A family affair
A small farm in the US is making a name for hybrid striped bass

Lifting the lid
What will happen when competition law is loosened in Norway

Baby food
Inve CEO talks hatchery nutrition, China, and innovation

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FIGHTING FISH

HOW TO FARM CANNIBALS

★LOBSTER★

★CRAB★

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Cannibalism. The word may conjure images from horror movies, but the practice of eating one’s own kind is not limited to fictional scenarios. Crabs and lobsters are both cannibals, and that alone has been enough to keep the spread of crab and lobster aquaculture around the globe at bay for most species.

However, as demand grows so does innovation, and developments in recent years show promise for the two shellfish.

Darden Restaurants’ plans for an open-air lobster farm in Malaysia are slated to take effect in four to five years, after the company finishes the infrastructure work. When it is completed, the company says it will be the largest lobster farm in the world. The truth is, it will not be many competitors.

“No one has attempted this species in particular that we’re aware of,” Darden spokesperson Rich Jeffers tells FFI.

The spiny lobster species Darden plans to farm is one that it already sells at its Red Lobster restaurant chain, along with the American Lobster (*Homarus americanus*). But unlike American Lobsters, spiny lobsters are not cannibalistic, making them much easier to farm.

American lobsters are not being farmed at the commercial level yet due to their cannibalistic nature, Robert Bayer, executive director of the University of Maine’s Lobster Institute, tells FFI. High production costs are the main reason American lobster farming has not taken off, Bayer says.

Farmers must keep them in separate pens; heated water is required in order to reduce the grow-out period; and feed costs are high, Bayer says. Even with heated water, the grow-out period of two to three years is long compared to other species, he says.

“There is no (American) lobster farming at the commercial level,” Bayer says.

**MINE’S THE PENTHOUSE:** Norwegian Lobster Farm has patented this “apartment” living model for lobster farming.

Lobster and crab are two of the world’s most prized seafood products, but unfortunately their cannibalistic tendencies are preventing large-scale aquaculture operations from getting off the ground.
“It’s so far off in our future – I don’t expect to see it in my lifetime.”

Yet across the Atlantic, one company is seeing some success with the European lobster (Homarus gammarus). Norwegian Lobster Farm claims to be “the only company in the world producing plate-sized lobsters.” The Norwegian company has a semi-commercial scale lobster farm in Norway and predicts in future the industry can reach commercial levels of 500 to 1,000 metric tons per year by 2020.

“The most difficult part has been cannibalism and to find a suitable technology enabling single-cages farming in large volumes,” Norwegian Lobster Farm managing director Asbjorn Drengstig tells FFI. “But through an innovative ‘apartment block’ model, Norwegian Lobster Farm has cleared this hurdle, and is now producing 2 to 3 metric tons annually, he says.

‘Apartment blocks’ for lobsters
Norwegian Lobster Farm has patented a new farming technology in 23 countries that incorporates all necessary prerequisites for successful and profitable culture of plate-sized lobsters. This technology lifts the crustacean industry from 2D to 3D by effectively utilizing all three dimensions in the water column. Moreover, the company has developed automated technologies that now supplement most of the procedures that previously were dependent on manual labor. The concept includes the use of selection robots (classification of larval stages), feeding robots, harvesting robots, remote desktop solutions and image processing software to identify moults, mortality and the time for harvesting.

Sharing information is new challenge
Drengstig says the main bottleneck to the industry’s growth now is not the challenge of production but the capital available to launch commercially scalable projects. He is establishing a network between existing hatcheries in the United Kingdom, Spain, Norway and Iceland.

“Co-operation between growers, combined with good public incentives for doing so, would lower the threshold for commercialization,” Drengstig says. “Within the lobster aquaculture industry, there are tendencies towards competition instead of co-operation too early in the process – if we share, we receive double back,” says Drengstig.

Water quality
Desirable levels of water quality for clawed lobsters are temperatures of 18-22 deg C, a salinity of 28-35 ppt, more than 6 mg oxygen/L (>70 percent saturation), pH of 7.8-8.2 and less than 14 μg N/L as un-ionized ammonia. writes Asbjorn Drengstig in the member’s magazine of the European Aquaculture Society. For short periods, lobster will tolerate considerably lower oxygen and higher ammonia concentrations than indicated but ammonia concentration is the most limiting parameter in recirculation systems for seawater, says Drengstig.

At Norwegian Lobster Farm’s hatchery, the biofilter is efficiently removing total ammonia (TAN) at rates of 50-70 percent depending on biomass load versus how much of the biofilter’s capacity was utilized. In initial tests, concentrations of un-ionized ammonia in the tanks were in the range 0.5 μg N/L. Lobster feed is high in protein and the ammonia excretion rates in the animals are correspondingly high – average rates of 0.1-0.5 g TAN/kg/day has been reported for adult lobster, according to Drengstig.

Lobster feed
While the absence of a high quality formulated feed was once a limiting factor to lobster aquaculture of Norwegian Lobster Farm developed a new formulated feed especially engineered for the European lobster, with an FCR of around 1.2-1.34 kilos per kilo weight gain, the composition of which is as follows:

<table>
<thead>
<tr>
<th>Nutritional content</th>
<th>% of dry weight</th>
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</thead>
<tbody>
<tr>
<td>Protein</td>
<td>54.7</td>
</tr>
<tr>
<td>Lipid</td>
<td>15.6</td>
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<tr>
<td>Carbohydrates</td>
<td>13.6</td>
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<tr>
<td>Ash</td>
<td>9.5</td>
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<tr>
<td>Water</td>
<td>6.8</td>
</tr>
<tr>
<td>Energy (MJ/kilo)</td>
<td>21.6</td>
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</tbody>
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While there are commercial aquaculture ventures for crab species popular in Asia – the mud crab – no one has yet cracked the code for species popular in the world’s other big crab market – the United States.

The Atlantic blue crabs that US East Coast consumers spring for are so prone to cannibalism that they tend to eat each other whenever stocking densities reach commercial levels, David Eggleston, Professor of Marine Science at North Carolina State University, tells FFI. Swimming blue crabs, found in Southeast Asia, are similar to the Atlantic blue crab, but they too are prone to cannibalism.

With demand putting pressure on supply, crab enhancement programs have sprung up in Alaska and the Philippines, and Eggleston helped launch a blue crab aquaculture research project in North Carolina in 2000.

The nine-year project, involving multiple universities on the East Coast, produced 40,000 juvenile blue crabs over four culture cycles in freshwater ponds in Maryland and North Carolina. But cannibalism during the early juvenile stages of production was a major blow to the project’s success, says North Carolina Sea Grant (NCSG), the founder of the project.

Of the crabs that were put into six freshwater lakes used, a mere 15 percent survived. The majority did not survive to full growout stage, and only half of those were able to be extracted from the water, Eggleston says. Ultimately, the conclusion was not encouraging, says Marc Turano, Mariculture and Blue Crab Specialist for North Carolina Sea Grant (NCSG).

“It is not commercially viable because of the hatchery phase,” Harry Daniels, project researcher and head of the biology department at North Carolina State University, tells FFI.

Based on the information available so far, Eggleston agrees. Plus, he says, there is no available supplier of juvenile blue crabs. Unlike other species, farmers must produce the crab seed themselves, and the hatchery process for doing so is “very labor intensive and very technical,” according to Daniels.

Future hope
Despite the paltry overall survival rate of 15 percent, Eggleston is hopeful for the future of blue crab farming, and so are people across the United States. Since his grant funding ran out in 2009, Eggleston says he has received three to ten calls per week from individuals and companies interested in blue crab farming, and that rate has climbed the last couple of months. Phillips Foods – US-based seafood company and the world’s largest manufacturer of blue swimming crab meat – has also shown strong interest from the outset. It contributed $500,000 (€414,000) to get the project going.

Eggleston hopes industry will pick up where he left off in 2009. After the project ended, the National Oceanic and Atmospheric Administration (NOAA) turned down his request for more funding to continue the research, and he is now immersed in other research, leaving a bounty of unanswered questions that he hopes industry will answer. First of all, forms other than soft shell crab need to be studied.

“That’s the kind of thing I’d love to see industry look into,” Eggleston says. “Rather than say this is absolutely not economically feasible, I’d rather think of it as ‘here are the bottlenecks, let’s see if industry can solve them’,” he says.

Dipping toes into aquaculture hatchery program
As researchers have attempted to define a viable business model for the industry, the National Fisheries Institute’s (NFI) Crab Council’s 17 member companies, including Bumble Bee Foods, have been working on enhancing their access to blue
swimming crab, a closely related product to blue crab, the best way it knows how – through enhancement programs.

There have been declines in the size and amount of females in the Philippines in recent years, according to the Philippine government. In response to these declines and a desire to ensure a healthy resource in future years, Phillips Foods and other NFI Crab Council member companies are dipping a toe into aquaculture with a hatchery program.

The program aims to enhance the existing crab stock in the Philippines by raising crabs to the two month stage and then releasing them into the wild, Rhodes said. The program could go too ways – expand into full-blown aquaculture or be mixed altogether – depending upon its success.

“If we find that our hatchery costs for the year aren’t covered by the costs we get for producing it then we would re-evaluate whether to keep doing it,” Edwin Rhodes, vice president for sustainability and aquaculture development for Phillips Foods, tells FFI.

Phillips is monitoring the project continually and plans to begin tagging the hatchery crabs that are released in order to track crab survival rates. The company is part of NFI’s crab enhancement program. For every crab that it imports into the United States, the company sends $0.015 to the Philippines’ crab hatchery program, which produces juveniles for release into the wild.

“The area could support millions and millions of small crabs,” Rhodes says. “And if they don’t have them, we could put those small crabs there. So we’re open to all ideas, including going back to straight aquaculture, where we could go into ponds or tanks.”

Phillips has no plans for crab aquaculture, but Rhodes said the company is “very interested” in supporting research by writing letters to project funders.

**Extraction Issues**

Beyond the cannibalism at juvenile stages is the issue of extracting the crabs from the water, which also proves difficult due to researchers’ focus on soft shell crabs. They were targeted for their value, which is “dramatically” higher than hard shell crabs, the NCSG says. Soft shell crabs also have the market advantage of not being as closely tied to the roller coaster rides of commodity prices. But their extreme fragility makes extraction from the ponds difficult. Researchers tried removing soft shell crabs – also known as peeler crabs – from ponds using a crab pot baited with a male. The practice worked but only allowed them to extract half the population. Males were not attracted to the pots by other males.

David Eggleston’s project boasted some promising facts. Most importantly, the lack of a crab seed or juvenile supply could be solved. Blue crabs have been mass-produced for research, which means there is a precedent for hatchery production that has been set, NCSG’s report says.

Growth rates were perhaps the most promising aspect of the project, as they were able to grow them at one of the highest rates ever recorded for blue crabs.

Disappointing survival rates could be improved upon. In Eggleston’s trials, predators were not removed from the habitat, and it is possible that survival rates would improve if they were.

DIGGING DEEP: Terry Armstrong (bending), North Carolina department of agriculture, and Brian Shannon, ex-North Carolina State University harvesting blue crabs in Plymouth, North Carolina