copper Association
- Open Blue
- Australis Barramundi
- Barramundi Asia
- Naqua
- SalMar
- Maruha Nichiro
- Kindai University
- Icthus Unlimited
- Dongwon Fisheries
- Mowi

- SalMar
- Grieg Seafood
- Andromeda Group
- Mubadala
- Kilic Group
- Amerra Capital Management
- AKVA Group
- Philosofish
- Cargill
- Sagun Group
- BioMar
- Skretting
- University of New England
- Impact 9
- Hatch
- Oceanus Group

- Rabobank
- Blue Aqua International
- DHI Group
- St. Andrews
- Westpac
- The Company One
- Wieland
- Blumar
- New Zealand King Salmon
- Tassal
- NOAA
- FAO
- Midt-Norsk Havbruk
- Norway Royal Salmon
- Wieland Group
- Egersund Net

# INFOGRAPHICS



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# INFOGRAPHICS

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### Norway's development license designs (offshore)



#### SALMAR Passion for Salmar

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Height: 68 m Diameter: 110 m Capacity: 6,240t Comission date: 2017



Arctic Offshore Farming



Atlantis Subsea Farming

# SALMON

ORWAY

Height: 40 meters Diameter: 79 m Capacity: 5,990t Comission date: 2020





Height: 14-15 m Diameter: 50 m Capacity: 780t Comission date: 2019



Source: DNB, SalMar and Norway Royal Salmon

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- Up close: analysis of New Zealand King Salmon's Blue Endeavour project

Infographics: Norwegian, Chinese offshore cage designs

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- Turkish players struggling with low price environment
- Growing market share in Europe

**Infographics:** Production peaks as prices continue to fall, map of Mediterranean players, combined Andromeda Group

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#### TEN PREDICTIONS

• We end the report with 10 predicitons about the future of marine aquaculture

### PREVIEW

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"It is clear that the world's oceans and large lakes cannot take anymore fishing pressure, and they cannot (and will not) produce anymore aquatic foods for humanity, and that seawater aquaculture (mariculture) is the only solution to the world's food supply." – Barry Costa-Pierce of the University of New England.

Aquaculture has gone from being a negligible proportion of global marine protein supply four decades ago, to representing 40% of the total in 2014. Nearly all of that output has come from nearshore farms, a trend that has caused endless conflict with coastal communities because of environmental mishaps or simply Nimbyism.

Limited space in sheltered coastal waters and environmental damage is forcing aquaculture companies to consider bigger and stronger cages further out to sea. In salmon, the wealthiest marine aquaculture industry, there are very few areas in the world where governments are willing to give additional licenses to expand output. The only solutions are going on land with recirculating systems, or further out to sea.

Offshore farming is aquaculture's blue ocean opportunity. Mastering farming finfish and seaweed in the high seas could significantly increase the world's food supply in a sustainable way.

Water depths of 50 meters are seen as an upper limit for offshore farming as the threshold of far how divers can safely go to inspect moorings. Some engineers are working on IoT-driven designs that don't require divers or on site workers. That's a vision that prompted Ulf Winther, a consultant working with Norwegian government research institute Sintef, to say that aquaculture farming methods will be unrecognizable in ten years time.

With nearshore farming sites strained, aquaculture will move further offshore and onto land via recirculating aquaculture systems (RAS), The Nature Conservancy and Encourage Capital said in a joint publication on sustainable finance. The industry has not yet reached a consensus on which is the superior model. In salmon, SalMar is investing heavily in offshore designs, moving the needle with its 110-meter-wide Ocean Farm 1 farm in central Norway. The world's major salmon farmers have stayed away from investing in RAS grow-out projects, although Norway's Grieg family invested in a Japanese RAS facility midway through 2019.

Perhaps the most telling story of all is that of Australis Barramundi, a company created by RAS expert Josh Goldman. His company, Australis Barramundi, successfully started a land-based barramundi farm in Turner Falls, Massachusetts and began offshore farming in Vietnam a couple of years later, in 2010. Goldman was able to compare the financial results of the two models side-by-side, over several years. In 2018, Goldman chose to sell the land-farm, while doubling capacity at the offshore farm in Vietnam. Goldman considers that offshore pens and tropical species represent the next high growth area of aquaculture.

Farming in deeper water resolves the key issue of unused feed and faeces accumulating on the seabed, potentially causing disease and environmental decay. More exposed sites have better water quality and disperse nutrients from a cage over a wider area.

But aquaculture continues to be blighted by net pen escapes at salmon farms and other species held in nearshore cages. Cooke's 2017 net pen collapse in Washington, shortly after buying out the assets of a bankrupt company, effectively ended Atlantic salmon farming in the United States when state governor Jay Inslee outlawed it. Mowi already reported the first major net pen escape in early 2020 after a storm battered a site in Scotland. We ask the experts how the industry can end its poor track record of net pen escapes.

Also, a key differentiator with coastal farming is accessibility. Whereas farmers can visit coastal sites found less than 500m from the shore on a daily basis, offshore sites might be visited every 3-10 days, requiring remote operations and automated feeding. Designing new systems requires reinventing the entire farming process, from feed to disease prevention and cage design. It's an area where Norway is expected to show further leadership, given its vast resources, the need to expand the salmon farming industry and its track record of cross-sector collaboration. China is fast developing its own offshore platforms to grow salmon, and Japan and South Korea are not far behind.

In Asia, the massive potential of tropical marine aquaculture could give way to the new salmon. But farmers in these areas are restricted by a lack of capital.

### PREVIEW

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Tropical marine species such as barramundi, cobia and yellowtail are often touted as the next potential high growth aquaculture industry after salmon and could take off in countries with abundant marine areas offering stable, year-round temperatures. But there is a learning process for each species. It's "not a cut and paste job" from transferring learning from the coldwater salmon industry to warm-water species, said Jesper Clausen, a former feed technician for Cargill.

One industry that has followed in the footsteps of salmon is the seabass and sea bream industry, using largely the same technology. Greece and Turkey, the main two producers, are in a strong consolidation phase. Andromeda Group, a new industry giant formed by private equity firm Amerra Capital Management and United Arab Emirates' sovereign wealth fund Mubadala, is looking to expand the market for Mediterranean fish. The industry has suffered for several years from overinvestment and thus oversupply, leading to lower prices. This industry could be entering a new era.

Several Asian countries are pursuing what they consider the 'holy grail' of aquaculture, domesticating bluefin tuna. Scientists have overcome several key challenges such as cannibalism and collisions with netting. Alejandro Buentello, a former executive of feed giant Archer Daniel Midland, has worked on an improved feed conversion ratio, resolving one of the key pain points that the fish need to eat lots of forage fish to reach market size. Buentello's company, Ichthus Unlimited, is competing with Maruha Nichiro, the world's largest seafood company.

The bivalve industry, as one of the world's most sustainable sources of seafood, is entering an exciting new area. Chile and New Zealand have emerged as market leaders in the global mussel export market. Farms started out decades ago in sheltered bays in both countries and have steadily been placed further away from the coast, with longer long-line structures becoming the industry norm. Still, a stronger marketplace is needed for the industry to invest in more robust farming systems in areas of open sea. As we have seen with other species, growing a new market is not easy. It requires highly efficient and sustainable farming operations, and marketing dollars. The US is currently seeing an explosion in demand for oyster culture, which is stimulating interest in farm areas from Maine to the Pacific Northwest.

Eating seaweed is becoming fashionable in the US among the health conscious. There is some way to go for aquatic plants to become a mainstream food in Western markets, but Asian demand is as strong as ever. There is lots of exciting new research into potential uses of algae, and investments in new farming systems could surge in the next decade. Seaweed is one of the most sustainable ways of feeding the planet, and represents a remarkable opportunity to increase plant protein without putting more strain on current water and land resources.

Cage design is changing, and future iterations could incorporate the best of both full offshore design and traditional designs, said Einar Wathne, a former Cargill executive who now helps start-ups via Norway's NCE Seafood Cluster.



Aquatraz is a new salmon cage design aimed at solving escapes and contact with sea lice

### PREVIEW



GiliOcean, an Israeli cage designer, said its cages have withstood brutal storms with 11-meter high waves. There have also been several breakthroughs in submersible cages, which avoid storm damage and can also be lowered to cooler depths in summer months. We spoke to several cage manufacturers and quizzed them on ways in which net pens can withstand exposed offshore conditions.

We also focus on the challenge of feeding fish on offshore farms. Feed pellets require different nutritional formulations as fish get stressed in turbulent offshore waters. Feeding systems will also require significant modifications, as feed would have to be stored at offshore sites. There are questions surrounding issues such as how to feed fish kept in submerged cages, for instance.

Another key issue involves property rights. Few countries have carried out marine spatial planning to plant for the development of offshore aquaculture. And there has been even less of a debate on how to integrate offshore aquaculture farms with other marine structures such as wind farms and oil rigs. Some countries are advancing the global debate. We discuss advancements made in this area by Germany.

Norway will soon experiment with awarding licenses for its Exclusive Economic Zone (EEZ), and New Zealand has just crafted a new aquaculture plan that entails offshore sites. We zone in one project, New Zealand's King Salmon's Blue Endeavour offshore site, that will test this new framework. Countries such as New Zealand and Norway are lighting up a path for others to follow by devising new aquaculture strategies with stakeholder participation.

Finally, we cast the spotlight on countries that will be protagonists in 21st century aquaculture for different reasons. China will likely get more involved in developing aquaculture of neighboring countries such as the Philippines. Saudi Arabia, with generous subsidies and gret marine resources in the Red Sea, is sure to attract new industry actors. The US will likely develop an offshore aquaculture industry if it can smooth out permitting issues. Like other reports published so far, we round off by making ten predictions about the future of mariculture.



Feeding barge arrives at offshore site designed by Israel's GiliOcean

# **REPORT AUTHORS**



#### Matt Craze



Matt started Spheric Research in 2017 to provide global insights into the seafood industry. Spheric Research provides consulting services and has completed projects in Asia, Europe and the Americas. It has also produced multi-client studies in conjunction

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### PUBLISHERS



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#### SPHERIC RESEARCH

Spheric Research provides research and consultancy services to the global food industry. The company has published the *Aquaculture Frontiers* series of reports, providing a thorough overview and analysis of the global aquaculture industry. The reports were created in partnership with Undercurrent News.

#### UNDERCURRENT NEWS

Undercurrent News was started by Eva Tallaksen and Tom Seaman in 2012 and has become an authoritative voice in the seafood industry. Undercurrent places an emphasis on high-quality journalism and provides first-hand coverage of key trade shows and industry seminars around the world.

#### **Bonnie Waycott**

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Bonnie Waycott is a widely-read columist for the Global Aquaculture Alliance and a global authority on many technical aspects of aquaculture. She holds a a MsC in sustainable aquaculture from the University of St. Andrews and writes frequently for industrial publications

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# AQUACULTURE FRONTIER SERIES

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