Aquatic Nuisance Species Status Report
Nonnative Fish and Wildlife Program

Florida Fish and Wildlife Conservation Commission
October 2021 through May 2022
Prepared for Gulf & South Atlantic Regional Panel on Aquatic Invasive Species

MARINE NONNATIVE SPECIES STATUS REPORT

Lionfish

2022 Lionfish Removal and Awareness Day and Lionfish Challenge

Figure 1. Join in the 2022 Lionfish Removal and Awareness Day!

The 2022 Lionfish Awareness and Removal Day (LRAD) was held May 15, 2022, in Destin, FL. Visitors had the opportunity to taste lionfish, watch fillet demonstrations, participate in family-friendly games and much more (Figure 1). This event was held in conjunction with the state's largest lionfish removal event, the Emerald Coast Open Lionfish Derby on May 13 and 14, with a final weigh-in on the 15th, 2022. The six days leading up to LRAD is called Restaurant Week. Each day, one of six participating restaurants created and sold a lionfish dish that highlighted the great taste and versatility of this unique seafood. It is hoped that the more people that taste lionfish, the higher the public demand for this unwanted but available resource will be. The 2022 LRAD event was very successful with 145 participants removing 13,835 lionfish. The First Place Team for Most Lionfish removed 1,623 fish. Prizes were also awarded for the largest lionfish (436 mm) and smallest lionfish (39 mm).

The Florida Fish and Wildlife Conservation Commission (FWC) is also planning to hold the 2022 Lionfish Challenge. The goal of the Challenge is to encourage and reward recreational and commercial divers for removing lionfish from Florida waters. The Lionfish Challenge is scheduled to begin May 20th and run through Labor Day, September 6th, 2022. The Challenge is a statewide event open to recreational and commercial divers. Checkpoints will be set up around

the state for recreational divers to submit their catch and commercial divers will provide copies of trip tickets to document the weight of lionfish they harvested. At the end of the Challenge the recreational diver with the most lionfish and the commercial diver with the most weight of lionfish will be crowned the Lionfish King or Queen for their category. To keep divers interested, there will be a tiered prize system based on the number or weight of lionfish submitted to encourage continued harvest. There will also be bi-weekly raffles for all participants that have submitted a qualified entry. Participants in the Challenge have historically removed a lot of lionfish as the 2021 Recreational Lionfish King brought in 1,194 fish and the Commercial Lionfish King won with over 3,000 pounds. This Challenge is a fun and potentially rewarding way to help reduce the number of lionfish on Florida's reefs. Additional information on the 2022 Lionfish Challenge can be found at http://fwcreefrangers.com/lionfish-challenge

The FWC has developed a variety of programs designed to increase lionfish removals by sponsoring tournaments and offering incentives to recreational and commercial divers. FWC will provide funding to qualified "hosts" to organize and hold lionfish tournaments. Since July 2020, FWC has sponsored 19 lionfish tournaments whose participants have removed over 22,000 lionfish (Table 1.)

Table 1. FWC sponsored lionfish tournaments held between July 2020 and June 2022.

Fiscal Year	Number of Tournaments Sponsored	Total number of participants	Total number of lionfish harvested
July 2020-June 2021	9	441	16,866
July 2021-June 2022**	10	141	5,716

** Data for this fiscal year is not complete. 5 of the 10 sponsored tournaments have yet to be held. We anticipate another 300 participants and around 20,000 lionfish harvested among these 5 tournaments.

The Recreational Lionfish Harvest Program aims to incentivize dive charter boat operators to conduct recreational lionfish-specific harvesting trips to increase the number of lionfish removed from Florida waters. Charters conduct a lionfish-specific harvest trip and will be eligible for reimbursement if the total lionfish harvest is equal to 8 lionfish multiplied by the total number of divers. Charters will be reimbursed for $50/diver. These trips have resulted in nearly 10,000 lionfish being removed from Florida waters (Table 2).

Table 2. Recreational Lionfish Harvest Program results from July 2020 through September 2021.

Fiscal Year	Number of Participants	Trips conducted	Total Number of Lionfish Harvested
July 2020-June 2021	17	206	6,402
July 2021-September 2021	10	87	3,199

*Program normally spans the entire fiscal year but was limited to 3 months long for FY 21-22.

The Commercial Lionfish Harvest Program provides incentive for commercial divers to harvest lionfish and sell their fish to licensed wholesale dealers. In addition to their lionfish sales, FWC will reimburse commercial participants with $3 per pound of lionfish with the submission of their trip ticket (Table 3).

Table 3. Commercial Lionfish Harvest Program results from July 2020 through April 2022

Fiscal Year	Number of Participants	Trips Conducted	Total Pounds of Lionfish Harvested	Conversion to Number of Lionfish
2020-2021	29	254	12,294.72	13645.64
2021-2022	18	92	5,029	5581.58

*Program normally spans entire fiscal year but was limited to Fall and Spring seasons for FY 21-22

The Lionfish Challenge is a summer long incentive program that encourages divers to harvest lionfish. Prizes are awarded on a tier basis to encourage harvest even for those who cannot compete to win (Table 4).

Table 4. Lionfish Challenge results from May-September 2020 and May-September 2021.

Year	Number of Registered Participants	Total Number of Lionfish Harvested
2020	665	21,569
2021	471	21,146

** 2022 Lionfish Challenge begins May 20th. 230 people have registered already.

Green Mussel (*Perna viridis*)

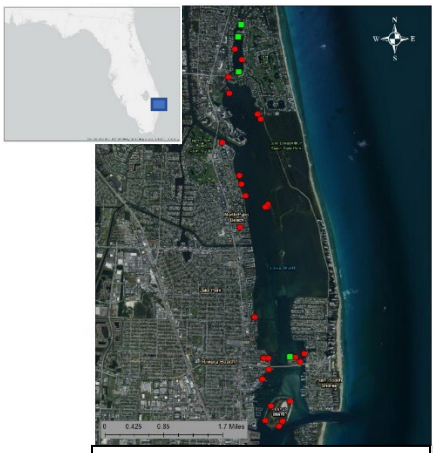

Figure 2. Lake Worth Lagoon survey locations with (green) and without (red) green mussels, 2022

Green Mussels *(Perna viridis*) were first discovered in Tampa Bay in the late 1990s and rapidly increased in abundance. They soon spread south along the west coast, into the Keys and then up the east coast to several locations north of but not in Lake Worth Lagoon (LWL). However, in October 2020 Green Mussels were reported from Little Lake Worth Lagoon on the north end of LWL (Figure 2). FWC and other partners are currently undertaking major restoration projects in the Lake Worth Lagoon including creating nesting islands surrounded by rip rap intended for native oyster habitat. Green Mussels are a bio-fouling organism and there are concerns that they could displace native oysters and cause substantial economic fouling issues for ships and structures such as floating docks, channel markers, pilings, and intake pipes.

There have been no new green mussel reports from the Lake Worth Lagoon or other Intracoastal Waterway sites since February 2021. However, a flier (Figure 3) has been developed and disseminated to LWL stakeholders to aid in the identification and reporting of green mussels to FWC.

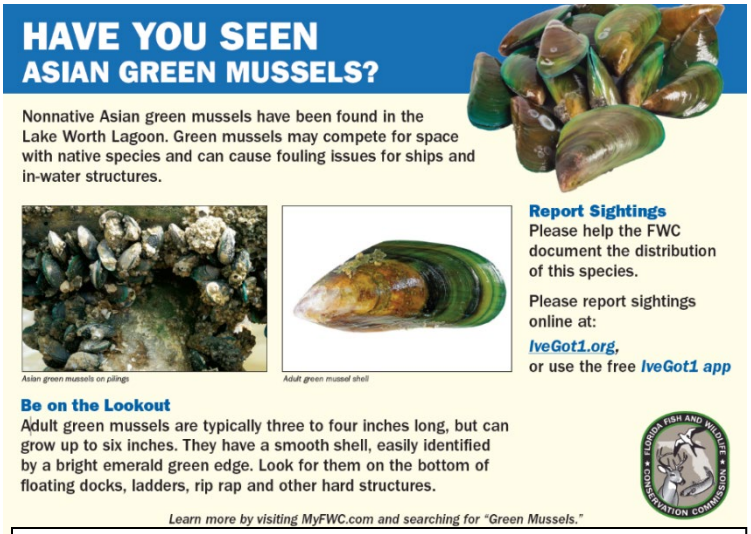

Figure 3. Green mussel (*Perna viridis*) identification and reporting flier.

Asian Tiger Prawns

During this report period, the FWC did not receive any reports of Asian Tiger Prawn (*Penaeus monodon*).

FRESHWATER NONNATIVE AQUATIC SPECIES STATUS REPORT

Fish Slam 2022

The first in-person Fish Slam since the onset of Covid 19 was held March 29 and 30, 2022 in southwest Florida. The primary objectives of this event were to resample sites reported to have arapaima, document the distribution of Butterfly Peacock (*Cichla ocellaris*) and Clown Knifefish (*Chitala ornata)* found in a June 2021 survey, and assess the species composition and abundance of nonnative fish in previously unsampled waterbodies. Forty-four fish biologists from 7 organizations sampled 30 sites from Naples to Englewood, Florida (Figure 4). This sampling effort was one of best attended Fish Slams to date and set a record for number of electrofishing boats participating in the event (n = 15). Sampling gear included electrofishing boats, backpack electrofisher, minnow traps, cast nets, seines, dipnets, and hook and line. Fifteen species of nonnative fishes were collected or observed. Mayan cichlids (*Mayaheros uropthalmus*), Blue and Nile tilapia (*Oreochromis* spp.), and Sailfin

Figure 4. Nonnative fish species collected from one of the 2022 Fish Slam sites in Southwest Florida.

Catfish (*Pterygoplichthys* spp.) were the most widespread and abundant species collected. A total of 13 adult Clown Knifefish were collected from three interconnected homeowner association lakes in Venice, FL. Fifteen adult Clown Knifefish were removed from these lakes the first time they were sampled in June 2021. It is unclear how long Clown Knifefish have been present in these lakes, but it is speculated that they may be the source of Clown Knifefish found in another nearby lake system. Butterfly Peacock have been reported from the Cape Coral area for several years but based on our electrofishing efforts, they were limited to a small portion of the freshwater canal system in this city. The presence of this species at this location is likely due to an illegal introduction by an angler. This was the 12th event since the program began in 2013. For general information on Fish Slam events, please see the webpage for the Florida Non-native Fish Action Alliance at https://www.usgs.gov/centers/wetland-and-aquatic-research-center-warc/science/florida-non-native-fish-action-alliance?qt-science_center_objects=0#qt-science_center_objects.

Figure 5. A new nonnative freshwater fish tentatively identified as a Tire Track Eel (*Mastacembelus armatus)* collected from Cape Coral during the Spring 2022 Fish Slam.

A new nonnative species, tentatively identified as a Tire Track Eel or Zig Zag Eel (*Mastacembelus armatus*) was collected from a single site in Cape Coral, FL during the 2022 Fish Slam (Figure 5). Two individuals were collected, and additional follow-up sampling is planned. Tissue samples are being collected by USGS for eDNA and the eels will be returned to the Florida Museum of Natural History and added to their collection.

A range extension for Spotfin Spiny Eels (*Macrognathus siamensis*, Figure 6) was documented by FWC as part of the 2022 Fish Slam. Four Spotfin Spiny Eels ranging in size from 169-262 mm TL were collected from the Miami Canal where it flows under Alligator Alley (I-75). This site is approximately 26 miles north of their last known location,

Figure 6. Spotfin Spiny Eel (*Macrognathus siamensis*) collected from the Miami Canal during the 2022 Fish Slam.

Southwest CISMA Invasive Fish RoundUp

Figure 7. Nonnative fish species caught as part of the 2nd Invasive Fish RoundUp , May 2022

The FWC and Southwest Cooperative Invasive Species Management Area (SWCISMA) partners held their 2nd Invasive Fish RoundUp on April 29 – May 1, 2022. More than 100 youth and adult anglers on 33 teams registered for the event and seventy-five anglers from 29 teams brought in 3,424 fish weighing 1,886 pounds. Anglers brought a total of 12 different nonnative fish species into the weigh-in site at Bass Pro Shops in Ft. Myers, FL (Figure 7). The primary species brought in by number were Mayan Cichlids, Blue and Nile tilapia, Oscars (*Astronotus ocellatus*), and Sailfin Catfish (Figure 8). There were no new species collected this year, but there were some uncommon ones including Pike Killifish (*Belonesox belizanus*), Black Acara (*Cichlasoma bimaculatum*), and Brown Hoplo (*Hoplosternum littorale*). Anglers competed for prizes donated by local sponsors and many of the partners set up outreach booths to promote Prevention of nonnative species release. Anglers are encouraged to keep and eat their fish, and some did. The remaining fish were donated to a composting facility. Southwest Florida does not receive much directed fish sampling effort so this event along with the Fish Slam held the end of March 2022 in this area were valuable tools that assisted FWC in assessing nonnative fish distributions and abundance.

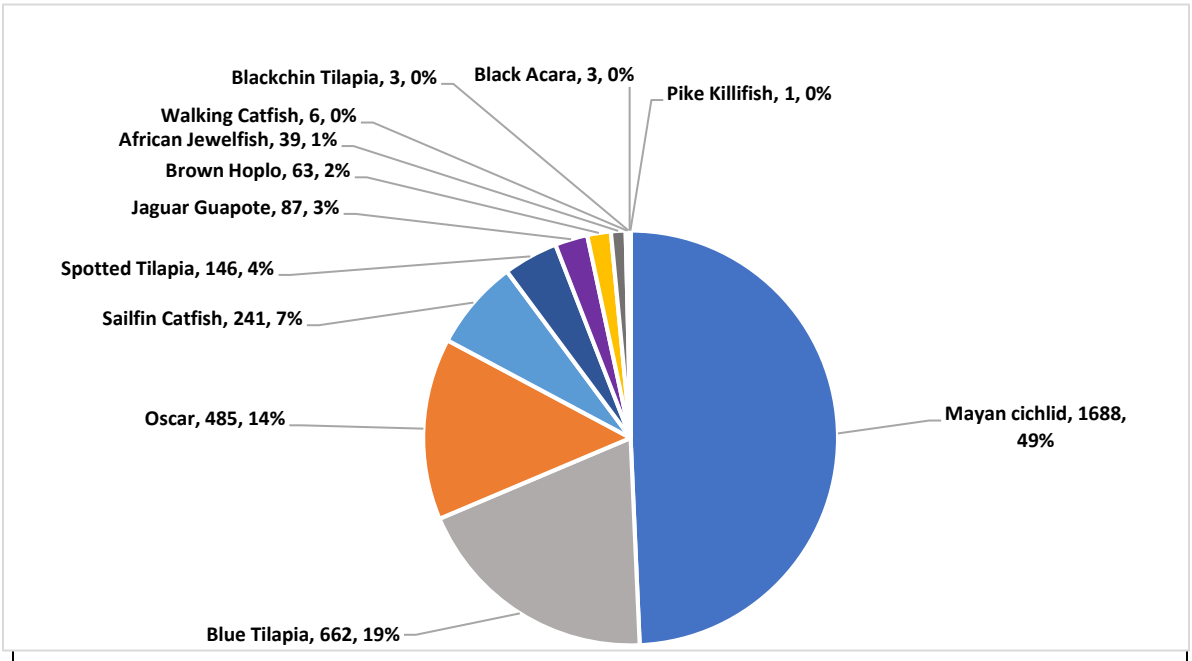

Figure 8. Angler catch composition of nonnative fish species caught as part of the 2nd Invasive Fish RoundUp , May 2022.

Bullseye Snakehead, Largemouth Bass, and Butterfly Peacock Habitat Use and Diet Overlap in Lake Ida

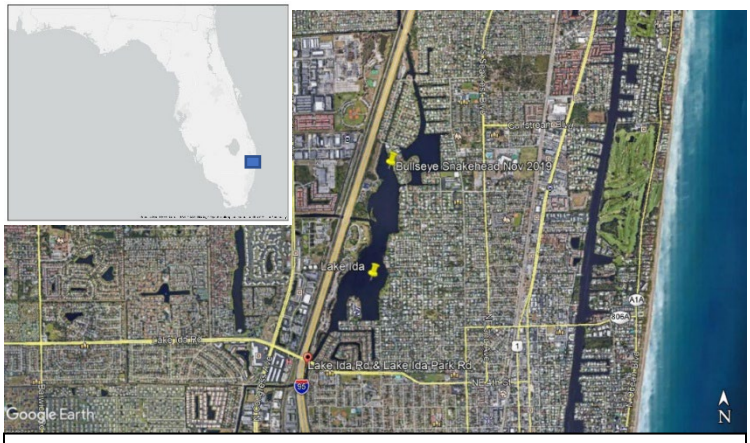

Figure 9. Lake Ida in east central Palm Beach County.

Bullseye snakehead (*Channa marulius*) have recently moved into the Lake Ida-Osborne chain-of-lakes system in southeastern Palm Beach County (Figure 9). These lakes, although highly modified, represent some of the most natural aquatic habitats in this area. An FWC multi-divisional internal grant proposal was funded to examine how these top-level predatory species use the 'natural' habitats and to compare stomach contents to snakeheads, bass and peacocks collected in manmade urban canals. By better understanding how these species utilize resources in the Lake Ida system, we may develop insight into how they may interact in natural everglades habitats further to the west. Butterfly Peacock occurs in these areas, but Bullseye Snakehead have not been documented in the everglades to date. Stomach content collection of the three species began in July 2020 and will continue through June 2022 to examine seasonal and ontological differences in diet and diet overlap among species (Figure 10).

Figure 10. A school of juvenile Bullseye Snakehead *(Channa marulius*) from in a recent collection trip to Lake Ida in Palm Beach County.

Preliminary results indicate a high degree of overlap in diet between the three species with fish the principal prey group by weight. Fish comprised 98% of the biomass consumed by Butterfly Peacock followed by 90% for Largemouth Bass and 50% for Bullseye Snakehead. Bullseye Snakeheads have the most diverse diet consuming a variety of turtles including a small number of Florida Softshell (*Trionyx ferox*), Florida Mud Turtle (*Kinosternon bauri*), and Florida Musk Turtle (*Sternotherus odoratus*), Florida Water Snake (*Natrix fasciata pictiventris*), and even a Two-toed Amphiuma (*Amphiuma means*). One of the softshell turtles was recovered alive and released. This invasive fish also consumed prey items in large numbers including >800 cane toad tadpoles

Figure 11. Cane toad tadpoles, softshell turtle, and crayfish recovered from a Bullseye Snakehead using gastric lavage.

(*Rhinella marinus;* Figure 11*).* Cane toad adults are highly toxic to many animals, but it is unknown if consuming the tadpoles harms the Bullseye Snakeheads.

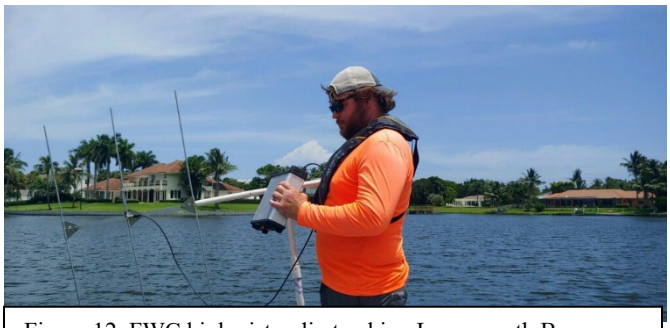

Figure 12. FWC biologist radio tracking Largemouth Bass, Butterfly Peacock, and Bullseye Snakehead on Lake Ida.

In March 2021 radio transmitters were surgically implanted into 25 each of the three target species and tracking began in April 2021. Fish movements are being monitored by three shore-based remote receivers and by handheld receivers on boats (Figure 12). The fish were also tagged with reward tags to evaluate catch rates of these popular sportfish by anglers. Tracking has shown a wide variety of movements within the lake as well as into the interconnected canal systems including a Bullseye Snakehead that an angler caught that had traveled 15 miles from the implantation site in 15 months. Researchers have documented some mortality of radio-tagged fish and plan to recover the tags and implant them again this fall to monitor movements over another "winter" to see how these species respond to cold water conditions. A database is under construction to allow FWC to enter and analyze the fish movement from active and remote tracking data collections.

Standardized Electrofishing Survey for Nonnative Freshwater Fish

Figure 13. Bullseye snakehead (*Channa marulius*) collected from Cypress Creek Canal using standardized electrofishing.

The goal of the FWC's standardized electrofishing program is to monitor native and nonnative fish populations in southeast Florida urban canals (Figures 13, 14). This proactive means of detecting new or rare species can assist with early detection and rapid response to introductions of nonnative freshwater fishes in south Florida. To increase the power of this approach, the FWC's Nonnative Fish and Wildlife Program (NFWP) coordinated with FWC Freshwater Fish Management staff to develop a modified sampling protocol based on their long-term monitoring program. The new protocol keeps three fixed-starting point transects that the FWC's NFWP

Figure 14. Nonnative fish species collected using standardized electrofishing.

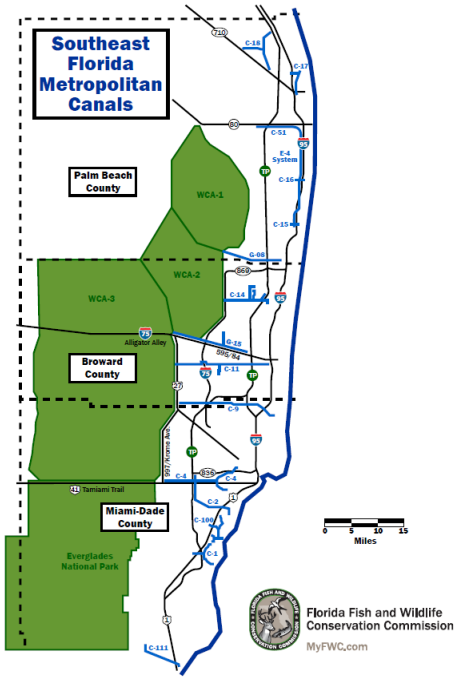

Figure 15. Map of NFWP core canals: the C-100 and C-4 canals in Miami-Dade County; the C-9 and C-14 canals in Broward County, and the C-16 and C-51 Canal in Palm Beach County.

has used since 1997. Additionally, three to five randomly chosen daytime transects were added to this protocol. In October 2021, the NFWP sampled six core canals using these modified protocols. The core canals: Cutler Drain (C-100) and Tamiami Canal (C-4) in Miami-Dade County, Snake Creek (C-9) and Cypress Creek (C-14) in Broward County and the Boynton (C-16) and West Palm Beach (C-51) in Palm Beach County have fish communities representative of those found in the metropolitan Miami-West Palm Beach area (Figure 15). Collectively, these canals have been sampled using standardized methods since 2000. A total of 2,011 fish were collected in 58 daytime electrofishing pedal minutes from six core canals. Native fish (24 species) comprised 72% of the total catch and nonnative fish (17 species, Figure 14) comprised the remainder. Overall, eight additional native fish species were collected from the supplemental transects but combined, represent <1% of the total number of native fish collected in these samples. No additional nonnative fish species were collected in the supplemental transects. Native sportfish, primarily Redear Sunfish (*Lepomis microlophus*), Bluegill (*L. macrochirus)*, and Largemouth Bass (*Micropterus salmoides floridanus*) comprised 85% of the native fish catch, and 61% of all fish collected. Spotted Tilapia (*Tilapia mariae*), Butterfly Peacock (*Cichla ocellaris*), and Mayan Cichlid (*Cichlasoma uropthalmus*), were the principal nonnative fish species collected, making up 60% of the nonnative fish collected in these samples and 17% of the total number. These efforts did not collect any new nonnative species.

Zebra Mussels (*Dreissena polymorpha*)

No confirmed reports of Zebra Mussels were received during this report period.

Arapaima (*Arapaima gigas*)

Figure 16. Photo by: Citron. Licensed under Creative Commons BY-SA 3.0 Unported. Available: https://commons.wikimedia.org/wiki/File:

The U.S. Fish and Wildlife Service (USFWS) received funding for an Early Detection Rapid Response project to support ongoing FWC efforts to prevent the establishment of Arapaima (*Arapaima gigas,* Figure 16) and other potentially detrimental invasive fish species in Florida. The funding allowed for the purchase of large-mesh gillnets, a snagging rod, and a bowfishing kit that can be used by FWC in the event an Arapaima is observed. The funding also paid for USGS and USFWS travel expenses to sample waterbodies with reports of Arapaima. In November 2021 a new report of an Arapaima in a brackish

water canal in Cape Coral, FL was received by FWC. FWC conducted several shoreline surveys and one electrofishing survey, but no Arapaima were observed or collected and no additional reports of Arapaima in this location have been received. The fish was likely a large Snook or Tarpon, species that frequent these canals. In March 2022, follow-up sampling at five reported Arapaima sites was repeated as part of a USGS, USFWS, and FWC Fish Slam. No Arapaima were observed or collected in these samples. FWC has developed outreach materials to inform the public on the potential environmental consequences of releasing this fish and to encourage anglers to report observations or catches to FWC's IveGot1 hotline. For more information, visit FWC's Arapaima website at:

https://myfwc.com/wildlifehabitats/profiles/freshwater/arapaima/

Tilapia Removal From Silver Glen Spring

Figure 17. Silver Glen Springs flows into Lake George on the St. Johns River in Lake County, FL.

Tilapia *(Oreochromis* spp.) migrate in large numbers from Lake George (Lake County) into the spring run of Silver Glen Spring during the winter to escape cold water temperatures and remain into the spring (Figure 17). There is concern that these large numbers of tilapia may displace native fish species and that their bedding activities may uproot native aquatic plants and decrease the forage available to manatees that overwinter in this spring. Biologists with the FWC's Fish and Wildlife Research Institute (FWRI) are exploring different methodologies to try and remove tilapia from these spring runs without causing undue stress to the manatees. Electrofishing is not an option due to the likelihood of accidentally shocking a manatee. Bowfishing and spearfishing may be useful removal tools but are not efficient to remove large numbers of tilapia at one time and can only be used when manatees are not present. Heavy mats of algae were on the bottom of this spring, so seining was not an option, so FWRI tried gillnets to harvest the tilapia. FWRI tied the nets together, encircled schools of tilapia, and drug the nets across the bottom much like a seine (Figure 18). They were able to encircle the fish, but some fish were able to escape by breaking through the nets or swimming through sections with large mesh sizes. Many fish escaped when the fish hit the net, pulled the leadline off the bottom, and swam under the leadline. Even with these difficulties, over 300 pounds of tilapia were removed. Efforts

Figure 18. Tilapia removal efforts in Silver Glen Springs, FL. Note the large number of tilapia in front of the gillnet and the algal mat on the bottom.

are underway to purchase new gillnets constructed with stronger monofilament line, a single mesh size, and a heavier leadline. If funding is available, FWRI will try the new nets next winter.

Biocontrol of Tropical Clawed Frogs (*Xenopus tropicalis*)

Figure 19. An adult Tropical Clawed Frog (*Xenopus tropicalis*) removed from a pond in Riverview, FL.

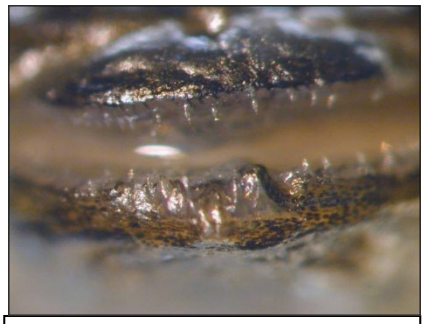

Figure 20. Close-up of the jaws of an Eastern Mosquitofish (*Gambusia holbrooki*).

The FWC has contracted researchers with the University of Florida (UF) to use the native Eastern Mosquitofish (*Gambusia holbrooki)* as a biocontrol species on Tropical Clawed frogs (TCF; *Xenopus tropicalis;* Figure 19) found in small retention ponds in the Riverview area near Tampa, FL. Previous UF studies have shown that TCF eggs and tadpoles are found only in ponds without fish and that Eastern Mosquitofish prey heavily on these life stages of the frogs (Figure 20). The researchers are currently sampling ponds for presence/absence data on adult TCFs to identify their range and determine relative abundance. Once the rainy season begins in June, ephemeral ponds will form creating suitable breeding habitat for TCF that will deposit eggs or tadpoles. Upon detection of vulnerable life stages of TCF, the ponds will be stocked with Eastern Mosquitofish and TCF populations monitored to assess depredation impact. The goal of this project is to make both permanent and ephemeral ponds inhospitable to TCF reproduction and recruitment and ultimately, to eradicate this species from Florida. This work will continue through June 2023.

Upcoming Events

GSARP Spring Meeting: The spring meeting of GSARP will be held June 28 and 29, 2022 in-person in Gulf Shores, Alabama.

2022 Lionfish Challenge: The 2022 Lionfish Challenge is scheduled to run from May 20 through Labor Day September 6. The goal of the Challenge is to encourage and reward recreational and commercial divers for removing lionfish from Florida waters. For more information visit FWC's lionfish website at: https://fwcreefrangers.com/lionfish-challenge/