



Florida Aquaculture Plan

Charles H. Bronson

Commissioner of Agriculture

Florida Dept of Agriculture and Consumer Services

2011-2012



Florida Aquaculture...

- *469 aquafarms reported \$61.3 million in sales.*
- *Greatest variety of species farmed in the United States.*
- *Top U.S. producer: tropical and marine ornamental fish, hard clam, live rock.*
- *Oyster reef construction and maintenance, Florida's longest running marine conservation program, began in 1913.*

Cover image: Paddle-wheel aerator at work in a West Florida channel catfish pond.

Florida Aquaculture



Dear Floridians:

Florida aquaculture is an extraordinarily diverse segment of Florida agriculture. More than 1,500 species or varieties of fish, plants, molluscs, crustaceans, and reptiles are grown in ponds, tanks, high-tech indoor systems, and on leased, sovereign submerged lands. Florida aquafarmers produce products for the food and non-food markets that include seafood (fish and shellfish), freshwater and marine aquarium hobby, high fashion leather, water gardening, bait, biological control, or seed for national and international aquaculturists to culture. This diversity is unique to Florida.

The Florida Aquaculture Plan is a planning tool to coordinate efforts amongst the Florida Legislature, Governor's Office, state agencies, and state university system. Public investment and a cooperative public-private approach are needed to sustain Florida aquaculture growth and development. There are many challenges facing Florida farmers and Florida: global trade, adverse weather, and national economic woes. Together we can solve these problems and with this planning document we have a road map for future success.



Sincerely,

A handwritten signature in cursive script that reads "Charles H. Bronson".

Charles H. Bronson
Commissioner of Agriculture

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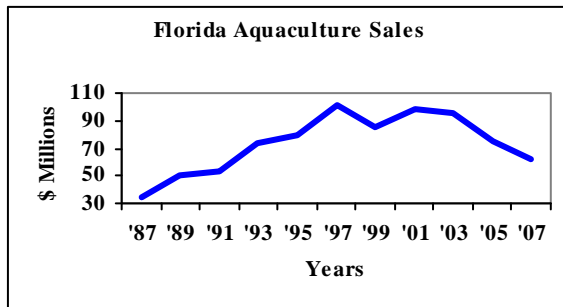
Executive Summary

Florida Aquaculture is a very diverse agricultural segment across the factors critical to aquafarming: species, production systems, and geographic locations. Floridians farm an estimated 1,500 species or varieties of fish, plants, molluscs, crustaceans, and reptiles. These products are sold into food and non-food markets that include seafood, freshwater and marine aquarium hobbies, high fashion leather, water gardening, bait, or biological control.

Farm designs used to produce these products include lined and unlined earthen ponds, raceways, high-tech indoor tanks, tank and pond hybrid systems, and sovereignty submerged land leases (e.g., hard clam, oyster and live rock). Aquaculture facilities are constructed and managed to be environmentally compatible with Florida's abundant natural resources and varied ecotypes.

Florida aquaculturists have dramatically improved the efficient use of land and water. Aquaculturists in 1987 managed 8,425 acres of land and water distributed over 342 farms to produce \$4,154 worth of sales per acre. In 2005, 359 Florida aqua-farms produced more than six times the value of sales (\$24,917 per acre) through improved production practices and efficient water management and re-use on 3,010 acres of land and water.

Over 20 years of state and national agricultural surveys, Florida aquaculture has grown from \$35 million in 1987 to \$61 million in 2007. Sales by Florida aquaculturists steadily increased from 1987



(the first survey) until 1997 and has declined since then. Decline is attributed to farmer decision making to leave aquaculture because of the destructive 2004 and 2005 hurricanes, rising feed and fuel costs, and increasing competition from global trade. However, Florida's aquaculturists are adapting to change by investigating new species to culture (e.g., marine ornamentals, molluscs, and food fish), new markets (e.g., biofuel), and new production systems (e.g., marine net pens).

Over the last 27 years, since the inception of the Florida Aquaculture Policy Act, the Florida Legislature has repeatedly amended the Act to: consolidate regulatory activities to one agency, recognize that aquaculture is an agricultural endeavor, and invest public funds in applied research, industry development, job retraining, and public education at the high school and university levels. Through these critical public policy changes and public investments the makeup of the industry has evolved and grown to benefit rural communities and small businesses throughout Florida.

The *Florida Aquaculture Plan 2011-2012* provides an analysis of industry status and identifies technical, production, economic, and market related challenges that must be solved to insure continued growth and expansion. Societal, political and economic trends that are accelerating globalization of trade, fuel and feed costs, and information exchange and technology sharing requires unceasing innovation by Florida farmers to remain competitive. As an advisory body to the Commissioner of Agriculture, the Aquaculture Review Council identified the following challenges. Each challenge is of equal importance to the industry.

2011-2012 Florida Aquaculture Plan Priorities

Comprehensive Issues

- Develop innovative production techniques that comply with Best Management Practices for aquaculture.
- Improve understanding of the ecological effects associated with nonnative species, strengthen farm biosecurity, and expand public education.

- Develop packaging and processing techniques to improve quality, shelf life, and marketability of aquaculture produced products.
- Develop techniques to eliminate or mitigate off-flavor compounds in aquaculture food products.
- Develop reproductive techniques, including molecular and cellular approaches, to spawn and produce economically viable marine and freshwater aquaculture species.
- Develop cost effective, high performing post-larval production diets through improved feed technology and feed management strategies.
- Create infrastructure to enhance veterinary support to develop health maintenance protocols, diagnostic programs, and clinical responses to health challenges.
- Approve new drugs, chemicals or develop alternative methods to combat pests and pathogens in farm production systems.
- Conduct market research encompassing value, demand, product form, price, substitutable products, and competitive sources.
- Integrate industry-public agency marketing efforts to address consumer awareness, and product promotion.
- Compile and disseminate up-to-date state regulatory actions that affect the sales of live products.
- Enhance educational opportunities for all educational levels as a means to bring aquaculture to the public and train a skilled workforce.
- Survey of aquaculture educational programs in the Florida school system at middle school through post-secondary level.

Ornamental Fish and Aquatic Plants

- Develop improved production techniques for existing and new species, gain approval for new drugs to maintain fish health, and develop better recirculation technology to conserve water.
- Increase research on particular diseases of ornamental fish.
- Develop new farm management tools to increase profitability and efficiency.
- Marine ornamentals: Quantify and qualify physiological, nutri-

tional, cultural, economic, health management and market information. Develop and test practical production techniques.

- Aquatic plants: Develop production methods for plants not currently in culture, quantify plant nutritional needs, and identify new pesticides for use on the farm.
- Create and support national marketing campaign to expand the hobby in cooperation with aquarium equipment manufacturers and distributors.

Molluscs

- Improve production practices for molluscan shellfish, especially hard clams, with emphasis on predator and fouling control, and species diversification.
- Improve hard clam genetics to increase summer survival and product quality.
- Seek Interstate Shellfish Sanitation Conference approval for a faster brevetoxin assay to replace current practices.

Food Fish

- Integrate freshwater and marine demonstration projects that bring production, economic, and marketing specialists together to improve or develop: production systems (ponds, recirculating tanks, raceways, cages, and hybrid systems), spawning and hatchery techniques, and product value.
- Improve fish nutrition for the variety of specialty species grown and produce microencapsulate feeds and batch plankton culture procedures for larval marine species.
- Reduce feed costs and develop plant-based replacements for fish meal and oil.
- Evaluate the performance of existing manufactured diets on emerging fish species.
- Develop techniques to spawn and produce hybrid striped bass fingerlings on a continuous basis.
- Create the opportunity to commercially culture the shortnose sturgeon.

Alligator

- Identify and develop treatments for skin diseases and parasites.
- Develop new markets for number 2 and number 3 grade raw hides.
- Expand demand for alligator meat in markets outside of Florida.
- Develop efficient and effective feeds for better nutrition.
- Determine genetic predisposition for skin diseases.
- Establish an alligator leather production, wholesale, and retail infrastructure.

Gamefish: Fry, Fingerlings, and Stockers

- Improve larval nutrition for species by developing microencapsulated feeds and the techniques to mass culture zoo- and phytoplankton.
- Improve fish health and develop low impact handling/grading and culture techniques to reduce cannibalism.

Biotechnology

- Explain gene interaction and expression.
- Induce host immunity and resistance to pathogens.
- Create bioprocess engineering for beneficial bacteria and viruses.
- Increase lipid production in biofuel microalgae.

Florida Aquaculture Plan: Purpose and Intent

As established in the Florida Aquaculture Policy Act (Chapter 597, Florida Statutes), aquaculture is agriculture and the Florida Department of Agriculture and Consumer Services is the lead aquaculture agency (visit <http://www.leg.state.fl.us/Statutes/> for current Florida laws). The Act directs the Department to coordinate and assist in the development of aquaculture and to regulate aquafarms with the objectives of protecting or conserving Florida's natural resources. In order to meet these objectives, the Department's Division of Aquaculture was created on July 1, 1999. The Act directs the Department to annually revise the *Florida Aquaculture Plan*.

The *Florida Aquaculture Plan 2011-2012* is created to ensure effective communication between the Governor, Legislature, public, farming community, and agencies about the status and needs of Florida's aquaculture industry. The *Plan* describes aquacultural priorities and identifies mechanisms for increasing aquaculture production, which leads to the creation of new agribusinesses, job opportunities, income for aquaculturists, and other benefits to the state. Funds designated by the Legislature for aquaculture research and development must be used to address the projects and activities designated in this plan.

The Florida Aquaculture Review Council, a farmer advisory committee to the Commissioner of Agriculture, uses the *Florida Aquaculture Plan 2011-2012* as a steering document. The Council annually weighs aquaculture education and applied research proposals. Projects are reviewed for their applicability to the goals and needs identified in the *Plan*. Council recommendations are then transmitted to the Commissioner of Agriculture for inclusion in the Department's annual budget submission to the Governor and Legislature. If these projects survive the state budgeting process, a contractual agreement is developed between the applicant and the Department. For a list of projects completed since Fiscal Year 2000, please see Appendix A.

Florida Aquaculture

Florida Aquaculture is an extraordinarily diverse farming sector across the species, production systems and geographic locations found in the state. There are an estimated 1,500 species or varieties of fish, plants, molluscs, crustaceans, and reptiles grown. Florida aquafarms culture products for food and non-food markets that include seafood (fish and shellfish), freshwater and marine aquarium hobbyists, high fashion leather, water gardening, bait, biological control, biofuels, or as “seed” for national and international aquaculturists.

Sales by Florida aquaculturists steadily increased from \$35 million in 1987 (the first survey) to a peak of \$102 million in 1997 and has declined since then. Decline is attributed to farmer decision making to leave aquaculture because of extensive hurricane damage in 2004 and 2005, high land values during 2006-2007 that contributed to farm sell-off, rising energy and feed costs, and global competition with foreign producers.

Florida aquafarms are primarily small enterprises in which the owner/operator and family members or partners provide labor and financing. Of the 469 Florida aquafarms that reported farm gate sales in 2007, 58% or 274 farms sold less than \$50,000 worth of aquaculture products, 26% or 121 farms had sales between \$50,000 and \$250,000, and 14% or 66 farms sold between \$250,000 and \$1,000,000.



Farm designs include lined and unlined earthen ponds, outdoor and indoor raceways, indoor tank systems that recondition and recirculate production water, hybrid systems of indoor tanks and outdoor ponds, and leased sovereignty submerged lands. Aquaculture facilities have been constructed and managed to be environmentally compatible with Florida’s flora, fauna, and varied ecotypes.

Florida's Natural Resources

Florida encompasses 65,758 square miles with a tidal shoreline 8,460 miles long. Surface water resources encompass 11,761 square miles and consist of 1,700 streams and rivers 51,858 miles in length, 7,712 lakes, reservoirs, and ponds, 700 springs, and 4,460 square miles of estuaries. Groundwater resources supply 90% of the state's population with potable drinking water and 50 percent of the water needed for agriculture, industry, mining, and electric power generation. Florida's marine waters extend 3.45 statute miles into the Atlantic Ocean and 10.376 statute miles into the Gulf of Mexico with Florida's Gulf Coast composing the eastern shore of America's only Mediterranean-type sea: the 600,000 square mile Gulf of Mexico. Florida is also unique to North America in that its 447 mile north-to-south axis traverses a sequence of diverse ecotypes: North Florida red clay hills, longleaf pine flatwoods, coastal estuaries of the Gulf and Atlantic coasts, deep white sands of the Lake Wales ridge, bald cypress swamps and wet prairies, Gulf and Atlantic coast barrier islands, South Florida karst limestone soil, and the Caribbean-style cays of the Florida Keys. These unique ecological characteristics yield a mosaic of habitats and organisms that have been shaped by a global location that traverses tropic and temperate zones, an ancient and recent geological history, humid climate at latitudes characterized by deserts, and a peninsular configuration that combines island and continental biogeographies.

Aquacultural production occurs throughout the state and has yielded economic benefits to rural communities (i.e., jobs and income) and increased crop diversification. Several examples illustrate these efforts.

Rural coastal communities hit hard by fishery regulations have welcomed the jobs and income by hard clam farming. Five federal and state supported fishermen retraining programs helped jumpstart production which rapidly grew from \$0.43 million worth of product sold during 1987 to \$15 million in 2007. Small coastal and inland communities of the Panhandle, Big Bend, Charlotte Harbor, and Indian

River Lagoon near Sebastian are principal clam production centers that generate \$52 million in total economic impact to the State of Florida (labor, input purchases and ancillary businesses). One of Florida's richest counties, Hillsborough, recognized the phenomenally low ratio of public service support dollars to net economic impact generated by ornamental fish farms and together with the state and federal governments supports a dynamic research facility in Ruskin, the University of Florida's Tropical Aquaculture Laboratory, to strengthen Florida's tropical fish and aquatic plant producers. Citrus producers suffering low product prices examined the potential to grow marine shrimp and baitfish in hard freshwater and pushed for the construction of an aquaculture demonstration and education farm at the University of Florida's Indian River Research and Education Center.

Land and water utilization efficiencies have dramatically improved over the last 20 years as a result of public investment in research and demonstration. Aquaculturists in 1987 managed 8,425 acres of land and water to produce \$4,154 worth of sales per acre. In 2005, farmers utilized 3,010 land and water acres to yield \$24,917 in sales per acre, a six-fold increase, through efficient water management and reuse, improved production practices, and the culture of higher value species.

The diversity in species and production systems provide advantages to small aquafarms. Commodity agriculture creates opportunities for farm concentration and economies of scale that are not readily available to the small farmer. However, large farms cannot readily adopt flexible production schedules, rapidly evolving biological and technical knowledge, or access specialty niche and ethnic markets. Small farmers can adapt to changing circumstances (market or technology) to stay one-step ahead of global competition. Florida aquaculturists are primarily small farmers and the importance of public sector investment in Florida aquaculture cannot be overemphasized. Production and technical information tailored to small farms (scale and cost) and information delivery methods that accommodate small businesses that do not have spare time or personnel are needed.

Public investment that supports research or demonstration facilities in Gainesville, Cedar Key, Ruskin, Ft. Pierce, and Tallahassee creates opportunities to distribute information and demonstrate technology where it is needed in formats and forums readily absorbed and immediately implemented by small farms.

Tropical and Temperate Ornamental Fish and Invertebrates

Ornamental fish production started in Miami in the late 1920s. Tropical fish farming rapidly expanded following the return of World War II veterans. They brought home an appreciation for colorful Asian and South American tropical fish and aquatic plants and began experimenting with outdoor ponds in the warm climate of South Florida.



These pioneers demonstrated the feasibility of air transport by shipping Florida raised ornamental fish via a war surplus DC-3 on a round-the-world tour during the early 1960s. Today, tropical fish production is concentrated in Hillsborough and Polk Counties with some farms located near Miami to take advantage of the Tampa, Orlando or Miami international airports.



Other farms can be found throughout the state, but primarily in the southern half where winter temperatures are favorable.

Ornamental fish for the home aquarium and water garden are Florida's most valuable aquaculture products accounting for 52% of total aquaculture sales. The 2007 Census of Agriculture reported 203 producers with farm gate sales of \$32.1 million. An estimated 600 to 800 species and varieties are produced. Well known aquarium fish include guppies, mollies, swordtails, tetras, gouramies, koi, goldfish, angels, barbs and African cichlids.

While the freshwater ornamental fish industry has grown since the first aquaculture survey in 1987, the current national economic conditions combined with the explosive growth in pet superstores and changing patterns in the spending of disposable income have im-

packed product distribution and sales. Tropical fish farmers are surviving by modifying production to avoid certain low-valued species, adopting production strategies to reduce cost and intensify production, supporting the national FisHedz.com consumer directed promotional campaign to expand the aquarium hobby, and differentiating their business on a service basis. Standard pond production technologies are being gradually improved and intensified to increase production system control and reduce costs. Farmers are adding greenhouse pond covers for freeze protection during the winter and building recirculation systems to increase stocking rates and avoid predation and weather related losses. Farmers have also tested consumer direct marketing via the Internet and tailored production to fit in with “big box” retail store demand and pricing.



The future for ornamental species production, which requires a warm climate and higher levels of technology than many other forms of aquaculture, is bright in Florida. The University of Florida has strengthened its role through sustained expansion and technological improvements at the Tropical Aquaculture Laboratory in Ruskin (<http://tal.ifas.ufl.edu/>). The Laboratory has demonstrated the culture of higher valued species, spawning technology for new species, on-farm management and aquatic animal health practices. They are also continually testing a variety of production systems to conserve water, increase yields, and reduce on-farm mortality. The Laboratory offers diagnostic and production related services. The level of available expertise at the Laboratory includes a U.S. Department of Agriculture Veterinarian Medical Officer and a non-native fish ecologist.

The freshwater ornamental fish sector is a mature agri-business with a 90-year history of growing fish in Florida. Farmers are focused on maintaining market share and developing new techniques

to improve production as well as adding species that are currently imported or entirely new to the hobby. Public assistance is needed to improve profitability and environmental sustainability through activities that include approval of therapeutants to maintain fish health, refinements in water quality management and conservation, new breeding and production methods to create brighter colors and eye-catching finnage, and national promotion to expand the aquarium-keeping hobby.

Aquatic Plants

Aquatic plants are primarily produced in the central and southern portions of Florida for aquarium, water gardening, wetland restoration, and food markets. Aquatic plants are produced by 19 farms with sales totaling \$17.56 million worth of aquatic plants in 2005. In excess of 730 plant species were cultured with most of the production geared to aquarium and water gardening markets. Common types include hardy and tropical water lilies, lotuses, *Anubias*, *Canna*, *Cryptocoryne*, *Echinodorus*, *Iris*, *Vallisneria*, *Aponogeton*, *Cabomba*, and watercress.



Sales have been declining since 2002 with a significant decrease in 2009 due to the recession. Increasing competition from overseas producers in China and Israel continues to play a role in declining sales. Some large wholesalers have switched from domestic sources and are primarily buying from foreign producers. Florida producers are continuing to adjust production to target midsized wholesalers or large retailers by offering a full-line of plant species and aggressively seeking new species or breeding new varieties to produce fuller, more colorful flowering plants.



Aquarium plant producers are supporting the national FisHedz.com aquarium hobby promotional campaign and all aquatic plant producers are increasing their marketing efforts to counter foreign competition and communicate product information and availability.

Aquarium plant producers propagate colorful, slow growing submerged plants that enhance the beauty of home aquariums. Plants with interesting textures, shapes, colors and sizes create living, three-dimensional habitats and absorb nutrients to keep aquariums healthy and vibrant. Aquarium plants are available bunched, bare-root or potted, depending on their growth characteristics and value.



Water gardening has become very popular in the United States as a means to add beauty and value to homes and businesses. Horticulture, trade and consumer publications have nourished this interest by featuring articles describing the design, construction and maintenance of ponds, fountains and grottos. Aquatic plants are an essential component for functional and aesthetic purposes. Florida growers of water lilies and submerged and emergent aquatic plants rapidly expanded production in the mid-1980s and significantly expanded each year to meet demand until the year 2001. From that point on overseas competition has taken a larger and larger share of the market. Considerable effort has been made by producers and University of Florida horticulturists to perfect hybridization and tissue culture techniques to produce new and colorful lilies and to standardize the appearance of popular plants.

A wide variety of native aquatic plants, as well as aquatic plant habitats, are damaged directly or indirectly by human habitation. Ecologists, engineers, and other professionals have developed methods to restore damaged wetlands and mitigate unavoidable losses. Laws requiring wetland restoration have created a mitigation plant industry. The demand for mitigation plants is directly tied to the

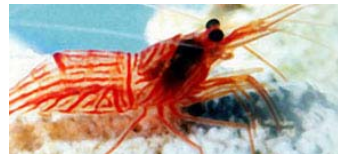
construction industry and the state's efforts to reduce the collection of wild wetland plants.

The aquatic plant production sector of Florida aquaculture will continue to grow as interest in water gardening expands and wetland mitigation/restoration grows. The industry is in need of additional licensed aquatic pesticides for use in controlling pests on the farm. The recent success of the UF-Tropical Aquaculture Laboratory to gain special use labeling for a commonly available pesticide has brought welcomed relief to growers beset by a variety of invertebrate plant pests. Research into the nutritional needs of aquatic plants and research to determine production methods for plants not currently in culture will help boost the industry.

Marine Ornamental Species and Live Rock

Estimates are that 1.5-2 million households worldwide keep marine aquaria (approximately 800,000 in the United States). The global wholesale trade in marine species for aquaria amounts to \$200-330 million and includes fish, corals, sponges, anemones, molluscs, crustaceans and live rock. The annual, global marine ornamental fish trade is estimated to be 40 million specimens. Approximately 1,500 marine ornamental fish species, 500 invertebrate species, and 200 coral species are wild-caught or farmed and sold into the trade.

Most of the wild caught species are associated with reef systems because the majority of pelagic species are unsuited to life in small to medium aquaria. Due to advances in aquarium



keeping, "mini-reef" aquariums are now possible and are one of the fastest growing components of the hobby. In comparison to freshwater fish tanks, mini-reef aquariums require live rock and sand and a variety of reef invertebrates to properly function as captive ecosystems. All of these factors have energized efforts to culture ornamental marine species for the aquarium trade. Only about 40 of the species currently traded can be farm raised and are commercially available. Cultured fish account for one to two percent of the global trade.

Enterprising Florida farmers have been commercially raising clownfish since the early 1970s. Three facilities were dedicated to the culture of marine tropicals with emphasis on clownfish. Currently, a variety of marine species (gobies, dottybacks, sergeant majors, queen triggerfish, angelfish, seahorses, and ornamental shrimp) are being investigated or produced on a limited scale. Rapid growth in the production of marine tropicals is hampered by a lack of information related to life history, culture techniques, nutrition, health management and economic analysis. Recent advances in marine food fish aquaculture, specifically in hatching and larval rearing of small marine eggs and larvae, may create an opportunity for an increase in the species which can successfully be cultured on farms.

In addition to colorful and exotic marine reef fish, hobbyists are also interested in a wide variety of crustaceans, corals, and molluscs. Various ornamental shrimp (golden banded coral, fire, Caribbean anemone, clown anemone and peppermint), molluscs (queen conch, Florida fighting conch, giant clams (*Tridacna* spp)) and other invertebrates (feather duster worm) are prime candidates for aquaculture. Immediate production and distribution of these species is slowed by work needed to resolve larval survival or regulatory conflicts.

Land-based aquaculture of corals, both hard and soft corals, is another emerging segment of marine ornamental production. Most production involves taking “cuttings” or fragments of parent colonies and allowing them to grow to market size. Regulations surrounding harvest, possession, and sale of native Atlantic and Caribbean hard corals limits this production to Indo-Pacific species, but research is being conducted to explore opportunities to culture native corals for restoration purposes.

Live rock consists of living marine plants and animals growing on the surface and within the crevices of dead coralline rubble pieces or porous calcareous rock. Encrustation may consist of sponges, algae, anemones, marine worms, tunicates, bryozoans and an undefined number and variety of microflora and fauna. Hobbyists value the live rock for aesthetic and functional reasons. Live rock in an aquar-

ium creates an instant reef of varied life forms and the macro- and micro-biotic components maintain water quality. Approximately, two pounds of live rock are used for every gallon of water in the aquarium.

The harvest of naturally-occurring live rock in Florida waters (state and federal) was prohibited in the late 1990s. During the peak, roughly 300 tons of live rock valued at an estimated \$10 million was harvested annually. Former live rock harvesters have established nearly 50 submerged land leases in state and federal waters. They deposited fossilized, quarried coralline or calcareous rock on these leases to provide a substrate for the recruitment of encrusting species. Rock placed too shallow becomes an attachment site for undesirable algae and all sites have experienced damage and loss due to algae blooms and tropical weather systems. Some producers have moved their live rock production into land-based greenhouses to avoid losses due to storms and other environmental factors present in the open water.



To satisfy some of the demand for marine ornamentals, a wide variety of organizations around the world have been working to solve biological and technical problems. Floridians have been at the forefront of these efforts but have lacked the resources to sustain consistent physiological, nutritional, culture and market research for a wide variety of high quality species. The Florida Sea Grant Program and the UF-Tropical Aquaculture Laboratory have made recent commitments to expanding public sector research and extension education efforts in marine ornamentals, focusing on farmer needs and opportunities.

Molluscs: Clams, Oysters, Scallops, and Mussels

Florida is perfectly positioned as the preeminent source of environmentally sustainable and friendly, farm-raised molluscs. Estuaries on



the Gulf and Atlantic coasts are rich in phytoplankton and have clean water and moderate temperatures that make for a long growing season that can yield marketable hard clams in a third of the time that northern growers experience.

Filter-feeding oysters, clams or mussels sequester significant amounts of carbon by consuming phytoplankton and absorbing dissolved organic matter. Carbon becomes a primary component of its shell and for every kilogram of live clams or oysters grown in Florida waters approximately 114 grams of carbon are removed from the water column and benthos. The Florida Sea Grant Program is investigating the carbon sequestration associated with hard clam aquaculture (shell and sediment deposition).

The Department manages 1.4 million acres spread over 38 shellfish management areas in accordance with the Model Shellfish Ordinance created and maintained by the Interstate Shellfish Sanitation Conference to insure wholesome and safe shellfish are available to national and international consumers. Florida's principal molluscs are the hard clam and American oyster; although, several other bivalve molluscs are being tested to diversify production.

The northern hard clam is farmed to satisfy national demand for food and seed clams in three regions of the state: Big Bend, Charlotte Harbor, and Indian River Lagoon. Production of farm-raised hard clams has grown at an almost exponential rate since 1995 when public investment occurred to retrain fishers impacted by a Constitutional Amendment that limited certain fishing gear. Between 1995 and 2007 the value of hard clams tripled from \$5.4 million to \$15.2 million. A University of Florida 2008 economic survey found that

during 2007 approximately 185 million cultured hard clams were purchased by Florida wholesale dealers, producing grower revenues of \$19 million and a total economic impact of \$53 million. The growing and marketing of farm-raised hard clams to wholesale dealers, restaurants, food service buyers, retail seafood shops, and direct to consumers in and outside of Florida created a total impact that includes \$31.5 million in value added revenue, \$25.2 million in labor income, \$4.6 million in property income (rents, royalties, interest, dividends, and corporate profits), \$1.6 million in indirect business taxes, and 606 jobs (full and part time).



While total sales have grown rapidly, per unit revenue and total farm profitability have declined. To offset a trend of low prices that will be exacerbated by increased production, clam farmers are seeking public sector investment in efforts to: reduce mortality during culture, continue and improve a pilot crop insurance program managed by the U.S. Department of Agriculture, market hard clams to Florida's 18 million residents and 80 million seasonal visitors, diversify production with new species, reduce seed costs, and increase shelf life through improved handling and temperature management. The vehicles to drive these initiatives has been laid with increased cooperation amongst research institutions and state agencies that have focused on clam production needs at the University of Florida's Shellfish Aquaculture Research and Education Facility on Cedar Key (<http://shellfish.ifas.ufl.edu/>).

A statewide shellfish extension specialist, scientists from the University of Florida, and the private sector are investigating the potential to broaden Florida's mollusc product line by spawning, culturing, harvesting, handling, and marketing a variety of alternative species. Several molluscs (blood and ponderous arks and sun ray venus clam) have proven market value and demand but little is known about their production characteristics. Market and production work are needed

for a variety of candidates: southern surf clam, angel wing clam, pen clam, queen conch, Florida fighting conch and mussels. They are also determining optimal productivity of current aquaculture lease areas by testing planting rates and determining total carrying capacity. The University of Florida and the Department have cooperatively posted real-time weather and water quality characteristics to the Division of Aquaculture web site for farmers to make on-the-spot planting, harvesting and crop maintenance decisions (<http://www.FloridaAquaculture.com>).

Another valuable shellfish is the American oyster that is cultured on over 500 acres of state owned submerged lands leases. These leases, located in Apalachicola Bay, yield a very flavorful oyster that is served on the half-shell to discerning oyster connoisseurs throughout the United States. Low market prices for wild-harvested oysters have limited growth in culturing oysters. Recently consumer interest in fresh oysters has increased and may reignite efforts to investigate the production of sterile, triploid oysters. A triploid oyster does not expend energy on summer reproduction and yields a full-meated product all year long.

The sophisticated production and marketing infrastructure developed to support the hard clam industry provides a model and avenue for the immediate marketing of alternative mollusc species and should greatly shorten the time required to move a species from an experimental stage to the consumer. In a span of 20 years, the cultured hard clam has evolved from the interest of a few farmers to Florida's role as the prominent source of U.S. farm raised hard clams. The opportunity and potential to repeat this success for one or more molluscs is entirely possible if sufficient public investment is made into the basic production and marketing work to prove farm and market level feasibility and profitability.

Marine and Freshwater Crustaceans

Pacific white shrimp (*Litopenaeus vannamei*), Malaysian prawn (*Macrobrachium rosenbergii*), and Australian red claw crawfish (*Cherax quadricarinatus*) are produced in greater or lesser amounts in Florida for a variety of markets. Interestingly, all are grown in freshwater

including the Pacific white shrimp that is grown in hard freshwater (nonpotable water used for irrigation with a hardness in excess of 100 parts per million calcium carbonate).

Production of Pacific white shrimp for retail and restaurant markets and as “seed” for national and international farms is limited to south Florida and the Keys. Shrimp farming is highly speculative and technically demanding. The University of Florida, Indian River Research and Education Center, near Ft. Pierce, constructed with public funds outdoor demonstration ponds with the goal of providing research information, biological and economic, to potential shrimp farmers. Results suggest that pond culture will only yield a single crop per year. Adding greenhouses to the production system will jumpstart the small shrimp seeded to ponds (termed “postlarvae”) or become the principal production system for year round growth. The success of shrimp aquaculture in Florida will rely upon technical expertise, creative methods to reduce production costs, and a sound marketing strategy that addresses a limited production schedule and niche markets.



Malaysian prawn and the Australian red claw crawfish are being produced in tropical countries and are under investigation by universities in the U.S. southeast to resolve market, economic and production challenges for the U.S. farmer. Small farmers are attracted to these species because of reputed high market value and relatively easy production. Objective evaluations are needed to demonstrate marketability, technical feasibility and profitability. Florida’s subtropical environment and very competitive seafood market pose unique challenges to small farmers that yield product on an intermittent basis and in variable quantities.

Alligator

Most of Florida’s alligator farms are located in central and southern Florida to benefit from the warm temperatures which are needed for consistent growth. Much of the alligator farm-gate value derives

from raw hides which are sold to international fashion markets. World economics combined with the merger of high-end fashion houses has resulted in good prices for flawless raw hides and little to no interest in number 2 and lower grade hides. Much of the Florida produced meat is sold in Florida; however, with slower in-state tourism some farms have higher than normal meat inventory.

Alligator producers are working to create and satisfy new markets and solve disease problems impacting hide quality. During the late 1990s, alligator farmers and wild alligator trappers cooperatively created a Florida Alligator Marketing and Education Advisory Committee to identify and fund marketing and educational projects that will inform, educate and encourage alligator meat, leather, and other by-products consumption by the general public and commercial purchasers. Funding for projects supported by the Committee are derived from a portion of the alligator-related regulatory fees collected by the Fish and Wildlife Conservation Commission.



The Committee and Department have promoted American alligator leather during international leather product shows, developed and promoted alligator meat recipes, initiated alligator meat promotions in the Western United States, triggered furniture and fashion designs that incorporate alligator leather, and created consumer and trade educational literature to promote increased alligator product consumption (visit <http://www.fl-alligator.com>).

Alligators are extremely resilient animals, the last of the living dinosaurs, but experience low on-farm reproductive rates and are prone to unique skin infections that reduce hide quality. The University of Florida investigated reproductive functions and recommended dietary and farm design improvements. Disease treatments are hampered by the lack of therapeutants labeled for alligators. Public investment is needed to: identify and treat skin infections that scar finished alligator leather, increase national and international promo-

tional efforts, identify and test therapeutants, work on nutritional requirements for all alligator life stages (juvenile, yearling, and adult), develop markets for number 2 and number 3 graded hides, and expand out-of-state meat markets.

Food Fish

Aquaculturists are motivated to profitably produce food fish species to offset the nation's seafood deficit; however, Florida is one of the most competitive and active seafood markets in the world. The state is uniquely positioned as a point-of-entry for seafood products from the Caribbean, Central America, and South America. During 2009, Florida seafood companies imported approximately 128 million pounds of edible seafood worth \$1.9 billion for sale within Florida, North America, or to re-export. In addition to imports, Florida is a dynamic seafood producer. Preliminary 2009 information from the Florida Fish and Wildlife Research Institute indicates that Florida's 8,210 commercial fishers landed 61 million pounds of high value seafood and fishery products worth \$101 million. During 2007 Florida aquaculturists sold an estimated \$3.5 million worth of catfish, hybrid striped bass, sturgeon and tilapia to local, state, national and international markets.

A complex infrastructure exists to purchase, process, and re-sell edible fish and shellfish. Approximately 300 Florida-based businesses process seafood by methods as simple as gutting and icing fish to large scale breeding and packaging of shrimp, crab, or fish products. Another 1,100 businesses buy and sell seafood as dockside fish buyers, wholesalers, brokers and importers/exporters. Florida is also a huge market for seafood with an international reputation for delicious seafood that is sold through a \$27 billion restaurant industry and 4,380 seafood retailers (independent and grocery chain stores) that satisfy 80 million visitors and 18 million residents. Florida's residents are seafood fanatics. They consume 37 pounds of seafood (purchased and self-caught) per person per year which is over twice the national per capita average of 16 pounds.

As a result, Florida aquaculturists have competed by utilizing two basic strategies. They have produced products at costs competitive

with large farms to access similar markets or they grow species targeted to specific niche markets (local retailers and consumers familiar with the farm and in search of high quality products) that yield enough market value to offset small farm costs of production. Unfortunately, suitable niche markets and the ability of Florida's 91 small farms to produce products at competitive prices are objectives difficult to consistently achieve.

The U.S. catfish industry during 2009 consisted of 1,306 farms, 146,900 acres and farm gate sales of \$410 million (predominantly located in Mississippi, Alabama, Arkansas and Louisiana). Florida has 54 catfish farms that sold \$979,000 worth of catfish during 2007. Approximately 12 of these farmers are located in the western Panhandle and cooperatively grow and market channel catfish. They cooperate to construct catfish ponds, purchase feed, share harvest equipment and market their catfish to reduce costs and compete with large, out-of-state producers.

The U.S. hybrid striped bass industry consists of 50 farms with 2009 production of 8.5 million pounds. Three farms in Florida produced 271,000 pounds and reported higher prices and increased production costs relative to the rest of the nation. Hybrid striped bass are the product of a cross between white and striped bass accomplished in hatcheries which are out-of-state and have high transportation costs. Unfortunately, wild, gravid females are used to produce fingerlings and year-to-year fingerling availability fluctuates. This instability coupled with growing interest by white tablecloth restaurants in Florida and the Mid-Atlantic Region's willingness to pay a premium price for on-ice, whole fish creates an opportunity for small farms that can rapidly modify production. However, this is a hard won opportunity fraught with risk and uncertainty.

Tilapia (consisting of several species and species hybrids) are extremely durable fish that can thrive in poor quality water on low-cost feeds derived from vegetable protein. They are grown by small farms throughout central and south Florida because of simplicity and ease of culture. Tilapia produced in tropical and sub-tropical countries (Asia and Central and South America) are imported in huge

quantities and at low prices to dominate the U.S. grocery and food service markets. Other competing sources include an annual 3 to 4 million pound wild harvest of blue tilapia in central Florida that is sold in rural seafood markets in Florida, Georgia and Alabama and an end-of-summer harvested crop produced from Alabama watershed ponds. The Alabama harvest dramatically drives live prices downward during September and October to \$0.75 to \$0.90 per pound. Florida tilapia farms primarily market their live or fresh production locally to avoid seasonal price fluctuations and competition from imported products.

Tilapia are a perfect species to use in educational programs and 26 Florida elementary, middle or high schools as well as three Sheriff operated programs for troubled youth grow tilapia in pond or tank systems. Growing fish in the classroom is a unique educational tool that combines science, social studies, math, and language arts into a single course of study. There is also the end-of-year reward of a memorable dinner for students, parents, and faculty.

Florida farms culture the greatest variety of sturgeon species than any other state in the nation: Atlantic, Siberian, sterlet, bester, Russian, *Huso huso*, *Acipenser stellatus*, and Adriatic sturgeons.

Three sturgeon farms are beginning to commercially harvest caviar for local, national and international markets after a 10-year startup period during which female fish reached sexual maturity. Marketing this high-value seafood has, to a limited extent, offset the long and risky grow-out period. Fortunately, sturgeon meat has the market values of high-grade tuna and swordfish and is in a class by itself for its texture, flavor and appearance. Expensive tank systems that recirculate, clean, and cool the water are utilized as the species are cultured far from their temperate homelands. State, national, and international



regulations govern sturgeon production and commerce because of well-founded concerns associated with the wild sturgeon managed and harvested in the Caspian Sea region.

Work, partially funded by projects supported by the Aquaculture Review Council, at the Mote Marine Laboratory and Harbor Branch Oceanographic Institute, Florida Atlantic University (HBOI-FAU) is unraveling biological and production questions associated with the production of cobia and pompano in systems that recirculate and recondition production water. Mote's Center for Aquaculture Research and Development is designing, constructing and evaluating inland recirculating technologies to produce marine species. Commercial-scale marine fish broodstock, larval and fingerling systems have been developed and evaluated. These systems include a wastewater treatment loop allowing them to recirculate 100% of the system water. Mote's commercial demonstration farm is producing Siberian sturgeon in intensive recirculating systems. Marine fish species being addressed at Mote include common snook, pompano, red drum, and red snapper.

HBOI-FAU in partnership with US Department of Agriculture, Agricultural Research Service (USDA-ARS), is developing warm water aquaculture technology and transferring it to industry for commercial application. By designing and refining methods of farming saltwater fish at inland locations the program also aims to: provide opportunity for Florida and the US agricultural sector, eliminate the need for aquaculture operations to locate on increasingly scarce coastal lands, and realize the trade and food biosecurity benefits of a strong domestic aquaculture industry. Among the many successes of the HBOI-FAU and USDA-ARS program are the development of spawning techniques for Florida pompano, numerous advances in feeding and water recirculation techniques, and grow out of Florida pompano and cobia to market size in large-scale production systems.

Public investment to support food fish production infrastructure development—hatcheries, processing and distribution—are needed to improve farm gate value and reduce input costs. Feed and certain supplies have doubled or tripled in cost which affects all aspects of

food fish production. Additional assistance is needed to develop the technology to yield consistent fingerlings of economically-viable species, market research to define competitive products and identify suitable markets, and an integrated public-farmer promotion effort to focus attention on product quality and availability.

Miscellaneous Species

Floridians also produce gamefish fingerlings (largemouth bass, sunfish, and catfish), triploid grass carp, turtles, snails, frogs and bait fish to satisfy specialty local, national, and international markets. National and international demand for alligators and turtles (softshell, snappers, and sliders) as well as local and national demand for triploid grass carp, snails and frogs is being met by 43 farms with \$6.2 million in sales during 2007. Thirty-one gamefish producers sold \$622,000 worth of products. The technical and market knowledge required to successfully produce these products and sell them for a profit is unique to each species. Producers have expressed a need for specific public investment to improve feeds, primarily nutritional content and digestibility, to achieve improved growth and animal health.



Aquaculture Education, Training, Research and Extension

Floridians benefit from a wide variety of public or private educational, training, research, and extension programs. Two public and two private universities offer: 1) basic and applied research into species and production systems and 2) educational opportunities that result in undergraduate, graduate, or post-graduate degrees. A community college offers Associate of Science degree and aquaculture education programs also exist at 26 elementary, middle and high schools where fish farming is used as a learning tool. These programs are:

Harbor Branch Oceanographic Institution at Florida Atlantic University supports educational and marine aquaculture research programs. The Aquaculture Center for Training, Education and Demonstration integrates traditional education with practical industry experience. Their goal is to prepare students for a career, start or expand an aquaculture business, implement new technology, or continue with additional education and training. Students benefit from learning by participating in research projects and production studies. Key concepts and new technologies from each research program are incorporated in the curriculum, and are reflected in the hands-on activities and course manuals. Marine aquaculture research at a 30-acre Aquaculture Development Park has a goal of researching and developing economically feasible and environmentally sustainable methods to grow fish, molluscs and crustaceans for food and stock enhancement. They place a high priority on research projects that lead to commercial applications and technology transfer programs that support the expansion of competitive and sustainable aquaculture industries. Please visit <http://www.fau.edu/hboi/>.

Hillsborough Community College provides students the opportunity to earn an Associate in Science or Associate in Applied Science degree for an entry-level employment as an aquaculture field/farm assistant or laboratory technician. Please visit <http://www.hccfl.edu/br/departments/aquaculture.aspx>.

Florida Agricultural and Mechanical University operates an aquaculture demonstration facility and offers technical assistance to small, rurally located farmers that wish to diversify and include aquaculture as a component of the farming operations. Contact Dr. Uford Madden, 850-412-4253, for information.

Florida Institute of Technology established the first undergraduate training program in the United States in 1977. Emphasis is placed on developing skills in the biological sciences and learning culture methodology and technology for important aquatic species. Please visit <http://www.fit.edu/>.

University of Florida, School of Forest Resources and Conservation, Program of Fisheries and Aquatic Sciences, provides objective science to support the protection and management of fisheries and aquatic resources, with innovation and excellence in research, education and extension. Faculty have programs in four areas: Aquaculture, Aquatic Animal Health, Conservation and Management of Natural Environments, and Sustainable Fisheries. Many projects span these areas and involve collaboration with other scientists at the University of Florida, other universities and institutes, and state & federal resource management agencies. Students can achieve undergraduate or graduate degrees. Please visit <http://fishweb.ifas.ufl.edu/>.

University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, Aquaculture Program plays a major role in aquaculture research and development, consultation and participation, technology transfer of marine fish hatchery and growout for commercial operations. Emphasis is placed on technology and management strategies for sustainable aquaculture development, including marine fish and crustacean aquaculture, environmental issues and project development. Degrees offered include Master of Arts and Master of Science in Aquaculture through the divisions of Marine Affairs and Policy and Marine Biology and Fisheries. An interdivisional Ph.D. degree is also available. Please visit <http://aquaculture.rsmas.miami.edu/>.

Privately Supported Aquaculture Research

Mote Marine Laboratory is dedicated to developing the technologies needed to raise fish species with a high market value and/or a high recreational demand. Mote's Center for Aquaculture Research and Development is developing land-based recirculating systems and technologies to produce a variety of marine finfish and invertebrates. Species that have been addressed include common snook, Florida pompano, red drum, red snapper, hard corals, marine shrimp and long-spined sea urchins. Freshwater research is focusing on sturgeon husbandry techniques for caviar and meat production. The information Mote gains through this research will be used to produce fish and invertebrates for restocking depleted species in the wild and to meet our growing national demand for seafood. Mote's Marine Aquaculture Program conducts research at Mote Aquaculture Research Park in eastern Sarasota County and at our Tropical Research Laboratory in the Florida Keys. Please visit <http://www.mote.org>.

Aquaculture Extension Assistance

The University of Florida provides aquaculture production and technical assistance through the Florida Cooperative Extension Service, Program of Fisheries and Aquatic Sciences, and Florida Sea Grant Program. Please visit <http://www.fishweb.ifas.ufl.edu> and <http://www.flseagrant.org/>.

Research and demonstration programs are in Ruskin and Cedar Key that focus on ornamental species (fish and plants) and shellfish (clam, oyster, scallop) aquaculture, respectively. Please visit the Tropical Aquaculture Laboratory website, <http://tal.ifas.ufl.edu/>, and Florida Shellfish Aquaculture Extension website, <http://shellfish.ifas.ufl.edu/>.

Each of Florida's 67 counties has a Florida Cooperative Extension Service Office with an extension agent to answer aquaculture questions. Consult the county government section of your phone book to locate the office nearest you.

Aquaculture Advisory Councils

Aquaculture Review Council

The Aquaculture Review Council provides a means of communication between the aquaculture industry and the Department of Agriculture and Consumer Services (597.005 Florida Statutes). The Council consists of nine members: chair of the State Agricultural Advisory Council, chair of the Aquaculture Interagency Coordinating Council, and seven Commissioner of Agriculture appointees. The seven appointees represent the principle farming groups (alligator, aquatic plant, food fish, mollusc, and tropical fish) and a representative each for commercial fishing and the aquaculture industry at-large (i.e., miscellaneous species).

The Council recommends rules and policies governing the business of aquaculture to the Commissioner of Agriculture and annually submits a list of recommendations for short-term research and education projects designed to solve problems designated in the *Florida Aquaculture Plan*. The Council also identifies and discusses problems that serve as barriers to the growth and development of aquaculture and has been a key in the continued growth of the aquaculture industry. See Appendix A for projects recommended and included by the Commissioner of Agriculture in the Department's annual budget for state funding. Council meeting minutes are available under "Advisory Groups" at <http://www.FloridaAquaculture.com>.

Aquaculture Review Council Members

Heath Davis Commercial Fishing Davis Seafood	Allen Register Alligators Gatorama
Gene Evans Food Fish Evans Farms	Dan Solano Shellfish Cedar Key Aquaculture Farms, Inc.

Brad McLane, Vice-Chair
Aquatic Plants
Florida Aquatic Nursery, Inc.

Marty Tanner
State Agriculture Advisory Council
Aquatica Tropicals, Inc.

Jim Michaels
Aquaculture Industry Member-at-Large
Mote Marine Center for Aquaculture
Research and Development

Art Rawlins
Tropical Fish
Rawlins Tropical Fish

Sherman Wilhelm
Aquaculture Interagency Coordinating Council
Florida Department of Agriculture and Consumer Services

Aquaculture Interagency Coordinating Council

The Aquaculture Interagency Coordinating Council encourages the development of Florida aquaculture by establishing positive inter-agency cooperation (597.006 Florida Statutes). The Council is a forum for the discussion of governmental aquaculture regulations and the formulation of policy alternatives to facilitate aquaculture development. The Council is charged with establishing and maintaining effective cooperative linkages between member agencies, the Aquaculture Review Council, and institutions to ensure that recommendations for improvement are responsive to the needs of aquaculturists. This group meets as necessary and is composed of the several state agencies that have regulatory, research, extension, and economic development responsibilities affecting commercial aquaculturalists. The Council's meeting minutes and annual reports are available under "Advisory Groups" at <http://www.FloridaAquaculture.com>.

Aquaculture Interagency Coordinating Council Members

Charles Adams
University of Florida
Florida Sea Grant Program

William Patterson III
Florida Institute of Oceanography
University of West Florida

Lawrence Carter
Florida A&M University

Diane Scholz
Office of Trade, Tourism and
Economic Development

Lee Edmiston
Florida Dept of Environmental
Protection

Sherman Wilhelm
Florida Department of Agricul-
ture and Consumer Services

Tom K. Frazer
University of Florida
Institute of Food and Agricultural
Sciences

Chris Young
Florida Fish and Wildlife
Conservation Commission

Barbara Lenczewski
Florida Department of Community Affairs

Regulatory Agencies

Department of Agriculture and Consumer Services

The Department is the primary regulatory body for aquaculture in Florida (597.003 Florida Statutes). They implement the Aquaculture Certificate of Registration and Aquaculture Best Management Practices (BMPs) to identify aquaculture producers and their products and insure that the best-suited production and management practices are used at each certified farm to protect and conserve Florida's natural resources (597.004 Florida Statutes).

Florida's Aquaculture Certification and BMP program are nationally recognized by aquaculturists and state and federal regulatory agencies. This program eliminated burdensome requirements from multiple state agencies and is one of only four aquaculture BMP programs in the United States that was created by law and operated and managed by a single state agency. The *Aquaculture Best Management Practices Manual* is a living document that is periodically revised as technology or production practices evolve. Please visit <http://www.FloridaAquaculture.com> and click on "Publications" to find the current 5L-3 Aquaculture Best Management Practices rule and manual.

Fish and Wildlife Conservation Commission

The Commission exercises executive and regulatory powers over terrestrial, freshwater, and marine fish and wildlife. Specific to commercial aquaculture, the Commission maintains lists of prohibited and conditional restricted nonnative aquatic species, prohibits the commercial sale of products derived from certain game fish, issues a Special Activity License for broodstock collection, and operates marine and freshwater hatcheries for fish and shellfish stock enhancement. Please visit <http://myfwc.com/> for more information.

The Fish and Wildlife Research Institute assesses and restores ecosystems and studies of freshwater and marine fisheries, aquatic and terrestrial wildlife, imperiled species, and red tides. Posted to the Institute's website are statewide red tide status and over 1,000 biologi-

cal and ecological reports dating from 1948. Please visit <http://research.myfwc.com/>.

Department of Environmental Protection

The Department protects, conserves and manages Florida's natural resources and enforces the state's environmental laws. Aquaculture facilities that produce more than 100,000 pounds of warmwater species and discharge more than 30 days per year must acquire a National Pollution Discharge Elimination Discharge Permit as a responsibility delegated under the Clean Water Act from the U.S. Environmental Protection Agency. For more information, please visit <http://www.dep.state.fl.us/water/wastewater/iw/index.htm>.

Water Management Districts

Florida's five water management districts (Northwest, St. Johns, South, Southwest and Suwannee) manage or protect: water quality, flooding, ecosystem restoration, and water supply. Aquaculturists must acquire water consumption (surface and groundwater) and well construction permits from the Districts. Visit <http://www.flwaterpermits.com/> for more information. Please note permit requirements are different amongst the Districts.

Aquaculture Review Council Funded Projects

The Aquaculture Review Council annually recommends to the Commissioner of Agriculture projects to include in the Department's budgeting process. To follow are the projects that were funded through the support of the Commissioner, Governor and Legislature.

Fiscal Year 2009-10

No projects funded due to state budgetary constraints.

Fiscal Year 2008-09

Aquaculture Career Choices in Middle School

Department of Agriculture and Consumer Services
Division of Aquaculture

Aquaculture Education for Florida Teachers

University of Florida and Hillsborough Community College

Aquaculture Small Learning Community (Development and Implementation)

River View High School – Aquaculture SLC

Aquaculture Marketing and Education

Department of Agriculture and Consumer Services
Division of Marketing

Aquaculture Immersion Excursion: A Teacher Workshop Series for Integrating Aquaculture Education into the Classroom

Harbor Branch Oceanographic Institution

*Commercial Farm Production of the Florida Bay Scallop (*Argopecten irradians*, Lamarck 1819), an Alternative Molluscan Aquaculture Species*

Bay Shellfish Company

Non-Native Aquatic Species and Aquaculture Research and Education

University of Florida
Institute of Food and Agricultural Sciences

Florida Aquaculture-In the Classroom, In the Community, and In the Future
Florida Aquaculture Association

Mass Scale Production of Copepods for Marine Aquaculture
University of Florida

*Design and Evaluation of Marine Fish and Live Feeds Recirculating Systems
for Inland Aquaculture – Year 2*
Mote Marine Laboratory

Fiscal Year 2007-08

No projects funded due to state budgetary constraints.

Fiscal Year 2006-07

Exploring Current and Potential Aquaculture Opportunities in Florida
Florida Aquaculture Association

*Design and Evaluation of Marine Fish and Live Feeds Recirculating
Systems for Inland Aquaculture*
Mote Marine Laboratory

Development of Small Scale Aquaculture Farms in North Florida
Florida A&M University

*An Instruction Video Guide To Hurricane Preparedness
For Florida Aquaculture Producers*
Harbor Branch Oceanographic Institution

Fiscal Year 2005-06

*The Cause, Control and Prevention of Brown Spot
and Pix Hide Scars in Alligator Skins*
University of Florida
College of Veterinary Medicine

*Developing Marine Fish Hatchery and Nursery Culture
to Expand Florida's Aquaculture Industry – Year 3*
Mote Marine Laboratory

*Improving Sturgeon Production System Design:
Integrated Research, Production and Education*
Wildwood Middle School

Fiscal Year 2004-05

*Intensive, semi-intensive and extensive fingerling production of cobia
(Rachycentron canadum) in Florida using tanks, mesocosms and ponds*
University of Miami
Rosenstiel School of Marine & Atmospheric Science

*Developing Marine Fish Hatchery and Nursery Culture
to Expand Florida's Aquaculture Industry – Year 2*
Mote Marine Laboratory

Fiscal Year 2003-04

One-stop web site for Florida Aquaculture
Department of Agriculture and Consumer Services
Division of Aquaculture

Fiscal Year 2002-03

*Commercial Scale Penaeid Shrimp Demonstration in Inland Freshwater
Systems Indian River Research and Education Center Current and Potent-
tial Aquaculture Opportunities in Florida*
Florida Aquaculture Association

*Developing Marine Fish Hatchery and Nursery Culture
to Expand Florida's Aquaculture Industry*
Mote Marine Laboratory

Fiscal Year 2001-02

The Collier City/Pompano Beach Aquaculture and Hydroponics Complex
Collier City/Pompano Beach Community Development Corporation
& Nova Southeastern University

Fiscal Year 2000-01

Aquaculture Marketing

Florida Department of Agriculture and Consumer Services

*Proposal to Demonstrate the Commercial Production for Aquaculture
of Russian Sturgeon in Florida*

Mote Marine Laboratory

Picture Credits

Dark Hammock Turtles - page 30.

Florida Aquatic Nurseries - pages 16 and 17.

Florida Dept of Agriculture and Consumer Services - cover; pages 3, 11, 21, 22, and 25.

Florida Institute of Technology - page 18.

Florida Tropical Fish Farms Association - page 14.

Mote Marine Laboratory - page 28.

Reef Aquaria Design, Inc. - page 20.

University of Florida, Indian River Research and Education Center - page 24.

University of Florida, Tropical Aquaculture Laboratory - page 15.



Florida Aquaculture Plan 2011-2012

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