

Moon Fish Fire

BURNED AREA REHABILITATION PLAN

July 29, 2020



Panel: Examples of low to high intensity fire effects on tree islands, small islands typically show more severe effects.

UNIT: Big Cypress National Preserve (BICY)

LOCATION: Collier County, Florida

DATE: July 29, 2020

PREPARED BY: Courtney Angelo, BICY Botanist, Deborah Jansen, BICY Wildlife Biologist, Matthew McCollister, READ Assigned to Moon Fish Fire and Billy Snyder, BICY Biologists

RECOMMENDED BY: Jill Waisley, BICY Fire Planner

Recommended	Name		Position	
	Anthony Pernas		Chief of Resource Management	
	Signature		Date	
	<i>[Signature]</i>		8/20/20	

Recommended	Name		Position	
	James Sullivan		Fire Management Officer	
	Signature		Date	
	<i>James R. Sullivan</i>		8/21/20	

Approved	Name		Position	
	Thomas Forsyth		Park Superintendent	
	Signature		Date	
	<i>Thomas P Forsyth</i>		Aug 21, 2020	

Introduction

This Burned Area Rehabilitation Plan has been prepared in accordance with the Department of the Interior and National Park Service policy. This plan provides rehabilitation recommendations for all lands burned within the Moon Fish Fire footprint and impact areas including: public lands administered by the National Park Service. The primary objectives of the Moon Fish Fire Burned Area Rehabilitation Plan are:

- 1) To repair or improve lands unlikely to recover naturally from severe wildland fire damage by emulating historic or pre-fire ecosystem structure, function, diversity, and dynamics according to approved land management plans.
- 2) Restore or establish healthy, stable ecosystems, even if these ecosystems cannot fully emulate historic or pre-fire conditions as specified in approved land management plans.

Based on observations and scientific data, wildland fire has been shown to exacerbate invasive plant infestations. *Melaleuca quinquenervia* (Melaleuca) is a fire-adapted species which spreads easily into burned and surrounding areas post-fire. Melaleuca fruit capsules which contain copious amounts of seeds are also stimulated to open and release seeds after wildfire adding more propagules to the system than pre-fire conditions. *Schinus terebinthifolia* (Brazilian pepper) is a primary succession species that favors disturbance such as wildfire scars and mechanical soil disturbance. *Lygodium microphyllum* (Old World climbing fern) is also present in the area. Given the invasive behavior of this species, it can quickly invade burned areas and smother native vegetation. Additionally, Big Cypress National Preserve has historic chronological data of invasive plant infestations since the early 1990's that were mapped using systematic aerial reconnaissance and Digital Aerial Sketch Mapping (DASM).

Additionally, based on observations and scientific data, tropical hardwood hammocks and ecotonal regions likely contain T&E (federally and listed) species in BICY. T&E species are highly susceptible to displacement and local extirpation by invasive species. Within the tropical hardwood hammocks, the functional types of listed species range from hammock trees to herbaceous plants to rare epiphytes. Furthermore, the state-listed Florida tree snail (*Liguus fasciatus*) located within these hardwood hammocks rely on hammock species for their survival. This BAR rehabilitation plan addresses how to implement a comprehensive plan to strategically treat invasive plant species in the wildland fire footprint; while, prioritizing tree islands and hammocks that have listed species of concern (i.e., plants and Florida tree snails). Hardwood hammocks in this area of the Preserve have never been comprehensively surveyed and multi-scale floristic (listed and invasive plants) and Florida tree snail inventories in this region would inform invasive plant management to effectively direct invasive plant treatment protocols to mitigate further loss across these hammock systems.

Fire Background

The Moon Fish Fire (25,834 acres) includes one wildland fire within Big Cypress National Preserve (BICY) (Fig. 1; Appendix A). The fire began on 5/7/20 and was declared 100% contained on 5/26/20. The Moon Fish Fire primarily burned within BICY, however there was a small portion of the fire (<5%) that burned into the western boundary of Everglades National Park (EVER). The fire consumed dense, coarse grass; cypress prairies, sloughs, and tropical hardwood hammock islands. A staggering 431 hardwood hammocks of varying sizes, totaling 1076 acres were impacted by the wildland fire. All these habitats were in extended drought conditions during the incident.

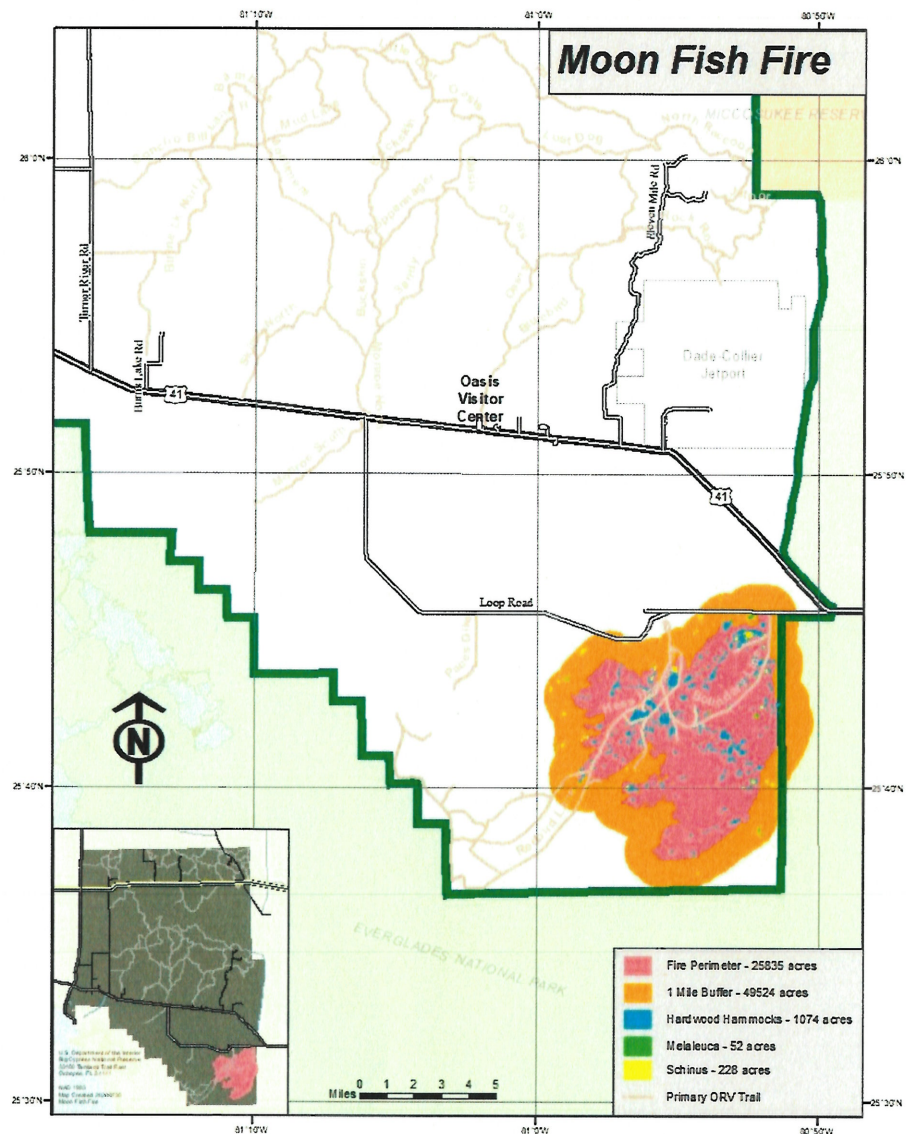


Figure 1. Map of the Moon Fish Fire with a one mile buffer in orange.

Hydrological conditions of the Preserve

The Preserve entered April in a state of deep and prolonged drought. The April 2020 drought conditions mirrored spring droughts of the 2009 Deep, 2011 Jarhead and 2018 Avian wildland fire seasons.

During spring 2020, the water table dropped below the root zone of large cypress trees for an approximate 10-12-week period from mid-March to late May, making stands of cypress more susceptible to mortality in the presence of fire. During March, all visited cypress domes were completely dry, along with some sloughs only containing small pockets of water. The water table was measured to be located 3-4 feet below the center of cypress domes. Using cypress domes as a reference system for lack of moisture within BICY during the Moon Fish Fire, the equivalent in the tropical hardwood hammocks would be roughly 6-7 feet above the water table during this period. This resulted in a sustained and widespread deficiency in soil moisture within these systems.

The tree islands, and hardwood hammocks within, would typically not burn unless conditions were extremely dry as they were in the Moon Fish Fire. Under drought conditions, wildland fire is more likely to burn deeper into the surface soil layer and into ecosystems that are normally less likely to burn (e.g., domes, strands, sloughs, and hammocks). In the hardwood hammocks of the Moon Fish Fire, a significant impact to the hammocks and tree islands was the loss of organic soils. Subsequently, the burned organic soil layer that was present from lack of fire provided excess nutrients to this system that has evolved with relatively low nutrients. Furthermore, as soils burned, hardwood hammock species' root systems were exposed and often consumed resulting in large hammock trees falling to the ground. This increase in nutrient and functional space will further provide niches for invasive plant species to invade these disturbed systems.

Fire Damages and Threats to Human Safety and Natural and Cultural Resources

Please see the READ report for a more detailed description of cultural and natural resources in and around the Moon Fish Fire footprint. Vegetation communities in the wildland fire footprint consisted of upland areas that include hardwood hammocks within tree islands at slightly higher elevations than the surrounding seasonally flooded prairies. The seasonally flooded prairies are a fire-adapted plant community that could naturally burn every 2-5 years. In contrast, tropical hardwood hammocks are not fire-adapted and typically do not burn unless conditions are extremely dry as previously mentioned herein.

The Moon Fish Fire impacts to tropical hardwood hammocks were the primary concern for the Resource Management Division at BICY. Fire effects were dynamic on the tree islands and included complete loss of vegetation on smaller islands and mixed effects on larger islands. These mixed effects ranged from simply low tree and shrub mortality along the island edge, to high tree mortality of edges with some tree survival in the island interior, to a complete loss of vegetation. A significant component of the fire's impact to the island vegetation is the loss of organic soils.

Due to historic lack of fire in hammocks, an organic soil layer accumulated providing resources to the plant communities on these tree islands; this is significant because the Everglades ecosystem in general is a relatively low nutrient system. As these soils burned, the root systems of these trees were often consumed and many of these stands of large hardwoods showed freshly fallen trees as a result. The extent of this impact will not be observable until the following growing season. The increase in functional space and system nutrients, though, will provide access and resources for fast-growing invasive plant species to thrive and invade.

In these diverse tree islands, the Moon Fish Fire penetrated the hardwood hammocks and disturbed island edges in a mosaic pattern across the wildfire's footprint. This footprint likely hosts up to twenty-six T&E plant species (i.e., 1 federally listed species; 19 endangered and 6 threatened state-listed species). More than 75% of these species have a special listing status by The Institute for Regional Conservation for South Florida (i.e., eight rare, four imperiled, and eight critically imperiled species). Furthermore, T&E species are highly susceptible to displacement by invasive species and likely to be impacted by them within the Moon Fish Fire footprint due to the level of disturbance caused by the fire. Due to the lack of comprehensive floristic surveys in this area, there is a need for this type of survey to direct and prioritize invasive plant treatments to hammocks and ecotonal edges where there may be a higher diversity of listed species over other areas (see Appendix B, for detailed budget and methodology). For example, the federally listed, *Dalea floridana* (Florida prairieclover), is likely found along ecotonal fringes in this footprint.

In addition to the tropical hardwood hammocks that exist on these tree islands, tropical hardwood hammocks are hosts to the state-listed, endemic Florida tree snail (*Liguus fasciatus*). The Florida tree snail, *L. fasciatus*, is known to occur in approximately 40 tree islands within the perimeter of the Moon Fish Fire. Unique color variations were found within some of these impacted islands. A May 22 aerial survey and May 23 ground survey within the fire's perimeter indicated extensive mortality of both the snails and the trees they inhabit. This cursory examination suggested that the smaller tree islands retained little if any suitable habitat and the larger islands lost substantial tree snail habitat. Often, the tree islands host snail populations with unique color morphs that may only exist on a few or even one island. This species and the color varieties that remain are an important wildlife resource to the National Park Service. The tree island habitats of South Florida have been lost to development to the point that EVER and BICY contain the majority of this species' habitat.

The Florida tree snail populations on islands that experienced high tree mortality also experienced high snail mortality. Furthermore, the snails that did not die from the Moon Fish fire will have a low probability of survival without quality habitat like tropical hardwood hammock tree species. NPS biologists and Steve Sparks (Liguus Tree Snail researcher/expert) determined monitoring of these populations will be needed to determine the long-term survival of different populations and color morphs. An inclusive one-year post-fire survey of state-listed Florida tree snail populations would be advised by Dr. Tim Collins (Florida International University) (see Appendix C, for detailed budget and methodology) and would complement the floristic surveys

in directing prioritization of invasive plant management and treatments across the fire's footprint.

Invasive Species

The most significant invasive species in the fire perimeter are Brazilian pepper (*Schinus terebinthifolia*), Old World climbing fern (*Lygodium microphyllum*), and Melaleuca (*Melaleuca quinquenervia*). The most recent comprehensive systematic reconnaissance flights (SRF) mapping invasive species in the Moon Fish Fire footprint were performed in 2012/13. At that time, within the fire footprint and buffer region around the fire, there were 228 acres of Brazilian pepper (*Schinus terebinthifolia*) and 52 acres of Melaleuca (*Melaleuca quinquenervia*). We are predicting that populations of Brazilian pepper and Melaleuca have likely expanded by at least 10% since the 2012/13 surveys. Ground observations from READs on Moon Fish indicate the presence of Old World Climbing Fern (*Lygodium microphyllum*). The presence of *Lygodium* was expected, but currently there has been no mapping of the species in the fire footprint within BICY. It is known based on SRF of nearby EVER that there are vast uncontrolled populations of *L. microphyllum* occupying the same coastal fringe environment.

As a result of the high levels of disturbance and increased soil nutrients created by the wildland fire and suppression efforts there is a high probability of these known infestations expanding within the fire footprint in the coming years. The burned area assessment completed by the BICY team *does not* recommend additional DASM to detect new invasive plant locations within the fire footprint; although, comprehensive ground surveys are recommended one-year post-fire.

Melaleuca (*Melaleuca quinquenervia*) is a fast-growing tree that is native to Australia. *Melaleuca* seeds are dispersed by wind and water, but many seed capsules are stored on mature trees and are explosively released after fire. In marl prairies and pineland uplands within the Buzzard wildland fire footprint, some level of *Melaleuca* infestation has occurred from 2018 fire. Within the Buzzard fire footprint, infestations of *Melaleuca* where dense monocultures exist with no mature trees, suggest seedlings germinated from a dormant seedbank that may have persisted unknowingly till recently. The population is likely to increase due to its post-fire behavior described herein.

Brazilian Pepper (*Schinus terebinthifolia*) is an invasive species from Brazil and Argentina. Open wetlands and cypress communities generally have very low infestation levels of Brazilian pepper restricted to high spots and cypress tree bases. Infestation levels in uplands (i.e., pinelands and hammocks) vary greatly. History of human use, fire frequency and disturbance probably dictate infestation levels in these communities. The heaviest Brazilian pepper infestations occur along roadsides and canal banks, in abandoned agricultural land and around old home sites. Brazilian pepper is a primary succession species and will quickly colonize areas of disturbance. It is anticipated that fire lines created will develop quickly into monocultures of Brazilian pepper.

Old World climbing fern (*Lygodium microphyllum*) is a fire-adapted invasive plant species from southeast Asia. Old World climbing fern is a priority invasive plant species found in the Preserve

due to its rapid growth and difficulty of control. Known locations of Old World climbing fern identified through DASM in other areas of the Preserve have been treated annually for the last several years. One-acre pre-fire infestation level of Old World Climbing fern will likely increase due to movement into the fire footprint from dissociated populations and spore movement. Dead snags that result from tree mortality throughout the fire area will certainly catch *Lygodium* spores and provide a physical pathway for germination in the disturbed areas. Healthy undisturbed coastal hammock islands in BICY have shown a resistance to invasion, however once the hammock vegetation is removed, invasion occurs quickly. This distributional increase should be visible within one-year post-fire.

The plant with the highest potential for invasion into the tropical hardwood hammocks is Old World Climbing Fern based on its behavior and spread into other tree islands across south Florida, followed by Brazilian pepper. To fully quantify the extent of invasive populations and inform invasive plant management and treatments, comprehensive surveys of remaining rare and endangered plant species (federally and state-listed), state-listed Tree snail populations, and a general condition assessment of the hammock islands should be performed; in addition, to a post-fire one-year invasive plant survey. A preliminary inventory of Liguus snail populations in BICY will be implemented this summer by BICY staff, and a comprehensive survey will complement the floristic survey (invasive and T&E plant species) to further direct and prioritize invasive species treatment across the expansive Moon Fish Fire footprint. Both the floristic and Florida tree snail surveys requested in this proposal will be implemented by local scientists affiliated with conservation research entities and universities in south Florida (Appendix B and C, for details).

Minimally, a comprehensive invasive plant survey 1-year post-fire should be performed to account for any populations of invasive plants that have either gone undetected or invade due to the post-fire disturbed condition to ensure invasive plants are thoroughly surveyed and treated. This funding request has been made by Billy Snyder, BICY Biologist, Courtney Angelo, BICY Botanist, and Deborah Jansen, Wildlife Biologist, therefore will be brought forward for analysis.

This strategy will allow for the following while also eliminating any further damage to listed T&E plant species and Florida tree snail populations:

- Prioritizing treatment of current populations of invasive plants to minimize displacement of listed species (T & E) or host tree species utilized by Florida tree snails.
- Quantification of new or undetected invasive plant populations to prioritize treatment in highly vulnerable tree islands and/or hammocks.
- Treatment of new populations detected in a manner that will safeguard T & E species (i.e., both plants and tree snails).
- Short-term retreatment of all species to maximize effectiveness of treatment.

Big Cypress National Preserve Management Requirements

The primary concern for burned area rehabilitation and long-term recovery of the Moon Fish Fire footprint is preventing invasion by non-native, invasive plants and the loss of T&E species (i.e.,

plants and snails). Sections that experienced a high severity burn and were mechanically disturbed will be vulnerable to invasion from nearby seed sources. Fires in similar vegetation types in the near vicinity have been invaded quickly and required extensive control. BICY has actively managed invasive plants since the 1980s and many of the sites are under a cyclic maintenance program, however new invasions are a constant threat.

Several guidance documents dictate the need for the preserve to take actions to address these current threats to its resources. Government Performance and Results Act (GPRA) planning language identifies natural areas and resident biota as entities identified for protection and restoration:

- Goal Ia1A (Disturbed Areas Restored) identifies goals for rehabilitation and restoration of areas within the Preserve.
- Goal Ia1B outlines requirements to reduce areas dominated by exotic plants. Activities supporting these goals clearly promote restoration of natural biological systems and have been met consistently for several years.
- Goal Ia2B identifies biota of management concern and indicates that their populations will be managed to a desired condition.

The South Florida and Caribbean Parks Exotic Plant Management Plan and Environmental Impact Statement (August 2010), Big Cypress National Preserve planning section, identifies Old World climbing fern, Brazilian pepper and *Melaleuca* as highly invasive and a priority for management by elimination. The Resource Management Plan for Big Cypress National Preserve (1998) references vegetation management, also generally as exotic plant control, and species listed for protection. There is at least one reference to developing a Vegetation Management Plan in the plan outline; this is primarily focused on exotic plants (p. 28).

A requirement to manage biological systems in nearly their natural conditions is found in some of the legislative framework that created the Preserve: "...assure the preservation, conservation, and protection of the natural, scenic, hydrologic, floral and faunal, and recreational values of the Big Cypress Watershed in the State of Florida and to provide for the enhancement and public enjoyment thereof..." (An Act to establish the Big Cypress National Preserve in the State of Florida and for other purposes. [88 Stat. 1225] [P. L. 93-440] October 11, 1974; Sec. 1 (a)). As community identifiers, and as the common components in most biological communities, the plant biota can be considered as the basis for management considerations in each area. Therefore, plans for management based on plant communities and their constituent plants should be considered as fundamental for decisions (management) that are focused on natural areas.

Proposed treatments in the Moon Fish footprint fit the preceding guidance well, and with rehabilitation would have a much more successful long-term prognosis than if left to be addressed under the preserve's normal control program.

FIRE LOCATION AND BACKGROUND INFORMATION

Fire Name	Moon Fish Fire
Fire Number	Wx 20-023
Agency Unit	BICY
Region	SER
State	Florida
County(s)	Collier
Ignition Date/Cause	5/7/2020; trespass vehicle that was stranded
Zone	Southwest Florida Caribbean
Date Fully Contained	5/26/2020
Jurisdiction	NPS
Total Acres	25,834 acres
Date Contained	5/26/2020

NATURE OF PLAN

Type of Action (check one box below)

X	Initial Submission
	Amendment to the Initial Submission

REHABILITATION ASSESSMENT *Rehabilitation Objectives*

- Prevent the establishment of non-native, invasive plant species
- Prioritizing treatment of current populations of invasive plants to minimize displacement or local extirpation of listed species (T & E) or host tree species utilized by Florida tree snails, along with Florida tree snail populations.
- Quantification of new or undetected invasive plant populations to prioritize treatment in highly vulnerable tree islands and/or hammocks.
- Treatment of new populations of invasive species detected in a manner that will safeguard T & E species (i.e., both plants and snails).
- Short-term retreatment of all species to maximize effectiveness of treatment.
- Detect at least 95% of non-native invasive plant occurrences within the Moon Fish Fire footprint

- Use integrated pest management (IPM) to prevent the establishment of non-native invasive plants within the Moon Fish Fire footprint
- Use standard effectiveness monitoring protocols to ensure success of non-native invasive plant removal treatments
- For the Moon Fish Fire project, multiple ground surveys of treatment sites during treatment and a reconnaissance flight post-treatment shall be performed to determine effectiveness of invasive species treatments. If a 95% kill rate is not achieved for any area of the project after three months following project completion, one additional thorough treatment of the project area will be the responsibility of the Contractor at no cost to the Government.

TEAM ORGANIZATION, MEMBERS, AND RESOURCE ADVISORS

Burned Area Emergency Response Team Members: *(List of technical specialists used to develop the plan)*

Position	Team Member (Agency)
Hydrologist	Bob Sobczak (NPS)
Wildlife Biologist	Deborah Jansen (NPS)
Botanist	Courtney Angelo (NPS)
Exotic Plant Specialist	William Snyder (NPS)
Fire Planner	Jill Waisley (NPS)

SUMMARY OF ACTIVITIES AND COSTS

REHABILITATION ACTIVITIES COST SUMMARY TABLE – Moon Fish Fire

Spec #	Title	Unit	Unit Cost	# of Units	Work Agent	Cost (FY 21)
1	Invasive Plant Control	Burn Site			SC	\$285,500
1	Post-fire 1-year floristic (invasive and T&E) survey across fire footprint (26,000 acres)(Appendix B, budget details)	Burn Site			SC/CA	\$119,342
1	Post-fire Liguus snail survey across fire footprint (Appendix C, budget details)	Burn Site			CA	\$110,658
TOTAL COST						\$515,500
Work Agent: CA=Coop Agreement, FA=Force Account, G=Grantee, P=Permitee, SC=Service Contract, TSP=Timber Sales Purchaser, V=Volunteer						

INDIVIDUAL SPECIFICATION

TREATMENT/ACTIVITY NAME	Invasive Plant Control	PART E SPECIFICATION #	1
NFPORS TREATMENT CATEGORY*	Invasive Species	FISCAL YEAR(S) (list each year):	2021/2022/2023
NFPORS TREATMENT TYPE *	Chemical Treatment	WUI? Y/N	Y
IMPACTED COMMUNITIES AT RISK	Natural Areas	IMPACTED T&E SPECIES	1 Federally-listed species, 25 State-listed (T & E) species; State-listed Florida tree snails

* See NFPORS Restoration & Rehabilitation module

Number and Describe Each Task:

A. General Description: Detect, control, and monitor non-native invasive species in burned areas and prevent the expansion of known populations into newly disturbed sites. Control will follow procedures well established and ongoing for the BICY Invasive Plant Management program, emphasizing integrated pest management (IPM) techniques (herbicides, biological, mechanical, and cultural control methods) as appropriate to prevent the spread and establishment of noxious weeds within the fire area.

The work will be conducted by private contractors currently under an ID/IQ contract administered by the Southeast region of the National Park Service. The Contractor will furnish all labor, equipment, personal protective equipment (PPE), herbicides, dyes and adjuvants for the control of invasive plants.

B. Location/(Suitable) Sites: See Invasive plant distribution map, results of 2012/2013 DASM (Appendix A). We used data collected from the 2012/2013 DASM and ground surveys to determine coverages of invasive plants in the fire footprint. The next DASM flights for BICY will be carried out in late 2020 or early 2021.

C. Design/Construction Specifications: Contractor work performance will consist of furnishing all labor, equipment, and supplies (including herbicide and adjuvants), and performing all operations for controlling invasive plants listed under Project Goals in the areas described in Project Description or delineated in Project Map(s). Every effort shall be made by the contractor to avoid damage to native vegetation or wildlife. The contractor is responsible for the control and/or removal of all invasive plants including mature trees/shrubs, saplings, and seedlings.

D. Purpose of Treatment Specifications: Control spread of non-native invasive species into susceptible burned areas that will change the native plant composition. Treatments will support development of native biological communities and more natural fire recovery by these communities.

E. Treatment Effectiveness Monitoring Proposed: For the Moon Fish project, multiple ground surveys during treatment and a reconnaissance flight post-treatment would be performed to determine effectiveness of project treatment. If a 95% kill rate is not achieved for any area of the project after three months following project completion, one additional thorough treatment of the project area will be the responsibility of the Contractor at no cost to the Government. Invasive plant treatments provided by BAR funding have been effective for multiple species, including the three listed for this project, in previous years (2008-present) within BICY. For a list of success BAR projects and species information see Appendix D.

This area of invasive plant treatment will be part of a larger ongoing invasive management program at BICY. Monitoring of invasive plants occurs continuously, but is primarily done with DASM at 5-7 year intervals. In DASM, locations and amounts of invasive plants are mapped to provide staff and contractors information to plan and manage operations. In addition, to DASM, NPS biologists practice EDRR methodology and evaluate areas within the Preserve for novel invasive species infestations during any type of field work.

CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM FY 21
Ground treatment (low to medium density Brazilian pepper) 250 acres	\$225,500
Ground treatment (low to medium density Melaleuca) 57 acres	\$57,000
Ground treatment (low to medium density Lygodium) 2 acres	\$3,000
Post-fire one-year floristic (invasive and T&E) fire footprint (26,000 acres) (Appendix B, budget details)	\$119,342
Post-fire state-listed Liguus snail survey across fire footprint (Appendix C, budget details)	\$110,658
TOTAL CONTRACT COST	\$515,500

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY21	5/1/2021	4/30/2022	S	Acres		26,000 acres	\$515,500
FY22	5/1/2022	4/30/2023	S			**FY21	\$285,500
FY23	5/1/2023	4/30/2024	S			**----	\$285,500
TOTAL							\$1,086,500

**BAR Funding Year 2 and 3:

BAR funding needs for year 2 and 3 as described above should be based on the actual invasive plant populations based on the one-year comprehensive surveys which includes an updated invasive plant survey and treatment protocol in response to T&E species. That dollar amount could be similar to year one's request or could be higher. For planning purposes, \$285,500 should be used as a placeholder until after the year one surveys are complete and a modified request is submitted.

SOURCE OF COST ESTIMATE

1.	Estimate obtained from 2-3 independent contractual sources.	
2.	Documented cost figures from similar project work obtained from local agency sources.	
3.	Estimate supported by cost guides from independent sources or other federal agencies.	C
4.	Estimates based upon government wage rates and material cost.	
5.	No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, E = Equipment M = Materials/Supplies, T = Travel, C = Contract, F = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

List Relevant Documentation and Cross-Reference Location within the Accomplishment Report.

Figure 1 Map of the Moon Fish Fire footprint

Appendix A Distribution of Invasive Plants within the Moon Fish Fire footprint (results of 2012/2013 DASM)

Appendix B Floristic Survey budget and details

Appendix C Liguus snail survey budget and details

Appendix D Lists previous BAR awards to BICY, including target species of the award

TOTAL COST BY JURSDICTION

JURISDICTION	UNITS TREATED	COST
Big Cypress National Preserve FYs 21,22,23	1	\$1,086,500.00
	TOTAL COST	\$1,086,500.00

BURNED AREA ASSESSMENT REPORTS

Objectives

To determine extent of area likely to be invaded by invasive plants and prioritize treatment based on distributions of T&E species.

Issues

Invasive non-native plants are located within and adjacent to the burned area.

Observations

Background information: The burned area is dominated by several plant communities: hardwood hammocks and prairies.

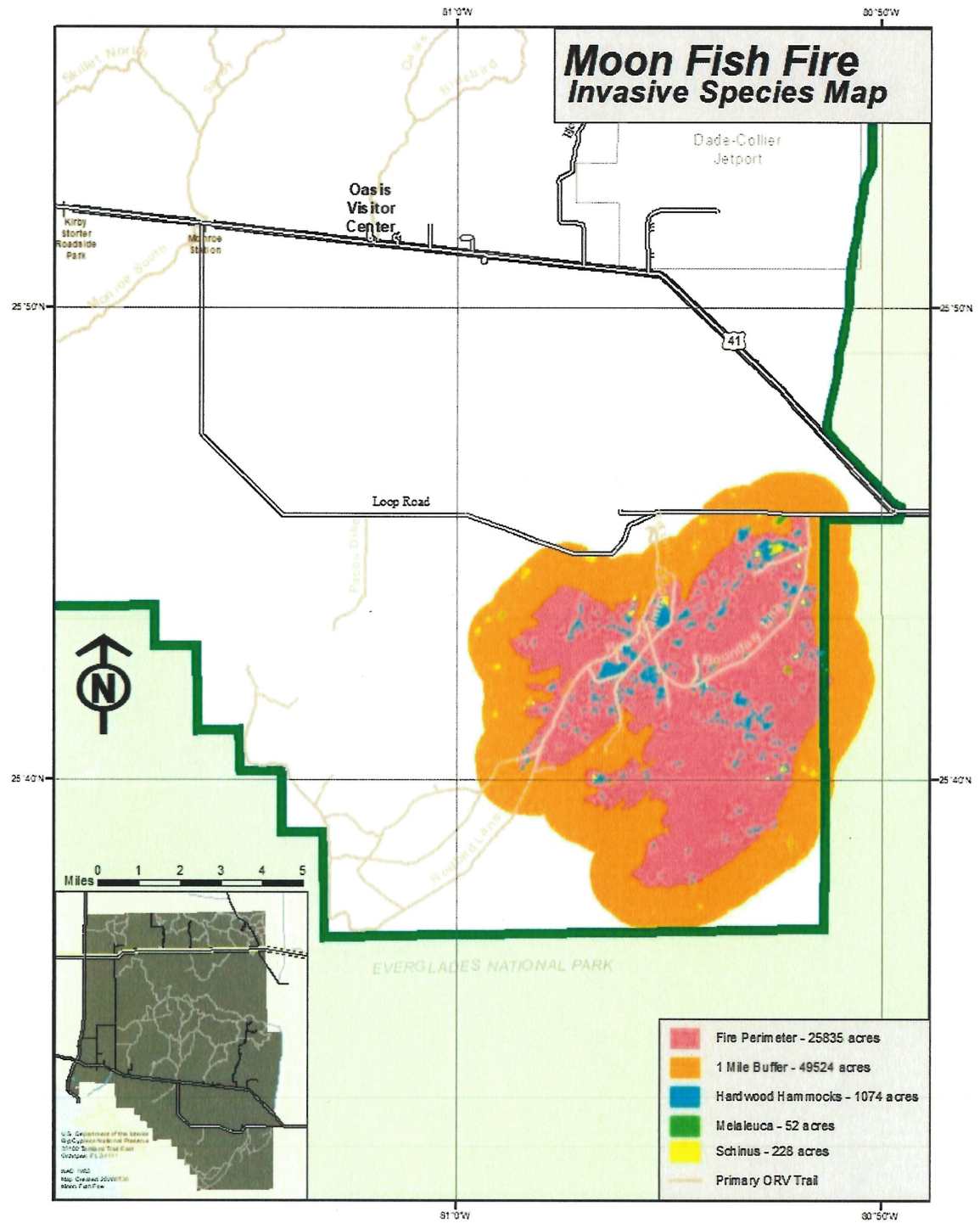
Reconnaissance Method: The initial reconnaissance was conducted on foot and SRF (2012/13). Documented invasive plants found within the fire perimeter include Brazilian pepper, Old World climbing fern, and Melaleuca.

Findings: Several areas burned with sufficient severity to warrant continued monitoring and control of invasive plants. Funds are requested for FY21, FY22, FY23 to treat invasive plants.

Recommendations

Management (specification related):

Rehabilitation funds are requested to completely treat all invasive plants within the fire footprint. In addition, to comprehensively survey the wildland fire footprint for listed T&E plant and state-listed Florida tree snail species to direct and prioritize invasive species treatments.



Appendix A. Moon Fish Fire perimeter with invasive species distribution

Appendix B. Comprehensive floristic survey (invasive and T&E species) budget

Survey of approximately $\frac{3}{4}$ of the hammocks within the Moon Fish Fire footprint

317 hammocks x 2.5 hammocks/day = 127 days

2 Field Botanists at \$62.00/hr x 10/hrs/day = **(\$620/day)**

Survey work = 127 days x \$620.00/day = **(\$78,740)**

Process data = 10 days x \$620.00/day = **(\$6,200)**

Overhead for a Cooperative Ecosystem Studies Unit (CESU) Partner at 17.5% = **(\$14,864)**

Airboat fuel and maintenance = AV gas at approximately \$4.00 per gallon, plus required repairs or maintenance = **(\$7,500)**

Survey supplies (GPS units, notebooks, and field presses) = **(\$1,415)**

Survey Subtotal = **(\$108,719)**

Travel Expenses:

Overnight Accommodations at \$60.00/day x 137 days = **(\$8,220)**

Mileage approximately 90 miles from Miami to Big Cypress at \$0.445 per mile 60 round trips **(\$2,403)**

Travel Subtotal = **(\$10,623)**

Total Requested Floristic Survey Funding = (\$119,342)

Comprehensive site inventories will be executed on tree islands within the Moon Fish Fire footprint. Floristic inventories will be initiated within sites that were actually burned, along with the larger hammocks. Burned hammocks will have experienced more disturbance giving way to invasion; while, larger hammocks will likely have the most diversity of plants and the potential for a greater abundance of listed T&E species. To evaluate these sites, parallel transects will be used over the entire hammock area to prepare site lists, along with GPS coordinates of the presence/absence of invasive and T&E plant species. This data will be used to direct invasive species treatment across the fire footprint.

Appendix C. Liguus Tree Snail budget and detailed methodology

Budget

Salary and Wages:

Salary is requested for 1 post-doc for 1 year to carry out field surveys, and assist in data analysis
(\$45,000)

Salary is requested for an undergraduate OPS student for two semesters (20 hours per week at \$12.00 per hour for 39 weeks). This student will assist in field work and data collection for two semesters.
(\$9,360)

No salary is requested for Timothy Collins

Fringe Benefits:

No fringe benefits are requested for Timothy Collins, and fringe is not charged for undergraduate OPS students. Fringe benefits for the post-doctoral position are calculated at 34.29% **(\$15,430)**

Travel:

Travel funds requested include:

Per Diem when returning to Miami is impractical and inefficient for extended field work: 40 nights at rate of \$36 per day per person. **(\$2,880)**

Lodging for two at \$80.00 per person per night for 40 nights **(\$6,400)**

Mileage approximately 90 Miles from Miami to Big Cypress at \$0.445 per mile 80 round trips **(\$3204)**

Airboat fuel and maintenance:

(\$3,000) AV gas at approximately \$4.00 per gallon, plus required repairs or maintenance.

Materials and Supplies:

1 hand-held GPS units (for locating sites, marking transects, etc.) at **(\$450.00)**; laser rangefinder (for determining canopy heights and heights of snails in trees) **(\$350.00)**; 1 pair binoculars (for identifying snails high in trees) **(\$300.00)**; ladder **(\$100.00)**; digital camera with telephoto zooms (for recording images of snails, habitats, etc.) **(\$550.00)**, tags for non-damaging labeling of snails **(\$300.00)**

General field supplies: containers, transect tapes, headlamps, batteries, markers, rubber boots to be bleached between sites, notebooks, reagents and ethanol for specimen preservation, bottles, gloves, and tubes for collecting **(\$500)**.

Subtotal \$87,824

Indirect Costs: \$22,834

Indirect Costs for Florida International University are calculated at the federally negotiated off-campus rate of 26% MTDC.

Total Requested Funding: \$110,658

The goal of *Liguus fasciatus* surveys is to determine the status of Florida tree snail populations across the range of hammocks affected by the fire, and to provide baseline data that will be needed to monitor the recovery of Florida tree snails in these hammocks. It is estimated that *Liguus* inhabited approximately 40 islands within the perimeter of the Moon Fish Fire. The effects of the fire vary among islands, with small islands suffering greater effects. In addition to the fire-affected hammocks, nearby islands that appear to have been unaffected by the fire will be surveyed for comparative data. Initial meander surveys will be conducted over a 1-hectare area to survey for living tree snails, and for tree snail shells, which would indicate that snails occupied the site at one time, even if no living snails are found. If no snails are found, a second 1-hectare area will be meander surveyed. If it is established that tree snails occupy a given island, three 200-meter linear transects will be set up, with their ends GPS-located and marked by flagging tape or other temporary marking. Walking surveys of each transect will be carried out over 40 minutes. Each occurrence of a live tree snail will be recorded by color morph. Color morphs will be photographed, and, where permitted, will be documented by collections of dead shells. These shells will be deposited at the Florida Museum of Natural History on completion of the project. Other native Florida tree snails (*Orthalicus* and *Drymaeus*) will be noted when encountered. Recently-hatched or young of the year snails will be recorded. The tree species that snails are found on will be recorded, whether the host tree is near an edge or toward the center of a hammock, and the activity of the snails (moving, feeding, aestivating, mating, laying eggs). The soil/leaf litter depth will be measured to assess whether it is of sufficient depth for egg laying. Each transect will be traversed a minimum of five times to determine the index of abundance for each species. This index of abundance can be used to compare abundances among sites and to estimate trends in populations over time (Link and Sauer, 1997, 1998, 2002). Islands where living *Liguus* are found will be surveyed a second time during the year.

In addition to the surveys, for a subset of 8 islands, 80 m² plots will be established in parts of the hammock where *Liguus* occurs. Snails will be marked with a unique small tag near the apex of the shell, using liquid nails, which has been shown to be the best adhesive for field-based studies on invertebrates (Turner et al., 2012). After labeling, subsequent re-surveys of the population via observation will be conducted. Specifically, snails with markings are sighted and counted along with counts of snails without marks. All sightings occur within reasonable/safe reach of the observers. These plots will be surveyed twice during the year, with searches for marked snails within 20 m of the plots. The goals of the mark-resighting surveys are twofold, 1) to provide a more accurate estimate of the snail populations than can be provided by index of abundance comparisons, and 2) to enable comparison with past surveys of *Liguus* populations in Big Cypress (Bennetts et al. 2000a, b).

A final survey goal will be to assess whether the New Guinea Flatworm (*Platydemus manokwari*) has penetrated into the tree islands of the Big Cypress. This non-native predatory flatworm is reported to be widely distributed in Florida and has been verified in Collier and Monroe counties. The appearance of the NGF in South Florida has coincided with a startling decline in native tree snails and other land snails at some locations. At sites that are surveyed for *Liguus*, we will also look for evidence of flatworms, sometimes found within the shells of recently dead snails feeding on the carcasses, or in moist, protected areas, such as under logs or rocks. If flatworms are encountered, 3 will be collected for DNA sampling, with the samples destroyed by analysis. If it is established that NGF occupy a given site, five 5-meter-square quadrats will be randomly placed, and all of the flatworms in the quadrat counted to determine abundance.

Citations

- Bennetts, R. E., Sparks, S.A., and D Jansen. 2000a. Host-tree selection by Florida tree snails *Liguus fasciatus* (Müller, 1774) in Big Cypress National Preserve, Florida, USA. *The Nautilus* 114 (3) 112-116.
- Bennetts, R. E., Sparks, S.A., and D Jansen. 2000b. Factors influencing movement probabilities of Florida tree snails *Liguus fasciatus* (Müller) in Big Cypress National Preserve following Hurricane Andrew. *Malacologia* 42 (1-2) 31-37.
- Link, W. A., and J. R. Sauer. 1997. Estimation of population trajectories from count data. *Biometrics* 53:63–72.
- Link, W. A., and J. R. Sauer. 1998a. Estimating population change from count data: application to the North American Breeding Bird Survey. *Ecological Applications* 8:258–268.
- Link, W. A., and J. R. Sauer. 2002. A hierarchical analysis of population change with application to Cerulean Warblers. *Ecology* 83 (10) 2832-2840.
- Turner, R. L. Carter, G. M., Castro, I. C. and M. A. Minor. 2013. Use of adhesives to attached devices to invertebrates: Implications for depredation by ship rats (*Rattus rattus*). *New Zealand Journal of Zoology* 40 (2) 93-101.

Appendix D. Table of BAR awards to Big Cypress National Preserve, along with target species

YEAR	BAR Award	Target species
2008	Midrest Strickland BAR	Multiple species
2010	Deep Fire BAR	Schinus
2011	Deep Fire South BAR	Schinus
2012	Jarhead BAR	Multiple Species
2012	Jarhead Phase 2 BAR	Multiple Species
2014	Huckabee BAR	Multiple Species
2016	Huckabee BAR	Multiple Species
2016	Orange Blossom BAR	Schinus
2017	Birdon BAR	Multiple Species
2017	Mud Lake BAR	Multiple Species
2018	Cowbell BAR	Aerial Lygodium
2018	Parliament BAR	Aerial Melaleuca
2019	Cowbell BAR	Aerial Lygodium
2019	Avian BAR	Melaleuca
2020	Cowbell BAR	Aerial Lygodium