

**FEEDING AMERICA: MAKING SUSTAINABLE
OFFSHORE AQUACULTURE A REALITY**

HEARING

BEFORE THE

**COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE**

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

OCTOBER 16, 2019

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SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

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CONTENTS

Hearing held on October 16, 2019	Page 1
Statement of Senator Wicker	1
Letter dated December 17, 2018 to Senator Roger Wicker and Senator Marco Rubio from The Center for a Livable Future, Johns Hopkins Bloomberg School of Public Health	36
Statement of Senator Cantwell	2
Statement of Senator Blumenthal	29
Statement of Senator Young	31
Statement of Senator Sullivan	32
Statement of Senator Markey	35

WITNESSES

Linda Cornish, Founder and President, Seafood Nutrition Partnership	4
Prepared statement	7
Kathryn Unger, Managing Director, Cargill Aqua Nutrition North America and President, Stronger America Through Seafood, Inc.	9
Prepared statement	11
Benjamin S. Halpern, Director, National Center for Ecological Analysis and Synthesis; and Professor, Bren School of Environmental Science and Man- agement, University of California, Santa Barbara	13
Prepared statement	15
Dr. Paul Doremus, Deputy Assistant Administrator for Operations, National Marine Fisheries Service, National Oceanic and Atmospheric Administra- tion, U.S. Department of Commerce	18
Prepared statement	20
Jeremiah (Jay) Julius, Chairman, Lummi Nation	22
Prepared statement	24

APPENDIX

Letter dated October 15, 2019 to Senator Roger Wicker and Senator Maria Cantwell from Christian Cannon, President, Spat Tech	41
Letter dated October 24, 2019 to Senator Roger Wicker from Jim Parsons, President, National Aquaculture Association	49
Response to written questions submitted to Linda Cornish by:	
Hon. Roger Wicker	52
Response to written questions submitted to Kathryn Unger by:	
Hon. Roger Wicker	54
Hon. John Thune	54
Response to written questions submitted to Benjamin S. Halpern by:	
Hon. Roger Wicker	55
Hon. John Thune	56

FEEDING AMERICA: MAKING SUSTAINABLE OFFSHORE AQUACULTURE A REALITY

WEDNESDAY, OCTOBER 16, 2019

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Committee met, pursuant to notice, at 10:01 a.m. in room SH-216, Hart Senate Office Building, Hon. Roger Wicker, Chairman of the Committee, presiding.

Present: Senators Wicker [presiding], Cantwell, Blumenthal, Young, Sullivan, and Markey.

OPENING STATEMENT OF HON. ROGER WICKER, U.S. SENATOR FROM MISSISSIPPI

The CHAIRMAN. Good morning. Today, the Committee gathers for a hearing on the topic Feeding America: Making Sustainable Offshore Aquaculture a Reality.

I'm glad to convene this hearing with my colleague, the distinguished Ranking Member, Senator Cantwell.

I'd like to welcome our panel of witnesses and thank them for appearing. They are Linda Cornish, President, Seafood Nutrition Partnership; Kathryn Unger, Managing Director, CQN North America at Cargill Aqua Nutrition; Ben Halpern, Director of the National Center for Ecological Analysis and Synthesis at University of California, Santa Barbara; Paul Doremus, Deputy Assistant Administrator for Operations at NOAA Fisheries and NOAA Lead for Seafood Production and Aquaculture; and Chairman Jay Julius of the Lummi Nation.

Today's hearing will focus on the potential benefits to our Nation's economy and health of offshore aquaculture.

America imports over 90 percent of the seafood we consume. Simply put, there's not enough fresh, healthy, and local seafood produced in the United States to meet consumer demand and that's what we'll talk about today.

Hardworking fishermen across this country are closing that gap, including those in my home state of Mississippi, with the farm-raised catfish industry. Mississippians use aquaculture to restore oyster reefs, replenish stocks for sport fishing, grow seaweed for the biofuels of the future, and provide fresh seafood for America's restaurants.

These men and women are testaments to the fact that our Nation already has the best-managed fisheries in the world but bridging the divide between domestic supply and demand will require us also to have the best-managed aquaculture in the world.

Aquaculture will never replace wild-caught fisheries. However, it can replace imports with better American-grown products. If this happens, not only will the quality of our seafood be improved but a more robust domestic supply chain will benefit producers, retailers, and consumers.

We've already seen the economic rewards of aquaculture extend beyond coastal communities. Aquaculture also creates jobs in states like Nebraska, Indiana, Kansas, and South Dakota because products grown in the Heartland can be used as a major component of aquaculture feed.

Positive health impacts of eating more fish also go without saying. Americans eat approximately half of the amount of seafood recommended for a healthy diet. As world population increases, wild-caught fisheries will not be able to produce enough to meet needs.

This hearing provides an opportunity for witnesses to discuss potential job creation from increased aquaculture and the broad health benefits of eating more seafood. Because of programs like NOAA's Sea Grant, the U.S. is the leader of aquaculture technology, but we're often unable to use that technology in our own waters.

For example, despite the fact that we have technical expertise and entrepreneurs ready to start growing fish, there are no finfish aquaculture operations in Federal waters.

By carefully considering existing uses of our busy coasts, we can thoughtfully place new aquaculture facilities and reduce spatial conflicts.

Today's witnesses can provide their perspectives on the benefits of open ocean aquaculture and about where we can make decisions about the location of aquaculture facilities.

This month, I plan to introduce the Advancing the Quality and Understanding of American Aquaculture Act or AQUA Act. Under this bill, NOAA would be directed to take the lead in the Federal permitting process, effectively organizing a currently fragmented regulatory system.

This bill would not allow any shortcuts around environmental protections. This legislation would create a set of national standards for sustainable aquaculture similar to the standards set by the Magnuson-Stevens Act. Because of the Magnuson-Stevens Act, the U.S. has the best-managed fisheries in the world. We should lead the world and the aquaculture management, also.

I invite our witnesses to provide the Committee with their views on how we can improve the permitting process for aquaculture in Federal waters. I also ask them to discuss their thoughts on potential aquaculture legislation, including my AQUA Act.

So we look forward to a good discussion, and I'm very pleased to recognize my good friend and Ranking Member, Senator Cantwell.

**STATEMENT OF HON. MARIA CANTWELL,
U.S. SENATOR FROM WASHINGTON**

Senator CANTWELL. Thank you, Mr. Chairman, and thank you for holding this hearing and inviting one of our witnesses, especially Chairman Jay Julius of the Lummi Nation. I appreciate him traveling all the way from the Northwest.

Chairman Julius is a lifelong fisherman and knows firsthand how fish farms can impact wild salmon stocks and our fishing rights.

Fish farm failures, mismanagement, and poor oversight have adversely impacted our fisheries, our coastal communities, and our ecosystem. Chairman Julius and everyone in Washington State knows about the high-quality sustainable seafood that can come from our state's shellfish farms. However, I also appreciate the fact that the Chairman is looking beyond shellfish and trying to look at the promise that this might bring, but we also have to look at the potential for tremendous peril when it comes to finfish agriculture. We must proceed with caution and get this right.

Two years ago in my state, a net pen failed and broke apart, sending around 300,000 non-native farmed Atlantic salmon into Puget Sound. This salmon spill threatened tribes, our fisheries, and our ecosystem. The spill of non-native fish into the Salish Sea exposed our native fisheries to disease and habitat competition.

People from all over the world travel to the Pacific Northwest to have our salmon. The fish farm failure compromised that economic livelihood of many people and yet there was no plan in place for how to respond to the spill. Recognizing that their sacred and protected resources were at risk, the Lummi Nation and their tribal partners sprang into action to catch the escaped fish.

Our Washington State legislature responded to the crisis by phasing out farming of non-native finfish agriculture in our waters and imposed fines on the Cook Agriculture for its negligence.

Washington's spill wasn't the first incident and it certainly won't be the last. Just 2 months ago, the same company had yet another salmon spill on the Atlantic Coast in Canadian waters near the United States and even though this spill happened across the maritime border in Canada, we all know that fish move.

These farm salmon swam down the coast and so we've heard very little in response from NOAA about how to deal with these spills or the fact that I believe they didn't take the spill in Washington serious enough.

We also have international examples of where finfish agriculture operations and oversight failed. In 2016, salmon farming in Chile contributed to a harmful algae bloom that killed nearly 300 million salmon and countless shellfish. The Scottish Environmental Protection Agency is currently investigating a Norwegian salmon farming company for allegations of its large-scale use of pesticides harming the environment.

So let me be clear. Poorly managed and under-regulated offshore aquaculture poses a direct threat to our marine ecosystems and domestic fisheries. It is my understanding that the Chairman is working on legislation to seize the opportunity that aquaculture represents but we would be remiss if we didn't address some of the challenges.

There are many unanswered questions when it comes to offshore aquaculture. Who decides where to site the facilities? Who will monitor and inspect the offshore fish farms? What response plans are in place for companies to respond?

In our instance, the company blamed the changing of the tide and the full Moon, I think it was. Basically said that was the prob-

lem that broke open their pens. When in reality it was just gross negligence.

So what happens to bad actors? Will these offshore farms impact our wild fisheries? How do we prevent and monitor for entanglement and bycatch?

So these are just some of the questions, Mr. Chairman, and I know we could go on, but our maritime ecosystems are already under dire threat from rapidly-changing acidity in our oceans, marine heat waves, oxygen depletion, and global climate change, and while we need high-quality protein to feed the world, it must be sustainable.

So we can't further exacerbate the problems of our current fisheries and so we must answer these questions.

So I look forward to working with you on this issue. I know the many challenges and, as I said, our shellfish industry has proven that there are great ways that you can produce aquaculture, but they meet many high standards and I applaud them for meeting those standards.

I would just point out, Mr. Chairman, our committee rules require that witnesses provide written testimony in advance of the hearing, yet as of 9 p.m. last night, we still did not have testimony from the agency witnesses because I understand that they are going through a review of the Department of Commerce.

These issues are legally and scientifically hard and NOAA needs to make sure that they are giving us this information so that we can have answers and questions prepared.

Our Pacific Northwest shellfish growers consistently demonstrate that science-based sustainable aquaculture is a benefit to both the environment and the economy and so we need to make sure that we are fully addressing these issues at today's hearing.

Thank you, Mr. Chairman.

The CHAIRMAN. Well, thank you very much, Senator Cantwell, for a very balanced and thought-provoking opening statement, which I very much appreciate, and also thank you for pointing out the delay that we experienced with one of the opening statements.

I'm told there was an OMB review that was required that took a little more time and we received that written statement late last night. So thank you for pointing that out. We'll work on that, be advised, in the future.

But at this point, let's hear five-minute opening statements from each of our witnesses, and we'll begin down here with Ms. Cornish.

Welcome and thank you.

**STATEMENT OF LINDA CORNISH, FOUNDER AND PRESIDENT,
SEAFOOD NUTRITION PARTNERSHIP**

Ms. CORNISH. Great. Thank you, Senator Wicker and Committee Members, for the invitation to testify today.

I will focus my testimony on the health and nutritional benefits of seafood. Specifically how Seafood Nutrition Partnership is improving public health by encouraging healthy seafood consumption.

Eating seafood solves many of the key issues we face today. Seafood is essential for our health, the health of our planet, and our future food security. Seafood, which includes fish and shellfish, is a healthy lean protein, a nutrition powerhouse filled with vitamins,

minerals, and essential fatty acids, eicosapentaenoic acid or EPA, docosahexaenoic acid or DHA.

These Omega-3s are essential because our bodies cannot produce them to any appreciable amount and therefore we need to eat seafood and/or take supplements as needed.

Seafood supports our heart health, brain health, eye health, and overall wellness. There are over 40,000 studies since the 1970s that have been published on health benefits of seafood omega-3s.

The brain is made up of fats and DHA Omega-3s are key building blocks for the cell structure. It has been said that as calcium is to bones, DHA is to the brain. Moms-to-be who ate seafood at least twice a week had babies with higher IQs than moms who did not eat seafood and numerous high-quality studies show that eating seafood as part of a healthy diet can help to reduce risk of dying from heart disease by 30 to 50 percent.

The U.S. Dietary Guidelines for Americans and prominent health organizations, such as the American Heart Association and World Health Organization, recommend eating seafood at least twice a week and taking in at least 250 milligrams of Omega-3s EPA and DHA a day.

Unfortunately, only 10 percent of Americans follow the dietary guidelines to eat seafood twice a week and Americans on average only take in 80 milligrams of Omega-3s EPA/DHA per day.

We have a public health crisis in the U.S. mainly from diseases that can be prevented. Per the CDC, seven out of 10 premature deaths in the U.S. can be preventable through diet and lifestyle changes. Ninety percent of our 3.3 trillion health care spending is on chronic diseases and mental health conditions. So eating the recommended amount of seafood can be part of a solution to our public health crisis.

Seafood Nutrition Partnership is a nonprofit with a mission to help Americans get healthier through a balanced diet that includes seafood. Our vision is for Americans to live smarter and healthier through sustainable seafood and our strategy is to build lifelong seafood consumers.

How we help the American public. Our work includes communicating seafood nutrition science. We hold an annual State of the Science Symposium to bring the latest seafood nutrition science and information to global health leaders and nutrition policy-makers. We translate available science into educational resources for health and nutrition professionals, retail and food service operators, K through 12 schools, workplace wellness and the general public.

We have an extensive reach with health and nutrition professionals. To date, we have reached over 26,000 RDNs. Registered dietitians are trusted health and nutrition advisors and work in all areas of our society.

In addition, we conduct public health campaigns to build awareness of the health benefits of consuming seafood and educating people on how to buy, cook, and eat seafood. Our Seafood Twice a Week Campaign has secured over 52,000 people to pledge to eat seafood twice a week and our newest seafood campaign is encouraging families to feed their kids more seafood to build lifelong seafood consumers.

These public health campaigns have been conducted in Birmingham, Alabama; Boston, Massachusetts; Brunswick, Georgia; Charleston, West Virginia; Hartford, New Haven, Connecticut; Indianapolis, Indiana; Jacksonville, Florida; Lexington, Kentucky; Memphis, Tennessee; Oklahoma City, Oklahoma; and Toledo, Ohio.

To date, we have generated over seven billion positive impressions on the benefits of eating seafood for better health.

Since our founding in 2013, the per capita consumption of seafood in the U.S. has grown from 14 pounds to 16 pounds per person per year and one in three Americans have started to add seafood to their diets more often.

The opportunities for expanding sustainable aquaculture in the U.S. are the ability to ensure a healthier America, support our future food security, and support food equity.

Seafood is important for our citizens to eat to support overall health and wellness. It has a much lower environmental footprint than land-based agriculture and an adequate supply of seafood will help to make it available for all Americans.

Currently, we eat 16 pounds of seafood per person per year. If we all ate two portions of seafood a week, we will need 26 pounds of seafood per person per year. We do not currently have enough seafood to provide every American with the recommended two servings of seafood per week.

The barriers to expanding sustainable aquaculture are around the misconceptions of farmed fish. We encourage consumers to eat a variety of sustainable seafood that is both wild and farmed, domestic and imported. We receive many questions on farmed fish, such as whether it's okay to eat farmed fish, if it's as nutritionally beneficial to eat wild fish, and certainly around how fish is raised.

We remind consumers that seafood is the last source of wild food that we have commercially available. Almost everything we have on our dinner plates, from beef, chicken, pork, vegetables, fruits and grains, are farmed.

America has a beautiful history and heritage of being skilled farmers of our great land and we have the experience of good farming practices that we can take to farming in our oceans.

From a nutritional standpoint,——

The CHAIRMAN. If we could wrap it up, we'll have the entire statement——

Ms. CORNISH. OK.

The CHAIRMAN.—in the record.

The CHAIRMAN. We appreciate that very fine statement. Thank you very much.

[The prepared statement of Ms. Cornish follows:]

SEAFOOD NUTRITION PARTNERSHIP
October 14, 2019

Senator ROGER WICKER, Chairman,
United States Senate,
Committee on Commerce, Science, and Transportation,
Washington, DC.

Re: October 16, 2019 Hearing on “Feeding America: Making Sustainable Offshore Aquaculture a Reality.”

Dear Senator Wicker,

Thank you for the invitation to testify at the hearing on “Feeding America: Making Sustainable Offshore Aquaculture a Reality” on October 16, 2019. My testimony on the opportunities and barriers to expanding sustainable aquaculture in the U.S. to foster informed discussions on the environment, economic, and social impacts of open ocean aquaculture is enclosed. I will focus my testimony on the health and nutritional benefits of seafood and how Seafood Nutrition Partnership is improving public health by encouraging healthy seafood consumption.

Health and Nutritional Benefits of Eating Seafood

Eating seafood solves many of the key issues we face today. Seafood is essential for our health, the health of our planet, and our future food security. Seafood, which includes fish and shellfish, is a healthy lean protein and a nutrition powerhouse filled with vitamins, minerals, and essential omega-3 fatty acids eicosapentaenoic acid (EPA) + docosahexaenoic acid (DHA).

These omega-3s are essential because our bodies cannot produce them to any appreciable amount and therefore we need to eat seafood and/or take supplements as needed. Seafood supports heart health, brain health, eye health, and overall wellness.

- There are over 40,000 studies since the 1970s that have been published on the health benefits of seafood and omega-3s.
- The brain is made up of fats and DHA omega-3 fatty acids are key building blocks for the cell structure. It has been said that as calcium is to bones, DHA is to the brain.
- Moms to be who ate seafood at least twice a week had babies with higher IQ than moms who did not eat seafood.
- Numerous high-quality studies show that eating seafood as part of a healthy diet can help to reduce the risks of dying from heart disease by 30–50 percent.
- Studies show that people with higher omega-3 levels in their blood had an 80–90 percent risk reduction in sudden cardiac death.
- Half of the eye’s light detecting cells are made up of omega-3s.

The U.S. Department of Agriculture and Health and Human Services Dietary Guidelines for Americansⁱ and other prominent health organizations such as the American Heart Associationⁱⁱ and World Health Organizationⁱⁱⁱ recommend eating seafood at least twice a week and taking in at least 250mg of omega-3 fatty acids EPA+DHA a day. Unfortunately, only about 10 percent of Americans follow the dietary guideline to eat seafood twice a week^{iv} and Americans on average take in about 80–90mg of omega-3s EPA+DHA per day^v.

Seafood’s Nutritional Role in America’s Public Health Crisis

Per the Centers for Disease Control and Prevention, 7 out of 10 premature deaths in the U.S. can be preventable through diet and lifestyle changes^{vi}. 90 percent of our \$3.3 Trillion in healthcare spending is on chronic diseases and mental health conditions^{vii}. Eating the recommended amounts of seafood can be part of the solution to our public health crisis.

ⁱ <https://health.gov/dietaryguidelines/2015/guidelines/>

ⁱⁱ <https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/fish-and-omega-3-fatty-acids>

ⁱⁱⁱ https://www.who.int/nutrition/topics/5_population_nutrient/en/index13.html

^{iv} https://ods.od.nih.gov/pubs/2015_dgac_scientific_report.pdf

^v <https://www.ncdc.gov/nchs/nhanes/Default.aspx>

^{vi} <https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm>

^{vii} <https://www.cdc.gov/chronicdisease/about/costs/index.htm>

Seafood Nutrition Partnership's Role in Improving Public Health by Encouraging Healthy Seafood Consumption

Seafood Nutrition Partnership (SNP) is a charitable non-profit formed in 2013 with a mission to help Americans get healthier through a balanced diet that includes seafood.

- *Our Vision:* For Americans to live smarter and healthier through sustainable seafood.
- *Our Strategy:* Build lifelong seafood consumers.

SNP is supported by our Board of Directors, Scientific & Nutrition Advisory Council, National Leadership Council, Ambassadors, Partners, and Donors^{viii}. SNP's work includes:

- *Communicating Seafood Nutrition Science*^{ix}: We hold an annual State of the Science Symposium to bring the latest seafood nutrition science and information to global health leaders and nutrition policy makers. We translate available science into educational resources for Health & Nutrition Professionals, Retail & Foodservice Operators, K–12 Schools, Workplace Wellness, and the general public.
- *Educating Health & Nutrition Professionals*^x: We have an extensive reach with health & nutrition professionals. To date we have reached over 26,000 Registered Dietitian Nutritionists (RDNs). RDNs are trusted health and nutrition advisors and many work in retail, foodservice, workplace wellness, K–12 schools, higher education, healthcare, and institutions.
- *Conducting Public Health Campaigns:*
 - We conduct public health campaigns to build awareness of the health benefits of consuming seafood and educating people on how to buy, cook, and eat seafood^{xi}.
 - Our #Seafood2xWk Campaign has signed up 52,298 people to pledge to eat seafood at least twice a week.
 - Our newest#LittleSeafoodies Campaign is encouraging families to feed their kids more seafood to build lifelong seafood consumers.
 - These public health campaigns have been conducted in Birmingham AL; Boston, MA; Brunswick, GA; Charleston WV; Hartford/New Haven CT; Indianapolis, IN; Jacksonville, FL; Lexington, KY; Memphis, TN; Oklahoma City, OK; Toledo, OH.
 - To date we have generated over 7 billion positive impressions on the importance of eating seafood for better health.

Since our founding in 2013, the per capita consumption of seafood in the U.S. has grown from 14 pounds to 16 pounds per person per year^{xii}, and 1 in 3 Americans have started to add seafood to their diets more often.

Opportunities and barriers to expanding sustainable aquaculture in the U.S. to foster informed discussions on the environment, economic, and social impacts of open ocean aquaculture

Opportunities: The opportunities to expanding sustainable aquaculture in the U.S. are the ability to ensure a healthier America, support our future food security, and support food equity. Seafood is important for our citizens to eat to support overall health and wellness, it has a much lower environmental footprint than land-based agriculture, and an adequate supply of seafood will help to make it available for all Americans.

Americans currently eat on average 16 pounds of seafood per person per year. If we all ate two portions of seafood a week, or 8 ounces of seafood a week, we will need 26 pounds of seafood per person per year. We do not currently have enough seafood to provide every American with the recommended two servings of seafood per week. With 70 percent of the planet covered by oceans and currently only about 3 percent of the ocean is utilized to grow our food, we have the capacity and know-how to grow more healthy seafood for our citizens.

Through the work of Seafood Nutrition Partnership, consumers are getting more comfortable with eating seafood as it is being recognized for its numerous health

^{viii} <https://www.seafoodnutrition.org/about-us/>

^{ix} <https://www.seafoodnutrition.org/seafood-research/>

^x <https://www.seafoodnutrition.org/resources/health-professionals/>

^{xi} <https://www.seafoodnutrition.org/>

^{xii} <https://www.fisheries.noaa.gov/resource/document/fisheries-united-states-2017-report>

benefits as well as a sustainable protein option for the future^{xiii}. Today, 80–90 percent of U.S. retailers and restaurants have a sustainable seafood policy in place. So, American consumers can feel good about choosing seafood.

Barriers: The barriers to expanding sustainable aquaculture are around the misconceptions of farmed fish. We encourage consumers to eat a variety of sustainable seafood that is both wild and farmed, domestic and imported. We receive many questions on farmed fish, such as whether it is okay to eat farmed fish, if it is as nutritionally beneficial as wild fish, and general uncertainty around how fish is raised.

We remind consumers that seafood is the last source of wild food that we have commercially available. Almost everything we have on our dinner plates, from beef, chicken, pork, vegetables, fruits, and grains are farmed. America has a beautiful history and heritage of being skilled farmers of our great land and we have the experience of good farming practices that we can take to farming in our oceans. We encourage fish farmers to utilize the best available science and responsible farming practices to grow healthy seafood for Americans. We need to communicate the importance of eating both wild and farmed fish to the American public, and we need to have an adequate supply of healthy seafood to meet the growing seafood demand.

Nutritional profile of farmed fish: From a nutritional standpoint, farmed fish have a similar nutrient profile to that of wild fish. A great level of science and technical skills are required to grow fish successfully at the commercial level and fish are fed a feed that mimics what wild fish eat in the wild. The U.S. Department of Agriculture has a FoodData Central database^{xiv} that analyzes the major foods available to the American public, and it shows that farmed fish is nutritionally comparable to that of wild fish.

Thank you for the opportunity to testify on the importance of seafood nutrition for the American public at the U.S. Senate Committee on Commerce, Science, and Transportation hearing on October 16, 2019. I look forward to productive discussions on feeding Americans healthy seafood.

Sincerely,

LINDA CORNISH, MBA,
Founder & President.

The CHAIRMAN. Ms. Unger.

**STATEMENT OF KATHRYN UNGER, MANAGING DIRECTOR,
CARGILL AQUA NUTRITION NORTH AMERICA AND
PRESIDENT, STRONGER AMERICA THROUGH SEAFOOD, INC.**

Ms. UNGER. Chairman Wicker, Ranking Member Cantwell, and Members of the Committee, thank you for the opportunity to testify before you today on the important issue of offshore aquaculture.

My name is Kathryn Graves Unger, and I am Managing Director of Cargill's North America Aqua Nutrition Business and also President of Stronger America Through Seafood or SATS.

I am honored to speak about the value of providing American consumers with a steady, healthy, and sustainable supply of U.S. farm-raised seafood.

I care about responsible farming. In fact, my husband and I own a plot of land in my home state of North Carolina where we are currently starting a small solar-powered organic farm.

This passion for sustainability is a primary reason why I joined Cargill's Aqua Nutrition Team to deliver on Cargill's promise of healthy seafood for future generations. We are committed to supporting the sustainable growth of the global aquaculture industry.

But right now, the U.S. ranks 16th in production of farmed seafood. We import most of the seafood we consume and half of the fish eaten in the United States comes from farms, but not from American farms. Honestly, we can do better.

^{xiii} <https://www.seafoodnutrition.org/seafood-research/seafood-sustainability/>

^{xiv} <https://fdc.nal.usda.gov/index.html>

While wild-caught fishing will continue to be an important source of seafood for Americans, the growing global demand for seafood cannot be met by wild-caught fishing alone. That's why SATS supports maintaining a robust commercial fishing industry alongside aquaculture production.

Growing U.S. aquaculture production benefits our economy, public health, and the environment. The United States' long coastline, Exclusive Economic Zones, skilled labor force, superior technology, ample feed sources, and growing seafood market puts us at the top of the list of countries with aquaculture potential.

Doubling U.S. aquaculture production to about one million tons could create an additional 50,000 direct and indirect jobs that could provide additional stable, year-round employment opportunities in coastal and fishing communities where opportunities are often limited and seasonally dependent.

Growing U.S. offshore aquaculture production also benefits U.S. agriculture. Replacing wild-caught fishmeal and fish oil with alternative protein, such as soy, eases pressure on ocean resources while also providing a new market outlet for U.S. soybean farmers.

Sustainable raw materials for feed are also important. Cargill's goal is for all our marine ingredients to come from Marine Stewardship Council-certified fisheries by 2025 and our U.S.-sourced marine ingredients will be fully MSC-certified by next spring. Cargill also supports increasing conservation practices on soybean farms.

Finally, farmed seafood is a healthy meal option, providing a variety of nutrients to humans that are not supplied in meaningful quantities by other foods. Unfortunately, despite the known health benefits, Americans are not meeting their targeted seafood consumption.

So why aren't we producing our seafood here at home? The answer is simple. There is no clear regulatory framework for permitting, enforcement, or management of offshore aquaculture in U.S. Federal waters.

This means anyone wanting to invest in offshore farming in U.S. waters faces a very unclear, expensive, and uncertain process to gain permission to operate.

One example of this is Pacifico Aquaculture, headquartered in San Diego. Instead of tackling the uncertain permitting process in the U.S., Pacifico took their U.S.-based investors 60 miles south of the U.S. border into Ensenada, Mexico, where they now operate a striped bass farm that employs over 200 workers and they ship that bass primarily back to U.S. retailers.

According to Pacifico's CEO, they would be willing to look into further investments here but not until the regulatory process is made clear.

So given the numerous benefits of U.S.-based aquaculture, it did not make sense to me why so many roadblocks exist to developing this industry. That is why SATS was created, to support congressional action to establish a clear permitting process for U.S. marine aquaculture while also prioritizing environmental and societal health.

I will state clearly that SATS is not asking to eliminate or reduce proper oversight of or regulations for offshore aquaculture, but

rather, seeks a clearly defined regulatory path forward to provide certainty for businesses that want to make these major investments in our economy.

Thank you, Senator Wicker, for your leadership in developing and introducing the AQUAA Act, and I implore members of this committee to join Senator Wicker and commit to bipartisan support for enacting sustainable offshore aquaculture legislation soon, and SATS stands ready to support your efforts.

[The prepared statement of Ms. Unger follows:]

PREPARED STATEMENT OF KATHRYN UNGER, MANAGING DIRECTOR, CARGILL AQUA NUTRITION NORTH AMERICA AND PRESIDENT, STRONGER AMERICA THROUGH SEAFOOD, INC.

Chairman Wicker, Ranking Member Cantwell, and Members of the Committee, thank you for the opportunity to testify before you today on the important issue of offshore aquaculture. My name is Kathryn Unger and I am Managing Director of Cargill's North American Aqua Nutrition business and also President of Stronger America Through Seafood, or SATS, a coalition of business leaders who joined together to promote Federal policies favorable to U.S. seafood production and aquaculture. But that is my professional life. Personally, I care deeply about the environment, am a seafood-lover, and a bit of a health and fitness-nut, and I am honored to speak about the value of providing American consumers with a steady, healthy and sustainable supply of U.S. farm-raised seafood.

I care deeply about being a good steward of the land and responsible farming practices. In fact, my husband and I own a plot of land in my home state of North Carolina where we will open a small, organic farm that is solar powered. This passion for sustainability is a primary reason why I joined Cargill's Aqua Nutrition team almost five years ago. Cargill was making big investments globally in fish feed production and, knowing that aquaculture has the least environmental impact of any animal protein production available, it seemed like the perfect position to blend my personal and professional values.

Cargill is a global agribusiness company with 160,000 employees across 70 countries who work relentlessly to achieve our purpose of nourishing the world in a safe, responsible and sustainable way. Every day, we connect farmers with markets, customers with ingredients, and people and animals with the food they need to thrive. My business, Cargill Aqua Nutrition, is a world leader in aquaculture feed and nutrition. To deliver on our promise of healthy seafood for future generations, we are committed to supporting the *sustainable* growth of the global aquaculture industry, enabling better seafood and partnering with farmers to help them succeed. We operate regional businesses in Chile, the North Sea, North America, northern Latin America, and Asia.

Early in my time at Cargill, I learned that aquaculture is the fastest growing food sector in the world but, sadly, the U.S. ranks only 16th in production of farmed seafood, behind producers in Asia, Europe, South America, Canada and Africa. This means that the U.S. is missing out on something. While wild-caught fishing will continue to be an important source of seafood for Americans, the growing global demand for seafood cannot be met by wild-caught fishing alone. That is why SATS supports maintaining a robust commercial fishing industry alongside offshore aquaculture production. The U.S. imports most of the seafood it consumes, and half of the fish eaten in the United States comes from farms—but not from American farms¹. American aquaculture (both marine and freshwater) meets only 5–7 percent of U.S. demand for seafood. Honestly, we can do better.

Before I address why the U.S. lags so far behind in aquaculture production, I want to elaborate on what the U.S. is missing out on by not engaging in domestic production.

For the Economy: Globally, aquaculture is one of the fastest growing, sustainable forms of food production. According to the World Bank, by 2030, aquaculture's share in the global seafood supply will expand to supply over 60 percent of fish for human consumption, whereas wild-capture seafood production will remain steady. The United States' long coastline, expansive Exclusive Economic Zone (EEZ), skilled labor force, superior technology, ample feed sources, and growing seafood market put us at the top of the list of countries with aquaculture *potential*. A doubling of

¹http://www.nmfs.noaa.gov/aquaculture/faqs/faq_aq_101.html

U.S. aquaculture production to about 1 million tons could create an additional 50,000 direct and indirect jobs, assuming 20 direct jobs per 1,000 tons of seafood produced, or five jobs per 1,000 tons in equipment, feeds, processing, marketing, and food service. These jobs could provide additional stable, year-round employment opportunities in coastal and fishing communities where opportunities are often limited and seasonally dependent.

In addition, U.S. offshore aquaculture production can also benefit U.S. agriculture. Replacing wild-caught fishmeal and fish oil with alternative proteins, such as soy, eases pressure on ocean resources while also providing a new market outlet for U.S. soybean farmers. Soybeans contain much needed omega-3 fatty acids, proteins, and unsaturated fats that are critical for healthy fish. Soy can replace from one-third to one-half of the fishmeal in feeds for many farmed species, and soybean meal has a significantly lower cost than most animal meals. And, farmers stand ready to meet new demand for soybeans. Soybean production in the U.S. has increased more than tenfold in the last four decades, and can sustain this growth in the coming years.²

For the Environment: With modern siting and monitoring technologies, marine finfish aquaculture can be managed in an *environmentally sound* manner that mitigates impacts on competing ocean uses and ocean ecosystems. Marine aquaculture requires no land, minimal fresh water and a relatively small amount of space to provide abundant, healthful seafood making it an extremely efficient means of animal protein production.

Aquaculture is also a highly efficient way of producing nutritious food. Naturally high conversion rates of feed to seafood have been improved over the last two decades. Nevertheless, our industry continues to look for ways to increase sustainability and meet consumer demands for more information about the food that they eat. As a major feed producer, we are mindful that our decisions affect the sustainability of the value chain and are taking steps to reduce the footprint even further. This all starts with the feed raw materials and their origins. We work continuously with our suppliers to develop more sustainable sources of marine and plant-based raw materials.

One recent example is a partnership with the World Wildlife Federation to better manage the wild fish stocks that we use for our fishmeal and oil. Our goal is for all marine ingredients to come from Marine Stewardship Council (MSC)-certified fisheries by 2025, and we are well on our way to meeting that target. For our U.S.-sourced marine ingredients we will be fully MSC-certified by next spring, and globally we are over 40 percent.

For our soy-based feeds, our sourcing depends on the region in which the feed is being produced. For our U.S. feed operations—including any expansion that may come to support the growth of U.S. marine aquaculture—we will use only U.S. grown soy. As noted earlier, use of soybean meal in feeds can reduce pressure on wild fish resources and prevent overfishing. In addition, we are working to increase the sustainability of U.S. soybean production through partnerships with farmers focused on increasing soil health, which has numerous environmental benefits as well as benefits to the farmers' bottom line.

For our health: Farmed seafood provides a source for local, affordable meal options that benefit public health. The U.S. Dietary Guidelines currently recommend that Americans eat at least eight ounces of a variety of seafood per week—which equates to 2 meals a week. This is because seafood provides a variety of nutrients to humans that are not supplied in meaningful quantities by other foods, such as omega-3 fatty acids and fat soluble vitamins, such as A, D and K. Unfortunately, despite the health benefits, Americans are not meeting the recommended consumption target, with data from 2016 suggesting that Americans are only consuming about 2.7 ounces of seafood per week, or 1/3 of recommendations.³ Growth of abundant, local, U.S.-produced seafood could be key to changing those habits.

Clearly, aquaculture is something that we should be doing ourselves here in the U.S.

So, WHY AREN'T WE? The answer is simple: *There is no clear regulatory framework for the permitting, enforcement or management of offshore aquaculture in U.S. Federal waters.* This means anyone wanting to invest in offshore farming in U.S. waters faces a very unclear, expensive and uncertain process to gain permission to operate. Nobody is in charge but everybody is in charge—which leaves potential investors and farmers with few options but to take their money, and jobs, overseas.

One example of this is Pacifico Aquaculture, headquartered in San Diego, California. Instead of tackling the uncertain permitting process in the U.S., Pacifico took

² <https://ussec.org/wp-content/uploads/2015/10/Farm-land-sea.pdf>

³ <https://www.ers.usda.gov/amber-waves/2016/october/americans-seafood-consumption-below-recommendations/>

their U.S.-based investors 60 miles south of the U.S. border into Ensenada, Mexico, where they now operate a remarkable striped bass farm. Pacifico employs 200 workers in Mexico, including divers, engineers, processors, harvesters and biologists, and has become a major employer in the community. Pacifico is selling their delicious, sustainably-sourced, fully-traceable striped bass to major U.S. retailers, high-end white tablecloth restaurants and sushi outlets. According to Pacifico's Chief Executive Officer Frank Dulcich, they would be willing to look into further investments in the U.S., *but not until the regulatory process is made clear*. He recently told me, "The current situation makes it difficult to accurately assess business plans as permitting and expansion considerations are handicapped by an environment where there is very little confidence in the ability to receive permits."

Other groups have tried for decades and spent millions of dollars to navigate the regulatory quagmire surrounding offshore aquaculture development, and very few have succeeded. Another California-based group, Hubbs Sea World Research Institute, started their permitting journey in the late 1990s. They have spent over \$4 million so far and still do not have the requisite permits to farm yellowtail off the coast of Southern California. According to them, the primary roadblock has long been a lack of consistency or coordination among Federal agencies, including the National Oceanic and Atmospheric Administration, Environmental Protection Agency, Army Corps of Engineers, U.S. Coast Guard, and U.S. Navy, as well as State agencies.

Given the numerous benefits of U.S. aquaculture to our economy, our health, and the environment, it did not make sense to me why so many roadblocks exist, effectively preventing the development of a robust offshore aquaculture industry in the United States. Not one to stand by and wait for someone else to fix our problems, in late 2017, I called a group of U.S. seafood industry leaders to Washington, D.C. to identify possible solutions to the U.S. aquaculture problem. That first meeting led to what is now Stronger America Through Seafood and together we are advocating for an improved regulatory environment that can support a vibrant U.S. aquaculture community. Companies like Red Lobster, Sysco, Pacific Seafoods, Taylor Shellfish, High Liner Foods, Fortune Fish and many others who are on the Board of SATS determined that our first order of business would be to support an act of Congress which would establish a clear permitting process for U.S. marine aquaculture while also prioritizing environmental and societal health.

Since that time, SATS has been very pleased with the work that you, Senator Wicker, have undertaken to develop and introduce the AQUAA Act in the last Congress. I am confident that legislation like this could provide much-needed regulatory certainty for U.S. marine farmers while also preserving the environment, local economies and public health. Legislation like the AQUAA Act will lead to increased U.S. seafood production that benefits *ALL* Americans.

I will state clearly that SATS is not asking to eliminate or reduce proper oversight of or regulations for U.S. offshore aquaculture. However, *what is needed is a clearly defined regulatory path forward to provide certainty for businesses that want to make these major investments in our economy*. I implore the members of this Committee to join in your effort Senator Wicker to enact offshore aquaculture legislation soon. My colleagues and I at Cargill and at Stronger America Through Seafood are eager to share our knowledge and experience to support this process. I am happy to answer any questions you may have.

Thank you.

The CHAIRMAN. Thank you very much, Ms. Unger. We appreciate that.

And we now recognize Dr. Halpern of UC Santa Barbara. Welcome, sir.

**STATEMENT OF BENJAMIN S. HALPERN, DIRECTOR,
NATIONAL CENTER FOR ECOLOGICAL ANALYSIS AND
SYNTHESIS; AND PROFESSOR, BEN SCHOOL OF
ENVIRONMENTAL SCIENCE AND MANAGEMENT,
UNIVERSITY OF CALIFORNIA, SANTA BARBARA**

Dr. HALPERN. Chairman Wicker, Ranking Member Cantwell, and Members of the Committee, thank you for the opportunity to testify here today about the science around offshore aquaculture.

My name is Dr. Ben Halpern, and I am the Director of the National Center for Ecological Analysis and Synthesis, the first and longest-running center of its kind of the world, and a Professor of Marine Conservation at the Bren School of Environmental Science and Management at the University of California, Santa Barbara.

I got my Ph.D. in Marine Ecology and have spent the last 15 years of my career focused on global scale research questions that address topics, such as the cumulative impact of human activities on oceans and measuring the many benefits people derive from the ocean, in particular related to the food we get from fisheries and aquaculture.

Marine aquaculture has huge potential to provide nutritious and environmentally friendly food, but to produce safe, sustainable, and scientifically informed marine aquaculture requires clear policy based on the best available science.

To that end, I would like to offer three related main points. First, we have to get our food from somewhere and there is huge potential in U.S. waters from marine aquaculture. Second, all food production has impact but not all foods are equal. Well-managed offshore aquaculture can have low impact. Third, science already provides a number of key best practices and advantages of offshore aquaculture and ecosystem-based integrated aquaculture frameworks already exist to guide aquaculture siting.

Americans love seafood, annually consuming nearly 50 pounds of seafood per capita. Many argue that our country was founded on the backs or fins of cod and fisheries remain the fabric and diet of many communities around our country.

In the last few decades, strong and effective fisheries management has returned many of our stocks to healthy, sustainable levels, but that success creates a Catch-22. There's relatively little room for further growth and sustainable harvest of wild fisheries to feed our ever-increasing appetite for seafood.

Indeed, currently the U.S. imports roughly 65 percent of its seafood. Thus, there are only two options for meeting growing seafood demand in the future: import more seafood or farm it in our own waters.

There is huge potential in U.S. waters for marine aquaculture. The U.S. would only need to farm one-hundredth of 1 percent of its EUZ to produce all of the seafood people eat domestically. This huge production potential in such a small space creates key opportunities for strategic science-informed siting of marine aquaculture to maximize benefits and minimize conflicts and negative impacts while still meeting conservation objectives.

Whether we harvest fish, farm fish, grow livestock, or farm crops, we have an impact on the environment, but not all food production is created equal. As scientists, we measure these impacts in many different ways. The emissions of greenhouse gases that fuel climate change, the nitrogen pollution that leads to dead zones in lakes and coastal waters, the natural landscapes converted and tilled under, the spread of non-native species or pests, the use of limited freshwater resources, and so on. These costs vary enormously among different foods growing in different places using different means.

Offshore aquaculture has impacts on the environment just like any other food production, but in many cases, these impacts are far

less than those for other foods. Little to no freshwater is needed, feed innovations have reduced nitrogen pollution to very low levels, very small amounts of space are needed to grow food in the sea, and for shellfish and seaweed aquaculture, some can actually improve local water quality rather than add pollutants.

Strategic and science-informed siting of offshore aquaculture can further reduce potential environmental impacts. For example, some best practices for offshore aquaculture include placing farms at least 300 feet away from critical benthic habitat, in ocean currents at least one-tenth of a mile per hour and at least 60 feet above the sea floor, and maintaining low stocking densities to reduce the chance of diseases.

The perception of many people in the U.S. is that aquaculture is bad, offshore in particular. The science does not bear this out for offshore aquaculture if it is managed well, but nonetheless aquaculture policy and management efforts will continue to face this public perception.

It is critical that efforts to create aquaculture policy are informed by science and adaptive to new science. As a global leader in the management of our marine resources, the U.S. has the opportunity, knowledge, and capacity to produce safe, sustainable, and scientifically informed marine aquaculture in a way that sets the global standard.

Thank you for your time and attention. I welcome any questions you may have.

[The prepared statement of Dr. Halpern follows:]

PREPARED STATEMENT OF BENJAMIN S. HALPERN, DIRECTOR, NATIONAL CENTER FOR ECOLOGICAL ANALYSIS AND SYNTHESIS; AND PROFESSOR, BREN SCHOOL OF ENVIRONMENTAL SCIENCE AND MANAGEMENT, UNIVERSITY OF CALIFORNIA, SANTA BARBARA

Chairman Wicker, Ranking Member Cantwell, and members of the committee, thank you for the opportunity to testify here today about the science around offshore aquaculture. My name is Dr. Ben Halpern and I am the Director of the National Center for Ecological Analysis and Synthesis, the first and longest running center of its kind in the world, and a Professor of marine conservation at the Bren School of Environmental Science and Management at the University of California, Santa Barbara. I got my PhD in marine ecology and have spent the last 15 years of my career focused on global-scale research questions that address topics such as the cumulative impact of human activities on oceans and measuring the many benefits people derive from the ocean, in particular related to the food we get from fisheries and aquaculture.

My research leverages synthesis, which is a scientific tool that brings together all available data and evidence, collected as part of dozens to hundreds of studies from around the world, to extract the ‘big picture’ and identify key gaps in our knowledge. I then use other analytical tools to strategically fill those gaps. This context is important because it helps explain my scientific approach and perspective—my work doesn’t focus on if or where to site a specific aquaculture farm off the coast of California, for example, but instead focuses on broader questions about the potential and limits to growth in marine aquaculture globally or in the U.S., the comparative environmental impacts of different kinds of aquaculture, and the lessons learned about best practices for offshore aquaculture.

Aquaculture comes in many forms and flavors. There are three broad places where aquaculture is done—freshwater (on land), brackish (in estuaries), and marine. Globally, freshwater aquaculture is the majority of total production, with marine and brackish aquaculture totaling about 40 percent (FAO 2018). In the U.S., approximately 43 percent is marine (FAO 2018).

There are also three broad types of aquaculture—seaweed, shellfish, and finfish. Within each of these broad categories there are dozens to hundreds of different spe-

cies that are grown globally. As of 2017, at least 18 species of marine finfish could viably be farmed in the U.S. and dozens of shellfish already are.

Marine aquaculture has huge potential to provide nutritious and environmentally-friendly food that simultaneously creates economic value and local jobs. But to produce safe, sustainable and scientifically-informed marine aquaculture requires clear policy based on the best available science.

To that end, I would like to offer three related, main points:

1. We have to get our food from somewhere, and there is huge potential in U.S. waters for marine aquaculture.
2. All food production has impact, but not all foods are equal—well managed offshore aquaculture can have low impact.
3. Science already provides a number of key best practices and advantages of offshore aquaculture, and ecosystem-based/integrated aquaculture frameworks already exist to guide aquaculture siting.

The U.S. has huge potential for safe and sustainable offshore aquaculture

Americans love seafood, annually consuming nearly 50 pounds of seafood per capita, or 6.8 million metric tons total a year, above the global average. Many argue that our country was founded on the backs—or fins—of cod, and fisheries remain the fabric and diet of many communities around our country. In the last few decades, strong and effective management of fisheries has returned many of our stocks to healthy, sustainable levels. But that success creates a catch-22. There is relatively little room for further growth in sustainable harvest of wild fisheries to feed our ever-increasing appetite for seafood here or in other countries.

Indeed, currently the U.S. imports roughly 65 percent of its seafood (Gephart *et al.*, 2019)—not the 90 percent number that often gets mentioned, but 65 percent is still the majority of our seafood. Even if we didn't export any of the seafood we catch and farm in the US, we would still be more than a million metric tons short of current domestic seafood demand. Thus, there are only two options for meeting growing seafood demand in the future: import more seafood, or farm it in our own waters.

There is huge potential in U.S. waters for marine aquaculture (Gentry *et al.*, 2017), even when using very conservative assumptions about where and to what extent to allow aquaculture (Fig. 1). The U.S. would only need to farm 0.01 percent of its EEZ to produce *all* of the seafood people eat domestically. We don't need to do even that, though, because we have our fisheries too. This huge production potential in such a small space creates key opportunities for strategic, science-informed siting of marine aquaculture to maximize benefits and minimize conflicts and negative impacts while still meeting objectives of conservation and other marine sectors.

All food production has impact, but not all foods are equal

Whether we harvest fish, farm fish, grow livestock, or farm crops, we have an impact on the environment. We can't feed the nearly 330 million people in the U.S. without having an impact on the environment. But not all food production is created equal. As scientists, we measure these impacts in many different ways: the emissions of greenhouse gases that fuel climate change, the nitrogen pollution that leads to dead zones in lakes and coastal waters, the natural landscapes converted and tilled under, the spread of non-native species or pests, the use of limited freshwater resources, and so on. These costs vary enormously among different foods grown in different places using different means.

Offshore aquaculture has impacts on the environment, just like any food production. But in many cases these impacts are far less than those for other foods. Little to no freshwater is needed, feed innovations have reduced nitrogen pollution to very low levels, very small amounts of space are needed to grow food in the sea, and for shellfish and seaweed aquaculture, some can actually improve local water quality rather than add pollutants. Strategic and science-informed siting of offshore aquaculture can further reduce potential environmental impacts.

In other cases the impacts of offshore aquaculture may be similar to other foods. The potential for spread of disease, and the antibiotics used to deal with disease, is common to many food production systems. For offshore aquaculture, these risks appear easier to mitigate. In the U.S., no antibiotics have been cleared for use, and there are known best practices that significantly reduce rates of disease, so clear and established strategies exist to minimize issues of disease. Another potential impact comes from risk of escape of farmed fish into wild stocks. Integrated ecosystem-based management of aquaculture provides one mechanism for reducing these risks.

Guiding best practices for offshore aquaculture

There is sufficient science to inform and guide best practices for offshore aquaculture that can be used to help minimize environmental impacts. Some of these guidelines include:

- Place farms at least 300 feet (less than a football field) away from critical benthic habitat
- Farms placed in ocean currents at least 0.1mph have better growth and a lower pollution footprint
- Farms positioned at least 60 feet above the seafloor have little impact on the seafloor below
- Lower stocking densities reduce the chance of diseases—for example, the European ‘organic’ standard is 11 kg/m³ for finfish
- Use anti-predator netting and anchoring to reduce wildlife conflict and entanglements
- Promptly remove attractants to minimize wildlife interactions
- Apply strict rules on antibiotics—currently none are permitted for use in U.S. marine waters
- Require consistent and standardized monitoring and reporting of conditions and farm practices to help inform science and improve best practices
- Establish and implement distinct criteria for finfish, shellfish, and seaweed

The perception of many people in the U.S. is that aquaculture is bad, offshore in particular (Froehlich *et al.*, 2017). The science does not necessarily bear this out for offshore aquaculture if it is managed well, but none-the-less aquaculture policy and management efforts will continue to face this public perception. It is critical that efforts to create aquaculture policy are informed by science and adaptive to new science. Well-managed aquaculture will need to take into account community and social aspects, and the science on this is more sparse.

I would like to end by reiterating something I started with. To produce safe, sustainable and scientifically-informed marine aquaculture requires clear policy based on the best available science. As a global leader in the management of our marine resources, the U.S. has the opportunity, knowledge and capacity to do this in a way that sets a global standard.

Thank you for your time and attention. I welcome any questions you may have.

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Figure 1. From Gentry et al. 2017.

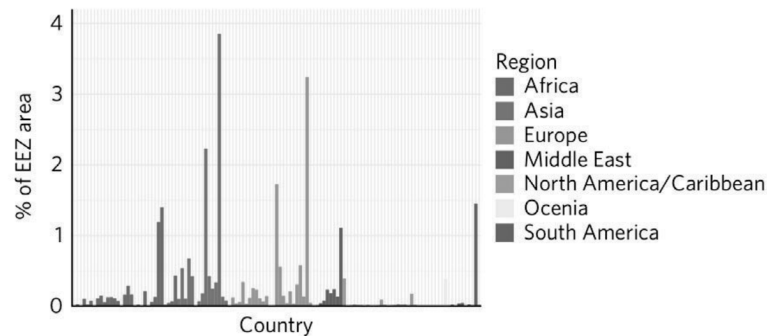


Fig. 3 | Percent of each country's EEZ required for finfish aquaculture to supply its current seafood consumption. Each bar represents a single country grouped by region. The vast majority of countries would need to farm much less than 1% of their EEZ to produce all of the seafood they are currently consuming. More detail is provided in Supplementary Fig. 8.

The CHAIRMAN. Thank you very, very much, Dr. Halpern.
And is it Dr. Doremus? Welcome and you're recognized for your opening statement.

STATEMENT OF DR. PAUL DOREMUS, DEPUTY ASSISTANT ADMINISTRATOR FOR OPERATIONS, NATIONAL MARINE FISHERIES SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE

Dr. DOREMUS. Thank you, Chairman Wicker, Ranking Member Cantwell, and Members of the Committee.

I'm Paul Doremus, and I am the Deputy Assistant Administrator for Operations within NOAA's National Marine Fisheries Service.

We support the long-term sustainability of our fisheries to benefit commercial, recreational, and subsistence fishermen as well as aquaculture producers, the seafood industry, and coastal communities that depend on fisheries and the other marine resources that we are responsible for stewarding.

Limits to wild fisheries, environmental changes, the nutritional benefits of seafood, and trends in global seafood markets all point toward the need to increase U.S. marine aquaculture production.

I appreciate the opportunity to discuss aquaculture with you today and to convey the uncapped potential of this segment of the U.S. seafood sector.

U.S. fisheries are among the world's largest and most sustainable. By preventing the overfishing and rebuilding stocks, we're strengthening the value of fisheries to the economy and the communities that depend on them while ensuring the sustainable supply of seafood for the Nation in the future.

However, the U.S. currently imports at least 85 percent of its seafood and about half of that is from aquaculture produced in

other countries. The U.S. trade deficit in seafood has grown to over 16 billion and is increasing steadily.

In effect, we have outsourced the large majority of our seafood production and the associated jobs that go with that. We've captured fishery production approaching biological limits. Major increases in domestic seafood production can really only come from aquaculture.

While NOAA Fisheries is committed to improving output from the sustainable harvest of wild-captured fisheries, there is simply not enough fish in the ocean to meet demand. Global aquaculture supplies more than half of all seafood produced for human consumption and that percentage will continue to rise as global seafood demand increases while wild harvest levels remain relatively flat and relative to other types of farming, growing seafood is one of the most resource-efficient ways to produce protein, generally requiring less space, less feed, and less freshwater than farming the equivalent amount of animals on land.

With proper management and with science-based polls, such as those developed by NOAA and our partners, we can minimize environmental impacts, minimize user conflicts, and realize the benefits among those being public health and nutrition benefits, that have been cited from a more seafood-rich diet. All of these are substantial reasons.

Stated simply, responsible aquaculture is good for the economy, it's good for the planet, and it's good for our people, but despite these benefits and despite strong and growing demand for more seafood, U.S. aquaculture production remains far below its potential.

The U.S. has the second largest EUZ in the world but ranks 17th in aquaculture output. An uncertain regulatory environment, particularly in Federal waters, has constrained the growth of U.S. marine aquaculture.

To overcome these constraints, NOAA works to facilitate permitting and siting of aquaculture facilities and contributes to the science and technology advancements needed to develop and manage responsible aquaculture production.

For example, NOAA recently released our Ocean Reports Tool. This is an intelligent web application that provides a transparent, rigorous, and very efficient way to identify sustainable areas for siting new aquaculture and other industries while minimizing potential user conflicts. Sustainable aquaculture really begins with siting and this tool will help us work with the fishing industry and with other ocean users to get it right at the start.

NOAA's scientists and our partners have worked on numerous other tools to foster sustainable aquaculture developments, such as new feeds, models to predict and avoid negative impacts to water quality and wild populations, and new ways to promote the resistance to disease, such as probiotics in the shellfish industry.

Looking ahead, we can build on many years of sustainable seafood management under the Magnuson-Stevens Act and improve the future for the U.S. seafood sector as a whole.

The U.S. has one of the most dynamic, accountable, and innovative wild capture fishery management systems in the world and our fishermen abide by the most robust stewardship laws.

NOAA manages its wild capture fisheries in a coordinated, multi-stakeholder process that is rooted in science. This approach is built into the fabric of our organization. It is how we do business, and we will apply these same approaches and lessons from wild fish management to the management of the aquaculture sector in the marine environment.

By making aquaculture facility permitting more efficient and coordinated and by expanding investment in research, the U.S. can produce greater volumes of high-quality local seafood and be more competitive in the global marketplace. We can support the growth of U.S. seafood farming in ways that complement our management of commercial fishing and provide additional employment and economic opportunities throughout the seafood supply chain.

We stand ready to work with the Committee on this important national issue.

Thank you for the opportunity to be here today, and I certainly look forward to your questions.

[The prepared statement of Dr. Doremus follows:]

PREPARED STATEMENT OF DR. PAUL DOREMUS, DEPUTY ASSISTANT ADMINISTRATOR FOR OPERATIONS, NATIONAL MARINE FISHERIES SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE

Good morning, Chairman Wicker, Ranking Member Cantwell, and Members of the Committee. My name is Paul Doremus and I am the Deputy Assistant Administrator for Operations within the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) in the Department of Commerce. From daily weather forecasts and severe storm warnings, to fishery management, coastal restoration, and supporting marine commerce, NOAA's products and services support economic vitality and affect more than one-third of America's gross domestic product. NMFS' mission includes supporting sustainable fisheries, including aquaculture, while recovering and conserving protected marine species. We support the long-term sustainability of our fisheries to benefit commercial, recreational, and subsistence fishermen as well as aquaculture producers, the seafood industry, and coastal communities that depend on those fisheries and coastal resources. Our support for aquaculture is part of a larger priority initiative to grow the American Blue Economy.

Limits to wild fisheries, environmental changes, the nutritional benefits of seafood, and trends in global seafood markets underscore the need to increase U.S. marine aquaculture production, particularly in Federal waters. I appreciate the opportunity to discuss aquaculture with you today, and to convey the untapped potential of this segment of the U.S. seafood sector.

Overview and Opportunities

U.S. wild-capture fisheries are among the world's largest and most sustainable. By preventing overfishing and rebuilding stocks, we are strengthening the value of fisheries to the economy and communities that depend on them, and also ensuring a sustainable supply of seafood for the Nation in the future. However, the U.S. currently imports at least 85 percent of its seafood, about half from aquaculture in other countries. The U.S. trade deficit in seafood has grown to over \$16 billion and is increasing. In effect, we have outsourced the large majority of our seafood production and associated jobs. By providing a clear regulatory framework for aquaculture in Federal and State waters, we could increase U.S. seafood production, while maintaining a healthy and vibrant wild capture fishery industry, creating more jobs in coastal communities and throughout the agricultural heartland and providing our country with more local sources of one of the most healthy, sustainably produced forms of protein. Stated simply, responsible aquaculture is good for the economy, good for our communities, and good for the planet.

NMFS is fully committed to improving output from the sustainable harvest of wild capture fisheries; however, there simply is not enough fish in the water to meet demand. Today, global aquaculture supplies more than 50 percent of all seafood produced for human consumption. That percentage will continue to rise as global seafood demand increases. In addition, relative to other types of farming, growing sea-

food is one of the most resource-efficient ways to produce protein, generally requiring less space, less feed, and less fresh water than farming the equivalent amount of terrestrial animals. With proper management and science-based tools, such as those developed by NOAA and our partners, we can minimize environmental impacts and user conflicts. These two conditions—the global imbalance between supply and demand and the comparatively low environmental impact of seafood production—are compelling reasons alone for focusing on U.S. aquaculture production. The benefits to public health and nutrition of a more seafood-rich diet provide yet additional reasons. Despite these considerable benefits, U.S. aquaculture production remains far below its potential.

The United States has significant untapped potential to expand sustainable marine aquaculture. While the U.S. has the second largest Exclusive Economic Zone (EEZ) in the world, it ranks 17th in the world in aquaculture. An uncertain regulatory environment has constrained the growth of U.S. aquaculture. To overcome these burdens and increase domestic aquaculture production over the next decade, NOAA is working to improve opportunities for investment in and development of aquaculture businesses by facilitating permitting and siting of aquaculture facilities and by advancing the science and technologies needed to develop and manage responsible aquaculture production.

NOAA's Role

At NOAA, we support cutting-edge science and research to grow sustainable aquaculture in the United States. I'd like to provide just a few examples to highlight these efforts.

Sustainable aquaculture begins with proper siting. To this end, NOAA recently released our OceanReports tool, an intelligent web application developed in partnership with the Bureau of Ocean Energy Management and the Department of Energy. OceanReports is capable of providing custom spatial analysis of any U.S. ocean space within seconds. Now anyone can quickly get wide-ranging information for a particular space—from ocean laws to environmental data and economic data about shipping activity and energy infrastructure. By providing instant access to an ocean of data and spatial reports for our “ocean neighborhoods,” this web-based tool provides a transparent, rigorous, and efficient way to identify sustainable areas for siting new ocean industries while minimizing potential user conflicts. OceanReports and similar tools provide an excellent starting point for discussions with the fishing industry and other ocean users about where to site, or not site, aquaculture operations. This tool is one example of a larger NOAA-wide effort to rapidly advance emerging technologies such as artificial intelligence, unmanned systems, and cloud computing to more effectively and efficiently accomplish our mission.

NOAA scientists and our partners have also worked on numerous other tools to foster sustainable aquaculture development. These include supporting advances in new finfish feeds that have significantly reduced the amount of wild fish required to raise a given volume of farmed fish; models to predict and avoid negative impacts to water quality and wild populations; and novel ways such as use of probiotics to reduce the incidence of disease in shellfish farms. NOAA continues to refine and expand these and other tools.

Looking Ahead

NOAA has a long history of sustainable seafood management under the Magnuson-Stevens Fishery Conservation and Management Act. The United States now has one of the most dynamic, accountable, and innovative wild-capture fishery management systems in the world. Our fishermen abide by the most robust stewardship laws. Evolving over the past 40 years, the results of our science-based management system are impressive: overfishing and overfished stocks are at historic lows. NOAA manages its wild fisheries in close coordination and proactive engagement with states, fishing communities, environmental organizations, and the public in a coordinated multi-stakeholder process. This approach is built into our fabric and we apply these same collaborative, locally driven approaches and lessons from wild fish management to marine aquaculture. However, in order to be more effective, we need to address several key underlying challenges.

By making aquaculture permitting more efficient and coordinated, U.S. aquaculture production can be more competitive in the marketplace. Furthermore, providing mechanisms establishing the security of tenure required for private sector investment in offshore aquaculture is essential for growth in this space.

Currently, there is only one commercial aquaculture facility permitted in Federal waters—a mussel farm off the coast of California. There are several pilot and commercial projects at various stages in the permitting process; however, none are at commercial production levels. A good model of sustainable aquaculture offshore pro-

duction is occurring in state waters. Blue Ocean Mariculture operates in Hawaiian state waters but in conditions similar to the open-ocean given the location's steep continental shelf. Blue Ocean's fully integrated facility optimizes the life cycle of a finfish species called Almaco jack from hatch to harvest. Production begins with fertilized eggs from dedicated brood stock, meaning there is no capture pressure on wild fish populations beyond securing the initial brood stock. They transfer juvenile fish from their hatchery facility to open ocean net pens. Careful monitoring occurs during feeding. This feeding approach, along with the selection of a site with relatively deep waters and strong currents, greatly reduces the probability of feed settling to the bottom. The farm site has been in continuous operation within the Humpback Whale National Marine Sanctuary since 2004 and adheres to robust environmental monitoring protocols. It recently received authorization to expand production on its current site.

Blue Ocean Mariculture is just one example of how industry is implementing what we have learned since the origins of U.S. marine aquaculture about how to properly locate and manage marine aquaculture to reduce potential impacts and user conflicts. It also provides a compelling example of what kind of businesses can evolve in Federal waters if we respond to the challenges that have prevented more extensive investment in this promising segment of the seafood sector.

We can support the health and future prosperity of sustainable seafood through U.S. seafood farming in ways that complement our management of commercial fishing and provide additional employment and economic opportunities throughout the seafood supply chain. The Department stands ready to work with the Committee on this important national issue. Thank you again for the opportunity to testify before your Committee today. I would be happy to answer any questions you may have.

The CHAIRMAN. Thank you, Dr. Doremus.

And, Chairman Julius, we're now pleased to recognize you for your statement.

**STATEMENT OF JEREMIAH (JAY) JULIUS, CHAIRMAN,
LUMMI NATION**

Mr. JULIUS. Good morning and thank you, Chairman Wicker, Ranking Member Cantwell, Members of the Committee. Thank you for the opportunity to testify on both the threats and benefits of off-shore aquaculture.

My name is Jay Julius, a fisherman and Chairman of the Lummi Nation.

Located in the Northwest corner of Washington State, the Lummi Nation and its people represent the largest fishing tribe in the country. Since time immemorial, the Lummi people have relied on the Salish Sea and the fisheries it provides for ceremonial, subsistence, and economic purposes.

Our lives and culture depend on the health and sustainability of its resources and our right to harvest these resources is protected by our treaty with the United States.

Native salmon stocks are already under tremendous pressure and struggling to survive. Habitat destruction, pollution, lack of forage fish are but a few of the threats facing salmon today.

In August 2017, an environmental disaster took place in the Salish Sea and directly impacted the Lummi Nation. The desires of a foreign corporation, Cook Aquaculture, to negligently exploit our waters led to the massive release of a pollutant, approximately 240,000 Atlantic salmon, an invasive species, into our waters.

The Lummi Nation incurred significant expense in trying to clean up the mess created by Cook. We declared a state of emergency and it was literally all hands on deck as our fishing fleets stopped everything as well as the government they were doing to capture the Atlantic salmon and clean up the spill.

It's important to note this industry was operating in our waters without our consent. This industry has the potential to adversely impact our ability to exercise our treaty-reserved rights.

Having seen firsthand how poor aquaculture policy can threaten fragile ecosystems and endanger fish stocks, I have several suggestions on principles for future aquaculture policy.

First, the rights of treaty tribes need to be protected. It is not uncommon for aquaculture facilities to be sited in areas that are an integral part of our usual and accustomed fishing places of the Lummi Nation.

Consequently, as part of the permitting process for these facilities, the Federal Government is required to ensure that treaty rights are not abrogated or impinged upon by any permitted project.

This right was recognized by Federal courts who, in *Northwest Sea Farms v. United States Army Corps of Engineers*, blocked the permitting of an offshore aquaculture facility because of its potential impacts on treaty fishing rights of the Lummi Nation.

Second, there should be a ban on non-native fin fish aquaculture. The risks of disease, pollution, predation, and integrating are far too great, particularly in my region where we are struggling to recover native species.

Certain forms of net pen aquaculture externalize the true cost of industry while ensuring that a few multi-national corporations reap tremendous economic benefits while endangering our way of life.

Third, the regional differences and priorities need to be respected. While full-scale offshore aquaculture may be acceptable in some regions of the country, it's not appropriate in many regions, including the waters where my people fish.

Finally, there needs to be strong environmental protections and enforcement of those laws. The Cook disaster happened because of weak laws and little or no inspections or enforcement from either the State of Washington or Federal Government.

While aquaculture presents many threats, it also has been essential in keeping the fishing traditions of the Lummi people alive.

Due to habitat destruction, previous management practices by state and local governments, climate change, and many other reasons, the fish populations in the Salish Sea have been decimated and are a fraction of their historic levels.

In order to maintain even the most meager of fisheries, my people have relied on fin fish and shellfish hatcheries to maintain our way of life and provide for our families.

Lummi Nation started the hatchery program in 1969, but it wasn't until 1975, the year after the Bolt decision, that the hatchery program shifted to focus on releasing juvenile salmon to enhance the water surrounding Lummi Nation.

Today, the Lummi Nation has become one of the major producers of Chinook and Coho salmon in the Salish Sea. Hatcheries are an important part of aquaculture and when done correctly can help to supplement wild fish populations, provide a resource for tribal and non-tribal fishermen, and an important food source for endangered species, such as orcas.

Under Phase 2 of the Bolt decision, hatchery fish are treaty fish, mitigation for lost habitat. It is both the treaty and trust responsibility of the Federal Government to ensure that future aquaculture policy both support and enhance our Nation's hatchery infrastructure.

Under the United States Constitution, our treaty with you is the supreme law of the land and a healthy Salish Sea is essential to our treaty rights, our identity as a people, our culture, and our way of life.

Thank you for this opportunity to testify, and I look forward to answering any questions.

[The prepared statement of Mr. Julius follows:]

PREPARED STATEMENT OF JEREMIAH (JAY) JULIUS, CHAIRMAN, LUMMI NATION

Chairman Wicker, Ranking Member Cantwell, members of the Committee, thank you for the opportunity to testify on both the threats and benefits of offshore aquaculture.

Located in the Northwest corner of Washington State, the Lummi Nation and its people represent the largest fishing tribe in the country. Since time immemorial the Lummi people have relied on the Salish Sea and the fisheries it provides for ceremonial, subsistence and economic purposes. Our lives and culture depend on the health and sustainability of its resources and our right to harvest these resources is protected by our treaty with the United States. Native salmon stocks are already under tremendous pressure and struggling to survive. Habitat destruction, pollution, lack of forage fish are but a few of the threats facing salmon.

In August of 2017, an environmental disaster took place in the Salish Sea and directly impacted the Lummi Nation. The desires of a foreign corporation, Cooke Aquaculture, to negligently exploit our waters lead to the massive release of a pollutant, approximately 240,000 Atlantic salmon, an invasive species, into our waters. The Lummi Nation incurred significant expense in trying to clean up the mess created by Cooke. We declared a state of emergency, and it was literally all hands-on deck as our fishing fleet stopped everything they were doing to capture the Atlantic Salmon and clean up the spill. It's important to note, this industry was operating in our waters without our consent. This industry has the potential to adversely impact our ability to exercise our treaty-reserved rights.

Having seen firsthand how poor aquaculture policy can threaten fragile ecosystems and endangered fish stocks, I have several suggestions on principles for future aquaculture policy.

First, the rights of treaty tribes need to be protected. It is not uncommon for aquaculture facilities to be sited in areas that are an integral part of the usual and accustomed fishing places of the Lummi Nation. Consequently, as part of the permitting process for these facilities, the Federal government is required to ensure that treaty rights are not abrogated or impinged upon by any permitted project. This right was recognized by the Federal courts who, in *Northwest Sea Farms v. United States Army Corps of Engineers*, blocked the permitting of an offshore aquaculture facility because of its potential impacts on treaty fishing rights of the Lummi Nation.

Second, there should be a ban on non-native finfish aquaculture. The risks of disease, pollution, predation and interbreeding are far too great, particularly in my region where we are struggling to recover native species. Certain forms of net pen aquaculture externalize the true costs of the industry while ensuring that a few multinational corporations reap tremendous economic benefits while endangering our way of life. Nutrient loading (phosphorus and nitrogen), toxic heavy metals, predation, competition, colonization and disease all accompany certain forms of net pen aquaculture.

Third, regional differences and priorities need to be respected. While full scale offshore aquaculture may be acceptable in some regions of the country, it is not appropriate in many regions, including the waters where my people fish.

Finally, there needs to be strong environmental protections and enforcement of those laws. The Cooke disaster happened because of weak laws and little or no inspections or enforcement from either the State of Washington or Federal Government.

While aquaculture presents many threats, it has also been essential keeping the fishing traditions of the Lummi people alive. Due to habitat destruction, previous

management practices by state and local governments, climate change, and many other reasons, the fish populations in the Salish Sea have been decimated and are a fraction of their historic levels. In order to maintain even the most meager of fisheries my people have relied on finfish and shellfish hatcheries to maintain our way of life and provide for our families.

Lummi Nation started a hatchery program in 1969, but it wasn't until 1975, a year after the Boldt Decision that the hatchery program shifted to focus on releasing juvenile salmon to enhance the waters surrounding Lummi Nation. Today, the Lummi Nation has become one of the major producers of Chinook and Coho salmon in the Salish Sea. Hatcheries are an important part of aquaculture, and when done correctly, can help to supplement wild fish populations, provide a resource for tribal and non-tribal fishermen and an important food source for endangered species, such as Orcas. Under Phase II of the Boldt Decision, hatchery fish are Treaty fish, mitigation for lost habitat.

It is both the treaty and trust responsibility of the Federal government to ensure that future aquaculture policy both support and enhance our Nation's hatchery infrastructure.

Under the United States Constitution, our Treaty with you is the Supreme Law of the Land and a healthy Salish Sea is essential to our Treaty Rights, our identity as a people, our culture, and our *Sche lang en*, our way of life.

Thank you for the opportunity to testify and I look forward to answering any questions.

The CHAIRMAN. Well, thank you very much.

I think the testimony has been very, very interesting and thought-provoking.

Ms. Cornish, Mrs. Wicker and I are expecting our seventh grandchild in 5 weeks. I'm intrigued that if moms eat seafood twice a week, babies have higher IQ. Do we still have time to talk to my daughter-in-law?

Ms. CORNISH. You do, Senator Wicker. It starts with the moms that are expecting but also kids as they're born, if they eat seafood, there's a new study coming up, in fact we'll publish press on it today, that kids up to 18 still receive benefits from eating seafood at least twice a week.

The CHAIRMAN. And kids up to age 60 and 70, also.

Ms. CORNISH. Still helps.

The CHAIRMAN. Well, it does sound like this is a way to alleviate the striking lack of seafood intake that we have as Americans and clearly there's a lot that needs to be done.

Let me ask. I think, Chairman Julius, you raised a lot of issues there. You wouldn't have had the invasive species grown there at all. I understand your testimony.

How could the aquaculture business have been more careful in preventing this escape into nature?

Mr. JULIUS. I think the carefulest way is no bringing of invasive species in our waters, period.

The CHAIRMAN. I understand that, but were they careless in the type of nets or was this an accident? Was it a weather event?

Mr. JULIUS. Yes.

The CHAIRMAN. How did that happen?

Mr. JULIUS. So 3 days following the net pen collapse, the state was not aware. They left voice mails in the government office machines and they came out with a press release saying that the solar eclipse created high tides.

The CHAIRMAN. How soon were you aware of the collapse?

Mr. JULIUS. We weren't aware until the Tuesday, three days following the collapse, and it wasn't confirmed until Wednesday when we went out there ourselves and witnessed it.

The CHAIRMAN. OK. Right. Well, then let me ask you, Dr. Doremus, and then maybe skip on to academia here.

If NOAA is the lead agency, how are we going to resolve this conflict, avoid it, and facilitate conversations between the stakeholders and at what stage of the process should NOAA engage with local communities, such as fishermen and tribes?

Dr. DOREMUS. Thank you, Senator. The range of stakeholder consultations are indeed very broad. We are accustomed to working in the wild capture sector with states, with tribal authorities, with industry, and many other environmental stakeholders that care about how we steward our resources.

As I indicated earlier, in many respects, aquaculture really starts with siting and that's the most important stakeholder-driven process. We've innovated new tools to make that process work well, such as ocean reports, as I cited in my testimony, and we think that with those kinds of science-based decisionmaking aids that we can bring the right people to the table, all the authorities involved, and the multiple users of the ocean resources to early in the process decide where and what ways do we want aquaculture in a given region.

As Chairman Julius noted, one major consideration, for example, is what species are allowed in the region and a significant way to mitigate risks from escapement is to focus on a naturalized or native species, and this indeed has been NOAA's policy. It has been our policy statement around aquaculture for many years and it seems to be a strong trend in the thinking of how best to do responsible aquaculture.

Those discussions happen right up front and I think through that degree of collaboration, we would see significant mitigation of the conflicts that you cited.

The CHAIRMAN. Dr. Halpern, what are you learning at the University of California about this issue?

Dr. HALPERN. About the issue of siting or about the issue of—

The CHAIRMAN. Of solving the conflict between potential job creators in aquaculture and the concerns and interests of the local fishermen and tribes.

Dr. HALPERN. Well, there are two parts to it. One, as I said in my testimony, there's so much potential in such a small space, it creates a lot of opportunity to think strategically about where to site aquaculture in a way that minimizes any potential conflict with other stakeholder users.

But in the end, it's a policy decision and a social decision, not a scientific one, about what kinds of species and operations we want in any particular waters. So the science absolutely can inform what potential risks there might be and what potential opportunities there are, but in the end, it's a social and policy decision.

The CHAIRMAN. Show of hands. We've had testimony that we're just not going to be able to increase the amount of traditionally caught seafood for Americans.

Does everyone agree with that? Show of hands.

[Show of hands by all witnesses.]

The CHAIRMAN. OK. All right. I think that was Chairman Julius' testimony. Thank you to our witnesses.

I'll recognize my friend, Senator Cantwell.

Senator CANTWELL. Thank you, Mr. Chairman, and recognizing, you know, how important this issue is to you and to, you know, our colleagues, I would again say that I feel like the Washington experience shows the both positive aspects and some very negative aspects.

As I said, our shellfish industry has done tremendous work and while most people in this Washington wouldn't know a darn thing about a geoduck, I guarantee you the Asian market is consuming it at a very high price.

So there are benefits, but Chairman Julius' comments show the great risk and how we didn't have an appropriate response from NOAA and that in a bipartisan way, if I'm correct, Mr. Chairman Julius, I think, in fact, it was the Republicans who led the way in our state legislature to just shut down the non-native aquaculture that existed in our state and the reason is we have more than 15,000 fishing jobs and we have recreational fishermen and they weren't having it. They just weren't having it.

And so I guess I'd go back to you on this point about the risk to the fishing economy that exists in both tribal and non-tribal parts of our region, why they felt so threatened by this collapse and catastrophe and why those fish, those non-native fish were such a threat to the already endangered runs of salmon.

Mr. JULIUS. Yes. It's quite broad what led up to it and this legislation. Sport, state, and tribal fishermen struggle right now. Underfunded hatcheries, hatcheries have produced and provided for a long time and now you've seen a major cut in hatchery funding while tribes have severely increased funding or heavily increased funding, trying to build and continue to build the hatchery runs.

So when the cleanup took place, sport fishermen, when we arrived onsite, sport fishermen were notified before everyone, including tribal fishermen. Their attempt to pull these out of the water was unsuccessful because they had fed on—I'm not sure, for lack of better terms, cat food form all their lives. So that's all they'd known. They adapted after a couple weeks when they were caught in rivers 25 miles up, local rivers. They figured it out how to hunt after a short period of time but immediately after the collapse, they couldn't hook them.

So for many reasons, I think leading up to this, you know, look at the situation with the orcas and the Southern resident killer whales. There's a major—we're at a major tipping point right now for the survival of the Salish Sea as a whole, all that call it home, and the rivers, the health of the rivers and the tribes.

Senator CANTWELL. Thank you. And so do you have any idea how many people work at that particular Cook site?

Mr. JULIUS. I want to say it was 50s, 58 maybe or total.

Senator CANTWELL. Yes. So 58 people versus 15,000 and that's not even including, you know, the diversity of our fishing economy downstream.

OK. So one thing I wanted to say, Dr. Doremus. So this is why we want money for stock assessments. This is why we want better fisheries management. I don't agree that we can't do better on creating more wild fish. We already heard about the hatchery programs.

This is going to be a challenge. This is not an either or question but we shouldn't be negligent in understanding the risk that this poses to our native sources of salmon in the Pacific Northwest which is just vital. I can't even say how vital it is to the Northwest economy and to say nothing of the larger economy in Washington, Oregon, and Alaska.

So one thing I've also been impressed with is this issue, what I would call just scraps, the notion that the tribe seafood industry has now created a seafood pasta that's 10 grams of protein, or the fact that they're using the whole fish in fish powder, which I think we need to do a little bit more research on as we look at fishing protein issues on a global basis.

Why shouldn't we just up the R&D budget on all of these things, in addition to this discussion we're having today?

Dr. DOREMUS. Thank you, Senator. I think you're absolutely right to point out that it isn't fully an either or situation.

Our approach to seafood competitiveness and trying to improve the prospects for U.S.-produced seafood is a holistic approach. It involves ways in which we can enhance output from our wild capture fisheries. You pointed to several very important things that we can continue to work on, full utilization of product.

There are also issues around underutilized species. There's areas where we are capturing under quota. So we're not—AR fishermen are not selling at a level that is sustainable. All of these things are very, very much a focus of the National Marine Fisheries Service and are a complement to our focus on aquaculture.

We do believe on a global basis, looking fundamentally, supply and demand, that the amount of increased wild capture output is not going to be sufficient to meet demand, either U.S. or globally, and a balanced approach that can foster really responsible aquaculture, that can deal with risks, like the escape risk that you've pointed to, through close industry-government collaboration, improved engineering, risk management techniques, as the Chairman pointed out, species selection, all of these kinds of issues are ways that governments can collaborate with industry to reduce the risk of these kinds of problems.

In fact, for the countries that do report escapes, like the U.S.—

Senator CANTWELL. I'm over my—

Dr. DOREMUS. I'm very sorry.

Senator CANTWELL. I'm sorry. I'm over my time. So I want to let my colleagues, but I just want to make clear, too, that I'm also a believer in exporting Magnuson-Stevens as a policy around the globe.

If we're going to embrace this notion of aquaculture, we should also be embracing that the rest of the world can do very well and we can benefit from it, as well, of helping them understand fisheries management. What is sustainable fisheries management?

Dr. DOREMUS. Senator, I couldn't agree more. We do seek to do that and we would love to see the U.S. get in the position of being able to do the same for the aquaculture sector, set a high bar, sustainability-oriented, and hold the world to that standard.

Senator CANTWELL. Thank you.

The CHAIRMAN. Thank you. I would note that there will be a series of four votes on the Floor beginning at 11. So we're going to do our best to be mindful of that, too.

Senator Blumenthal is next.

**STATEMENT OF HON. RICHARD BLUMENTHAL,
U.S. SENATOR FROM CONNECTICUT**

Senator BLUMENTHAL. Thank you, Mr. Chairman.

My apologies for missing a part of the hearing. As you may know, we have a lot of hearings going on, usually and especially so this morning.

I would like to ask about state preemption for offshore aquaculture farms that will affect operations in state waters, the interplay between Federal and state laws and regulations.

I understand that the topic for today's hearing is offshore aquaculture in Federal waters, but obviously there are no real enforceable boundaries between Federal and state waters and the two are inextricably linked.

In New England, our state borders are situated in close proximity to each other, making the need for cooperation and coordination all the more necessary. The Federal Government really has to take into consideration the concerns of local and state governments when making decisions about offshore aquaculture and it should encourage cooperation among the states.

What process do you think should be in place for state and local stakeholders to engage on these issues? How can NOAA, for example, effectively address state and local concerns about offshore aquaculture farms which undoubtedly would have an effect on state waters?

Dr. DOREMUS. I'd be happy to answer that, Senator, and thank you for the question.

We do collaborate very closely with the states in the management of wild capture fisheries and would have very much the same approach to working with the states in decisions around permitting for aquaculture facilities in Federal waters off state boundaries.

So we think that there are tools for planning and for engagement not only at multiple levels of government but with multiple stakeholder communities who currently use or have interest in using ocean resources and we've put considerable investment into tools that would facilitate that decisionmaking and we have a very deep commitment to that process.

We also have experience through existing mechanisms, such as the Coastal Zone Management Act, to ensure consistency between permitted activities in Federal and in state waters. That offers at least one model where a Federal agency really can't authorize an activity without the approval of the states and that is one mechanism. There may well be others, but that is certainly one mechanism that we have a lot of experience with and in my estimation has worked very well in helping to coordinate state-Federal activities in ocean space.

Senator BLUMENTHAL. Do you think states ought to have the option to opt out of the development of an offshore aquaculture facility if it disagrees with the priorities that are set forth in the Coastal Zone Management Plan?

Dr. DOREMUS. There have certainly been discussions of how states could ultimately opt out. The only observation I could make is that we need to make sure that whatever mechanism is put in place to ensure consistency between state preferences, state needs, and Federal offshore activities is done in a way that provides consistency and predictability for industry.

I do think that one of the main things that has been well mentioned in testimony here today, the uncertainty around the regulatory environment has been a major barrier to investors and to the growth of the aquaculture industry.

So whatever mechanism is used, if it can be done in a way that provides a stable and consistent and predictable regulatory environment, that would be most effective.

Senator BLUMENTHAL. Ms. Unger, you are sort of the representative here from the corporate side, and I notice in your testimony, you give as the reason for the lack of investment and involvement in aquaculture, and I'm quoting, "There is no clear regulatory framework for the permitting, enforcement, or management of offshore aquaculture in Federal waters." Why is that?

Ms. UNGER. I truly believe that what's missing is something like the AQUAA Act that Senator Wicker has brought forward, so that we have comprehensive legislation that addresses questions, such as whether or not to allow native species and what kind of enforcement needs to be in place, what kind of supervision we need to give to help prevent bad actors, what kind of investment must be had in terms of the equipment and the technology to help prevent escapes.

All of those things won't be dictated specifically in this but generally can be addressed in a comprehensive aquaculture act and it really does need to be nationwide and comprehensive so that we know what the standards are and we have the opportunity to do it right.

Senator BLUMENTHAL. Do you think others, like Cargill, and I assume you're speaking for your company here,—

Ms. UNGER. And Stronger America through Seafood.

Senator BLUMENTHAL.—would be joining in this effort? In other words, would the private sector strongly support and would there be dissenters?

Ms. UNGER. Cargill 100 percent supports a thriving aquaculture industry in the United States and I think that we have the ability, because we're starting from scratch here now to benefit from the decades of aquaculture that have existed in other developed countries and we see industry investing in that heavily.

The example I gave, while I think you were out, was that of Pacifico which went south into Ensenada in order to invest in aquaculture specifically because of the lack of clarity here in the United States. Industry stands ready to support.

Senator BLUMENTHAL. Thank you. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator Blumenthal.

Senator Young.

**STATEMENT OF HON. TODD YOUNG,
U.S. SENATOR FROM INDIANA**

Senator YOUNG. Ms. Unger, I'm going to pick up on that line of questioning—

Ms. UNGER. Yes, sir.

Senator YOUNG.—momentarily, but I appreciate you being here.

I happen to be incredibly excited about the possibilities not just for individual Americans but for people worldwide as it relates to farmed seafood and the continued growth of the U.S. aquaculture industry.

As I understand, we're Number 14 in the world. My sense is the United States can do much better than that. You've indicated that by your estimates, a mere doubling of U.S. aquaculture's industry would lead to 50,000 jobs, roughly. It would, of course, benefit our ag sector and many of our rural communities. It would give our soy farmers in particular another outlet for their crops. It would reduce our environmental footprint and, of course, you know, there are market forces at play here.

To the extent you have seafood that grow at a more rapid rate in a controlled environment that increases the supply, that decreases the price, that increases accessibility for a very healthy product to improve the health and wellness of our citizens and to feed the world.

The United Nations indicates that global food production will have to double by the year 2050 at which time no new land will be available.

So we, America, through the private sector in particular can help lead the way in helping to address some of these challenges and seizing opportunities.

In Indiana, we have a facility I visited not too long ago located in Delaware County, the town of Albany, where we had production which started of GE salmon at a now defunct or formerly defunct fish facility. This has saved taxpayer dollars. This has led to the creation of 160 jobs, and they're already in production.

This type of salmon grows to market size in 16 to 18 months as compared to traditional, you know, few years, but they faced over 20 years of regulatory review before receiving approval in 2015.

The last regulatory hurdle was removed earlier this year and since then, great things have happened in Albany, which I mentioned. We have 160,000 healthy fish that are now swimming in very safe, controlled environments in landlocked tanks.

Albany's become an innovative example about what I sense will continue to occur if we get the regulatory environment right around the country. They're helping with jobs and wages. They're helping with upward economic mobility. They're helping with health and wellness, all the stuff we talk about around here. Environmental sustainability.

Unfortunately, knowing that an approval could take 20 years constrains investment and communities in Indiana and across the Nation who are looking to get involved in aquaculture may not do so with that regulatory environment continuing the way it is.

So I may ask you to recapitulate something you just discussed, but I think it's really important. Your reference to Pacifico Aquaculture, which is headquartered in San Diego, and you explained

that they've decided to take their business to Mexico due to our cumbersome, uncertain, and chaotic permitting process around aquaculture.

In your opinion, how should the U.S. react to this regulatory uncertainty? I know the Chairman has introduced his AQUA Act, which it sounds as though that will mitigate any of the concerns of the industry and with the investors.

Tell us about the benefits of that and anything else we might do to reduce regulatory uncertainty.

Then secondarily, maybe you could explain what are the implications for inaction.

Ms. UNGER. OK. I'm going to try to answer all of that in one go here.

I think first, one of the things that you make me think of is the importance and the need that Americans want of transparency and choice and options with respect to the seafood that they consume and I think that by producing our seafood here, we provide the ability through the AQUAA Act to produce that seafood here and give Americans transparency, choice, and options with respect to the aquaculture that they have, including the farm that you mentioned there, and so people can choose how they want to spend their dollars.

I think that producing here is important because we are going to continue to consume aquaculture. We will continue to consume seafood. We'll consume as much wild catch as we can, but it cannot keep up with the global growth in the human population and the need for that healthy seafood, and if we don't produce here, we will simply continue to import and I heard we are 16th. You mentioned 17th. You mentioned 14th. No matter what the number, we're not where we need to be and we're not taking advantage of the resources that we have at our disposal.

Senator YOUNG. Thank you. I look forward to working actively with the Chairman and others who seem to be providing constructive solutions to address the permitting challenges.

Thank you.

The CHAIRMAN. Thank you, Senator Young.

Senator Sullivan is next.

**STATEMENT OF HON. DAN SULLIVAN,
U.S. SENATOR FROM ALASKA**

Senator SULLIVAN. Thank you, Mr. Chairman, and thank you for holding this hearing, and the witnesses, thanks for your excellent testimonies.

It's a very important issue, I think, for a lot of our states, certainly important issue for my state. You know, on this committee, I like to mention that my state is the super power of seafood, the state of Alaska. We have almost 60 percent, close to 60 percent of all the commercial, recreational subsistence seafood harvested in the United States comes from Alaska's waters. So this is a very important issue.

Close to 60,000 of my fellow Alaskans are employed in this industry and I was honored to have the Chairman out in Alaska this August seeing some of the different aspects of the Alaska fisheries

industry, which was a great visit. Thank you again, Mr. Chairman, for coming.

But, you know, since 1990, fin fish aquaculture has been prohibited in Alaskan waters. However, Alaska does choose to allow certain forms of aquaculture, such as salmon fishery enhancements through hatcheries, aquatic farming of shellfish and seaweeds.

So what I wanted to ask first of Dr. Doremus is the resources that NAMSA, NOAA have to just manage fisheries writ large as currently exist are strained. We think, you know, our fisheries commonly referred to as the best-managed, most sustainable fishery, the Alaska fishery probably in the world, but that takes data, that takes science, that takes the ability for sustainable stocks.

Do you worry that a full development of offshore aquaculture would compete for the limited funds that NOAA and NAMSA have to already manage fisheries such as those in Alaska, and has there been thought to the development of some sort of cost recovery program, similar to commercial fisheries, in an effort to self-fund portions of what would be significant Federal financial need?

Dr. DOREMUS. Thank you, Senator. We have ultimately to look to Congress for deciding on the allocation of resources on the different components of the seafood sector that we address.

We certainly understand our core requirement around continued surveys, stock assessments, and enhancing the science required to sustainably manage our living marine habitat.

Senator SULLIVAN. And I think most of these Senators on this committee fully support that. I certainly do, and I've been a huge advocate for you all to be fully funded to do that mission, critical mission. We just don't want that to be undermined.

Dr. DOREMUS. We can't thank you enough for your support and we don't want that to be undermined either. We do view ultimately complementarity between these two parts of the seafood world and we'd like to approach this in as holistic and balanced manner as possible. We don't foresee the need—certainly you're very clear on this—to reduce existing levels of support on the wild capture side. That is no one's intent at all.

Senator SULLIVAN. Good. We wouldn't be supportive of that.

Dr. DOREMUS. I understand, sir, and thank you for your continued support there. We do think a lot of things like the regulatory improvements are major improvements that can be made with very modest resource levels and we stand ready to work with the Committee and others on assessing requirements for sustainable and responsible management of aquaculture.

Senator SULLIVAN. Let me follow up on Senator Blumenthal's questions relating to state interests and, Chairman Julius, I want to compliment you on your testimony. I think a lot of what you raised are concerns that I share in what's happened, particularly with regard to the issue of more localized interest, and the regional differences, as you mentioned, that need to be respected. I think that's a very important point.

Senator Blumenthal highlighted this with the idea of kind of an opt-out provision or an exclusion provision as it relates to states and the important issues that you raise with regard to tribes, and I think they're analogous in many ways.

I'd like just very quickly for you and Dr. Doremus, also, to just talk about the importance—I think it's an important concept here to be able to have regional differences, the potential for states, like mine, to have very, very strong interest in healthy fisheries, to be able to opt out in areas where they think it can't be managed.

Dr. Doremus, I know you weren't trying to say this, but your response to Senator Blumenthal kind of indicated that the interest of industry might trump those of states and I certainly hope that's not the view that you were taking.

But, Chairman Julius, can you just comment a little bit further on your testimony and your thoughts on this?

Mr. JULIUS. Absolutely. Thank you, Senator. Like yourself and like your state, Washington, before it was the Apple State, was the Salmon State and for a number of—

Senator SULLIVAN. My state is still the Salmon State.

Mr. JULIUS. Yes, yes. And if ours could be, we would love that to be our reality again.

When we entered into the treaty 164 years ago, that was our reality and that's what we secured it. I was important for us to maintain that.

New settlers who came in always wrote about the fact that they could walk across the backs of the salmon on every river, my river, the Nooksack, the Skagit, the Fraser just north of us, which we rely heavily on. Today, we're faced with water quality standards. How much fish can you consume per week without being harmed or how high do the increases of cancer go if you consume more than one a week, 175 grams a week? You know, what does that increase do?

Those are the realities we live with right now. EPA's now looking to lower those standards even more than what we agreed upon in 2016. Those are some of the things we face with the pollution and salmon's directly tied to the contaminants that are dumped into the Salish Sea for jobs and for corporations and industry, but those are some of the things we face today and those are our reality.

While we can eat five times a week salmon, king salmon and things like that, there are extreme dangers that we live with today. That is our reality with the cancer risks and things like that from water quality standards.

So, you know, I'll keep it short, but, you know, those are some of the things we face, what it was yesterday, what it is today. I think if we can restore habitat, I think if we can, you know, work together, come together to bring back what the Creator gifted us with since time immemorial and look at where we're at today, I think we could feed this country with what the two states used to produce and could produce if we can focus some intention on that because bringing in net pens and things like that for yourself, for Washington State is kind of a slap in the face when we know that we have the ability to produce with the natural, the rivers and the streams. We just need to work on that together.

Senator SULLIVAN. Thank you, Mr. Chairman.

The CHAIRMAN. Well, thank you.

Senator Markey, you are next on the list. Let me announce that the Floor has advised Senators that they're not going to be as flexible with holding votes open today as they've been in the past.

So with that in mind, Senator Markey, you are recognized.

**STATEMENT OF HON. EDWARD MARKEY,
U.S. SENATOR FROM MASSACHUSETTS**

Senator MARKEY. Thank you, Mr. Chairman, and thank you for your flexibility in allowing me to ask questions at this time.

Last month's IPCC Report on the Ocean in a Changing Climate found that the maximum sustainable catch of global fisheries could decrease as much as 25 percent by the year 2100. Warming ocean waters are already causing our wild fish populations to migrate north and making it more difficult for cod stocks to rebuild. The Gulf of Maine is the fastest warming body of water behind the Arctic and New England fisheries are ground zero.

Dr. Halpern, I have a few questions to get through, so please answer with a simple yes or no.

Do you agree that wild fisheries are currently being affected by climate change?

Dr. HALPERN. Yes.

Senator MARKEY. The IPCC report also illustrates how climate change threatens aquaculture and shellfish. When carbon dioxide dissolves in water, it reacts to form acids that can be lethal to baby oysters, mussels, and scallops that we love in New England. It prevents them from forming their shells. The shellfish industry is a crucial economic driver for our coastal communities.

For example, in 2017, over \$511 million worth of scallops were landed in the United States, mostly in New Bedford.

Dr. Halpern, would you agree that climate change and greenhouse gas emissions adversely affect shellfish?

Dr. HALPERN. Yes.

Senator MARKEY. The IPCC report also found that kelp forests and other sensitive ocean ecosystems are also at high risk if global warming exceeds 3.6 degrees Fahrenheit.

Dr. Halpern, do you agree that climate change can hurt kelp and seaweed farms, a form of aquaculture?

Dr. HALPERN. Yes, if they're not able to move.

Senator MARKEY. Climate change will only continue to exacerbate warming waters, ocean acidification, harmful algae blooms, the spread of diseases, and storms that could increase the risk of fish escapes from aquaculture pens. We need to sustain the wild-caught fisheries and shellfisheries we already have by taking action on climate and supporting our fishermen and women.

We also need to understand the environmental risks of aquaculture and how they might interact with climate change before opening up all Federal waters to this industry.

Mr. Julius, you spoke about the devastating effects of climate change, habitat destruction, and other threats on the fishing traditions of the Lummi people.

Do you agree that we must account for climate change in supporting wild-caught fisheries in developing any aquaculture?

Mr. JULIUS. Yes.

Senator MARKEY. As Congress considers, Mr. Chairman, ways to expand aquaculture and support the \$200 billion fishing industry, climate change must be a central part of the conversation to avert the worst of these effects on our entire seafood industry.

We need to take climate action now. We know that the more acidity in the ocean, the greater the change, the greater the impact is going to be on each and every one of the subjects that we've been talking about here today.

My hope is that this warning that we received from the IPCC will only accelerate the time in which we begin to realize that we're endangering industries that we never associated historically with this threat of global warming, but the evidence is now incontrovertible that it does.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much, Senator Markey.

I want to thank our very knowledgeable and articulate panel of witnesses.

I would like at this point, without objection, to submit a letter written by several fisheries scientists entitled *Advancing the Quality and Understanding of American Aquaculture Act*, to be included in the hearing record and that will be done at this point in the record without objection.

[The letter referred to follows:]

THE CENTER FOR A LIVABLE FUTURE
JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH
Baltimore, MD, December 17, 2018

Senator ROGER WICKER,
Dirksen Senate Office Building,
Washington, DC.

Senator MARCO RUBIO,
Russell Senate Office Building,
Washington, DC.

Disclaimer: The opinions expressed herein are our own and do not necessarily reflect the views of The Johns Hopkins University.

RE: Senate Bill 3138: The "Advancing the Quality and Understanding of American Aquaculture Act" or "AQUAA Act"

Dear Senators Wicker and Rubio,

We are researchers at The Johns Hopkins Center for a Livable Future, based at the Bloomberg School of Public Health in the Department of Environmental Health and Engineering. The Center engages in research, policy analysis, education, and other activities guided by an ecologic perspective that diet, food production, the environment, and public health are interwoven elements of a complex system.

We are writing to share our concerns and provide pertinent information regarding Senate Bill 3138, the "Advancing the Quality and Understanding of American Aquaculture Act" or the "AQUAA Act." Aquaculture, or farmed seafood, plays an important and growing role in our global food system, providing more than half of the seafood consumed globally,¹ and there are potential economic opportunities and benefits for nutrition and sustainability associated with expansion of some types of aquaculture. At the same time, robust oversight of aquaculture operations is needed to minimize negative impacts on ecosystems and public health.

The AQUAA Act aims to establish a regulatory system and permitting process for offshore aquaculture in the Exclusive Economic Zone (*i.e.*, Federal waters) and fund research and development to advance the aquaculture industry. Offshore aquaculture operations may produce molluscan shellfish (*e.g.*, oysters, mussels, clams, and scallops), seaweed (*e.g.*, kelp, nori), and/or fish. Molluscan shellfish and aquatic plants have fewer potential environmental impacts compared to fish because they do not require feed inputs or receive disease treatments in open water. They also take up nutrients, such as nitrogen and carbon, from the water column.

Fish production in coastal or nearshore waters poses additional challenges compared to seaweed and molluscan aquaculture, and moving fish production to an offshore setting involves a developing type of aquaculture that is not fully characterized. Although over half of the seafood consumed globally is farmed, fish farmed in marine settings contributes 8 percent of farmed seafood (excluding plants) and almost all of this production currently takes place in coastal settings.¹ Ongoing chal-

Challenges in coastal fish production include fish escapes, disease transfer among farmed and wild fish, use of veterinary drugs to treat infectious diseases in farmed fish, and release of fish waste into the environment; additional details on these problems are provided below. The environmental and public health risks associated with coastal fish production are likely transferable in some ways to offshore aquaculture. It is critical that expansion of the aquaculture industry to offshore waters be accompanied by comprehensive, robust, and transparent oversight to address uncertainty and prepare for unforeseen challenges that will need to be addressed by regulators and the industry.

Coastal Fish Production: Ongoing Challenges

The following section provides information about pressing challenges in coastal fish production that are highly relevant to the emerging offshore fish aquaculture industry. For a full summary of these issues, please refer to our 2018 Science Brief: *Ecosystem and Public Health Risks from Nearshore and Offshore Finfish Aquaculture*.² We provided similar information in a comment submitted to the National Oceanic and Atmospheric Administration (NOAA) in 2014 regarding the proposed Fishery Management Plan for Regulating Offshore Marine Aquaculture in the Gulf of Mexico.³

Occupational Health and Safety

Working in the near- or offshore aquaculture industry (including molluscan shellfish and seaweed production) incorporates elements from multiple occupational fields, including agriculture, commercial fishing, and commercial diving, all of which have high rates of injury, illness, and death for workers.^{4,5} In general, occupational risks for aquaculture workers in various settings include electrical shock; drowning; slips; trips; falls; sprains and strains; machinery-related accidents; fires; explosions; and exposure to chemicals, infectious pathogens, and veterinary drugs.^{4,5} Offshore aquaculture workers may face increased risk for accidents resulting in injuries or deaths compared to onshore aquaculture workers due to the challenging setting. Recent research in Norway and Australia found elevated rates of injuries among aquaculture workers compared to other industries.^{6,7} Despite the unique combination of risks these workers face, countries, including the United States (U.S.), continue to rely on existing laws that do not adequately protect aquaculture workers rather than passing new regulations specific to these challenges.^{8,9} In a 2014 analysis of U.S. policies, we identified a critical regulatory gap for occupational safety and health for aquaculture workers in Federal waters. We found that the Federal Occupational Safety and Health Act does not apply to offshore aquaculture operations in Federal waters due to limitations in jurisdictional authority.¹⁰

Fish Escapes

Farmed fish escapes remain a perpetual issue for coastal fish aquaculture in the U.S. and abroad. Several million farmed fish escape net pens across the globe every year, with significant economic losses to producers.¹¹ Large escapes have been documented in recent years in Europe and Canada,^{11,12} and in August 2017, approximately 160,000 farmed Atlantic salmon escaped from net pens in Washington State.¹³ The success rate of catching escaped fish and returning them to the farm are very low, averaging around 8 percent according to one study.¹⁴ These farm escapes can pose ecological risks in the short- and long-term when escaped fish compete for food or resources with wild populations, and/or establish a population in the wild on their own or by breeding with wild fish.^{15,16}

Disease Pressures and Treatments

Disease burden associated with parasites, bacteria, and viruses is a significant consideration for the aquaculture industry, with the associated economic losses related to disease treatment and the culling of sick or dead fish, and also for wild fish populations. Disease outbreaks on near- and offshore aquaculture operations can spread to wild fish populations, and vice-versa.¹⁷ Veterinary drugs, including antibiotics and antiparasitics, and their residues have been found in surrounding ecosystems.^{18,19} Many producers have used vaccines to prevent specific diseases and reduce the need for antibiotics. Norway, the world's largest producer of farmed salmon, is an example of a country that has utilized vaccines and other methods to reduce their use of antibiotics. At the same time, the salmon industry in Norway and other countries have a significant and ongoing problem with sea lice, a parasite.^{20,21} Sea lice infestations have resulted in rising production costs due to mortalities and the cost of antiparasitic treatments, and treatments have led to wide-spread resistance among sea lice. In

2016, the Norwegian salmon industry experienced a 19 percent mortality rate in net-pens, mostly due to sea lice and other diseases.²²

Fish Waste

There is no system for collecting and managing animal waste from net-pens and cages in near-and offshore fish aquaculture. Instead, farms are ideally sited in areas with water flow that disperses fish waste. In some cases, fish waste accumulates in sediment below net pens and cages. Fish waste contributes nutrients into the surrounding environment; in 2010, marine fish aquaculture waste was estimated to contain 345 million kg of nitrogen and 50 million kg of phosphorus.²³ If concentrated in a water body, this nutrient loading can cause algal blooms, which lead to low oxygen levels and a 'dead zone' that kills fish and other marine animals.

These public health and environmental risks must be taken into account when considering establishment of this industry, and any development must be pursued in a careful manner with a high level of oversight and transparency.

The AQUAA Act places lead regulatory authority of offshore aquaculture with NOAA, within the U.S. Department of Commerce. Importantly, NOAA and the Commerce Department have explicitly stated goals to establish and grow marine aquaculture (*i.e.*, coastal and offshore).^{24,25} This regulatory structure could result in prioritization of industry expansion over protection of the environment and public health. The appearance of conflict of interest presented by these stated goals highlights the need to assign lead regulatory authority to another agency.

We should learn from experiences in other countries. Canada is the fourth largest producer of farmed salmon, and the Canadian Department of Fisheries and Oceans (DFO) has regulated aquaculture and also worked to support industry growth. A commission examined the country's aquaculture industry in recent years as part of an inquiry into a decades-long decline of sockeye salmon in the Fraser River, and the final recommendations included 13 focused on aquaculture. One recommendation called for a complete separation of industry regulation and promotion,²⁶ and DFO has begun to meet the directive.²⁷

Recommendations for the AQUAA Act

As written, the AQUAA Act lacks an appropriate framework or regulatory structure needed to prevent, monitor, and respond to the issues we describe above. Below, we offer recommendations for strengthening the proposed regulatory system for the offshore aquaculture industry in the U.S.

- Identify an agency to oversee safety and health for offshore aquaculture workers, and provide adequate resources to support efforts to i) monitor safety and health and ii) develop and deliver safety training for the industry. Develop a robust set of requirements for reporting of injuries, illnesses, and deaths to support surveillance. Data should also be reported to the Occupational Safety and Health Administration, and information should be accessible to researchers, with aggregated reports released annually.
- Increase requirements for monitoring and reporting to include monthly reports of fish stocking, fish biomass, feed use, veterinary drug use, escapes, and diseases. All information should be posted by regulatory agencies on a website accessible to the public.
- Require active environmental monitoring systems that test for fish pathogens, escaped farmed fish, nutrient loading, veterinary drugs, and drug resistant microorganisms in fish tissue and sediment samples. The monitoring system should be fulfilled by trained agency staff with cooperation from industry staff. This system should also incorporate assessments of specific regional impacts and pathways for remediation if all individual permitted sites are in compliance but problems are still present.
- Set limits in each category of environmental impact that, if exceeded, result in increased monitoring, penalties, and termination of permits.
- Develop specific requirements for adoption of new best management practices that will be developed while the operation is permitted. This is especially critical if the proposed permit duration of 25 years in the AQUAA Act is retained. Best management practices can include technology, equipment, husbandry practices, disease treatments, and other production practices.

²⁴NOAA has the specific goal of growing marine aquaculture 50 percent by 2020, and the Department of Commerce's 2018–2020 Strategic Plan includes a specific objective, Strategic Objective 2.1, to increase aquaculture production with a focus on marine aquaculture.

- For fish, limit acceptable species to native, non-genetically engineered species to reduce negative impacts resulting from fish escapes.
- Separate Federal regulatory efforts from aquaculture industry promotion to reduce potential conflicts of interest. Identify and charge another regulatory body with oversight responsibility and authority.

Thank you for considering our comments. Our oceans are a critical, shared resource and must be protected. To set the parameters for an offshore aquaculture industry in U.S. ocean waters that is highly sustainable and accountable, the AQUAA Act should set high standards at this important stage. We welcome the opportunity to discuss this further and answer any questions you many have. Please contact us at (410) 2231811 or by e-mailing Dr. Jillian Fry, Director, Seafood, Public Health & Food Systems Project, at JFry3@jhu.edu.

Sincerely,

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The CHAIRMAN. The hearing record will remain open for two weeks. During this time, Senators are asked to submit any questions for the record. Upon receipt, the witnesses are requested to submit their written answers to the Committee as soon as possible but by no later than Wednesday, November 13, 2019. I hope that will be okay.

So at this point, we'll conclude the hearing again with the thanks to our witnesses. We appreciate you being with us today and this hearing is adjourned.

[Whereupon, at 11:20 a.m., the Committee was adjourned.]

A P P E N D I X

SPAT TECH
15 October 2019

Senator ROGER WICKER,
555 Dirksen Senate Office Building,
Washington, DC.

Senator MARIA CANTWELL,
511 Hart Senate Office Building,
Washington, DC.

Dear Chairman Wicker and Ranking Member Cantwell:

Spat Tech respectfully submits this statement to the record for the U.S. Senate Committee on Commerce, Science, and Transportation's hearing, "Feeding America: Making Sustainable Offshore Aquaculture a Reality." As a company operating at the intersection of coastal restoration, aquaculture, and technology, Spat Tech sees myriad opportunities for emerging aquaculture technologies to not only more sustainably feed America, but also to provide countless other ecosystem services that allow our coastal communities to function more resiliently in the face of climate change and other potential environmental harms.

Spat Tech is a Perkinston, Mississippi-based oysters-as-a-service company. We grow native oysters in our land-based facility for the purpose of replenishing existing oyster reefs and building new reefs to help restore the ecological balance of our coasts. Our first-of-its-kind zero discharge, environmentally friendly hatchery utilizes artificial salt water in a proprietary recirculating process and is capable of large-scale production needed for restoration-sized projects. Our aim is to replenish the once-vibrant oyster reefs of coastal America with high-quality oyster clusters. Ultimately, our process allows us to put healthy and resilient oysters into the marine environment—oysters that are capable of spawning naturally within 6 months of placement.

We recognize that certain aquaculture methodologies have been criticized and derided for their environmental impacts. Spat Tech has consciously taken a different approach. We conceive of aquaculture as one potential ecosystems service among many provided by oysters. A 2,000 basket project, for example, could result in 60 million oysters being placed in a single reef. This is equivalent to 300,000 sacks of oysters and is capable of filtering 3.6 billion gallons of water a day, providing habitat to juvenile fishes, and serving as a breakwater to protect coastal communities.

Unfortunately, technologies like Spat Tech's face some resistance from government and academia because the technology is, largely, unproven at scale. However, innovation is desperately needed—particularly when it comes to oyster restoration and aquaculture—because traditional methodologies are no longer as effective at restoring historic reefs. In order to truly realize the potential of technologies like Spat Tech, governments at all levels must have the ability to experiment with new technologies and to invest in innovative approaches. To that end, we encourage the Committee to advance legislation that provides sufficient funding for states to invest in and accelerate large-scale projects that allow private companies like Spat Tech to demonstrate the potential of their innovations.

According to a study recently published in the journal of Environmental Science & Technology, if Americans replaced ten percent of their meat consumption with oysters, the greenhouse gas savings would be equivalent to keeping nearly 11 million cars off the road. Certainly, America must contend with the significant land- and resource-use impacts posed by the production of land-based meats. Aquaculture provides one solution, but we cannot simply replace one land- and resource-intensive process with another. By developing technologies and approaches in which aquaculture is merely one benefit among many, we can ensure that we not only feed America but also improve environmental outcomes—to the benefit of our coastal communities.

We appreciate the opportunity to submit this letter to the record. Attached for your further information is a presentation providing more details about Spat Tech's

hatchery and process. We would welcome the opportunity to host you for a tour of our facility.

Most sincerely,

CHRISTIAN CANNON,
President,
Spat Tech.

Attachment



OBJECTIVE

- Replenish the amount of oysters in the water.
- Put more larvae in the water column at each natural spawn.
- Create seed grounds that are utilized as a resource.
- Build new reefs.

BENEFITS

- Create a habitat for migratory birds and waterfowl.
- Clean the water through oyster filtration.
- Recreational fishing area.
- Natural reproduction releases billions of oyster larvae into the water column annually.
- Break the wave energy to help conserve and protect the coastline.
- Repopulate existing reefs and to build new ones.

PROCESS

- Using proprietary processes, collect and nurture brood stock at our one of a kind, recirculating, artificial salt water, zero discharge hatchery.
- Collect eyed-larvae and seed them onto substrate, resulting in extremely high density concentrations of spat.
- Move the substrate to our nursery to allow them to grow in a natural environment for up to 90 days, before being put on designated project sites.

THE HATCHERY

Only known hatchery of its kind.

Zero discharge and environmentally friendly.

Utilizes artificial salt water in a proprietary recirculating process.

Capable of large scale production needed for restoration sized projects.



PROCESS

Collect, condition, and spawn brood stock.

Feed larvae and brood stock through our nutrition system.

Collect eyed larvae and seed onto substrate.

Move high density spat-on-substrate to our nursery and allow them to grow.

Put seed oysters onto the project.

Ability to feed out over 45 trillion cells of algae a day.



Growing algae to be fed to Spat-Tech larvae.

PROCESS

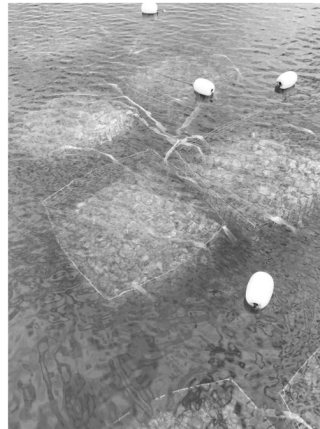
Utilize substrate to set oysters on. Currently using specially made concrete. Has evolved:

- Dried Shell
- Fossilized Oyster Shell
- Fossilized Shell

Cubic yard baskets are specially made to Spat-Tech specifications and filled with substrate. Lessons learned.

Eyed larvae are seeded into the baskets and allowed to grow naturally for up to 90 days.

Seed oysters are placed on the project site.

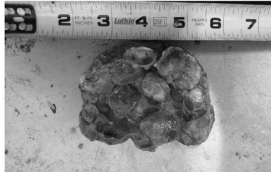


RESULTS

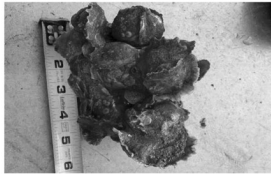
Aims to replenish with oyster clusters.

High density results in as many as 30,000 seed oysters per cubic yard.

By selective culling, Spat-Tech is putting a healthier oyster onto projects.



4 month old oyster cluster



12 month old oyster cluster



14 month old oyster cluster

RESULTS

The oysters will start to spawn naturally within 6 months of placement.

A basket produces up to 30,000* seed oysters.

A 2000 basket project could have 60 million oysters at placement.

300,000 equivalent sacks of oysters.

Would filter 3.6 billion gallons of water a day.

As the reef grows dynamically, the above statistics grow exponentially.



OYSTER GROWTH

60 million seed oysters on 2000 baskets.

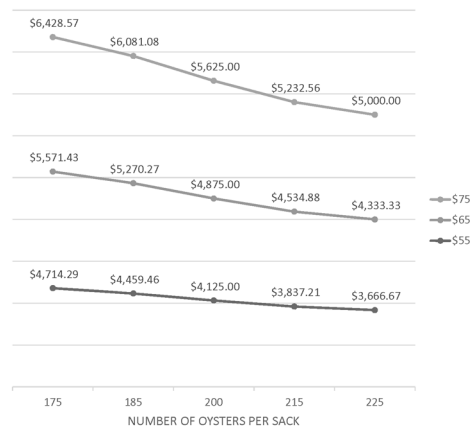
Each averages 7-8 million eggs at spawning.

275 trillion eggs produces 140 trillion larvae during each natural spawn.

If 1 in one-hundred thousand survive, the original seed oysters produce 2.75 billion spat into the water column at each spawn.

Each oyster can spawn twice annually.

INDIVIDUAL BASKET HARVEST VALUE AT 15,000 SEED OYSTERS



ECONOMIC CASE FOR SPAT-TECH

The most cost effective way to put high density spat-on-shell into the water.

Can show the ROI on oysters harvested exceeds cost of seed oysters put out.

Spat-Tech projects beat oyster relays in cost and results.

SPAT-TECH TECHNOLOGY

Our technology was developed to meet the mission statements of the following organizations:

- Coastal Conservation Association
- The Nature Conservancy
- Audubon Society
- Coalition to Restore Coastal Louisiana
- Pontchartrain Basin Foundation
- Gulf Restoration Network
- Restore or Retreat
- National Fish and Wildlife Foundation



Senator ROGER WICKER, Chair,
U.S. Senate Committee on Commerce, Science, and Transportation,
Washington, DC.

RE: Feeding America: Making Sustainable Offshore Aquaculture a Reality
October 16, 2019

The Honorable Senator Wicker:

Please accept the following comments from the National Aquaculture Association¹ to inform the presentations and comments during a recent hearing entitled, *Feeding America: Making Sustainable Offshore Aquaculture a Reality*, that referenced the Cooke Aquaculture net pen failure, escape of Atlantic salmon in the Puget Sound region, Atlantic salmon escapes in Maine and current environmental regulation for inshore and offshore marine aquaculture.

Farming Atlantic Salmon in the State of Washington

Farming fish in state waters, less than three nautical miles from the coast and within coastal inlets and bays, has been practiced since the 1970s and mid-1980s, in Maine and Washington, respectively. A 2014 analysis led by NOAA scientists reported for farms growing Atlantic salmon in nearshore waters:

“[U.S.] Marine fish farms are required to comply with regulations similar to those of other food-producing and marine industries. Existing U.S. regulations address the environmental effects of net-pen aquaculture effectively. Technological progress, better monitoring, and adaptive oversight of the U.S. net-pen aquaculture industry have resulted in sustainable, affordable, and domestically produced seafood (page 520).”²

An in-depth analysis concerning the risk of farming Atlantic salmon in Puget Sound, far from their natural range and in proximity to several Pacific salmon species, was completed by NOAA in 2002.³ The authors reported:

“ . . . the risks associated with escaped Atlantic salmon are low, in particular:

- The expectation that Atlantic salmon will increase current disease incidence in wild and hatchery salmon is low.
- The risk that escaped Atlantic salmon will compete with wild salmon for food or habitat is low, considering their well-known inability to succeed away from their historic range.
- The risk that salmon farms will adversely impact Essential Fish Habitat is low, especially when compared to other commonly accepted activities that also occur in nearshore marine environments.

. . . there appears to be little risk associated with escaped Atlantic salmon, in particular:

- There is little risk that escaped Atlantic salmon will hybridize with Pacific salmon.
- There is little risk that Atlantic salmon will colonize habitats in the Puget Sound chinook salmon and Hood Canal summer-run chum salmon ESUs [evolutionary significant unit].
- There is little risk that escaped Atlantic salmon will prey on Pacific salmon.

¹ The National Aquaculture Association is a U.S. producer-based, non-profit association incorporated in 1991 that supports the establishment of governmental programs that further the common interest of our membership, both as individual producers and as members of the aquaculture community. For over 28 years NAA has been the united voice of the domestic aquaculture sector committed to the continued growth of our industry, working with state and Federal governments to create a business climate conducive to our success, and fostering cost-effective environmental stewardship and sustainability.

² Rust, M.B., K.H. Amos, A.L. Bagwill, W.W. Dickhoff, L.M. Juarez, C.S. Price, J.A. Morris Jr. and M.C. Rubino. 2014. Environmental performance of marine net-pen aquaculture in the United States. *Fisheries* 39(11): 508–524.

³ Waknitz, F.W., T.J. Tynan, C.E. Nash, R.N. Iwamoto, and L.G. Rutter. 2002. Review of potential impacts of Atlantic salmon culture on Puget Sound chinook salmon and Hood Canal summer-run chum salmon evolutionarily significant units. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-53. (<https://www.nwfsc.noaa.gov/publications/scipubs/techmemos/tm53/tm53.pdf> accessed October 18, 2019).

- There is little risk that existing stocks of Atlantic salmon will be a vector for the introduction of an exotic pathogen into Washington State.
- There is little risk that the development of antibiotic-resistant bacteria in net-pen salmon farms or Atlantic salmon freshwater hatcheries will impact native salmonids, as similar antibiotic resistance often observed in Pacific salmon hatcheries has not been shown to have a negative impact on wild salmon (page x)."

Subsequent peer-reviewed papers reported the same conclusions.⁴

A recent and highly publicized net pen collapse and escape of farm-raised Atlantic salmon in Puget Sound resulted in state legislation phasing out nonnative fish culture when existing permits expire. An initial analysis by the Washington Department of Natural Resources⁵ concluded:

"What were the implications for the Puget Sound ecosystem from the Cypress Island Atlantic salmon net pen failure?

1. To date, there is no evidence that the escaped Atlantic salmon were eating native fauna nor is there evidence that they were sexually mature.
2. Over time, the fish in the marine system contracted native pathogens and have shown decreasing health status.
3. Atlantic salmon have been found in a limited number of rivers in Puget Sound (Skykomish and Skagit rivers). Atlantic salmon have not been seen at any DFW [Department of Fish and Wildlife] hatchery despite monitoring. There is no indication that Atlantic salmon have been caught in Nooksack drainage or at Whatcom Creek Hatchery drainage. DFW was present at the chum spawns in late fall at Bellingham Technical College and did not see any Atlantic salmon in Whatcom Creek.
4. The limited numbers of Atlantic salmon found in the freshwater system appear healthy. There is no evidence that they were feeding in the freshwater system nor were they sexually mature. The Atlantic salmon in freshwater may survive for some time.

Monitoring through the winter and the subsequent fall will be critical to know if the Atlantics remain in the freshwater systems and if they are reproducing (page 113)."

Public concern following the escape focused on the presence of piscine orthoreovirus (PRV) in escaped Atlantic salmon that were tested for pathogens. Subsequent analysis revealed:

"The ubiquitous nature of piscine orthoreovirus (PRV), its apparent historic presence in wild Pacific salmonid stocks in the Pacific Northwest and the lack of clear association with disease in Pacific salmonids suggest the virus poses a low risk to wild species of Pacific salmonids."⁶

And state agency analysis of public comments further rebutted concerns that a unique pathogen or disease had been introduced.⁷

Atlantic Salmon Escape in Maine

Maine net pen farms culture Atlantic salmon in proximity to a Gulf of Maine Atlantic salmon population that is listed as endangered under the authority granted by the Endangered Species Act. Through a collaborative effort by the farming and

⁴Nash, CE. 2003. Interactions of Atlantic salmon in the Pacific Northwest VI. A synopsis of the risk and uncertainty. Fisheries Research 62:339–347. Waknitz, F.W., R.N. Iwamoto and M.S. Strom. 2003. Interactions of Atlantic salmon in the Pacific Northwest IV. Impacts on local ecosystems. Fisheries Research 62:307–328.

⁵Clark, D., K. Lee, K. Murphy and A. Windrope. 2018. 2017 Cypress Island Atlantic Salmon Net Pen Failure: An Investigation and Review. Washington Department of Natural Resources, Olympia, WA. (https://www.dnr.wa.gov/sites/default/files/publications/aqr_cypress_investigation_report.pdf?vdqi7rk&6zpmjt5 accessed October 18, 2019).

⁶Pacific Northwest Fish Health Protection Committee and Myers. 2017. Piscine orthoreovirus (PRV) in the Pacific Northwest appears to be of low risk to wild Pacific salmonids. Informational Report No. 10 (<https://www.dnr.wa.gov/sites/default/files/publications/PRV%20whitepaper%20revised%20Sept%202017.pdf?3c0h5&g0ewylow29> accessed October 18, 2019).

⁷Washington Department of Fish and Wildlife. 2018. WDFW review of Wild Fish Conservancy's Feb. 15 news release on presence of virus in escaped Atlantic salmon. (<https://www.documentcloud.org/documents/4381114-WDFW-Response-to-Wild-Fish-Conservancy-Release.html> accessed October 18, 2019).

environmental community a salmon containment policy was created in 2002.⁸ Containment management is based upon a hazard analysis critical control point program and has resulted in no escapes since 2003.⁹

Federal Environmental Regulations Relative to Offshore Aquaculture

In the United States, since the 1970s, the U.S. Environmental Protection Agency (EPA) has held authority to regulate discharges from fish farms (*e.g.*, nutrients, chemicals and solid waste) under several iterations of the Clean Water Act. More recently, environmental groups sought EPA re-evaluation of the Clean Water Act standards applied to aquaculture.

During a four-year period, between 2000 and 2004, the agency completed a detailed technical review of its then-current standards and modern aquaculture methods, including those used for marine aquaculture. Formal rulemaking was conducted to ensure that Clean Water Act regulations for aquaculture met all standards of environmental protection mandated by Congress. In that process, the EPA determined, contrary to the position of environmental groups, that the proposed and adopted revised regulations assured environmental protection.

Other current Federal regulatory authorities, unilaterally or in partnership with the states, provide enforceable standards to protect navigation and navigational aids, water and benthic quality, food safety, drug and chemical use, aquatic animal health, endangered species, wild fishery stocks (with respect to potential aquaculture impacts to those populations), marine mammals, migratory birds and essential fish habitat. The existing and newly proposed aquaculture permitting procedures also provide an opportunity for coastal states to comment on proposed Federal permits and leases associated with offshore marine aquaculture. Existing laws applicable to aquaculture operations include, but are not limited to, the Animal Health Protection Act; Animal Medicinal Use Drug Clarification Act; Coastal Zone Management Act; Endangered Species Act; Federal Food Drug and Cosmetic Act; Federal Insecticide, Fungicide, and Rodenticide Act; Federal Water Pollution Control Act (Clean Water Act); Lacey Act; Magnuson-Stevens Fishery Conservation and Management Act; Marine Mammal Protection Act; Migratory Bird Protection Act; National Environmental Policy Act; Outer Continental Shelf Lands Act; and Rivers and Harbors Act.

Through rulemaking, judicial rulings and an opportunity to comment on significant Federal permitting by other Federal agencies, the U.S. Environmental Protection Agency, National Oceanic and Atmospheric Administration, U.S. Department of Agriculture, U.S. Army Corps of Engineers, U.S. Coast Guard, U.S. Department of Defense, Federal Aviation Administration, U.S. Fish and Wildlife Service, Bureau of Ocean and Energy Management, and state agencies (agriculture, natural resources, and environmental protection) have an important regulatory role relative to offshore aquaculture and, in particular, the coastal states are provided an opportunity to comment on proposed Federal permits and leases associated with offshore marine aquaculture.

Current regulatory authority exists to appropriately protect marine water quality and benthic environmental systems, manage fish escapes, protect wild fish stocks, marine mammals and migratory birds, protect essential habitat, require responsible drug and chemical use, ensure safe navigation, and assure consumers that they will have access to safe foods. Indeed, it has been argued, and we agree, that:

- a) The regulatory environment in the United States has become increasingly stringent in recent years in terms of both the number and complexity of regulations that affect U.S. aquaculture.¹⁰
- b) Especially difficult is the lack of a lead agency at both Federal and state levels to effectively coordinate and streamline regulatory and permitting processes that result in timely decisions and more certainty for investment in new enterprises and expansion of existing operations. The overall cumulative effect has been continued increases in the regulatory costs and risk faced by aquaculture growers in the United States.¹¹

⁸Whoriskey and Goode. 2003. Finding resolution to farmed salmon issues in eastern North America. Atlantic Salmon Federation. (<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.180.6133&rep=rep1&type=pdf> accessed October 22, 2019).

⁹Please visit: <https://www.maine.gov/dmr/aquaculture/reports/documents/ReportedEscapesofFarmedAtlanticSalmoninMaine.pdf>.

¹⁰Engle, C.R. and N. M. Stone. 2013. Competitiveness of U.S. aquaculture within the current U.S. regulatory framework. *Aquaculture Economics and Management* 17(3): 251–280.

¹¹Ibid.

In conclusion, NAA urges the Committee to support the expansion of offshore aquaculture by providing the opportunity to lease a site and a clear pathway for commercial use of Federal waters for farming fish, shellfish and seaweed. The important concerns expressed at the recent hearing regarding salmon farming in coastal waters of Washington and Maine can be effectively managed under existing environmental laws and regulations and mitigated by applying known science and Best Management Practices available today.

The existing U.S. regulatory regime governing coastal and offshore aquaculture is rigorous and comprehensive. Issues concerning environmental impacts on wild stock and coastal ecosystems, such as: disease introduction and transfer, competition for food and habitat, and genetic dilution have been studied and the risk of negative impacts on fisheries is low across the board. Thank you for your efforts and NAA would be pleased to work with you and your staff to finalize the pending legislation and move it forward.

Sincerely,

JIM PARSONS,
President.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROGER WICKER TO
LINDA CORNISH

Question 1. Are there nutritional differences between eating farmed and wild caught fish?

Answer. It depends on the diet fed to farmed fish. This question was addressed by the 2015 Dietary Guidelines Advisory Committee in their Scientific Report on pages 293 and 294, "What are the comparative nutrient profiles of current farm-raised versus wild caught seafood?" "For commonly consumed fish species in the United States, such as bass, cod, trout, and salmon, farmed-raised seafood has as much or more of the omega-3 fatty acids EPA and DHA as the same species captured in the wild. In contrast, farmed low-trophic species, such as catfish and crawfish, have less than half the EPA and DHA per serving than wild caught, and these species have lower EPA and DHA regardless of source than do salmon. Farm-raised seafood has higher total fat than wild caught.

Recommended amounts of EPA and DHA can be obtained by consuming a variety of farm-raised seafood, especially high-trophic species, such as salmon and trout.

The U.S. population should be encouraged to eat a wide variety of seafood that can be wild caught or farmed, as they are nutrient-dense foods that are uniquely rich sources of healthy fatty acids. It should be noted that low-trophic farm-raised seafood, such as catfish and crayfish, have lower EPA and DHA levels than do wild-caught. Nutrient profiles in popular low-trophic farmed species should be improved through feeding and processing systems that produce and preserve nutrients similar to those of wild-caught seafood of the same species."

Question 2. What is the latest scientific evidence as it relates to seafood consumption and brain development?

Answer. There is strong evidence on seafood consumption supporting brain development. Seafood is widely recognized as the richest food source of omega-3 docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) in the American diet. Moreover, DHA and EPA are widely known as metabolites that support neural structure and metabolism in the brain. A paper recently published in the Journal of Prostaglandins, Leukotrienes and Essential Fatty Acids (PLEFA) by a group of leading dietary fats scientists that utilized U.S. Department of Agriculture Nutrition Evidence Systematic Review protocols and conducted two systematic reviews on the health benefits from consuming seafood for infant and adolescent brain development. This paper is titled, "Relationships between seafood consumption during pregnancy and childhood and neurocognitive development: two systematic reviews," and focused on studies that examined seafood consumption. These reviews focused on seafood as a whole food and not any of its constituent nutrients. An additional paper, "An abundance of seafood consumption studies presents new opportunities to evaluate effects on neurocognitive development," published in PLEFA provides more background on the systematic review paper.

Among the key findings of the systematic reviews is an average 7.7 IQ point gain in children whose mothers ate seafood during pregnancy compared to mothers who did not eat seafood. This paper uncovered 44 scientific studies since 2000 that collectively show the importance of consuming seafood by moms to support the brain development of their babies as well as the need for children to consume more fish and shellfish. Highlights from the paper, which evaluates studies on over 100,000 mother-offspring pairs and over 25,000 children, includes:

- Twenty-four (24) studies reported that seafood consumption among mothers was associated with beneficial outcomes to neurocognition on some or all of the tests administered to their children. The beneficial outcomes appeared on tests administered as early as three days of age and as late as 17 years in age. Five studies reported null results on all tests. Zero studies reported negative results on any test.
- In the studies that reported beneficial associations with IQ, children gain an average of 7.7 full IQ points when their moms ate seafood during pregnancy compared to moms that did not eat seafood. The size of benefits for IQ ranged from 5.6 to 9.5 points.
- In addition to IQ, measures of neurocognitive outcomes included verbal, visual and motor skill development, scholastic achievement, and four specifically looked at hyperactivity and ADHD diagnoses. One finding showed that children of mothers not eating oily seafood had nearly three times greater risks of hyperactivity.
- Benefits to neurocognitive development began at the lowest amounts of seafood consumed in pregnancy (one serving or about 4 oz per week) and some studies looked at greater than 100 oz. per week. No adverse effects of seafood consumption were found for neurocognition in any of the 29 publications on seafood consumption in pregnancy or the additional 15 publications on seafood consumption by offspring (44 studies total).
- Seafood contains nutrients including zinc, iron, choline, folate, iodine, selenium, vitamins A, D, B6, and B12, and omega-3 fatty acids that contribute as a whole package to these important outcomes.

American Academy of Pediatrics, Health Canada, the European Food Safety Authority, and World Health Organization are among the medical and government organizations that have recommended seafood consumption. For instance, the American Academy of Pediatrics^{vi} earlier this year that emphasized the importance of fish and called attention to the fact that U.S. children are not eating enough seafood and are missing the important nutrients from fish.

Question 3. What are the health benefits of eating seafood for adults?

Answer. The health benefits of eating seafood for adults are numerous and backed by strong scientific evidence. In summary, eating seafood supports brain health, heart health, and overall wellness.

- Older adults with highest fish consumption lived an average of 2.2 years longer.
- Fish literally saves lives. Eating seafood two to three times per week reduces the risk of death from any health-related cause by 17 percent.
- Seven out of 10 deaths in the U.S. are preventable through nutrition and lifestyle changes, like adding omega-3s to your diet. Low seafood intake contributes to 55,000 deaths each year, making seafood deficiency a leading dietary contributor to preventable death in the U.S.
- In the NIH–AARP Diet and Health Study published in 2018 titled, “Association of fish and long-chain omega-3 fatty acids intakes with total and cause-specific mortality: prospective analysis of 421,309 individuals^x,” found that consumption of fish and long-chain omega-3 polyunsaturated fatty acids were robustly associated with lower mortality from major causes. The study followed the participants made up of a total of 240,729 men and 180,580 women for 16 years and found that higher fish and long-chain omega-3 polyunsaturated fatty acids intakes were significantly associated with lower total mortality. Comparing the highest with lowest quintiles of fish intake:
 - *Men* had 9 percent lower total mortality, 10 percent lower cardiovascular disease (CVD) mortality, 6 percent lower cancer mortality, 20 percent lower respiratory disease mortality, and 37 percent lower chronic liver disease mortality.
 - *Women* had 8 percent lower total mortality, 10 percent lower CVD mortality, 38 percent lower Alzheimer’s disease mortality.

This study included double (two-fold) the number of participants as has been reported in all other prospective cohort studies to date.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROGER WICKER TO
KATHRYN UNGER

Question 1. What are the economic benefits of offshore aquaculture for inland states?

Answer. Globally, aquaculture is one of the fastest growing, sustainable forms of food production. According to the World Bank, by 2030, aquaculture's share in the global seafood supply will expand to supply over 60 percent of fish for human consumption, whereas wild-capture seafood production will remain steady. A doubling of U.S. aquaculture production to about 1 million tons could create an additional 50,000 direct and indirect jobs, assuming 20 direct jobs per 1,000 tons of seafood produced, or five jobs per 1,000 tons in equipment, feeds, processing, marketing, and food service. These jobs could provide additional stable, year-round employment opportunities in coastal and fishing communities where opportunities are often limited and seasonally dependent.

In addition to supporting coastal communities, U.S. offshore aquaculture production can also benefit U.S. agriculture and inland states. Replacing wild-caught fishmeal and fish oil with alternative proteins, such as soy, eases pressure on ocean resources while also providing a new market outlet for U.S. soybean farmers. Soybean production in the U.S. has increased more than tenfold in the last four decades, much of it on the same land as yield per acre and growing efficiencies have increased. We believe soybean farmers can be a key beneficiary of a domestic aquaculture industry.

Finally, aquaculture can benefit all Americans by providing an affordable, healthy, and sustainable protein meal option. The U.S. Dietary Guidelines currently recommend that Americans eat at least eight ounces of a variety of seafood per week—which equates to 2 meals a week. Unfortunately, despite the health benefits, Americans are not meeting the recommended consumption target, with data from 2016 suggesting that Americans are only consuming about 2.7 ounces of seafood per week, or 1/3 of recommendations. Growth of abundant, local, U.S.-produced seafood could be key to changing those habits.

Question 2. How can the feed industry use ingredients that are low value for human consumption to create aquaculture feed?

Answer. Cargill's aqua feed business is committed to sustainability, and this starts with our ingredients. The species used for fishmeal and oil fall into two categories—forage fish and trimmings/by-products. Forage fish are generally not species used for direct human consumption. These fish are cooked and squeezed, extracting the oil and meal at the same time. Trimmings and by-products are extracted after fish caught for direct human consumption are processed to remove the fillets, leaving plenty of nutrients behind.

Currently about 1/3 of Cargill's global marine ingredients come from trimmings and fishery by-products, and we are working to increase that number. In Canada our proportion is close to 50 percent as there is so much material to source. The ability to reuse fish trimmings and by-products are part of our aqua feed enables a more circular industry and cuts down on food waste.

Question 3. How has Cargill worked to decrease the amount of fish products in aquaculture feed?

Answer. As noted in response to question 2, we are continuing to work to increase the amount of marine ingredients from trimmings and fishery by products to displace the need for forage and wild-caught marine ingredients. Currently, about 1/3 of Cargill's global marine ingredients come from trimmings and fishery by products. In addition, we are continuing to use soy and other alternative proteins in our feed. Soybeans contain much needed omega-3 fatty acids, proteins, and unsaturated fats that are critical for healthy fish. Soy can replace from one-third to one-half of the fishmeal in feeds for many farmed species, and soybean meal has a significantly lower cost than most animal meals. We continue to look at ways to incorporate soy and other healthy proteins into our feeds to displace the need for marine ingredients, where possible.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN THUNE TO
KATHRYN UNGER

Question. South Dakota soybeans are some of the best in the world and are used in many products, including fish feed. Some may be surprised to hear that land-locked states like ours have an important role to play in aquaculture.

In fact, Prairie AquaTech, a technology company that has developed and patented a high-protein fish feed from soy meal, is based in Brookings, South Dakota. Due

to high demand in their product, they completed construction of a new commercial facility earlier this year capable of processing 30,000 tons of feed annually.

a. What would be the economic impact on soybean-growing states if the United States embraces domestic aquaculture?

Answer. Growth in U.S. offshore aquaculture production will benefit U.S. agriculture. Replacing wild-caught fishmeal and fish oil with alternative proteins, such as soy, eases pressure on ocean resources while also providing a new market outlet for U.S. soybean farmers. For Cargill's U.S. aqua business, we would source soy from U.S. farmers for our aqua feed to support a U.S. aquaculture industry. Soybean production in the U.S. has increased more than tenfold in the last four decades, much of it on the same land as yield per acre and growing efficiencies have increased. We believe soybean farmers can be a key beneficiary of a domestic aquaculture industry.

b. Work continues to be done to improve the environmental impacts associated with soy-based fish feed. Prairie AquaTech, for example, has been internationally recognized for its work in reducing phosphorus effluent. Can you speak to the innovations we are seeing in this space to support the sustainable growth of the aquaculture industry?

Answer. Cargill is likewise committed to nourishing the world in safe, responsible, and sustainable way. Sustainable feeds start with sourcing responsible raw materials for both our marine and terrestrial ingredients. For our global aqua feed business, our soy sourcing depends on the region in which the feed is being produced. For our U.S. operations, including any expansion that may come to support the growth of U.S. marine aquaculture, we will use only U.S. grown soy. We are working to increase sustainability of U.S. soy farmers through partnerships focused on increasing soil health, which has numerous benefits both for the environment and for farmers' bottom lines.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROGER WICKER TO
BENJAMIN S. HALPERN

Question 1. What is the difference between offshore and onshore aquaculture? What are the benefits of moving aquaculture operations offshore?

Answer. Offshore aquaculture is defined differently in each country, but in the United States it generally refers to aquaculture that is located at least 3nm off the coast. Onshore aquaculture can either refer to coastal aquaculture (ocean aquaculture near the coast, usually within 1nm of the coast) or aquaculture on land. These differences in location have large implications, on average, for the environmental impact of aquaculture. On land, aquaculture is comprised almost entirely of freshwater species and has a substantial requirement for freshwater inputs and can often create downstream pollution that impacts rivers and lakes. The impacts of coastal marine aquaculture vary by the species being farmed and the specific location, but can include habitat destruction, pollution inputs to sensitive habitats, and leaching of antibiotics into surrounding waters, among others, although some coastal aquaculture, in particular shellfish and seaweed farming, can actually create net benefits for coastal ecosystems.

The main benefits from offshore aquaculture accrue with finfish farming. Deeper water and stronger currents lead to very little detectable impact from pollution, little to no impact on the habitat below the farm (if the water is deep enough), and little need for antibiotics (the faster water means the fish stay healthier as they swim to stay in place). There are also fewer potential conflicts with other sectors, which tend to be concentrated near coastal areas (tourism, coastal property values, nearshore fishing, and so on). However, data on these impacts and benefits comes from relatively small-scale offshore farms; we do not yet have sufficient data on the potential impacts of very large scale, industrial fish farming to know if environmental impacts of large-scale offshore aquaculture might be greater than small-scale farming.

Question 2. How do the environmental impacts of offshore aquaculture compare to other types of food production?

Answer. All food production has at least some impact on the environment, and different foods have very different total environmental impacts. Anything that is fed (livestock on land, farmed finfish) will have a greater overall impact than most unfed food (e.g., crops and shellfish) because the environmental impact of the food production comes from both the direct impact of the food product itself and the indirect impact from growing the food crops that are fed to those animals. In most cases, shellfish farming has less environmental impact than most crop farming because it

takes almost no resource input to farm shellfish, whereas crops require tilling the land, adding water and fertilizer in most cases, and often adding pesticides.

Ocean aquaculture has the additional benefits that no freshwater is directly needed (but for fed fish, growing the feed requires water resources) and feed conversion ratios (how much feed is needed to grow a kilogram of food product) are generally much better. Moving aquaculture offshore has the additional benefits that pollution impacts are near zero and the need for antibiotics is significantly reduced. Growth rates of the fish are also often faster, allowing for shorter time to reach market size.

Question 3. How can science help inform the siting of offshore aquaculture?

Answer. The decision about where to site anything (whether on land or in the sea) involves assessing the costs and benefits to different sectors and making a strategic decision about how to optimize the outcome, *i.e.*, find win-win situations where possible and minimize costs. Science is fundamental to this process at many levels. At the highest level, the field of decision science, which is closely allied to economics, emerged to address exactly these types of questions, and conservation science later grew out of decision science in order to apply the approaches to resource management questions. At the scale of local decisions, different disciplines of science are key to understanding how any action (*e.g.*, placing a aquaculture farm in a specific location) will impact the ecology, economics, social and cultural aspects of the people and species in that location. Environmental impact assessments are one of the main mechanisms for implementing and synthesizing this local-scale science, but these assessments vary substantially in the degree to which they do or do not incorporate multiple disciplines and data into their assessments.

When siting decisions are made without science to inform them, there is not only much greater risk of decisions that unnecessarily harm or impact a sector, but also of settling on lose-lose outcomes where all parties involved could actually be better off if they had let science guide the evaluation of possible siting options. There are many real-world examples of where such lose-lose outcomes have occurred when science was insufficiently used.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JOHN THUNE TO
BENJAMIN S. HALPERN

Question. Dr. Halpern, in your testimony, you discuss the public perception of aquaculture. Some critics of aquaculture point to the use of fishmeal as feed to suggest that aquaculture is a zero sum game. That is to say, by increasing aquaculture, you are decreasing the amount of wild caught fish available for consumption. How does growth in the soy-based feed industry impact our wild caught fisheries and address these concerns?

Answer. There are two parts to the answer to this question. First, the critiques around the need to feed fishmeal to aquaculture are largely misguided. Prior to the growth in global aquaculture, forage fish (the source of fishmeal) were caught at the same level globally and largely fed to pigs and chickens (and used as fertilizer for crops). Because forage fish are of higher value to aquaculture, the market has shifted to 75 percent of forage fish going to aquaculture, *i.e.*, aquaculture farms are willing to pay a higher price for fishmeal than pig and chicken farmers, but there is still 25 percent of the global supply that goes to feed pigs and chicken, and the total catch is still the same. As such, decisions about how much forage fish to remove from the ocean are not driven by aquaculture demand but instead by fisheries policy; the markets then just determine where that catch ends up. If we want to leave more fish in the ocean, policy must make this decision.

However, because the global catch of forage fish has an ecological limit (and we have largely reached this limit during the past 30 years), there is concern that as aquaculture continues to grow, the ability of forage fish to provide a secure supply of feed is at risk. Soy-based feed is already a major component of fish feed for several species (especially farmed salmon) and has the potential to provide an increasing supply of feed components. Soy-based feed is unlikely to have any benefit to wild caught fisheries, but it will have the benefit of allowing further growth of the aquaculture sector.