

# South Florida Ecosystem Restoration Task Force: Invasive Exotic Species Strategic Action Framework *Progress and Accomplishments Since 2015*

The Invasive Exotic Species Strategic Action Framework (Framework) was first completed in 2015. Since its completion, much progress toward invasive species management has been made. The accomplishments and areas of progress are listed by the four Goals in the Framework: Prevention, Eradication through Early Detection and Rapid Response (EDRR), Containment, and Long-Term Management/Resource Protection. They are further divided by five general categories:

- ✓ Tool Development
- ✓ Changes to Policy or Laws
- ✓ Capacity Building and Outreach
- ✓ Coordination Improvements
- ✓ Research

Please note that not all Goal areas have all five categories.

Progress has been made in all four Goal areas. Rule-making and policy changes have made a big impact on how we prevent and manage exotic species. Additional EDRR tools, programs, and creative capacity building have increased the number of individuals looking for newly introduced species. Research has been key in identifying methods to manage and locate invasive exotic species. Coordination efforts are more routine and integrated throughout the landscape at many levels and have been a central component to success. There have also been great strides in managing against several species previously considered somewhat “hopeless” for management actions, such as pythons and lionfish. This progress proves that collective and collaborative efforts, along with leadership support and sustained, predictable resources, make the difference in protecting natural resources from the harmful impacts of invasive exotic species.

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## Goal 1: Prevention

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### Tool Development

**Horizon Scanning Tool:** Prevention is identified as one of the most cost-effective methods in invasive species management. A recent tool of prevention that is being utilized in Florida is horizon scanning. Horizon scanning is a method of systematically evaluating non-native and invasive species using existing information to predict their emersions and pathways for their introduction. This effort is being led by the University of Florida (UF) in collaboration with the Florida Fish and Wildlife Conservation Commission (FWC) and other agencies. The goal of this tool is to create a list of high-risk species of plants, marine organisms, invertebrates, and vertebrates in order to prevent them from invading Florida.

**Law Enforcement Management Information System:** The FWC is currently utilizing data from the U.S. Fish and Wildlife Service's (USFWS) Law Enforcement Management Information System (LEMIS) and FWC-issued import permits to monitor trade and importation information in the state. This information is used to help inform decision making, as well as providing an avenue for horizon scanning. The live animal trade is the number one vector for nonnative fish and wildlife introductions in Florida, but the popularity of individual species changes temporally. Importation data for Florida provides useful information for monitoring trends and trade numbers of live animals

**Risk Screening/Assessment:** The FWC has supported multiple risk screening projects for nonnative aquatic species using the Freshwater Fish Invasiveness Screening Kit (FISK) and the Aquatic Species Invasiveness Screening Kit (AS-ISK). FISK was initially developed in 2005 as a tool to screen potentially invasive freshwater fish species. It has since been further developed (FISK v2 developed in 2013) and calibrated for use in Florida (FISK v2 calibrated for Florida in 2015). In 2016, AS-ISK was developed as a means of combining taxa-specific screening kits into a single tool for any aquatic species. The FWC has supported multiple FISK projects including ongoing screenings of 11 species of damselfish with AS-ISK and a recently completed project that used FISK to screen the following species:

- Crucian carp (*Carassius carassius*)
- Largescale carp (*Hypophthalmichthys harmandi*)
- Prussian carp (*Carassius gibelio*)
- Wels catfish (*Silurus glanis*)
- Eurasian minnow (*Phoxinus phoxiunus*)
- Stone moroko (*Pseudorasbora parva*)
- European perch (*Perca fluviatilis*)
- Roach (*Rutilus rutilus*)
- Amur sleeper (*Perccottus glenii*)
- Zander (*Sander lucioperca*)
- Atlantic salmon (*Salmo salar*)
- Alligator gar (*Atractosteus spatula*)

Additionally, FWC staff used recent risk assessments and conducted new risk screenings to add four reptiles, four birds, and groups of mammals to the state's Prohibited Nonnative Species List that pose a high risk to Florida if introduced into the state. See details in next section.

## Changes to Policy or Laws

**Rule Changes to Protect Florida:** The United States Association of Reptile Keepers filed a lawsuit in the D.C. District Court challenging a 2012 rule (and later added the 2015 rule to the lawsuit) in which the USFWS designated the Burmese python, Northern African python, Southern African python, reticulated python, and green, yellow, Beni, and DeShauensee's anacondas as injurious wildlife under the Lacey Act. The D.C. Circuit ruled that Section 18 U.S.C. § 42(a)(1) of the Lacey Act does not prohibit transport of injurious wildlife between states within the continental United States. This means that transportation of injurious wildlife between the 49 states within the continental United States (the contiguous 48 States and Alaska) is not prohibited by the statute, unless such movement of the wildlife is restricted due to conditions associated with previously issued permits. The federal court ruling has many implications for Florida. This ruling removed protections to Florida that had been in place for over 30 years. In response to the court ruling, the FWC approved rule changes in Chapter 68-5, F.A.C., regarding these high-risk nonnative species and their introduction, possession, and prohibition in Florida on February 21st, 2019. All rule changes became effective on May 2, 2019.

**High-risk Nonnative Wildlife Prohibited:** Many high-risk nonnative birds, mammals, and reptiles have been added to the state's Prohibited Nonnative Species List (Chapter 68-5, F.A.C.). A few examples include mongoose, meerkats, fruit bats, yellow anacondas, and red-whiskered bulbul. Prohibited species may only be possessed by permit at qualifying facilities for educational exhibition or research use.

## Capacity Building and Outreach

**Detector Dogs at the Border:** State border law enforcement agencies at the ports, the FWC and the Florida Department of Agriculture and Consumer Services (FDACS), have expanded the use of detector dogs. The FWC has five detector dogs in total, two of which are based in south Florida.

**Pet Amnesty Program:** There has been continued success with FWC's Exotic Pet Amnesty Program (EPAP). The EPAP was created in 2006 and subsequently established in rule in 2008. From 2006-2014, the FWC held 30 events with over 2,300 exotic pets surrendered. As efforts ramped up since 2015, the FWC hosted an additional 19 events with over 3,700 additional exotic pets surrendered. This total since 2015 includes over 430 Conditional animals that were not released into the wild. Exotic pet owners are also encouraged to surrender any unwanted pets year-round using the Exotic Species Hotline (888-IVE-GOT1). EPAP currently has over 700 active adopters.

## Goal 2: Early Detection and Rapid Response

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### Tool Development

**Go/No-Go Screening Tool:** The need for a decision support tool was identified in the 2015 Framework. The decision support tool, subsequently developed through the U.S. Geological Survey's (USGS) Priority Ecosystem Studies program, provides a standardized and transparent process for ranking those nonnative species that warrant a rapid response after their detection within the ecosystem. This tool is currently being adapted by the FWC for statewide use. The FWC uses this tool to inform EDRR and management decision making. The tool estimates scores for the risk of invasion and feasibility of controlling the species, taking into account the species' biology, history of invasiveness, fecundity, and climate suitability.

**Risk Assessment:** The UF-Institute of Food and Agricultural Sciences (IFAS) Assessment of Non-Native Plants in Florida's Natural Areas is a risk assessment tool that evaluates the invasion risk of established nonnative plant species and hybrids as well as those proposed for introduction. Since 2015, over 400 nonnative plants were evaluated or re-evaluated using this tool.

**Early Detection Tools for Fish:** Several programs have been initiated or continued to aid in early detection of new exotic fish species including Fish Roundups by Cooperative Invasive Species Management Areas (CISMAs) and Fish Slams (sampling) by the FWC and the USGS. In an effort to sample waterbodies not routinely sampled by the FWC, semi-annual Fish Slams continue to be held (8 since 2015). Nearly 100 individuals from 20 organizations have participated. Nearly 200 unique sites have been sampled and 36 nonnative species have been collected. No new species have been captured but range expansions were documented for five species.

**Long-term Monitoring Program in Urban Canals of Southeast Florida:** Since 1997, monitoring and assessment of the relative abundance and distribution of nonnative freshwater fish has been ongoing by the FWC in urban canals. Beginning in 2016, additional transects were added to increase the detection probability of nonnative fish. No new species have been discovered but uncommon native and previously identified nonnative species have been found which provides a more comprehensive inventory of the species present.

### Capacity Building and Outreach

**More EDRR Capacity and Responders in Everglades National Park:** Invasive species staff in the National Park Service (NPS) in south Florida have improved early detection capacity by participating in training for park interpretative staff, meeting with park staff from law enforcement and maintenance divisions, providing park-wide email updates about invasive species issues, and working with communication staff to publish invasive species articles in the South Dade Newsleader. These efforts have resulted in the reports, and in some cases, removal of invasive iguanas, agamas, and other species that are early in the invasion curve inside ENP.

**Nonnative Fish Roundups:** Education and outreach are important tools in preventing the release of nonnative fish and wildlife. 2019 marked the 10<sup>th</sup> anniversary of the Everglades CISMA (ECISMA) Nonnative Fish Round Up. Between 2016 and 2019, 210 participants caught over 5,000 nonnative fish (nearly 4,000 total pounds) of 21 different species. No new species of nonnative fish were caught by the anglers. Participants were encouraged to consumptively use their catch and the remainder was donated to a wildlife facility.

**Giant African Land Snail (GALS) Eradication Program:** The FDACs developed an extensive outreach program as part of the GALS monitoring and removal effort. Due to human health concerns, ample resources were allocated, and the number of cases being reported continues to decrease. Monitoring for new introductions continues.

**Citizen Reporting:** The Exotic Species Hotline was developed in cooperation with the Nature Conservancy, Everglades National Park, and FWC. Initially beginning in the Florida Keys, this hotline was used to obtain reports of pythons. To supplement this hotline, the University of Georgia and UF helped to develop a smart phone app that people can use to report observations instead of calling the hotline number. Data from all sources are shared across FWC and EDDMapS.

A combined total of 17,764 reports have been received in Florida on the exotic species hotline, IveGot1.org, and the IveGot1 smart phone app. These reporting tools are instrumental in EDRR and have helped determine new areas where populations may be establishing. For example, reports from these sources led to the discovery of an emergent Argentine black and white tegu population in Charlotte County in 2018 where over 100 tegus have been removed to date. The exotic species hotline, currently managed by the FWC, has received 12,153 reports since its statewide inception in 2011. An additional 5,611 reports have been received via IveGot1 and the smart phone application.

**Engaging Experts to Identify Exotic Plants:** Regional botanists now provide EDRR technical support to invasive plant sighting reports through the Early Detection and Distribution Mapping System (EDDMapS) to improve rapid response coordination. Assigned plant identification experts receive notifications of new plant reports submitted through IveGot1/EDDMapS then notify appropriate jurisdictions when EDRR priority species are reported.

**Expanding Capacity to Respond to Exotic Animals:** The FWC and the South Florida Water Management District (SFWMD) expanded and enhanced training programs for rapid responders including building a python removal contractor program (see details of programs under Goal 4). The FWC currently compensates python removal contractors for rapid response efforts. The SFWMD also maintains an agreement with UF to have “on-call” rapid response support from invasive species technicians.

**Authorized Agents Removing New Exotic Species:** The NPS has grown the number of volunteers in its Authorized Agent Python Removal Program from 13 in October 2018 to 65 in September 2019. Except for venomous or otherwise dangerous species, these NPS volunteers are allowed to remove any nonnative reptile and amphibian from Everglades National Park, Biscayne National Park, and Big Cypress National Preserve. Most of the animals removed are Burmese pythons, but there are already several examples of EDRR successes attributable wholly or in part to the NPS volunteers, including the removal of a Nile crocodile, a brown caiman, and several green iguanas. These volunteers have also responded to sightings of other species outside the scope of the paid python-removal contractors (e.g., a carpet python) on NPS lands.



## Coordination improvements

**Rapid Response Programs:** Several species management initiatives have benefited from coordination groups like CISMA or smaller interagency groups. (FDACS/FWC) “eradicated” the Gambian Pouch Rat and still monitoring to confirm success and look for new introductions. Two species of nonnative fish, the Bay snook and the blue mbuna, were detected in an isolated waterway in Pinecrest Gardens, Miami, Florida. There was a concern these species could escape into a neighboring canal during a heavy rain event. Repeated attempts to remove the fish by ECISMA and the USGS were unsuccessful due to the need to protect valuable fish also within the pond. A hurricane in 2018 killed the valuable fish and allowed the FWC and the USGS to successfully renovate the pond. This opportunistic approach led to the successful eradication of the two nonnative fish species.

The FWC was notified of four bullseye snakeheads having been illegally stocked in an abandoned golf course pond in Miami-Dade County. Bullseye snakeheads are currently not found south of I-595 near Fort Lauderdale therefore the Miami-Dade location represented a threat to not only a new county but to the Everglades. This population of bullseye snakehead was successfully removed in 2017.

**EDRR Plant Lists:** CISMA within the Everglades footprint now actively maintain EDRR plant lists specific to their region. Plants are typically categorized as priority for eradication (i.e., known to occur within the CISMA and candidates for eradication) or “be on the lookout” (i.e., not documented in the CISMA but present elsewhere or a probable risk for introduction). The Florida Natural Areas Inventory has compiled these lists and works with the CISMA to maintain the lists.

**Regional CISMA EDRR Initiatives:** Through these cooperative organizations, natural resource managers and invasive species biologists plan collaborative efforts to manage priority EDRR plant species in their regions. These efforts typically combine dedicated monitoring and control field days with stakeholder training (e.g. identification) and research to improve control tools. Two current examples of regional invasive plant eradication efforts are tropical nutrush (*Scleria microcarpa*) in the Kissimmee River basin and Asian black mangrove (*Lumnitzera racemosa*) in Miami-Dade County.

**System-wide, Systematic Invasive Plant Monitoring Network:** ECISMA partners are establishing a monitoring network that covers the Everglades Protection Area and expands and synthesizes multiple monitoring efforts. The program incorporates landscape-scale observations (Systematic Reconnaissance Flights), new introduction pathway monitoring (Corridors of Invasion), and finer scale mapping (Digital Aerial Sketch Mapping) to address multiple monitoring objectives.

**ECISMA’s EDRR Plan:** During annual workshops, the development of priority species lists and discussions of how coordination occurs has improved ECISMA partners’ ability to respond quickly. The FWC has an internal priority list for both animals and plants developed with input from CISMA members. All CISMA now maintain a plant list for EDRR.

## Research

**Metagenomic Surveys:** Environmental DNA or eDNA is DNA that is collected from a variety of environmental samples such as soil, water, etc., rather than directly sampled from an individual organism. eDNA surveys can thus help detect a variety of species present in south Florida. The US Department of Agriculture (USDA) has completed a metagenomic survey and the USGS has one that is ongoing. The USGS is applying existing Burmese python eDNA methods in systematic surveys of south Florida waterways to monitor possible range expansions and is developing markers for other species as well.

## Goal 3: Containment

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### Tool Development

**Evaluating and Improving Control Methods:** The USGS conducted several evaluations to improve containment of Argentine black and white tegus outside Everglades National Park in Miami-Dade County. These evaluations included trap design because previous efforts did not allow capture of small tegus. The USGS developed a modified trap that allows capture of the smallest tegus and is more efficient at catching tegus in all but the largest size classes. Other evaluations focused on comparing the effectiveness of several baits, including chicken eggs, fermented egg oil, cat food, and visual lures, and chicken eggs remained as effective or better than the tested alternatives.

### Capacity Building & Outreach

**Targeted Outreach:** The Office of Everglades Restoration Initiatives (OERI) and several partner agencies targeted pet supermarkets in the City of Coconut Creek for education events resulting in the city's involvement in CISMAs and the pet store stopping the sales of tegus. Additionally, OERI helped develop, with FWC and Zoo Miami information, brochures for the veterinarian community. The brochures targeted the customers as potential exotic pet adopters as part of the FWC nonnative adopters' program and encouraged the owners to not let their exotics loose.

### Coordination Improvements

**Structured Decision-Making Workshop on Pythons and Monitors:** The Arthur R. Marshall Loxahatchee NWR held a workshop in 2013 to discuss pythons possibly entering the refuge. A specific outcome from the workshop included the development of a predictive model that determined that the northward-moving python front was less than 20 kilometers from the Refuge and that pythons were expected to be established and breeding by 2020 (Bonneau et. al. 2016). A USGS-funded eDNA study (2014) later determined the presence of python DNA in water samples from the refuge interior. On September 16, 2016, a refuge law enforcement officer ran over a 10-foot Burmese python on the L-40 levee just south of the main headquarters. This was the first documented python recovered at the Refuge following several unconfirmed reports. Gut content analysis revealed the presence of bobcat and marsh rabbit hair. As of April 2020, there is still no confirmation of Burmese pythons breeding in the Refuge. In addition, a 2017 a workshop to keep Nile monitor lizards out of the refuge was held and resulted in outreach initiatives in the surrounding community, as well as removals in nearby areas.

**Multiple Agency Control on the A.R.M. Loxahatchee National Wildlife Refuge:** The Refuge is a 143,000-acre wetland landscape characterized by a matrix of tree islands and freshwater marsh. The area is owned by the State of Florida and managed by the USFWS. Despite many years of invasive plant management in the Refuge, melaleuca and Old World climbing fern continue to infest large portions of the ecosystem. A collaborative effort between the SFWMD, FWC, and the USFWS began in 2014 to address the infestations. To date approximately 93,000 acres have initially been treated or retreated as

maintenance control. A combined funding commitment of \$5 million annually has made maintenance control for the whole Refuge an attainable objective.

**Argentine Black and White Tegu Workshops:** A 2014 structured decision-making workshop for the Argentine black and white tegu led to a list of research needs, several that have been implemented. Additionally, it was the first of continued agency coordination to control tegu population, outreach initiatives, and resource needs identification.

**CISMA Containment Initiatives:** Regional CISMA partners organized multiple regional containment initiatives during the past five years. During annual interagency summits, invasive species biologists plan collaborative efforts to manage invasive plants considered priority for regional containment. The efforts usually combine dedicated monitoring and control field days as well as stakeholder outreach to improve reporting of new locations. Mission grass in Palm Beach County and Wright's nutrush in Francis Taylor Everglades Water Management Area are two current examples of regional plant containment efforts.

## Research

**Expanding Knowledge of Tegus During Brumation:** Argentine tegus undergo brumation, a period of seasonal inactivity during the winter months that is similar to hibernation. During brumation, tegus are generally not available to trap. The USGS, with support from Everglades National Park, is undertaking a study to characterize the variation in brumation activities across individual tegus (e.g., the timing of when brumation starts and ends, the extent of activity during brumation) and to determine whether things like habitat, temperature, tegu size, and tegu sex are associated with that variation. The aim is to allow managers to focus control efforts when and where they will be most efficient.

**Developing eDNA for Reptile Detection:** A recent study compared eDNA and detector dog success when conducting Northern African python surveys (FWC, NPS, USGS, and other CISMA agency volunteers). Although eDNA results showed presence, the dogs were unable to detect in some cases. eDNA was also used to confirm python presence in areas past their known range.

## Goal 4: Long-term Management and Resource Protection

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### Tool Development

**Detector Dog Programs:** In addition to being used at ports for prevention (See Goal 1), detector dogs are also deployed to find species already present in the ecosystem. Detector dogs have been used to look for Burmese and Northern African python presence in the Bird Drive Basin Recharge Area in western Miami-Dade County. Dogs currently help to identify avocado trees infected by laurel wilt disease, which is carried by an invasive ambrosia beetle. Those trees are then removed to stop the spread to the entire grove. The FWC plans on incorporating detector dogs as part of EDRR and long-term management efforts and has conducted proof of concept research with university partners; this effort began in July 2020.

**Integrated Pest Management:** Fifty-two conservation lands containing 461,940 acres are now considered at maintenance control levels for priority invasive plant species such as Lygodium, Brazilian pepper, and melaleuca. Sustained control of these plants at low infestation levels is due to years of coordination, funding, and integrated pest management.

### Changes to Policy or Laws

**State Rules for Lionfish to Prevent Additional Introductions:** In late 2014, the FWC prohibited the importation of live lionfish into Florida, intentional breeding of lionfish in captivity in Florida, and the harvest or possession of lionfish eggs or larvae in Florida for any purpose other than destruction.

**Lionfish Fishing Laws and Support to Encourage Removal:** FWC lionfish fishing rules include: no minimum size limits, no seasonal closures, no recreational fishing license required when using certain gear, and no bag limits for recreational or commercial harvest of lionfish. Additionally, the use of rebreathers is also allowed to harvest lionfish. Support for removal has increased with nonnative species removal gear exemption permits being issued by the FWC during derby or other removal events in areas otherwise closed to fishing. The National Oceanic Atmospheric Administration's (NOAA) Office of National Marine Sanctuaries (ONMS) issues permits to allow spears in the Florida Keys National Marine Sanctuary's no fishing zones to specifically harvest lionfish. The FWC also "pays back" charter fishermen and/or dive shop expenses for trips that are specifically completed as lionfish harvest and education trips and provides monetary assistance and prizes to put on tournaments that remove lionfish. Since 2014, the State of Florida has signed executive orders allowing for the harvest of an additional spiny lobster over the bag limit during the recreational mini-season if a certain amount of lionfish have been removed and documented by an angler. Lastly, NOAA Fisheries is currently updating the federal list of allowable gear to specify gear for lionfish harvest in federal waters and regularly issues Exempted Fishing Permits for trap testing studies and Letters of Acknowledgement for lionfish research.

- Total Lionfish Commercial Harvest (Gulf of Mexico and South Atlantic with majority of landings off Florida)
  - 2019: 48,973 pounds
  - 2018: 53,551 pounds
  - 2017: 123,275 pounds
  - 2016: 114,239 pounds

- 2015: 77,204 pounds

Note: It is believed a combination of hurricane events around Florida in 2017 and the continued success of regular, shallow-water lionfish removal derbies has decreased the commercial catch seen in recent years.

**New Authorities for Removing Reptiles:** Everglades National Park and Big Cypress National Preserve allow python removal contractors to remove pythons inside NPS lands. This groundbreaking rule change will provide much needed assistance in reducing the impacts to national resources. FWC's Executive Order 17-11 authorizes the lethal take of nonnative reptiles on 22 FWC-managed properties in south Florida. See section below for more details.

## Capacity Building and Outreach

**Lionfish Outreach and Education Efforts:** Outreach and education for lionfish have been expanded including Lionfish Removal and Awareness Days, tournaments/derbies, events, outreach programs, and educational materials, videos, and guides that are publicly available on multiple agency websites. Many of these events partner with researchers to provide scientific data on harvested lionfish. A few examples are listed below:

- FWC Lionfish Challenge
- FWC "Become the Predator" workshops
- FWC Lionfish classroom Invasion
- FWC Reef Rangers program
- Lionfish Removal and Awareness Days
- Reef Environmental Education Foundation (REEF) annual derbies
- Lionfish Summit Workshops
- NOAA-ONMS Lionfish Invitational
- Citizen scientist reports of lionfish sightings to USGS, NPS, and/or FWC

From 2014-2018, the FWC has tracked the removal of over 510,000 lionfish from Florida waters during its Lionfish Challenge, Removal and Awareness Days, and other sponsored and supported events. Some statistics are presented below.

- FWC Lionfish Challenge
  - 2018 Recreational Category: 10,117 lionfish removed
  - 2018 Commercial Category: Over 16,000 lbs. removed
- FWC Lionfish Removal and Awareness Day
  - 2015-2018: 45,000 lionfish removed
- Total Lionfish Recreational Removal Tournaments/Derbies (FWC sponsored and supported)
  - 2019: 19,161 lionfish removed (15 events)
  - 2018: 20,159 lionfish removed (20 events)
  - 2017: 24,029 lionfish removed (23 events)
  - 2016: 27,167 lionfish removed (27 events)
  - 2015: 14,838 lionfish removed (40 events)

**Python Removal Scale and Consistency Increased:** Interagency partners have been actively removing pythons since 2008 but the scale and consistency of removal has changed. Prior to 2015, much of python removal consisted of agencies partnering together to survey and remove from targeted areas.

Python Patrol was one of the few active python removal programs originally started by the Nature Conservancy before FWC absorbed the program. Since 2015, more python removal programs have been developed and implemented that provide consistent removal of pythons. Hunting and removing pythons has also become easier due to increased number of removal locations and the enactment of less stringent hunting rules regarding nonnative species.

Florida's python removal team is made up of two closely connected programs: the FWC Python Action Team – Removing Invasive Constrictors (PATRIC) and the SFWMD Python Elimination Program (PEP). Each program was designed to compensate independently contracted python removal experts for their time spent looking for and removing invasive large constrictors in the Everglades ecosystem in Florida. PATRIC and PEP both launched in spring 2017 with approximately 25 contractors each, however both programs have grown to 50 contractors each with a total of 100 python removal experts currently active. This increase in participation in both programs has led to a corresponding increase in python captures. Together both programs have accounted for the removal of over 4,100 pythons in the three years since the program's inception. This team continues to expand access with contractors now able to work on NPS, SFWMD, FWC, and state park properties. Additionally, the NPS Python Removal Authorized Agent Program was expanded in 2018 from 40 to over 140 authorized agents.

**Python Challenge:** The FWC has hosted three Python Challenge™ events, one in 2013 (68 pythons removed), a second in 2016 (106 pythons removed), and a third event in 2020, known as the Python Bowl (80 pythons removed). Though details of the events have morphed over the years, the ultimate goals remain the same: to increase awareness about invasive species using pythons to engage the public in invasive species removal efforts. During each Python Challenge™, registered participants removed pythons from public lands for a chance to win prizes. In 2020, more than 750 people in both "Pro" and "Rookie" categories registered from 20 states to take part in a 10-day competition to remove Burmese pythons from the Everglades. Special prizes were also awarded to Active Duty and Veteran participants. The FWC and the SFWMD teamed up with the Miami Super Bowl Host Committee, NPS, UF, the Fish and Wildlife Foundation of Florida, Bass Pro Shops, the Bergeron Everglades Museum and Wildlife Foundation, and other partners and sponsors to host this exciting event.

**Python Patrol Trainings:** Participants are guided by FWC staff experienced with the safe handling, humane killing, and removal of pythons. Efforts to train the public and partners has increased dramatically since 2013. From 2013-2014, 30 training sessions were attended by 469 people. Since 2015, FWC has held 185 Python Patrol trainings for over 2,600 participants. Recently the FWC has increasingly focused on training natural resource professionals and groups who spend a significant portion of their time in areas that pythons are known to inhabit. Python Patrol sessions are ramped up in advance of Python Challenge™ events as well.

**Nonnative Species Training Increases the Number of Volunteers Able to Respond to Reports:** The FWC has held 6 Nonnative Species Responder trainings resulting in 72 people trained on how to respond to, capture, and handle a variety of nonnative taxa. These individuals volunteer for FWC and are occasionally called upon to respond to reports of nonnative species near the area where they live.

## Coordination improvements

**Interagency Python Management Plan:** The FWC, with support from Everglades National Park, initiated the development of the first Interagency Python Management Plan. This formal and facilitated process began in 2019. The plan helps create a unified approach to python management. Through working collaboratively, land managers can prioritize management efforts and leverage resources to collectively combat this widespread invasive species and the threat it poses to the Greater Everglades Ecosystem, as well as the Comprehensive Everglades Restoration Plan (CERP).

**Coordination is Established at Multiple Levels:** Regional invasive species biologists, researchers, and natural resource managers continue to work together to ensure open communication on new research findings. Annual and biennial meetings hosted by FWC (Invasive Plant Research Review), the Florida Invasive Species Council (Annual Symposium), ECISMA (Everglades Invasive Species Summit), the Greater Everglades Ecosystem Restoration (GEER) Biennial Research Conference, and others generate numerous opportunities for information/technology exchange and collaboration. ECISMA also maintains research coordination teams for specific taxonomic groups (e.g., invasive reptiles) to help agencies establish common research strategies and priorities. Other CISMAs continue to coordinate important EDRR plant lists. The Task Force continues to coordinate all taxa conversations related to restoration through the Framework and reporting in the Integrated Financial Plan and Biennial Report.

**Integrated Pest Management:** Over 730,000 acres of the Everglades complex of wildlife management areas (Everglades, Holey Land, and Rotenberger WMAs) are now considered at maintenance control levels for priority invasive plant species such as melaleuca. Sustained control of these plants at low infestation levels is due to years of coordination and integrated pest management by the SFWMD and the FWC.

## Research

**Biological Control Agents:** State and federal partners continued financial and technical support for the development of new biological control agents for control of priority invasive plants in Florida. Researchers at the USDA and UF/IFAS conducted research to determine the viability of potential agents for Brazilian pepper, Old World climbing fern (OWCF), melaleuca, water hyacinth, air potato, earleaf acacia, downy rose myrtle, and other species. In 2019, the federal government approved the release of two new agents for the control of Brazilian peppertree—the Brazilian peppertree thrips and the yellow Brazilian peppertree leaf-galler. Rearing and releasing of the thrips began in 2019. Release of the leaf-galler is expected in 2020.

**Improving Control of OWCF:** UF/IFAS researchers, in coordination with the SFWMD, FWC, and USFWS, conducted numerous greenhouse and field trials to improve herbicidal control of Old World climbing fern. Land managers report limited success in controlling OWCF in some Everglades habitats. New research has identified effective alternatives to standard herbicides and ruled out several other untested herbicides proposed for use. This research has also helped to improve management strategies by identifying potentially optimized retreatment intervals.



**Monitoring of Long-term Trends in Invasive Reptiles:** UF/IFAS, in cooperation with SFWMD and FWC, now conducts standardized monthly surveys for Burmese pythons and other animal species throughout the Everglades Protection Area. This multi-year monitoring program, called the Everglades Invasive Reptile and Amphibian Monitoring Program, is designed to detect long-term trends in invasive reptile and native animal abundance and distribution patterns.

**Radio Telemetry Monitoring of Burmese Pythons:** Pythons are being tracked using radio telemetry in Collier County to understand behaviors and look for opportunities for control in upland habitats by several partners including, the USGS, the Conservancy of Southwest Florida, and Big Cypress National Preserve (BICY). Investigating pythons in BICY is more recent and understanding how the species' behaviors are different in this habitat has aided in resource protection efforts. The understanding that pythons use gopher tortoise burrows has also led to more removals and better success.

**Improving Python Management:** The USDA continues to look for better ways to manage pythons. Currently manual removal is the only method. Opportunities to improve success rates with new tools continue to be investigated. Python chemical communication/pheromone development and trap and lure evaluation with Burmese pythons are ongoing research efforts.

**Lionfish Traps Assessment:** The NOAA Fisheries and ONMS Programmatic Environmental Assessment for Testing Traps to Target Lionfish in the Gulf of Mexico and South Atlantic, including within the Florida Keys National Marine Sanctuary, was completed to allow for faster issuance of exempted fishing permits for lionfish trap testing studies.

**Lionfish Removal Research:** Removal studies by NOAA, other agencies, and multiple universities have shown that regular, targeted removals of lionfish are successful. Since 2015, multiple state and federal grants and requests for proposals have been issued on this topic. In recent years, a shift to deep water removal research has been highlighted, including deep water lionfish trap development.

**Lionfish Studies Promote Safe Consumption:** Studies have shown that lionfish mercury levels are low, comparable to species on Florida's least restrictive consumption advisory list for the general population. This enables the FWC and others to encourage the public to help remove lionfish and consume them.

Lionfish Assessment and Control in NPS: NPS efforts have been sustained at appreciable levels for 10 years, and as a result, there is a more thorough understanding of where lionfish are most likely to occur within the park (and therefore where to focus efforts). Due to this sustained effort, it is likely the number of lionfish in the park has been reduced. The table below shows that in recent years, fewer lionfish are being removed per manhour than in years earlier when the invasion was building, indicating some management success. Biscayne National Park has reduced lionfish densities compared to other areas. This could be due to the sustained removal effort. The current population estimate is a range of 216,000 to 286,000 lionfish within park boundaries.

<b>Year</b>	<b>Total Lionfish Removed</b>
2015	1,583
2016	1,113
2017	1,291
2018	462
2019	1,245
2020	17