Should Atlantic Salmon Aquaculture Be Permitted in the Gulf of Maine?

By Ashley Cooper

The Gulf of Maine denotes the body of water extending from Cape Cod, Massachusetts to Cape Sable, Nova Scotia, spanning two nations and countless aquatic ecosystems. Its cold waters are ideal for Atlantic salmon; wild populations have resided in the Gulf of Maine and its surrounding watershed for centuries. Human influence largely shapes these Atlantic salmon populations in and around the Gulf of Maine, and as various historic spawning grounds – from the Connecticut River to the Androscoggin River, draining into the Atlantic Ocean in Connecticut and Maine respectively – have become unsuitable for the *Salmo salar*, the Gulf of Maine Distinct Population Segment (DPS) of Atlantic salmon has achieved an endangered status. The National Oceanic and Atmospheric Administration (NOAA) notes, “The populations of Atlantic salmon present in the Gulf of Maine DPS represent the last wild populations of U.S. Atlantic salmon.” Yet in the past few decades the Gulf of Maine has become a breeding ground to a select population of domesticated Atlantic salmon, as aquaculture – “fish farming,” if you will – continues to grow both locally and globally.

Since the conception of Atlantic salmon aquaculture by Norwegian brothers Sivert and Ove Grøntvedt in the 1960s, early breeders have been able to reverse salmon’s tendency as an R-rated species to produce vast amounts of offspring with subsequently low survival rates, dramatically lowering the instances of juvenile salmon mortality. The inversion of Atlantic salmon’s mortality rates, coupled with increased global demand for food supplies due to booming populations, created the perfect opportunity for aquaculture expansion.

The World Wildlife Fund (WWF) points out that currently, “Salmon consumption worldwide is three times higher than it was in 1980...Salmon aquaculture is the fastest
growing food production system in the world—accounting for 70 percent (2.4 million metric tons) of the market.” According to Jason Clay, WWF’s senior vice president of market transformation, salmon aquaculture has become a $5.4 billion industry. National Geographic, joining the chorus of voices in the aquaculture debate, reports that “[t]wo years ago [in 2012], global aquaculture production passed global beef production.” In their article on salmon farming, *Salmon Farming Gets Leaner and Greener*, National Geographic pointed to the United States in 2013 as the largest market for farmed salmon, consuming 353,000 tons of *Salmo domesticus* – the domesticated, genetically advanced counterpart of *Salmo salar* resulting from the countless generations of salmon breeding that began in Norway.

The Gulf of Maine has played a central part for both American and Canadian salmon aquaculture endeavors. NOAA observed, “More than 1.4 million tons of farmed Atlantic salmon is produced worldwide...with the majority of farmed Atlantic salmon coming from Canada, Chile, Norway, and other European countries...[In 2012] The United States also exported 7,400 tons, worth $47.9 million. In that same year, Maine produced about 12,000 tons valued at $78 million.” Canada’s Atlantic coast was responsible for 41,448 tons of salmon.

Salmon aquaculture has garnered a general reputation as environmentally unfriendly: it is often portrayed as a dirty, detrimental occupation. The Monterey Bay Aquarium, given to educating seafood consumers on the basis of sustainability with their Seafood Watch program, compiles data from various scientific and peer-reviewed sources to create a comprehensive guide on what to eat. The three ratings given to every fish range from “Best Choices” to “Good Alternatives” to “Avoid.” Farmed Atlantic salmon is the only fish under the “Salmon” category that warrants the “Avoid” rating. Only one form of farmed Atlantic salmon is exempt from such condemnation, garnering the “Good Alternative” rating:
Verlasso Atlantic salmon from Chile. Seeing as the Monterey Bay Aquarium fails to mention Gulf of Maine salmon as a viable “Good Alternative,” the reader is left to relegate such produce into the overarching “Avoid” Atlantic salmon category. The website, however, concedes, “There are many environmental problems related to farming Atlantic salmon, which means most are rated as ‘Avoid.’ However, efforts to reduce some of these environmental impacts have been successful.” 11 Many other enterprises also argue that salmon aquaculture can be environmentally justifiable, while others still regard environmental concerns as mere misgivings. Do potential environmental deterrents from poor practices outweigh the sustainable efforts of more environmentally conscious endeavors? Given the scale of salmon aquaculture not only worldwide, but in the Gulf of Maine alone, fish farming begs the question – should Atlantic salmon aquaculture be permitted there? In order to fully assess this question and compile a comprehensive answer, one must be ready to consider all the various forms aquaculture can come in. From the good to the bad to the ugly, aquaculture presents itself in many different shapes and sizes.

How can a domesticated fish – or, to be fair to aquaculture, a few thousand fish – have the potential to adversely affect its wild counterparts? The answer, to aquaculture opponents, is obvious on a number of fronts. One such opponent, the aforementioned Monterey Bay Aquarium, explains in a report that when Atlantic salmon officially joined the list of endangered species, the organizations responsible for the assessment “noted interactions with farmed Atlantic salmon as one of several credible threats to the remaining wild fish population...In addition to interbreeding and disease transfer, escaped fish can compete with wild fish for food or territory.” 12 These organizations – the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) – stand as nonbiased sources. FWS is a governmental agency tasked with “[administering] a national program to
provide the public opportunities to understand, appreciate, and wisely use fish and wildlife resources,” 13 while NMFS is a branch of NOAA. These two federal associations are certainly not alone in their fear of domesticated salmon interfering with wild populations. Writer, journalist and a lifelong avid fisherman Paul Greenberg, whose works have been included in the New York Times and Book Review, echoes alarm concerning escaped domesticated salmon: “What makes the contemporary man-made salmon crisis unique and alarming is the effect humanity is having on the genome of all salmon species.” He further elaborates:

“The tamed-salmon genome is now markedly different from the wild-salmon genome. When domesticated salmon escape into the wild (as they do in the millions every year) they risk displacing a self-sustaining wild fish population with a domesticated race that is not capable of surviving without human support...Escaped farmed salmon may outcompete wild salmon in some phases in their life cycle only to be unable to reproduce later on down the line. Some maintain that this could have a fatal impact on the long-term viability of wild salmon everywhere.” 14

Greenberg argues that the innate “richness of salmons’ genetic material has allowed populations to opportunistically seize on new habitat when it emerges” following each natural contraction of the population. In essence, salmon are naturally resilient, yet the maintenance their of genetic diversity will be threatened by artificial selection from aquaculture farms if fish escape. And, historically, fish have escaped. Though there is a relatively small database for salmon escapes, the Department of Maine Resources website has kept tabs on salmon escapes from lease sites. According to its (albeit outdated) website, three escapes occurred in the eight years between 1995 and November 2003. Of these three documented salmon escapes from lease sites, an estimated 170,000 fish were let loose from Stone Island in December 2000. 15 Greenberg reports, “In the whole of the Atlantic Ocean,
wild salmon populations hover somewhere around five hundred thousand individuals compared with what may have once been a population of tens if not hundreds of millions of fish.” Given this account, these escaped salmon would equal almost $\frac{2}{5}$ of wild Atlantic salmon populations, and through interbreeding they could have the potential to displace the entire Atlantic species. And, as the Monterey Bay Aquarium verbalized in its report, genetic variation is not the sole problem freed salmon pose; aside from a very real fear that *Salmo domesticus* could outcompete *Salmo salar* for food and resources, further diminishing an already fragile population, domesticated salmon can easily carry diseases due to poor aquaculture maintenance and transfer said diseases to wild populations.

“Salmon farms harbor two especially virulent parasites: sea lice and kudoa (soft-flesh syndrome).” Pure Salmon Campaign, a global campaign that unites the U.S., Canada, Chile, Australia and Europe to better salmon production. Although the Pure Salmon Campaign has not been active since July 2010, the information they compiled and the aforementioned worries they expressed parallel that of many other activists. The first disease, sea lice, is a well-known and well-feared disease among aquaculture specialists. Sea lice are small, parasitic crustaceans, and various genera are known for their detrimental interactions with salmon (especially *Salmo domesticus*). These specific genera include *Lepeophtheirus salmonis* and various *Caligus*. Sea lice damage includes physical harm and can spark a generalized chronic stress response, and, since feeding requires attaching to a salmon’s skin or mucous coating, injuries also include “loss of blood and fluids, electrolyte changes, and cortisol release.” Sea lice are often linked to fish farms because domesticated salmon are concentrated in such high quantities, and sea lice levels are 73% higher at farms than in the wild. Sea lice have also been known to cause death in salmon, especially when they attached to vulnerable juvenile wild salmon. Coastal Alliance for Aquaculture Reform (CAAR), a
partnership created in 2001 to “protect wild salmon, coastal ecosystems, coastal communities and human health from destructive fish farming practices,” highlights the connection between sea lice and harm to wild juvenile salmon: “In the spring, when fish eggs hatch and juvenile salmon emerge from the rivers and make their way to the ocean many are exposed to sea lice during their journey because fish farms are typically located in sheltered waters along wild salmon migration routes.”  

CAAR maintains that if sea lice from farms in nearby saltwater areas kill juvenile salmon from a specific watershed area, fewer wild salmon will grow to be adults and return in future years. If this cycle continues, CAAR explains that eventually the watershed will no longer contain any wild salmon and a trophic cascade will ensue. Although this slippery slope logical fallacy will most likely not end in ecological destruction and food web collapse, increased wild salmon mortality due to sea lice would certainly cause ripples to be felt throughout its watershed area.

The second disease, kudoa thyrsites, or known more simply as soft-flesh syndrome, is another harmful parasite that attacks salmon. According to the Pure Salmon Campaign, “This microscopic insect breaks down muscle fiber in fish, turning the flesh to a jelly-like consistency and making it commercially worthless.”

Symptoms only show after fish are dead; therefore soft-flesh syndrome affects mainly economic success of fish farm and poses very little threat to wild salmon. Instead of soft-flesh syndrome, wild Atlantic salmon are more likely to be harmed by pollution and discharge from fish farms. Pure Salmon Campaign quotes supposed “industry insiders” in reporting that “a typical 200,000-fish salmon farm releases: nitrogen equal to 20,000 humans, phosphorus equal to 25,000 humans, and fecal matter roughly equivalent to a city of 65,000 people.” Considering that no credible source is attached to these numbers, one should not simply accept such statistics as concrete or 100% accurate. However, when one pairs these waste figures with an excerpt
from Greenberg’s book *Four Fish*, they can begin to appreciate just how much pollution fish farms generate. “Good farming sites with strong currents and clean water became rare. Farms were sited with poor water circulation and often in the proximity to passageways for dwindling runs of wild salmon...nitrogen wastes built up.” 23

One final substantial issue with salmon farming has little or nothing to do with its effects on other salmon; instead, this concern is tied to long-term sustainability, to the ocean’s viability in ten to twenty years. Producing one pound of farmed salmon can require as much as six pounds of wild fish feed. The CEO of the advocacy group Oceana declared, “If you are farming fish that eat fish, you are reducing the amount of fish available for humans to eat. Farmed salmon are dreadful for feeding people and for protecting ocean health.” 24 Although selective breeding and genetic engineering have lowered the natural feed-conversion ratio from 6:1 to roughly 3:1 (pounds wild fish: pound salmon), salmon remains the most farmed finfish in the developed world. 25 Yet the 3:1 ratio that Greenberg posed is markedly different from World Wildlife Fund’s statistics. The WWF writes, “Salmon aquaculture requires fewer resources than many other protein sources. For example, while approximately 10-12 pounds of feed are needed to produce one pound of beef, only 1.3 to 1.7 pounds of feed are needed to produce one pound of salmon.” 26 In regard to these two conflicting ratios, one cannot help but wonder how environmentally detrimental salmon really is. Regardless of a feed-conversion ratio equaling 6:1, 3:1, or somewhere between 1.3:1 and 1.7:1, salmon still requires less input per pound of meat than beef, which is also heavily consumed worldwide. Should we then hedge our efforts in making cow products more energy efficient? Should we disregard the feed-conversion ratio to focus on other issues, like the genetic maintenance of wild salmon or diseases and waste
produced and cultivated by fish farms? Above all, is there any way that Atlantic salmon aquaculture can be environmentally justifiable?

Many organizations in the salmon industry have contributed to a more recent trend towards environmental responsibility. According to WWF’s senior vice president of market transformation Jason Clay’s estimate, we can eventually meet the goal of a feed ratio that is one to one. In fact – one specific company has already achieved the goal of a 1:1 feed-conversion ratio: Verlasso. Verlasso, a combined effort between DuPont and AquaChile to farm salmon sustainably, situated on Chile’s Pacific coast, is the only farmed salmon company to achieve the Good Alternative status from the Monterey Bay Aquarium, and its impressive feed-conversion ratio did not go unnoticed. National Geographic reported in *Salmon Farming Gets Leaner and Greener*, an article run its March 2014 edition, that the venture has succeeded in achieving such a low ratio “because the company uses about a quarter as much fish oil as its competitors do.” According to Verlasso’s webpage, the company utilizes a genetically modified yeast to supplement the fatty omega three acids that, under normal industry practices, would be supplied by other fish like anchovies: “By feeding a diet that is less than 10% yeast we save 75% of the feeder fish used in traditional salmon aquaculture while retaining the omega-3s in our salmon.” Verlasso takes care to avoid the usual pitfalls of modern aquaculture; instead of keeping spawning adult salmon in streams or lakes, the broodstock is rather kept in self-contained tanks. Per fish, these tanks use only 1% of the water used in traditional systems, as advertised on Verlasso’s website. The company strays from using antibiotics preventatively, so antimicrobial resistance and evolving diseases are kept at bay while salmon waste containing antibiotic residue does not infiltrate natural water supplies. To further prevent against heavy antibiotic reliance, Verlasso kills salmon relatively early compared to many of their competitors. Finally, Verlasso acknowledges that
since there are no wild salmon inhabiting the surrounding waters, the Atlantic salmon stock provide no threat to natural populations. While this would not be the case for such a venture in the Gulf of Maine, utilizing the same self-contained tanks for broodstock and using a double netting system – like the one Verlasso uses to keep predators from going after salmon or injuring themselves on the aquaculture equipment – would better guard against interbreeding between wild and domesticated salmon.

One of the most groundbreaking efforts in the salmon industry to obtain true sustainability is the Global Salmon Initiative, or GSI. The GSI strives to fulfill the triple bottom line and find economic, environmental, and social success. As stated on the organization’s website, three of the four objectives set forth by the GSI directly pertain to sustainability:

1. “Bring together global farmed salmon producers and other industry stakeholders to strive towards significantly improving the sustainability of salmon farming
2. Cooperation to continue to outperform other sources of animal protein in terms of contribution to human health, environmental responsibility, and efficient feed conversion rate, and to be widely recognized for this accomplishment...
3. Translate environmental and social sustainability into greater economic sustainability through enhanced social license and market acceptance.”

Jason Clay, the aforementioned senior vice president of WWF, reports that the GSI constitutes of “15 companies, representing 70 per cent of global farmed production, [which] are committing that 100% of their production will be certified by the Aquaculture Stewardship Council by 2020. This should measurably reduce the impact of salmon production on some of the world's most ecologically important regions.”  

The Aquaculture Stewardship Council (ASC) guidelines which these 15 companies intend to adhere to are rigorous, and although they do not require the exact 1:1 feed-ratio Verlasso achieved, the
ASC’s target guideline ratio is 1.4:1, roughly half of the industry’s 2000 production ratio. Clay is very familiar with the ASC and its targets, as the World Wildlife Fund and the Dutch Sustainable Trade Initiative cofounded the NGO. National Geographic noted that ASC guidelines include “152 different indicators...including low tolerance for escaping fish, limits on antibiotics, a prohibition on genetic engineering, and sustainability and safety guidelines on food the fish can be fed.” As of January 2014, the ASC’s website had certified only 2 of the 15 salmon companies, although 7 others were in the process of being certified. These companies will serve as a pillar for environmental stewardship as the salmon industry moves forward.

Regarding the impacts of escaping fish, antibiotic use, and genetic engineering stated above, the ASC demonstrates an acute understanding of the relationship between domesticated salmon and fish farms’ potential detrimental effects. When it was initially founded, the ASC drew inspiration from the Salmon Aquaculture Dialogue (SAD), another product of the WWF’s hard work. The Steering Committee of the Salmon Aquaculture Dialogue published a report in June 2012 titled *Salmon Aquaculture Dialogue: Final Standards for Responsible Salmon Aquaculture*. The *Final Standards* report outlines the Salmon Aquaculture Dialogues’s stance on sea lice monitoring, setting guidelines for the ASC that will in turn guide the GSI. The document states,

> “Farms located in areas of wild salmonids must participate in monitoring of lice levels on wild out-migrating juvenile salmon or other important salmonids in the area...These standards require farms to show leadership in managing the interaction with wild populations... Enhanced leadership is an essential part of showing best practice in this high-priority issue of farm interaction with wild populations.”

SAD further comments that farms near wild populations should maintain levels of sea lice near zero during times where wild salmon are most susceptible, especially during juvenile
migration in the area, and dictates that farmers must maintain an awareness of wild
population routes and habits. These standards address many of the problems associated
with wild-domesticated interactions, and serve to largely reduce the potential havoc fish
farms can wreak on wild Atlantic salmon.

One final example of environmental stewardship and ecological responsibility can be
found in the closed-system method of fish farming known as Integrated Multi-trophic
Aquaculture (IMTA). An IMTA system is being pioneered by the company Cooke
Aquaculture, with farms located in each of the Atlantic Canadian provinces and Maine,
processing upwards of 160 million pounds of Atlantic salmon. In this approach, salmon are
not the main product of a system, but one part of an intricate, multifaceted environment.
Cooke Aquaculture begins their vindication of fish farming in noting, “Farmed Atlantic
Salmon reduces pressure on wild salmon stocks.” Indeed, that domesticated salmon
production alleviates threats to endemic populations is an argument for aquaculture that has
been used many times. In further exploring the potential for Cooke Aquaculture’s IMTA in
Four Fish, Greenberg observes, “In a sophisticated polyculture environment, salmon would
bypass the smaller fish that eat seaweed and would eat feed pellets synthesized from seaweed
directly...[T]he waste those salmon generated would in turn feed mussels and also grow more
seaweed.” Cooke Aquaculture echoes this message, explaining on its website, “IMTA
creates a balanced ecosystem as nutrients released from the salmon pens are recaptured to
become food and energy for the additional commercial crops of mussels and seaweeds.”
Greenberg advocates that such a producer would then be able to sell the seaweed and
mussels as separate, economically viable produce. A polyculture system like Cooke
Aquaculture’s greatly reduces the waste and contamination that have long been associated
with factory farms of any animal, while rewarding the grower with more products and a
wider market to sell to. In the end, polyculture endeavors to realize the same goal that Verlasso and the ASC have been working towards – a sustainable salmon economy.

Ultimately, aquaculture pits the prevalent downfalls of genetic engineering, the risk of domestic and wild salmon interbreeding, diseases like sea lice that are transferrable between populations (and non-transferrable diseases like soft-flesh syndrome), pollution and high feed-conversion ratios against dedicated approaches that incorporate low feed-conversion ratios (one-to-one, in Verlasso’s case), largely avoid antibiotic resistance, utilize double netting systems to prevent against either salmon escape or predator invasion, and rigorous standards set forth by the likes of the Aquaculture Stewardship Council and its compatriot the Salmon Aquaculture Dialogue, which have been accepted by ventures like the Global Salmon Initiative. Critics maintain, “Good farming sites with strong currents and clean water [are] rare,” and declare, “Farmed salmon are dreadful for feeding people and for protecting ocean health.” Such sentiments inevitably represent a push to get rid of aquaculture. Yet my generation has witnessed a new, growing environmental consciousness. We have seen aquaculture practices that effectively put to rest ecological qualms. And, as the World Wildlife Fund’s Jason Clay points out, “The aquaculture industry is not going away. In fact... most of the increase in seafood production will be seen in the aquaculture industry.” So, when faced with the dilemma of whether or not the Gulf of Maine, the last stronghold of U.S. wild Atlantic salmon, should allow domesticated salmon aquaculture to take place, one will hopefully keep in mind the advancements in environmental policy. In an expanding world and an expanding market, the real life salmon success stories seem more indicative of the general salmon economy than detrimental past habits. I would greatly appreciate seeing stringent regulations enforced in the Atlantic waters constituting the Gulf of Maine. Yet
even without such parameters I firmly believe that Atlantic salmon aquaculture is tending in the direction of environmental responsibility, and should be permitted in the Gulf of Maine.
Reflection:

This project has been in the works for a long time. My initial reaction in finishing is relief, although I am a little bit disappointed with what I feel to be the persuasiveness of my conclusion. While I believe that Atlantic salmon aquaculture should be allowed in the Gulf of Maine – I also would enact strict regulations, to be sure – I don’t feel like my conclusion resonates with the strength I initially imagined it to. What I would need in order to drive home my support for aquaculture, and hopefully convince those predisposed against it, would be a more clearly defined trend that the entire industry was moving in conjunction towards sustainability. Or, better yet, if the U.S. and Canada decided to enact nationwide policies adopting the ASC standards. I realize that allowing aquaculture in the Gulf of Maine to continue on under historic conditions could prove to be devastating, and there is no guarantee that environmental stewardship will displace the greed that drives lazy practices and promotes shortcuts regarding health impacts. However, the risk factor for salmon aquaculture will never reach zero; thus I fully support ecologically mindful fish farming, and a law enforcing the ASC standards would minimize these risks as effectively as is humanly possible.

Aside from my conclusion, my biggest regret in this project is not getting started sooner. I went into this past summer ready to examine the impact of nitrogen and phosphorous levels in the Long Island Sound on local lion’s mane jellyfish populations, and after taking relatively painstaking water samples and nutrient measurements every day for over a month and a half, I returned to school only to be told that my question – approved in my junior spring – would not suffice the criteria for the AP Cambridge Capstone research project. So that set me back a little farther than anticipated. I struggled to find a topic that was also close to home (I live in New England, and therefore wanted to examine an issue
pertinent that area) and interesting. In the end, I settled for aquaculture not because it appeared to me as a stimulating and rigorous topic, but mainly because it dealt with humans’ interactions with a body of water I was familiar with. While I’d consider myself as passionate about environmental science, I would not paint myself as particularly enthralled by Atlantic salmon... My lack of genuine passion for the topic contributed to an open mind concerning the debate regarding aquaculture and its environmental impacts, but it also made the research more tedious that it ideally would be. I have no one to blame but myself for this pitfall, and in the end the topic grew on me. Moving forward, I’m more aware how easy – or difficult – I can make a project for myself. And I realized that a hearty debate on a topic could incite interest, even when little is originally present. Above all, I realized that the way humans resolve the role aquaculture plays in our society – and our environment – will set the stage for an industry that is only predicted to grow...and grow.
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Land-based aquaculture has its attractions. There are no salmon net pens in the ocean, there's no danger of farmed fish escapes, and effluent from the fish is recycled, filtered and "rigorously treated" before it is discharged via an undersea pipeline, a kilometre offshore. Nordic Aquafarms' proposed $500-million US salmon operation in Belfast, Maine would produce 33,000 metric tonnes of fish annually when all phases are completed. Nordic Aquafarms proposes to use 7.7 million gallons of water a day, 30 per cent fresh, and 70 per cent seawater. Back in New Brunswick, Cooke Aquaculture, the province's biggest Atlantic salmon grower, is not ready to jump into eggs-to-harvest, land-based aquaculture. The Atlantic salmon (Salmo salar) is a species of ray-finned fish in the family Salmonidae. It is the 3rd largest of the Salmonidae and can grow up to a meter in length. Mongolian Taimen, and Pacific Chinook Salmon can be larger, with Taimen reportedly able to grow to 6 ft long. It is found in the northern Atlantic Ocean and in rivers that flow into this ocean. Most populations of this fish species are anadromous, hatching in streams and rivers but moving out to sea as they grow where they mature...

Maine is home to the only remaining populations of wild Atlantic salmon (Salmo salar) in the United States. These constitute the Gulf of Maine Distinct Population Segment (DPS), which has been listed as endangered since 2000. As anadromous fish, salmon face a large suite of threats to survival in both fresh and saltwater environments, including dams, pollution, and (historically) overfishing. Water quality is an essential component of suitable habitat for spawning and rearing. DEP monitors the water quality and biological communities in Maine's Atlantic salmon rivers and streams in close collaboration with state and federal agencies and non-profit groups, with the goal to restore and enhance the populations of this endangered species. Wild Atlantic salmon in the Gulf of Maine are listed as an endangered species.

Maine Atlantic salmon aquacultural production peaked in 2000 but lately has increased after a period of decline as management practices improved. In 2016, the Monterey Bay Aquarium Seafood Watch Program upgraded Maine-raised salmon to the list of yellow or "good alternative" seafoods. Read the full report from Seafood Watch.â–ºRegulatory Authority. Maine Department of Marine Resources regulates the aquaculture industry in state waters (within three miles of shore). In addition, the Clean Water Act requires aquaculture facilities to have water discharge (NPDES) permits from the Department of Environmental Protection. DEP inspects each salmon farm twice per year.