Florida Python Control Plan

2021

By signing below, the following administrators, on behalf of their respective agencies, agree to adopt this Florida Python Control Plan.
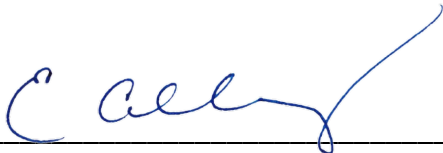
Date: 10/1/2021
Eric Sutton, Executive Director, Florida Fish and Wildlife Conservation Commission

Date: 10/19/21
Drew Bartlett, Executive Director, South Florida Water Management District

Date: 10/18/2021
Erin Albury, State Forester/ Director, Florida Forest Service

Date: 10/05/2021
Shawn Hamilton, Secretary, Florida Department of Environmental Protection

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Burmese pythons (*Python molurus bivittatus*) are large constrictor snakes native to Southeast Asia that have been introduced to southern Florida through the exotic pet trade. Pythons have likely been established in Florida since the 1980s and are currently distributed over a vast area of public and private lands, crossing multiple jurisdictions south of Lake Okeechobee to the Upper Keys and from the east and west coast of Florida. Pythons are considered to be a threat to native ecosystems, human health and safety, Everglades restoration efforts, and more. Negative impacts are exerted primarily through depredation of native wildlife and introduction of novel pathogens and parasites. Despite control efforts undertaken by land managers and partners since the early 2000s, the python population continues to expand in Florida with potential incipient populations continuously reported.

The Florida Python Control Plan (FPCP) is a Florida state agencies' plan that other land-managing organizations may choose to adopt, and it represents the collaborative efforts of 15 Federal, State, and local agencies, tribes, and one non-governmental organization (NGO) to address the need for a unified, interorganizational plan for control of invasive Burmese pythons. The overarching objective of the FPCP is to provide a science-based framework to coordinate and guide efforts to minimize adverse impacts of Burmese pythons in Florida and protect native ecosystems. The FPCP provides a strategic adaptive management framework for land managers, stakeholders, and the public to coordinate, develop, and implement python control efforts that are intended to make steady progress toward controlling the python population. These efforts are guided by four themes central to an effective python control plan—Policy and Regulations, Control and Monitoring, Research, and Communication. Specified for implementation of the FPCP are goals, strategies, and recommendations for each of the four themes.

State and federal policies and regulations have already been created to reduce the risk of future introductions of pythons in the state, but additional measures could help strengthen them and facilitate enforcement. Similarly, policies and regulations for removal of pythons and for research could be further developed and aligned across agencies. By working collaboratively on these goals, management objectives are more likely to be realized, and understanding and efficiencies will be increased.

Control and monitoring efforts for pythons are challenged by several factors including their biology (i.e., lack of predators, high reproductive output, and cryptic behavior). Pythons also inhabit remote locations that typically require specialized equipment to access and careful consideration of impacts to sensitive natural resources. Many of the areas where pythons are found are also home to native species of conservation concern, which limits the control tools that can be used. Ultimately, control tools currently available are unlikely to meet the needs of python control across a varied landscape that crosses multiple jurisdictions.

Research has long been an important component of python control and more research is needed, particularly to determine the effectiveness of existing control tools and to aid in development of new tools. Better understanding python biology in Florida will also allow researchers to estimate the size of the python population, making possible development of indicators for identifying successful control strategies. Additional collaboration among land managers and researchers to guide research needs and priorities will ensure management needs are met and research projects are adequately supported.

Python policy and regulatory actions, control efforts, and research all benefit from strategic, consistent, and organized communication among land managers, partners, and the public. An increase in interorganizational collaboration with a focus on creating and disseminating targeted messaging can promote an informed public that is engaged and supportive of management efforts. In addition, collective communication efforts can aid data sharing which may result in alignment of management efforts that maximize effectiveness and minimize duplication of efforts. Implementation of effective python control strategies will require sustained collaborative communication efforts among stakeholders during initiation and for the duration the strategy is enacted.

THEMES AND GOALS OF THE FPCP

Policy and Regulations
Goal 1: Implement or enhance existing policies and regulations that reduce the likelihood of future python release or introduction to limit population size and spread.
Goal 2: Encourage and facilitate python removal and reporting to advance python control efforts.
Goal 3: Align python removal policies and regulations to be consistent across jurisdictions, where possible, and clearly communicated to other stakeholders and the public to limit confusion and maximize efficiency.
Goal 4: Clarify and streamline policies and regulations governing research projects and permitting to facilitate research that can aid in improved python control.

Control and Monitoring
Goal 1: Prevent the expansion of the python population to areas outside of the known, established range, focusing on areas most vulnerable to impacts.
Goal 2: Reduce and contain the established python population and protect sensitive areas and areas of high ecological value.
Goal 3: Facilitate coordination and planning amongst land managers, researchers, and other stakeholders regarding effective control tools and management strategies.

Research
Goal 1: Advance science to assist land managers in decision-making on python control using the best available science.
Goal 2: Increase alignment of research priorities, investments, and protocols across land managers and partners to increase efficiency so researchers are focusing on questions that will have the greatest impact on management decisions.

Communication
Goal 1: Increase public awareness of the harmful impacts of pythons, the efforts being conducted to control them, and promote the ecological value of native species to inform, empower, and engage the public in python control efforts.
Goal 2: Increase interorganizational communication, data sharing, and collaboration.
Goal 3: Create a communication strategy to support implementation of the Florida Python Control Plan.

Collectively, these themes allow for synergistic, interorganizational collaboration among land managers, stakeholders, and the public for implementation of the FPCP. Implementation of the plan is detailed within the FPCP through the included work plan and draft action plan that will be guided by a Python Workgroup, to be convened upon the adoption of the plan by participating organizations and facilitated by the Florida Fish and Wildlife Conservation Commission. Adoption of the plan or serving on the Workgroup does not imply a legally binding commitment for any organization, nor is the FPCP a legally binding document. The Workgroup will also assign Teams to address each of the major plan themes, along with other issues needing special attention that may arise. The work plan and action plan, guided by the goals, strategies, and recommendations of the FPCP, provide direction for land managers and partners to work together to address python control across the Florida landscape in a unified manner while utilizing the best-available science.

ORGANIZATIONS PARTICIPATING IN DEVELOPMENT OF THE FLORIDA PYTHON CONTROL PLAN

FPCP Workshop Participants
- Broward County
- Collier County
- Conservancy of Southwest Florida
- Florida Department of Environmental Protection
- Florida Fish and Wildlife Conservation Commission
- Florida Forest Service
- Miami-Dade County
- Miccosukee Tribe of Indians of Florida
- Monroe County
- National Park Service
- Office of Everglades Restoration Initiatives
- Seminole Tribe of Florida
- South Florida Water Management District
- United States Army Corps of Engineers
- United States Fish and Wildlife Service

FPCP workshop coordination, drafting of plan content, and graphics of the final plan product were conducted by the University of Florida/ IFAS Fort Lauderdale Research and Education Center through funding provided by the FWC and NPS.

FPCP workshop facilitation was provided by the Florida State University FCRC Consensus Center through funding provided by the FWC.

LIST OF ACRONYMS

AFWA   Association of Fish and Wildlife Agencies
BICY   Big Cypress National Preserve
CERP   Comprehensive Everglades Restoration Plan
CISMA   Cooperative Invasive Species Management Area
CROC   Crocodile Lake National Wildlife Refuge
CSWF   Conservancy of Southwest Florida
DEP   Department of Environmental Protection
DOI   Department of the Interior
ECISMA   Everglades Cooperative Invasive Species Management Area
EDDMapS   Early Detection and Distribution Mapping System
eDNA   Environmental DNA
EDRR   Early Detection/Rapid Response
EIRAMP   Everglades Invasive Reptile and Amphibian Monitoring Program
EVER   Everglades National Park
FAC   Florida Administrative Code
FACA   Federal Advisory Committee Act
FCRC   Florida Conflict Resolution Consortium
FESFO   Florida Ecological Services Field Office, U.S. Fish and Wildlife Service
FDACS   Florida Department of Agriculture and Consumer Services
FFS   Florida Forest Service
FIATT   Florida Invasive Animal Task Team
FKIETF   Florida Keys Invasive Exotic Task Force
FLREC   Fort Lauderdale Research and Education Center, University of Florida
FPCP   Florida Python Control Plan
FWC   Florida Fish and Wildlife Conservation Commission
LOX   Arthur R. Marshall National Wildlife Refuge
NGO   Non-Governmental Organization
NPS   National Park Service
OERI   Office of Everglades Restoration Initiatives
REDDy   Reptile Early Detection and Documentation
ROC   Reptiles of Concern
SGA   Public Small Game Hunting Area
SFWMD   South Florida Water Management District
SWCISMA   Southwest Florida Cooperative Invasive Species Management Area
TNC   The Nature Conservancy
UF   University of Florida
USDA   United States Department of Agriculture

USFWS   United States Fish and Wildlife Service
USGS   United States Geological Survey
WEA   Wildlife and Environmental Area
WMA   Wildlife Management Area

INTRODUCTION

Burmese pythons were likely established in Everglades National Park (EVER) by the mid-1980s (Willson et al. 2011). Since then, pythons have proliferated with their primary population currently found south of Lake Okeechobee from the west coast to the east coast and into the Upper Keys (Figure 1). Efforts by land managers to address Burmese pythons and the negative impacts this invasive species poses to Florida's native ecosystems began in the mid-2000s (Figure 2; Appendix A) and have continued to present. Despite these efforts, Burmese pythons have expanded their distribution, and continue to disperse to new areas, with numerous negative impacts documented. As pythons are not limited by geopolitical boundaries, a unified approach to python control has been undertaken with the development of the Florida Python Control Plan (FPCP). Through working cooperatively, participants can prioritize efforts and leverage resources to combat this widespread invasive species and the threat it presents to the Greater Everglades Ecosystem, those portions of Florida where pythons are not yet established, as well as the Comprehensive Everglades Restoration Plan.
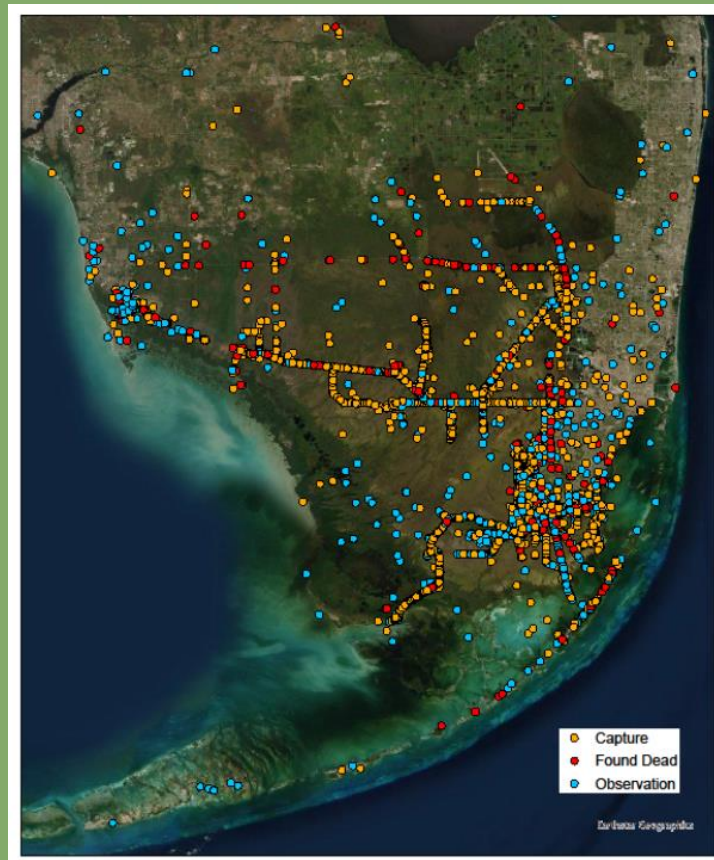

Figure 1 *Map of locations of Burmese python captures, observations, and individuals found dead in Florida. As of September 2020, over 12,000 Burmese pythons have been captured (yellow circles), found dead (red circles), or observed (blue circles) and reported to the Florida Fish and Wildlife Conservation Commission (FWC). Image courtesy of FWC.*

The FPCP was developed during 2019–2021 through a collaborative effort involving land managers representing over a dozen federal, state, and local agencies, tribes, and one non-governmental organization (NGO) (hereafter referred to collectively as land managers). Plan content was developed by participants during facilitated in-person workshops which shifted to online, virtual meetings in 2020 due to the COVID-19 pandemic. A list of participating organizations is provided (page 4). The overarching objective of the FPCP is creation of an interorganizational plan that serves as the foundation for long-term, strategic efforts to control Burmese pythons in Florida. The plan addresses four primary themes of a Burmese python control strategy: Policy and Regulations, Control and Monitoring, Research, and Communication. Goals, strategies, and recommendations were identified collectively under each theme, providing guidance to land managers for achieving steady progress towards python control. An Implementation section was also developed to provide a framework for execution of the plan. It includes clear expectations for the creation of an interorganizational Workgroup that will collaboratively develop annual action plans meant to focus and prioritize the recommendations identified for each goal and strategy for land managers to consider. Prioritization will be done with input from individual Teams created to address each theme. The draft operating principles and a first-year work plan for the Workgroup, along with a draft action plan detailing priority actions currently underway or planned for python control, are included within Appendices C and D, respectively.
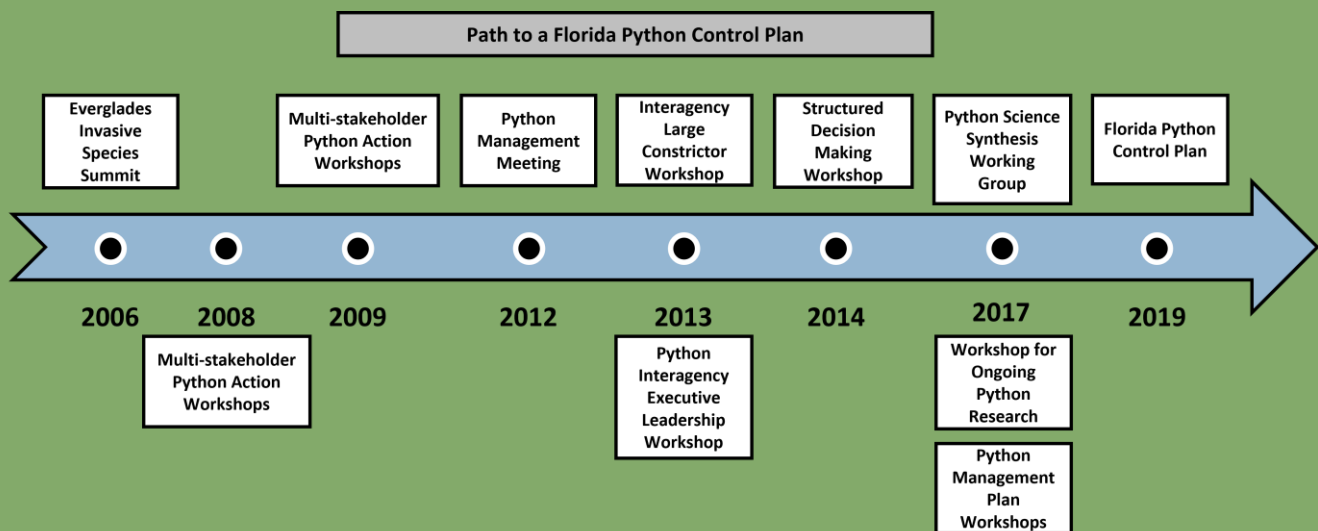
Figure 2 *Path to a Florida Python Control Plan. Timeline documents inter and intra agency meetings held to address the Burmese python invasion in Florida. The culmination of these meetings led to the initiative to develop a collaborative Florida Python Control plan. Meeting objectives and details for each workshop are provided in Appendix A.*

The plan also allows for continued evaluation of progress made toward reaching the mission and desired future conditions for the status of pythons in Florida (see Mission and Desired Future Conditions section); it is developed to be a living-document, guided through sound science, and revised as new information becomes available. Such an adaptive management framework is fundamental to the success of the FPCP, where land managers enact the best strategies to advance python control based upon available science, which is supported by regular monitoring, assessment, and adaption.

The management approach and strategies identified within this document are guided by the status of the Burmese python invasion along the invasion curve (Figure 3). The invasion curve marks the trajectory of a nonnative species upon its introduction as it spreads within its introduced range; as the population and associated impacts increase, control goals become limited and the associated control cost increases with each successive stage of the invasion.
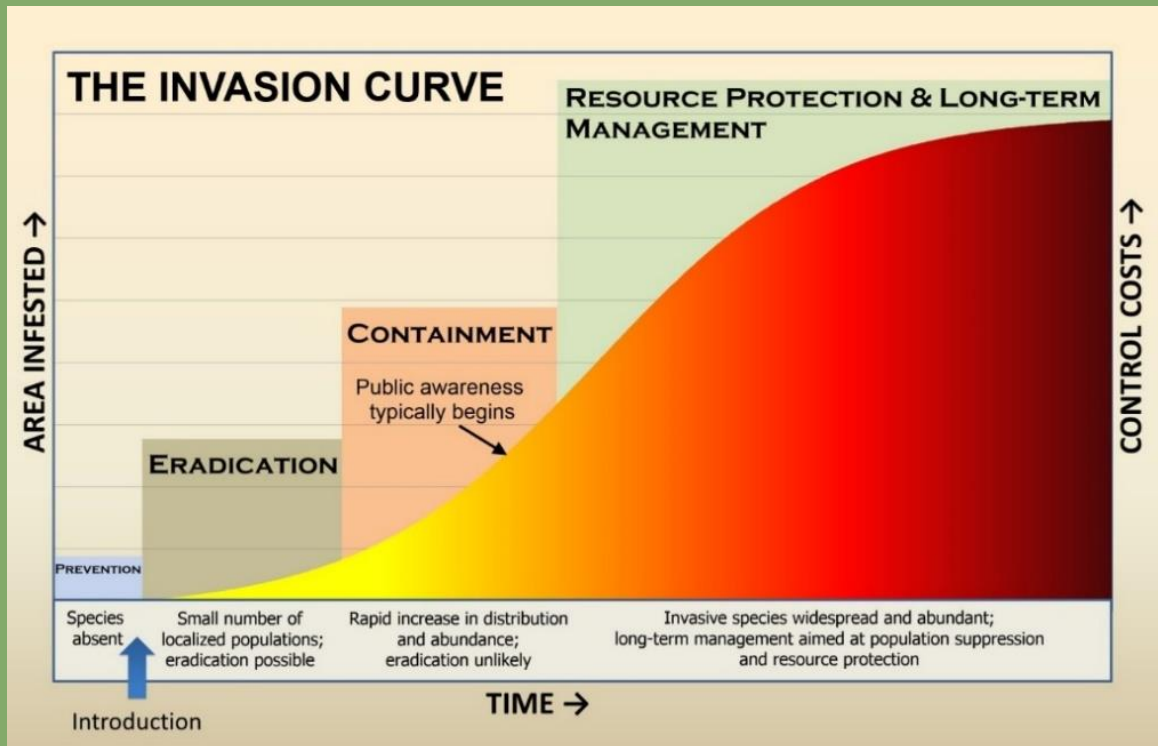
Figure 3 Invasion curve detailing the stages of management applicable to a nonnative species upon introduction, including eradication, containment, and resource protection and long term management. As time increases after a species is introduced, the area in infested expands, control costs increase, and management strategies change to reflect feasible outcomes. (Rodgers 2010, Adapted from Invasive Plants and Animals Policy Framework, State of Victoria, Department of Primary Industries)

Whereas, in hindsight prevention of an invasive species, such as Burmese pythons, would be most cost effective, pythons are currently widely established across southern Florida. Eradication of pythons, while an ultimate goal, eludes current management and control tools and is not a viable objective for southern Florida currently. While widespread eradication may not be feasible, local eradication remains a goal where possible, for example select areas (i.e., Upper Keys). Strong suppression efforts may help contain the population at some boundaries; however, most of the python population covers a vast area, requiring long-term management and costly resources.

Strong and sustained coordination among land managers and stakeholders is necessary to effectively manage Burmese pythons. The challenges associated with python control, including extremely low detection probability, remote, hard-to-access habitats, high reproductive output, and few available predators of adult pythons, are compounded by the snake's widespread distribution over public and private lands encompassing many geopolitical boundaries with varying levels of management resources. Past experience with similar challenges, such as control of invasive plants, has demonstrated the economic and environmental benefits of collaboration, coordination, and resource sharing. Adopting a similar approach increases the likelihood of achieving more timely and cost-effective outcomes at the landscape level.

MISSION AND DESIRED FUTURE CONDITIONS

> *The primary purpose of the Florida Python Control Plan is to provide a science based framework to coordinate and guide efforts to protect native ecosystems and minimize adverse impacts of Burmese pythons in Florida.*

This plan incorporates a multi-faceted, adaptive management approach to python management in which federal, state, and local agencies, tribes and non-governmental organizations (NGOs) work together along with stakeholders to prevent further python introductions, reduce and contain python populations, and develop a coordinated set of goals and strategies to combat the Burmese python invasion in the State of Florida. Within the plan, strategies are provided for land managers to coordinate and leverage resources and facilitate communication and collaboration among land managers, stakeholders, and the public. In addition, provided within the plan are means of evaluating the efficacy and viability of control actions, including both operational and research facets, as well as recommendations for periodic review and updating of plan content.

The desired future conditions for Burmese pythons in the State of Florida include:

- The Burmese python population and range are controlled to minimize or prevent negative impacts to natural resources, human health and safety, and the economy;

- The public is aware of the negative ecological and socio-economic impacts of pythons, is knowledgeable about what to do when they encounter pythons, and supports python control measures;

- Research is supported to advance knowledge of the species, the python invasion, and to develop and refine control tools and technologies;

- Land managers and stakeholders are engaged and empowered to implement appropriate science-based control actions; and

- Increased collaboration and coordination among land managers and stakeholders leads to political and financial support to implement the Florida Python Control Plan.

SYNERGY BETWEEN RESEARCHERS AND LAND MANAGERS

Although this control plan is divided into four themes (Policy and Regulations, Control and Monitoring, Research, and Communication), there is interaction among them, and successful outcomes are interdependent   none can operate in isolation.

There is an interchange among the four themes in which each contributes information that is utilized in an adaptive management framework. While the synergistic interactions among all four themes are key to an effective plan, the intention of this section is to recognize the challenges that researchers and land managers face in invasive species control and suggest a means to continue their collaborative efforts to address these challenges.

Integrating scientific research with adaptive management strategies for pythons within a diverse landscape with multiple stakeholders is challenging, but feasible when partners work together. Researchers and managers share common goals regarding the urgency of the python invasion and work together closely to integrate under various structures and mandates inherent within federal, state, and local agencies, tribes, NGO's, and private landowner interests. Stakeholders, researchers, and managers working collaboratively in an adaptive management framework can increase the success of the FPCP, with the framework providing an avenue for consistent evaluation and evolution of the strategies and practices involved in python control.

The adaptive management process is often used to bring stakeholders together to tackle problems in the face of uncertainty and incomplete knowledge. Flexibility is necessary to test and adopt new science-based control techniques or to pivot and react to changing conditions to determine which control tool will work best under varying conditions. Execution of a strategic plan that is stewarded vigilantly, and includes a deliberate, hypothesis-driven monitoring and assessment component, will allow researchers and land managers to assess and incorporate feedback from management actions and improve outcomes. Use of adaptive management by all participants is key to achieving these goals as this feedback system allows for proactive science-based management strategies based upon continuous evaluation of management outcomes among researchers, land managers, and policy makers, fueled by effective and strategic communication.

BIOLOGICAL BACKGROUND

Status and Threats of Burmese Pythons in their Native Range

Burmese pythons are large constrictor snakes native to Southeast Asia (Bangladesh; Cambodia; China; Hong Kong; India; Indonesia; Lao People's Democratic Republic; Myanmar; Nepal; Thailand; and Viet Nam; IUCN 2020). Since 1979, over 300,000 pythons were imported live to the USA, primarily for the pet trade (Reed and Rodda 2009; Reed et al. 2012). Despite flourishing in their introduced range, Burmese pythons are listed as vulnerable by the International Union for Conservation of Nature (IUCN 2020), with human-caused population declines (e.g., habitat destruction) reported throughout many areas within its native range. Though a similar population decline in Florida is a management goal, the anthropogenic causes of population decline in the native range (primarily habitat loss and associated issues) are not available as management tools in Florida, because pythons occur primarily in habitats where development is undesirable. Instead, natural population controls (e.g., depredation, competition, and disease) can be simulated by an integrated management approach, where multiple management tools are identified and simultaneously applied to control pythons in Florida.

The python population in Florida is admixed, containing genetic material from multiple source populations (see Taxonomy section below) and this genetic variability is among the reasons relocating Florida pythons to their native range is not desirable.

Taxonomy

Burmese pythons (*Python molurus bivittatus*) were historically recognized as a subspecies of the Indian python (*P. molurus*), and though recently they have more often been considered a separate species (*P. bivittatus*), the evidence is ambiguous (e.g., there is not consensus whether they occur in the same or different habitats in parts of their native range; Jacobs et al. 2009; Schleip and O'Shea 2010), and determination of their taxonomy may remain uncertain without genetic or other strong evidence from the native range. Nevertheless, genetic work has shown there is admixture of Burmese and Indian pythons in Florida (i.e., there are genes from recent ancestors of both taxa in Florida; Hunter et al. 2018), thus research and management of the python population in Florida should consider natural history traits of both species. Similarly, we incorporate information from both taxa when available and appropriate in this plan, and we acknowledge the mixed ancestry by using *Python molurus bivittatus* for the Florida population.

Size, Growth, Reproduction, and Survival

Burmese pythons are large snakes, with multiple wild-caught pythons removed from Florida exceeding 18 feet in total length; however, most observations are of smaller pythons. The mean body length of 4,922 pythons removed by SFWMD and FWC contractors from March 2017 through July 2020 from a number of state and federal lands is 1.90 m and 1.72 m, respectively (Rodgers et al. 2021). It is

Hatchling Burmese pythons. Photo: CSWF

important to note that different detection methods and habitat types can result in different size biases (Falk et al. 2016; Smith et al. 2016). Growth rates of free-ranging pythons greater than one year of age have not been estimated, but Burmese pythons that are overfed in captive conditions can grow 0.2 m per month (Frye and Mader 1985).

Regardless, wild Burmese pythons can grow to sizes much larger than any native snake found in the United States (Powell et al. 2016*).*

Rates of maturation, fecundity (reproductive output), and survival can be used in population models to evaluate control efforts and estimate population size and growth, and there are estimates of many but not all of these life history traits for wild Burmese pythons. In general, female pythons reach reproductive maturity at 2.6 m (Reed and Rodda 2009), and male pythons are reproductive at 1.7 m (Reed and Rodda 2009; but see Willson et al. 2014 and Smith et al. 2015 for small-size exceptions). Copulation occurs during December-March, when a single receptive female may be courted by multiple interested males (Smith et al. 2016), who presumably find her using chemical signals (i.e., pheromones; Richard et al. 2019). Multiple males may fertilize a single clutch (Skelton et al. in review), and though parthenogenesis (asexual reproduction) occurs in Burmese pythons, it has been documented only a few times in captivity (Booth et al. 2014), so its frequency in wild pythons is uncertain. The female will lay eggs approximately May-June, and she stays with them, protecting them from predators and cold temperatures, until they hatch, typically during late July-August (Harvey et al. 2008; Reed and Rodda 2009). Nest sites in Florida are variable and may occur in either natural or human-made sites (Wall 1921; Snow et al. 2010; Hanslowe et al. 2016; Wolf et al. 2016). Clutch size varies according to the size of the female, and a 4 m python may have a clutch size of approximately 40 eggs (Willson et al. 2014). Females may lay clutches in consecutive years (Bartoszek unpublished), but average clutch frequency has not yet been estimated. Survival rates of wild Burmese pythons in Florida are not well characterized, but hatching success appears high in the few clutches analyzed to date with success rates of 77% (Wolf et al. 2016) and 92% (Hanslowe et al. 2016) observed. Survival of young pythons may be similar to that of comparable sized native snakes, while survival of adult (i.e., larger) pythons may be higher than survivorship of native snakes (Willson et al. 2011).

Feeding and Diet

Burmese pythons are non-venomous and kill their prey by constriction. In their native range, pythons have been documented to consume mammals, birds, reptiles, amphibians, and fish (Mash 1945, Bhupathy and Vijayan 1989), with mammals and birds consisting of the bulk of prey items consumed. Burmese pythons in Florida have been documented to prey on a wide range of mammal and bird species, and, less commonly, two species of reptiles (Snow et al. 2007a; Dove et al. 2011; Dove et al. 2012; Romagosa unpublished). The isotopic niches, a measure of dietary breadth of a species,

derived from python diet samples in Florida are among the largest of any animal studied to date, underscoring the diversity of prey that pythons consume (Smith et al., in review). Along with diverse types of prey, pythons also consume diverse sizes of prey; rodents comprise the majority of diet samples analyzed thus far (Cherkiss et al. unpublished; Romagosa et al. unpublished), but pythons can also consume very large prey items (e.g., a python had eaten an adult white tailed deer and her two fawns consecutively; Boback et al. 2016; another python that had eaten a white tailed deer weighing 110% of its body weight; Bartoszek et al. 2018a). Some species consumed by pythons are already at risk and protected by federal, state, and/or local laws (e.g., Key Largo woodrats, Greene et al. 2007).

Burmese python with distended food bulge from ingestion of a white-tailed deer. Photo: CSWF

Though typically thought of as sit-and-wait predators, there is also evidence that Burmese pythons actively forage for and search out prey, which has implications for wading bird colonies and other resources in Florida that may be attractive to pythons (Dove et al. 2012; Orzechowski et al. 2019a, 2019b).

Impacts in Florida

Burmese pythons in Florida are problematic because of the significant negative impacts they have on the environment, primarily through depredation of native wildlife, and there are several lines of evidence that pythons are causing these negative effects. Compared to years prior to the python invasion, observations of many small- and medium-sized mammals are significantly reduced, in some cases by 90% or more, in areas where pythons now occur (Dorcas et al. 2012). Translocation experiments using marsh rabbits showed that in areas where pythons do not occur, a diverse predator community preys on rabbits, but in areas where pythons do occur, pythons are the primary predator, and the depredation pressure is focused over shorter time periods (McCleery et al. 2015). The timescale and geographic extent of the python invasion coincides with other factors that may also explain changes in prey populations (e.g., altered hydrology), but many of these alternative hypotheses have been tested and rejected (Sovie et al. 2016).

Pythons cause direct impacts to native species when they reduce population sizes through depredation, but pythons are also indirectly impacting other species or populations. These indirect impacts can be similarly profound with recent research indicating that: 1) invasive parasites, brought by pythons from Asia, now infect native snakes, often at higher infection intensities than in pythons (Miller et al. 2018, 2020); 2) turtle-nest depredation has decreased in areas where pythons occur because raccoons, a primary nest predator of turtles, are now rare in these areas (Willson 2017); and 3) humans may be more likely to get Everglades Virus, a zoonotic disease, because pythons have reduced mammal diversity so that now rodents, the primary host of the virus, are more often fed on by the mosquito vectors (Hoyer et al. 2017). Together with direct impacts, these examples illustrate the pervasive, cascading, and perhaps unanticipated impacts of pythons on the Florida ecosystem.

Though there is evidence of increased transmission risks of Everglades Virus in humans, an actual increase in transmission has not been tested for or demonstrated (Hoyer et al. 2017), and

evidence collected to date suggests that the overall risk of pythons to humans is low. For example, there were only five documented instances where a python struck unprovoked at a human in Everglades National Park during 2003-2012 (Reed and Snow 2014). None of these instances involved constriction, the python aborted the strike before biting in three of the five instances, and injuries were minor in the two instances where a bite did occur (Reed and Snow 2014). All of these events involved park staff and not visitors; given the millions of visitors to EVER during that time, this finding suggests that free-ranging pythons represent a very low risk to human health and safety (Reed and Snow 2014).

Habitat Use

Burmese pythons can occur in most habitats available in southern Florida, including mangroves, fresh-water marshes, tree islands, pine rocklands, and agricultural lands (Hart et al., 2015; Walters et al. 2016; Mutascio et al. 2018). They occasionally occur in residential areas (see also EDDMapS.org). There are also observations of pythons swimming in open waters of Biscayne Bay and the Gulf of Mexico (Hanslowe et al. 2018; Bartoszek et al. 2018b) and, as demonstrated in a laboratory setting, juvenile pythons can survive in sea water for approximately a month (Hart et al. 2012). In general, pythons spend a disproportionate amount of time in upland habitats with canopy cover, particularly during breeding season, and though they may travel through areas of deep water, less time is spent there (Hart et al. 2015; Walters et al. 2016). Habitat use by pythons may vary by bio-region and individual, with some pythons exhibiting more affinity to aquatic environments relative to other habitat types (Bartoszek et al. 2021).

Detectability

Burmese pythons are hard to find due to their cryptic coloration and secretive behaviors, and their low detection probability is a major challenge to effective python control and research. Detection probability, concerning detection of an individual python, is the probability that an individual animal is found if present. Pythons are well camouflaged and may remain motionless for extended periods in water, vegetation, or underground; because of this behavior, even expert searchers found individual pythons in a 31 m x 21 m natural outdoor enclosure only ~1% of the time (Dorcas and Willson 2013). Detection rates may be even lower in wild pythons, and the consequences of this low efficiency are many. For example,

A Burmese python partially exposed in vegetation demonstrates the difficulty in detecting this cryptic species. Photo: SFWMD

detection of pythons by human searchers has shown to be an effective tool for python detection and removal; however, nearly all pythons removed by human searchers are found on roads (Falk et al. 2016) where pythons are more visible to searchers. Therefore, significant increases in individual detection probability may confer only marginal improvements to overall efficiency (e.g., improving detection by

100% only increases a 1% probability to 2%), and research on pythons can be time-consuming and expensive if detection probability limits sample sizes. Nonetheless, not all management and research rely on detection (e.g., a gene drive, where genetically engineered individual pythons are released into the environment to propagate their genes within a population, does not require detection). For control activities that do require detection, the probability of finding a python can vary according to type. For example, in 50 x 50 m controlled study plots, trained detector dogs were able to detect pythons 2.5 times faster compared to human searchers; however, when detector dogs were used to search for wild pythons the dogs ability to detect pythons was affected by environmental factors (e.g., temperature, humidity, and wind direction) which can limit their application to detect wild pythons (Romagosa et al. 2011). It should also be recognized that while detection is an important component of control, the ability to both detect and remove pythons are key to effective control.

Detector dog finds python hidden near base of tree. Photo: NPS

Occupancy-based approaches use a different definition of detection probability. In these cases, it is the probability that the species of interest, rather than an individual animal, can be found if present. For example, an eDNA study may have a 95% probability of detecting python DNA in a sample set containing that DNA, and this information is useful in inferring where pythons occur. Where pythons do occur, a human searcher may have a ~1% probability of finding an individual python located in the immediate area they are searching.

Invasion History in Florida

Because individual detection probability is low, we expect that a new python population would be undetected for a period of time until density increases, and indeed, models that use observation data along with demography and detection estimates suggest that the Florida population was established in Everglades National Park in the mid-1980s or before (Willson et al. 2011), and regular observations of pythons in EVER did not begin until 1995 (Meshaka et al. 2000; Snow et al. 2007b). Hurricane Andrew was a Category-5 storm that devastated southern Miami-Dade in 1992, and while this event may have caused the release of pythons from captive facilities, it is unlikely to be the initial source of pythons in southeastern Florida (Willson et al. 2011), and there is not a clear genetic signal suggesting multiple introductions in that area (Hunter et al. 2018). There is, however, some evidence that a secondary introduction may have occurred in southwestern Florida (Hunter et al. 2018; Bartoszek et al. 2020).

Potential for Range Expansion

The potential range of Burmese pythons in North America remains unresolved, but it is informed by climate modeling, cold-temperature events, and python evolution and behavior. At least three modeling approaches have generated hypotheses of python range expansions, and results vary depending on the data used and model type, complexity, and fit: some models predict that pythons will expand their range to more of the southeastern US, and other models predict that pythons will remain restricted to extreme southern Florida (Pyron et al. 2008; Rodda et al. 2009, 2011). A record-breaking cold event occurred in southern Florida in 2010 when temperatures dropped to 10°C or below for 48 hours, and numerous free-ranging pythons in the Everglades were observed dead shortly after the cold weather (Mazzotti et al. 2011). Additionally, wild-caught pythons held in outdoor enclosures at two locations (Aiken County, South Carolina and Alachua County, Florida) north of the invasive range were exposed to cold temperatures, and many of these snakes also died (Avery et al. 2010; Dorcas et al. 2011). Several of these free-ranging and captive pythons did not seek available shelters (i.e., they exhibited maladaptive behaviors; Avery et al. 2010; Dorcas et al. 2011; Mazzotti et al. 2011). Nonetheless, many wild pythons survived the cold spell, and genomic data suggest the event imposed strong selection on the population for improved cold tolerance (Card et al. 2018). Furthermore, pythons may use gopher tortoise and other animal burrows for reproductive activity, and because these behaviors occur during the winter months and burrows are available in many areas north of the current python range, these burrow-use behaviors may facilitate further expansion into colder areas (Bartoszek et al. 2018c) through providing underground refugia to escape extreme temperatures.

MANAGEMENT BACKGROUND

A Challenging Invader

Burmese pythons were first declared established in Everglades National Park by Meshaka et al. in 2000. As sightings steadily rose both inside EVER and on nearby state lands in the early 2000s, South Florida land managers had to adapt to managing against a new species unlike any other in the state. At that time there was little scientific information available to help determine appropriate control actions and predict impacts on native ecosystems. As Burmese pythons were recognized as a high-priority invasive species, land managing agencies and organizations instituted changes in policies and regulations and collaborated with researchers to learn more about the species and develop control and monitoring tools. They also focused on communication strategies to elevate public awareness of this and other invasive wildlife issues, as well as improve interagency coordination on efforts.

The Burmese python quickly became the most notorious invasive species among Florida's invasive wildlife when images on local and national news of large snakes constricting adult alligators and white-tailed deer captured the imagination of the public. There has consistently been widespread support for efforts to remove pythons, but biological characteristics of the species, environmental characteristics of the invaded areas, and differences in the governing rules and cultures of the different agencies and partners have presented challenges to land managers and researchers. These challenges include a low detection rate, limited effective control tools, a lack of baseline data and assessment tools, impediments to access on some properties, lack of staff time or resources to invest in long-term

decision-making processes, challenges with coordinating and sharing research, and inconsistencies in communication among agencies, stakeholders, and the public.

Implementation of a long-term, system-wide monitoring and assessment program could aid in development of control strategies and allow land managers to prioritize areas to target, thus increasing efficacy while minimizing associated costs. However, because government funding often must be spent annually and there can be uncertainty in the duration that funding will be available, many projects are conducted over a relatively short time frame, and interest from new researchers seeking long-term projects may be limited. Limiting the number of long-term projects that can be conducted may prevent a thorough understanding of python biology, population and distribution and hinder the ability to evaluate the effectiveness of control strategies. Additionally, while recently some government agencies have received substantial resources to support python control and research, other agencies receive little to no funding or resources for python management and would benefit from interorganizational collaborations to aid in python removal on their lands.

By the time it was determined that pythons were established in Florida, pythons were likely far along on the invasion curve (Figure 3) which translates to a robust infestation and high control costs. Since 2004, land managing organizations in Florida have spent approximately 10.6 million dollars on management efforts for Burmese pythons (Figure 4). Consistent funding is essential for optimal invasive species management and was lacking for invasive wildlife over the first two decades of the 2000s, although dedicated funding has steadily increased since 2017. Funding allotments towards control efforts have not always been well-coordinated among the organizations managing different areas. Increasing coordination on funding priorities and strategic planning in all areas of python management should increase the capacity to control Burmese pythons in Florida.

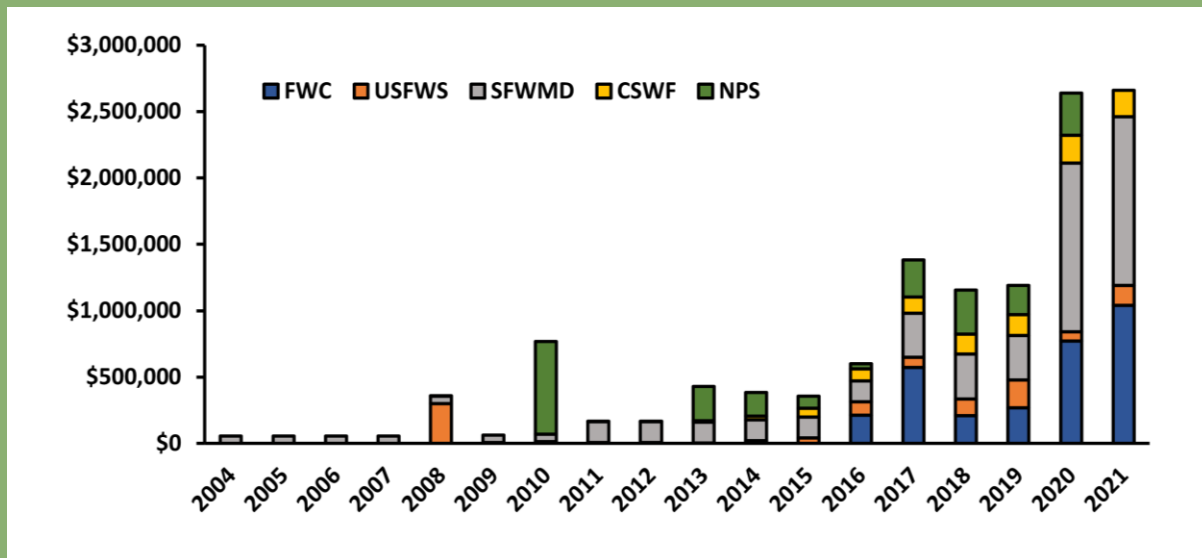**Figure 4** *Agency expenditures on Burmese python management per fiscal year. The FWC follows state fiscal year (July 1   June 30); The USFWS, SFWMD, NPS, USGS and CSWF follow federal fiscal year (October 1 September 30). Note agency expenditures for 2021 may reflect projected estimates for some organizations. Data for 2021 python expenditures for NPS were not available at time of publication.*

Interorganizational Collaboration

Because invasive species know no geopolitical boundaries, interorganizational collaboration is a necessity for managing invasive species across the landscape. In South Florida, multiple federal, state, and local agencies, tribes, and NGOs manage over four million acres of land. Many of these entities have long been coordinating on Everglades restoration efforts and other land management issues, including invasive species. Invasive plants were the primary focus in the 1980s and 1990s and the lessons learned and infrastructure created to combat these species could be applied to Burmese pythons and other invasive wildlife. Land managers collaborated with researchers to understand the biology of the species and created new and innovative techniques for management. As part of the Comprehensive Everglades Restoration Plan (CERP), funding was provided for the US Department of Agriculture Invasive Plant Research Laboratory and the state legislature created the University of Florida Center for Aquatic and Invasive Plants. Long-term management plans like the Melaleuca Management Plan were written to help guide efforts and creation of these plans encouraged regular collaboration and information sharing among stakeholders. Also significant was how government agencies fostered an environment in which a commercial exotic vegetation control industry was created. This important public-private partnership provided the resources to regularly treat millions of acres of land and important innovation in products and techniques to improve efficiency. All of these efforts resulted in a robust and a well-funded invasive plant management infrastructure that has since expanded throughout the state. Management of Burmese pythons in Florida would likely be aided by a similar infrastructure focusing on control of invasive animals.

As invasive animals have become more problematic for Everglades restoration, many of the same partners that worked on invasive plant issues also collaborated on invasive animals. Groups like the South Florida Ecosystem Restoration Workgroup's Florida Invasive Animal Task Team (FIATT), Florida Keys Invasive Exotic Task Force (FKIETF), the Everglades Cooperative Invasive Species Management Area (CISMA), and the Southwest Florida CISMA have all played important roles in bringing agencies together to work on invasive animal issues with limited resources where pythons were often the focal point.

During the first decade of python management (2000-2010), partners tested novel ideas and created innovative programs that served as both potential control tools and vehicles for public awareness (e.g., the FWC's Exotic Pet Amnesty Program). Programs were created with the goal of aiding early detection and rapid response efforts in what was thought to be the early part of the invasion where containment, and potentially eradication in new locations, was still possible. Most of these foundational programs continue to operate today on a much larger scale: Python Patrol, the Exotic Species Reporting Hotline, the Early Detection and Distribution Mapping System (EDDMapS) and the Exotic Pet Amnesty Program. More detailed information on the history of these programs and detailed descriptions of specific agency/organization contributions can be found in Appendix B.

As python management entered the second decade (2010-2020), strategies shifted from containment toward resource protection and long-term management of the python population in most locations. As described in the introduction of the FPCP, several interorganizational workshops and meetings specifically addressing pythons were held to further coordinate efforts and create long-term strategies (Figure 2; Appendix A), possibly with increasing recognition the likelihood of eradicating pythons across the landscape was low. However, agencies experienced a lack of dedicated funding and

Python contractors with captured Burmese python. Photo: FWC

personnel to work on invasive wildlife issues during most of this time period which may have hampered the development of cohesive long-term strategies and programs. In recent years, several government agencies have received significant dedicated funding to focus on python control and research efforts, greatly increasing the potential to advance collaborative management efforts to address pythons across the landscape.

The initiative to develop the Florida Python Control Plan in 2017 and the creation of the paid python removal contractor program have both been catalysts for agencies to authorize additional personnel and resources to manage Burmese pythons. The creation of the python removal contractor program has required an increased level of interagency cooperation as agencies work together to align their programs and expand access to as much public land as possible. Development of a control plan has helped to foster even greater interagency collaboration by convening 15 different organizations over a multi-year process. It is the intention of these entities that this control plan and its guidelines are part of a living document that will be regularly assessed and updated over time ensuring the best science-to-management guidelines and tools will continue to be inculcated and utilized. More details on specific agency involvement and collaboration can be found below and in Appendices A-D.

Python Policies and Regulations

Regulations and agency policies play an important role in preventing or reducing the spread of a newly introduced species (Figure 5). Regarding invasive species management, an obvious purpose for regulation is the prevention of new introductions or spread. When pythons were first determined to be breeding in the Everglades, they could be possessed as pets without a permit, although a permit was required for commercial purposes and exhibition. Burmese pythons, along with other large constrictors, were popular in the exotic pet trade and a number of breeders and importers/exporters were operating in the state. Both the state and federal wildlife management agencies have since changed regulations related to Burmese pythons and other high-risk large constrictor snakes in efforts to limit the damage caused by invasive pythons in Florida and other states.

As the state agency charged with managing Florida's fish and wildlife and with constitutional authority over captive wildlife regulations, the FWC first created rules to more closely regulate Burmese pythons and other large constrictor snakes in 2008. Burmese pythons were one of six species added to the newly created Reptiles of Concern (ROC) list which required a license for personal possession. The FWC also created the Exotic Pet Amnesty Program in 2008, one of the first of its kind. The program provides a legal alternative to release for pet owners who need to surrender their unwanted exotic pets, including regulated species such as pythons. These pets were then adopted out to qualified adopters. The intent of these actions was to prevent new releases of pythons and other nonnative wildlife into Florida. Over the course of the next twelve years, the FWC continued to work to further

regulate Burmese pythons as well as create policies and programs to allow for different user groups, and eventually paid contractors, to remove pythons from the landscape.

After being petitioned by the SFWMD to list the Burmese python as an injurious wildlife species under the Lacey Act (18 U.S.C. 42) and following the subsequent release of the 2009 USGS publication (Reed and Rodda 2009) of bio-profiles and risk assessment for nine large constrictor snakes including Burmese pythons, the USFWS conducted an injurious wildlife evaluation of nine large constrictor snakes under the federal Lacey Act and ultimately listed the Burmese python and other constrictor snake species as injurious wildlife in 2012 and 2015. This listing prohibited importation of the species into the United States as well as transport across state lines without a permit. However, in 2017, a District of Columbia Circuit Court held that the plain language of the statute does not prohibit transport of injurious wildlife between states within the continental United States. Until April 2021, Burmese pythons were regulated as a Conditional species in Florida in Rule Chapter 68-5 F.A.C., and this rule chapter is further supported by Section 379.372 Florida Statute, which limits the possession of and allowable activities using Burmese pythons. A permit is required to possess any live Burmese python, including when temporarily possessing them for transportation purposes. A small number of Reptile of Concern licenses still exist for those individuals in possession of pet Burmese pythons prior to these rule changes. On April 29, 2021, new rules went into effect that moved all lizards and snakes listed in chapter 68-5, F.A.C. as Conditional to Prohibited, limiting possession further. Permits may only be issued to qualifying facilities for educational exhibition, control purposes, or research. Permitted facilities are inspected by FWC Law Enforcement personnel regularly and must meet strict caging, biosecurity, recordkeeping, and reporting requirements. Captive Burmese pythons must also be PIT tagged, with limited exceptions. See Appendix B for more information.

Wild Burmese pythons are not protected by the State of Florida except by animal cruelty laws. Python removal occurs in a variety of ways across South Florida on private, federal, state, and tribal lands. Pythons can be humanely killed on private lands at any time with landowner permission; no permit or license is required. The FWC Executive Order 20-17 allows for the year-long lethal take of pythons and all other nonnative reptiles without any permit or license on 25 FWC Wildlife Management Areas (WMAs), Wildlife and Environmental Areas (WEAs) and Public Small Game Hunting Areas (PSGHAs), in accordance with the provisions of that order.

Pythons may not be removed or killed by members of the public on some public lands due to restrictions on killing any animal found there, including some DOI and DEP lands. However, programs exist that allow for removal of pythons on most of these lands by authorized individuals. These individuals are trained to identify and remove pythons, thus reducing the risk that native wildlife may be inadvertently harmed. On federal lands, existing policies and authorities support python control efforts and other invasive species prevention and management actions. National Park Service policies (2006) state that "Exotic species will not be allowed to displace native species if displacement can be prevented" (NPS Management Policies 4.4.4, 1996). This directive is achieved through decision-making that combines analysis, public involvement, and accountability to ensure that impacts of control support identified park purposes and designations (such as Wilderness). Similarly, on USFWS refuges, there is broad support for invasive species management, but each Refuge has responsibility for evaluating and implementing actions within the context of that Refuge's purpose, priorities, and directives.

As Burmese pythons are distributed across geopolitical boundaries, control efforts that cross jurisdictions are necessary for effective python management. Interorganizational collaboration

through the control plan regarding land access across federal, state, and tribal lands will allow for implementation of management strategies at the landscape level and prevent areas that may become a haven for pythons due to lack of resources for python management. Currently there are different regulations on how, when, and with what means you can remove a python between different land units. While these regulations have been put into place to both restrict movement of pythons and protect native species, they may also inadvertently create barriers to python removal. Land managers can identify and reduce these barriers by working together through the framework of the FPCP.
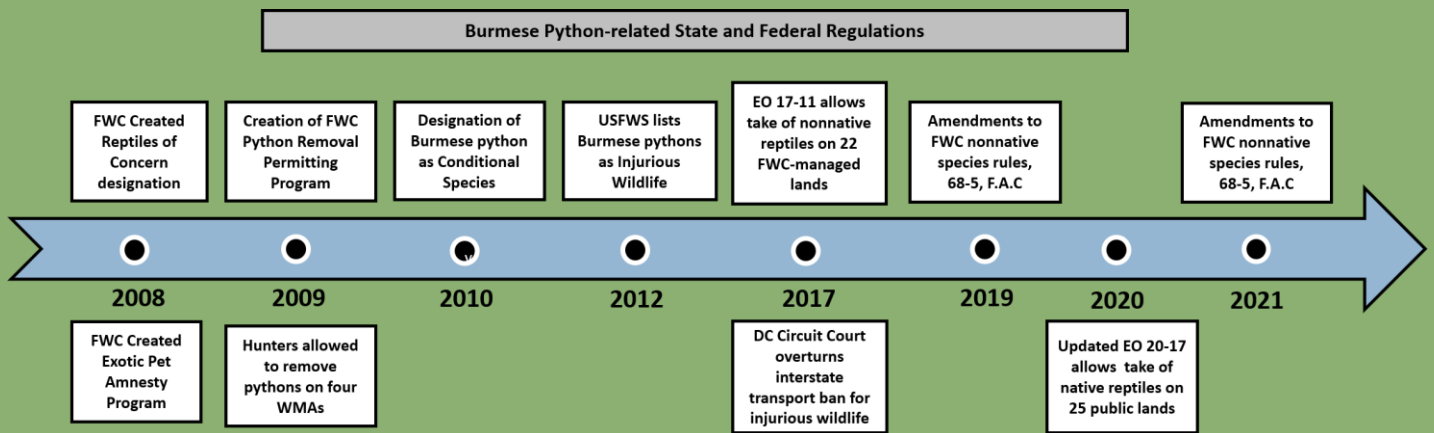

Figure 5 *Timeline of Burmese python related policies and regulations. Additional details for each regulation can be found in Appendix B.*

Control and Monitoring

Removal efforts at the beginning of the invasion varied between the primary land managing agencies. Early on, several agencies recognized the value in recruiting interested citizens to remove pythons. These individuals were often reptile and amphibian enthusiasts who had helped to identify some of the first hot spots (areas with apparent high python abundance) in the python invasion. The NPS began issuing Letters of Authorization (LOAs) to such individuals in the early 2000s which allowed them to remove pythons from NPS lands. In 2009, the FWC also began permitting citizens to remove pythons. The SFWMD, through a contract with the University of Florida, also managed volunteers to remove pythons on SFWMD lands. Python removal by citizen volunteers managed by NPS, FWC and SFWMD resulted in the removal of roughly 1,500 pythons between 2005 and 2017. Since 2013 the Conservancy of Southwest Florida (CSWF) and research partners have removed over 500 adult pythons from a removal area of approximately 55 square miles.

 In 2017, the FWC and SFWMD initiated programs that contracted paid individuals to remove pythons from state lands and many of the volunteers joined these programs resulting in a decrease of pythons removed by volunteers on federal lands but an increase in pythons removed from state lands. Contractors were eventually allowed to remove pythons from federal lands, as well, and from 2017 through 2020, over 6,000 pythons have been removed by paid contractors in these programs. Land managers have also provided opportunities for their own employees to participate in trainings so that they are able to identify and remove pythons they encounter in the field safely and humanely. More recently, several organizations have hired staff whose primary job is removing pythons. Since 2018, the FWC, SFWMD, NPS, USFWS, the Miccosukee Tribe and Seminole Tribe, and the CSWF all have either staff that manage python removal efforts as a primary part of their position or technicians or interns who conduct removal activities. Currently, most python removals are conducted by paid contractors working for State-managed python contractor removal programs and operating on state and federal lands. The CSWF conducts python removal efforts on private lands working closely with landowners. Other agencies continue to operate removal programs relying in part, or solely, on volunteers such as the NPS volunteer authorized agent program and the Crocodile Lake National Wildlife Refuge

USFWS volunteer captures a Burmese python at Crocodile Lake NWR, Key Largo, FL. Photo: USFWS

(CROC) volunteer python removal program. The FWC also encourages outdoor enthusiasts who use state lands for hunting and recreation, as well as private landowners, to kill pythons encountered, but there are currently no reporting requirements in these situations, so data to monitor removal on these lands is unavailable. The FWC, SFWMD, and others also host the Florida Python Challenge®, an outreach event that promotes python removal by the public as well as professionals by offering prizes for pythons removed in different categories. As noted above, python removals increased substantially with the introduction of paid python removal contactors, but it is unclear how these efforts are affecting the python population. Despite their large adult size, due to the cryptic coloration and secretive behaviors of pythons, they are notoriously hard to detect in the wild. Python removal contractors have spent over 57,000 search hours to remove 6,000 pythons—an average of 9.5 hours per python (Kirkland unpublished). When pythons are detected, they are almost always successfully removed; yet their low detection rate requires a significant amount of time and resources spent for python control. Low detectability combined with the fact that pythons are almost always removed when located necessitate the development of novel statistical methods to analyze population trends and successfully monitor effects of removal efforts over time. The FPCP provides a framework to formalize a monitoring and assessment program that fully addresses the needs for desired python control across the landscape, increasing the ability of land managers and partners to assess control methodologies.

Pythons are widely distributed across southern Florida and are dispersed amongst variable habitats in both remote and peri-urban (i.e., an area adjacent to an urban area) locations. While removal of pythons from more disturbed habitats like roads and levees is already challenging due to low detectability, pythons established in remote interior lands pose additional logistical challenges.

In order to be more effective at detecting pythons in all habitat types, land managers have worked with researchers on a number of projects to improve detection (Rodgers et al. 2021). Two techniques that have been successfully used to remove pythons from the interiors of natural areas are scout snakes and detector dogs. Scout snake projects (formerly known as Judas or sentinel snake projects) utilize radio-telemetered pythons during mating season to lead researchers to other pythons and vice versa (Smith et al. 2016; Bartoszek et al. 2021). This tool is a useful method for locating pythons in the interior of the landscape where dense vegetation, standing water and solution holes make detection even more difficult. However, this method is also time

Burmese pythons captured while tracking a radio-telemetered scout snake in Big Cypress National Preserve. Photo: NPS

and resource intensive and associated costs can be high in remote areas of the invaded range (Smith et al. 2016). Detector dogs are another tool that have shown some success in locating wild pythons using scent and could be deployed for targeted removal of pythons from biologically sensitive areas, for surveys to better understand the distribution of pythons, as well as in Early Detection/Rapid Response (EDRR) efforts (Romagosa et al. 2011). However, environmental conditions can hamper their effectiveness and there is no way to distinguish whether they are detecting the scent of a snake that is still in the area. Additional detection and control methods are regularly being developed and evaluated, including those focusing on attracting pythons. Traditional methods such as prey-baited traps have not shown to be effective in areas with already high prey base (Reed et al. 2011) and research on pheromonal attraction requires further refinement and testing (Currylow pers. comm.).

While there have been advances in implementing these control methods in recent years, sustained monitoring for temporal and spatial changes in the python population and subsequent responses of native wildlife are needed. Currently, SFWMD is funding UF to address potential changes in the abundance of pythons and native wildlife as a way to evaluate their contractor program. As previously mentioned, monitoring for these cryptic species is hindered by logistical difficulties and an effective monitoring program that spans jurisdictions will require considerable resources. The University of Florida Everglades Invasive Reptile and Amphibian Monitoring Program (EIRAMP) was developed to serve as a monitoring program for pythons and other invasive reptiles and native wildlife. However, the number of surveys needed each month to detect pythons on the invasion front outpaces the resources available. In addition, successful monitoring programs ideally occur over a long period of time and can be expensive. Challenges with securing long-term funding and prioritizing specific landscape and impacted species have resulted in limited available monitoring information.

Centralized data collection and storage of python sightings and removals is still evolving and currently limits comprehensive analysis to support monitoring and assessment of control efforts. Recently, the agencies collecting the majority of these data began to deposit a minimum of basic sighting information with the EDDMapS online database. While these agencies are now working on

refining their individual data transfer protocols, other organizations are unable to publish their data to this public website. For example, the CSWF conducts scout snake research and python removal on connected public and private lands and cannot report specific python removal data in order to protect the privacy of private landowners who allow this work to occur on their property. The Miccosukee Tribe of Indians of Florida maintains their right to privacy as a top priority. The Miccosukee Fish & Wildlife Department maintains an active python removal program and continues to collaborate with local agencies and universities when possible, but the Miccosukee Business Council does not support the release of any python data collected within Miccosukee Tribal Lands.

Likewise, the Seminole Tribe of Florida ("Seminole Tribe") is a federally recognized tribe pursuant to Section 16 of the Indian Reorganization Act of 1934, as amended. While the Seminole Tribe fully supports the overall mission of invasive species management and readily engages on a partner level in these matters, it is necessary to do so in a manner that still protects tribal interests and sovereignty. Data collected in relation to this effort may contain culturally sensitive information not appropriate for public dissemination. As a result, data contributed on a partner or public level may be a subset of the dataset which while contributing to the overall effort of state-wide invasive species management, also allows for protection of culturally sensitive information and Tribal interests.

Research

Research plays an integral role in managing invasive species by providing knowledge about a species biology and its potential impacts in a new environment. Research is also needed to effectively develop and refine tools for control and monitoring. Primary objectives of current research efforts are focused on increasing python detection and removal, evaluating the efficacy of existing management and control efforts, investigating new removal tools, understanding direct and indirect impacts of pythons on natural resources and ecosystems, and furthering our understanding of the ecology and life history parameters of pythons in Florida. As demonstrated in the Biological Background section, much has been learned over the years about the biology of Burmese pythons and about the impact of this species in Florida. The USGS is currently leading a project to create a collaborative review of all published, relevant research on Burmese pythons in Florida and synthesize it into a published manuscript which will help guide existing management efforts as well as identify future research priorities.

Even so, researchers and managers acknowledge that there are still significant gaps in our understanding that can affect the ability to make optimal management decisions for python control. Python management continues to be hindered by a lack of tools to assess management strategies as well as a lack of baseline data, such as population estimates or indices, needed to measure success of management strategies and to develop key performance indicators. Scientists are lacking a number of vital rate statistics for wild Burmese pythons in Florida, including survival estimates for all life stages, age to reproductive maturity, and fecundity. These statistics may help refine management decisions as far as targeting specific sex and size classes of pythons for maximum control effect. More importantly, vital rate statistics are also needed for developing an accurate population estimate for pythons in Florida. Suggested population sizes of pythons have ranged from as low as 10,000 to as high as 300,000 and there is a high level of interest by land managers in being able to estimate the size of the Burmese python population more confidently. Without a confident estimate of population size, it is difficult to assess the direct impacts of control and removal efforts on this species. Use of traditional

methodologies to estimate animal populations are not desirable for Burmese pythons as these methods often require marking and releasing a significant number of individuals back into the environment to estimate the frequency at which they are recaptured. Such techniques are not practical given the negative impacts from pythons and the fact that they are very difficult to detect. Utilizing indirect methods to gauge the success of management strategies is possible through monitoring of native wildlife populations that are impacted by pythons; past studies have employed this approach (Dorcas et al. 2012, McCleery et al. 2015) and current research, conducted by UF through funding provided by SFWMD, examines variation in detection of pythons and their prey as an indirect means of assessing the impact of contractor programs. Therefore, contractor programs themselves yield significant amounts of data that can be used to further knowledge of python ecology and increase our ability to detect and remove pythons. These data can also be used to develop metrics for quantifying the effect of removal programs on python abundance and the abundance of native taxa impacted by pythons, but collection should be standardized among the programs to provide maximum benefit. The Florida Python Control Plan aims to create a framework by which all land managers and partners can work together more closely on all python-related research to maximize efforts and overcome some of these difficulties.

Communication

Communication refers to both sharing information with the public via outreach efforts and exchange of information among land managing organizations and researchers. Public outreach efforts have focused on increasing public awareness of the Burmese python invasion and the impacts to the Greater Everglades Ecosystem, including the adverse effects of pythons on native wildlife and the threat that invasive species, such as pythons, pose to CERP. An emphasis on reporting python sightings was encouraged early on through programs such as the Eyes and Ears training and, eventually, the Exotic Species Reporting Hotline and EDDMapS. As the public became more aware of the Burmese python invasion, the primary objective has become informing the public about rules regarding python removal so that the public is empowered to identify, report, capture, and humanely kill pythons to increase detection and removal efforts. In the past, communication and media outreach has been conducted largely independently by individual organizations; however, concerted effort to develop strategic communications would advance or support management.

Current outreach efforts conducted within and among federal, state, local, tribal and NGOs include programs and events to reach both a broad and targeted audience. Educational outreach materials including pamphlets, fliers, and presentations are created for the public and more specific audiences such as land managers and natural resource professionals, outdoor

Demonstration of safe capture techniques for Burmese pythons during FWC Python Patrol training. Photo: FWC

recreational groups (sportsmen and sportswomen), law enforcement, contractors, and youth groups. These targeted efforts aim to reach individuals with an increased likelihood of encountering a python in the wild and provide them with the skills necessary to identify, report, and when possible, safely capture the animal. Special events such as the Florida Python Challenge®, Python Patrol Training, Exotic Pet Amnesty Days and other outreach events can serve dual purposes by helping to promote awareness while achieving control and prevention objectives. For example, the Florida Python Challenge® is a multi-day python removal competition that is open to the public. While python removal during this event is important, the primary objective of the Florida Python Challenge® is to spread awareness of the python invasion. Early Detection/ Rapid Response programs, such as the Exotic Species Reporting Hotline (1-888-Ive-Got1), also engage the public by providing a way to report python sightings. These reports are assessed by biologists for credibility and responded to when appropriate. Pythons encountered are removed when possible. Data from reports made by the public, as well as from multi-agency removal efforts, are documented in EDDMapS, an online platform aimed to track the distribution and abundance of nonnative species in Florida.

Effective internal and external communication are key to how well actions are coordinated, information is shared, and for informing and gaining support from the public. Over the years, interagency communication regarding pythons has occurred sporadically as part of collaborative efforts but has not been consistent or formalized. There is no central hub for managers to keep each other informed on research projects or annual projects. Currently the EDDMapS website is the primary way that different agencies and organizations can access python removal and sighting data; as mentioned under Control and Monitoring, not all groups submit their records to EDDMapS and most maintain their own internal python databases. Different agencies and organizations may have their own websites with information on their respective programs, but they are not all linked together in a way that is easy to find information for either the public or partner land managing organizations.

While coordination among managers of public lands is key, so also is coordination among land managers and private landowners. Finding ways to work with private landowners to promote python control and removal will be critical for successful management strategies. Increasing communication among agencies and landowners is needed so that landowners are informed, and possibly incentivized, to report and remove pythons from their lands. This coordination will further the efficacy of removal programs and allow for management and control of pythons at the landscape scale.

THEMES, GOALS, STRATEGIES AND RECOMMENDATIONS

Policy and Regulations

Introduction

Regulations and policies are currently in place to limit the likelihood of future releases of Burmese pythons and to facilitate python removal and control efforts. Future enhancements to this regulatory and policy framework are possible in the following areas: 1) restricting future possession and trade of pythons in attempt to prevent intentional and accidental releases; 2) increasing removal through reduction of obstacles and careful consideration of incentives and commercialization; 3) improving public understanding of rules related to python removal; and 4) facilitating research that will

advance science-based management practices. In addition to reducing the python threat, these improvements can significantly enhance the efficiency of programs and coordination among the many partners involved in python control.

Restricting possession and trade to reduce future python release or introduction: Florida and the federal government have implemented numerous regulations to restrict possession and trade of Burmese pythons. These regulations may be further enhanced, refined, or aligned to reduce the potential for illegal transport and possession, as well as accidental or intentional releases of pythons. Increased collaboration by land managers and law enforcement will also help to improve enforcement of current and future regulations.

Increasing python removal: Python removal occurs in a variety of ways across South Florida on public and private lands. As discussed in the Management Background, there are various policies allowing for python removal by private citizens on public lands as well as initiatives that support python removal by private landowners. In recent years, these programs have greatly expanded removal in a number of ways, but there are still circumstances in which a member of the public may find themselves unable to act (besides reporting the sighting) upon encountering a python. For example, lethal removal is not allowed on a number of state and federal properties, but pythons also may not be transported alive without a permit from the state. The level of python removal effort that occurs also varies across these lands due to differences in allowable methods of removal. Effective removal would likely benefit from more consistency in control efforts across the landscape and an assessment is needed for how to best involve the public and private landowners in those efforts.

Providing incentives for python removal may lead to increased participation among public and private landowners as well as private contractors. The state-managed paid python removal contractor programs operate on this principle, where contractors are incentivized to remove pythons on both state and federal lands by being compensated for their efforts. These programs have increased the number of pythons removed from the landscape significantly and are the most effective means of removing pythons currently available. Contractors are paid both by the hour and by the foot for pythons removed, further incentivizing removal. Providing incentives based on number removed and/or size removed should be evaluated and considered carefully. Unintended consequences could include illegal breeding of pythons to submit for payment, or translocating pythons to new areas to start a population that might be more geographically convenient to access. Incentives can be used strategically to direct python control by contractors such as offering premium pay for areas considered to be on the fringe of the breeding population, while other incentives (e.g., paying extra for pythons, themselves) may deter contractors from searching in areas thought to have fewer pythons. Actions by land managers to encourage removal of pythons should be used strategically with consideration of how incentives contribute to successful control and must consider safeguards to reduce the possibility of unintended consequences. Current or future incentive programs should be assessed periodically to determine their effectiveness and may need to be adjusted as appropriate to ensure management goals are met.

Commercial activities include selling python meat or products made from python skin, paid tours, or excursions to find and remove pythons, and for-profit social and traditional media productions. Commercialization can raise awareness, support, and engagement for invasive species control from the public and government officials and possibly increase removal. It is relevant to note that not all commercial activities are allowed on all properties and illegal commercialization can

contribute to the unintended consequences described above. Commercial use of python products should be recognized and evaluated for its benefits and harms to python control and to human health and safety.

The privatization of python removal and commercial use is likely to continue to grow and expand in Florida. As it does, a natural evolution may include transitioning from individual contractors to small businesses conducting python removal, similar to the development of the exotic plant contractor industry described in the Management Background. The FPCP is expected to provide a vehicle for careful analysis and strategic implementation of these private enterprises to maximize their benefit.

Policies and regulations are consistent and communicated clearly: As noted above, the variety of site- or jurisdiction-specific regulations can create barriers to python removal, depending on the individual and property involved. These differences have at times contributed to confusion among the public and land managers and can also erode public confidence or hinder removal, research, and management. Simplifying all python-related policies and regulations and making them completely consistent across jurisdictions is probably not attainable because of the variety of management directives and special designations for individual lands. However, work towards alignment of a set of core rules and policies should continue. Where alignment cannot be achieved, clear communication of policies and regulations under the different jurisdictions can significantly reduce issues. Creating one public website where all current regulations and policy are presented in easy-to-understand documents and maps could improve understanding of python control efforts and reduce demands on law enforcement.

Improving policies and regulations for research and monitoring which aid in developing management tools and improving management practices: Federal agencies' policies require that decisions be based on the best available scientific and technical information and encourage pursuit of scientific investigations that will improve management decisions. The NPS management policies support research to provide a basis for policy, planning, and decision-making, to minimize impacts to resources, and to determine causes of management problems. Similarly, state agencies consider research a crucial component of advancing and refining invasive species control. Research can improve land managers' understanding of invasive species and strengthen detection and removal capabilities by refining existing tools, evaluating methods used, and developing innovative approaches to python control.

Permitting processes, conditions and reporting requirements should be clear, easily accessible, and better aligned among agencies. Information on research permits issued and research underway should be shared among agencies to aid in reviewing multi-jurisdictional permits and improve awareness among land managers of ongoing work. To the extent practicable, permittee reporting requirements should also be streamlined for multijurisdictional permits.

Table 1. Goals, Strategies, and Recommendations for Policy and Regulations

Goal 1: Implement or enhance existing policies and regulations that reduce the likelihood of future python release or introduction to limit population size and spread.
Strategies and Recommendations

Strategy 1.1: Develop regulations that further restrict possession of pythons or breeding of pythons and improve safeguards to prevent escape and introduction.
Recommendation 1.1.1: Evaluate penalty structure for illegal possession or other activities with Burmese pythons and identify areas where it could be strengthened.
Recommendation 1.1.2: Evaluate the potential for adding requirements to possess Burmese pythons that may include requiring Continuing Education Units, training, bond insurance similar to venomous reptiles, or sterilization for pythons imported or possessed for exhibition in Florida.
Recommendation 1.1.3: Strengthen Rule 68-5 F.A.C. as it pertains to Burmese pythons in Florida to further limit possession and reduce likelihood of additional introductions.
Recommendation 1.1.4: Promote and expand the Exotic Pet Amnesty Program to ensure this alternative to releasing pythons into the wild in Florida is known and understood by the public.
Recommendation 1.1.5: Identify gaps in current regulations that are not clear and provide recommendations on potential regulatory changes to agency leadership for potential adoption.
Recommendation 1.1.6: Proactively coordinate with adjacent states and federal government on developing regulations to work toward consistent rules and policies that limit possession and risk of escape within the full extent of the python potential range.   1.1.6.1: Coordinate with partnering organizations like the Association of Fish and Wildlife Agencies (AFWA) to coordinate with adjacent states to stay updated and coordinated on intentional movement or emigration of pythons to other states and enforcement actions.   1.1.6.2: Routinely coordinate with USFWS regarding regulations and enforcement actions.
Strategy 1.2: Adopt policies to increase enforcement of current and future laws to reduce the volume of illegal activity with Burmese pythons.
Recommendation 1.2.1: Foster collaboration among natural resource workers and FWC, NPS, USFWS, Tribal and local Law Enforcement to provide training and coordination on management actions and enforcement issues.
Recommendation 1.2.2: Provide training opportunities to collaborate on current regulations and restrictions and programs that are addressing pythons on public conservation lands.
Recommendation 1.2.3: Work with law enforcement agencies to identify priority patrol areas where patrol efforts could be focused.
Recommendation 1.2.4: Collaborate with law enforcement and State Attorneys to successfully prosecute illegal activity pertaining to pythons.
Recommendation 1.2.5: Encourage citizens to report illegal activity/violations through rewards, educational programs, and promoting the Wildlife Alert system.
Recommendation 1.2.6: Quantify enforcement costs and ensure they are included when evaluating management methods such as recreational removal and commercialization that require 'checks and balances' to meet python management goals.
Goal 2: Encourage and facilitate python removal and reporting to advance python control efforts.
Strategies and Recommendations
Strategy 2.1: Facilitate python removal by the public.
Recommendation 2.1.1: Provide policies and rules for the public to take immediate action when encountering a python that are well-publicized and easy to understand and follow.

2.1.1.1: Seek regulatory exceptions for pythons (on an agency-basis; not property-basis) for lands where removing wildlife is not allowed.

2.1.1.2: Work to remove obstacles to python removal by the public.

2.1.1.3: Adopt reporting requirements for removals to allow data collection and evaluation that will inform management.

Recommendation 2.1.2: Evaluate or assess python removal by the public to guide education, outreach, and training that will increase safe removal and reporting by the public.

Strategy 2.2: Identify and evaluate incentives to private citizens, landowners, or private contractors to implement python control that include safeguards to prevent release, illegal breeding, spreading of pythons across Florida or otherwise encourage other illegal (or detrimental) activities for profit.

Recommendation: 2.2.1: Explore potential incentives to encourage private landowners to control pythons on their properties.

Recommendation: 2.2.2: Evaluate food and python product commercialization and regulate as appropriate working with Florida Department of Agriculture and Consumer Services (FDACS).

2.2.2.1: Develop a strategy and clear criteria for measuring effectiveness (and risk) of commercialization.

2.2.2.2: Determine how to monitor and limit commercialization of python products, if necessary, to support python management goals.

2.2.2.3: Evaluate need for and apply health advisories consistent with policy to inform use of pythons for food due to potentially high mercury levels.

Recommendation: 2.2.3: Clarify what commercial activities are allowed under different jurisdictions such as National Park Service, State Parks, National Wildlife Refuges, state conservation lands, or private lands, including areas where harvest for python products and commercial activities such as tours, etc. can occur.

2.2.3.1: Evaluate impact of only allowing commercial activities to occur on some properties within the python range.

2.2.3.2: Consider feasibility of modifying regulations to increase uniformity in allowed commercial use.

Recommendation 2.2.4: Develop and update a policy statement on recommendations for commercialization, incentivization, and/or compensation for python removal.

Strategy 2.3: Explore the potential for development of professional python removal small business contractor entities (as opposed to individual contractors).

Recommendation 2.3.1: Explore developing professional python contractor entity that can be tasked to achieve particular management actions (small business grants, etc.).

Recommendation 2.3.2: Explore contracted entity to provide oversight of contractor program as an alternative to agency-managed programs.

Strategy 2.4: Formally and regularly evaluate python removal programs against standards of cost-effectiveness and support for management objectives.

Recommendation 2.4.1: Develop methods to determine or evaluate cost/benefit of incentivized removal compared to other management tools.

Recommendation 2.4.2: Eliminate or curtail efforts that are not effective or poorly support python management goals.

Goal 3: Align python removal policies and regulations to be consistent across jurisdictions, where possible, and clearly communicated to other stakeholders and the public to limit confusion and maximize efficiency.
Strategies and Recommendations
Strategy 3.1: Improve communication of laws and policies to provide clarity to the public regarding removal, possession, and transportation of pythons.
Recommendation 3.1.1: Identify where allowances and laws are confusing and review current rules and regulations to identify areas that could be addressed.
Recommendation 3.1.2: Provide policy and regulation information using clear language in accessible formats and reinforce in public training materials. 3.1.2.1 Provide information to the public in multiple platforms. 3.1.2.2 Provide multi-lingual information in, at a minimum, Spanish/English.
Recommendation 3.1.3: Provide updates to policies and regulations across platforms and ensure rules are current on all platforms.
Strategy 3.2: Develop and maintain agreements that support stakeholder collaboration on python management.
Recommendation 3.2.1: Develop agreements to better align procedures and support science.
Recommendation 3.2.2: Develop agreements to promote access.
Recommendation 3.2.3: Develop agreements to share resources and provide support.
Goal 4: Clarify and streamline policies and regulations governing research projects and permitting to facilitate research that can aid in improved python control.
Strategies and Recommendations
Strategy 4.1: Clarify agency permitting permit issuance criteria, timelines, and considerations for researchers and to the degree possible align research priorities, areas of regulatory concern related to python research, and permit conditions so that these are as consistent as possible across agencies and address priority concerns.
Strategy 4.2: Ensure that permitting agencies have clear research project permit application requirements that are communicated on their website and on the application to help disseminate this information to potential researchers interested in developing research projects in Florida on pythons.
Strategy 4.3: Simplify, coordinate, and streamline reporting requirements for research projects.
Recommendation 4.3.1: Permitting agencies coordinate to remove redundant reporting requirements.
Recommendation 4.3.2: Make permitting fulfillment reports from researchers available across agencies, as allowable (reports to funding agencies and reports to permitting agencies).

Control and Monitoring

Introduction

Efforts to control Burmese pythons have been ongoing since the species was determined to be established in Florida. While important advances have been made in the resources and technology available to control the population over the past 20 years, gaps remain in knowledge about the size and extent of the established population and of the effectiveness of different control methods. In addition, stakeholders may hold different views on how to define effectiveness for different python control methods and on where and how different tools should be implemented. By working together to develop a holistic approach to deploying methods across the landscape, all the different efforts and approaches can be expected to be more effective at controlling the python population. Currently, land managers and researchers do not consider state-wide eradication of Burmese pythons to be feasible with current tools and management; however, management strategies may differ from location to location, and the goal of eradication may be appropriate for areas where incipient python populations exist. Through utilizing the most recent data on the extent of the python population along with use of detection tools, the stage of the python population can be determined along the invasion curve (Fig. 2) and guide control strategies across the landscape.

Preventing expansion: Outside of the known population range and along the invasion front, control efforts may aim to prevent the expansion of the population and include attempts at local eradication, especially in priority conservation areas inhabited by protected species. Creating a comprehensive and coordinated EDRR strategy that utilizes detection tools (such as eDNA) and improves upon existing reporting and response tools will help managers target areas along the fringe of the known range for removal efforts, ideally preventing further expansion and establishment of pythons into areas where they are currently not. Establishment of rigorous monitoring programs could also aid in detection and prevention of new incipient populations, as well as assessing impacts, although more information on meta-population dynamics and localized population trends is needed. Prioritizing lands that have not yet experienced invasion along with lands containing high priority resources is paramount to protecting populations of threatened, endangered, or rare species in these areas.

Reducing and containing the established population: Where pythons are established, they are in the far right on the invasion curve (Fig. 3), where long-term management is focused on population suppression and resource protection. The current strategy involves vigorous control and removal efforts in areas with established python populations to protect resources, and to curb further spread to adjacent non-impacted lands. While many pythons have been removed, methods for evaluating the effectiveness of python control strategies are still in development. Similarly, various control techniques are being tested and implemented but most need further assessment to understand and improve their effectiveness. The FPCP aims to improve Burmese python control through the development of a more comprehensive and integrated control strategy that considers the biology of pythons, their interactions with the environment and seasonal behaviors, characteristics of the landscape, and how these factors play into the effectiveness of removal efforts and tools, similar to an integrated pest management approach. This type of approach also takes into consideration the use of control efforts and tools in an environmentally and culturally sensitive way. These principles, guided by consultation with land

managers and partners, could be used to create strategies focused on asset-based protection to conserve ecosystems or species that are particularly vulnerable to the python invasion.

Facilitating coordination and planning: Today land managers, researchers, and other stakeholders are working together more closely than ever to coordinate and plan control activities. Coordination can increase capacity for response, allow for better information sharing, and promote more work across geopolitical boundaries. Increasing and expanding python awareness and educational training opportunities can encourage participation among land managers and the public in python removal activities, particularly with containment and suppression of established populations. Continuing to facilitate and strengthen collaboration between land managers and partners, stakeholders, and the public is expected to benefit the development and implementation of control tools and strategies using an integrated pest management approach to ensure both resource protection and long-term management of the Burmese python in Florida.

Table 2. Goals, Strategies, and Recommendations for Control and Monitoring

Goal 1: Prevent the expansion of the python population to areas outside of the known, established range, focusing on areas most vulnerable to impacts.
Strategies and Recommendations
Strategy 1.1: Develop comprehensive Early Detection/Rapid Response (EDRR) strategy to increase efficiency of detection and removal of incipient populations, especially on priority conservation lands.
Recommendation 1.1.1: Work with land managers and researchers to characterize the python population in South Florida in a standardized way (e.g., the South Florida Environmental Report 'stop light' format and/or the invasion curve), delineate the leading edge of the python invasion and identify priority lands just outside of the established range where efforts may be prioritized. 1.1.1.1: Obtain from, or work with researchers to create site prioritization tool to characterize lands where EDRR should be a priority. 1.1.1.2: Prioritize removal on population boundaries (including urban areas) and identify and take measures to protect non-impacted, sensitive lands.
Recommendation 1.1.2: Create monitoring guidelines that include the use of innovative technologies along with existing reporting and monitoring programs (e.g., EDDMapS and the Everglades Invasive Reptile and Amphibian Monitoring Program (EIRAMP)) to monitor along the leading edge of the invasion on public and private lands in urban, suburban, and rural areas where possible.
Recommendation 1.1.3: Maintain, expand, and improve existing detection and reporting tools and response capabilities: FWC Exotic Species Reporting Hotline and EDDMapS/IveGot1.org. 1.1.3.1: Expand agency response capability by further developing responder network utilizing staff from partner organizations, the paid contractor programs, volunteer authorized agent, and other volunteer programs. 1.1.3.2: Utilize and expand the use of innovative tools to aid or improve python detection and removal outside of the established population (e.g., infrared-equipped UAS, detector dog program, etc.)
Recommendation 1.1.4: Improve efforts/abilities to conduct EDRR on private lands/urban interface with landowner collaboration and approval.

Goal 2: Reduce and contain the established python population and protect sensitive areas and areas of high ecological value.
Strategies and Recommendations
Strategy 2.1: Improve upon and further develop current python removal programs and control tools.
Recommendation 2.1.1: Use integrated pest management approach to combine tools, techniques, and technologies according to the season, characteristics of area and effectiveness to improve detection and increase removal of pythons 2.1.1.1: Work with researchers to develop metrics for control effectiveness. 2.1.1.2: Develop Control Matrix to easily communicate different techniques that may be used to remove pythons under different temporal and spatial conditions to public and private landowners.
Recommendation 2.1.2: Strategically utilize paid python removal contractor and volunteer programs. 2.1.2.1: Continue to improve efficacy of all programs by incorporating input from university/research partners regarding both the effectiveness and potential negative impacts of different strategies and directing efforts appropriately. 2.1.2.2: Expand contractor access to appropriate public lands in South Florida (e.g., Counties, State Parks, etc.) as recommended by land managers and contract managing agencies. 2.1.2.3: Increase number of contractors working across landscape, as recommended by land managers and contract managing agencies. 2.1.2.4: Increase number of authorized agents on NPS lands, as recommended by NPS staff and land managers and considering limits from compliance. 2.1.2.5: Explore supplying contractors and authorized agents with additional tools (e.g., gas, head lamps, etc.) to encourage python removal. 2.1.2.6: Support "mentorship" program through authorized agents and paid contractors who need field assistants to provide with additional help while conducting removal efforts. 2.1.2.7: Pursue venues to support the creation of a professional invasive wildlife industry, similar to what exists for the exotic plant treatment industry.
Recommendation 2.1.3: Facilitate python removal by staff, other contractors, and researchers working on public lands. 2.1.3.1: Agencies and/or individual management units work internally to create mechanisms and processes that allow for removal of pythons and other invasives on their properties by area staff, contracted entities, and researchers working on their lands who are willing and able to do so. 2.1.3.2: Provide training to all interested staff, contractors, and researchers on reporting and removing pythons. 2.1.3.3: Grant access to partners to conduct python control on public land and partner properties both opportunistically and working collaboratively during coordinated workdays.
Recommendation 2.1.4: Facilitate python reporting and removal by public, outdoor sports people, and outdoor recreationists and develop guidelines and recommendations to encourage these activities that support management goals for each property.

2.1.4.1: Provide training on existing reporting tools to visitors of natural areas.

2.1.4.2: Expand hours of hotline to 24/7.

2.1.4.3: Include information on how to collect and report data on observed or removed Burmese pythons for different areas in Python Patrol trainings or demonstrations.

2.1.4.4: Host youth python hunts annually to empower and educate future generations

2.1.4.5: Host Python Patrol trainings for hunters and outdoor recreationists multiple times throughout the year (targeted audiences).

2.1.4.6: Support "mentorship" program through authorized agents and paid contractors who need field assistants to get more people trained in the field with professionals.

Recommendation 2.1.5: Utilize available data and guidance from land managers to prioritize sensitive ecosystems, protected species, and other priority resources within the established range.

2.1.5.1: Increase searches in remote and/or sensitive areas (e.g., Key Largo, Greater Everglades interiors and tree islands) that are currently under-surveyed.

2.1.5.2: Use available detection tools to assess python presence in sensitive habitat areas.

2.1.5.3: Identify sensitive areas where strategic control efforts are limited to qualified professionals utilizing informed tactics.

Goal 3: Facilitate coordination and planning among land managers, researchers and other stakeholders regarding effective control tools and management strategies.

Strategies and Recommendations

Strategy 3.1: Expand or increase interagency capacity to respond to, and address python threat.

Recommendation 3.1.1: Develop a partnering entities MOU to improve coordination and to address burdens that hamper response/control efforts (e.g., access).

Recommendation 3.1.2: Expand or increase capability where needed (i.e., dedicated personnel, contractors, volunteers, and funding).

Strategy 3.2: Create and utilize science-guided adaptive management framework to facilitate working with researchers to assess past and present prevention, containment, and resource protection strategies and make improvements.

Strategy 3.3: Provide input to the Python Workgroup on development and improvement of tools and techniques for detection and removal efforts.

Strategy 3.4: Develop guidelines and recommendations to encourage activities by land managers, stakeholders, and the public that support management goals and directives appropriate for heterogeneous landscapes across varying geopolitical boundaries.

Strategy 3.5: Maintain engagement in response, removal, and control efforts.

Recommendation 3.5.1: Provide python patrol training to the public and land managers more frequently.

3.5.1.1: Support "mentorship" program through authorized agents and paid contractors.

3.5.1.2: Recruit trained individuals as responders for agencies that need volunteers.

Recommendation 3.5.2: Encourage and facilitate python hunting and reporting by traditional sportsman/outdoor enthusiast on properties where it is allowable.

3.5.2.1: Host annual youth hunt.

3.5.2.2: Provide Python Patrol training to these groups.

Research

Introduction

An important objective of the FPCP is to support science-based decision making by land managers so they are using the most current information on pythons available to drive control, assessment, and monitoring actions. Much of this information comes from research and is part of the exchange that exists between research and management in an adaptive management framework. Both research and management activities produce new knowledge that can improve decision making for managers and policy makers using this framework. These interactions are typically done between one contracting agency and the research institution they have contracted and sharing of research is limited outside the bounds of the contract. The FPCP proposes increased collaboration among researchers and land managers in determining research questions and needs to ensure research that supports control efforts and monitoring is prioritized and facilitated. Additional coordination among land managers to align those research priorities, investments and protocols would increase information sharing and efficiency among funding partners.

Collaboration among researchers and land managers: Strategies under this goal aim to advance collaboration between researchers and managers so that research aids managers in decision-making using the best-available information, and researchers are focusing on the questions that will have the greatest impact on management decisions. Utilizing this framework optimizes the coordination of several processes including evaluation of management activities, solicitation of research ideas and proposals, prioritization of research needs that address all areas of the invasion curve (see Introduction; Figure 3), allocation of funding from multiple sources with limited stability and constrained mechanisms for disbursement, and knowledge transfer of research results.

Alignment of research priorities: Within this optimization, additional needs and considerations are recognized and solutions are proposed to mitigate them. For example, many datasets for pythons are data poor, because many types of observations are time-consuming and expensive to obtain. Optimizing and increasing coordination of efforts with a focus on the interdependent relationship between research and management is necessary to enact goals and strategies that successfully address python control.

Table 3. Goals, Recommendations, and Strategies for Research

Goal 1: Advance science to assist land managers in decision-making on python control using the best-available science.
Strategies and Recommendations
Strategy 1.1: Identify baseline and priority research needed to aid management decisions.
Recommendation 1.1.1: Identify and evaluate ecological indicators or indicators of management success, including python and python-impacted populations.
Recommendation 1.1.2: Establish long-term monitoring using performance indicators.
Recommendation 1.1.3: Characterize the geographic range of pythons.
Recommendation 1.1.4: Identify areas sensitive to impacts of pythons.

Recommendation 1.1.5: Further characterize direct and indirect impacts of pythons, including socioeconomic impacts.
Recommendation 1.1.6: Forecast python population changes under future conditions (e.g., climate change and restoration efforts) to aid managers in decision-making.
Recommendation 1.1.7: Identify knowledge gaps hindering decision-making.
Strategy 1.2: Evaluate and improve efficacy (including cost) of control, management, and detection tools.

Recommendation 1.2.1: Identify research projects that will contribute to managers' ability to limit or control spread of pythons.
    1.2.1.1: Develop and evaluate use of barriers to contain pythons and restrict spread.
    1.2.1.2: Expand and evaluate rapid response tools.

Recommendation 1.2.2: Assess tools for detection of pythons.
    1.2.2.1: Assess visual searching and removal efforts.
        1.2.2.1.1: Assess python contractor removal programs.
        1.2.2.1.2: Assess volunteer python removal programs.
        1.2.2.1.3: Assess staff python removal programs.
    1.2.2.2: Assess public reporting of python sightings.
    1.2.2.3: Assess trapping methodology for pythons.
    1.2.2.4: Assess use of detector dogs for python detection.
    1.2.2.5: Assess use of eDNA to detect pythons.
    1.2.2.6: Assess use of wildlife cameras to detect pythons.

Recommendation 1.2.3: Assess use of telemetered snakes to detect breeding aggregations (i.e., "scout snakes", formerly known as Judas snakes).
Recommendation 1.2.4: Assess biocontrols to control python populations.
Recommendation 1.2.5: Assess habitat manipulation as a means to limit spread of pythons.
Recommendation 1.2.6: Assess the use of bounties and other rewards programs in control of pythons.
Recommendation 1.2.7: Assess use of repellants to repel pythons.
Recommendation 1.2.8: Assess reproductive inhibition as a means to control pythons.
Recommendation 1.2.9: Assess egg/nest destruction to reduce python populations.
Recommendation 1.2.10: Assess pheromonal attractants to increase detection of pythons in the wild.
Strategy 1.3: Develop new control, management, and detection tools.

Recommendation 1.3.1: Assess use of synthetic biology to control python populations.
    1.3.1.1: Assess use of CRISPR/ CAS9 gene drives
    1.3.1.2: Assess use of RNAi methodology

Recommendation 1.3.2: Assess other detection tools.   1.3.2.1: Use of IR or near-IR/ reflectance.
Recommendation 1.3.3: Assess use of telemetered prey to detect and remove pythons.
Recommendation 1.3.4: Recognize that development of new tools will rely on innovative technologies and novel applications of these tools or existing technologies.
Strategy 1.4: Characterize python biology to support evaluation of management tools.

Recommendation 1.4.1: Estimate vital rates (i.e., survival, reproduction, and age or size structure) for population model.
Recommendation 1.4.2: Identify natural barriers to python expansion.
Strategy 1.5: Conduct research to evaluate the feasibility of restoration of python-impacted ecological function and python-impacted populations.
Recommendation 1.5.1: Identify existing or establish new baseline data of community composition prior to python invasion.
Recommendation 1.5.2: Identify and evaluate ecological indicators or indicators of successful restoration efforts (includes python and python-impacted populations).
Recommendation 1.5.3: Consider active restoration activities (i.e., see work on reintroductions of native taxa in Guam).
Goal 2: Increase alignment of research priorities, investments, and protocols across land managers and partners to increase efficiency so researchers are focusing on questions that will have the greatest impact on management decisions.
Strategies and Recommendations
Strategy 2.1: Solicit research ideas from researchers, the public, and private sector.
Recommendation 2.1.1: Develop a proposal-submission portal (Python Portal) to accept research ideas from professional and community scientists. Managers will be able to access these proposals and work with the researchers to develop into a full proposal and build collaborations in a way that meets agency needs.   2.1.1.1: Standardize proposal format to allow clear and consistent evaluation while also not burdening applicants with a time-consuming application.   2.1.1.2: Ask applicants to categorize their proposal by topic and make available the number of proposals per topic that have been received, prioritized for funding, and funded (see 2.2.1).   2.1.1.3: Define the proposal evaluation process and make that process available on the portal; this may vary slightly from year-to-year (see 2.2.1).   2.1.1.4: Identify the most recent and previous annual research priorities on the portal (see 2.2.1).   2.1.1.5: Provide access to scientific articles, when possible, by topic and encourage applicants to become familiar with these articles beforehand to make their proposal more competitive.
Recommendation 2.1.2: Encourage and support innovation in research.   2.1.2.1: Develop process to evaluate high-risk but potentially high-reward proposals and how they would compete against lower-risk and lower-reward proposals.   2.1.2.2: Facilitate integrative projects by providing contact information and area of expertise for funded python researchers on the portal for non-python scientists to find and use to develop collaborations.
Strategy 2.2: Develop research priorities of land managers and identify current research investments to efficiently use resources.
Recommendation 2.2.1: Compile and prioritize research needs of land managers and partners.

2.2.1.1: Prioritized research needs can be solicited beforehand, possibly via a research conference, review of proposals submitted to the Python Portal, and/or questionnaires to managers about what new information would improve their decision-making.

2.2.1.2: Land managers should consider input of least one external researcher who does not have any conflicts of interest (e.g., this person does not work on pythons in Florida) and can provide technical expertise and guidance.

Recommendation 2.2.2: Recognize research deficiencies and actively seek solutions or alternatives to mitigate these deficits.

Recommendation 2.2.3: Develop a research-progress system (Python Portal) where managers can summarize funded research and provide progress updates (see 2.3.1.1).

Strategy 2.3: Improve dissemination of research to researchers and managers.

Recommendation 2.3.1: Support and contribute to a repository (Python Portal website) for python research information and data.

2.3.1.1: Provide 1-page summaries of ongoing research with links to full reports or publications. Funding agencies are encouraged to require these summaries as part of their annual reporting for researchers, and they should follow a standard format and be written for a broad audience (e.g., provide a four-sentence summary, introduction, objectives, preliminary or coarse results, and management implications). These can be sufficiently general to not preclude publication in a peer-reviewed journal at a later date. Multiple reports from multi-year projects should be linked.

2.3.1.2: Provide a list of citations and associated PDFs, when possible, of relevant literature organized by topic.

2.3.1.3: Provide standardized removal and monitoring information.

2.3.1.4: When possible, make data available that was submitted as part of permitting processes.

2.3.1.5: Ask researchers to submit their data to open access repositories (e.g., Dryad, GenBank, ScienceBase) and provide links to these data.

Recommendation 2.3.2: Identify and support python coordinator(s) to serve as liaison between researchers and managers.

Recommendation 2.3.3: Foster long-term, collaborative, interdisciplinary research projects.

2.3.3.1: Prioritize research that can be completed incrementally (e.g., in one-year blocks over multiple years).

2.3.3.2: Reduce risk for multi-year projects by prioritizing research that can be cost-shared among agencies and organizations. Cost-sharing may occur sequentially, with different agencies funding at different times, or it may occur simultaneously but with funding allocated towards different principal investigators.

Recommendation 2.3.4: Simplify permitting requirements and facilitate collaboration across jurisdictional boundaries.

2.3.3.1: Develop MOU or other instruments as appropriate.

2.3.3.2: Develop process to evaluate permit applications that may be high-risk but are also high-reward in cost-savings or management implications.

2.3.3.3. Utilize Python Portal website to identify permit requirements and resources for researchers, including information required by agencies and organizations.

> **Recommendation 2.3.5**: Funding agencies and organizations should aim to include contract funds to support publication of research to aid dissemination of research results.
>
> **Recommendation 2.3.6**: Land managing organizations and researchers should continue to work collaboratively on protocols to protect research investments such as scout snakes through informing python removal contractors and hunters to not remove scout snakes from the wild.

Communication

Introduction

The successful implementation of the goals, strategies, and recommendations of the FPCP will require strategic, consistent, and organized communication efforts among land managers, partners, and the public. Collaborative strategic communication efforts can help foster an informed and engaged public that is supportive of control actions and increase information sharing among managers and partners resulting in decision making using the best available information. These efforts can ensure implementation of the FPCP results in management efforts maximized for long-term efficiency.

Increasing public awareness: Increasing public awareness of the python invasion and the impacts that this and other invasive species have on Florida ecosystems, as well as Everglades restoration efforts will help to promote public engagement in python control efforts. Promoting the ecological value of native species to foster a public appreciation of the complexities of ecological communities and the ways in which they benefit Florida's native systems will also create a more informed public.

Increasing interorganizational collaboration: Collectively creating and disseminating messaging to the public using strategic media and outreach strategies can have numerous benefits. Empowering the public with the skills and expertise necessary to help address the problem may lead to an increase in invasive species reporting and removal, as well as prevent release of nonnative species. Additionally, providing current information from all partners on the control and research efforts underway, and the lessons learned from these projects that have already been tested or performed, will reduce the potential for a misinformed public and promote public buy-in for policy, control and monitoring, and research actions. Coordinated communication should include shared talking points and outreach materials and should be promoted proactively to maximize associated benefits. Moreover, information should be centralized and easily accessible for partners and the public to stay informed and engaged in python management.

Communication efforts to support the FPCP: Effective communication among managers, researchers, policy makers, and other stakeholders actively involved in python control and research is also important. As python management is a dynamic endeavor, creating a platform and standards for information sharing is necessary to ensure partners have access to the best information available to make decisions. Promoting data sharing and collaboration will result in alignment of management efforts to maximize effectiveness and minimize duplication of efforts. Partners will also need to collaborate on communication efforts to promote and support implementation of the FPCP. Development of a collaborative strategic communication plan can help promote initiation of the plan, as well as its continuation over time, among land managers and partners.

Table 4. Goals, Strategies, and Recommendations for Communication

Goal 1: Increase public awareness of the harmful impacts of pythons, the efforts being conducted to control them, and promote the ecological value of native species to inform, empower, and engage the public in python control efforts.
Strategies and Recommendations
Strategy 1.1: Provide training for python identification and capture/restraint to increase python reporting and removal among individuals who are likely to encounter pythons. (Note it is illegal in the state of Florida to transport a live Burmese python without a permit.)
Recommendation 1.1.1: Promote online trainings for identifying nonnative and native reptiles (e.g., the FWC python removal training) to increase accurate reporting and removal of nonnative species.
Recommendation 1.1.2: Establish interagency staff to develop, coordinate, and provide trainings.
Recommendation 1.1.3: Increase the number of capture/restraint trainings (e.g., FWC Python Patrol training) for the public and land managers focused to reach individuals who may encounter pythons through work or recreating.
Recommendation 1.1.4: Develop a training to instruct participants on approved humane methods of dispatching pythons to support python removal efforts.
Recommendation 1.1.4: Provide EDDMapS and Exotic Species Reporting Hotline training for the public and land managers to increase reporting of pythons.
Recommendation 1.1.5: Provide audience-specific trainings to increase their effectiveness (see Strategy 1.3 for targeted audiences).
Recommendation 1.1.6: Create and expand upon multilingual outreach materials to support multicultural communications in effort to increase python reporting and removal.
Strategy 1.2: Coordinate and collaborate on communication and outreach efforts and materials among land managers to increase their effectiveness and present a unified message.

Recommendation 1.2.1: Promote and expand unified communication and outreach efforts.
   1.2.1.1: Encourage coordination and collaboration among public affairs and outreach specialists from land managing partners.
   1.2.1.2: Encourage the creation of shared talking points based on the best available science and common goals for public engagement through outreach.
   1.2.1.3: Create shared media kits with information from land managing partners to be utilized at events.
   1.2.1.4: Collaborate to be receptive and proactive towards media requests to reach broad and specific audiences with a strategic messaging for each.
   1.2.1.5: Promote the use of invasive species awareness and reporting apps (e.g., EDDMapS and IveGot1).
   1.2.1.6: Develop a process for coordination of multi-agency news releases to demonstrate unified messaging.

Recommendation 1.2.2: Create a public Python Portal website that centralizes current information on pythons in Florida to be utilized by the public and others interested in the issue. See Implementation section, Goal 3, for details on website content.

Recommendation 1.2.3: Strategically hold and/or attend outreach events to provide information on the pythons and to increase reporting on python sightings and removals.

    1.2.3.1: Develop specific messaging for events in areas where pythons are not yet established to create public awareness of reporting to detect dispersing or incipient python populations.

    1.2.3.2: Support and promote Florida Python Challenge® events as python awareness efforts.

    1.2.3.3: Support and contribute to outreach efforts by the local Cooperative Invasive Species Management Areas (CISMAs), including summarizing conference findings as news releases for the public and presenting research highlights on social media.

    1.2.3.4: Support and promote the FWC Exotic Pet Amnesty Program to increase awareness of no-fault programs to surrender exotic pets and decrease release of pets into the wild.

    1.2.3.5: Create outreach kits with information from multiple land managing partners to be used at events.

    1.2.3.6: Reach out to the pet industry and hobbyists to provide information on pythons and promote responsible pet ownership.

        1.2.3.6.1: Promote outreach through attending pet trade conventions.

        1.2.3.6.2: Visit local pet stores and breeders to educate and find adopters for animals surrendered Amnesty days.

    1.2.3.7: Look for opportunities to inform and empower the hunting community and other outdoor enthusiasts.

        1.2.3.7.1: Provide training and education on python reporting and removal opportunities and regulations.

        1.2.3.7.2: Provide prizes as incentives for python reporting and removal.

    1.2.3.8: Engage with public and private schools to educate on pythons and other invasive species.

        1.2.3.8.1: Identify education outreach resources offered by different counties, agencies, and organizations.

        1.2.3.8.2: Develop and/or update existing curriculum to share with schools.

        1.2.3.8.3: Provide presentations and other learning materials for schools and educators.

Recommendation 1.2.4: Utilize multiple platforms to share strategically planned and coordinated messaging.

    1.2.4.1: Utilize traditional and social media to promote events and disseminate coordinated messaging.

    1.2.4.2: Utilize billboards and murals for advertising campaigns.

    1.2.4.3: Utilize mass/bulk mailings, neighborhood canvassing, and other methods to deliver tailored messaging to specific locations.

    1.2.4.4: Utilize vehicle wraps to promote the 1-888-Ive-Got1 Exotic Species Hotline and invasive species awareness.

Recommendation 1.2.5: Support community-based education efforts.
    1.2.5.1: Identify community-based education organizations (e.g., religious organizations, NGOs, and environmental organizations) and provide information and materials on python management.
    1.2.5.2: Inform community-based organizations of funding opportunities and other ways in which they can support python management.

Strategy 1.3: Identify additional stakeholder groups and venues to target for audience-specific communication to increase messaging and its effectiveness.
Recommendation 1.3.1: Identify stakeholder groups that may be targeted for specific communication including, but not limited to, elected officials; researchers; citizen scientists; private-land owners; law enforcement; first responders; agricultural and horticultural workers; utility workers; outdoor recreationists; python hunters; and media outlets.
Recommendation 1.3.2: Develop new and innovative ways to engage the public.   1.3.2.1: Engage with accredited or certified zoological and other educational facilities located throughout the state to provide information on python invasion, including existing reporting tools, that can be shared with visitors.
Goal 2: Increase interorganizational communication, data sharing, and collaboration.
Strategies and Recommendations
Strategy 2.1: Seek opportunities to increase communication among interorganizational partners at organizational meetings that already occur (i.e., CISMA meetings) or by holding additional meetings when collaboration is needed.
Recommendation 2.1.1: Strive for representation by all stakeholders at meetings, when possible, and provide written summaries for those who were not represented.
Recommendation 2.1.2: Provide presentations on project updates, new findings, etc.
Strategy 2.2: Centralize python information to increase communication, data sharing, and collaboration.
Recommendation 2.2.1: Create a Python Portal website for internal use by land managers and partners to access current information on pythons and control recommendations. See Implementation section, Goal 3, for details on website content.
Recommendation 2.2.2: Promote use of EDDMapS for python reporting and develop privacy functionality to allow for reporting sensitive data.
Recommendation 2.2.3: Encourage land managers and partners to report on and receive periodic, up-to-date summaries of python activities.
Strategy 2.3: Determine how interorganizational communication can be used to support EDRR efforts.
Goal 3: Create a communication strategy to support implementation of the Florida Python Control Plan.
Strategies and Recommendations
Strategy 3.1: Create a communication plan for the roll-out and implementation of the FPCP to provide information and garner support from the public, politicians, and stakeholders.
Recommendation 3.1.1: Distribute FPCP to land managers through workshops, fact sheets, etc.

IMPLEMENTATION

Introduction

The FPCP was created in an inclusive, collaborative process by 15 organizations including federal, state, and local agencies, tribes, and an NGO. Implementation will require a similar level of commitment and collaboration. That commitment may take a variety of forms, depending on the needs and authority of the organization, including:

- Formal approval –state agencies are expected to take this route.
- Adoption – federal agencies may choose this route
- Resolution or letter of support
- Participation on the Workgroup or in a Team to further plan implementation

The goals of the FPCP will be implemented through the formation of a Workgroup with duties and responsibilities outlined in an organizational document which includes initial "Principles of Operation" and a Workplan (Appendix C). The Workgroup will be composed of a collaborative team of federal, state, and local agencies, tribes, and NGOs and will provide oversight and coordination of multi-jurisdictional activities through development and implementation of an annual recommended Burmese Python Action Plan. Membership to the Workgroup will initially be offered to participants in the development of the FPCP and may expand to include additional land-managing organizations affected by Burmese pythons. The Workgroup will convene to carry out the mission and science-based adaptive framework of the FPCP, integrating a multi-faceted approach to python management by working collaboratively on initiatives to prevent new introductions, reduce spread, coordinate on research priorities, and improve communication among land managers and to the public. The Workgroup will be supported in these endeavors by Teams that will correspond to the four different themes of this plan, and additional Teams created by the Workgroup, as needed. The Workgroup and its Teams will meet regularly throughout the year per guidelines created by the Principles of Operation which will also serve as a charter outlining how Workgroup business will be conducted to support a unified set of goals, strategies, and recommendations to combat Burmese python populations within the state of Florida.

Adoption, approval, or support of the plan confirms that the organization is willing to work cooperatively on the Workgroup or its Teams to further implementation of the plan. The FPCP, while providing a forum for interorganizational collaboration, is not a legally binding document. Members agree to:

- Participate in Workgroup and Team meetings and discussions as appropriate;
- Engage with the perspectives and priorities of other Workgroup and Team members and exchange information to develop jointly supported approaches to python control; and
- Work together in the implementation of projects and approaches, consistent with their respective missions, authorities, and resources.

Management of Burmese pythons will be a reality in Florida for the foreseeable future and the FPCP is meant to provide a formal framework for organizations to collaborate on the problem for as long as is needed and subject to revision as appropriate. The FPCP is not meant to be prescriptive for how any particular organization should adopt and participate in further collaboration. Organizations that do take a more active role should commit the personnel time needed for regular meetings as described below but are not expected to commit resources when none exist.

Communication among the collaborating organizations and to stakeholders and the public is vital to achieving the goals of the plan. A Python Portal will be created as an online platform to provide relevant information to user groups and will include both a public website and an internal site meant for use by Workgroup members.

Table 5. Goals, Strategies, and Recommendations for Implementation

Goal 1: Adopt the FPCP developed by the participating land managers.
Strategies and Recommendations
Strategy 1.1: Each agency, tribe, or organization will adopt, approve, or commit to working on some, or all initiatives in the plan, and participate on the Workgroup as appropriate.
Recommendation 1.1.1: Develop one or more vehicles for formalizing participation in implementation, as appropriate.
Recommendation 1.1.2: Ensure each entity will address public comment and environmental compliance as needed within its adoption, approval, or commitment process.
Goal 2: Establish a Workgroup to Implement the FPCP.
Strategies and Recommendations
Strategy 2.1: Adopt and refine an organizational document that includes initial operating principles and workplan. This document should establish the purpose, annual products, leadership, and membership guidelines for reaching consensus on recommendations to leadership, organizational structure, and a tentative meeting schedule with basic agenda for the FPCP Workgroup and for all Teams organized thereunder.
Recommendation 2.1.1: Invite each agency/organization that participated in the development of the FPCP to have a representative on the Workgroup regardless of whether each agency/organization will formally approve or adopt the FPCP.
Strategy 2.2: Establish Python Workgroup functions using Principles of Operation in Appendix C.
Recommendation 2.2.1: Establish a regular meeting schedule and initial workplan for the Workgroup.
Strategy 2.3: Create annual Action Plans.
Recommendation 2.3.1: Include yearly project priorities and report on progress made during the previous year.
Recommendation 2.3.2: Include long-term strategies and actions on python control and research in the yearly action plan with target dates.
Recommendation 2.3.3: Establish First Year Action Plan with actions already underway or have firm commitments by participating agencies and organizations.

Strategy 2.4: Create FPCP Teams.
Recommendation 2.4.1: Establish four Teams using the four themes (Policy and Regulations, Control and Monitoring, Research, and Communication) of the FPCP.
Recommendation 2.4.2: Establish special Teams, as needed.
Strategy 2.5: Convene or co-sponsor a yearly FPCP meeting or conference.
Strategy 2.6: Update the FPCP at suggested five-year intervals.
Goal 3: Create a python portal website *(e.g., Burmesepython.fl; PythonPortal.gov, etc.).*
Strategies and Recommendations
Strategy 3.1: Work collaboratively to create a website with the most current information on pythons for both the public and for other land managers and stakeholder groups.
Recommendation 3.1.1: Designate the Communication Team to create, implement, maintain, and promote both a public-facing and internal python portal.

Recommendation 3.1.2: Designate webpages within Python Portal for public use, where information is provided, and public engagement is supported.
        3.1.2.1: Provide links to the FPCP and Action Plans.
        3.1.2.2: Provide interactive map with rules and regulations for removing pythons clearly represented for each property.
        3.1.2.3: Provide links to EDDMapS showing python removal numbers.
        3.1.2.4: Provide information on management efforts and research projects.
        3.1.2.5: Provide information for the public to become involved in python management and removal.

Recommendation 3.1.3: Create an internal site within the Python Portal for use by organizations that are Workgroup members, where information and tools for land managers are provided.
        3.1.3.1: Provide information on control tools and other resources.
        3.1.3.2: Provide talking points and outreach and education materials.
        3.1.3.3: Establish a research proposal submission portal.
        3.3.3.4: Provide citations of relevant research and links to articles, when possible.

ANTICIPATED SOCIAL, ECONOMIC, ECOLOGICAL, AND MANAGEMENT IMPACTS OF IMPLEMENTING THE FPCP

Introduction

The primary purpose of this plan is to protect native ecosystems and minimize the adverse impacts of pythons in Florida, but it is recognized that the actions taken can also have adverse effects. Because of the extreme detrimental effects of Burmese pythons, especially on native wildlife, the benefits of control efforts should outweigh the detrimental effects when consideration is taken towards mitigating impacts.

Impacts from both the recommended actions and from Burmese pythons to society and other state resources are considered. The primary cumulative effects of implementing the different recommendations under each theme are as follows:

Policy and Regulations: *Continue to implement regulations to limit possession* of captive Burmese pythons in order to decrease new introductions, limit breeding/propagule pressure.
Facilitate python removal through changes in policies and public land rules and regulations.

Control and Monitoring: *Continue to increase removal opportunities* for the public, researchers, agency staff and volunteers, and paid contractors, and utilizing tools such as detector dogs, scout snakes and near infrared cameras, and other tools as they become available.

Research: *Utilize research to inform management* by working collaboratively to prioritize and coordinate funding for projects that will improve managers' ability to detect and remove pythons from the wild.

Communication: *Communicate clearly with a common message* to the public and across agencies regarding the python invasion, control actions and how to participate in python management.

This section describes the impacts to society and the resources of the state of Florida that are expected to occur if management efforts for invasive Burmese pythons either stay the same or decrease as opposed to if the recommendations from this plan are adopted which are expected to increase or expand overall efforts and coordination in the four themes. Not every action or recommendation will be analyzed because their specific impacts are already included by the overarching theme impacts. Analyses of the individual actions are provided in the corresponding tables, where available. Impacts are described under four categories: Social, Economic, Ecological and Management.

Social

- Human health, safety, and property

> ***Human Python Conflict:*** *Any interaction between a person and a python that results in a negative impact to a person, whether direct or indirect, real, or perceived, and may affect human health and safety, or personal property.*

Wild Burmese pythons are rarely aggressive towards humans when left alone. Reed and Snow (2014) reported only five unprovoked strikes or attempted strikes from pythons in Everglades National Park from 2006 to 2011, all on biologists traversing flooded wetlands. However, there are records of Burmese pythons and other large constrictors killing humans both in the wild and in captivity across the globe, even unprovoked (Humane Society 2012). While deaths are rare, Burmese pythons also have dozens of long, sharp teeth that can inflict

serious flesh wounds. In Florida, family pets and backyard agricultural animals have been killed by wild pythons.

Burmese pythons may also affect human health indirectly by causing changes in native ecosystems. By significantly reducing native mammal populations, mosquitos are feeding more often on rats which harbor more diseases that are transferable to humans (Hoyer et al. 2017). These indirect impacts are difficult to find and predict making mitigation more difficult.

If the Florida python population continues to grow in number and expand in geographic area, there will be more opportunity for human-python conflict. Likewise, risk may increase if more members of the public become engaged by controlling and dispatching pythons on private properties and state and federal lands. The potential threats to human health and safety were part of the justification for creating the state python contractor removal program and python removal by professionals likely involves the least amount of risk. Increasing the ability for other trained individuals to remove pythons (e.g., government land managers) should also create less risk to human health and safety.

- Cultural resources and historic properties

Burmese pythons occur in areas that contain both cultural and natural resources that are important to the Miccosukee and Seminole tribes and other communities. Tribal, state, and/or federal laws protect these resources. Data suggests that pythons have negatively impacted mammal populations in the Everglades, like marsh rabbit and white-tailed deer populations (Dorcas et al. 2012, McCleery et al. 2015). The reduction in population negatively affects the ability of tribes and traditional hunters to use these important cultural resources. The Seminole Tribe has identified the Burmese python invasion as the largest threat to Tribal Trust resources for both immediate and potential long-term considerations. Conversely, management activities can have a localized, negative impact on cultural resources and historic properties with increased traffic and human activities to particular areas.

- Visitor use and experience

The presence of Burmese pythons in South Florida has both deterred and attracted visitor use. Some visitors have expressed fear of visiting Everglades National Park due to perceived danger of encountering a python and a reduction in some wildlife species may also reduce interest in visiting the Everglades. While most people prefer that Burmese pythons were not in Florida, there are a number of user groups who travel to South Florida specifically to see pythons, including reptile enthusiasts who want to see these animals in the wild and hunters wishing to hunt a novel species.

Similarly, some visitors may perceive paid contractors as hunters and think negatively of encountering hunters in a national park while other visitors may be very interested in seeing python removal contractors or researchers in action. Determining if python presence and their management creates a net-positive or net-negative impact for either of these reasons could be a costly and subjective endeavor and may not have benefit to land managers.

- Raising awareness about pythons and other invasive species

50

   Burmese pythons have garnered significant attention from news media, the public, and politicians from all levels of government. The reactions of the public to specific media reports can even elicit new directives or initiatives from agency leads and politicians. However, the issue is more complicated than many people realize, and the nuances of python management are not always well-communicated with a unified message. There is an opportunity to continue to improve awareness about python management and other invasive species that may be equally as detrimental.

   Raising awareness about the issue of Burmese pythons also results in raising awareness about methods being employed to control them. Over the years, the public has shown strong interest in some of these methods including how to humanely kill pythons, use of detector dogs, and investigating the development of synthetic biology tools (e.g., CRISPR/ CAS9 gene drive and RNA interference) for pythons and other species and it is expected that they will continue to do so. Land managers should carefully consider public perception of these tools and develop clear and consistent messaging in advance of press releases that involve sensitive topics like these and others.

Table 6. Social Impacts

Social impacts	Recommended management actions	Without management action	With management action
Human health, safety, and property	*Continue to implement regulations to limit possession*	• Pathways for new python introductions and/or incentives to maintain wild populations in Florida will exist.	• Reduced pathways for additional introductions and incentives to maintain wild populations.
	Continue to increase removal opportunities & *Facilitate python removal through changes in policies and public land rules and regulations*	• A growing and expanding python population poses increasing risks to interests of humans and their pets, agricultural and horticultural resources.	• Increasing the ability for removal by professional contractors and other trained individuals to control pythons may result in decrease in population, slower spread, and eradication in some areas. • Python control by untrained members of the public increases risk to untrained individuals.
	Utilize research to inform management	• Removal efforts will be less efficient.	• Removal efforts will be more efficient and directed. Potential will exist for novel issues to emerge as new methods are considered.
	Communicate clearly with a common message	• Different stakeholders may receive different, possibly conflicting information leading to inconsistent public reaction to issues.	• Public will receive clear, consistent message that will help them to remain safe and protect themselves, their pets, and agricultural animals.

Social impacts	Recommended management actions	Without management action	With management action
Cultural Resources and Historic Properties	*Continue to increase removal opportunities*	• A growing and expanding python population could continue to have negative impacts on both Tribal members and hunter cultural resources (certain wildlife species).	• Increasing management efforts will increase use of affected areas and may indirectly cause negative impacts to cultural resources. • Increasing removal efforts may result in decrease in python population, slower spread, and eradication in some areas that benefit traditional/cultural activities.
Visitor use and experience	*Continue to increase removal opportunities*	• Tourism to natural areas in South Florida may decrease because of fear of pythons and decrease of some native wildlife. • Tourism of natural areas in South Florida may increase due to people interested in trying to view or remove a python in Florida.	• Increasing management efforts may control population, or give impression of population control, resulting in less fear of visiting Florida due to pythons. • Increasing management efforts create slightly more traffic or crowding in limited cases. • Visitors can be either dismayed or interested in seeing python removal activities.
	Communicate clearly with a common message	• Stakeholders may have different, possibly conflicting information, generally detracting from the experience.	• Visitors will receive clear, consistent message that will help them to remain safe, to know what to do if they see a python and

Social impacts	Recommended management actions	Without management action	With management action
			understand what land managers are doing to control pythons.
Raising awareness about invasive species	*Continue to increase removal opportunities*	• Pythons have become emblematic of invasive wildlife issues, but some politicians and members of the public may not think enough is done to control pythons.	• Continuing to increase removal activities will demonstrate dedication to and the importance of controlling the species.
	Utilize research to inform management	• Current technology may not provide the most effective control tools.	• Fostering innovation and thinking outside of the box can provide new management tools that increase effectiveness. • Some methods may be viewed negatively or with suspicion if they are not sufficiently tested and communicated.
	Communicate clearly with a common message	• Stakeholders may have different, possibly conflicting information.	• Working together on communication will increase public awareness and understanding of the issues and should result in additional support.

Economic

- Exotic pet trade

    Burmese pythons were a popular species in the pet trade in Florida and a number of importers/exporters, breeders, and other commercial operations were present in the state until the Burmese python became a Prohibited species in Florida on April 29, 2021. Burmese python sales were estimated to range between $11,000 and $44,000 in value for 2019 (Florida Fish and Wildlife Conservation Commission report 2020). Increased regulations have eliminated commercial breeding and sales of Burmese pythons and other high-risk constrictors in Florida.

- Tribal members

    Pythons have reduced mammal populations as much as 90% in some areas of the Everglades including animals that are culturally important and necessary for preserving the culture of Tribal communities. This forces people to travel further afield to obtain animals in different parts of Florida. Additionally, subsistence hunting for Tribal communities has been a way of life for millennia. Tribal members are less able to hunt deer or other animals to feed their families because the pythons have consumed them. Both the Miccosukee and Seminole tribes in Florida view the Burmese python invasion as an economic threat.

- Agricultural industry

    There have been several reported situations where wild pythons have attacked and killed small livestock and poultry in South Florida. Based on the small number of reports received, impacts to individual farms are likely small, but in one case a goose was killed by a research python that was being tracked using radio telemetry and the federal government provided the owner compensation for the animal.

- Tourism

    For the same reasons as stated under the Social Impacts section, there have likely been both negative and positive impacts to tourism related to the python invasion. There has not been a substantial effort to try to quantify these impacts.

- Land manager operations

    Burmese pythons within the known breeding area in South Florida are in the Resource Protection and Long-term Management portion of the invasion curve, meaning that their population is widespread and abundant and at the most expensive point to control. Control costs range from direct payment to contractors to indirect impacts such as increased road use in some areas and increased need for road maintenance as a result. As contractor programs have grown, more staff have been hired and sophisticated tools developed to manage them.

Considerable funds must also be spent on research to find effective research tools, determine impacts, and develop resource protection strategies. These funding sources largely come from trust funds or taxpayer funds although some projects have received support from private organizations and donor funds.

The attention on pythons has also resulted in more attention on other invasive species and in some cases increased funding for those lesser-known species has been a result but, overall, funding for invasive wildlife has been lacking when compared to funding for invasive plant control.

- Python control utilizing private contractors

Python removal outside of agency staff has grown from purely volunteer efforts to FWC and SFWMD employing up to 100 individuals paid by the hour and by the foot for each python. The annual contractor budget of those two agencies for FY 2020-21 is $600,000. These positions are a full-time job for some contractors and others do it to supplement income, but it is mostly a low-tech endeavor for which the primary cost is fuel. At this point, it is not a comparable industry compared to invasive plant control industry but, it is conceivable that python removal will evolve to become more organized and professional and spawn new innovation through private industry. Such an industry could eventually encompass the management of other widespread invasive species like tegus and iguanas. Currently, pest control companies are the primary responders for those types of species, but most do not do wide-scale control on public lands, which is becoming more important.

- Commercialization of python products

Some python contractors and other individuals either sell python hides and meat or make products themselves out of the hides. This activity can further incentivize removal efforts or potentially lead to unintended consequences, such as creating a long-term market for these products that incentivizes never reaching complete eradication or starting new populations to be harvested. Many invasive species management programs do not to allow individuals to profit off products made from a species that agencies are working to eliminate for this reason. As this practice continues, it may come to generate significant income for some individuals. If at some point agencies change course and begin to regulate products to be made from captured pythons, it could cause economic harm to those individuals or even create an underground market for those products. Commercialization may also have benefits, such as providing additional incentive for removal and raising awareness.

Table 7. Economic Impacts

Economic impacts	Recommended management actions	Without management action	With management action
Pet trade	*Continue to implement regulations to limit possession*	• Personal and commercial sales of pythons would continue at current rate.	• Additional regulations and costs could cause a hardship for both personal and commercial sales of pythons. • Businesses only relying on the sale of Burmese pythons may no longer operate in Florida.
Tribes	*Continue to implement regulations to limit possession; Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities; Utilize research to inform management*	• A growing and expanding python population could continue to have negative impacts on Tribal cultural resources (certain native wildlife species).	• Successful control of the python population could result in a rebound for some native species populations removing the hardship in pursuing traditional use. • Increasing management efforts will increase use of affected areas and may indirectly cause negative impacts to cultural resources.

Economic impacts	Recommended management actions	Without management action	With management action
Agricultural industry	*Continue to implement regulations to limit possession; Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities; Utilize research to inform management*	• A growing and expanding python population could have negative impacts on small agricultural operations.	• Successful control of the population may reduce risk to agricultural operations. • Coordinated research could improve identification and avoidance of impacts.
	Communicate clearly with a common message	• Agricultural industry may not be aware of opportunities available to control pythons.	• Agricultural industry will be aware of opportunities available to control pythons and may sustain less loss of property to python predation.

Economic impacts	Recommended management actions	Without management action	With management action
Tourism	*Continue to implement regulations to limit possession; Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities; Utilize research to inform management*	• A growing and expanding python population could have negative impacts on tourism due to perceived threat of pythons and reduction or loss of popular species.	• Efforts to control the population may result in fewer pythons and reduce impacts to native wildlife, improving tourism related to Florida's abundance and diversity of wildlife.
	Communicate clearly with a common message	• Stakeholders may have different, possibly conflicting information.	• Public will receive clear, consistent message on how to prevent negative interactions with pythons while visiting Florida and about efforts to control pythons causing them to have less reservations about visiting Florida.

Economic impacts	Recommended management actions	Without management action	With management action
Agency and NGO Management and Operations	*Continue to implement regulations to limit possession; Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities; Utilize research to inform management*	• A growing and expanding python population will increase the cost and resources going into managing pythons and mitigating the effects, as well as working to coordinate with other organizations.	• More coordinated efforts between all Stakeholders should result in more effectiveness and efficiencies.
	Communicate clearly with a common message	• Stakeholders may present different, possibly conflicting information to the public. • Stakeholders may not be effectively sharing information and collaborating with one another.	• Public will receive clear, consistent message and support increased measures to control pythons. • Stakeholders will effectively share information and collaborate with one other resulting in more effective and therefore, efficient python control while avoiding poor outcomes or new issues.

Economic impacts	Recommended management actions	Without management action	With management action
Python control utilizing private contractors	*Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities; Utilize research to inform management*	• Agencies will continue to manage contractors on an individual basis which is demanding of resources.	• Removal contractors could create businesses where they manage other contractors who conduct activities on a more regimented and controlled basis which would be more efficient and cheaper for agencies to manage and could be more effective at python control.
	Communicate clearly with a common message	• Inconsistent communication of expectations to contractors creates room for error and unintended consequences which must be managed at a cost.	• Consistent communication results in a more predictable performance and reduces management burden.

Economic impacts	Recommended management actions	Without management action	With management action
Commercialization of python products	*Continue to implement regulations to limit possession;*	• The economic benefits of the current level commercialization of python products have not been analyzed.	• If commercialization of python products becomes more regulated, it may result in economic loss for those who invest in such ventures.
	Communicate clearly with a common message	• Different agencies communicate different expectations of what qualifies as commercialization which creates inconsistencies among programs and has resulted in some contractors being penalized for activities in certain locations when other contractors conducting similar activities are not.	• Agencies communicate similar messages which may economically benefit or negatively impact individuals, depending on the common messaging. • Communicating similar messages may improve management effectiveness by aligning compensation for removal with management objectives.

Ecological

- Native species and ecosystems

       The state of Florida contains a number of biologically diverse and unique ecosystems found nowhere else and a large area of South Florida is made up of significant natural areas. The Everglades is the largest subtropical wilderness in the United States and home to part of the largest mangrove ecosystem in the western hemisphere. Florida Bay and the adjacent Florida Keys National Marine Sanctuary contain one of the largest seagrass meadows in the world. Everglades National Park holds a number of special designations, including International Biosphere Reserve, World Heritage Site (Endangered), and a Wetland of International Importance. These ecosystems are home to a number of plant and wildlife species protected by the state and/or federal government due to the historic pressures and impacts on their populations. The primary impact caused by Burmese pythons is direct depredation on native wildlife. Pythons are generalists and eat a wide variety of small to large mammals, birds, and even other reptiles. Research has demonstrated that pythons can cause significant declines in local populations of some mammal species (Dorcas et al. 2012, McCleery et al. 2015).

       Burmese pythons also have indirect impacts to native species. They have been found to host and spread nonnative parasites to native snake species (Miller et al. 2018). These parasites can be especially detrimental to native snakes as a novel host species (Miller et al. 2020).

       The direct and indirect impacts culminate in a reduction in native species diversity in an ecosystem and can cause cascading trophic effects. The mosquito example described in the section on impacts to human health references one of these trophic effects in which mosquitos are now feeding more on rats which more commonly host diseases transferable to humans than the other native mammals whose populations pythons have significantly impacted (Hoyer et al. 2017). Declining raccoon populations have led to both positive and negative trophic impacts to other native species. As raccoon populations have declined, depredation on turtle nests has decreased, possibly including endangered sea turtles (Willson 2017). However, raccoons also may play a role in reducing other invasive species that prey on nesting birds, like iguanas (Smith et al. 2006).

       By taking measures to remove pythons and reduce their overall numbers, native species will be protected from depredation and populations may recover. It will likely also be important to develop techniques to protect priority species (e.g., wading bird nesting colonies) during particularly vulnerable times.

       Land managers must also recognize and mitigate for impacts from python control management activities. Python removal activities involve working within natural areas, often at night using very powerful lights, which inevitably disturbs wildlife and even can cause direct mortality from vehicles. Special consideration must be taken where these activities could disturb wildlife during important nesting seasons, such as operating airboats near wading bird nesting colonies, searching for, and removing pythons from gopher tortoise burrows, or using bright lights by beaches where turtle nesting is occurring.

       The development of a private industry to remove pythons may also provide incentives to never fully eradicate the species or even moving animals to start new populations and those unintended consequences would subsequently have detrimental impacts to native species.

Python removal contractors may also spread seeds or reproductive parts of invasive plant species on their person or vehicles to natural areas where they conduct python removal work. This unintended action could result in the spread or introduction of a non-native plant to very remote areas and otherwise pristine ecosystems and potentially ecosystem-level changes.

- State and federally listed species

Invasive species pose the second biggest threat to native wildlife after habitat loss. Florida has a number of imperiled species, some of which are already protected due to declines in population and limited ranges. Several listed species have already been documented in Burmese python diets (Cherkiss et al. unpublished; Romagosa et al. unpublished) and the wide variety of other mammals and birds in their diets indicate that pythons could potentially consume the majority of listed bird and terrestrial mammal species in Florida, along with the two crocodylians found in the state. It is quite possible the Burmese pythons could cause the extirpation of rare species, similar to how the invasive brown treesnake has caused a number of extinctions of endemic species on the U.S. Territory of Guam (Rodda et al. 1999).

Table 8. State and Federally Listed Wildlife Vulnerable to Burmese Python Predation.

Common Name	Scientific Name	Status	Found in Burmese Python Diet
REPTILES			
American alligator	*Alligator mississippiensis*	FT(S/A)	X
American crocodile	*Crocodylus acutus*	FT	
BIRDS			
American oystercatcher	*Haematopus palliatus*	ST	
Audubon's crested caracara	*Polyborus plancus audubonii*	FT	
Bachman's wood warbler	*Vermivora bachmanii*	FE	
Black skimmer	*Rynchops niger*	ST	
Black Rail	*Laterallus jamaicensis*		
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	FE	
Eastern black rail	*Laterallus jamaicensis jamaicensis*	FT	
Eskimo curlew	*Numenius borealis*	FE	
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	FE	
Florida burrowing owl	*Athene cunicularia floridana*	ST	
Florida grasshopper sparrow	*Ammodramus savannarum floridanus*	FE	
Florida sandhill crane	*Antigone canadensis pratensis*	ST	

Common Name	Scientific Name	Status	Found in Burmese Python Diet
Florida scrub-jay	*Aphelocoma coerulescens*	FT	
Ivory-billed woodpecker	*Campephilus principalis*	FE	
Kirtland's warbler (Kirtland's wood warbler)	*Setophaga kirtlandii (Dendroica kirtlandii)*	FE	
Least tern	*Sternula antillarum*	ST	
Little blue heron	*Egretta caerulea*	ST	X
Marian's marsh wren	*Cistothorus palustris marianae*	ST	
Piping plover	*Charadrius melodus*	FT	
Red-cockaded woodpecker	*Picoides borealis*	FE	
Reddish egret	*Egretta rufescens*	ST	
Roseate spoonbill	*Platalea ajaja*	ST	X
Roseate tern	*Sterna dougallii dougallii*	FT	
Rufa red knot	*Calidris canutus rufa*	FT	
Scott's seaside sparrow	*Ammodramus maritimus peninsulae*	ST	
Snowy plover	*Charadrius nivosus*	ST	
Southeastern American kestrel	*Falco sparverius paulus*	ST	
Tricolored heron	*Egretta tricolor*	ST	
Wakulla seaside sparrow	*Ammodramus maritimus juncicola*	ST	
White-crowned pigeon	*Patagioenas leucocephala*	ST	
Whooping crane	*Grus americana*	FXN	
Worthington's marsh wren	*Cistothorus palustris griseus*	ST	
Wood stork	*Mycteria americana*	FT	X
MAMMALS			
Anastasia Island beach mouse	*Peromyscus polionotus phasma*	FE	
Big Cypress fox squirrel	*Sciurus niger avicennia*	ST	*S. niger* has been documented but subspecies was not determined
Choctawhatchee beach mouse	*Peromyscus polionotus allophrys*	FE	
Everglades mink	*Neovison vison evergladensis*	ST	
Florida bonneted bat	*Eumops floridanus*	FE	
Florida panther	*Puma [=Felis] concolor coryi*	FE	

Common Name	Scientific Name	Status	Found in Burmese Python Diet
Florida salt marsh vole	*Microtus pennsylvanicus dukecampbelli*	FE	
Gray bat	*Myotis grisescens*	FE	
Indiana bat	*Myotis sodalis*	FE	
Key deer	*Odocoileus virginianus clavium*	FE	
Key Largo cotton mouse	*Peromyscus gossypinus allapaticola*	FE	
Key Largo woodrat	*Neotoma floridana smalli*	FE	X
Lower Keys rabbit	*Sylvilagus palustris hefneri*	FE	
Perdido Key beach mouse	*Peromyscus polionotus trissyllepsis*	FE	
Red wolf	*Canis rufus*	FE	
Rice rat	*Oryzomys palustris natator*	FE (Lower Keys population)	
Sanibel Island rice rat	*Oryzomys palustris sanibeli*	ST	
Sherman's short-tailed shrew	*Blarina shermani*	ST	
Southeastern beach mouse	*Peromyscus polionotus niveiventris*	FT	
St. Andrew beach mouse	*Peromyscus polionotus peninsularis*	FE	

Source: Florida Fish and Wildlife Conservation Commission: Florida's Endangered and Threatened Species, Updated December 2018; USFWS Florida Ecological Services Field Office.

FE = Federally-designated Endangered
FT = Federally-designated Threatened
FT(S/A) = Federally-designated Threatened species due to similarity of appearance
FXN = Federally-designated Threatened Nonessential Experimental Population
ST = State-designated Threatened
SSC = State Species of Special Concern

     As previously mentioned in discussing impacts to native wildlife and ecosystems, management actions can also impact listed species and managers should consider mitigations to reduce these impacts, such as limiting more destructive or disruptive types of access to biologically important areas during critical times of the year for some species. Agencies should consult with FWC and USFWS when appropriate or required due to potential impacts to listed species.

- Wetlands

    Wetlands compose a large part of the South Florida landscape making it important to consider python and management impacts to wetland ecosystems. Pythons are habitat generalists and can utilize the seasonally flooded habitats of the Greater Everglades for all their biological functions. As discussed above, their greatest impacts are to wildlife found in these habitats and the severe impacts to local populations of meso-mammals can create cascading trophic effects that may ultimately alter the abiotic characteristics of wetland ecosystems including geological features and processes and water quantity and quality. Those impacts on abiotic features of wetlands have yet to be identified but it is possible they will be discovered as we continue to learn about Burmese pythons in Florida.

    There are certainly identifiable potential impacts to wetlands from some of the different management activities. As discussed, most python removal efforts involve individuals searching over many miles of roads and trails. These activities are mostly conducted by automobile, but managers are working to increase removal efforts within the interior of some of these natural areas which involves the use of specialized equipment such as swamp buggies and airboats. Both these types of equipment cause significant impact to wetland ecosystems by creating and utilizing trails which destroys vegetation, compacts soils, altering the hydrology and causing disruption in water flow. The use of off-road vehicles has been restricted or regulated through many of these areas due to the significant damage they can cause in a short amount of time and the long recovery time that is needed to restore the ecosystem to its natural state.

- Marine or estuarine resources

    Marine and estuarine resources also compose a large part of the South Florida landscape and pythons have been found to use both areas, as well. Again, the majority of python impacts to these resources would be to local fauna.

    These particular ecosystems can also be very delicate and management actions by boats and specialized equipment could impact the function of these areas if not well-regulated. In Florida, mangrove habitats found in these areas are protected and should not be damaged during management activities.

- Upland habitats

    Florida has a number of unique upland habitats also utilized by pythons, especially as their range expands outside of the greater Everglades. Similar to other areas described, the majority of impacts from pythons are to local fauna and special care should be taken while conducting management activities not to damage unique flora and fauna in these habitats.

- Air quality

    There is no known mechanism by which pythons would impact local air quality but management activities involving vehicles would be expected to decrease air quality locally when there is high use in certain areas, especially at night. The decrease should be temporary, but

trends in high use areas should be monitored. The use of vehicles will also contribute to increasing greenhouse gas emissions.

- Soundscapes

    There is no known mechanism by which pythons would impact local soundscapes but management activities involving vehicles would be expected to cause temporary increases to noise pollution locally. Again, trends in high use areas should be monitored.

- Lightscapes

    There is no known mechanism by which pythons would impact local lightscapes but management activities involving vehicles would be expected to increase light pollution. Some python removal professionals use very large and/or bright light bars and other lights to search for pythons. The increase in light pollution should be temporary but could be significant depending on the types of lights used and wildlife use of affected areas and trends should be monitored.

- Wilderness

    There are over one million acres of wilderness or proposed wilderness within Everglades National Park and Big Cypress National Preserve. The Wilderness Act instructs federal land management agencies to manage wilderness in a way that preserves its wilderness character. There are five qualities that make up wilderness character: an area should be untrammeled, undeveloped, natural, include opportunities for solitude and unconfined recreation, and have other features of value. Burmese pythons pose a threat to the "natural" character of wilderness in that they alter and degrade the natural ecosystem. Everglades National Park has found that management actions to remove pythons from wilderness are necessary due to the impact to that quality along with requirements of other federal legislation that mandate protecting parks from the effects of non-native species.
    Management actions to remove pythons could also impact wilderness, and NPS is required to carefully evaluate the impacts that actions taking place in designated or proposed wilderness might have to the five qualities of wilderness character. Specifically, the use of mechanical vehicles is prohibited within designated wilderness, which would preclude many of the typical management activities from taking place within the large majority of Everglades National Park. Other management activities that may threaten wilderness characters would also need to be evaluated. There has been precedence to allow limited use of vehicles on old roads within proposed wilderness. That use is being evaluated for both the impact to the resources as well as whether it is effective at removing a significant number of pythons to make the activity worthwhile.

- Unintended consequences of novel management methods

The use of a wide range of novel control tools for Burmese pythons has been recommended and, in some cases, tested in the field. These tools may have unintended consequences on native ecosystems which should be carefully considered before implementation. Examples could be a detector dog disturbing ground-nesting wildlife to the intentional or unintentional introduction of genetically altered pythons developed to control Florida's python population to the python's native range. Because many of these tools are being used for the first time in this application, a rigorous protocol should be created for vetting different management actions before they are implemented in the field.

Table 9. Ecological Impacts

Ecological impacts	Recommended management actions	Without management action	With management action
Native species and ecosystems	*Continue to implement regulations to limit possession*	• Loopholes in regulations and current level of enforcement may result in pythons becoming established in additional locations in the state where they would have negative impacts on native species and ecosystems.	• Additional regulations could reduce incentives to keep pythons and other large constrictors in the state for personal or commercial use and decrease the chances of additional and negative impacts to native species and ecosystems. • Coordinated and enhanced policies on enforcement could further reduce impacts.
	Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities	• A growing and expanding python population is expected to have negative impacts on native wildlife species and ecosystems. • There may be some benefits to ground-nesting and other native wildlife with reduction of native predators by pythons, but trophic implications are not well-understood, and it is expected that impacts from an	• Increased python removal is expected to primarily have net positive impacts to native wildlife and ecosystems. • Increased removal activities may impact sensitive areas and wildlife during critical stages of their life cycle. • Searching by vehicle or on foot in remote areas may cause negative impacts to habitats and disturb wildlife. • Using novel detection tools like detector dogs or drones may disturb wildlife.

Ecological impacts	Recommended management actions	Without management action	With management action
		unchecked python population would be primarily negative.	• Managers should consult with FWC and USFWS regularly before adding or increasing actions in sensitive areas or those important to native wildlife, such as threatened and endangered species.
	Utilize research to inform management	• Management efforts may be ineffective while adversely impacting native species and ecosystems.	• Management efforts would be informed by science that supports the most effective actions with a net benefit to native species and ecosystems.
	Communicate clearly with a common message	• Communication between Stakeholders will continue to be informal and uncoordinated resulting in less effective python control.	• Communication between Stakeholders will be centralized and coordinated resulting in more effective collaboration and data sharing resulting in better protection of native species and ecosystems.
State and federally listed species	*Continue to implement regulations to limit possession*	• Loopholes in regulations may result in pythons becoming established in additional locations in the state where they would have negative impacts on state and federally listed species.	• Additional regulations could reduce incentives to keep pythons and other large constrictors in the state for personal or commercial use and decrease the chances of additional releases and negative impacts to state and federally listed species.
	Facilitate python removal through changes in policies	• A growing and expanding python population is expected	• Increased python removal is expected to primarily have net positive

Ecological impacts	Recommended management actions	Without management action	With management action
	and public land rules and regulations; Continue to increase removal opportunities	to have negative impacts on state and federally listed species. • There may be some benefits to ground-nesting and other listed species with reduction of native predators by pythons, but trophic implications are not well-understood, and it is expected that impacts from an unchecked python population would be primarily negative.	impacts to state and federally listed species. • Increased removal activities may impact sensitive areas and wildlife during critical stages of their life cycle. • Managers should consult with FWC and USFWS regularly before adding or increasing actions in sensitive areas or those important to listed species.
	Utilize research to inform management	• Management efforts may be ineffective while adversely impacting listed species.	• Management efforts would be informed by science that supports the most effective actions with a net benefit to listed species.
	Communicate clearly with a common message	• Communication between Stakeholders will continue to be informal and uncoordinated resulting in less effective python control.	• Communication between Stakeholders will be centralized and coordinated resulting in more effective collaboration and data sharing resulting in better protection of listed species.

Ecological impacts	Recommended management actions	Without management action	With management action
Wetlands	*Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities*	• A growing and expanding python population is expected to have negative impacts on native ecosystems, including wetlands.	• Increased python removal is expected to primarily have net positive impacts on native ecosystems, including wetlands. • Increased removal activities may impact sensitive areas and wildlife in wetland ecosystems. • Wetlands could be especially sensitive as currently the majority of the python population is found within wetland ecosystems and specialized equipment that creates scars in the landscape is required, and has been authorized in some cases, to search for pythons.
Marine or estuarine resources	*Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities*	• A growing and expanding python population is expected to have negative impacts on native ecosystems, including marine or estuarine resources.	• Increased python removal is expected to primarily have net positive impacts on native ecosystems, including marine and estuarine resources • Increased removal activities may impact sensitive areas and wildlife in marine and estuarine ecosystems • Estuarine habitats could be especially sensitive as specialized equipment that creates scars in the

Ecological impacts	Recommended management actions	Without management action	With management action
			landscape is required to search for pythons in remote estuarine locations.
Upland habitats	*Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities*	• A growing and expanding python population is expected to have negative impacts on native ecosystems, including upland habitats.	• Increased python removal is expected to primarily have net positive impacts on native ecosystems, including upland habitats. • Increased removal activities may impact sensitive areas and wildlife in upland habitats.
Air quality	*Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities*	• Pythons are not expected to measurably impact air quality.	• The majority of python removals are conducted by contractors surveying roads in vehicles. Traffic on these roads and levees has increased considerably during certain times of the year and likely temporarily decreases local air quality. Vehicle use will also increase greenhouse gas emissions.

Ecological impacts	Recommended management actions	Without management action	With management action
Soundscapes	*Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities*	• Pythons and ongoing removal efforts are not expected to measurably impact soundscapes.	• The majority of python removals are conducted by contractors surveying roads in vehicles. Traffic on these roads and levees has increased considerably during certain times of the year and likely temporarily increases unnatural noise in local soundscapes.
Lightscapes	*Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities*	• Pythons are not expected to measurably impact lightscapes. • The majority of python removals are conducted by contractors surveying roads in vehicles with enhanced lighting. Traffic on these roads and levees has increased considerably during certain times of the year which temporarily increases	• Improved guidance could reduce lighting impacts in key areas.

Ecological impacts	Recommended management actions	Without management action	With management action
		unnatural light in local soundscapes and may disturb wildlife in adjacent natural areas, including roosting birds.	
Wilderness	*Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities; Utilize research to inform management*	• A growing and expanding python population is expected to have negative impacts on native ecosystems, including wilderness. • Current removal efforts may continue to have minor impacts to Wilderness values.	• The majority of python removals are conducted by contractors surveying roads in vehicles with enhanced lighting and in specialized equipment. This type of use results in impacts to wilderness values and any exceptions should be very carefully considered.
Unintended consequences of novel management methods	*Facilitate python removal through changes in policies and public land rules and regulations; Continue to increase removal opportunities; Utilize research to inform management*	• A growing and expanding python population is expected to have negative impacts throughout the state of Florida and possibly beyond.	• Creation and implementation of novel research methods could provide new pythons control tools or increase the effectiveness of existing methods. • Novel management methods could have a number of unintended consequences that can be difficult to predict and recognize.

Control and Management

- Land managing organization commitment to Workgroup and collaboration on developing recommendations and agency coordination

Control and management of widespread invasive species can require substantial commitments of resources and time by managing agencies. This plan proposes creating an on-going Workgroup to carry out the implementation of the plan by meeting regularly and closely coordinating management actions and funding for research. This level of coordination is expected to occur several times throughout the year and produce collaborative products like annual action plans and reports. Participants must be committed long-term to carrying out the recommendations of this plan by both planning for staff participation and having a willingness to make recommendations to leadership jointly and with sensitivity to the unique needs of their partner agencies. They must also be willing to revisit the plan regularly to evaluate recommendations and change course when necessary and eventually update the plan.

Partners participating in development of the Florida Python Control Plan. Photo: FWC

- Land managing organization commitment to science to management linkage

Not all control actions will be shown to have benefits that outweigh costs or damage to native ecosystems. A perception that they will produce benefits may be furthered by publicity from traditional and social media. Agencies should commit to following the recommendations from tested science, even when it means curtailing or changing programs that have become popular. Improving the link between science and management should result in more consistent progress toward achieving control goals by focusing management on effective methods, testing innovative approaches, and incorporating lessons learned.

- Long-term management and development of contractor programs

Paid python removal contractors will likely be a tool for control for the foreseeable future. Currently agencies are managing 100 individual contractors. Management of both the contractors and the data they produce is time intensive. Managing agencies must be willing to expend sufficient resources to make sure contractor programs are operating within the terms and conditions of the contract and that the data collected can be used to evaluate the effectiveness of the programs and improve efficiency.

Agencies may consider guiding this group into a more professional occupation that is more sustainable to manage and foster an environment for tool development through private industry.

- Irreversible or irretrievable commitments of resources

Python control tools may make significant and long-term demands on resources. One example is the creation of an agency detector dog program where an agency must essentially become the owner of the dog or the agency must provide funding to pay for a full-time dog handler and keeper.

As of 2020, land managing organizations have spent millions of dollars on research and control of Burmese pythons. Implementing the recommendations in this plan will inevitably require additional resources but more coordinated management efforts should result in reduced risk of losses on committed funding or support by ensuring feasibility of projects and interorganizational support.

Table 10. Management Impacts

Management Impacts	Recommended management actions	Without management action	With management action
Land managing organization commitment to Workgroup and joint decision making and coordination		• Stakeholders coordinating ad hoc, only on specific projects or issues in small groups.	• Stakeholders have a formal structure for collaboration and meeting frequently to coordinate.
Land managing organization commitment to science to management linkage	*Adopt and Implement Strategies and Recommendations of the Florida Python Control Plan*	• Stakeholders independently determine research needs possibly resulting in research projects that may not serve needed management objectives or may not be adequately funded to fully answer important questions.	• Stakeholders have a formal structure for coordinating on requesting and supporting needed research, which is communicated to research community. Researchers have a standardized way to submit proposals, share data and study results, and research permitting is streamlined.

Management Impacts	Recommended management actions	Without management action	With management action
Long-term management and development of contractor programs		• Contractor programs likely to continue to expand and become difficult to manage and meaningful data analysis to determine efficiencies will also be more difficult.	• Contractor programs developed into more professional entities with data analysis in mind.
Irreversible or irretrievable commitments of resources		• Investments in python control tools may become hard to maintain.	• Python control tools are implemented with long-term use in mind, including with long-term support for staff to manage them.

LITERATURE CITED

Avery, M.L., Engeman, R.M., Keacher, K.L., Humphrey, J.S., Bruce, W.E., Mathies, T.C. and Mauldin, R.E., 2010. Cold weather and the potential range of invasive Burmese pythons. Biological Invasions, 12(11), pp.3649-3652.

Bartoszek, I.A., Smith, B.J., Reed, R.N., and Hart, K.M., 2021. Spatial ecology of invasive Burmese pythons in southwestern Florida. Ecosphere. (In press)

Bartoszek, I.A., I.C. Easterling, K. King, and Andreadis, P.T., 2020. *Python bivittatus* (Burmese python) aberrant pattern. Herpetological Review 51(1):155-156.

Bartoszek, I.A., Andreadis, P.T., Prokopervin, C., Patel, M. and Reed, R.N., 2018a. *Python bivittatus* (Burmese Python). Diet and prey size. Herpetological Review, 49, pp.139-140.

Bartoszek, I.A., Hendricks, M.B., Easterling, I.C., and Andreadis, P.T., 2018b. *Python bivittatus* (Burmese python) dispersal/marine incursion. Herpetological Review 49(3):554-555.

Bartoszek, I.A., Andreadis, P.T., Prokop-Ervin, C., Curry, G., & Reed, R.N., 2018c. Python *bivittatus* (Burmese Python) and *Gopherus polyphemus* (Gopher Tortoise). Habitat Use, Breeding Aggregation, and Interspecific Interaction. Herpetological Review 49(2):353–354.

Bhupathy, S. and Vijayan, V.S., 1989. Status, distribution, and general ecology of the Indian python *Python molurus molurus* Linn. in Keoladeo National Park, Bharatpur, Rajasthan. Journal of the Bombay Natural History Society, 86(3), pp.381-387.

Boback, S.M., Snow, R.W., Hsu, T., Peurach, S.C., Dove, C.J. and Reed, R.N., 2016. Supersize me: Remains of three white-tailed deer (*Odocoileus virginianus*) in an invasive Burmese python (*Python molurus bivittatus*) in Florida. BioInvasions Records.

Booth, W., Schuett, G.W., Ridgway, A., Buxton, D.W., Castoe, T.A., Bastone, G., Bennett, C. and McMahan, W., 2014. New insights on facultative parthenogenesis in pythons. Biological Journal of the Linnean Society, 112(3), pp.461-468.

Card, D.C., Perry, B.W., Adams, R.H., Schield, D.R., Young, A.S., Andrew, A.L., Jezkova, T., Pasquesi, G.I., Hales, N.R., Walsh, M.R. and Rochford, M.R., 2018. Novel ecological and climatic conditions drive rapid adaptation in invasive Florida Burmese pythons. Molecular Ecology, 27(23), pp.4744-4757.

Dorcas, M.E., Willson, J.D. and Gibbons, J.W., 2011. Can invasive Burmese pythons inhabit temperate regions of the southeastern United States? Biological Invasions, 13(4), pp.793-802.

Dorcas, M.E., Willson, J.D., Reed, R.N., Snow, R.W., Rochford, M.R., Miller, M.A., Meshaka, W.E., Andreadis, P.T., Mazzotti, F.J., Romagosa, C.M. and Hart, K.M., 2012. Severe mammal declines coincide with proliferation of invasive Burmese pythons in Everglades National Park. Proceedings of the National Academy of Sciences, 109(7), pp.2418-2422.

Dove, C.J., Snow, R.W., Rochford, M.R. and Mazzotti, F.J., 2011. Birds consumed by the invasive Burmese python (*Python molurus bivittatus*) in Everglades National Park, Florida, USA. The Wilson Journal of Ornithology, 123(1), pp.126-131.

Dove, C.J., Reed, R.N. and Snow, R.W., 2012. Consumption of bird eggs by invasive Burmese pythons in Florida. Reptiles & Amphibians, 19(1), pp.64-66.

Falk, B.G., Snow, R.W. and Reed, R.N., 2016. Prospects and limitations of citizen science in invasive species management: A case study with Burmese pythons in Everglades National Park. Southeastern Naturalist, 15(sp8), pp.89-102.

Ferriter, A., Thayer, D., Goodyear, C., Doren, B., Langeland, K., and Lane, J. 2005 South Florida Environmental Report, Chapter 9: Invasive exotic species in the South Florida environment. South Florida Water Management District. West Palm Beach, Florida. Available online at 2005 SFER, Volume I – Chapter 9: Invasive Exotic Species in the South Florida Environment (sfwmd.gov).

Frye, F.L. and Mader, D.R., 1985. Precocious sexual maturity in a juvenile male python. The Journal of Zoo Animal Medicine, 16(2), pp.69-72.

Frýdlová, P., Mrzílková, J., Šeremeta, M., Křemen, J., Dudák, J., Žemlička, J., Němec, P., Velenský, P., Moravec, J., Koleška, D. and Zahradníčková, V., 2019. Universality of indeterminate growth in lizards rejected: the micro-CT reveals contrasting timing of growth cartilage persistence in iguanas, agamas, and chameleons. Scientific reports, 9(1), pp.1-14.

Florida Fish and Wildlife Conservation Commission, 2020. Statement of estimated regulatory costs of proposed changes to Chapter 68-5, F.A.C.

Greene, D.U., Potts, J.M., Duquesnel, J.G., and Snow, R.W., 2007. Geographic distribution: *Python molurus bivittatus* (Burmese python). Herpetological Review, 38, p. 355.

Hanslowe, E.B., Falk, B.G., Collier, M.A., Josimovich, J.M., Rahill, T.A. and Reed, R.N., 2016. First record of invasive Burmese Python oviposition and brooding inside an anthropogenic structure. Southeastern Naturalist, 15(sp8), pp.103-106.

Hart, K.M., Schofield, P.J. and Gregoire, D.R., 2012. Experimentally derived salinity tolerance of hatchling Burmese pythons (*Python molurus bivittatus*) from the Everglades, Florida (USA). Journal of Experimental Marine Biology and Ecology, 413, pp.56-59.

Hart, K.M., Cherkiss, M.S., Smith, B.J., Mazzotti, F.J., Fujisaki, I., Snow, R.W. and Dorcas, M.E., 2015. Home range, habitat use, and movement patterns of non-native Burmese pythons in Everglades National Park, Florida, USA. Animal Biotelemetry, 3(1), p.8.

Harvey, R.G., Brien, M.L., Cherkiss, M.S., Dorcas, M.E., Rochford, M., Snow, R.W., and Mazzotti, F.J., 2008. Burmese Pythons in South Florida: scientific support for invasive species management. EDIS. 2008 May 19;(4).

Heino, M., and Kaitala V. 1999. Evolution of resource allocation between growth and reproduction in animals with indeterminate growth. Journal of Evolutionary Biology 12:423–429.

Hoyer, I.J., Blosser, E.M., Acevedo, C., Thompson, A.C., Reeves, L.E. and Burkett-Cadena, N.D., 2017. Mammal decline, linked to invasive Burmese python, shifts host use of vector mosquito towards reservoir hosts of a zoonotic disease. Biology letters, 13(10), p.20170353.

Humane Society (https://www.humanesociety.org/sites/default/files/docs/constrictor-snake-attacks-factsheet.pdf).

Hunter, M.E., Johnson, N.A., Smith, B.J., Davis, M.C., Butterfield, J., Snow. R.W., and Hart, K.M., 2018. Cytonuclear discordance in the Florida Everglades invasive Burmese python (*Python bivittatus*) population reveals possible hybridization with the Indian python (*P. molurus*). Ecology and evolution 8, no. 17: 9034-9047.

Jacobs, H.J., Auliya, M. and Böhme, W., 2009. Zur taxonomie des dunklen tigerpythons, *Python molurus bivittatus* Kuhl, 1820, speziell der population von Sulawesi. Sauria, 31(3), pp.5-16.

Mazzotti, F.J., Cherkiss, M.S., Hart, K.M., Snow, R.W., Rochford, M.R., Dorcas, M.E. and Reed, R.N., 2011. Cold-induced mortality of invasive Burmese pythons in South Florida. Biological Invasions, 13(1), pp.143-151.

McCleery, R.A., Sovie, A., Reed, R.N., Cunningham, M.W., Hunter, M.E., and Hart, K.M., 2015. Marsh rabbit mortalities tie pythons to the precipitous decline of mammals in the Everglades. Proceedings of the Royal Society B: Biological Sciences, 282(1805), p.20150120.

Meshaka Jr, W.E., Loftus, W.F. and Steiner, T., 2000. The herpetofauna of Everglades National Park. Florida Scientist, pp.84-103.

Miller, M.A., Kinsella, J.M., Snow, R.W., Hayes, M.M., Falk, B.G., Reed, R.N., Mazzotti, F.J., Guyer, C. and Romagosa, C.M., 2018. Parasite spillover: indirect effects of invasive Burmese pythons. Ecology and evolution, 8(2), pp.830-840.

Miller, M.A., Kinsella, J.M., Snow, R.W., Falk, B.G., Reed, R.N., Goetz, S.M., Mazzotti, F.J., Guyer, C. and Romagosa, C.M., 2020. Highly competent native snake hosts extend the range of an introduced parasite beyond its invasive Burmese python host. Ecosphere, 11(6), p.e03153.

Murphy, J.C. and Henderson, R.W., 1997. Tales of giant snakes: a historical natural history of anacondas and pythons. Malabar, FL: Krieger Publishing Company.

Mutascio, H.E., Pittman, S.E., Zollner, P.A. and D'Acunto, L.E., 2018. Modeling relative habitat suitability of southern Florida for invasive Burmese pythons (*Python molurus bivittatus*). Landscape ecology, 33(2), pp.257-274.

Orzechowski, S.C., Frederick, P.C., Dorazio, R.M. and Hunter, M.E., 2019a. Environmental DNA sampling reveals high occupancy rates of invasive Burmese pythons at wading bird breeding aggregations in the central Everglades. PloS one, 14(4), p.e0213943.

Orzechowski, S., Romagosa, C.M., and Frederick, P.C., 2019b. Invasive Burmese pythons (*Python bivittatus*) are novel nest predators in wading bird colonies of the Florida Everglades. Biological Invasions 21, no. 7: 2333-2344.

Powell, R., Conant, R., and Collins, J.T., 2016. Peterson field guide to reptiles and amphibians of eastern and central North America. Houghton Mifflin Harcourt.

Pyron, R.A., Burbrink, F.T. and Guiher, T.J., 2008. Claims of potential expansion throughout the US by invasive python species are contradicted by ecological niche models. PLoS One, 3(8), p.e2931.

Reed, R.N. and Rodda, G.H., 2009. Giant constrictors: biological and management profiles and an establishment risk assessment for nine large species of pythons, anacondas, and the boa constrictor. US Department of the Interior, US Geological Survey.

Reed, R.N., Hart, K.M., Rodda, G.H., Mazzotti, F.J., Snow, R.W., Cherkiss, M., Rozar, R. and Goetz, S. 2011. A field test of attractant traps for invasive Burmese pythons (*Python molurus bivittatus*) in southern Florida. Wildlife Research, 38, pp.114-121.

Reed, R.N., Willson, J.D., Rodda, G.H. and Dorcas, M.E., 2012. Ecological correlates of invasion impact for Burmese pythons in Florida. Integrative Zoology, 7(3), pp.254-270.

Reed, R.N. and Snow, R.W., 2014. Assessing risks to humans from invasive Burmese pythons in Everglades National Park, Florida, USA. Wildlife Society Bulletin, 38(2), pp.366-369.

Richard, S.A., Tillman, E.A., Humphrey, J.S., Avery, M.L. and Parker, M.R., 2019. Male Burmese pythons follow female scent trails and show sex-specific behaviors. Integrative zoology, 14(5), pp.460-469.

Rodda, G.H, Sawai, Y., Chiszar, D., Tanaka, H. 1999. Problem snake management: The habu and brown treesnake. Cornell University Press.

Rodda, G.H., Jarnevich, C.S. and Reed, R.N., 2009. What parts of the US mainland are climatically suitable for invasive alien pythons spreading from Everglades National Park? Biological Invasions, 11(2), pp.241-252.

Rodda, G.H., Jarnevich, C.S., & Reed, R.N. 2011. Challenges in identifying sites climatically matched to the native ranges of animal invaders. PloS one. 6(2):e14670.

Rodgers, L., Mason, C., Kirkland, M., Brown, R., Quincy, K., Metzger, E., Tipping, P., Miller, M., Mazzotti, F., Funck, S., Peters, A., Bohaty, C., Lane, J., and Laroche, F. Draft 2021 South Florida Environmental Report, Chapter 7: Status of nonindigenous species. South Florida Water Management District. West Palm Beach, Florida. Available online at sfer_toc_v1.pdf (sfwmd.gov).

Rodgers, L. 2010. Adapted from Invasive Plants and Animals Policy Framework, State of Victoria, Department of Primary Industries.

Romagosa, C.M., Steury, T.D., Miller, M.A., Rogers, B., Angle, T.C., Gillette, R., and Guyer, C., 2011. Assessment of detection dogs as a potential tool for python detection efforts. Report to National Park Service – Everglades National Park and the South Florida Water Management District.

Schleip, W.D., and O'Shea, M., 2010. Annotated checklist of the recent and extinct pythons (Serpentes, Pythonidae), with notes on nomenclature, taxonomy, and distribution. ZooKeys, (66), p.29.

Smith, B.J., Rochford, M.R., Brien, M., Cherkiss, M.S., Mazzotti, F.J., Snow, S., and Hart, K.M., 2015. Largest breeding aggregation of Burmese Pythons (*Python bivittatus*) Kuhl 1820 (Squamata: Pythonidae) and implications for potential development of a control tool. Reptiles & Amphibians, 22(1), pp.16-19.

Smith, B.J., Cherkiss, M.S., Hart, K.M., Rochford, M.R., Selby, T.H., Snow, R.W., and Mazzotti, F.J., 2016. Betrayal: radio-tagged Burmese pythons reveal locations of conspecifics in Everglades National Park. Biological Invasions, 18(11), pp.3239-3250.

Smith, H.T., Meshaka, W.E., Engeman, R.M. Crosset, S.M., Foley, M.E., and Bush, G., 2006. Raccoon predation as a potential limiting factor in the success of the green iguana in southern Florida. USDA National Wildlife Research Center. Staff Publications. 448.

Snow, R.W., Brien, M.L., Cherkiss, M.S., Wilkins, L.A.U.R.I.E. and Mazzotti, F.J., 2007. Dietary habits of the Burmese python, *Python molurus bivittatus*, in Everglades National Park, Florida. Herpetological Bulletin, 101, p.5.

Snow, R.W., Krysko, K.L., Enge, K.M., Oberhofer, L., Walker-Bradley, A., and Wilkins, L., 2007. Introduced populations of *Boa constrictor* (Boidae) and *Python molurus bivittatus* (Pythonidae) in southern Florida. In: The Biology of Boas and Pythons (eds Henderson RW and Powell R), pp. 416– 438. Eagle Mountain Publishing, Eagle Mountain, Utah.

Snow, R.W., Wolf, A.J., Greeves, B.W., Cherkiss, M.S., Hill, R. and Mazzotti, F.J., 2010. Thermoregulation by a brooding Burmese Python (*Python molurus bivittatus*) in Florida. Southeastern Naturalist, 9(2), pp.403-405.

Sovie, A.R., McCleery, R.A., Fletcher, R.J., and Hart, K.M., 2016. Invasive pythons, not anthropogenic stressors, explain the distribution of a keystone species. *Biological Invasions*, *18*(11), pp.3309-3318.

Walters, T.M., Mazzotti, F.J. and Fitz, H.C., 2016. Habitat selection by the invasive species Burmese python in southern Florida. *Journal of Herpetology*, *50*(1), pp.50-56.

Willson, J.D., Dorcas, M.E. and Snow, R.W., 2011. Identifying plausible scenarios for the establishment of invasive Burmese pythons (*Python molurus*) in Southern Florida. *Biological Invasions*, *13*(7), pp.1493-1504.

Willson, J.D., Snow, R.W., Reed, R.N. and Dorcas, M.E., 2014. *Python molurus bivittatus* (Burmese python). Minimum size at maturity. Herpetological Review, 45(2), pp.343-344.

Willson, J.D., 2017. Indirect effects of invasive Burmese pythons on ecosystems in southern Florida. Journal of Applied Ecology, 54(4), pp.1251-1258.

Wolf, A.J., Walters, T.M., Rochford, M.R., Snow, R.W. and Mazzotti, F.J., 2016. Incubation temperature and sex ratio of a *Python bivittatus* (Burmese Python) clutch hatched in Everglades National Park, Florida. Southeastern Naturalist, 15(sp8), pp.35-39.

APPENDIX A: PATHWAY TO A FLORIDA PYTHON CONTROL PLAN

Python control efforts have been undertaken by land managers and partners since the mid-2000s. Inter- and intra-organizational meetings held to address the Burmese python invasion in Florida are listed below. The culmination of these meetings led to the initiative to develop a collaborative Florida Python Control Plan. Meeting objectives and details are provided for each workshop.

2004 – 2009 Everglades Invasive Species Summit

- The South Florida Ecosystem Restoration Task Force created the Florida Invasive Animal Task Team (FIATT) in 2003 to focus on invasive animal issues as part of Everglades restoration (Ferriter et al. 2005).
- Invasive reptile specialists were invited to the first annual Everglades invasive species coordination meeting in 2004 (SFWMD and DOI) where they discussed coordination on the emerging issue of Burmese pythons.
- The invasive species coordinating body, mandated by the Everglades Forever Act, expanded to an all-taxa invasive species group (previously focused solely on invasive plants) at the July 2006 Everglades Invasive Species Summit in BICY.
- The Summit resulted in the creation of the Everglades Cooperative Invasive Species Management Area (ECISMA).

2008 – 2009 Multi-stakeholder Python Action Workshops

- Three workshops were sponsored by the USFWS South Florida Ecological Services Office to coordinate interagency action among multiple partners and to provide a common base for funding requests.
- Workshops took place in South Florida in 2008 and 2009. Updates were provided by partners on the current python distribution and science in support of control efforts including trapping design and deployment results, baiting/pheromone testing, and the EDRR Python Patrol program sponsored by The Nature Conservancy in the Florida Keys.
- Workshop objectives included building upon management, research, and outreach efforts already completed for pythons and identifying future priority actions.
- Results of the workshop included detailed narratives outlining priority needs for python management in regard to planning, assessment (monitoring), control, research, and public awareness.

2012 Python Management Meeting

- The Rookery Bay National Estuarine Research (RBNER) staff hosted the Python Management meeting in September 2012 at Rookery Bay Environmental Learning Center and included wildlife professionals (primarily state and federal employees) working on python issues throughout Florida.

- The primary objectives were to share information on python invasion and improve python management in the region to protect native biodiversity while mitigating impacts of python on protected lands in Southwest Florida.
- The meeting resulted in the centralization of efforts in the area to be led by the SWCISMA.

2013 Python Interagency Executive Leadership Workshop
- The Python Interagency Executive Leadership Workshop took place January 2013 at the Miccosukee Tribal Resort.
- The primary goal was to present collective knowledge to agency leadership resulting in better coordination and determination of next steps.
- The result was involvement by OERI to create a Strategic Action Framework.

2013 Interagency Large Constrictor Workshop
- The Interagency Large Constrictor Workshop took place November 2013 at the Krome Center in Miami-Dade County and was hosted by EVER and USGS.
- This was a four-day workshop with the last two days dedicated for federal partners due to Federal Advisory Committee Act (FACA) restrictions.
- Goals for the workshop were to summarize science related to management and determine priorities for future scientific and management steps.

2014 Structured Decision-Making Workshop
- In June 2014, a Structured Decision-Making Workshop was held at the National Conservation Training Center, Shepherdstown, WV. This workshop was hosted by the USFWS.
- The workshop was held in response to the threat of pythons in Arthur R. Marshall Loxahatchee National Wildlife Refuge (LOX).
- The goal of the workshop was to help LOX utilize resources, surveil for, and control Burmese pythons, and minimize ecological damage in the Refuge.
- The workshop resulted in a summary white paper of the workshop, reaction diffusion modeling that has been used to help model spread of pythons, and management and research recommendations for LOX.

2017 Workshop for Ongoing Python Research
- The Workshop for Ongoing Python Research was held March 2017 at Long Key Nature Center and was hosted by FWC and EVER.
- This workshop brought land managing partners together with researchers to provide updates on research and management practices.
- During the meeting participants discussed detection and management tools, current python control and management efforts, future actions, and development of Florida Python Control Plan.
- This workshop marks the initial step in laying the foundation for a statewide python control plan.

2017 Python Science Synthesis Working Group

> The Python Science Synthesis Working Group was held August 2017 at UF FLREC in Davie and was hosted by USGS.

- The goal of the working group was to publish a collaborative manuscript synthesizing existing research on Burmese pythons in Florida and to identify future research priorities
- This endeavor is in progress.

2017 Python Management Plan Workshops

- The Python Management Plan Workshops took place during November 2017 and consisted of seven public workshops hosted by the FWC across southern Florida.
- The objective of the workshops was to obtain public feedback on python management issues in South Florida, specifically, the development of a FPCP.
- These workshops resulted in the opportunity for the public to share input, learn about python invasion, and the impacts of this invasive species.

Partners participating in development of the Florida Python Control Plan. Photo: FWC

2019 – 2021 Florida Python Control Plan

- The initial meeting of the Florida Python Control Plan was held in April 2019 in Fort Lauderdale, FL and was hosted by the FWC and the NPS.
- Subsequent meetings of the FPCP were planned to be held quarterly over an approximately 2-year period.
- Objectives of the FPCP workshops were to create a statewide plan developed by federal, state, local, tribal, and NGO land managing partners to manage pythons that will coordinate management goals, objectives, and actions so that efforts and projects complement those of partners.
- The result of the FPCP is to be used as a guide for managers to employ a unified approach to managing the python invasion across a diverse and varied geopolitical landscape.

APPENDIX B: ASSOCIATED FEDERAL AND STATE REGULATIONS

- On June 23, 2006, the U.S. Fish and Wildlife Service received a petition from the South Florida Water Management District requesting that Burmese pythons be considered for inclusion in the injurious wildlife regulations under the Lacey Act (18 U.S.C. 42, as amended). The District was concerned about the number of Burmese pythons found in Florida, particularly in Everglades National Park and on the District's widespread property in South Florida.

- On January 31, 2008, as a result of the petition from the SFWMD, the USFWS published a notice of inquiry in the Federal Register (73 FR 5784) soliciting available biological, economic, and other information and data on *Python*, *Boa*, and *Eunectes* genera for possible addition to the list of injurious wildlife under the Act and provided a 90-day public comment period.

- On July 1, 2008, the Florida legislature passed changes to §379.372, Florida Statutes (F.S.), which tasked the FWC with creating a list of Reptiles of Concern (ROC), that included Burmese pythons and required people in possession of those reptiles to obtain a license.

- On October 23, 2008, the FWC passed rules to create the Exotic Pet Amnesty Program in Chapter 68-5, F.A.C. These rules provide amnesty for people surrendering unlawfully possessed fish or wildlife to the FWC. This new program allows pet owners to surrender regulated animals without penalty as an alternative to releasing them into Florida or trying to sell them without a license. Surrendered animals are placed with pre-qualified, appropriately licensed adopters at no cost to the owner.

- In July 2009, the FWC began the Python Removal Permit (PRP) program that allowed pythons to be removed on certain state-managed lands. The PRP allowed qualifying individuals to take Burmese pythons under a set of guidelines and conditions outlined in the permits. The PRPs required permittees to report the location and date of capture to FWC, allowing the FWC to collect data on python captures. This program was a partnership between reptile enthusiasts and the FWC.

- In fall 2009, FWC began allowing hunters to remove Burmese pythons from four Wildlife Management Areas (WMAs): Everglades and Francis S. Taylor; Holey Land; Rotenberger; and Big Cypress. Hunters with appropriate licenses and permits could remove Burmese pythons from these four WMAs during open hunting seasons. A Conditional Reptiles Season was also developed in three of these management areas when Burmese pythons and other Conditional reptile species could be lethally removed.

- On July 1, 2010, the Florida Legislature passed amendments to §379.372, F.S., which listed several nonnative species as ROCs (Burmese python, reticulated python, Northern African

python, Southern African python, amethystine/scrub python, green anaconda, and Nile monitor). The new language allowed for limited possession by licensed individuals and included grandfathering provisions for people in possession of the listed species as pets prior to their listing as a ROC. The legislation disallowed any further acquisition of these animals as personal pets. People with grandfathered pets were authorized to keep their animals for the life of the individual animals. No animals obtained after this date were eligible to be possessed as grandfathered pets.

- In August 2010, the FWC passed regulations to clarify the new possession requirements outlined in §379.372, F.S. This included moving Burmese pythons and the other ROCs to the state's Conditional species list. Under the FWC's rules in Chapter 68-5, Florida Administrative Code (F.A.C.), the possession of Conditional species is limited to qualifying facilities for commercial import/export, public educational exhibition, and research use. A permit is required to possess any Conditional species for these qualifying use types. Conditional species permit applicants must meet strict containment requirements and pass inspection prior to permit issuance. Burmese pythons and other Conditional species must also be marked with a passive internal transponder (PIT) tag and the facility must meet specific recordkeeping and reporting requirements.

- On January 23, 2012, the USFWS listed the Burmese python, Northern and Southern African python, and the yellow anaconda as injurious wildlife under the Lacey Act. This change prohibited the importation and interstate movement of the listed species into Florida and the rest of the United States, except by permitted entities in limited circumstances. This listing impacted the Burmese python trade in Florida, as breeders had been predominantly selling out of state because possession of pythons as personal pets in Florida was prohibited since their listing as a Conditional species and people with grandfathered pets could not obtain any new pythons beyond their individual grandfathered animals.

- In 2013, 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 mentioned below to the lawsuit) in which the USFWS designated the Burmese python, Northern African python, Southern African python, reticulated python, green, yellow, Beni, and DeShauensee's anacondas as injurious wildlife under the Lacey Act.

- On April 9, 2015, the USFWS added the Beni anaconda, DeSchauensee's anaconda, green anaconda, and reticulated python to the injurious wildlife list under the Lacey Act.

- On March 23, 2017, the FWC's Executive Director signed Executive Order 17-10 allowing South Florida Water Management District contractors to take Burmese pythons and Northern African pythons on Southern Glades Wildlife Environmental Area, Frog Pond Public Small Game Hunting Area, and Rocky Glades Public Small Game Hunting Area.

- On March 31, 2017, the FWC's Executive Director signed Executive Order 17-11, allowing the take of nonnative reptiles on 22 FWC-managed Wildlife Management Areas (WMA), Public Small Game Hunting Areas (SGA), and Wildlife and Environmental Areas (WEA) in southern Florida. This effort was aimed at removing perceived barriers to the lethal take of nonnative reptiles on the included public lands. The order allows nonnative reptiles to be taken at any time throughout the year except by use of firearm (unless provided for by specific area regulation) and traps. The order does not allow for live transport of Conditional, Prohibited, or any other species requiring a permit for possession from the listed areas; a permit is still required for live transport and possession of Burmese pythons and other Conditional or Prohibited species.

- In April of 2017, a District of Columbia Circuit Court overturned the interpretation of certain provisions of the federal Lacey Act related to injurious wildlife regulation. Following this court ruling, the importation of injurious wildlife species into the United States from another country is still prohibited, except by permit from the USFWS. However, 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 wildlife is restricted by previously issued permits. The Federal court ruling had many implications for Florida as it removed protections to Florida that had been in place for over 30 years.

- In October 2018, the FWC stopped issuing Python Removal Permits to members of the public. These permits previously authorized collection and transport of live Burmese pythons from three FWC-managed areas in southern Florida; Everglades/Francis S. Taylor WMA, Holey Land WMA, and Rotenberger WMA. Due to extremely low reported permit use (only 1 python was reported as being transported under a valid permit in the year preceding this decision), the FWC discontinued the program except for limited cases for Cooperative Invasive Species Management Area cooperators and government agency employees transporting live pythons as a part of their required job duties. Members of the public can still take pythons using lawful means and with landowner permission, but pythons must be humanely killed at the site of capture rather than being transported alive.

- On December 27, 2018, a reorganization of the FWC's nonnative species rules in Chapter 68-5, F.A.C., went into effect. The new chapter structure provided improved clarity and streamlining of the rules related to nonnative species, Conditional species, Prohibited species, the Exotic Pet Amnesty Program, and lionfish.

- On May 2, 2019, amendments to the FWC's nonnative species rules in Chapter 68-5, F.A.C., went into effect. These new rules provided definitions for terms used in the chapter, including those applicable to qualifications for permits to possess Burmese pythons. The amendments also added the injurious birds, mammals, and reptiles originally regulated in FWC Executive Order 18-46 to the state's Prohibited species list,

created limited grandfathering language for those species, and provided a 90-day grace period for people to come into compliance with the new rules.

- On May 28, 2020, the FWC's Executive Director signed Executive Order 20-17, expanding the allowance of take of nonnative reptiles on additional FWC-managed WMAs, SGAs, and WEAs in southern Florida.

- On July 1, 2020, changes in Florida Statue 379.372 went into effect that further restricted possession of Burmese pythons in trade.

- In July 2020, the Florida Chapter of the United States Association of Reptile Keepers initiated a lawsuit (Florida vs. FWC in the Florida Circuit Court). The premise was whether the legislature has the authority to pass regulations on wildlife.

- On July 24, 2020, FWC staff proposed draft rules changes to address the statutory changes in July 2020 that approved was by the Commissioners. This draft language recommended moving Burmese pythons and the other species of snakes and lizards on the Conditional list to the Prohibited List. This change would no longer allow the commercial breeding and sale of these species.

- On August 27, 2020, the Circuit Court found that changes made by the Florida Legislature to Florida Statue 379.372 were inconsistent with FWC rules/regulations pertaining to invasive reptiles and therefore unconstitutional and unenforceable. The Court recognized that FWC has the authority to adopt whatever reasonable rules it wants pertaining to wildlife resources in the state, irrespective of the unconstitutional ruling by the Court. The summary judgment was filed and became effective September 24, 2020.

- On February 25, 2021, FWC Commissioners approved rules further addressing the importation, breeding, and possession of high-risk invasive reptiles. Approved rule changes to Chapter 68-5, F.A.C. address Burmese pythons, Argentine black and white tegus, green iguanas, and 13 additional species of high-risk nonnative reptiles that threaten Florida's native wildlife, economy, and human health and safety. These 16 species were added or moved to the Prohibited species list which restricts importation, possession, and transfer of these species, increases reporting requirements for permittees, increases biosecurity requirements, and prohibits acquiring these reptiles to be kept as pets or for commercial sale, with limited exceptions. These rules went into effect on April 29, 2021.

APPENDIX C: DRAFT WORKGROUP OPERATING PRINCIPLES AND 2021 WORKPLAN

PURPOSE OF THIS APPENDIX

Participants in development of the FPCP created the materials in this appendix to expedite the establishment of the Workgroup recommended in the Implementation section of the plan, and to help that Workgroup begin work quickly and efficiently. The materials also provide a sense of the expected scope and the character of Workgroup activity during its first year.

These materials are not official Workgroup Operating Principles or a 2021 Workplan until the Workgroup reviews, refines and adopts them during its first year of operation. Agreement to adopt the plan or serve on the Workgroup does not imply a legally binding commitment for any organization, nor is the FPCP a legally binding document.

INITIAL WORKGROUP CONVENING

Within the first month of the FPCP being finalized, The initial meeting of the Workgroup will be facilitated by the Florida Fish and Wildlife Conservation Commission.

INITIAL MEMBERSHIP

Any organization that participated in the development of the FPCP may participate as a member of the Workgroup during its first year by submitting to the four convening entities a letter of intent or a written request similar to a letter of intent to do so.

Teams will be designated by the Workgroup with the intention of focusing specific themes within the FPCP.

Workgroup and Team members agree to:

- Participate in Workgroup and Team meetings and discussions as appropriate;
- Engage with the perspectives and priorities of other Workgroup and Team members and exchange information to develop jointly supported approaches to python control; and
- Work together in the implementation of projects and approaches, consistent with their respective missions, authorities, and resources.

The Workgroup will review and refine membership guidelines as it deems useful after its first year of existence.

INITIAL OPERATING PRINCIPLES

PRINCIPLE 1 – PURPOSE OF THE WORKGROUP

The Workgroup and its Teams will serve as a collaborative forum for developing strategies, projects, and measures to implement the FPCP. This may entail:

- Identifying and building support for implementation strategies, projects, or measures;
- Coordinating support for member efforts;
- Exchanging, discussing, and disseminating information; and
- Sequencing or prioritizing implementation efforts where necessary.

PRINCIPLE 2 – ANNUAL PRODUCTS

The Workgroup will develop the following items yearly:

- An Action Plan, addressing the theme sections of the FPCP, including a list of supported or priority projects for that year and improvements/enhancements to existing programs or new tasks for upcoming years.

- A yearly report of progress towards achieving the goals, strategies, and recommendations of the FPCP.

- The Workgroup may develop other products, as it deems useful.

- The Workgroup may choose to update the FPCP as it deems necessary.

PRINCIPLE 3 –MEMBERSHIP

The Workgroup meetings will be facilitated by the Florida Fish and Wildlife Conservation Commission. The Workgroup may modify this principle as it deems useful.

Initial Workgroup membership will be open to all 15organizations that participated in development of the FPCP. The Workgroup may revise membership guidelines after its first year.

PRINCIPLE 4 – TEAMS

The Workgroup may establish Teams as needed to collaborate on addressing specific issues or sets of issues, and to develop or enhance recommended projects or measures consistent with the FPCP, to be considered by the Workgroup for inclusion in the yearly Action Plan. 2021 Teams will include at a minimum the following, consistent with the theme sections of the FPCP:

- Policy and Regulations
- Control and Monitoring

- Research
- Communication

INITIAL WORKPLAN

All dates are estimates based on completion of the FPCP by June 1, 2021. Schedules for subsequent years should begin in January.

While Workgroup work is not focused on legislative action, meetings should be timed to allow entities participating on the Workgroup to consider on-going Workgroup discussions and work in their budgetary requests.

WORKGROUP MEETING 1 – Summer 2021

- Review and refine 2021 membership structure, workplan, and operating principles
- Adopt schedule for 2021 Workgroup meetings
- Review 2021 Action Plan prepared by the FPCP Team
- Identify coordination needed to continue implementation of 2021 Action Plan
- Identify issues to be addressed in developing 2022 Action Plan
- Establish and charge Teams

Teams – Between Workgroup Meetings

- Coordinate and collaborate to continue implementation of 2021 Action Plan, including early establishment of the Python Portal
- Begin to develop potential recommendations to the Workgroup for 2022 Action Plan items

WORKGROUP MEETING 2 – September/October 2021

- Confirm initial membership structure, workplan, and operating principles
- Discuss on-going implementation of the 2021 Action Plan, and identify items needing additional support or implementation assistance from the Workgroup or Workgroup members
- Review and refine preliminary 2022 Action Plan recommendations identified by Teams

Teams – Between Workgroup Meetings

- Coordinate and collaborate to continue implementation of 2021 Action Plan
- Refine potential 2022 Action Plan recommendations to the Workgroup in response to Workgroup input

WORKGROUP MEETING 3 – November/December 2021

- Discuss on-going implementation of the 2021 Action Plan, and identify items needing additional support or implementation assistance from the Workgroup or Workgroup members
- Review potential 2022 Action Plan recommendations revised by Teams in response to Workgroup Meeting 2 feedback
- Confirm items to be included in 2022 Action Plan
- Develop draft priorities, if appropriate

Teams – Between Workgroup Meetings

- Coordinate and collaborate to continue implementation of 2021 Action Plan
- Revise 2022 Action Plan recommendations to the Workgroup, as needed

WORKGROUP MEETING 4 – January 2022

- Revise as necessary and confirm 2022 Action Plan
- Develop draft priorities, if appropriate
- Review and revise annual report of progress toward FPCP implementation

Teams – Between Workgroup Meetings

- Coordinate to continue implementation of 2021 Action Plan
- Begin identification of 2022 Action Plan items in response to Workgroup input

APPENDIX D: DRAFT 2021 ACTION PLAN

This appendix identifies only activities and projects that organizations participating in development of the FPCP were implementing or had committed to as the FPCP was finalized, and that contribute to the implementation of the FPCP recommendations.

The appendix provides a sense of the initial range of projects and activities that could realistically be a focus of Workgroup coordination and collaboration as the Workgroup begins work in 2021, even before it independently begins development of its 2022 Action Plan.

PLEASE NOTE: The FPCP participants initiated development of this appendix after other portions of the FPCP were substantially complete. **AS OF JUNE 1, 2021 THE MATERIAL IN THIS APPENDIX IS INCOMPLETE, AND STILL UNDER REVIEW AND FURTHER DEVELOPMENT BY THE WORKGROUP**.

Policy and Regulations

Table 10. Goals, Strategies, and Recommendations for Policy and Regulations Action Plan

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Goal 1: Implement or enhance policies and regulations that reduce the likelihood of future python release or introduction to limit population size and spread.					
Strategies and Recommendations					
Strategy 1.1: Develop regulations that further restrict possession of pythons or breeding of pythons and improve safeguards to prevent	• Propose draft rules to move Burmese pythons to the Prohibited species list. The proposed language is still	• FWC	• Complete		

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
escape and introduction.	being developed but would result in more restrictive regulations for the possession of Burmese pythons. Expect implementation in 2021 if adopted.				
Recommendation 1.1.1: Evaluate penalty structure for illegal possession or other activities with Burmese pythons and identify areas where it could be strengthened.	• The penalty structure is set by the Florida Legislature in state statutes. Many of the relevant penalties for python-related issues are set forth in Sections 379.4015 and 379.401, Florida Statutes.	• FWC, SFWMD with legislature	• Ongoing		
Recommendation 1.1.2: Evaluate the potential for adding requirements to possess Burmese pythons that may	• Propose draft rules that might cover some of this. Expected to be partially	• FWC	• Ongoing		

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
include requiring Continuing Education Units, training, bond insurance similar to venomous reptiles, or sterilization for pythons imported or possessed for exhibition in Florida.	addressed in 2021.				
Recommendation 1.1.3: Strengthen Rule 68-5 F.A.C. as it pertains to Burmese pythons in Florida to further limit possession and reduce likelihood of additional introductions.					
Recommendation 1.1.4: Promote and expand the Exotic Pet Amnesty Program to ensure this alternative to releasing pythons into the wild in Florida is known and understood by the public.	• No expansions are planned in 2021, but plan to continue efforts at current level.	• FWC, SFWMD,NPS, USFWS			
Recommendation 1.1.5: Identify gaps in	• Propose draft rules that partially	• FWC	• Partial – ongoing	• Ongoing	• Ongoing,

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
current regulations that are not clear and provide recommendations on potential regulatory changes to agency leadership for potential adoption.	address recommendation 1.1.5 in 2021.				
Recommendation 1.1.6: Proactively coordinate with adjacent states and federal government on developing regulations to work toward consistent rules and policies that limit possession and risk of escape within the full extent of the python potential range. 1.1.6.1: Coordinate with partnering organizations like the Association of Fish and Wildlife Agencies (AFWA) to coordinate with adjacent states to stay updated and coordinated on					

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
intentional movement or emigration of pythons to other states and enforcement actions. 1.1.6.2: Routinely coordinate with USFWS regarding regulations and enforcement actions.					
Strategy 1.2: Adopt policies to increase enforcement of current and future laws to reduce the volume of illegal activity with Burmese pythons.					
Recommendation 1.2.1: Foster collaboration among natural resource workers and FWC, NPS, USFWS, Tribal and local Law Enforcement to provide training and coordination on management actions and enforcement issues.	• Host an annual meeting with partners and LE, planned in partnership with all agencies.	• FWC, SFWMD, NPS, FFS, Rookery Bay NERR, other	• Ongoing	• Ongoing	• Ongoing

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Recommendation 1.2.2: Provide training opportunities to collaborate on current regulations and restrictions and programs that are addressing pythons on public conservation lands.	• Coordinate with LE regularly. FWC has held several internal webinars specifically for LE on proposed rule changes.	• FWC, SFWMD, NPS, FFS, Rookery Bay NERR, other	• Ongoing	• Ongoing	• Ongoing
Recommendation 1.2.3: Work with law enforcement agencies to identify priority patrol areas where patrol efforts could be focused.	• This is done throughout the year re: PATRIC and Python Challenge especially.	• FWC, SFWMD, NPS, FFS, other	• Ongoing	• Ongoing	• Ongoing
Recommendation 1.2.4: Collaborate with law enforcement and State Attorneys to successfully prosecute illegal activity pertaining to pythons.	• Currently work with LE on enforcement issues continue to build better communication and coordination on those efforts.	• FWC, NPS, SFWMD	• Ongoing		
Recommendation 1.2.5: Encourage citizens to report illegal activity/violations through rewards,	• Promote reporting illegal activities through PATRIC	• FWC	• Ongoing	• Ongoing	• Ongoing

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
educational programs, and promoting the Wildlife Alert system.	• Encourage contractors to call Wildlife Alert if they see something illegal in field				
Recommendation 1.2.6: Quantify enforcement costs and ensure they are included when evaluating management methods such as recreational removal and commercialization that require 'checks and balances' to meet python management goals.					
Goal 2: Encourage and facilitate python removal and reporting to advance python control efforts.					
Strategies and Recommendations					
Strategy 2.1: Facilitate python removal by the public.					
Recommendation 2.1.1: Provide policies and rules for the public to take immediate action when	• FWC currently has EO 20-17 • NPS now has decision allowing contractors and	• FWC, SFWMD, NPS, FFS	• Partial, ongoing	• FWC may expand areas of access for public.	• FWC may expand areas of access for public. TBD

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
encountering a python that are well-publicized and easy to understand and follow. 2.1.1.1: Seek regulatory exceptions for pythons (on an agency-basis; not property-basis) for lands where removing wildlife is not allowed. 2.1.1.2: Work to remove obstacles to python removal by the public. 2.1.1.3: Adopt reporting requirements for removals to allow data collection and evaluation that will inform management.	volunteers to keep pythons captured				
Recommendation 2.1.2: Evaluate or assess python removal by the public to guide education, outreach, and training that will increase safe removal and reporting by the public.					

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Strategy 2.2: Identify and evaluate incentives to private citizens, landowners, or private contractors to implement python control that include safeguards to prevent release, illegal breeding, spreading of pythons across Florida or otherwise encourage other illegal (or detrimental) activities for profit.					
Recommendation: 2.2.1: Explore potential incentives to encourage private landowners to control pythons on their properties.	• FWC has the Python Pickup program currently • CSWF has Python Pickup Service in Collier County	• FWC, CSWF	• Partial, ongoing	• Ongoing	• Ongoing
Recommendation: 2.2.2: Evaluate food and python product commercialization and regulate as appropriate working with Florida Department of Agriculture and	• FWC and SFWMD are currently working on evaluating mercury to assess safety for human consumption.	• FWC, SFWMD	• Ongoing		

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Consumer Services (FDACS). 2.2.2.1: Develop a strategy and clear criteria for measuring effectiveness (and risk) of commercialization. 2.2.2.2: Determine how to monitor and limit commercialization of python products, if necessary, to support python management goals. 2.2.2.3: Evaluate need for and apply health advisories consistent with policy to inform use of pythons for food due to potentially high mercury levels.					
Recommendation: 2.2.3: Clarify what commercial activities are allowed under different jurisdictions such as National Park Service, State Parks, National Wildlife Refuges, state	• SFWMD and NPS have defined what they consider as prohibited commercial activities				

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
conservation lands, or private lands, including areas where harvest for python products and commercial activities such as tours, etc. can occur. 2.2.3.1: Evaluate impact of only allowing commercial activities to occur on some properties within the python range. 2.2.3.2: Consider feasibility of modifying regulations to increase uniformity in allowed commercial use.					
Recommendation 2.2.4: Develop and update a policy statement on recommendations for commercialization, incentivization, and/or compensation for python removal.	• Policy and Regulations Team should be created	• FWC, SFWMD, USFWS, NPS, Other	• Ongoing	• Policy and Regulations Team meeting	• Policy and Regulations Team meeting
Strategy 2.3: Explore the potential for development of				• TBD based on budget	

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
professional python removal small business contractor entities (as opposed to individual contractors).					
Recommendation 2.3.1: Explore developing professional python contractor entity that can be tasked to achieve particular management actions (small business grants, etc.).					
Recommendation 2.3.2: Explore contracted entity to provide oversight of contractor program as an alternative to agency-managed programs.					
Strategy 2.4: Formally and regularly evaluate python removal programs against standards of cost-effectiveness and support for	• FWC and SFWMD have tasked UF with evaluating current contractor python data	• FWC, SFWMD, CSWF	• Ongoing	• FWC and SFWMD have tasked UF with evaluating contractor python data	

108

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
management objectives.	• CSWF has evaluated trapping and is continuing to evaluate telemetry and other methods				
Recommendation 2.4.1: Develop methods to determine or evaluate cost/benefit of incentivized removal compared to other management tools.					
Recommendation 2.4.2: Eliminate or curtail efforts that are not effective or poorly support python management goals.					
Goal 3: Align python removal policies and regulations to be consistent across jurisdictions where possible, and clearly communicated to other stakeholders and the public to limit confusion and maximize efficiency.					
Strategies and Recommendations					
Strategy 3.1: Improve communication of laws and policies to provide clarity to the public regarding removal, possession, and					

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
transportation of pythons.					
Recommendation 3.1.1: Identify where allowances and laws are confusing and review current rules and regulations to identify areas that could be addressed.	• FWC currently engaging stakeholder focus groups for new regulations	• FWC	• Partial		
Recommendation 3.1.2: Provide policy and regulation information using clear language in accessible formats and reinforce in public training materials. 3.1.2.1: Provide information to the public in multiple platforms. 3.1.2.2: Provide multi-lingual information in, at a minimum, Spanish/English.	• Workgroup/ Communication Team should start discussing python portal website in 2021	• FWC, SFWMD, FFS, others	• Ongoing	• Ongoing	• Ongoing
Recommendation 3.1.3: Provide updates to policies and regulations across					

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
platforms and ensure rules are current on all platforms.					
Strategy 3.2: Develop and maintain agreements that support stakeholder collaboration on python management.	• FWC, SFWMD and NPS have an agreement on python removal programs • FWC, DEP and FFS also have agreement in place • FWC is part of the ECISMA MOU • CSWF has agreements with Big Cypress and MOUs with private landowners	• FWC, SFWMD, NPS, FFS. CSWF	• Ongoing	• FWC and SFWMD and NPS have an agreement on python removal programs • FWC, DEP and FFS also have agreement in place • FWC is part of the ECISMA MOU	• FWC and SFWMD and NPS have an agreement on python removal programs • FWC, DEP and FFS also have agreement in place • FWC is part of the ECISMA MOU
Recommendation 3.2.1: Develop agreements to better align procedures and support science.	• FWC, SFWMD, NPS, FFS, pursue this through contractor program	• FWC, SFWMD, Rookery Bay NERR, FFS, CSWF, others	• Partial		
Recommendation 3.2.2: Develop agreements to promote access.	• NPS, FFS, CSWF will work to expand access				

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Recommendation 3.2.3: Develop agreements to share resources and provide support.	• SFWMD, FWC, NPS, FFS and others are advancing the ECISMA MOU	• SFWMD, FWC, NPS, FFS, CSWF, others	• Partial		
Goal 4: *Clarify and streamline policies and regulations governing research projects and permitting to facilitate research that can aid in improved python control.*					
Strategies and Recommendations					
Strategy 4.1: Clarify agency permitting permit issuance criteria, timelines, and considerations for researchers and to the degree possible align research priorities, areas of regulatory concern related to python research, and permit conditions so that these are as consistent as possible across agencies and address priority concerns.	• FWC is currently working on this • FWC works with stakeholders to collect recommendations for any permitting criteria that is put into rule	• FWC, NPS, Rookery Bay NERR	• Ongoing		

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Strategy 4.2: Ensure that permitting agencies have clear research project permit application requirements that are communicated on their website and on the application to help disseminate this information to potential researchers interested in developing research projects in Florida on pythons.	• FWC is currently working on this and continually working to provide the best information possible on applications and webpages	• FWC	• Ongoing		
Strategy 4.3. Simplify, coordinate, and streamline reporting requirements for research projects.					
Recommendation 4.3.1: Permitting agencies coordinate to remove redundant reporting requirements.					
Recommendation 4.3.2: Make permitting fulfillment reports from					

Goals, Strategies, and Recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
researchers available across agencies, as allowable (reports to funding agencies and reports to permitting agencies).					

Control and Monitoring

Table 11. Goals, Strategies, and Recommendations for Control and Monitoring Action Plan

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Goal 1: Prevent the expansion of the python population to areas outside of the known, established range, focusing on areas most vulnerable to impacts.					
Strategies and Recommendations					
Strategy 1.1: Develop comprehensive Early Detection/Rapid Response (EDRR) strategy to increase efficiency of detection and removal of incipient populations, especially on priority conservation lands.	• FWC has EDRR capacity • FWC contractor program has access to many edge areas of known range and will be expanding available contractor survey	• FWC, SFWMD, NPS, USFWS Refuges, and other partners on their lands	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
	areas into Rookery Bay • FWC may have Detector Dog team search some of these edge range areas and sensitive habitats (i.e., bird rookeries)				
Recommendation 1.1.1: Work with land managers and researchers to characterize the python population in South Florida in a standardized way (e.g., the South Florida Environmental Report 'stop light' format and/or the invasion curve), delineate the leading edge of the python invasion and identify priority lands just outside of the established range where efforts may be prioritized.	• SFWMD is currently funding an eDNA project • FWC PATRIC and SFWMD PEP offer "premium pay" for contractors conducting surveys along fringe of known range	• SFWMD	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
1.1.1.1: Obtain from, or work with researchers to create site prioritization tool to characterize lands where EDRR should be a priority. 1.1.1.2: Prioritize removal on population boundaries (including urban areas) and identify and take measures to protect non-impacted, sensitive lands.					
Recommendation 1.1.2: Create monitoring guidelines that include the use of innovative technologies along with existing reporting and monitoring programs (e.g., EDDMapS and the UF Everglades Invasive Reptile and Amphibian Monitoring Program (EIRAMP)) to monitor	• FWC has EDRR policies in place and operates the 888-IVEGOT1 hotline, SFWMD, NPS and other agencies have EDRR capacity on their lands	• FWC, SFWMD, NPS	• Partial, ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
along the leading edge of the invasion on public and private lands in urban, suburban, and rural areas where possible.					
Recommendation 1.1.3: Maintain, expand, and improve existing detection and reporting tools and response capabilities: FWC Exotic Species Reporting Hotline and EDDMapS/IveGot1.org. 1.1.3.1: Expand agency response capability by further developing responder network utilizing staff from partner organizations, the paid contractor programs, volunteer authorized agent, and other volunteer programs. 1.1.3.2: Utilize and expand the use of innovative tools to aid or improve python	• FWC maintain FWC Exotic Species Reporting Hotline, and IVEGOT1 website with UGA • Start utilizing near infrared cameras • Utilizing detector dog team, rapid response capability – NPS, SFWMD on their lands	• FWC	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
detection and removal outside of the established population (e.g., infrared-equipped UAS, detector dog program, etc.)					
Recommendation 1.1.4: Improve efforts/abilities to conduct EDRR on private lands/urban interface with landowner collaboration and approval.	• FWC responds to EDRR calls on private lands	• FWC	• Ongoing	• Ongoing, SFWMD, NPS and other agencies may assist	• Ongoing
Goal 2: Reduce and contain the established python population and protect sensitive areas and areas of high ecological value.					
Strategies and Recommendations					
Strategy 2.1: Improve upon and further develop current python removal programs and control tools.					
Recommendation 2.1.1: Use integrated pest management approach to combine tools, techniques, and technologies according to the season,				• FFS plans to add this	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
characteristics of area and effectiveness to improve detection and increase removal of pythons 2.1.1.1: Work with researchers to develop metrics for control effectiveness. 2.1.1.2: Develop Control Matrix to easily communicate different techniques that may be used to remove pythons under different temporal and spatial conditions to public and private landowners.					
Recommendation 2.1.2: Strategically utilize paid python removal contractor and volunteer programs. 2.1.2.1: Continue to improve efficacy of all programs by incorporating input from university/research	• FWC, SFWMD will maintain their contractor program and expand available search areas • FWC provides its contractors with the necessary tools • FWC, SFWMD will maintain its	• FWC, SFWMD	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
partners regarding both the effectiveness and potential negative impacts of different strategies and directing efforts appropriately. 2.1.2.2: Expand contractor access to appropriate public lands in South Florida (e.g., Counties, State Parks, etc.) as recommended by land managers and contract managing agencies. 2.1.2.3: Increase number of contractors working across landscape, as recommended by land managers and contract managing agencies. 2.1.2.4: Increase number of authorized agents on NPS lands, as recommended by NPS staff and land managers and considering limits from compliance.	assistants with the contractor program				

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
2.1.2.5: Explore supplying contractors and authorized agents with additional tools (e.g., gas, head lamps, etc.) to encourage python removal. 2.1.2.6: Support "mentorship" program through authorized agents and paid contractors who need field assistants to provide with additional help while conducting removal efforts. 2.1.2.7: Pursue venues to support the creation of a professional invasive wildlife industry, similar to what exists for the exotic plant treatment industry.					
Recommendation 2.1.3: Facilitate python removal by staff, other contractors, and researchers working on public lands.	• FWC Python Patrol trainings • FWC has MOU/ MOA's with DEP, FFS, NPS, SFWMD	• FWC, SFWMD, NPS, FFS	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
2.1.3.1: Agencies and/or individual management units work internally to create mechanisms and processes that allow for removal of pythons and other invasives on their properties by area staff, contracted entities, and researchers working on their lands who are willing and able to do so. 2.1.3.2: Provide training to all interested staff, contractors, and researchers on reporting and removing pythons. 2.1.3.3: Grant access to partners to conduct python control on public land and partner properties both opportunistically and working collaboratively	• NPS provides training and guidance for staff				

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
during coordinated workdays.					
Recommendation 2.1.4: Facilitate python reporting and removal by public, outdoor sports people, and outdoor recreationists and develop guidelines and recommendations to encourage these activities that support management goals for each property. 2.1.4.1: Provide training on existing reporting tools to visitors of natural areas. 2.1.4.2: Expand hours of hotline to 24/7. 2.1.4.3: Include information on how to collect and report data on observed or removed Burmese pythons for different areas in Python Patrol trainings or demonstrations.	• FWC is targeting more sports and recreationists for Python Patrol trainings • Youth Python hunts will be hosted annually • FWC enacted EO 02-17 • NPS exploring how to allow python capture by public on NPS lands	• FWC, NPS, FFS	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
2.1.4.4: Host youth python hunts annually to empower and educate future generations 2.1.4.5: Host Python Patrol trainings for hunters and outdoor recreationists multiple times throughout the year (targeted audiences). 2.1.4.6: Support "mentorship" program through authorized agents and paid contractors who need field assistants to get more people trained in the field with professionals.					
Recommendation 2.1.5: Utilize available data and guidance from land managers to prioritize sensitive ecosystems, protected species, and other priority resources	• FWC plans on using detector dog team for some targeted searching in sensitive areas; NPS plans to collaborate with FWC to test dogs in key areas	• FWC, NPS, FFS	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
within the established range. 2.1.5.1: Increase searches in remote and/or sensitive areas (e.g., Key Largo, Greater Everglades interiors and tree islands) that are currently under-surveyed. 2.1.5.2: Use available detection tools to assess python presence in sensitive habitat areas. 2.1.5.3: Identify sensitive areas where strategic control efforts are limited to qualified professionals utilizing informed tactics.	• NPS plans to provide access for "events" to access remote sites • FFS plans to promote this				
Goal 3: Facilitate coordination and planning among land managers, researchers and other stakeholders regarding effective control tools and management strategies.					
Strategies and Recommendations					
Strategy 3.1: Expand or increase interagency capacity to respond to, and address python threat.					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Recommendation 3.1.1: Develop a partnering entities MOU to improve coordination and to address burdens that hamper response/control efforts (e.g., access).					
Recommendation 3.1.2: Expand or increase capability where needed (i.e., dedicated personnel, contractors, volunteers, and funding).					
Strategy 2.2: Create and utilize science-guided adaptive management framework to facilitate working with researchers to assess past and present prevention, containment, and resource protection strategies and make improvements.					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Strategy 3.3: Provide input to the Python Workgroup on development and improvement of tools and techniques for detection and removal efforts.	• Control Team should be created			• Research Team meetings	• Research Team meetings
Strategy 3.4: Develop guidelines and recommendations to encourage activities by land managers, stakeholders, and the public that support management goals and directives appropriate for heterogeneous landscapes across varying geopolitical boundaries.					
Strategy 3.5: Maintain engagement in response, removal, and control efforts.	• FWC, SFWMD, and others will continue	• FWC, SFWMD	• Ongoing	• Ongoing	• Ongoing
Recommendation 3.5.1: Provide python patrol training to the public and land	• FWC will continue Python Patrol • FWC/ SFWMD have assistants in the	• FWC, SFWMD	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
managers more frequently. 3.5.1.1: Support "mentorship" program through authorized agents and paid contractors. 3.5.1.2: Recruit trained individuals as responders for agencies that need volunteers.	field with contractors • FWC recruits volunteers for EDRR				
Recommendation 3.5.2: Encourage and facilitate python hunting and reporting by traditional sportsman/outdoor enthusiast on properties where it is allowable. 3.5.2.1: Host annual youth hunt. 3.5.2.2: Provide Python Patrol training to these groups.	• FWC has targeted more sportsman/outdoor groups for Python Patrols • FWC will continue to participate in annual youth hunt	• FWC, SFWMD, FFS	• Ongoing	• Ongoing	• Ongoing

128

Research

Table 12. Goals, Recommendations, and Strategies for Research Action Plan

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Goal 1: Advance science to assist land managers in decision-making on python control using the best-available science.					
Strategies and Recommendations					
Strategy 1.1: Identify baseline and priority research needed to aid management decisions.					
Recommendation 1.1.1: Identify and evaluate ecological indicators or indicators of management success, including python and python-impacted populations.				• FFS may pursue indicators on their lands	• Ongoing
Recommendation 1.1.2: Establish long-term monitoring using performance indicators.					
Recommendation 1.1.3: Characterize					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
the geographic range of pythons.					
Recommendation 1.1.4: Identify areas sensitive to impacts of pythons.	• NPS, and other agencies will identify priority areas on NPS lands	• NPS	• Partial	• FFS, others plan to identify sensitive areas	• Ongoing
Recommendation 1.1.5: Further characterize direct and indirect impacts of pythons, including socioeconomic impacts.					
Recommendation 1.1.6: Forecast python population changes under future conditions (e.g., climate change and restoration efforts) to aid managers in decision-making.					
Recommendation 1.1.7: Identify knowledge gaps hindering decision-making.					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Strategy 1.2: Evaluate and improve efficacy (including cost) of control, management, and detection tools.	• UF/SFWMD contract to evaluate contractor programs; ad hoc/informal evaluations	• FWC, SFWMD, CSWF	• Partial, Ongoing	• Ongoing	
Recommendation 1.2.1: Identify research projects that will contribute to managers ability to limit or control spread of pythons. 1.2.1.1: Develop and evaluate use of barriers to contain pythons and restrict spread. 1.2.1.2: Expand and evaluate rapid response tools.	• FWC currently has EDRR • IveGot1 hotline and contractors	• FWC, SFWMD	• Partial, ongoing	• Ongoing, FFS plans to develop rapid response on their lands with FWC	• Ongoing
Recommendation 1.2.2: Assess tools for detection of pythons. 1.2.2.1: Assess visual searching and removal efforts. 1.2.2.1.1: Assess python contractor removal programs.	• FWC will evaluate efficiency of Detector Dog team, FWC, SFWMD have tasked UF to evaluate contractor removal	• FWC, SFWMD, USGS	• Partial, ongoing	• FWC has tasked UF with evaluating contractor python data	

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
1.2.2.1.2: Assess volunteer python removal programs. 1.2.2.1.3: Assess staff python removal programs. 1.2.2.2: Assess public reporting of python sightings. 1.2.2.3: Assess trapping methodology for pythons. 1.2.2.4: Assess use of detector dogs for python detection. 1.2.2.5: Assess use of eDNA to detect pythons. 1.2.2.6: Assess use of wildlife cameras to detect pythons.					
Recommendation 1.2.3: Assess use of telemetered snakes to detect breeding aggregations (i.e., "scout snakes", formerly known as Judas snakes).	• NPS/USGS/CSWF intend to undertake this	• NPS, USGS, CSWF	• Partial, ongoing		

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Recommendation 1.2.4: Assess biocontrols to control python populations.					
Recommendation 1.2.5: Assess habitat manipulation as a means to limit spread of pythons.				• FFS may assess for their lands	• FFS may assess for their lands
Recommendation 1.2.6: Assess the use of bounties and other rewards programs in control of pythons.					
Recommendation 1.2.7: Assess use of repellants to repel pythons.					
Recommendation 1.2.8: Assess reproductive inhibition as a means to control pythons.					
Recommendation 1.2.9: Assess egg/nest destruction to reduce python populations.					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Recommendation 1.2.10: Assess pheromonal attractants to increase detection of pythons in the wild.					
Strategy 1.3: Develop new control, management, and detection tools.					
Recommendation 1.3.1: Assess use of synthetic biology to control python populations. 1.3.1.1: Assess use of CRISPR/ CAS9 gene drives 1.3.1.2: Assess use of RNAi methodology					
Recommendation 1.3.2: Assess other detection tools. 1.3.2.1: Use of IR or near-IR/ reflectance.	• FWC funding research with UCF for Near Infrared camera development to improve detection	• FWC	• Ongoing	• Ongoing	
Recommendation 1.3.3: Assess use of telemetered prey to detect and remove pythons.	• FWC is funding research on telemetered rats, with	• FWC, SFWMD	• Partial, ongoing		

134

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
	SFWMD support on their lands.				
Recommendation 1.3.4: Recognize that development of new tools will rely on innovative technologies and novel applications of these tools or existing technologies.	• FWC funding research on mammal lures (rabbits)	• FWC	• Partial		
Strategy 1.4: Characterize python biology to support evaluation of management tools.					
Recommendation 1.4.1: Estimate vital rates (i.e., survival, reproduction, and age or size structure) for population model.	• Data collection is under way, but currently ad hoc	• CSWF, USGS	• Ongoing		
Recommendation 1.4.2: Identify natural barriers to python success.					
Strategy 1.5: Conduct research to evaluate the feasibility of restoration of python-					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
impacted ecological function and python-impacted populations.					
Recommendation 1.5.1: Identify existing or establish new baseline data of community composition prior to python invasion.					
Recommendation 1.5.2: Identify and evaluate ecological indicators or indicators of successful restoration efforts (includes python and python-impacted populations).					
Recommendation 1.5.3: Identify and evaluate ecological indicators or indicators of success (includes python and python-impacted populations).					
Recommendation 1.5.4: Consider active					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
restoration activities (i.e., see work on reintroductions of native taxa on Guam).					
Goal 2: Increase alignment of research priorities, investments, and protocols across land managers and partners to increase efficiency so researchers are focusing on questions that will have the greatest impact on management decisions.					
Strategies and Recommendations					
Strategy 2.1: Solicit research ideas from researchers, the public, and private sector.					
Recommendation 2.1.1: Develop a proposal-submission portal (Python Portal) to accept research ideas from professional and community scientists. Managers will be able to access these proposals and work with the researchers to develop into a full proposal and build collaborations in a way that meets agency needs.					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
2.1.1.1: Standardize proposal format to allow clear and consistent evaluation while also not burdening applicants with a time-consuming application. 2.1.1.2: Ask applicants to categorize their proposal by topic and make available the number of proposals per topic that have been received, prioritized for funding, and funded (see 2.2.1). 2.1.1.3: Define the proposal evaluation process and make that process available on the portal; this may vary slightly from year-to-year (see 2.2.1). 2.1.1.4: Identify the most-recent and					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
previous annual research priorities on the portal (see 2.2.1). 2.1.1.5: Provide access to scientific articles, when possible, by topic and encourage applicants to become familiar with these articles beforehand to make their proposal more competitive.					
Recommendation 2.1.2: Encourage and support innovation in research. 2.1.2.1: Develop process to evaluate high-risk but potentially high-reward proposals and how they would compete against lower-risk and lower-reward proposals. 2.1.2.2: Facilitate integrative projects by providing contact information and area	• FWC, SFWMD supports research to improve our ability and invites proposals to detect and remove nonnative wildlife including pythons, NPS/USGS to complete pheromone study	• FWC, SFWMD, NPS		• FWC regularly supports research to improve our ability to detect and remove nonnative wildlife including pythons	• FWC regularly supports research to improve our ability to detect and remove nonnative wildlife including pythons

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
of expertise for funded python researchers on the portal for non-python scientists to find and use to develop collaborations.					
Strategy 2.2: Develop research priorities of land managers and identify current research investments to efficiently use resources.	• Research Team should be created	• Workgroup	• Ongoing	• Ongoing	• Ongoing
Recommendation 2.2.1: Compile and prioritize research needs of land managers and partners. 2.2.1.1: Prioritized research needs can be solicited beforehand, possibly via a research conference, review of proposals submitted to the Python Portal, and/or questionnaires to managers about what new information	• Research Team should be created	• Workgroup	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
would improve their decision-making. 2.2.1.2: Land managers should consider input of least one external researcher who does not have any conflicts of interest (e.g., this person does not work on pythons in Florida) and can provide technical expertise and guidance.					
Recommendation 2.2.2: Recognize research deficiencies and actively seek solutions or alternatives to mitigate these deficits.				• Ongoing	• Ongoing
Recommendation 2.2.3: Develop a research-progress system (Python Portal website) where managers can summarize funded					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
research and provide progress updates (see 2.3.1.1).					
Strategy 2.3: Improve dissemination of research to researchers and managers.					
Recommendation 2.3.1: Support and contribute to a repository (Python Portal website) for python research information and data. 2.3.1.1: Provide 1-page summaries of ongoing research with links to full reports or publications. Funding agencies are encouraged to require these summaries as part of their annual reporting for researchers, and they should follow a standard format and be written for a broad audience (e.g.,	• Workgroup/ Communication Team should start discussing python portal in 2021	• Workgroup	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
provide a four-sentence summary, introduction, objectives, preliminary or coarse results, and management implications). These can be sufficiently general to not preclude publication in a peer-reviewed journal at a later date. Multiple reports from multi-year projects should be linked. 2.3.1.2: Provide a list of citations and associated PDFs, when possible, of relevant literature organized by topic. 2.3.1.3: Provide standardized removal and monitoring information. 2.3.1.4: When possible, make data available that was					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
submitted as part of permitting processes. 2.3.1.5: Ask researchers to submit their data to open access repositories (e.g., Dryad, GenBank, ScienceBase) and provide links to these data.					
Recommendation 2.3.2: Identify and support python coordinator(s) to serve as liaison between researchers and managers.	• FWC has an Interagency Python Management Coordinator	• FWC	• Ongoing	• Ongoing	• Ongoing
Recommendation 2.3.3: Foster long-term, collaborative, interdisciplinary research projects. 2.3.3.1: Prioritize research that can be completed incrementally (e.g., in one-year blocks over multiple years). 2.3.3.2: Reduce risk for multi-year projects	• FWC, SFWMD, NPS, USGS, CSWF currently collaborate on projects with some other partners	• All organizations	• Ongoing		

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
by prioritizing research that can be cost-shared among agencies and organizations. Cost-sharing may occur sequentially, with different agencies funding at different times, or it may occur simultaneously but with funding allocated towards different principal investigators.					
Recommendation 2.3.4: Simplify permitting requirements and facilitate collaboration across jurisdictional boundaries. 2.3.3.1: Develop MOU or other instruments as appropriate. 2.3.3.2: Develop process to evaluate permit applications	• FFS, NPS, and others working to address		• Ongoing		

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
that may be high-risk but are also high-reward in cost-savings or management implications. 2.3.3.3: Utilize Python Portal website to identify permit requirements and resources for researchers, including information required by agencies and organizations.					
Recommendation 2.3.5: Funding agencies and organizations should aim to include contract funds to support publication of research to aid dissemination of research results.	• Contracts/agreements are generally intended to result in publications	• All agencies?	• Ongoing		
Recommendation 2.3.6: Land managing organizations and researchers should continue to work collaboratively on					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
protocols to protect research investments such as scout snakes through informing python removal contractors and hunters to no remove scout snakes from the wild.					

Communication

Table 13. Goals, Strategies, and Recommendations for Communication Action Plan

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Goal 1: Increase public awareness of the harmful impacts of pythons, the efforts being conducted to control them, and promote the ecological value of native species to inform, empower, and engage the public in python control efforts.					
Strategies and Recommendations					
Strategy 1.1: Provide training for python identification and capture/restraint to increase python reporting and removal among individuals who are likely to	• FWC plans to continue Python Patrol in conjunction with partners	• FWC, NPS		• FWC may expand number of Python Patrol trainings	• FWC has Python Patrol

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
encounter pythons. (Note it is illegal in the state of Florida to transport a live Burmese python without a permit.)					
Recommendation 1.1.1: Promote online trainings for identifying nonnative and native reptiles (e.g., the FWC python removal training) to increase accurate reporting and removal of nonnative species.	• FWC has a Module created but it is not active • FWC plans to update and repost this module	• FWC			
Recommendation 1.1.2: Establish interagency staff to develop, coordinate, and provide trainings.	• FWC currently promotes in conjunction with other programs	• FWC, SFWMD, NPS, FFS	• Ongoing	• Ongoing, SFWMD, NPS could offer trainers	• Ongoing
Recommendation 1.1.3: Increase the number of capture/restraint trainings (e.g., FWC Python Patrol training) for the public and land managers focused to reach individuals who				• SFWMD, NPS, FFS, could offer trainers	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
may encounter pythons through work or recreating.					
Recommendation 1.1.4: Develop a training to instruct participants on approved humane methods of dispatching pythons to support python removal efforts.				• NPS, FFS, and others could assist	
Recommendation 1.1.5: Provide audience-specific trainings to increase their effectiveness (see Strategy 1.3 for targeted audiences).				• FFS could assist	• FFS could assist
Recommendation 1.1.6: Create and expand upon multilingual outreach materials to support multicultural communications in effort to increase python reporting and removal.	• FWC plans on doing this with Python Patrol – targeting natural resource workers, utility workers and LE • FWC has Spanish brochures for pythons	• FWC, SFWMD	• Ongoing	• Ongoing, other agencies to provide trainers?	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Strategy 1.2: Coordinate and collaborate on communication and outreach efforts and materials among land managers to increase their effectiveness and present a unified message.					
Recommendation 1.2.1: Promote and expand unified communication and outreach efforts. 1.2.1.1: Encourage coordination and collaboration among public affairs and outreach specialists from land managing partners. 1.2.1.2: Encourage the creation of shared talking points based on the best available science and common goals for public engagement through outreach.	• Outreach/ Communication Team should be created in 2021	• FWC, SFWMD, NPS, FFS, CSWF, others	• Ongoing	• Ongoing	• Ongoing.

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
1.2.1.3: Create shared media kits with information from land managing partners to be utilized at events. 1.2.1.4: Collaborate to be receptive and proactive towards media requests to reach broad and specific audiences with a strategic messaging for each. 1.2.1.5: Promote the use of invasive species awareness and reporting apps (e.g., EDDMapS and IveGot1). 1.2.1.6: Develop a process for coordination of multi-agency news releases to demonstrate unified messaging.					
Recommendation 1.2.2: Create a public Python Portal website that centralizes current information	• Workgroup/ Communication Workgroup should start discussing python portal in 2021	• Workgroup	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
on pythons in Florida to be utilized by the public and others interested in the issue. See Implementation section, Goal 3, for details on website content.					
Recommendation 1.2.3: Strategically hold and/or attend outreach events to provide information on the pythons and to increase reporting on python sightings and removals. 1.2.3.1: Develop specific messaging for events in areas where pythons are not yet established to create public awareness of reporting to detect dispersing or incipient python populations. 1.2.3.2: Support and promote Florida Python Challenge®	• FWC exotic pet amnesty days • 2021 Python Challenge • FWC supports Youth hunts • Agency staff attend other various festivals and outreach events including Repticon • FWC may start a Veteran's Day veteran python hunt	• FWC, SFWMD, Rookery Bay NERR, Florida Forest Service	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
events as python awareness efforts. 1.2.3.3: Support and contribute to outreach efforts by the local Cooperative Invasive Species Management Areas (CISMAs), including summarizing conference findings as news releases for the public and presenting research highlights on social media. 1.2.3.4: Support and promote the FWC Exotic Pet Amnesty Program to increase awareness of no-fault programs to surrender exotic pets and decrease release of pets into the wild. 1.2.3.5: Create outreach kits with information from multiple land managing partners to be used at events.					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
1.2.3.6: Reach out to the pet industry and hobbyists to provide information on pythons and promote responsible pet ownership. 1.2.3.6.1: Promote outreach through attending pet trade conventions. 1.2.3.6.2: Visit local pet stores and breeders to educate and find adopters for animals surrendered Amnesty days. 1.2.3.7: Look for opportunities to inform and empower the hunting community and other outdoor enthusiasts. 1.2.3.7.1: Provide training and education on python reporting and removal opportunities and regulations.					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
1.2.3.7.2: Provide prizes as incentives for python reporting and removal. 1.2.3.8: Engage with public and private schools to educate on pythons and other invasive species. 1.2.3.8.1: Identify education outreach resources offered by different counties, agencies, and organizations. 1.2.3.8.2: Develop and/or update existing curriculum to share with schools. 1.2.3.8.3: Provide presentations and other learning materials for schools and educators.					
Recommendation 1.2.4: Utilize multiple platforms to share strategically planned and coordinated messaging.	• SFWMD conducts some school education • CSWF engages invasive species	• SFWMD, CSWF	• Ongoing		

155

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
1.2.4.1: Utilize traditional and social media to promote events and disseminate coordinated messaging. 1.2.4.2: Utilize billboards and murals for advertising campaigns. 1.2.4.3: Utilize mass/bulk mailings, neighborhood canvassing, and other methods to deliver tailored messaging to specific locations. 1.2.4.4: Utilize vehicle wraps to promote the 1-888-Ive-Got1 Exotic Species Hotline and invasive species awareness.	education in public schools • Dalton Discovery Center				
Recommendation 1.2.5: Support community-based education efforts. 1.2.5.1: Identify community-based	• FWC, SFWMD, CSWF currently promote outreach efforts on many platforms	• FWC, SFWMD, CSWF	• Ongoing	• Ongoing, FFS to participate	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
education organizations (e.g., religious organizations, NGOs, and environmental organizations) and provide information and materials on python management. 1.2.5.2: Inform community-based organizations of funding opportunities and other ways in which they can support python management.					
Strategy 1.3: Identify additional stakeholder groups and venues to target for audience-specific communication to increase messaging and its effectiveness.	• SFWMD conducts some of this; CSWF engages schools and educators	• SFWMD, CSWF	• Ongoing		
Recommendation 1.3.1: Identify stakeholder groups that may be targeted for specific					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
communication including, but not limited to, elected officials; researchers; citizen scientists; private-land owners; law enforcement; first responders; agricultural and horticultural workers; utility workers; outdoor recreationists; python hunters; and media outlets.					
Recommendation 1.3.2: Develop new and innovative ways to engage the public. 1.3.2.1: Engage with accredited or certified zoological and other educational facilities located throughout the state to provide information on python invasion, including existing reporting tools, that can be shared with visitors.					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Goal 2: Increase interorganizational communication, data sharing, and collaboration.					
Strategies and Recommendations					
Strategy 2.1: Seek opportunities to increase communication among interorganizational partners at organizational meetings that already occur (i.e., CISMA meetings) or by holding additional meetings when collaboration is needed.	• Creation of Workgroup and Teams	• FWC, SFWMD	• Ongoing	• Ongoing	• Ongoing
Recommendation 2.1.1: Strive for representation by all stakeholders at meetings, when possible, and provide written summaries for those who were not represented.	• Inviting FPCP 15 agencies to each have 1 representative. • Develop plan for future inclusion of other agencies.	• Workgroup with all participating agencies	• Ongoing		
Recommendation 2.1.2: Provide presentations on	• ECISMA • SWCISMA • GEER	• All participating agencies	• Ongoing	• Ongoing	• Ongoing

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
project updates, new findings, etc.	• Other conferences as appropriate				
Strategy 2.2: Centralize python information to increase communication, data sharing, and collaboration.					
Recommendation 2.2.1: Create a Python Portal website for internal use by land managers and partners to access current information on pythons and control recommendations. See Implementation section, Goal 3, for details on website content.	• Workgroup/ Communication Team should start discussing python portal in 2021.	• Workgroup • FWC, SFWMD, NPS	• Partial? Depends on progress	• Complete in 2022 if not done in 2021	• Maintain site
Recommendation 2.2.2: Promote use of EDDMapS for python reporting and develop privacy functionality to allow for reporting sensitive data.					

Goals, strategies, and recommendations	2021 Action	Participating groups	Action complete, partially addressed, or ongoing?	2022	2023
Recommendation 2.2.3: Encourage land managers and partners to report on and receive periodic, up-to-date summaries of python activities.	• SFWMD, NPS, Rookery Bay NERR direct public to report occurrences via EDDMapS on their lands	• Workgroup	• Ongoing		
Strategy 2.3: Determine how interorganizational communication can be used to support EDRR efforts.					
Goal 3: Create a communication strategy to support implementation of the Florida Python Control Plan.					
Strategies and Recommendations					
Strategy 3.1: Create a communication plan for the roll-out and implementation of the FPCP to provide information and garner support from the public, politicians, and stakeholders.					
Recommendation 3.1.1: Distribute FPCP to land managers through workshops, fact sheets, etc.	• Should do in 2021 after FPCP is finalized	• FWC	• Complete in 2021		