

Florida Aquaculture Plan

November 2023



Prioritized recommendations for applied research and economic development by the Aquaculture Review Council for the purposes of creating new technologies, improved farm productivity, increased farm income and employment and other economic and environmental benefits to the state of Florida.



Dear Floridians:

On behalf of the Aquaculture Review Council, it is my distinct pleasure and honor to present a revised and updated *Florida Aquaculture Plan* as required by the Florida Aquaculture Policy Act. The *Plan* consists of aquaculture research and development recommendations, as required by statute ([597.003\(1\)\(b\) Florida Statutes](#)), that are provided to guide public investment into answering these challenges.

Florida aquaculture is an extraordinarily diverse agribusiness. Our state's unique climate, robust infrastructure, streamlined regulations and positive business environment position Florida to become the national leader in this burgeoning agriculture sector. There are approximately 1,000 certified aquaculture farms in Florida, located in every region of the state, which culture approximately 1,500 varieties of fish, plants, mollusks, crustaceans, corals and aquatic reptiles for food and non-food markets including seafood, freshwater and marine aquarium hobbyists, high fashion leather, water gardening, bait, biological control, "seed" for national and international aquaculturists, sporting, conservation and education. Farm gate sales of Florida aquaculture products (in real dollars) as reported by the USDA totaled approximately \$71.6 million in 2018, placing Florida 9th in the nation for total overall aquaculture value in 2018.

Societal, political and economic trends have accelerated global trade, fuel and feed cost volatility, information exchange and technology sharing. These factors require unceasing innovation by Florida farmers to remain competitive. Florida's aquaculturists are constantly adapting to change by investigating new species to culture, new markets and new sustainable production systems. A more detailed report of the industry can be found online in the 2020 *Florida Aquaculture Industry Overview* published by the Florida Department of Agriculture and Consumer Services (www.FDACS.gov/content/download/91723/file/2020IndustryOverview-April.pdf). While these are the most comprehensive and reliable data available, we know that they vastly underestimate the economic value of our aquaculture products (as is evident from the low survey response rate), and are not reflective of the strong growth, investment and innovation in Florida aquaculture over the past decade.

We are very appreciative of the state of Florida's history of investing public funds to support applied research, extension and education to benefit aquaculture farmers, product distributors and equipment manufacturers and suppliers. Public investment is critical to our continued success and ability to respond to unexpected technical and economic change. Support from legislators is also critical to the continued success of Florida's aquaculturists. With changing global trade dynamics, business practices, regulatory complexity and political pressures, the success of Florida's aquaculture farms will require legislative champions. We hope that the *Florida Aquaculture Plan* can serve as a tool to inform legislators of the challenges, complexities and opportunities for innovation and growth in Florida's most diverse agricultural industry.

Sincerely,

A handwritten signature in blue ink that reads "Geno Evans". The signature is written in a cursive, flowing style.

Geno Evans, Chair
Aquaculture Review Council

Applied Aquaculture Research and Development Priorities



These applied research and development priorities aim to answer biological, technical, economic and regulatory challenges that will benefit aquaculturists by:

- Diversifying production
- Proving the practicality of new technologies
- Improving farm productivity and sustainability
- Reducing input costs
- Increasing farm-gate income

A. Species

1. Determine ornamental fish and invertebrate species reproduction and grow-out characteristics of priority species identified by the Florida Tropical Fish Farms Association.
2. Determine production techniques for new bivalve species which have potential commercial applications.
3. Examine the commercial feasibility of producing and marketing emerging marine and freshwater food fish or crustacean species in pond, raceway or tank systems, including an economic analysis of production costs and potential market returns.
4. Examine the commercial feasibility of producing and marketing live marine and freshwater sportfish or bait species in pond, raceway or tank systems, including an economic analysis of production costs and potential market returns.
5. Develop improved stocks and associated methods for commercially farmed bivalves which improve production characteristics (e.g., tolerance to high temperature, low dissolved oxygen and salinity variation) in real-world farm conditions.
6. Create a tetraploid oyster broodstock line with high salinity tolerance (e.g., above 25 parts per thousand) that can be provided to Florida hatcheries.
7. Determine techniques for optimal growth and propagation of commercially important fresh and saltwater aquatic plant, moss and algal species.
8. Research on the impacts of red tide (*Karenia brevis*) on clams, including effects from exposure to low levels, uptake rates and brevetoxin kinetics in different tissues (adductor muscle, mantle, gonads, etc.).
9. Clam biotoxin depuration studies, including literature review of other methods of toxin neutralization from fields outside of aquaculture.
10. Enhancement of clam and oyster stock fitness to increase production and reduce mortality associated with environmental fluctuations and disease prevalence.

B. Production Cycle Improvements

1. Evaluate and recommend water conservation practices.
2. Investigate and compare costs of alternative energy sources (e.g., electric, propane, solar) to heat small and large scale grow-out systems.

3. Develop or compare methods to estimate shrimp or fish populations or biomass in ponds.
4. Research to support approval or legalization of methyl testosterone for ornamental fish.
5. Maintain the labeling of chemical pond treatments to control undesirable species (e.g., Dylox 420L and Karmex).
6. Increase upland aquaculture farm efficiency by identifying methods and technologies that can reduce production costs.
7. Evaluate bivalve shellfish production technologies relative to environmental effects, cost effectiveness and efficiency.
8. Investigate remote technologies for bivalve shellfish growing area surveillance and security.
9. Evaluate the chemical and biological (i.e., phytoplankton species) characteristics of shellfish hatchery production waters which maximize the survival and growth of commercially important bivalve species at early life stages.
10. Scale-up for commercial application of emerging technologies to mitigate off-flavor compounds in food fish recirculating production systems.
11. Investigate Integrated Aquaculture Systems (IAS) and Integrated Multi-Trophic Aquaculture (IMTA) to improve recirculating aquaculture system economics.
12. Develop water quality specific mineral supplement recommendations for low-salinity marine shrimp grow-out.
13. Develop alligator recirculating production system technologies to reduce water and energy consumption/costs.
14. Develop out-of-season spawning protocols to increase year-round oyster seed availability.
15. Provide extension services, training, to oyster hatcheries for tetraploid stock development including providing access to specialized laboratory equipment.
16. Provide extension services to new and existing farmers to help them improve productivity, survival, optimal growth rates and marketing strategies.
17. Research, and provide extension support for, the application of biofloc technology.
18. Investigate freezing technology and other value-added shellfish products.
19. Develop operational cost-saving methodologies for aquaculture producers.

C. Animal and Plant Health

1. Identify and develop disease diagnostic tools and potential treatment and prevention options, such as vaccines and regular disease surveillance programs.
2. Investigate methods to control microbial communities in aquaculture hatcheries and larval rearing systems.
3. Develop or enhance regular biosecurity training for growers and hatcheries, in both English and Spanish.
4. Develop a protocol to nest, incubate and hatch alligators to increase hatch rates and reduce or eliminate umbilical scarring.

5. Develop a protocol for rearing alligators to increase growth rates and reduce scarring from bites (density levels, frequency of feeding, water level and optimum grow-out house temperature).
6. Develop an environmental health monitoring program for shellfish hatcheries.
7. Investigate methods to control aquatic plant predators (i.e., *Physella* spp., *Marisa* spp., Lepidoptera, Amphipoda).
8. Provide pathology extension services to farmers to address and help resolve mortality and disease issues.
9. Investigate potential sources of oyster mortality at hatcheries and throughout the on-farm growing cycle.
10. Develop probiotics for Florida aquaculture production.
11. Conduct a risk analysis on the biological impact of *Perkinsus marinus* ("Dermo") for shellfish importation into and movement throughout the Gulf of Mexico.
12. Conduct research to address current and emerging issues in aquatic organism health.

D. Nutrition

1. Develop or improve live feed species and production protocols for marine and freshwater aquaculture species.
2. Evaluate alternative feed ingredients and dietary formulations to reduce feed costs and increase growth and reproduction of Florida aquaculture species.
3. Collect, identify, isolate and culture new native marine phytoplankton strains isolated from Florida waters for use in Florida hatcheries (for bivalves, fish, shrimp and other uses).

E. Environment

1. Conduct a science-based risk analysis (assessment and management) of non-native species that informs responsible cultivation and regulatory decisions.
2. Conduct risk assessments and develop a risk assessment tool for sustainable aquaculture of non-native species.
3. Identify ways to consider the benefits of aquaculture production when analyzing risk of invasion and potential environmental harm.
4. Quantify biotic and abiotic resistance to non-native species introduction in disturbed and undisturbed habitat.
5. Assess interactions between environmental conditions, stock characteristics, culture methods and lease sites for the optimization of farming practices of bivalve shellfish.
6. Determine upper/lower temperature tolerances of priority ornamental species to inform regulatory decisions.
7. Water quality testing and analysis (including chemical water properties, phytoplankton food sources, bacteria and other pathogens and land-based local chemical inputs) to establish baselines, understand potential mortality impacts and understand the conditions necessary for efficient production of bivalve (hard clams and oysters) larvae ($\leq 4\text{mm}$).
8. Investigate non-plastic alternatives to clam cover netting.

9. Conduct restorative/conservation aquaculture projects in direct collaboration with industry partners to identify impacts of and address coastal issues such as nutrient pollution, shoreline erosion and restoration of aquatic plant, shellfish and fish populations.
10. Determine the total value of the bivalve shellfish, seagrass and other aquaculture species' contribution to ecological services in the coastal and marine environment.
11. Investigate the use of native species to control non-native species.
12. Conduct an analysis of on-site and off-site noise and vibration effects and other environmental conditions on breeding activities of freshwater and saltwater fish.

F. Food Safety

1. Develop and obtain U.S. Food and Drug Administration (FDA) approval of an enzyme-linked immunosorbent assay (ELISA) and/or a liquid chromatography-mass spectrometry (LC-MS) test for determination of brevetoxin concentrations in shellfish (oyster or clam) meats.
2. Assess/develop harvest management and/or monitoring tools in compliance with the National Shellfish Sanitation Program (NSSP) harvest/handling requirements to assure product quality of cultured oysters.
3. Develop and provide regular Hazard Analysis and Critical Control Point (HACCP) education for aquaculture processing facilities.

G. Marketing

1. Test and develop a series of marketing templates and branding opportunities that farmers can use to promote Florida aquaculture product (i.e., social media campaign, digital platforms, product source and quality benefits).
2. Develop and test new recyclable, biodegradable and other non-styrofoam materials for shipping utility.
3. Develop an aquaculture-based model for agricultural tourism, and evaluate potential economic, educational and/or marketing impacts.
4. Identify domestic markets for grade 2 and 3 green, salted alligator skins.
5. Identify designers and/or manufacturers in Florida and the U.S. and educate them on marketing off grade alligator hides.
6. Conduct market research that could lead to expanding FDACS promotional support to develop and provide effective materials and programs that promote increased demand for farm-raised aquaculture products.
7. Create and conduct an aquarium fish and plant promotional campaign to increase sales and product values.

H. Economic and Regulatory Analysis

1. Conduct a Florida aquaculture development analysis to: 1) define aquaculture resource needs: water, soils, temperature; 2) describe and map geopolitical regions of the state that welcome aquaculture activities, agriculture zoning, potential municipal partnerships that will accept effluents and farming segments that will accept

effluents for crop irrigation; and 3) combine and provide this information as a GIS tool to state and county economic development officials.

2. Analyze the economic costs of regulation as a barrier to entry and business growth, including an analysis of worker's compensation costs, taxes, employee compensation and zoning regulations in coastal regions.
3. Conduct an analysis of aquaculture business economics for each commodity group throughout the state.
4. Conduct an analysis of policy, regulatory guidelines and/or economic incentives that can be used to aid and encourage business investment, growth and increased competitiveness.

I. Education

1. Support school education programs leading to certification(s) of competency in aquaculture.
2. Create an outreach campaign to promote the environmental benefits provided by Florida's aquaculture industry to community stakeholders, consumers and conservation organizations.
3. Develop a continuing education or licensing program for aquaculture workers, producers and processors in Florida.
4. Conduct a Florida aquaculture promotion/public education campaign.
5. Compile scientific literature and data related to clams and oysters in Florida and archive them in one place that is accessible to farmers, researchers and regulators.

J. Policy and Development

1. Produce an annual analysis and report on shellfish farming data, including growth, survival and plantings.
2. Conduct program development for bivalve shellfish, seagrass, seaweed, fish and other aquaculture species to be used in a nutrient mitigation, nutrient credit, nutrient trading or similar conservation/restoration program.
3. Conduct an analysis of policy, regulation and/or permitting process that can be used to aid, streamline and facilitate aquaculture activities.
4. Investigate the impacts of federal policy changes on the production of aquaculture commodities.
5. Collect, identify, isolate and culture new native marine macroalgae strains for use as a supplement in cattle feed.

To learn more about Florida aquaculture, visit the Florida Department of Agriculture and Consumer Services website, www.FDACS.gov, or contact the Division of Aquaculture at (850) 617-7600.

For additional information, please contact:

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Cover images, clockwise from top left: Assorted ornamental aquatic plants in aquarium; Tilapia; Angel fish; Alligator