

Final Report

Short-term Response of Plant Species of Special Concern and Exotics to The 1998 Florida Wildfires

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Summary

The 1998 Florida wildfires burned over 500,000 acres with total estimated economic costs of \$622 to 880+ million. While the wildfires were destructive economically, ecologically some plant species of special concern benefited. This conclusion is based on surveys conducted on public lands that burned in the 1998 wildfires to investigate the short-term response of plant species of special concern and exotics following the wildfires. A list of species of special concern was compiled and selected sites were surveyed by inventorying plants in 100m² plots at roughly 0.1-mile intervals along roads and firebreaks within or adjacent to burns. Plots were established and surveyed during the fall of 1998 after the wildfires and resurveyed the following spring and summer. For most sites studied, little plant survey data existed. Plant species lists were developed and locations mapped as part of this study and the information given to the appropriate land management agency. Several new locations for the fall-flowering ixia, Florida toothache grass, Florida threeawn grass, and Rugel's pawpaw were discovered during the initial fall survey. Additional locations of Florida beargrass, wild cocoa and rain lily were documented during the summer resurvey. Logging activities were extensive following these severe-drought wildfires and often create conditions favorable for establishment of exotics, albeit none were detected during this study. The burns should, however, continue to be monitored because stable, reproducing populations of invasive species were noticed along right of ways that are on, or adjacent to the public lands surveyed in this study.

A portion of the support for this project was used to help fund a sub-study of the impact of the wildfire on the federally endangered Rugel's pawpaw, part of an ongoing Florida Natural Areas Inventory study to document the demography of the species. Population size was estimated at about 200 individuals before the wildfires while postfire surveys recorded over 2000 individuals and an increase in flowering. This overall project of the impact of wildfires on plant species of special concern has demonstrated that a suite of plants considered to be fire-adapted species has increased in abundance, frequency and flowering following the 1998 wildfires.

Introduction

Within a six week period during early summer 1998, over 1700 fires swept across 500,000 acres of Florida real estate. These fires which burned during severe drought left behind an enormous path of destruction on federal, state and private lands. Total cost of fire suppression and economic damages is estimated between \$622 and 880 million, ranking it as one of Florida's worst disasters (Mercer et al. 2000). In the wake of this disaster, many issues and questions arose. A multifaceted study was funded by the Joint Fire Science Program to address nine of these topics with the expectation that results of the study will provide information useful in reducing the devastation from future wildland fires that occur under severe drought conditions.

Fire plays a major ecological role in shaping the structure of most ecosystems in Florida (Abrahamson 1984, Platt et al. 1988, Abrahamson and Hartnett 1990, Christensen 1993). For

example fire temporarily reduces fuel accumulations, decreases insect and disease impacts, promotes a diverse groundcover by reducing woody vegetation and speeds up nutrient recycling. More specifically, fire stimulates the regeneration of longleaf pine, wiregrass and other "fire-adapted" native species by either topkilling fire-sensitive species, particularly in juvenile stages or by stimulating flowering and seed production (Hessl and Spackman 1995).

Few empirical studies exist that document the response of rare plant species to fire. This field of study has been hindered by the lack of knowledge of the taxonomy, habitat and physiological requirements as well as population locations (Hessl and Spackman 1995). In their review of fire effects on endangered and threatened plant species, Hessl and Spackman (1995) found 126 references pertaining to the effects of fire on 172 federally listed plant species nationwide with one-third being unpublished references. For Florida, only 15 published references were found. These describe fire responses of 52 of the 516 listed endangered and threatened plant species listed for Florida (Coile 1998). Of these species, only seven had been documented to occur within or adjacent to areas impacted by the 1998 Florida wildfires (Johnson 1998, Pers. Comm.). Baseline surveys of location as well as life history, physiological or reproductive information of plant species of special concern within the wildfires would be extremely valuable to the understanding of the response of these species to wildfires during severe drought and would contribute to the overall knowledge of fire effects on threatened and endangered plant species in Florida and throughout the U.S.

Non-native species invasions are prevalent in Florida - more than 900 have been documented. Invasive species generally outcompete native plant species, reduce biodiversity in natural plant communities and degrade ecosystems. Invasion of exotics is often associated with soil disturbance such as rock plowing, strip mining, bedding and disking activities in natural plant communities which allow invasive species to take hold (Westbrook 1998). During the 1998 Florida wildfires, over 250 miles of plowed fire lines were created to suppress fires and protect homes and other structures. These control lines varied in depth, width and occurred over a wide range of soil types offering a variety of disturbed sites where invasive species could become established. It's likely the seeds of some species were transported to these sites on suppression equipment, much of which came from other regions.

Objectives

The objectives of this study were to: 1) assess the status and first year response of known populations of plant species of special concern in areas affected by the 1998 Florida wildfires, 2) identify and map any new populations discovered during the course of this study and, 3) determine the extent of exotic species introductions in both burn areas and adjacent control lines.

Methods

Study Sites

A list of potential study sites for plant surveys was established based on a general map of wildfires on public lands constructed by the St. John's River Water Management District (SJRWMD) using compiled fire map data which was overlaid onto public land ownership maps within the SJRWMD (Fig. 1). Study sites were prioritized as high if known locations of species of special concern occurred on a burn, and low if they occurred on an unburned area (Table 1).

Table 1. List of names, ownerships, counties and study site priorities for public lands burned by wildfires in 1998.

NAME	OWNERSHIP	COUNTY	PRIORITY
Bayard Point	SJRWMD	Clay	HIGH
Buck Lake Conservation Area	SJRWMD	Brevard	HIGH
Cecil Field Naval Air Station	US Navy	Duval	HIGH
Hal Scott Regional Park	SJRWMD	Orange	HIGH
Haw Creek Conservation Area	SJRWMD	Volusia	HIGH
Heart Island Conservation Area	SJRWMD	Volusia	HIGH
Lake George Conservation Area	SJRWMD	Volusia, Putnam	HIGH
Lake George State Forest	FDOF	Volusia	HIGH
Lake Woodruff National Wildlife Refuge	USFWS	Volusia	HIGH
Osceola National Forest	USFS	Baker, Columbia	HIGH
Port Orange	Port Orange Authority	Volusia	HIGH
Princess Place Preserve	FDEP	Flagler	HIGH
Pumpkin Creek State Buffer Preserve	SJRWMD	Duval	HIGH
Seminole Ranch Conservation Area	SJRWMD	Volusia, Brevard	HIGH
Tiger Bay State Forest	FDOF	Volusia	HIGH
Tosahatchee State Forest	FDEP	Orange	HIGH
Austin Cary Memorial Forest	UFL	Alachua	LOW
Bull Creek Wildlife Management Area	SJRWMD	Osceola	LOW
Bulow Creek State Preserve	FDEP	Volusia	LOW
Deep Creek Conservation Area	SJRWMD	St. Johns	LOW
Graham Swamp Conservation Area	SJRWMD	Flagler	LOW
Haw Creek State Preserve	FDEP	Volusia	LOW
Jennings State Forest	FDOF	Clay	LOW
Moses Creek Conservation Area	SJRWMD	St. Johns	LOW
Ocala National Forest	USFS	Marion, Lake	LOW
Pellicer Creek Conservation Area	SJRWMD	Flagler	LOW
Seminole Ranch	SJRWMD	Brevard	LOW
Spruce Creek	FDEP	Volusia	LOW
St Johns National Wildlife Refuge	USFWS	Brevard	LOW
Three Forks Conservation Area	SJRWMD	Brevard	LOW

Species of Special Concern

A list of potential and known locations of plant species of special concern on or adjacent to each study site was compiled by Florida Natural Areas Inventory (FNAI) staff (Table 2). In addition, lists of plant species of special concern were reviewed for each county using both FNAI data and Florida Department of Agriculture and Consumer Services records (Coile 1998).

Table 2. Common name, scientific name, flowering time (phenology) and county of known locations of plant species of special concern on or adjacent to public lands burned by the wildfires in 1998.

COMMON	SCIENTIFIC	PHENOLOGY	COUNTY
incised groove-bur	<i>Agrimonia incisa</i>	July-October	Columbia
pinewoods bluestem	<i>Andropogon arctatus</i>	October-November	Brevard
Florida threeawn grass	<i>Aristida rhizomophora</i>	July-October	Baker, Brevard, Duval, Volusia
Curtiss' milkweed	<i>Asclepias curtissii</i>	May-September	Baker, Brevard, Flagler, Orange, Volusia
southern milkweed	<i>Asclepias viridula</i>	April-June	Baker, Flagler, St. Johns
Curtiss' sandgrass	<i>Calamovilfa curtissii</i>	August-November	Brevard, Flagler, Volusia
Bartram's ixia	<i>Calydorea coelestina</i>	April-June	Baker, St. Johns
sand butterfly pea	<i>Centrosema arenicola</i>	June-September	Brevard, Orange, Volusia
pigeon wing	<i>Clitoria fragrans</i>	April-June	Orange
large-flowered rosemary	<i>Conradina canescens</i>	April-June	Brevard, Orange, Volusia
Florida toothache grass	<i>Ctenium floridanum</i>	July-October	Baker, Columbia, St. Johns
beautiful pawpaw	<i>Deeringothamnus pulchellus</i>	May-?	Orange
Rugel's pawpaw	<i>Deeringothamnus rugelii</i>	May-September	Volusia
Chapman's skeletongrass	<i>Gymnopogon chapmannianus</i>	September-November	Columbia, Flagler
hartwrightia	<i>Hartwrightia floridana</i>	September-November	Baker, Volusia
lake-side sunflower	<i>Helianthus carnosus</i>	July-September	Flagler, St. Johns
pine pinweed	<i>Leachea divaricata</i>	May-October	Brevard, Volusia

nodding pinweed	<i>Lechea cernua</i>	July-December	Brevard, Flagler, Orange, Volusia
Catesby's lily *	<i>Lilium catesbei</i>	July-October	all counties
West's flax	<i>Linum westii</i>	June-August	Baker
Florida spiny-pod	<i>Matelea floridana</i>	April-June	Columbia, Orange
fall-flowering ixia	<i>Nemastylis floridana</i>	July-November	Brevard, Flagler, Orange, St. Johns, Volusia
Florida beargrass	<i>Nolina atropocarpa</i>	May-August	Brevard, Orange, Volusia
Scrub bay	<i>Persea humilis</i>	all year	Brevard, Flagler, Orange, Volusia
wild coco	<i>Pteroglossaspis ecristata</i>	June-September	Baker, Brevard, Columbia, Orange, St. Johns
Florida mountain mint	<i>Pycnanthemum floridanum</i>	May-October	Flagler, St. Johns
St. John's Susan	<i>Rudbeckia nitida</i>	may-July; September-October	Baker, St. Johns
chaffseed	<i>Schwalbea americana</i>	May-August	Brevard, Volusia
variable leaf crown-beard	<i>Verbesina heterophylla</i>	June-August	Baker, Columbia, St. Johns, Volusia
clasping warea	<i>Warea amplexifolia</i>	August-October	Orange
Carter's warea	<i>Warea carteri</i>	all year	Brevard
rain lily	<i>Zephranthes simpsonii</i>	January-June	Brevard, Flagler, Orange, Volusia

* Not currently tracked by FNAI.

Field Survey Methods

Survey methods included driving along major roads and firebreaks, stopping every 0.1 to 0.5 miles and creating a list of plant species within an estimated 100m² circular area at each stop. Permits for collecting plant samples were obtained from the appropriate public land agency. Unknown plant species and voucher specimens were collected for identification. Taxonomy followed Wunderlin 1998 and Godfrey 1988. Estimates of population size and reproductive output (e.g., number of flowers or flowering stems) were made where possible. All stops were described in field notes and species of special concern were marked on a map for subsequent surveys. General survey areas were monitored three times during the course of the study, fall 1998, and spring and summer 1999. No permanent markers were established therefore exact locations of areas were not resurveyed. Locations of new populations found were mapped and given to the appropriate land agency and the FNAI.

Information and maps describing the location, type (plowed or disked), and width of control lines were obtained from the 1998 Florida wildfire record archives stored at the Tallahassee Florida Division of Forestry office, various district offices and county fire management offices. Information regarding existing locations of invasive species prior to the wildfires was obtained through communications with personnel familiar with invasive species in the area. A sub-sample of control lines was selected for survey. Surveys were accomplished by walking control lines in spring and summer 1999 and noting any non-native species present with an emphasis on Cogongrass (*Imperata cylindrica*) and Chinese tallowtree (*Sapium sebiferum*). Where present, population size, extent and reproductive effort were documented as well as associated plant species.

Results

Field Surveys

Plant species of special concern were surveyed during six field trips totaling 45 days between October 1998 and July 1999. General plant surveys were performed on nine selected sites of high priority: Lake Woodruff NWR, Lake George SF, Tiger Bay SF, Rima Ridge (considered separately from Tiger Bay SF), Tosahatchee SR, Osceola NF, Heart Island CA, Buck Lake CA, and Seminole Ranch CA. Other sites briefly visited included Bayard Point, Haw Creek CA, Haw Creek SP, and Lake George CA. Field notes were compiled for each site visit and are presented in Appendix A.

Based on the location data compiled by the FNAI, there were no known locations for species of special concern within the burned areas of public lands prior to the 1998 wildfires, therefore, the impact of wildfires on existing populations could not be assessed.

Most of the selected sites had little previous plant inventory work prior to this post-wildfire survey, therefore a preliminary species list and map were created for each site. The exception to this was Tosahatchee SR where a plant species list existed for the reserve. Over 360 plant species were observed in this study and species lists were compiled for each selected site (Appendix B). Over 1030 plant specimens were collected as vouchers or for identification purposes (Appendix C). Specimens are currently archived at the USGS, National Wetlands Research Center's herbarium in Lafayette, LA.

Fall 1998 Surveys

The response of fall flowering plants was significant and resulted in new site locations for several species of special concern including *Nemastylis floridana* (four new populations), *Aristida rhizomophora* (four new populations), *Ctenium floridanum* (one new location), and *Lilium catesbei* (two new populations). These plant species were all observed within areas burned in

1998. New populations of *Nemastylis floridana* were recorded at Lake George SF, Heart Island CA, Buck Lake CA, and Rima Ridge. The endemic, Florida threeawn grass, *Aristida rhizomophora*, was likely to increase greatly as evidenced from it flowering after the wildfires. This species occurred in populations at Lake Woodruff NWR, Lake George SF, Tiger Bay SF, and Rima Ridge. One new location of the endemic Florida toothache grass, *Ctenium floridanum*, was observed in the Osceola NF. One new population of Catesby's lily, *Lilium catesbei*, was observed at Tiger Bay SF and one new population at Lake George SF.

Spring/Summer 1999 Surveys

New populations were observed for four plant species of special concern as a result of the spring and summer 1999 surveys. Only two species, Rugel's pawpaw, *Deeringothamnus rugelii*, and wild coco, *Pteroglossaspis ecristata*, occurred within areas that burned in the 1998 wildfires. The other two species, rain lily (*Zephranthes simpsonii*) and Florida beargrass (*Nolina atopocarpa*) were observed in areas not impacted by the wildfires, but within the public land areas surveyed.

New locations of Rugel's pawpaw were observed at Tiger Bay SF and Rima Ridge. New populations of wild coco were also observed at Rima Ridge. A new population of rain lily occurred at Tosahatchee SR and a new population of Florida beargrass at Rima Ridge.

Invasive Species

There were no newly established populations of invasive species observed during this one year, short-term survey following the wildfires. However, it is not unlikely that new populations of invasive species will be established in the future. Extensive populations of cogongrass and other invasive grass species (e.g. vasey grass, *Paspalum urvillei*), exist along highway, roadway, railroad and powerline right-of-ways that occur on or adjacent to the public lands surveyed. These existing populations are stable seed producing populations that are a continued threat to nearby public lands. Establishment is most likely to occur on heavily disturbed sites where the top six inches of soil has been disked or turned over (e.g. from heavy logging activities). Additional surveys are needed to check for and monitor any new populations of invasive species. The success in controlling invasive species is related to the ability to detect it early and act quickly to remove it.

Rugel's pawpaw Study

A separate study was conducted by Helkowski and Johnson (2000) to determine the impact of the 1998 Florida wildfires on known populations of Rugel's pawpaw, a federally endangered species. In this study, over 200 individual pawpaw plants marked with permanent markers were

resurveyed following the wildfires in August 1998. The results of this survey showed that over 90 percent of the marked plants resprouted following the fires and with up to 49% flowering. In addition, total individual counts at the three study sites showed over 2000 individuals emerging following the fire with 80% flowering. This result showed a 10-fold increase in the number of individuals in the population and increased flowering following the wildfires. The final report covering this sub-study is presented in Appendix D.

Discussion and Conclusions

Although the 1998 wildfires were economically devastating, from an ecological standpoint, many plant species of special concern benefited. This was most evident in the study of the federally endangered Rugel's pawpaw which increased in both number of individuals and reproductive output following the wildfires. Other fire-adapted species such as the fall-flowering ixia, and Catesby's lily and endemics such as Florida threeawn grass and Florida toothache grass all flowered after the wildfires. It was not possible to study the direct impacts of wildfires on existing populations of species of special concern because there were no known locations of prior to the wildfires other than the Rugel's pawpaw population in which we found a positive response of growth following the wildfires.

The exact mechanism that induces plants to flower following fire is uncertain. Some have suggested a hormonal trigger (Norman Pers. Comm.), while others have suggested that fire reduces competition, increases light availability and speeds up nutrient recycling, all of which stimulate flowering and growth (Pyne et al. 1996). The effect of fire on plant reproduction is most likely a combination of factors presented above. But irrespective of the mechanism, fire can have a significant positive impact on the growth and reproduction of a suite of plant species considered to be fire-adapted.

Although the establishment of invasive species was not evident in this study, the potential for establishment still exists on heavily disturbed sites resulting from fire suppression and logging activities. Future surveys on public lands should be continued to check for the establishment of invasives along roadsides and forest edges where soil disturbances were heaviest.

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Appendix A. General field notes associated with plant surveys of sites from fall 1998 to Summer 1999.

Appendix B. List of plant species observed at each site surveyed following the 1998 Florida wildfires.

Appendix C. Data and site location for plant specimens collected as part of the 1998-99 plant surveys following the 1998 Florida wildfires.

Appendix D. Final report for Rugel's pawpaw study - Helcowski and Johnson, 2000.