

Preventing Escape of Non-Native Species from Aquaculture Facilities in Florida, Part 1: General Considerations and Regulations¹

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Introduction

Aquaculture is an important and diverse segment of the agricultural economy in Florida. Many industry segments including ornamental (aquarium and water garden species including fish, amphibians, and invertebrates), live bait, food finfish, and others culture and trade in non-native species (Figure 1) (Hill and Yanong 2010). Because most of these cultured organisms are not native to the state of Florida, their escape or release is an environmental and legal concern and should be a consideration in aquaculture farm construction and operation.

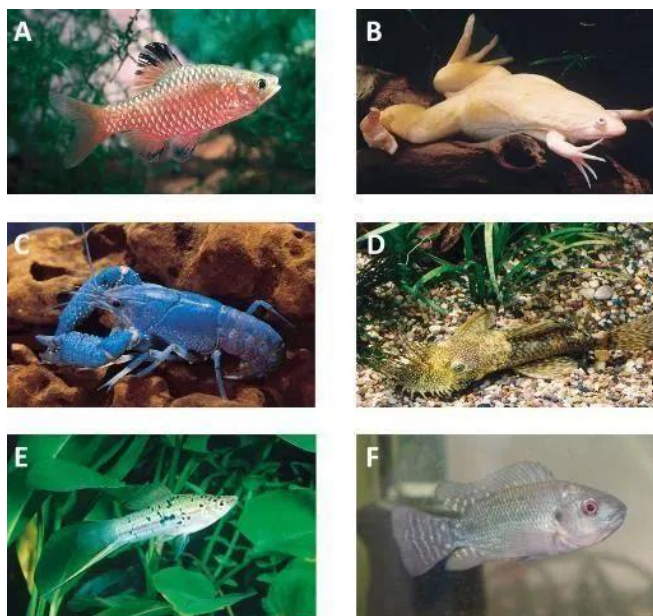


Figure 1. Examples of organisms produced at aquaculture facilities in Florida. Products include the rosy barb (A), African clawed frog (B), electric blue crayfish (C), bristlenose catfish (D), green swordtail (E) and tilapia (F).

Credit: Florida Tropical Fish Farms Association (A, B, C, D, and E), and Edgar Sanchez, Brooksville, FL (F)

This document is the first in a four-part series devoted to educating industry and other stakeholders on the importance of preventing the escape of non-native

species from aquaculture facilities as well as strategies for non-native species containment and regulatory compliance (Hill et al. 2016; Tuckett et al. 2016a; Tuckett et al. 2016b).

Series Contents

- **Part 1: General Considerations and Regulations**—introduces series, explains why non-native species containment is important, provides information on regulations, including the Florida Aquaculture Best Management Practices (BMPs) rule, describes the BMP inspection process, and provides advice on achieving compliance
- **Part 2: Facility Evaluation Strategies**—describes farm layouts, how fish escape, and a process that aquaculturists can complete to identify potential escape points on their farms
- **Part 3: Structural Strategies**—provides information on structures and barriers that can prevent escape
- **Part 4: Operational Strategies**—describes operational and management strategies to prevent escape

Why Worry About the Escape of Non-Native Species?

The escape of non-native species can be a problem for the environment, for aquaculture producers, and for the aquaculture industry. Some non-native species establish permanent populations in surrounding ecosystems, spread into other ecosystems, and cause harmful environmental, economic, or human health effects. Florida has a large number of established non-native freshwater fishes, some of which originated in aquaculture. These species are of management concern for natural resource agencies. This concern has led to new laws regulating aquaculture in an attempt to prevent escape or at least reduce the incidence of escape. Additional regulations and even prohibitions could be

imposed if the aquaculture industry fails to comply with existing regulations or if more problems with invasive species result from aquaculture escape.

For more information on definitions related to non-native species, their establishment and impacts, and considerations and implications for aquaculture, please see publications #4303, #4304, and #4305 of the Southern Regional Aquaculture Center of the US Department of Agriculture (Hill 2008; Hill 2009; Hill 2011).

The Aquaculture Certificate of Registration and Best Management Practices

Multiple state and federal agencies are involved in regulating aquaculture practices and the escape of non-native species (Hill 2013). Principal among these agencies is the Florida Department of Agriculture and Consumer Services, Division of Aquaculture (FDACS). FDACS regulations state that all facility operators engaged in aquaculture with non-zero sales are required to possess the Aquaculture Certificate of Registration, pay a nominal fee (currently \$100; expires on June 30 of each year), and also allow facility inspections to determine whether Aquaculture Best Management Practices (BMPs) are implemented (Figures 2 and 3) (FDACS 2015). The Florida Aquaculture Policy Act specifically states: "Any person engaging in aquaculture in the State of Florida must be certified by the department" (Florida Statutes 2013). Maintenance of the Aquaculture Certificate of Registration is one of the most important compliance concerns for aquaculture facility operators.



Figure 2. A certified aquaculture facility in Hillsborough County. A pond with support structures to hold bird netting can be seen in the foreground; greenhouses can be seen in the background.

Credit: UF/IFAS Extension



Figure 3. Florida Department of Agriculture and Consumer Services, Division of Aquaculture inspector at a certified aquaculture facility.

Credit: UF/IFAS Extension

Maintenance of the Aquaculture Certificate of Registration requires that aquaculture BMPs are followed. BMPs were created by FDACS as specifically mandated by Florida Law (FDACS 2007; Florida Statutes 2013). Florida Aquaculture BMPs cover a wide range of management and environmental topics. The BMPs take an outcome-based approach to the regulation of fish escape, stating, "Any method of containment that will effectively prevent non-native species from being released may be utilized" (FDACS 2015). The appendix of this publication contains the non-native species provisions of the Aquaculture

BMPs (FDACS 2015). Florida Aquaculture BMPs may change over time, so it is imperative for producers to follow the most current version.

FDACS incorporates Florida Fish and Wildlife Conservation Commission (FWC) guidelines on non-native species into the BMPs, specifically the conditional (i.e., restricted) and prohibited species lists. Obtaining an Aquaculture Certificate of Registration when culturing non-natives is necessary because FWC regulations indicate that "No person shall transport into the state, introduce, or possess, for any purpose that might reasonably be expected to result in liberation into the state, any freshwater fish, aquatic invertebrate, marine plant, marine animal, or wild animal life not native to the state, without having secured a permit from the Commission" (FAC 2010); this rule is in force if proper authorization is not obtained from FDACS. Additional rules will apply to the culture of transgenic and restricted species (see Appendix) as well as sturgeon and lionfish (FDACS 2007). Prohibited species are not allowed for commercial culture. Regulations can change, and producers are ultimately responsible for knowing the current state of regulation and for complying with BMPs.

The Inspection Process: What to Expect

Aquaculture BMPs require facility inspections to determine compliance; if your facility fails an inspection, you could lose your Aquaculture Certificate of Registration. The purpose of this section is to show what to expect when your facility is to be inspected. Typically, FDACS inspectors will conduct unannounced inspections as indicated by the Aquaculture Policy Act (FDACS 2015). However, site visits are sometimes scheduled to ensure operator availability and facility access. Inspections are mandated, and one visit per year is required; however, inspectors are encouraged to conduct two visits per year at each certified facility. The emphasis on inspection rate is likely wise, given that a higher inspection rate has been shown to increase compliance in other industries. Inspection rates will vary at each facility; research by the UF/IFAS Tropical Aquaculture Laboratory (TAL) of 23 ornamental aquaculture facilities in Hillsborough, Manatee, Pasco, and Polk Counties suggested inspection rates can vary between 1.5 to 2.5 visits per year, with twice yearly visits the norm (Tuckett et al. 2016c). While these data were acquired from ornamental aquaculture facilities, the results about inspection rates should apply

to other segments of the Florida aquaculture industry. Variation in the number of visits per facility can be the result of revisits by FDACS inspectors who found BMP non-compliance issues, but more frequent visitation may occur for a variety of reasons unrelated to non-compliance.

During visits, FDACS inspectors will ask producers about any changes at the facility, including whether any additional production capacity, effluent control structures, or species were added. Our research on the BMP inspection process showed that FDACS inspectors will most often note the following compliance issues during facility inspections: 1) ditch maintenance, 2) control structure maintenance, and 3) weed management. Thus, many compliance issues can be unrelated to the escape of fish. FDACS's outcome-based approach permits inspectors to alert producers that escape structures appear compromised but refrain from noting these issues in reports unless they determine that fish are present off-site. Because of the bright color of many typical ornamental fish, the presence of escaped organisms can be noted by inspectors, and our research suggests that FDACS inspectors will examine ditches for the presence of fish (Tuckett et al. 2016c). When major BMP non-compliance issues are observed (escape or other problems), FDACS inspectors will revisit the site. Roughly 5% of inspected facilities required a revisit; in our research, revisits were typically due to the presence of overgrown vegetation, which is generally not considered a BMP non-compliance issue. However, it does limit the ability of inspectors to evaluate BMP compliance. Other revisits were due to the maintenance of control structures and ditches. If FDACS inspectors are not able to see and evaluate effluent control structures because of overgrown vegetation, they will ask that the brush be removed and make a quick revisit once the site is cleared. Thus, regularly clearing vegetation to maintain access to these structures can minimize issues and additional visits. Our research also suggests the presence of a detention pond can decrease the probability of a non-compliance issue by over 50%. Detention ponds will also limit fish escape, especially if they are stocked with predatory native fish.

FDACS staff will inform producers of compliance issues, which can range from minor and easily correctable issues to major issues requiring considerable effort to correct. Our research shows that such major non-compliance issues are extremely rare. Non-compliance, especially repeated issues, can result in non-compliance letters,

administrative fines, and loss of certification. In addition, annual re-certification can be withheld if compliance issues are not resolved within 60 days.

How to Achieve Compliance

Because of the outcome-based approach of Florida Aquaculture BMPs, individual operators are left to decide for themselves the most appropriate methods to implement in order to be in compliance with Aquaculture BMPs and escape provisions. If restricted species are present, there is a minimum list of containment structures and practices that are required, though additional methods can be employed. Producers will better achieve compliance with Aquaculture BMPs if they 1) understand the process of escape, 2) determine the most likely points of escape on their own facilities, and 3) identify structural and operational strategies to maintain compliance with escape provisions. These topics are discussed in the remaining publications in this series.

In general, producers should regularly inspect barriers and check aquaculture effluents leaving the farm for the presence of cultured fish. Attention should be paid to any practices (e.g., pumping) that may increase the chance that fish might escape. Maintaining clean ditches (not full of sediments and not overgrown with vegetation) will facilitate producer and BMP compliance inspections. Detention/retention ponds (if practical) also help compliance. Take quick action to correct any escape issues. Contact FDACS staff for more information and assistance with BMP compliance. In addition, Extension faculty and staff at the UF/IFAS Tropical Aquaculture Laboratory in Ruskin are available to assist producers in preventing non-native fish escape from their facilities.

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Appendix

Florida Aquaculture Best Management Practices Rule (FDACS 2015) pertaining to non-native and restricted species. The following information is reproduced from pages 25–29 of this document, available online at <https://ccmedia.fdacs.gov/content/download/64045/file/BMP-Manual-Final-11-2023.pdf>.

Non-Native and Restricted Non-Native Species

A native species is a species within its natural range or natural zone of dispersal, within the range it could or would occupy without direct or indirect introduction by humans. Non-native species are those species not indigenous or native to a particular area.

Restricted non-native species include all species that are listed as conditional species in Rule 68-5.002, F.A.C. Changes in taxonomic nomenclature do not alter the regulatory status of a species; please contact FDACS if you plan to add new species to your facility to verify the restricted or prohibited status. See the appendix for the complete list.

Non-Native Species Containment

Aquaculturists who possess non-native species are responsible for preventing their release to the environment.

Best Management Practices

- All holding, transport, and culture systems must be designed, operated and maintained to prevent the escape of all life stages of non-native aquatic species into waters of the state. Any method of containment that will effectively prevent non-native species from being released may be utilized.
- Written authorization may be required from FWC and/or the U.S. Fish and Wildlife Service prior to importing non-

native aquatic species from outside of Florida or the United States.

Lionfish Best Management Practices

Although lionfish have never been aquacultured, the following BMPs are designed to limit the number of lionfish in Florida but still allow restricted grow out and sale of individuals legally harvested from Florida waters.

- The breeding or reproduction of lionfish (*Pterois* spp.) is prohibited regardless of the origin of the broodstock. 26 FDACS-02034 Rev. 09/2015
- Lionfish lawfully harvested in Florida waters or from adjacent federal waters pursuant to Rule 68B-5.006, F.A.C., may be possessed and grown out for sale at aquaculture facilities that meet the following containment requirements:
 - Lionfish cultured outdoors may only be held in culture systems that have the lowest point of the top edge of its levee, dike, bank, or tank at an elevation of at least one foot above the 100-year flood elevation determined by reference to elevation maps issued by the National Flood Insurance Program, U.S. Department of Homeland Security. Such culture systems shall have no water discharge or shall be constructed with a barrier system designed to prevent escape of adults, juveniles, and eggs in effluent water or into effluent treatment areas in the 100-year flood zone.
 - Lionfish cultured indoors may only be held in culture systems having no water discharge, having a water discharge through a closed drain system, or other system designed to prevent discharge of water containing adults, juveniles, and eggs.
- Any escape or accidental release of lionfish, regardless of life stage, including eggs shall be immediately reported to FDACS.

Restricted Non-Native Species Containment

Facilities culturing restricted non-native species must adhere to the following BMPs, as well as the BMPs listed for non-native species.

Best Management Practices

- Restricted non-native species cultured outdoors may only be held in a water body which has the lowest point of its levee, dike, bank, or tank at an elevation at least one foot above the 100-year flood elevation as determined by elevation maps issued by the National

Flood Insurance Program of the Federal Emergency Management Agency (FEMA).

- All holding, transport, and culture systems must consist of a solid construction, and be designed to prevent the escape of all life stages of aquatic species.
- The facility must have effective measures in place to prevent theft of restricted non-native species.
- Live sale or transfer of restricted non-native aquatic species or their hybrids is limited to those individuals specifically authorized by FDACS or FWC.
- Facilities must maintain records of all live purchases and/or all live sales of restricted species as listed in Rule 68-5.002, F.A.C. These records must include the date of 27 FDACS-02034 Rev. 09/2015 shipment, name, address, and Aquaculture Certification of Registration number(s) of the supplier and the recipient if purchased or sold in Florida and a copy of the Restricted Species Authorization or Conditional Species Authorization for the buyer. Records must be retained by the hatchery or farm and available for inspection for at least two years.
- Written authorization must be obtained annually from FDACS to possess restricted non-native species. Restricted species authorizations issued by FDACS expire on June 30 of each year and must be renewed annually. Any facility failing to maintain an active Aquaculture Certificate of Registration and restricted species authorization must legally and humanely dispose of any restricted species within their possession. Failure to do will result in referral to FWC.
- Written authorization may be required by FWC to import restricted non-native aquatic species.
- Restricted species shall not be taken on a fee or for-hire basis using hook and line or rod and reel.
- For owners of aquaculture facilities that are operating under permit or a certificate of registration, but which are not cultivating Nile perches (Genus *Lates*, all species including barramundi) as of April 11, 2007, and for owners of aquaculture facilities which are issued original permits or certificates of registration after April 11, 2007, Nile perches shall be held only in indoor facilities and shall not be taken on a fee or for-hire basis using hook and line or rod and reel. Facilities must be constructed to prevent the release of animals during a disaster.
- Northern largemouth bass (*Micropterus salmoides salmoides*) must meet restricted species containment requirements throughout Florida.
- Intergrade largemouth bass (northern largemouth bass x Florida largemouth bass *Micropterus salmoides floridanus*) must meet restricted species containment requirements at facilities south and east of the Suwannee River.
- The culture of restricted species of crawfish including Australian red claw (*Cherax quadricarinatus*), red swamp crayfish (*Procambarus clarkii*), and white river crayfish (*Procambarus zonangulus*) is limited to tank culture in an enclosed structure. All systems will be designed to meet the minimum requirements set forth above, as well as preventive measures to assure that the species is unable to escape indoor systems or crawl out of the tank system.
- The culture of restricted aquatic turtle species in outdoor facilities is limited to systems integrating a permanent containment barrier secured at least six inches below ground level to prevent escape by digging or erosion. Containment barriers shall be constructed of solid material, or its equivalent, and shall be secured in place. Mesh material cannot be used for the containment barrier.

Alternative Containment Practices

(Any system may be utilized as long as it meets the containment requirements above).

- No discharge or zero discharge production systems are designed to ensure that water from the production unit is not discharged from the facility. This includes design parameters and management practices to ensure that stormwater does not cause the system to discharge.
- Screened discharge systems utilizing screen or filter devices at the point of production unit discharge or at the point of discharge from the operation or effluent treatment facility (such as a detention or retention pond). A screen or filter device must be sized so as to retain the smallest size fish or egg. Examples of screened/filter systems include a series (multiples are used to ensure at least one screen is in place while others are cleaned) of mesh screens capable of screening all water, a dry bed filter constructed with gravel and sand to trap eggs and fish, a commercially available micro screen solids filter, or a pond trap with screened discharge.
- Disinfection or sterilization techniques such as ultraviolet light (UV), ozone, or chlorine may be utilized in conjunction with the above mentioned methods to ensure that live organisms do not escape the facility.

- Use of biological controls (e.g., stocking detention ponds with native predatory fish such as largemouth bass).

Prohibited Species

Prohibited aquatic species are not eligible for possession or culture in Florida. Prohibited species are identified by Prohibited Non-Native Species, Rule 68-5.003, F.A.C., and Aquatic Plant Importation, Transportation, Non-Nursery Cultivation, Possession and Collection, Rule 5B-64.011, F.A.C.

Best Management Practice

- Anytime a prohibited species is discovered at a certified facility without FWC authorization via a permit, it is to be immediately euthanized and properly disposed of.

Transgenic Species

Transgenic aquatic organisms are defined as organisms whose genomes have been modified by the introduction or deletion of specific genetic material. Organisms created by hybridization or polyploidy techniques do not fall under this definition.

Best Management Practice

- Certified aquaculturists must supply information to FDACS describing:
 - facility design

- production system design
- containment measures
- Federal Agency review
- biological information
- genetic construct and development process
- genetic construct introduction and organism information
- gene construct expression information
- related human health information
- survival and persistence studies
- Certified aquaculturists must apply to and receive from FDACS written authorization prior to culturing transgenic aquatic species. Authorization will only be considered:
 - after all requested information is provided;
 - after the Department has reviewed all other information that has been submitted by the public; and
 - if upon review of all the foregoing it can be determined that authorization will not pose a threat to the public health, safety, and welfare.
- Certified aquaculturists must adhere to all stipulations required in the FDACS written letter of authorization.

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