

Fishy Farms:

The Government's Push for Factory Farming in Our Oceans



About Food & Water Watch

Food & Water Watch works to ensure the food, water and fish we consume is safe, accessible and sustainable. So we can all enjoy and trust in what we eat and drink, we help people take charge of where their food comes from, keep clean, affordable, public tap water flowing freely to our homes, protect the environmental quality of oceans, force government to do its job protecting citizens, and educate about the importance of keeping shared resources under public control.

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SeaStation 3000 with feeding tube approximately 40 feet below the surface offshore of Honolulu, Hawaii, with divers on side.

Executive Summary

Over the past decade, people have become increasingly conscious about the environmental, cultural and economic repercussions of their food choices, and a movement has emerged to support more diverse, sustainable options. This movement has extended to choices about seafood, as people take note of issues such as overfishing and the environmental ramifications of different types of fish farming.

Despite this, the U.S. government continues to subsidize the development of open ocean aquaculture, a type of factory farming that threatens the health of our oceans, coastal communities and consumers. Factory fish farming involves the production of as many as tens of thousands of fish in cages off the coastline.

This report revisits the four U.S. taxpayer-supported factory fish farming experiments — in Hawaii, New Hampshire and Puerto Rico — that are described in Food & Water Watch's previous reports, *Seas of Doubt* and the first edition of *Fishy Farms*. Because all of these research and demonstration projects have previously received government funding to advance the industry, we have traced the operations' histories for lessons that can be drawn about the feasibility of ocean fish farming.

The results are bleak. This newest update finds that despite having as many as 13 years to overcome setbacks,¹ the farms have been largely unsuccessful,

facing some combination of technical, economic or environmental setbacks. They have experienced fish escapes, equipment failure and community opposition. In some cases, the problems have caused the operations to relocate, scale-back, sell out to other companies or even stop production altogether. Operations that have since been proposed have had difficulty securing permits and community support.

Even as new information about these facilities continues to demonstrate that their feasibility is uncertain, the data is becoming clearer about their potential impacts. A leading argument used to promote factory fish farming is that we need it to offset the U.S. seafood trade deficit — that is, to import less seafood and produce more seafood for local consumption. A Food & Water Watch analysis finds that to do this through factory fish farming, however, would require an almost unimaginable 200 million fish to be produced in ocean cages each year. This would call for approximately 41 percent of the entire global production of fishmeal to be used as feed, could produce as much nitrogenous waste as the untreated sewage from a city nearly nine times more populous than the city of Los Angeles and could lead to the escapement of as many as 34.8 million fish (if conditions are unfavorable) or 1–2 million fish (if conditions are ideal) into our oceans in one year alone.²

Despite years of opposition from consumers, environmentalists and coastal communities, as well as increasing evidence that this type of farming is infeasible and irresponsible, the federal government, under the National Oceanic and Atmospheric Administration (NOAA), has continued to sink resources to support this industry and develop a policy for it. The government already has spent over \$44 million in support of the troubled industry.³ During a time when people are pushing to trim the federal budget, NOAA continues to request money to support ocean fish farming — money that could be more wisely spent supporting job creation and economic growth in other areas.

After more than a decade of setbacks, it is time for the U.S. government to recognize that factory fish farming is not the solution for increasing seafood safety and availability. NOAA must stop taking money away from improving the sustainability of our

wild fisheries. Congress should act to prevent federal agencies from fast-tracking the development of the industry. The international community already has learned that large-scale, industrial, land-based agriculture cannot solve all economic and food security problems. When it comes to seafood and our oceans, we should take a lesson and avoid repeating the same mistakes.

Key Findings

- The factory fish farming industry has failed to demonstrate that it is environmentally sustainable or financially or technically viable on a commercial scale. None of the U.S. taxpayer-supported factory fish farming experiments have succeeded in proving that the industry is financially feasible or environmentally sustainable.
- Open ocean aquaculture is not a solution to the U.S. seafood trade deficit. According to Food & Water Watch analysis, based on examples from cobia, a type of fish currently in production, the United States would need to produce 200 million fish each year to offset the \$10 billion seafood trade deficit. Our estimates conclude that:
 - It would take more than 1.2 million tons of fishmeal — or 41 percent of the current estimated global supply — to feed this many fish.
 - Assuming that these fish produce a similar amount of waste as farmed salmon, this volume of production would lead to as much nitrogenous waste as the raw sewage from a city of over 34 million people — nearly nine times the city of Los Angeles.
 - If as many fish escaped from these farms as escaped on average over the course of three unfavorable years of salmon production in Washington state, 34.8 million fish could be released into our oceans, where they could compete and interbreed with wild fish. This is over 17 times as many fish as are estimated to escape from salmon farms in the Atlantic Ocean each year.
 - Even if the industry avoided the unfavorable conditions of storms or equipment failure, we could still expect 1–2 million fish to be released into our waters annually, comparable to the

quantity of salmon escapes in the Atlantic that some scientists believe has contributed to the extinction of wild Atlantic salmon.

- Ocean factory fish farms will not reduce pressure on wild fish populations. The aquaculture industry already is the world's largest user of fishmeal and fish oil, consuming 80 percent of the world's fish oil and half the fishmeal each year.
- Rather than contributing to domestic and global food supplies, open ocean aquaculture facilities will likely produce an expensive product that is out of reach for many U.S. consumers and may, in fact, contribute to food *insecurity* in populations that are dependent on the small fish species used in fishmeal and oil for protein.
- Like other factory-style industries with the goal of outputting as much as possible for the smallest cost, offshore fish farms will employ relatively few people, and the jobs may not be desirable or safe for workers.
- Despite spending many resources and staff time, neither NOAA nor Congress have successfully drafted a policy that could responsibly regulate factory fish farming.



Juvenile cobia responding to a feeding pipe in an offshore cage off of the island of Culebra, Puerto Rico.



IMAGE COURTESY OF NOAA

View of an offshore cage in the Gulf of Mexico near an oil rig.

Introduction

Currently located in Hawaii, and previously located or operating in New Hampshire and Puerto Rico, none of the U.S. taxpayer-supported factory fish farming experiments have succeeded. Each has been plagued by an assortment of difficulties. From shark encounters and fish escapes to financial troubles and lawsuits, these operations have not demonstrated that they can sustainably meet soaring demand for seafood and ease pressure on over-harvested wild fish populations.

For example, all of these operations have received government subsidies, and they have not demonstrated that they can be profitable — or even financially self-sustaining — without government assistance.⁴ In one notorious example, each pound of fish sold in a year by the Atlantic Marine Aquaculture Center, an experimental facility in New Hampshire, cost about \$3,000 in U.S. taxpayer dollars to produce.⁵ Kona Blue Water Farms, operating in Hawaii, is currently not on the market but has previously supplied a product that cost \$17 a pound for a fillet.⁶

Further, all of these operations claim that waste from the submerged cages is causing little or no harm to water quality, sea life or ecosystems in general.⁷ But with a maximum of four operating at any one time in the United States (and the closest of the two on separate Hawaiian Islands), the farms represent a tiny fraction of the thousands of cages that the industry

and its government backers envision building along U.S. coasts in the upcoming years. Looking at the impacts of a few farms alone does not reveal the full potential impact of opening the waters to an entire industry of factory fish farming.

All four of the operations discussed in this report have made claims of sustainability,⁸ and the president of one has strongly encouraged the National Organic Standards Board (NOSB) to create organic standards for net pen aquaculture.⁹ But ocean factory farmed fish cannot credibly be considered organic due to the massive amount of water pollution they can cause and the amount of non-organic feed made from wild fish (some that are already depleted) and non-organic agricultural feed constituents like soy that they can consume. This large-scale industry runs counter to the spirit of organics and the local and sustainable food movements.

The government hopes that offshore fish farms can help reduce the country's \$10 billion seafood trade deficit.¹⁰ Some claim that the industry could help U.S. consumers eat more domestic seafood and fewer tainted imports. Others even boast that it could boost worldwide food supplies and global food security. But existing and proposed operations in the United States have focused mainly on expensive boutique fish destined for high-end restaurants and sushi bars, not on varieties with widespread accessibility.¹¹ In fact, by feeding on smaller fish species, called forage fish, high-end farmed fish could actually reduce food security in communities across the world, many of which depend on smaller fish like anchovy or sardines (see box on page 10).

In sum, despite receiving more than \$44 million in U.S. taxpayer funding, millions more dollars in private investment¹² and extensive political support from agencies within the federal government, the open ocean aquaculture industry has failed to demonstrate that it is environmentally sustainable or financially or technically viable on a commercial scale.

Feedlots of the Sea: Factory Fish Farms and the United States

Fish farming itself is nothing new. Four thousand years ago, before written records, the Chinese were said to have begun farming carp.¹³ And fish ponds in Hawaii, called *loko i'a*, may have been in operation as early as 1200 A.D. These farms were constructed along the shore with seawalls and grates to keep in mature, typically herbivorous fish that were raised in a complex ecosystem. Hawaiian organizations are now working to restore the farms to provide local food for their communities.¹⁴

Many types of fish farming exist around the world and in the United States to this day — some sustainable, some not. But the type of aquaculture designed for the open marine waters most closely resembles salmon net pens, while replicating the large-scale livestock production model on land that grows thousands of animals in a confined environment. Marine fish are grown in cages or net pens that allow uneaten fish feed, fish waste and any antibiotics used in the operation to flow through the cages directly into the ocean.¹⁵

The first experimental offshore cages used in the United States were deployed off the coast of Washington state in 1989, and the first commercial operation opened in 2001.¹⁶ Both facilities were in state waters, within three miles of the coast.

In 1999, the National Oceanic and Atmospheric Administration (NOAA) called for a quintupling of the nation's annual aquaculture production by the year 2025 — from \$900 million a year to \$5 billion. The stated goal was to offset the seafood trade deficit, create more jobs and bring more high-quality seafood to U.S. customers.¹⁷

This has spurred the government's seemingly relentless push for the development of more offshore aquaculture, no matter its human and environmental costs, specifically pushing for the industry to be allowed in federal marine waters (typically between three and 200 miles off the coast), where it is out of reach of state environmental laws and far from other coastal activities:

- In early 2004, the Gulf of Mexico Regional Fishery Management Council, the body charged with advising the federal government on how to manage wild fisheries in the Gulf of Mexico, announced intentions to create a plan for developing fish farms in federal waters off the Gulf coast.¹⁸ The council developed this plan with input from a recently appointed member with a background in offshore aquaculture.¹⁹
- In 2005, pressed by NOAA, Congress introduced legislation in the U.S. Senate that would specifically authorize aquaculture in federal waters. It failed to pass.²⁰ Both the Senate and the U.S. House of Representatives introduced similar bills in 2007.²¹ Members of Congress introduced these bills as a courtesy to the Bush administration, and the measures were opposed by a wide array of fishing, environmental and consumer groups. None of the bills passed out of committee.²²
- Foiled by Congress, NOAA turned back to the regional development of the industry and hired consultants to help the Gulf Council develop its plan.²³

- Meanwhile, the Bush administration sought alternative ways to launch these farms in our oceans, including a 2008 proposal to allow the federal agency that regulates offshore oil and gas development, the Minerals Management Service under the Department of Interior, to grant permits for offshore aquaculture facilities attached to oil and gas structures.²⁴ After stark opposition from organizations and individuals, the proposal was dropped.²⁵
- In 2009, after years of debate and opposition, the Gulf of Mexico Regional Fishery Management Council finalized its regional plan for offshore fish farming. It was passed on to the newly appointed Secretary of Commerce under the Obama administration, but when the Secretary failed to veto it, it went into effect.²⁶ The agency said that it would neither approve nor disapprove the plan, but that it would instead develop a national policy on aquaculture by which to assess aquaculture.²⁷ The Gulf of Mexico plan was challenged in court, but the judge ruled that the lawsuit could not go forward until the agency finalized rules to implement it.²⁸
- In response to concerns about NOAA's aggressive push for the development of a fish farming industry, the National Sustainable Offshore Aquaculture Act was introduced in 2009.²⁹ The bill would

have authorized fish farming in federal waters but with some environmental standards. It did not pass out of committee.³⁰

- In 2010, the Research in Aquaculture Opportunity and Responsibility Act was introduced to put the brakes on open ocean fish farming until further studies could be conducted. The bill also contained measures to supplement wild seafood with sustainable methods of fish farming.³¹ The bill was unable to move forward before the legislative year ended.³²
- In June 2011, NOAA announced its final National Aquaculture Policy. The broad policy strongly promotes factory fish farming, while remaining vague on how the non-binding policy document would protect the marine environment and fishing communities. The document states that NOAA supports “sustainable aquaculture development that provides domestic jobs, products, and services and that is in harmony with healthy, productive, and resilient marine ecosystems, compatible with other uses of the marine environment, and consistent with [its] . . . National Oceans Policy.”³³ However, as demonstrated in this report, ocean fish farming may be inherently unsustainable, both environmentally and economically.
- The same day that it announced its National Aquaculture Policy, NOAA announced that it would issue rules to implement the Gulf of Mexico Fishery Management Council's very controversial aquaculture plan.³⁴
- Foreseeing that this was a possibility, in February 2011 U.S. Representative Don Young from Alaska introduced a bill that would block the Department of the Interior or Secretary of Commerce from allowing these operations in federal waters without specific Congressional approval. Rep. Young introduced the bill out of concern that offshore fish farming would damage Alaskan wild fisheries.³⁵

As can be seen, our nation is currently at a crossroads. NOAA can either heed the advice of congressional members, fishing and conservation groups and others and halt development of the factory fish farming industry, or it can continue to pursue the same tired offshore policies of the past to the detriment



*View from inside a Hawaii offshore aquaculture cage with *Moi* swimming near the surface*



Photo of the dewatering table as fish are taken from the offshore cage in Hawaii.

of the federal budget, the environment and coastal communities.

Why Factory Fish Farming Is Not Environmentally Sound or Sustainable

Pollution

Untreated fish waste, excess feed and dead fish empty directly from cages into the ocean. This waste has been shown to alter fragile marine habitats.³⁶ It is unknown how the oceans, which have already been damaged by industrial and agricultural pollution, and more recently by the catastrophic oil spill in the Gulf of Mexico, will respond to yet another source of pollution.

“Little is known about the assimilative capacity of the marine environment for these pollutants,” concludes a 2007 report commissioned by the Woods Hole Oceanographic Institution. “Pollution from a greatly expanded industry could have significant effects locally and regionally.”³⁷ The most recent edition of the Congressional Research Service’s report on open ocean aquaculture makes a similar point, noting that “The present lack of knowledge – owing to limited experience, lack of research funding, and few studies focusing specifically on open ocean aquaculture – limits understanding of potential environmental concerns.”³⁸

Although we do not know the full extent of the damage that can be caused by offshore aquaculture facilities, what we do know does not present a pretty

picture. A 2011 study accepted to the journal *Marine Environmental Research* analyzed the impacts of marine aquaculture on a large scale. Researchers found that aquaculture facilities were responsible for an increase of nutrients (or pollutants) in a gulf off the Italian Coast and wrote that “off-shore aquaculture may affect the marine ecosystem well beyond the local scale.”³⁹

Antibiotics, pesticides and the other drugs or chemicals used in these operations can also be damaging.⁴⁰ As with waste, little is known about how these drugs might affect the offshore marine environment, because the drugs that might be allowed on factory fish farms have not been tested in open ocean marine farming situations.⁴¹ Evidence does indicate several serious concerns associated with the use of aquaculture drugs.

For example, Maine lobsters have been harmed by pesticides used to control sea lice in salmon farms along the Maine and Canadian coasts.⁴² Further, antibiotics can kill beneficial seafloor bacteria and spawn antibiotic-resistant organisms. One study found that the use of antimicrobials on fish farms can lead to the creation of reservoirs of drug-resistant bacteria. According to the study, the genes responsible for this resistance may ultimately affect the human population through transfer to human pathogens.⁴³

Disease

The drugs mentioned above are used to overcome the increased risk of disease that exists when fish are packed densely together in operations, are exposed to pathogens in the marine environment and are subject to a number of other environmental stressors.⁴⁴

Sea lice is perhaps the most notorious of aquaculture infestations, thriving in the presence of new hosts, such as with the expansion or addition of a fish farm. According to a 2011 article, exposure to salmon farms with lice infestations may result in a “sharp decline” in wild pink salmon populations in British Columbia’s Broughton Archipelago.⁴⁵ In addition to sea lice, Infectious Salmon Anemia (ISA) has been a major problem for salmon farms. The disease was reported first in Norway, and later spread to Canada, Scotland,

the Faroe Islands and the United States.⁴⁶ Around 2007, the virus wreaked havoc on the salmon industry in Chile — devastating production and putting more than 7,000 people out of work.⁴⁷

Disease has also been a problem for open ocean aquaculture facilities in the United States. In Hawaii, for example, Kona Blue Water Farms has encountered problems with skin flukes, a parasite that does not harm human health but must be controlled due to its negative impact on the fish.⁴⁸ The company also has dealt with streptococcus infections, which it treated with the antibiotic florfenicol, a drug that has not been tested specifically for aquatic use in Hawaii's unique marine environment.⁴⁹

Escaped Fish

Fish escapes are a major problem on open water fish farms. They can be caused by equipment failure, staff error and adverse weather conditions. Fish raised in

aquaculture facilities are bred to thrive in farmed, rather than wild, environments. When escaped fish interbreed with wild fish, their offspring may have diminished survival skills, resulting in a genetically less fit wild fish population.

The recovery of wild salmon populations has been jeopardized by farmed salmon escapes. These escapees can interbreed with wild salmon and may harmfully alter the genetics of the wild stocks.⁵⁰ The international list of escape disasters is extensive: About 2 million farmed salmon escape into the North Atlantic each year, an amount equal to the number of wild salmon in the region.⁵¹ In six months of 2007 alone, more than 100,000 Atlantic salmon escaped from four facilities on the west coast of Scotland.⁵² On December 31, 2008, storms caused 700,000 salmon and trout to escape from various farms in Chile, prompting the leader of the Chilean Senate's Environmental Committee to proclaim the incidents an



Wild salmon spawning at Hood Canal.

Genetically Engineered Fish?

Some of the currently or previously operating open ocean fish farms have said that they will not use genetically modified fish.⁵⁹ If the industry grows to the scale that NOAA hopes, however, the industry will likely continue searching for new ways to mass-produce fish. The salmon farming industry, which is the near-shore analog of the open ocean industry, is attempting to do so through genetically modified fish. A company called AquaBounty Technologies has used genes from ocean pout (a eel-like fish) to create a genetically engineered salmon that supposedly grows twice as fast as regular salmon. This may sound like a salmon farmer's dream, but GE salmon will need to be fed large volumes of food made from wild fish, and they could have extremely negative impacts on wild fish populations if they escape.⁶⁰

“environmental disaster.”⁵³ In October 2009, 40,000 salmon escaped from a farm in British Columbia.⁵⁴ One year later, 70,000 salmon escaped from a farm in Norway.⁵⁵

And not all instances of escape occur so far from home. In 2010, an article revealed that a research project in the Bahamas, headed by University of Miami researchers, experienced a loss of approximately 90 percent of its fish.⁵⁶ Kona Blue Water Farms in Hawaii also has encountered ongoing instances of escapes.⁵⁷

The negative impacts of escaped farmed fish can be even more serious if the fish are non-native or have been genetically modified. California, Maryland and Washington have addressed this by banning farming of genetically modified fish in their state marine waters.⁵⁸

Pressure on Wild Fish

Although one might assume that farming fish could take the pressure off wild stocks, this is not actually true. Farmed fish often are fed large amounts of feed made from fishmeal and oil. These ingredients are derived almost exclusively from small ocean fish such as sardines, anchovies and herring, caught in mass quantities in the Northeast Atlantic and off North and South America’s Pacific coast.⁶¹ The aquaculture industry is the largest user of fishmeal and oil, and the amount demanded continues to increase.⁶² In 2006, an estimated 3.72 million metric tons of fishmeal were consumed, representing 68.2 percent of worldwide production and 0.84 million metric tons of fish oil, or 88.5 percent of production.⁶³ Many species of small fish being converted to aquaculture feed are being harvested beyond sustainable levels, not only leading to their depletion but also jeopardizing the predatory finfish that depend on them for survival, such as tuna, salmon, grouper and snapper.⁶⁴

Impacts on Marine Animals

Fish to Pellets to Fish Again

After small wild fish are processed into fishmeal and oil, fish feed processors mix in vitamins, minerals, cellulose, lipids and other ingredients. The mixture is molded into pellets, which aquaculture operators later feed to farmed fish.

So how many wild fish does it take to grow one farmed fish? The answer depends on the type of fish being farmed. To determine the “fish-in-fish-out ratio” we must look at how many pounds of feed a farmed fish is fed over its lifetime, calculate how much of the feed is made up of fishmeal or oil and then look at the amount of wild fish it took to create that meal or oil.

Typically, it takes four to five pounds of wild fish to produce one pound of dry fishmeal or 0.22 pounds of oil, which in turn constitutes somewhere around 40 percent of marine finfish feed.⁶⁵ On average, marine finfish gain one pound for every two pounds of feed that they eat.⁶⁶ Thus, for every pound of farmed fish that is produced for human consumption, it can take between two and six pounds of wild fish to produce. The following table lists conversion ratios for several species that have been grown in or proposed for open ocean fish farms.

The Wild Fish to Farmed Fish Conversion

Fish	Pounds of wild fish used to produce one pound of farmed fish
Cobia ⁶⁷	3.27–6.72
Red porgy ⁶⁸	4.64
Red drum ⁶⁹	3.71–5.56
Atlantic halibut ⁷⁰	2.74–3.17
Atlantic cod ⁷¹	2.81–3.07



Vegetarian Carnivores?

Recognizing the irreconcilable tension between declining fish stocks and aquaculture's projected demand for fishmeal, as well as the industry's costs of spending increasing amounts of money on fishmeal-rich feed, both independent and industry scientists have tried to replace the fishmeal in feed with other proteins, such as soybeans, canola, wheat gluten and peas.⁷² Some researchers also have focused on the potential of using algae as a feed ingredient.⁷³

Scientists are facing difficulties achieving desirable results feeding land-based vegetable proteins to carnivorous fish species that could be raised in offshore cages. These farmed fish require high-quality protein. The results of a number of experiments have shown that as the ratio of land-based feeds to fishmeal and oil in feed increases, fish can be more prone to reduced growth and even death, largely due to the difficulty of digesting these alternative proteins.⁷⁴ Many of these studies have focused on replacing fishmeal in feed with soy.

The livestock industry already has been criticized for its reliance on soy in feed, so it is troubling that the aquaculture industry may be repeating the same mistakes. In the United States, 93 percent of the soy produced is genetically modified,⁷⁵ and worldwide 77 percent of soy production is from genetically modified crops.⁷⁶ Further, extensive soy production has led to soil erosion, deforestation and reduction of tropical biodiversity in Latin American countries.⁷⁷ Kona Blue Water Farms has conducted feed trials with soy that has not been certified GMO-free.⁷⁸

In open ocean aquaculture, uneaten fish feed flows directly into the surrounding water. Although soy is also being extensively added to feed, little is known about the impacts to wild fish physiology and reproduction from this terrestrial plant entering the marine environment in large quantities.⁷⁹

Because algae are rich in omega-3 fatty acids and are produced in a fish's own marine environment, they are an obvious option for an alternative feed ingredient and would appear to be desirable over land-based crops. One research facility in Baltimore, Maryland, which hosts a demonstration land-based recirculating aquaculture facility, has experimented with feeding algae to fish.⁸⁰ Potential for algae in aquaculture, however, may be drowned out by lobbying and marketing efforts by powerful soy industry groups.⁸¹

Open ocean aquaculture facilities could negatively affect the marine animals that frequent these sites, including whales, seals, dolphins, turtles and sharks. Dolphins have frequented the site at Kona Blue Water Farms (see page 16), and the animals have apparently begun to exhibit “unnatural behaviors,” which may constitute conditioning. If the animals have become conditioned to respond to feeding opportunities at the site, they may experience reduced survival skills.⁸² An investigation of sharks and ocean-farming cages in Hawaii has found that sandbar sharks tend to aggregate around the cages, and that tiger sharks occasionally visited. Although the study concluded that the sharks were not affecting public safety at beaches adjacent to the cages, the researchers noted that the ecological effects of aggregating sharks are unknown.⁸³

Why Factory Fish Farming Won't Fix Our Economy

Due to the challenges of offshore fish farming, development of the industry could sacrifice environmental stewardship with little in return.

Logistical Difficulties

As discussed in the following profiles of fish farms, factory fish farming technology comes with a host of economic and feasibility challenges. To date, no U.S. operation has shown that it can be used to consistently raise healthy crops of fish and generate income.

The four facilities profiled in the original *Fishy Farms* report (2007) have faced major setbacks. The Atlantic Marine Aquaculture Center has lost funding and halted its open ocean fish farming demonstration. The owner of Snapperfarm shut down operations in Puerto Rico after finding that it could not expand, which the company blamed partly on U.S. regulations. Kona Blue Water Farms, failing to secure permission to expand, was forced to cut staff and has sold its cages in Hawaii to another company, although it continues to be heavily involved in the operation. It recently lost two cages that it was testing for production in federal waters. And finally, Hukilau Foods, once known as Cates International, has filed for bankruptcy.

An article in an industry publication discussing the

difficulties faced by two operations in Hawaii found that “Hawaii and the U.S. government have been generous with support – financial and otherwise – for both of these fledgling offshore operations. So you’ve got to ask yourself: If offshore can’t make it there, can it make it anywhere in the United States?”⁸⁴

The international community also has noted the difficulties of offshore aquaculture. A report by the Food and Agriculture Organization of the United Nations noted that offshore aquaculture means higher risk of fish escapes; higher transportation costs; difficulty in approaching cages during severe weather conditions; deeper [and more dangerous] operational routines for divers; and more expensive cages, mooring systems and nets.⁸⁵

No Jobs Here

In our current economy, job creation is a priority. Yet offshore fish farms are unlikely to create many jobs. In 2009, the two open ocean fish farms operating in Hawaii employed a total of 44 people. At that time, both companies were planning modifications to their business models. Combined, these modifications would result in an approximate overall 173 percent increase in production, from 2.2 million pounds of fish to 6 million pounds, but would lose five employees — an 11 percent decrease in employment.⁸⁶ According to Kona Blue Water Farms, the company needed to reduce the number of divers on staff in order to achieve profitability.⁸⁷

Furthermore, it seems that the few jobs that are offered may not be safe. Four former employees have filed lawsuits against Kona Blue Water Farms, alleging various failures to provide a safe working environment and claiming various physical and emotional repercussions.⁸⁸ A much greater loss occurred when a diver was killed at Hukilau Farms in 2011.⁸⁹

Not for Small-scale Entrepreneurs

As demonstrated in the profiles below, setting up an open ocean fish farm is a difficult and costly endeavor, often requiring government subsidies and private investment. Even with AOL’s Steve Case as an owner and infusing \$4.5 million into the operation in 2007,⁹⁰ Hukilau Farms in Hawaii filed for bankruptcy in

2010.⁹¹ Clearly, this industry will not be the domain of small businesses with limited resources, and if it were to restrict access to fishing grounds or damage wild fish populations, it could damage the small businesses of many fishermen.

Many commercial fishermen are suffering from competition with cheap seafood imported from other countries, as well as by disasters such as Hurricane Katrina and the BP Deepwater Horizon explosion. They fear that the advent of factory fish farming in the ocean will further damage their livelihoods.⁹² The state of Alaska banned open ocean aquaculture in its state waters in 1990 as fishermen experienced stiff competition from cheaper, mass-produced farmed salmon grown in Canada and other countries.⁹³ The rise of salmon farms was dealing a hard blow to fishermen facing competition from mass-produced farmed salmon.

What It Would Take to Offset the Seafood Deficit Through Factory Fish Farms

Proponents of offshore aquaculture claim that it could be used to offset the nearly \$10 billion U.S. seafood trade deficit, which is the amount of fish imported compared to the amount exported.⁹⁴ According to Food & Water Watch calculations, the United States would need to produce an astounding 200 million fish per year to close the deficit, based on data from open ocean cobia farms. This volume of production would require an unrealistic amount of small wild fish to be converted to fish feed and could lead to a frightening volume of escapes and pollution.⁹⁵

To feed this many farmed fish would take approximately 1.2 million tons of fishmeal, or 41 percent of the estimated global production.⁹⁶ In fact, this is a conservative estimate, and the requirements could actually be much higher if the operations cannot achieve a “feed-conversion ratio” of 1.75 or lower, or if a feed consisting of more than 50 percent fish-based protein is used.

Fishmeal is already demanded elsewhere, and production is currently decreasing,⁹⁷ so it is unlikely that this need for fishmeal could be met.

But if this limitation were somehow overcome, the



Sacks of anchovy fishmeal at Los Ferroles fishmeal plant in Peru.

production of 200 million fish on offshore factory farms could produce an astounding amount of environmental damage. **This many fish farms would result in approximately the same amount of nitrogen pollution as the untreated sewage produced by a city that is nearly nine times the population of Los Angeles.**⁹⁸

Further, as discussed earlier, escapement is a common problem on fish farms. For instance, over the course of three years in Washington state, the salmon industry lost approximately 17.4 percent of its fish annually.⁹⁹ If the farms averaged this same rate of escapes, 34.8 million fish could be released into our oceans each year. This is roughly 17 times the amount of salmon that escape from farms in the Atlantic Ocean per year — an amount that some scientists fear is leading to extinction of the wild species.

Granted, those three years, which are the only three for which we could obtain records, were considered to be the product of catastrophic events. In the unlikely scenarios that the new ocean fish farming industry consistently avoided adverse weather conditions or technical failures and lost only the minimum amount of fish that fish farms should expect, the industry could still be expected to release 1 to 2 million fish into the ocean every single year, approximately the same number of salmon



Closeup of netpen in the waters offshore of Catalina Island.

that escape each year in the Atlantic.¹⁰⁰

If this is what it would look like to offset the seafood trade deficit through offshore fish farming, it is clear that we must pursue other options, such as limiting imports and producing sustainable, healthy, affordable seafood domestically for U.S. consumers.

Why Factory Fish Farming Won't Benefit Consumers

Health Concerns

Perhaps the worst news for the offshore aquaculture industry is that its operations may produce hazards to human health. A serious public health concern with factory fish farms is the use of antibiotics. Antibiotics, which can be applied by way of medicated baths and medicated food,¹⁰¹ can enter the environment around cages, where they may alter the composition of marine bacteria.¹⁰² Evidence suggests that these antibiotic-resistant bacteria can, in turn, pass on their antibiotic resistance genes to other bacteria, including human and animal pathogens.¹⁰³

An increasing number of studies have documented elevated levels of bacterial antibiotic resistance in and around aquaculture sites. For example, before 1990 in the United Kingdom, the disease-causing bacteria *Aeromonas salmonicida* were sensitive to

amoxicillin. But after the antibiotic was introduced to fish farms, amoxicillin-resistant strains began to appear.¹⁰⁴ Evidence of antibiotic resistant bacteria also has been reported in the Mediterranean, where a study found a high percentage of resistant strains, indicating a widespread antibiotic resistance in the bacterial populations surrounding fish farms.¹⁰⁵

At a time when more and more consumers are moving toward organic meat and milk in order to avoid food products from animals that have been excessively exposed to antibiotics,¹⁰⁶ it is unclear why we would develop a new, antibiotic-dependent food industry.

Additionally, there is cause for concern that factory fish farms could lead to higher incidence of ciguatera in both farmed fish and surrounding wild fish populations. Ciguatera poisoning is the largest cause of finfish-related food-borne illness in the United States, and possibly globally. It causes an array of gastrointestinal, cardiological and neurological symptoms. Poisoning is contracted by consumption of a fish that has accumulated toxins living in microalgae.¹⁰⁷ A study examining the impacts of offshore rigs has parallels to offshore fish farms, as they both provide havens for toxins to accumulate. The study found that “use of these platforms for fisheries enhancement structures could have unintended consequences for human health,” and that “these concerns also extend to proposals for off-shore mariculture [marine aquaculture] operations.”¹⁰⁸

In addition, there is the possibility that farmed fish could contain higher levels of certain contaminants — such as PCBs, dioxins, flame retardants and pesticides — than wild fish. Although this has not been critically examined for all types of aquacultured fish, one study of salmon found that 13 out of 14 organochlorine contaminants are more common in farmed salmon than wild.¹⁰⁹ Another study has suggested that exposure to fish farms may increase mercury contamination in nearby wild fish. Rockfish around a salmon farm in British Columbia were found to have increased levels of mercury contamination after being exposed to farm waste and uneaten feed.¹¹⁰

A Costly Product

Further, products produced on offshore farms are likely to be out of reach for many U.S. consumers. The most commonly consumed seafood items in the United States are those that have become more widely and cheaply available at grocery stores and inexpensive restaurants: shrimp, canned tuna, salmon, pollock (used in fish sandwiches and fish sticks), tilapia and catfish.¹¹¹ The majority of seafood that U.S. consumers eat is imported, often from countries with less stringent regulations on the chemicals and conditions that seafood can be farmed in, leading to concerns about the quality and safety of these fish.¹¹²

In order to benefit the majority of U.S. seafood consumers, we need affordable seafood that is locally available and locally produced. However, open ocean aquaculture operators are primarily interested in growing premium products that can be sold for a high value. Kona Kampachi®, the brand name of Kona Blue Water Farm's fish, have been sold for \$17 a fillet.¹¹³ The newest fish farm on the horizon in Hawaii hopes to grow bigeye tuna, a popular species for sushi.¹¹⁴ Not only are these products out of reach for many consumers, they are also likely to be exported to Japan or countries in the European Union, where high-quality seafood can fetch a higher price.

Contributing to Global Food Insecurity?

As discussed earlier, it can take many pounds of small wild fish in order to grow the carnivorous marine finfish farmed in open ocean aquaculture operations. These small fish, such as anchovies and sardines, may not be in high demand for human consumption in the United States, but they are a healthy food source that low-resource populations in many parts of the world rely on for a component of their protein intake. A 2009 article pointed out the dire consequences of malnutrition around the globe, and the growing competition for small "pelagic" fish for direct consumption, or for reduction into fishmeal.¹¹⁵ If these small fish species are fished out to create food for large species of farmed fish, we may be trading many people's access to a nutrient-rich food source for fewer people's access to more high-value, sushi-grade fish.

Life in Factory Fish Farms



Since the original *Fishy Farms* was published, the four farms profiled have not fared well. Atlantic Marine Aquaculture Center has stopped production. Snapperfarm, in Puerto Rico, has ceased production, and its owner has moved production outside of the United States. Kona Blue Water Farms has sold its grow-out operations and has not had fish on the market in the past year. And finally, Hukilau Farms (formerly known as Cates International) has ceased production in the open waters in order to focus on its land-based hatchery. Three new operations have proposed development in Hawaii but have yet to make it to the operational stage. Another farm was proposed off the coast of California but mysteriously stopped, while complaining about the permitting process.

Atlantic Marine Aquaculture Center

In 2006, Richard Langan, director of the University of New Hampshire's Open Ocean Aquaculture Project told Congress that one of his center's goals was to explore the "economic viability of farming finfish."¹¹⁶ In early 2007, Langan observed: "At the University of New Hampshire, eight years of research and technology development have led us to conclude that a commercially viable and environmentally sound offshore aquaculture industry is an option for the U.S."¹¹⁷

Between 1997 and 2007, NOAA gave \$19 million in support to the Atlantic Marine Aquaculture Center. But since 2007, when AMAC and its various operational and technological setbacks were featured in the original *Fishy Farms* report, the center does not

appear to have fared well. All of the program’s progress reports on finfish aquaculture, updated regularly from 2000 onward, cease after 2007.¹¹⁸ A call placed to AMAC’s former spokesperson, Dolores Leonard, in August 2009, revealed that the project had lost some of its funding in 2007, leading to a reduction in staff, and research activities were therefore greatly curtailed.¹¹⁹

In 2008, however, the center did receive \$474,999 from NOAA to “support the advancement and improve the economic viability of offshore fish farming,”¹²⁰ as well as \$355,000 for research on offshore cage technology to find ways to optimize feeding processes, reduce fish stress and promote fish growth.¹²¹ These hefty grants did not result in new public information on the topics they were intended to explore. The center’s website has not even been updated since 2007. Although Langan once said that his operation had “made tremendous strides toward bringing offshore aquaculture closer to commercial reality,”¹²² in the end, it could not exist without research funding.

Snapperfarm and Open Blue Sea Farms

In 2003, Brian O’Hanlon, a young entrepreneur, put the first trial cages of cobia off the coast of the Puerto Rican island of Culebra.¹²³ The company, Snapperfarm, faced some initial growing pains. A 2010 paper that lists O’Hanlon as the second author details open ocean fish farm trials that occurred during a previous but unspecified year in Puerto Rico.¹²⁴

Between 2007 and 2009, the company ramped up operations, increasing production and experimenting with new production technologies, such as the self-propelled Aquapod, an enormous geodesic cage that can roam the ocean untethered.¹²⁵

By 2009, the company was growing 50 tons of cobia.¹²⁶ O’Hanlon had hoped to grow his facility up to 750 tons — 1,500 percent its current size.¹²⁷ After struggling through disease outbreaks in Puerto Rico and the loss of his fingerling supplier in Miami, Florida, he eventually gave up and moved to Panama, where he launched Open Blue Seafarms in conjunction with his investor, Aquacopia.¹²⁸ There he found the permitting system to be easier; as he explained to a reporter in 2010, Panama “has a very small government.” Lower



Staff prepare to send cobia juveniles through pipe to offshore cage at Culebra Island, Puerto Rico

labor costs and the ability to build larger facilities was also another draw.¹²⁹

O’Hanlon has acquired another operation, Pristine Oceans,¹³⁰ and developed what he describes as the largest offshore fish farm in the world, where he grows cobia nine miles off the coast within a 2,500 acre site.¹³¹ Currently, the company appears to be the most successful of the open ocean farms discussed in terms of production and scale, but it is unclear whether the farm could ever reach the same success in any conditions of the U.S. coastline, or while subjected to sufficiently environmentally and culturally protective regulations.

The company compares its product to “free-range beef, poultry and eggs,”¹³² appearing to try to capture interest from environmentally conscious consumers. It claims that its approach lessens environmental impact, providing a “guilt free, high quality, safe, healthy and sustainably cultivated seafood.”¹³³ Numbers on the company feed-conversion ratios, waste dispersal and incidence of escape are unavailable to the public, however. And considering that the farm hopes to net \$20 million in revenue annually using eight aquapods and has a permit to farm 10,000 tons of fish on its 3.5 square-mile farm,¹³⁴ it is hard to believe that this enormous farm is the type of operation that consumers of free-range eggs have in mind when they seek out seafood, clearly demonstrating that to be profitable factory fish farms must be large and capital

intensive.

Kona Blue Water Farms

Located off the western coast of the Island of Hawaii, Hawaii, Kona Blue Water Farms (KBWF) has possibly the most storied history of the open ocean operations. When Food & Water Watch profiled KBWF in 2007, the company already had experienced its share of tribulations, including killing a tiger shark in 2005 that frequented the site;¹³⁵ contamination of feed with melamine from China in 2007;¹³⁶ and over 1,000 fish escaped that same year when a diver left a zippered entrance to the cage open.¹³⁷

Since then, the troubles have continued. In 2009, a Galapagos shark attack released hundreds of the company's farmed fish into the wild.¹³⁸ The year before, a public official raised concerns about the farm's potential for causing impacts to benthic (seafloor) organisms and its failure to adequately address these issues during the permitting process to reconfigure the cage site.¹³⁹ Additionally, concerns were raised about unnatural behaviors in dolphins that had begun frequenting the farm site. The official was concerned that interaction with the farm could be causing "dolphin conditioning," which can be detrimental to the animals' survival due to altered feeding and social behaviors.¹⁴⁰

In 2008, the company applied for a modification to its permits in order to double the capacity of its operation.¹⁴¹ However, the farm faced opposition from the community. Two challenges were filed against the application, and KBWF withdrew its request.¹⁴² In 2009, the company submitted another application and received approval for modifying its net pen designs. This modification didn't enable KBWF to scale up, but it did allow it to experiment with new cage types.¹⁴³ KBWF claimed in its application that changes were necessary to achieve economic efficiency. The changes would also allow the operation to minimize its need for divers, shrinking its already small staff. In its application, the company wrote: "We believe that the only way for Kona Blue to achieve profitability for our Kona operation is by reducing our reliance on SCUBA divers."¹⁴⁴

Meanwhile, KBWF has expanded into Mexico with an



IMAGE COURTESY OF NOAA

A diver swimming toward the offshore cage in Hawaii with equipment.

operation in the Sea of Cortez.¹⁴⁵ Presumably, KBWF, like Snapperfarm, was looking to avoid the regulatory hurdles it faced in the United States. Following these various attempts to overcome financial difficulty and achieve profitability, Kona Blue sold its operation and received approval on January 8, 2010 to transfer it to Keahole Point Fish LLC, a company registered just months prior in Delaware.¹⁴⁶

In November 2009, KBWF said that it would temporarily halt production in Hawaii as it continued to develop a hatchery in Hawaii and move its operations in Mexico. Reportedly, fish would be back on the market by the end of 2010.¹⁴⁷ However, as of June 2011 Kona Kampachi® was still not on the market, and any availability of the product appears to have been fragmented since November 2009.¹⁴⁸

In January 2011, the company was charged for coral damage after it had parked an experimental pen that it was no longer using in the Kawaihae Small Boat Harbor on the western side of the Island of Hawaii. Twenty-eight instances of coral damage were cited. The \$13,500 fine was cut in half and eventually waived, allowing the company to use the monies instead to support coral conservation efforts.¹⁴⁹

In November 2010, KBWF applied to the National Marine Fisheries Service for a Special Coral Reef Ecosystem Fishing Permit in order to conduct an open ocean aquaculture operation in federal waters,

where it will attempt to raise fish in a cage towed by a boat largely floating with natural eddies.¹⁵⁰ In June 2011, KBWF received the permit, the first of its kind, setting a dangerous precedent for future operations. In March 2011, prior to the issuance of its permit, the company took empty cages out into the ocean for testing. They quickly lost one and had to sink the other.¹⁵¹ The permit has been legally challenged by both Food & Water Watch and KAHEA: The Hawaiian-Environmental Alliance.¹⁵²

Hukilau Farms, Formerly Known as Cates International

Cates International, the first commercial fish farm in the United States, first secured its lease in 2001.¹⁵³ The company took over operations from a demonstration facility led by University of Hawaii researcher



IMAGE COURTESY OF NOAA

View of seacage with anchor being deployed off Hawaii

Charles Helsley. Like the other facilities discussed in this report, Cates International has faced a difficult path in its quest for viability. One year into the experiment, Helsley wrote in a report that 30 percent of the fish had died from infections, lack of oxygen and other problems when they were transferred into fish cages. He wrote that the experiment was operating at sub-economic levels, and yet he optimistically wrote that *moi*, the species being cultured, could be raised “in an economically viable way.”¹⁵⁴

From site sampling between 2001 and 2004, researchers reported that the farm had “grossly polluted” the seafloor and “severely depressed” some types of sea life. “Despite the open ocean location and alongshore currents, the effects of fish feed and waste on the [seafloor] community were evident.” The ecosystem had been “drastically changed,” they found, and the effects had spread beyond the area beneath the cages.”¹⁵⁵

That same year, the company entered into agreement with Visionary LLC, a company owned by Steve Case of AOL-Time Warner, to form a company called Grove Farm Fish & Poi, LLC. In 2007, Cates International’s lease was transferred to this company, and the farm was renamed Hukilau Foods.¹⁵⁶ The company hoped that this merger would enable it to expand its operation and build a large land-based hatchery.

In 2008, a concerned government official commented that studies conducted at the farm had found a large cyanobacterial mat growing beneath cages, which raises concern because the sandy bottom underneath cage sites is a home for sea grasses that provide a meadow-like grazing habitat for a wide variety of marine organisms.¹⁵⁷ Despite these findings, in 2009 the company was granted approval to expand operation from 1.2 million pounds a year to 5 million.¹⁵⁸

However, the farm has not actually been able to scale up to this size. In June 2010, Randy Cates, founder of Cates International, sued Visionary LLC for what he alleged was mismanagement of the company.¹⁵⁹ Then, in November of that same year, according to an article in the *Honolulu Star-Advertiser*, the company filed for bankruptcy with only \$5 million in assets compared to \$8.6 million in debts.¹⁶⁰ The company estimated in July



Moi inside an offshore cage in Hawaii.

2011 that it would take two-and-a-half years to raise the \$9.8 million that would return it to profitability.

Cates has cited mismanagement and low survival rates of the fish as contributors to the bankruptcy. According to Cates, the survival rate for its fish dropped by more than 50 percent since 2009. The company has not had any fish on the market since February 2011, and with none currently being raised in its offshore cages, the fish will not likely be back in distribution until next year.¹⁶¹ The cages themselves are currently out of compliance with state regulations, since the company failed to obtain approval from state agencies before deploying new equipment.¹⁶²

Hukilau has been financed in part by American taxpayers through a \$3.8 million secured loan that the company received from the National Marine Fisheries Service and another, unsecured loan of \$64,450 from the U.S. Department of Commerce.¹⁶³

Other Farms

Over the past several years, additional farms have attempted to set up shop in marine waters around the country. Hubbs-SeaWorld Research Institute in San Diego, under the leadership of Don Kent, developed a plan to grow 1,000 metric tons of striped sea bass five miles off the coast of San Diego, and to eventually scale up to produce 3,000 metric tons annually.¹⁶⁴ The project was pitched as a demonstration project, a somewhat dubious claim considering that it was planning to produce more fish than any commercial farm operating in U.S. waters is permitted to.¹⁶⁵ In 2009, Don Kent submitted a letter asking that his permit applications for the operation be put on hold. After complaining about difficulties securing approval, he indicated that he would wait until the Obama administration's national aquaculture policy was finalized.¹⁶⁶

In 2009, a company called Indigo Seafood discussed opening a facility in an area half a mile off the western coast of the Island of Hawaii,¹⁶⁷ and another company in Hawaii, Maui Fresh Fish, LLC, is moving forward in the permitting process to establish a farm off of the Island of Lanai.¹⁶⁸

Most troubling, however, are developments with a company called Hawaii Oceanic Technology, Inc. In October 2010, the company received a 35-year lease from the Hawaiian Board of Land and Natural Resources for a 247-acre ocean farm site 2.6 nautical miles off the western coast of the Island of Hawaii.¹⁶⁹ The company plans to farm 12 million pounds of either bigeye or yellowfin tuna in its enormous, patent-pending "Oceanspheres."¹⁷⁰ The company boasts that its operations are environmentally sustainable and will represent a more efficient source of food than land agriculture or wild fish.¹⁷¹ And yet it also says itself that it takes up to 42 pounds of wild fish to create 10 pounds of marine farmed fish.¹⁷² Wasting 32 pounds of wild fish that could be consumed by other marine fish, animals or people hardly seems like an efficient source of production, especially considering the high cost that is generally associated with sushi-grade fresh tuna.

The company plans to deploy its first full-scale oceansphere in 2012.¹⁷³



Conclusions

As the United States emerges from recession, we must continue to prioritize the development of local economies, create steady job opportunities and spend federal money wisely. Meanwhile, efforts to support local businesses and “buy local,” while promoting environmentally sustainable, community-supportive businesses, have grown. The local foods movement has gained support from diverse sources as people have recognized potential economic and environmental benefits. In light of these trends, the federal government’s support of offshore factory fish farming seems woefully wasteful and out of place.

After over a decade of exorbitant financial support from the federal government and labor wasted by government officials and university scientists, the open ocean fish farming industry still has not provided any clear indication that it can create a significant number of jobs or an affordable source of quality fish products. The fledgling industry is not yet large enough to draw conclusions about the environmental ramifications of a full-scale industry, but evidence indicates that offshore fish farms, especially at the scale imagined by NOAA, will threaten the marine environment in a variety of ways.

If we want to achieve the goals of strengthening the economy, making more safe domestic seafood available, protecting our beautiful marine environments

and fostering a diverse array of businesses that rely on it, we must stop sinking money into this troubled industry. Instead, we must focus on managing our wild fish resources responsibly, developing alternative methods of sustainable fish farming, reducing seafood exports and limiting imports by turning away more contaminated seafood at the border.

Recommendations to Policymakers

- Support bills to prohibit federal agencies from authorizing commercial finfish aquaculture operations in federal waters.
- Support efforts to increase seafood inspections, so that U.S. consumers will not be exposed to unsafe, contaminated seafood imports.
- Support research and efforts to sustainably manage wild fish stocks, and explore other methods of aquaculture, such as land-based recirculating systems.

Recommendations to Consumers

- Let your Senators and Representatives know that you are concerned about offshore factory fish farming and its impacts.
- Make safe, sustainable choices about seafood. Show restaurants, vendors and others that you care about the type of seafood you eat. For tips, see Food & Water Watch’s *Smart Seafood Guide*.

Endnotes

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