



Florida Aquaculture Plan

October 2015



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 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 aquacultural 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. We culture approximately 1,500 species or varieties of fish, plants, molluscs, crustaceans, corals, and reptiles 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, or as “seed” for national and international aquaculturists to culture.

Societal, political and economic trends have accelerated global trade, fuel and feed cost volatility, and information exchange and technology sharing. These factors require unceasing innovation by Florida farmers to remain competitive. 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, sustainable production systems (e.g., alternative energy).

We are very appreciative of the state of Florida’s history of investing public funds to support applied research, extension, and education to benefit the aquaculture farmers, product distributors, and equipment manufacturers and suppliers. Public investment has been and is critical to our continued success and ability to respond to unexpected technical and economic change.

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

Thank you,

A handwritten signature in black ink that reads "Allen Register". The signature is written in a cursive, flowing style.

Allen Register, Chair
Aquaculture Review Council



Applied Aquaculture Research and Development Priorities

An annual Florida Aquaculture Plan is authorized by statute to communicate research and economic development needs by Florida aquaculturists to state government and the public. The goal for identifying these priorities is to support public funding to conduct practical research that will:

- Diversify production.
- Prove the practicality of new technologies.
- Improve farm productivity and sustainability.
- Reduce input costs.
- Increase farm-gate income.

This applied research answers biological or technical challenges that benefit aquafarmers raising aquatic plants, clams and oysters, crustaceans, alligators and turtles, and fish for food, aquariums, pond stocking, and bait.

Research Priorities

Species

- Determine ornamental fish species reproduction and grow-out characteristics of priority species identified by the Florida Tropical Fish Farms Association.
- Determine reproductive, production and/or marketing characteristics and potential for new and existing aquaculture species to diversify the bivalve molluscan shellfish industry.
- Develop techniques for increasing the level of domestication of new cultured bivalve molluscan shellfish species (e.g., polyploidy, selection and/or crossbreeding).
- Examine the commercial feasibility of producing and marketing emerging marine and freshwater food fish species in outdoor ponds, raceways, tanks or indoor tank or raceway systems to include an economic analysis of production costs and potential market returns.
- Examine the commercial feasibility of producing and marketing live marine and freshwater sportfish or bait species in outdoor ponds, raceways, tanks or indoor tank or raceways systems to include an economic analysis of production and marketing costs and potential returns.

- Develop and test the culture (production systems, costs and market value) of crustacean species such as blue crab and shrimp.

Production Cycle Improvements

- Evaluate and recommend water conservation practices.
- Investigate and compare costs of alternative energy sources (e.g., electric, propane, solar) to heat small and large scale grow-out systems.
- Develop or compare methods to estimate shrimp or fish numbers or biomass in ponds.
- Masculinize (improve color and/or finnage) ornamental fish through approved chemical or environmental treatments.
- Achieve the labeling of a chemical pond treatment to eliminate predacious zooplankton.
- Increase on-farm productivity and efficiencies by identifying and testing technology to reduce production costs.
- Investigate optimal production and environmentally compatible designs for bivalve molluscan shellfish harvesting implements.
- Develop methods to evaluate bivalve molluscan shellfish production technologies relative to environmental effects, cost effectiveness and efficiency.
- Develop cost effective remote technologies for bivalve molluscan shellfish growing area surveillance and security.
- Compare various techniques/methods to prevent and control bio-fouling of bivalve molluscan shellfish farming gear and products.
- Evaluate nursery design (i.e., water flow rate and direction, screen types and sizes, and substrates), environmental (i.e., chemical and physical) and biological (i.e., phytoplankton species) characteristics to maximize sunray venus clam nursery production of 88 micron to 4 millimeter seed.
- Develop a simple, cost effective genetic tool to identify and distinguish the tilapia species cultured in Florida.
- Scale-up for commercial application emerging technologies to mitigate off-flavor compounds in food fish recirculating production systems.
- Investigate Integrated Aquaculture Systems (IAS) and Integrated Multi-Trophic Aquaculture (IMTA) to improve recirculating aquaculture system economics.
- Develop and test native Florida seagrass production systems.
- Develop water quality specific mineral supplement recommendations for low-salinity marine shrimp grow-out.

Animal and Plant Health

- Develop procedures or protocols for disinfecting live feeds.
- Identify emerging diseases including diagnostic tools and possible treatment and prevention options for aquaculture species.

- Investigate methods to control microbial communities in aquaculture hatcheries and larval rearing systems.
- Identify the cause of and develop a hatchling alligator treatment or handling method to reduce or eliminate excessive umbilical scarring.
- Develop a protocol to nest, incubate and hatch alligators to increase hatch rates and reduce umbilical scarring.
- 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).
- Develop disease surveillance and health management strategies for cultured oysters.
- Determine the salinity tolerances for native Florida seagrasses and coastal emergent plants.
- Develop and establish an aquatic health and monitoring program for seed production of molluscan shellfish.

Nutrition

- Develop live feed protocols for marine and freshwater ornamental and food fish species.
- Evaluate alternative feed ingredients and dietary formulations to reduce feed costs and increase growth and reproduction of Florida aquaculture species.

Environment

- Conduct a science-based risk analysis (assessment and management) of non-native species that informs responsible cultivation.
- Quantify disturbed and undisturbed habitat biotic and abiotic resistance to non-native species introduction.
- Conduct a risk analysis of the tilapia species in Florida aquaculture to assist state agencies in decision-making regarding potential changes in tilapia management.
- Improve the understanding of bivalve molluscan shellfish farm environmental interactions concerning carrying capacity, water quality, benthic soils and bathymetry.
- Produce a how-to manual for the construction, maintenance and operation of an alligator anaerobic lagoon waste treatment system.
- Compile and publish data proving the value of riparian aquatic plants to reduce nutrients in surface water flow from land-to-water.
- Develop recommendations that identify the plant species to use in appropriate settings (i.e., upland, shoreline, emerged, littoral or submerged plantings) or to achieve specific design goals (i.e., nutrient

- uptake or soil stabilization) when designing and constructing wetland mitigation/restoration projects.
- Assess /develop harvest management and/or monitoring tools in compliance with NSSP harvest/handling requirements to assure product quality of cultured oysters.
 - Compile existing Florida seawater quality data to establish a baseline for all identified and quantified essential components (temperature, salinity, water chemistry, food supply, and including positive/negative impacting bacteria and pathogens) necessary for efficient and effective hatchery/nursery production of shellfish in Atlantic and Gulf Florida Waters. Design testing procedures for regular ongoing monitoring of these components that would identify significant changes that may effect production on any level from spawn to 4mm size.

Food Safety

- Develop and obtain FDA approval of a brevetoxin enzyme-linked immunosorbent assay (ELISA) test for shellfish (oyster, clam or mussel) meats.

Marketing

- Create and distribute a publication that describes Florida aquaculture: Culture methods, species grown, and potential environmental effects.
- Determine whether the consumer is discriminating between wild-harvested or farm-raised and domestic or imported aquatic species.
- Conduct a Florida aquaculture promotion/public education campaign for a segment of the population most likely to consume Florida grown products.
- Test Florida aquaculture product branding using social media to quantify the value-added benefit.
- Test Florida aquaculture product branding approaches (regional vs. generic vs. product quality characteristics).
- Create and conduct an aquarium fish and plant promotional campaign to increase sales and product values.
- Complete a market analysis (value, volume, demand and product specifications) and/or financial characteristics for Florida cultured oysters.
- Describe and define options and markets for the re-use or recycle of materials used in aquaculture farming, processing and shipping including compostable plastic.
- Improve shellfish and/or foodfish processors and public understanding of food safety and quality issues across the entire processing system from production practices to consumption.

- Create a directory of aquatic plant growers and products and distribute that directory to potential buyers (e.g., landscape architects, wetland restoration specialists, wholesale and retail nurseries, and wholesale and retail aquarium products).
- Identify domestic markets for grade 2 and 3 green, salted alligator skins.
- Identify designers/manufacturers in Florida and the US and educate them on marketing off grade hides.

Economic Analysis

- Conduct a Florida aquaculture versus foreign competitor strengths, weaknesses, opportunities, and threats (SWOT) analysis that will yield actionable recommendations to improve national and global competitiveness.
- 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.

Education

- Conduct a statewide aquaculture and business development and/or technology transfer workshop.
- Develop and support school education programs leading to certification(s) of competency in Aquaculture.
- Create and launch an educational campaign to inform the public on the importance of responsible pet ownership, environmental stewardship and increase awareness of the consequences of releasing nonnative species and pets.

Glossary

Anaerobic - Without oxygen.

Aquaculture - Cultivation of aquatic organisms (597.0015(1) F.S.).

Bathymetry - Underwater equivalent of topography that describes the bottom contours.

Bio-fouling - The attachment and growth of unwanted marine algae and animals (e.g., barnacles, oysters, calcareous worms) on hard or soft surfaces that add weight, restrict water flow, or create a safety hazard.

Benthic soil - The mix of clays, sands and organic matter that makes up the bottom of the sea.

Brand - The American Marketing Association defines a brand as a "name, term, sign, symbol or design, or a combination of them intended to identify the goods and services of one seller or group of sellers and to differentiate them from those of other sellers."

Brevetoxin - Toxic compounds contained in marine microorganisms that make up red tide.

Broodstock - Sexually mature animals maintained to reproduce and yield fertile eggs, larvae, or fingerlings for sale to other farmers or for grow-out on the farm.

Closed system - Water is filtered and recirculated with a tank or raceway production system located on-site.

Chromosome - A single piece of coiled deoxyribonucleic acid (DNA) containing many genes, regulatory elements and other nucleotide sequences.

Cross breeding - Breeding purebred parents of two different breed, varieties or populations with the intention of creating offspring that share the traits of both parents or producing an animal with hybrid vigor.

Enzyme-linked Immunosorbent Assay (ELISA) - A wet chemistry analytical tool that involves a compound (antigen) that binds to a known antibody that is linked to an enzyme. When the antigen and antibody combine a recognizable color change occurs that indicates the antibody is present.

Farm-gate - A price paid to the farmer for her or his production.

Geographic Information System (GIS) - Digitally recorded geographic information that is captured, stored, manipulated, analyzed, integrated, managed, and displayed as an interactive map.

Grow-out system – Tanks, raceways, ponds or combination thereof in which aquatic species are held captive, fed, protected, and monitored.

Hybrid vigor – An improved or increased function of any biological quality (i.e., enhanced traits) in hybrid offspring.

Integrated Aquaculture Systems (AIS) – Connecting aquaculture production systems with other production systems (e.g., horticulture or row crop agriculture) to re-use outputs (i.e., nutrient-laden waste water) as an input (i.e., fertilizer) and means to reduce or remove potential pollutants (i.e., nutrients).

Integrated Multi-trophic Aquaculture (IMTA) - Production system designs that facilitate the sharing of by-products (e.g., waste) from one aquatic species as inputs (e.g., fertilizers or food) for another to create balanced systems for environment remediation (biomitigation), economic stability (improved output, lower cost, product diversification and risk reduction) and social acceptability (better management practices).

Larvae – Any early motile life stage that develops from a fertilized egg and which may include a variety of life forms to survive changing aquatic environments.

Littoral – Close to the shore.

Live feed – Specific phyto- or zooplankton species produced to feed fish larvae.

Masculinize – To produce certain male secondary sexual characteristics.

Nucleotides – Organic molecules that serve as the subunits of nucleic acids like deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).

Off-flavor compounds – Complex organic molecules produced by microorganisms in a production system that are absorbed by fish and create unpalatable tastes and smells.

Ornamental fish or plants – Fish or plants produced for their color and/or shape for sale to aquarium and water garden hobbyists.

Phytoplankton – Microscopic single or multicellular plants or organisms that drift in the water column and use chlorophyll to produce energy.

Polyploidy – Cells and organisms containing more than two paired sets of chromosomes.

Risk Analysis - An integrated process of assessing environmental risk, identifying risk management options and communicating the analytical process and outcomes through rigorous, replicable methods conducted under protocols agreed upon by experts and stakeholders to arrive at answers to factual questions.

Riparian - Interface between land and water.

Salinity - Saltiness or dissolved salt content of a body of water.

Shellfish - Bivalve molluscs grown for human consumption (oysters, clams, scallops or mussels).

Stocking rate - The number of animals placed into a pond, tank, raceway or on leased submerged coastal lands for grow-out to a marketable size.

Zooplankton - Microscopic or very small animals that float in the water column and feed on organic debris or other zoo- or phytoplankton.

For additional information, please contact:

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Cover images courtesy Florida Department of Agriculture and Consumer Services, Division of Marketing and Development. Images, clockwise from top left: Citrus glazed gator ribs, beer battered freshwater catfish “fish & chips” with lemon, shrimp in deviled-egg boats, and wine steamed clams. For these and other delicious Florida seafood recipes, please visit <http://www.freshfromflorida.com/Recipes/Seafood>.