

Aquaculture and Its Impact on South Florida

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An increasing world population and an increasing demand for seafood has put a tremendous strain on most natural fisheries around the globe. In order to adapt to a growing global appetite for seafood, the aquaculture industry has undergone a massive boom in the past few decades. Fish farms are popping up all around the world, from Asia and South America to the United States. There are many ecological risks associated with the increased supply of food brought about by the aquaculture boom. Issues such as water pollution, increased aquatic diseases, and habitat destruction are all topics that come up when discussing the risks of aquaculture. Environmentalists and other groups have tried to encourage government regulations on the growth of the industry so that it can become sustainable. South Florida is one region that has been affected in many ways by the rise of aquaculture. This region shares many concerns with other areas facing a growing aquaculture industry, and South Florida also has unique challenges to overcome in responding to the effects of aquaculture. This paper argues that growth in the aquaculture industry is necessary to satisfy the global need for seafood; however, environmentally sustainable practices need to be developed and enforced in order to prevent further harm to the ecosystem of South Florida and other ecosystems around the world.

Demand for seafood in the United States is larger than almost anywhere in the world, but the United States has an \$8 billion seafood trade deficit.¹ The trade deficit with shrimp, specifically, is the largest in the United States, next to petroleum.² The US is the third largest importer of seafood in the world, importing 81% of all eaten fish products.³ Florida, in particular, is very reliant on the fish industry. The average Florida resident consumes between thirty to forty

¹ Marine Aquaculture Task Force. *Sustainable Marine Aquaculture: Fulfilling the Promise; Managing the Risks*. January, 2007. p. 1.

² John Tibbetts "Aquaculture: Satisfying the Global Appetite" *Environmental Health Perspectives*, Vol. 109, No. 7 (Jul., 2001), p. A321.

³ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. Division of Aquaculture: Florida Department of Agriculture and Consumer Services. p. 4.

pounds of seafood each year, which is twice the national average. There are over 4,600 seafood retailers in the state. More than 300 Florida-based businesses process seafood in some way, and 1,200 businesses buy and sell seafood. There is also a \$15 billion restaurant industry in the state that is extremely dependant on seafood.⁴

All of this fish has to come from somewhere, and the oceans, rivers, and lakes are feeling the strains of depleted fish stocks almost everywhere. As awareness of depleted natural catch-fisheries spread, the aquaculture industry grew. It is believed that aquaculture can help rehabilitate these natural fisheries by taking the strain of consumption off of them and also by releasing overfished, farmed species into the wild.⁵ Aquaculture has been practiced for at least three thousand years, beginning as small, subsistence ponds in China, where they used to grow carp.⁶ Aquaculture remained small-scale for thousands of years until the population boom after World War II, when aquaculture production began to grow at a rate of 8.8% per year starting in 1950.⁷ The aquaculture industry is now the fastest growing food production system worldwide.⁸ More than 40% of US imported seafood is farmed in origin. According to the U.N. Food and Agriculture Association, in 2004 aquaculture products were estimated to be 59.4 metric tons and worth roughly \$70.3 billion.⁹ Incredibly, it is believed that half of all seafood for human consumption is farm raised in origin, although this number includes escaped populations of farmed fish.¹⁰

Asia is currently responsible for approximately 90% of aquaculture production worldwide, with China producing nearly 69% of total aquaculture products. 90% of all

⁴ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 19.

⁵ Marine Aquaculture Task Force. p. 20.

⁶ John Tibbetts. p. A318.

⁷ Marine Aquaculture Task Force. p. 13.

⁸ John Tibbetts. p. A318.

⁹ Marine Aquaculture Task Force. pp. 9, 13.

¹⁰ Marine Aquaculture Task Force. p. 9.

aquaculture products as of 2002 were produced by developing nations.¹¹ There are numerous consequences, negative and positive, that result from this trend. China, with the largest population of any country in the world, faced enormous challenges in meeting the nutritional needs of all of its citizens, and aquaculture was part of the answer to this problem. Fish is a protein that is low in fat, high in amino acids, and low in calories. Seafood provides Asia with 25% of its protein, and it is the source of more than 50% of protein for more than 34 nations around the world.¹² John E. Bardach, as early as 1968 saw that aquaculture could help address the food shortages around the world and even become a lucrative business, even though he was only dealing with “scanty data” from a developing industry.¹³ There are also many economic benefits to developing sustainable aquaculture industries because they create many jobs in developing countries. The risks associated with growing aquaculture businesses, however, are that they are likely to be developed cheaply and in unsustainable ways in more impoverished countries, where most aquaculture is being practiced.

The aquaculture industry in the United States is small, but there is a desire to expand it due to the huge trade deficit and potential for growth and development. Currently, aquaculture products are estimated to be worth \$1 billion, with a \$5 billion goal being set for 2025 by the United States government.¹⁴ The U.S. produces less than 1% of the worldwide aquaculture output, but is still the third largest importer of seafood in the world. With 4,000 aquaculture facilities in the nation the industry may seem large, but many of the farms are small. Also, the

¹¹ Marine Aquaculture Task Force. p. 13.

¹² John Tibbetts. p. A320.

¹³ Bardach, John E. “Aquaculture” *Science*, New Series, Vol. 161, No. 3846 (Sep. 13, 1968), pp. 1098, 1104.

¹⁴ Marine Aquaculture Task Force. p. 1.

U.S. industry is not incredibly diversified, with catfish production accounting for 71% of total production in 2003.¹⁵

James Muir says, “It is now almost a truism that aquaculture is market-driven.”¹⁶ This statement points to the fact that demand dictates production, but it is important to understand where this demand comes from. The health benefits of eating fish are a large reason that demand is so high, and it is believed that fish consumption will increase by 30% in the next two decades, but there are also other changes in demand trends that have already occurred or are expected to happen concerning the quality of food.¹⁷ Current environmental concerns over depleted fish stocks and other “green” values in the United States and other developed countries are already altering the aquaculture industry.¹⁸ The organic sector is growing at 20% per year and currently represents an \$11 billion market. 70% of U.S. consumers claim to prefer seafood that is said to be sustainable.¹⁹ These statistics reflect a desire for higher quality seafood that does not damage the environment; yet, the seafood and aquaculture industries face unique challenges in meeting these goals due to the lack of organic standards for fish. Organic certifications for seafood are offered by more than twenty different organizations worldwide, all with different specifications. It is also impossible to transfer the organic qualities for terrestrial animals to seafood because of the entirely different nature of the animals.²⁰ The World Wildlife Fund is pushing for aquaculture

¹⁵ Marine Aquaculture Task Force. p. 10.

¹⁶ James Muir. “Managing to Harvest? Perspectives on the Potential of Aquaculture” *Philosophical Transactions: Biological Sciences*, Vol. 360, No. 1453, *Fisheries: A Future?* (Jan. 29, 2005), p. 204.

¹⁷ Stephanie Boehmer, Mary Gold, Stephanie Hauser, Bill Thomas and Ann Young. *Organic Aquaculture*. Beltsville, MD : Alternative Farming Systems Information Center, January, 2005. p. 10.

¹⁸ James Muir. p. 205.

¹⁹ Marine Aquaculture Task Force. p. 103.

²⁰ Stephanie Boehmer et. all, pp. 4, 7.

standards to be more stringent in terms of treatment of the animals, but they are going to need more help from the private sector in order to demand environmentally sustainable aquaculture.²¹

Given the size and continued development of the aquaculture trade around the world, it is important to note the environmental risks the business imposes and the impacts that the industry has had around the world, before focusing on its specific condition in South Florida. Until the aquaculture boom in recent decades, the industry was not considered environmentally destructive. With the growth of farms in wetlands and increased cage-farming in coastal zones, more areas are being affected by the industry by increased pollution, diseases, and habitat destruction.²² The destruction of mangroves in Southeast Asia and South America is of particular concern to many environmentalists. 50% of mangroves in the Philippines, 27% in Thailand, and 13% in Ecuador have been converted for aquacultural use.²³

There is also widespread concern about fish escapes from farms and the effect that they can have on the native species of plants and animals. It is estimated that 1.5% of fish escape from fish cages, and many are able to breed with native populations. These escapes occur as a result of routine operations like stocking or transferring tanks, infrastructural flaws, or natural disasters like hurricanes.²⁴ The genetic makeup of farmed fish is often far different from wild fish because of genetic engineering, and the farmed fish are generally not as genetically fit to survive in the wild, decreasing the health of the wild population.²⁵ If the species are not native, then there are other risks associated with escapes. Competition for food and space becomes an issue, as does predation on native species because most farmed fish are carnivores.²⁶ In some areas, escapes

²¹ Marine Aquaculture Task Force. p. 109.

²² T.V.R. Pillay. *Aquaculture and the Environment: Second Edition* (Oxford, UK: Blackwell Publishing) 2004. p. 3.

²³ T.V.R. Pillay. p. 31-32.

²⁴ James Muir. p. 200.

²⁵ Marine Aquaculture Task Force. p. 48.

²⁶ Marine Aquaculture Task Force. p. 49.

have become such a problem that the farmed species are dominating the environment. For example, it is believed that 50% of salmon caught in Norway are of farmed origin.²⁷

Diseases also pose many problems on aquaculture farms, and pathogens have sometimes spread to the outside environment as well. Diseases have devastated shrimp stocks around the world, oyster diseases hurt the east coast industry in the 1950s, and there have been countless numbers of fish that have died because of the crowded living situations on many farms.²⁸ There are only ten FDA approved drugs in the U.S., and there are risks that using these drugs will devalue the stock; consequently, vaccines are being developed to prevent diseases from ever infecting farms. All states along the east coast of the U.S. also have shellfish disease policies to help prevent and contain outbreaks.²⁹ Diseases not only affect farmed organisms, but they often spread to the environment, especially in aquaculture systems with direct access to waterways. In many shrimp disease outbreaks, the contagion spreads between the shrimp and the water, and it is then transferred to birds and other organisms that feed off the waste of the farm.³⁰

It is generally understood that aquaculture is unsustainable as it is practiced today. One reason is that underdeveloped countries often do not follow best management practices, which greatly increases the chance of disease outbreaks, fish escapes, and habitat destruction. Many people reject any government funding of the industry because of its harm to the environment. Others argue that the industry can never be sustainable because fish farms rely on wild fish populations for feed, which puts stress on species like anchovies, herring, and menhaden.³¹ Most

²⁷ James Muir. p. 201.

²⁸ Marine Aquaculture Task Force. p. 61.

²⁹ Marine Aquaculture Task Force. p. 64.

³⁰ John Tibbetts. "Aquaculture: Satisfying the Global Appetite." p. A322.

³¹ Joshua Reichert. "A Farm-Raised Fish Tale." December 5th, 2005.

http://www.pewtrusts.org/news_room_detail.aspx?id=23586 (accessed April 26th, 2009).

scientists and aquaculturists would disagree with these claims, saying that properly managed aquaculture causes little or no harm to the environment.³²

Considering the ecological impacts of aquaculture around the world, it is now important to explore the unique aspects of the industry as it is practiced in Florida. The state's aquaculture was practiced on a small scale until a boom in the late 1980s through the 1990s. In 1987, 342 farms sold \$35 million in aquacultural products. In 2003, the amount of farms grew to 544, and sales totaled \$99.5 million. Growth in the industry was hampered by the 2004 and 2005 hurricane seasons; consequently, in 2005 the number of farms dropped to 359, and they sold \$74.9 million in product.³³ Interestingly, total acreage of aquaculture facilities in Florida has decreased in the same time period, from 1987 to 2005. In 1987, the 342 farms totaled 8,425 acres; contrastingly, in 2005, 359 farms totaled 3,010 acres. Improved efficiency in growing techniques created a six fold increase in revenue per acre from \$4,154/acre to \$24,917/acre.³⁴

Florida aquaculture is unique for many reasons, one of which is that a large portion of aquacultural products are not used for human consumption. 65% of production in the state goes towards tropical fish species for aquariums. The remaining 35% spans a wide range of species of mollusks, food fish, alligator, game fish, crustaceans, and aquatic plants. An estimated total of 1,500 species are grown in Florida aquacultural facilities.³⁵ There are over 133 producers of tropical fish that breed from 600-800 species, worth an estimated \$33.2 million in 2005, contributing 44% of Florida's aquaculture revenue. There is a ninety year history of growing

³² John Tibbetts. p. A322.

³³ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 9.

³⁴ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 5.

³⁵ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. pp. 6, 9.

ornamental fish in the state, which is one important reason why this segment of the industry is so well developed.³⁶

Although other aquaculture sectors are not as developed in Florida, they are still extremely important to the industry. Two important products of Florida are aquatic plants and living rock. Nineteen farms in Florida produce \$17.56 million from 600 species of aquatic plants. Florida's living rock and coral industries have also helped protect natural reefs since harvesting in the wild was made illegal in the 1990s. The result of these marine rock farms is a cut in wild rock profits by almost \$10 million since 1990.³⁷ Another unique product of Florida aquaculture is alligator meat and hides. Florida is perfectly situated to be the leading producer of alligator in the country, but the market for meat is small and only the highest quality hides are used by fashion designers; consequently, researchers are trying to create new markets for alligator meat outside of the southern states and also find a market for lower-grade hides.³⁸

Mollusks and crustaceans are also important aquaculture products to Florida. Profits from Northern Hard Clam farms in the state have gone from \$5.4 million in 1995 to \$18.3 million in 2001. The development in this sector has been largely affected by research done at the University of Florida's Cedar Key facility, designed specifically to help aquaculturists.³⁹ Pacific white shrimp are also grown in South Florida and the Florida Keys, and production of these animals has grown especially since citrus farmers have realized they can produce them during the off-season for oranges in easily constructed ponds. Three ponds have been established on citrus

³⁶ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 11-12.

³⁷ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. pp. 12, 14.

³⁸ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 18.

³⁹ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 16.

farms near Ft. Pierce for research purposes in helping the culturing of this shrimp to become sustainable.⁴⁰

Fish farms comprise only a small section of the aquaculture production in Florida, but they also show some of the most promise for growth. Catfish farms, especially in Alabama, dominate the industry in the United States and are responsible for 71% of total aquacultural production.⁴¹ 155,000 acres spread around more than 1,000 farms are devoted to growing this animal around the country; yet, there are only twelve farms in Florida producing catfish. The University of Florida is trying to develop this industry to compete with other states.⁴² There are also small striped bass farms around the state, tilapia farms, and sturgeon farms which are significant to the state's aquaculture industry. Tilapia is an especially durable fish, able to survive in poor conditions; consequently, it is used in more than 15 middle and high school education programs to spread awareness of aquaculture. Interestingly, however, most tilapia production serves the local market because it cannot compete on the international scale of production, and wild tilapia is also common in Florida. The growing number of education programs using tilapia, however, is encouraging for the growth of the industry. Florida also breeds the widest variety of sturgeons, an extremely valuable and large fish, but it is hard to grow for a profit because 10 years are needed in order for these species to be used for caviar production. The University of Miami, along with the Mote Marine Laboratory, is researching ways to make this fish even more profitable for Florida aquaculturists.⁴³

Even with all of these varieties of species grown in Florida, aquaculture still represents only a fraction of the seafood production in the state. The 5,270 Commercial fishermen in

⁴⁰ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 17.

⁴¹ Marine Aquaculture Task Force. p. 15.

⁴² Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 20.

⁴³ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 21

Florida catch 81 million pounds of wild food-fish every year, worth \$173 million, while aquaculturists only produce \$1.4 million in food-fish.⁴⁴ One reason for this is that farms are generally small in Florida when compared to the huge catfish farms of Alabama or the farms in Asia and South America. 64% of farms use less than 6 acres, while only 13% use above 20 acres. There are also a wide range of production methods as a result of these many small farms. There are 166 facilities that use ponds, 50 that use raceways (long ponds with flowing water), 61 that use water recirculation systems, 6 that use non-recirculation systems, 6 that use cages, and 1 that uses farm pens.⁴⁵ It is also important to note that there are some benefits to the small scale of farms in that they are able to adapt more to changing circumstances and implement new, environmentally friendly technology.

Florida is home to many unique and fragile ecosystems; as a result, aquaculture has had many impacts on the environment, and the industry will continue to do so if facilities are not designed in a sustainable manner. The first recorded impact that the business had in Florida occurred when the *Hydrilla* plant invaded the waterways of Miami in 1959. A Tampa Bay farmer had received a plant to cultivate for sales in aquariums, and he sent some to a family on Old Cutler Road in Miami. This family, misidentifying the plant species, was going to market it to aquarium owners by growing it in the canal behind their house. Soon after, Snapper Creek in South Miami was affected by a severe weed infestation.⁴⁶

Another case of an invasive species altering Florida ecosystems occurred when a non-native population of blue tilapia escaped from farms. The species outcompeted the native tilapia for food, and spawning areas in the Everglades, drastically reducing the wild population and

⁴⁴ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 19.

⁴⁵ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 10.

⁴⁶ Florida Department of Environmental Protection. "How was Hydrilla Introduced into Florida?" Bureau of Invasive Plant Management Circular 18. http://myfwc.com/docs/WildlifeHabitats/InvasivePlants_Circular18.pdf (accessed April 27th, 2009).

other species of animals and vegetation.⁴⁷ One farmed species of clam in Cedar Key has also posed problems for aquaculturists because it has been able to genetically interact and hybridize with the wild population. These interactions greatly reduced the wild stock of clams, which poses problems for their long-term survival because the wild clams are more genetically fit to survive.⁴⁸

These are just a few examples of the effects that farmed species have had on Florida ecosystems, but these instances are important to understand when discussing the opposition to a growing aquaculture industry. Florida is home to many important ecosystems, and coral reefs and wetlands are especially vulnerable to effects of invasive species or aquatic diseases. The South Atlantic Fishery Management Council (SAFMC) lists many species native to Florida that could be threatened by continued growth of aquaculture: Red drum, snapper, grouper, bass, some shrimp, and corals are just a few of these species. Areas from Cape Canaveral to Biscayne Bay and National park are listed as areas that have been adversely affected by aquaculture, along with the Florida Keys National Marine Sanctuary. The east coast of Florida is home to more than 500 native species, and so the SAFMC contends that it is in need of protection from a large aquaculture industry.⁴⁹ The council states that small-scale production would be ok to continue, so long as genetically modified fish and non-native species are prohibited from being produced. These concerns also result from the fact that Florida fisheries are already under attack from other sources, such as pollution and overfishing.⁵⁰

⁴⁷ Ned Marsh and Ray Wolslegel, "Environmental Impact of Aquaculture." December 7th, 1998.
<http://www.providence.edu/polisci/students/aquaculture/EnvironmentalImpact.html>
(accessed April 26th, 2009).

⁴⁸ Marine Aquaculture Task Force. p. 51.

⁴⁹ South Atlantic Fishery Management Council, "Policies for the Protection and Restoration of Essential Fish Habitats from Marine Aquaculture." June, 2007.
<http://www.safmc.net/Portals/0/HabitatPolicies/SAFMCAquaPolicyFinalJune07.pdf> (accessed April 27th, 2009). pp. 2-3.

⁵⁰ South Atlantic Fishery Management Council. pp. 5-6.

Aquaculture in Florida is also the focus of much regulation for other reasons. Mangroves in the state have been being destroyed for years in order to encourage agricultural and urban development. The Lake Worth area, for example, has lost over 87% of its mangroves, while Tampa Bay has lost 44%. These areas are valuable for two very important reasons: Mangroves help to cycle organic materials and nutrients into the environment, and they also act as a nursery for snook, snapper, shrimp, and many other aquatic species.⁵¹ Mangroves are often the sites used to construct many fish farms on because of their proximity to the coast and access to water, and Florida cannot afford to lose more of these precious forests; however, it is interesting to note that mangroves are not even good sites for aquaculture because of the acidity of the water from the nutrients.⁵² Mangroves have simply been used because they were not seen to be useful for any other purpose in the past, but with more education as to their value in Florida, hopefully they can be preserved.

The Florida state government has done a lot in recent years to promote the development of the aquaculture industry, much like the Federal Government has. Until extremely recently, the process for obtaining and retaining aquaculture permits were extremely complex. There were 22 Florida Statute chapters, 16 rules chapters, and 534 rules that governed aquaculture in some fashion through the 1990s.⁵³ These complex regulations, along with a lack of venture capital were two reasons that aquaculturists saw a need for change in a 1995 survey. Directly related to these issues is the fact that aquaculture was not defined as agriculture in Florida, which subjected aquatic farmers to the strict regulations of commercial fishermen because they produced a

⁵¹ Florida Department of Environmental Protection, "Mangroves: Walking Trees." June 20th, 2008. <http://www.dep.state.fl.us/coastal/habitats/mangroves.htm> (accessed April 26th, 2009).

⁵² T.V.R. Pillay. *Aquaculture and the Environment: Second Edition*. p. 34.

⁵³ Florida House of Representatives Committee on Agriculture and Consumer Services. *Florida's Role in the Future of Aquaculture*. Tallahassee, FL. 1995. p. 2.

“natural resource,” rather than an agricultural product.⁵⁴ Efforts to classify aquaculture as agriculture were successful eventually, which simplified the processes for obtaining permits by having aquaculturists only answerable to the Department of Agriculture and Consumer Services (DACS).⁵⁵ These simplifications were largely the result of the efforts of the Aquaculture Review Council, which was put together by the government of Florida and represented members of all sectors of aquaculture. This group stated its desires to the state as to how the government could promote aquaculture growth.⁵⁶

It is significant that there was no environmentalist representative present on the Aquaculture Review Council; nonetheless, large farms producing more than 100,000 pounds of fish are subject to inspection from the Department of Environmental Protection (DEP) and are now forced to obtain federal permits under the Clean Water Act. Most small farms, however, have less strict requirements.⁵⁷ A possible reason for the omission of the DEP as a regulating body for small farms is that it has had conflicting regulations with the DACS in the past, and streamlining the growth of the aquaculture industry demanded only one governing organization.⁵⁸ The intervention of the DEP is arguably unnecessary in Florida and other developed areas, however, because aquaculture has been relatively sustainable where it has been developed with good regulations. Also, the aquaculture industry has environmental health in its best interest because clean water is necessary for producing the most valuable fish.⁵⁹

⁵⁴ Florida House of Representatives Committee on Agriculture and Consumer Services. p. 12.

⁵⁵ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 26.

⁵⁶ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 25.

⁵⁷ Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. p. 26.

⁵⁸ Florida House of Representatives Committee on Agriculture and Consumer Services. p. 11.

⁵⁹ Florida House of Representatives Committee on Agriculture and Consumer Services. p. 11.

Florida had been notorious for being the hardest state to develop an aquaculture business in until new legislation was passed, which is represented in the 2008 Florida Statutes.⁶⁰ As early as 1995, town meetings were called across the state that were to be attended by “aquaculture producers, environmentalist representatives of state and local governments, and other interested parties” in order to discuss the results of the aquaculture survey and propose legislation.⁶¹ Goals set by the *Florida Aquaculture Plan 2008-2009* were to educate the public on aquaculture, develop new techniques, expand all markets, reduce feed costs, expand the leather and meat markets for alligator, improve understanding of gene interaction, and develop immunity to pathogens.⁶²

The 2008 Florida Statutes reflect a desire to achieve the goals set in the *Aquaculture Plan* through legislation. Chapter 597 of the Florida Statutes is entirely dedicated to governing aquaculture, and it contains many important changes from prior legislation. First, aquaculture is defined as agriculture.⁶³ This definition places much less limitations on what species and how many animals that aquaculturists can produce and harvest. It is also stated that the government will enhance industry growth while also protecting the environment.⁶⁴ These broad claims should help to satisfy both producers and environmentalists.

One of the more interesting statutes states that the government can give state lands to aquaculturists, so long as they would not harm the environment.⁶⁵ Although there is a stipulation that the farms would have to be sustainable, the government’s economic concerns might override

⁶⁰ Florida House of Representatives Committee on Agriculture and Consumer Services. p. 15.

⁶¹ Florida House of Representatives Committee on Agriculture and Consumer Services. Appendix B.

⁶² Charles H. Bronson. *Florida Aquaculture Plan 2008-2009*. pp. 27-29.

⁶³ Florida Senate, "The 2008 Florida Statutes : Chapter 597 : Aquaculture."

http://flsenate.gov/statutes/index.cfm?App_mode=Display_Statute&URL=Ch0597/ch059.htm (accessed April 26th, 2009). Chapter 597.002.

⁶⁴ Florida Senate, "The 2008 Florida Statutes : Chapter 597 : Aquaculture." 597.0021.

⁶⁵ Florida Senate, "The 2008 Florida Statutes : Chapter 597 : Aquaculture." 597.003.

environmental concerns in the allotment of state lands, which could be devastating to certain ecosystems. It is important that the best management practices laid out in the statutes be followed stringently by all aquaculture producers if environmental damage is to be prevented. One of the most important laws set out in Chapter 597 is that it is illegal to mix farmed species with wild species, and there are punishments laid out for violating these best management practices.⁶⁶ Additionally, the federal government's Gulf Council has approved a plan for regulating offshore marine aquaculture in federal waters. This council, however, cannot supersede the Environmental Protection Agency or Coast Guard, and the plan focuses on species and habitat conservation rather than developing new species of fish to farm.⁶⁷ Clearly, based on all of this legislation devoted to aquaculture, the government is encouraging growth in the industry in order to keep up with the huge demand for seafood in South Florida and the rest of the United States.

Researchers in South Florida are looking into many new technologies and species of fish to grow in order to have a healthy, sustainable food source. One of the most interesting and widely publicized projects is being carried out by Dr. Benetti of the University of Miami, who has partnered with *Snapperfarm, inc.* to develop a plan to grow cobia in open-ocean cages off the coast of Puerto Rico (Currently, cobia is an illegal species to grow in the United States).⁶⁸ Dr. Benetti, one of the world's leading aquaculture experts, sees cobia as the future of aquaculture for many reasons. The fish is very valuable because it is difficult to catch in the wild, and the taste and texture make it a very desirable fish for restaurants. Cobia has very low mortality rates, has a high spawning rate, and grows extremely quickly in captivity. Perhaps the most important feature of the fish that makes it appealing, however, is that it is a native species of South

⁶⁶ Florida Senate, "The 2008 Florida Statutes : Chapter 597 : Aquaculture." 597.0041.

⁶⁷ Charles H. Bronson. "Florida Aquaculture" Issue 69. March, 2009.
http://www.floridaaquaculture.com/publications/Issue_69.pdf (accessed April 27th, 2009). p. 3.

⁶⁸ Josh Schownwald. "A Fish Farmer's Tale." January 19th, 2006.
<http://www.miaminewtimes.com/2006-01-19/news/a-fish-farmer-s-tale/1> (accessed April 27th, 2009). p.1.

Florida.⁶⁹ All of these characteristics make cobia an extremely appealing fish for Benetti and other aquaculturists.

There are, however, a lot of environmental, financial, and technological concerns in cobia development. The biggest concern for environmentalists is that cobia is intensely predatory fish, and in the event of a mass escape they could do tremendous harm to other species. Another concern of environmentalists is that the amount of food it takes to raise cobia would put a greater strain on wild populations of feed-fish like anchovies, which would not make up for the benefits of raising cobia.⁷⁰ Technological challenges mainly arise when constructing cages that are environmentally resistant. *Snapperfarm, inc.* has suffered from shark attacks that have ripped holes in their giant cages, which has resulted in hundreds of thousands of dollars of fish escaped into the environment. These cages are extremely expensive to produce in the natural habitats of the fish, costing roughly five times more than other methods of aquaculture; however, Benetti believes that the benefits of the cage system outweigh the cost because they result in less pollution to other ecosystems.⁷¹ Financial concerns arise because United States regulations make the fish unprofitable in our country, which supporters of the fish are trying to change as other countries develop more advanced cobia production systems.⁷²

Snapperfarm, inc. has been successful for a number of reasons in promoting the aquaculture industry in South Florida and the United States. Its bold program and intense research on new aquaculture techniques is a perfect example of what the industry needs in order to grow. Scientists at the Rosenstiel School of Marine and Atmospheric Science (RSMAS), at the University of Miami, are trying to use the cages in Puerto Rico to develop a “warning system”

⁶⁹ Josh Schownwald. p. 1.

⁷⁰ Josh Schownwald. pp. 4-5.

⁷¹ Josh Schownwald. p. 4.

⁷² Josh Schownwald. p. 5.

for environmental impacts of aquaculture so that the harmful effects of the trade can be avoided. Additionally, the National Ocean and Atmospheric Administration has given substantial grants of over \$1 million to RSMAS in order to develop these systems.⁷³ Large scale programs, like *Snapperfarm*, help to increase awareness of the needs for a sustainable aquaculture industry in the minds of the public, who are often the most effective supporters of change.

With increased government and private support for the aquaculture industry in South Florida, it is extremely likely that more productive, sustainable farms will be constructed in the future. There are obviously obstacles that need to be overcome in order to achieve the goals stated in the *Florida Aquaculture Plan*; however, the government and institutions like the University of Miami and University of Florida are leading the way in providing support for this extremely important industry. Environmental concerns need to be taken seriously by producers and regulating institutions. Solid science is the base upon which the industry needs to develop. Too many aquaculture producers around the world have constructed unsustainable farms in order to achieve quick profit; consequently, aquaculture is now commonly seen as an environmentally destructive industry. South Florida aquaculturists need to continue to adapt to new technologies in order to show the public how beneficial aquaculture can be in providing economic and nutritional benefits to many different communities.

It is indisputable that aquaculture will play an increasingly large role in the future of the seafood industry in South Florida, and across the globe, as the demand for seafood increases along with the world's population. State and federal governments are going to need to regulate the industry based on solid science and the best interest of all people. More efficient land and water use techniques need to be developed. Disease control at aquaculture facilities needs to be

⁷³ Rosenstiel School of Marine & Atmospheric Science, "Aquaculture Accolades." September 15th, 2006. <http://www.rsmas.miami.edu/pressreleases/20060915-aquaculture.html> (accessed April 26th, 2009).

improved, and non-native species need to be kept out of local habitats. Most importantly, the public needs to be educated on the real benefits and risks associated with aquaculture in order to encourage environmentally sustainable practices.

The values of aquaculture cannot be ignored. Half of *all* of the world's seafood, not just fish for human consumption, will be farmed by the year 2030; consequently, aquaculturists need to increase the benefits while eliminating the risks associated with the industry.⁷⁴ The nutritional needs of people around the world will be difficult to meet without a strong aquaculture industry. Farms provide hundreds of thousands of jobs to people in developing nations. Wild fisheries are allowed to recover while strains on their populations are alleviated because of increased production of aquaculture. South Florida has taken steps in the right direction in encouraging sustainable growth for the aquaculture industry. The results can be seen in the increased production with far less harmful environmental impacts. The facts all point to one conclusion: The benefits to the health, the economy, and the environment of the world outweigh the risks of a growing aquaculture industry that is developed with environmental sustainability in mind.

⁷⁴ James Muir. "Managing to Harvest?" p. 213.

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