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## A 20-YEAR RETROSPECTIVE REVIEW OF GLOBAL AQUACULTURE: GLOBAL EXPANSION AND PERSISTENT CHALLENGES

ARTICLE

## REFUTING MARINE AQUACULTURE MYTHS, UNFOUNDED CRITICISMS AND ASSUMPTIONS IN THE UNITED STATES

By: National Aquaculture Association \*

**A variety of tenacious myths critical of marine aquaculture** practiced in the United States have persisted for decades to be presented as facts to the public and Congress. The National Aquaculture Association (NAA) recently posted an updated analysis of refuting the variety of tenacious myths critical of marine aquaculture practiced in the United States. Authors of this analysis believe critics have erroneously assumed marine aquaculture-related environmental damage reported in other countries occurs in the United States. The reality is U.S. fish and shellfish farmers culture aquatic animals and plants within a very complicated and expensive legal, regulatory, husbandry and science-driven environment.



The United States is not a world leader in sustainable aquaculture production by volume or value but we are in the thoughtful and rigorous development of regulatory and non-regulatory production practices, animal nutrition and health management<sup>4</sup>, and the efficient processing and distribution of high-quality, wholesome foods. A recent analysis by Gentry et al. (2017) of global marine aquaculture potential concluded with a statement that is very relevant to U.S. aquaculture by highlighting the unlimited potential of the United States to be a global leader in sustainability, technology and production (internal citations deleted):

“Given the significant potential for marine aquaculture, it is perhaps surprising that the development of new farms is rare. Restrictive regulatory regimes, high costs, economic uncertainty, lack of investment capital, competition and limitations on knowledge transfer into new regions are often cited as impediments to aquaculture development. In addition, concerns surrounding feed sustainability, ocean health and impacts on wild fisheries have created resistance to marine aquaculture development in some areas. While ongoing and significant progress has been made in addressing sustainability issues with marine aquaculture, continued focus on these issues and dedication to ensuring best practices will be a crucial element shaping the future of marine aquaculture. Both the cultural and economic dimensions of development and the management and regulatory systems are critically important to understanding realistic growth trajectories and the repercussions of this growth. Our results show that potential exists for aquaculture to continue its rapid expansion, but more careful analysis and forward-thinking policies will be necessary to ensure that this growth enhances the well-being of people



Table 1

Marine Aquaculture Myths and Assumptions in the United States	
MYTH	FACT
American commercial fishing and marine finfish aquaculture cannot coexist.	Farmers and fishers co-exist quite well.
Federal regulations, permitting and environmental review processes are inadequate to manage offshore fish farms.	Nine federal agencies, 20 federal Acts and thousands of lines in the Code of Federal Regulations are very effective.
Marine net pens or sea cages are factory farms that in US waters would contribute marine pollution caused by excess feed, untreated fish waste, antibiotics and antifoulants	Feeds represent 60% of variable production costs and farms invest to prevent feed loss; nutrients become pollutants when discharged in excess - not so for net pen production; no antibiotics are approved for marine finfish; at harvest fish represent 2% to 4% of the volume of a net pen.
Offshore farms entangle marine animals.	Farms are not designed to entangle; entanglement is a very rare event.
Escaped farm-raised fish adversely impact wild fish stocks.	Not in the United States.
Fish Meal and Fish Oil in Fish Feeds are Unsustainable.	Current feeds produce more fish than are used as an important ingredient to produce feeds.
Farm-raised fish will displace US fisheries and are cheap and of low-quality.	Not so for US farm-raised fish and shellfish. US cost of production is higher because of the social and environmental regulatory costs and the cost of US goods and services purchased by the farming community.

while maintaining, and perhaps enhancing, vibrant and resilient ocean ecosystems”.

#### Myth: American commercial fishing and marine finfish aquaculture cannot coexist

The claim that commercial fishing and marine aquaculture cannot coexist has been made for the last 39 years and has been proven false for 23 coastal states where the production of Atlantic salmon, oysters, clams and mussels has grown, prospered and in many instances was led by commercial fishermen. Globally, commercial fishing has continued in concert with the growth in marine aquaculture production, and in the few instances where marine sea cages have been constructed and operated in the United States, i.e., Hawaii, Maine and Puerto Rico, those farms were often welcomed by commercial and recreational fishermen.

There is a global imperative to increase sustainable protein production with wild-caught and farm-raised seafood being a major component. The United States has the

ability to accomplish this goal while leading the world in environmental protection.

As farmers that produce a perishable product competing with the rest of the world for a small sliver of the U.S. seafood market, we believe our focus and the focus of U.S. fishermen should be on becoming the best and most efficient farmers and fishermen that we can be. Complaining that we cannot co-exist does not serve a shared goal of providing domestically produced product for the growing U.S. and global markets. By focusing on our collective ability to compete in world markets we will help preserve working waterfronts and ensure that coastal communities will remain resilient. Our competition is not each other, but low-cost foreign producers who do not have to comply with strict regulations.

#### Myth: Federal regulations, permitting and environmental review processes are inadequate to manage offshore fish farms

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 Federal Water Pollution Control Act (i.e., 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.

During January 2021, the U.S. Army Corps of Engineers (Corps) revised a nationwide permit for marine shellfish farming and created two new nationwide permits for seaweed and marine finfish farming. The Corps issues nationwide permits (NWP) to authorize activities under Section 404 of the Clean Water Act, discharges of dredged or fill material into waters of the United States, and Section 10 of the Rivers and Harbors Act of 1899, structures and work in navigable waters, where those activities will result in no more than minimal individual and cumulative adverse environmental effects.

The Environmental Protection Agency granted a NPDES during September 2020 for a publicly-funded, experimental and demonstration project in the Gulf of Mexico that is currently being appealed. We invite and encourage your independent analysis of the multi-agency, state and federal, generated permit. The full permit package is posted here: <https://www.epa.gov/npdes-per>

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mits/ocean-era-inc-velella-epsilon-aquatic-animal-production-facility-national-pollutant.

**Myth: Marine net pens or sea cages are factory farms that in US waters would contribute marine pollution caused by excess feed, untreated fish waste, antibiotics, and antifoulants**

**Feed Management and Fish Growth**

Feed is a significant cost to all fish farms and can range from 50% to 60% of variable costs. As a consequence, farmers invest in employee training and infrastructure to store, handle, deliver and monitor feed to fish as efficiently and with as little loss as possible. The practical aspects of feed monitoring technology is rarely presented in science literature; although, sophisticated approaches have been adopted to include cameras, Doppler radar, infrared detection, sonar sensors and water quality sensor arrays. Current feed monitoring in the United States utilizes farm employees observing feed consumption via video for each cage in an array of cages to stop feed delivery when fish near satiation.

Feed conversion ratio (FCR) (weight of feed offered/weight of fish produced) have trended downward as feed management and feed quality have improved from 3:1 (3 pounds of feed to 1 pound of harvested fish) to around 1:1.

**Fish Density**

Fish density is a production system is a complex question dependent upon species behavior, physiology, and water quality. The success of every farm growing animals, terrestrial or aquatic, depends upon the health and growth of the livestock. Fish grown at-sea in net pens benefit from standard practice of a low volume, 2% to 3%, at-harvest of fish relative to the volume of the sea cage or net pen.

**Excess feed, untreated fish waste and nutrients**

Current farm and feed management

practices refute the claims that offshore marine aquaculture causes water quality or benthic ecology damage.

Farms must conform to established production practices and federal regulations that require the efficient feeding of optimal feed formulations, feed management to reduce feed loss, feeding equipment maintenance, employee training in efficient feeding practices, and recordkeeping and reporting of feed efficiency (conversion of feed to the amount of fish produced). In the U.S. farms must comply with strict discharge standards and are closely monitored against a set of environmental impact metrics. If they exceed those discharge standards or impact metrics their National Pollution Discharge Elimination System (NPDES) permits granted by the U.S. Environmental Protection Agency can be rescinded. Without a

valid NPDES permit they must cease operations.

**Antibiotics**

The United States severely restricts the availability and use of aquatic animal medicines via the Food, Drug and Cosmetic Act. Other chemicals (e.g., disinfectants, detergents or other cleaning agents) that may be used by aquaculture facilities are regulated by the U.S. Environmental Protection Agency (EPA). The U.S. Food and Drug Administration reviews and approves aquatic animal medicines utilizing the same regulatory paradigm as that for human medicine (e.g., effectiveness to mitigate disease, effects to the animal, effects to the environment directly or indirectly, risk to human health). There are no antibiotics approved for use on marine fish such as cobia, snapper, flounder, halibut, cod or any of the other candidate fish for offshore marine aquaculture.

Antibiotics can only be used in conformance to label instructions or as prescribed by a licensed veterinarian. Federal regulations require that farms report medication use prior to administering a medication and following treatment. A farm must describe potential chemical use in their EPA permit application and conform to permit conditions if use is allowed. In most cases those permit conditions require environmental monitoring to detect any possible antibiotic residues. If residues are detected farms are required to change their operations to reduce any risk of environmental impacts.

**Antifoulants**

Biofouling in marine environments occurs when animals and plants attach to the hard and soft surfaces associated with fish, shellfish and seaweed production gear (cages, nets, baskets, floats, ropes and anchors). The grow-

ing animals and plants will add weight and drag, restrict water flow impacting filter feeding or oxygenation, reduce marketable value or shelter pathogens and parasites. Direct economic costs to the farm have been conservatively estimated at 5 to 15% of production costs.

Offshore marine fish farms must comply with federal regulations applicable for all marine use of antifoulants as does every commercial or recreational watercraft owner, navigation buoy manufacturer or public or private entities that maintain buoys and markers, and similarly for antifoulants applied to marine structures. In the case of commercial net pen farms most farms have eliminated net exchange and the use of antifoulants on nets and are using mechanical robotic net cleaners or copper-alloy metal mesh.

The use and application of antifoulants in the marine environment is regulated by EPA under authority granted

Complaining that we cannot co-exist does not serve a shared goal of providing domestically produced product for the growing U.S. and global markets.





consultations, as authorized by the National Environmental Policy Act, to enforce the provisions of the Endangered Species Act, Marine Mammal Protection Act, Migratory Bird Treaty Act and Magnuson-Stevens Fishery Conservation and Management Act to prevent injury or death to listed species, marine mammals and birds and to prohibit unpermitted fishery harvest, possession or sale.

Unlike fishing gear that is designed to intentionally “catch” animals, aquaculture gear is designed to contain animals being cultured without hurting them or any wild animals that may occur around farms.

### Myth: Escaped farm-raised fish adversely impact wild fish stocks

Belle and Nash (2008) noted that escaping fish may pose a variety of environmental risks including pathogen transmission, interbreeding with wild conspecific to introduce new genetics, competition for resources, predation, colonization or disruption or damage to existing commercial or recreational fishing. The authors concluded:

“For most of the aquatic species commercially cultured in the United States, these outcomes have neither occurred nor are anticipated to occur because:

- Producers have a strong economic incentive to prevent escape of cultured animals and to recover animals that do escape;
- Most pathogens are naturally occurring and ubiquitous;
- Most species are cultured in their native range;
- Successful introduction and spread of a nonnative species often meet strong biological resistance; and
- Federal and state agencies have implemented a variety of invasive-species regulations to prevent, control, manage, or mitigate potential impacts.”

This non-regulatory and regulatory framework has been effective for the United States. Farming fish in state waters, less than three miles



from the coast and within coastal inlets and bays, is practiced to a limited extent in Hawaii, Maine and Washington.

### Myth: Fish Meal and Fish Oil in Fish Feeds is Unsustainable

In 2018, about 88 percent (or over 172 million tons) of the 197 million tons of total global fish production was utilized for direct human consumption, while the remaining 12 percent (or about 24 million tons) was used for non-food purposes. Of the latter, 80 percent (about 20 million tons) was reduced to fishmeal and fish oil, while the rest (4 million tons) was largely utilized as ornamental fish, for culture (e.g. fry, fingerlings or small adults for on growing), as bait, in pharmaceutical uses, for pet food, or as raw material for direct feeding in aquaculture and for the raising of livestock and fur animals.

Fish meal, fish oil and fishery by-products (skin, bone, and offal) are used in the production of terrestrial and aquatic animal feeds, biofuel and biogas, dietetic products (chitosan), pharmaceuticals (omega-3 oils), natural pigments, cosmetics, alternatives to plastic, and constituents in other industrial processes. A significant but declining proportion of world fisheries production is processed into fishmeal and fish oil because of increasing use of fishery by-products to produce fish meal and fish oil and the use of substitutes such as plant, insect, algae and microbial produced proteins and oils.

Fishmeal and fish oil are still considered the most nutritious and most digestible ingredients for farmed fish, as well as the major source of omega-3 fatty acids (eicosapentaenoic acid [EPA] and docosahexaenoic acid [DHA]). However, their

inclusion rates in compound feeds for aquaculture have shown a clear downward trend, largely as a result of supply and price variation.

Within the United States considerable public and private research investment has been made with the goal of reducing the amounts of either ingredient in diets that will yield excellent animal health, growth and final products with desirable human nutritional benefits.

The U.S. aquaculture community utilizes feed formulations that strive to achieve appropriate nutrition rather than focusing on fish meal or fish oil as an indicator for sustainability. Farms should be recognized for utilizing compounded feeds appropriate for their aquatic animal and production system and that advances in the formulation of compounded feeds is advancing at a rapid and sustainable rate.

### Myth: Farm-raised fish will displace US fisheries and are cheap and of low-quality

Fundamentally for U.S. farmers it is very difficult to produce “cheap” fish in the United States because of the plethora of federal and state natural resource and environmental regulations focused on aquatic animal culture, possession, sale and health, water use and quality, land use and access to markets and local, state and national labor, safety, business regulations and permits and mandated minimum wage.

What is also clear – and often missing from the discussion of competition – is that competition will exist with or without domestic aquaculture. The marketplace is global and demand for seafood products is growing. The United States cannot meet consumer seafood demand through wild caught fishing activities alone. Seafood imports and other forms of protein, such as beef and chicken, already provide significant competition. Seafood business executives speaking at the National Marine Aquaculture Summit said that if seafood is not available from U.S. sources, their customers are demanding that they get it somewhere else.

New rules by the U.S. Food and Drug Administration authorized by the Food Safety Modernization Act have added additional regulations for the processing, handling and transportation of animal feeds and human food. Such controls help to make farm-raised seafood products safe and wholesome foods.

As U.S. farmers, we are at a very real price disadvantage and recognize import product prices as being one of our greatest challenges. In response, rather than a protectionist approach, the U.S. aquaculture community has been working to develop markets that appreciate locally grown and high-quality fish, shellfish and seaweed products. And we are working to educate the U.S. consumer of U.S. sustainable production practices,

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environmental stewardship and the nutritional benefits and value of buying U.S. grown foods.

*Editor's note: This analysis was revised and updated January 20, 2021. The present article summarizes the information found on it, however we strongly recommend our readers to access the original version to dig deeper on the references and sources consulted on the formulation of the analysis.*

### REFERENCES

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\*The National Aquaculture Association represents farmers across the United States that raise aquatic animals and plants destined for food, bait, ornamental, recreational fishing markets and as fertile eggs, larvae, fingerlings or shellfish seed to stock farms for grow-out. This association is a U.S. producer-driven, non-profit association incorporated in 1991 that for 30 years has worked ensure the aquaculture industry's sustainability, profitability and development occurs in an environmentally sustainable manner. The original version of this analysis can be found at: <http://thenaa.net/pub/NAA-Refuting-Marine-Aquaculture-Myths.pdf>