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Final Report

Ecological & Economic Consequences of the 1998 Florida Wildfires

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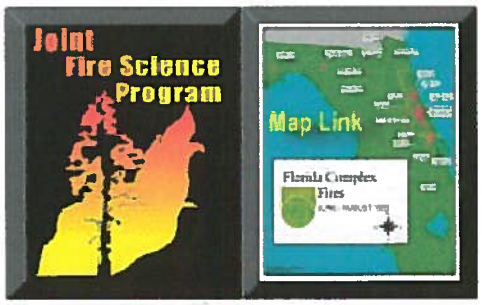

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Florida Forest Protection | Joint Fire Sciences

Tallahassee Weather

ECOLOGICAL AND ECONOMIC CONSEQUENCES OF THE 1998 FLORIDA WILDFIRES

Sue Grace and Dale Wade

EXECUTIVE SUMMARY

Over 2,000 wildfires burned 500,000 acres of Florida real estate, most of it between May and mid July, 1998. Although virtually every county was impacted, the fires were concentrated in the northeast quadrant defined by boundaries extending north from Orlando to the Georgia line and east from Orlando to the Atlantic Ocean. The fires occurred during record-breaking drought, consumed vast amounts of accumulated fuel in normally wet depressions that rarely burn in prescribed fires or during more typical wildfire conditions, and crowned through pine plantations and subdivisions forcing the evacuation of an entire county. Such extreme fire behavior is unusual but not unprecedented in Florida. Property damage, economic ramifications such as airport closures and tourism losses, natural resource damage, and suppression costs were estimated at between $620 and $890 million, ranking this as one of Florida's worst disasters. Air quality impacts such as respiratory problems requiring medical treatment were not addressed. The Joint Fire Science Board saw these fires as an opportunity to scientifically test some of the hypotheses raised in the wake of this catastrophe that resulted from the combination of two extreme events – record-breaking drought and an unusually high number of dry lightning storms. The research team assembled was comprised of people from: US Forest Service, Southern Research Station; US Geologic Survey, Biological Research Division; Florida Division of Forestry, Fire Control and Forest Management Bureaus; Florida Natural Areas Inventory; St. Johns River Water Management District; Auburn University; Dynamac Corporation; GP The Timber Company and; The Nature Conservancy. Study sites included a national forest, national wildlife refuge, several state forests, wildlife management areas, a state reserve, a water management district, and industrial woodlands. Individual study topics, objectives, results, and some management implications are presented below. Complete reports on each of these studies including a map of the fires, tables and figures can be found through the Florida Forest Protection Bureau web site at >http://flame.fl-dof.com/joint_fire_sciences<.

1) Topic: **Effects of Silvicultural Practices on Extreme Fire Behavior**

Objective:

- Determine potential fire behavior in pine flatwoods following partial timber harvest, prescription fire or understory herbicide application.

Results:

- For immediate reduction in potential wildfire behavior, prescription fire is best, but because of quick understory recovery, fire must be applied at least every 5 years.
- Partial harvest also provides immediate short-lived reduction in potential fire behavior, but necessary return interval is economically impractical.
- Eradication of understory with herbicides has no immediate fire behavior reduction benefits because dead stems remain standing. Beginning the 2nd year after treatment, however, potential fireline intensity decreased substantially and remained low for at least 6 years.
- Only prescribed fire and partial harvest reduced forest floor accumulations.

Management Implications:

- A short-interval prescribed fire program will substantially reduce overstory pine mortality during subsequent wildfires.
- In plantations a single herbicide application at crown closure will minimize potential fire behavior until harvest after a 2-year lag.
- Drought-season fires in herbicide-treated stands will have lower potential fireline intensity, but they will still be high severity and thus kill root systems, resulting in substantial overstory mortality.
- Combining fire and herbicide treatments untested, but should provide immediate and long-term reduction in both fire intensity and severity.

2) Topic: **Effects of Fuel Treatment on Overstory Mortality of Southern Pines**

Objectives:

- Quantify the effects of an array of prescribed fire frequencies on southern pine mortality after wildfire.
- Determine the effects of stand origin and site moisture level on overstory mortality after wildfire.

Results:

- Prescribed burn history significantly affected mortality.
- Mortality lowest in stands prescribed burned 1.5 years before wildfire (<10%).
- Mortality highest in stands where prescription fire not used (89%).
- Mortality significantly higher on normally wet areas than elsewhere (65% vs. 30%).
- No difference in mortality on sites burned by headfires and those burned by backfires.
- Little delayed mortality in planted stands, but some during 2 year in natural stands.
- Crown loss >75% was a good predictor of 2nd year mortality in natural stands.
- Stand origin (planted or natural) had no affect on overstory mortality when data adjusted for fact that trees usually not planted in normally-wet depressions.

Management Implications:

- A short-interval prescribed fire program will substantially reduce mortality during subsequent severe-drought wildfires.
- During severe drought fires, there is no difference in mortality between sites burned with headfires and those burned with backfires.
- Mortality is confined to 1st year in plantations but some takes place 2nd year in natural stands.
- 2nd year mortality can be reliably estimated 4 months after severe-drought wildfires.

3) Topic: **Performance of the BEHAVE Fire Prediction Model**

Objectives:

- Quantify BEHAVE model performance by comparing predicted to observed fire behavior.
- Document how Fire Behavior Analysts (FBA's) operationally used the BEHAVE model.

Results:

- First objective could not be met because copies of BEHAVE model runs were not found in archived FBA reports, nor was sufficient documentation provided to reproduce their BEHAVE runs.
- No single BEHAVE model worked so FBA's improvised to make predictions agree with observations by using different models for different outputs, adjusting input parameters until predictions matched observed behavior, or my abandoning the use of BEHAVE altogether and relying on their own expertise.
- Problems in data collection procedures are described and potential solutions suggested.

Management Implications:

- FBA's recognize the shortcomings of BEHAVE models and improvise to make reliable fire behavior predictions.)
- BEHAVE archive problems can be fixed.

4) Topic: **Predictors of Extreme Fire Behavior**

Objective:

- Correlate daily fire behavior, as measured by rapid fire growth, to the Atmospheric Dispersion Index (Lavdas Index) and the Lower Atmospheric Stability Index (Haines Index).

Results:

- Both indexes preformed well in predicting large fires in 1998 but not in 1999.

- Lack of wind information in Haines Index appeared to be a serious limiting factor.
- Lavdas Index had larger number of false alarms.
- A new index equivalent to the ratio of the Lavdas stability component to the transport windspeed component was best both years and had the fewest false alarms.

Management Implications:

- Using a ratio of stability to transport wind speed provides is a good indicator as to whether wind driven or plume dominated fires are likely on a given day. This information indicates which index is likely to perform best, Lavdas Index (wind driven cases) or Haines Index (plume dominated cases).

5) Topic: **Short-term Response of Plant Species of Special Concern and Exotics.**

Objectives:

- Assess the status and response of known populations of plant species of special concern.
- Identify and map new populations discovered during the course of the study.
- Determine the extent of exotic species invasions on burn areas and in adjacent control lines.

Results:

- Known populations of species of special concern all appeared to benefit.
- New populations of several species were found and mapped.
- Benefits were exemplified by the federally endangered Rugel's pawpaw which increased from 200 to 2000 individuals with increased flowering (80%).
- No exotics found on the burns but stable reproducing populations noted nearby.

Management Implications:

- Growing-season fires prior to August in this ecoprovince are likely to benefit uncommon plant species.
- Fresh burns will not necessarily be rapidly invaded by nearby exotic species.

6) Topic: **Fragmentation at the Landscape Level**

Objectives:

- Develop GIS-based maps showing fuel conditions useful in assessing fragmentation.
- Evaluate GIS-based fire and habitat maps for predicting and interpreting wildfire effects
- Determine effects of the fires on habitat suitability and population dynamics on a relatively isolated population of the federally listed Florida Scrub-Jay.
- Compare habitat suitability before extensive fire suppression (1943) with changes after 50 years of fire suppression using GIS.
- Use GIS to look for differences between areas occupied by Florida Scrub-Jays and unoccupied areas regarding fire history and habitat quality.
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Results:

- Florida Scrub-Jays cannot persist in habitat subjected to infrequent fire.
- Atlantic coast populations need more frequent fire than previously believed because vegetation recovers faster near the coast.
- GIS maps of landcover and fire boundaries are probably too coarse to predict and interpret the effects of wildfires.
- Habitat mapping applications are generally too coarse to provide the information needed for management and predicting population responses.
- Forest barriers between occupied and restored habitat should be expeditiously eliminated where the forests are artifacts of human activities.

Management Implications:

- Good Scrub Jay habitat requires frequent fire.
- Coastal scrub needs to be burned more frequently than interior scrub to provide suitable Scrub Jay habitat.

- Eliminate barriers between occupied and restored Scrub Jay habitat.
- Current GIS map capability too coarse to make specific postfire management decisions and predict population responses.

7) Topic: **Insect Responses**

Objectives:

- Determine tree mortality along a fire-intensity gradient.
- Monitor abundance of bark beetles and woodborers over time and correlate to tree mortality.
- Determine the prevalence of *Leptographium* spp. fungi in live tree roots.

Results:

- October 1998 survey showed tree mortality was related to fire intensity and ranged from 2% of trees in unburned control, 9% in low-intensity stands, to 64% in high-intensity stands.
- Predicted population explosion of bark beetles and subsequent increase in mortality during the summer of 1999 did not materialize.
- Of the trees alive in 10/1998, 31% in the high-intensity stands died, 2% in low intensity stands died, and 2% of the unburned control trees died during the next 12 months.
- Very little additional mortality occurred between October 1999 and June 2000 (<3% in high-intensity stands).
- No sampled trees in control plots had roots infected with *Leptographium* spp.
- No healthy roots found in high-intensity stands.
- >75% of live trees in high-intensity stands infected with *Leptographium* spp.
- 15-20% of sampled roots in moderate- and high- intensity stands had reproduction weevil larval galleries.
- 0-4% of sampled roots in controls and low-intensity stands had reproduction weevil larval galleries.

Management Implications:

- Most tree mortality occurred within the 1st year postfire.
- After large intense fires, bark beetle populations may not explode and attack adjacent unburned trees.
- Standing snags may not provide good conditions for brood survival during severe drought periods in FL (hot and dry).
- Do not immediately replant or reproduction weevils may be a problem.
- *Leptographium* prevalence is associated with fire intensity.
- Root weevil numbers and damage are high in high fire-intensity stands.

8) Topic: **Home Protection Strategies**

Objective:

- Evaluate the utility of some commonly recommended home protection strategies.

Results:

- This study reinforced 1985 study conclusions that use of metal soffits and amount of vegetation clearance around a home were the best homeowner strategies to provide protection from wildfire.
- Block construction (but not type of exterior), tile roof, lack of roof and yard debris, and defensible homeowner or fire department actions also all significantly increased the likelihood of home survival.
- Wooden privacy fences attached to, and firewood stacked next to, a house increased the likelihood of it sustaining fire damage.
- Only 16% of 75 homeowners interviewed were aware of wildfire protection strategies and only 8% had actually implemented one or more protection measures.

- The use of prescription fire at the Urban Wildland Interface (WUI) was very effective in protecting homes from subsequent wildfire. Of the 32 treated within 9 months prior to the '98 wildfires, only one was damaged.

Management Implications:

- Many of the interviewees were from a subdivision that had also lost several hundred homes to wildfire in 1985. The collective subdivision history of past conflagrations was thus either nonexistent, was not effectively passed on to new arrivals, or was dismissed as a one-time event.
- Agency efforts to communicate home protection strategies have not been fully successful and thus need to be increased and have the content and/or delivery system changed.
- Subdivision association bylaws, city/county ordinances, or state statutes/rules that spell out minimum structure protection thresholds should be considered.
- This analysis reinforces an Australian study that showed allowing homeowners to remain and protect their homes during conflagrations increased the probability of survival of both.
- The study shows fuel reduction measures such as prescribed burning at the WUI significantly improve the chance of structure survival during wildfire and should be greatly expanded.

9) Topic: **Economic Impacts**

Objective:

- Evaluate the efficacy of fuel reduction treatment policies and programs for reducing the economic impacts of catastrophic forest fires.

Results:

- Estimates of total damage from the '98 Florida fires ranged from $622 to $888 million.
- In the short run timber prices dropped with the sudden influx of salvaged timber but as soon as that supply declined, prices rose and have remained at a level above what they would have been had the fires not occurred.
- Forests at greatest risk under this severe drought were those coniferous stands in or near wetlands, especially bald cypress.
- Fragmentation of the forest appeared to increase wildfire risk.
- Wildfires within the past decade and reduced understory stature both reduced the likelihood of wildfire in 1998. Prescribed fire on the other hand showed only a weak statistically insignificant benefit. The effects of prescription fire on subsequent wildfire intensity were not addressed.
- In prior extreme-fire years, the number of small fires increased with a relative reduction in large fires, but in 1998, there were more large fires relative to small fires.
- Urbanization was positively correlated with area burned during 1998 in contrast to previous years.
- This ecoprovince accumulated a large wildfire deficit in the nine years prior to 1998.
- The 1998 wildfires more than consumed this deficit leaving the region with a wildfire "surplus". This did not happened in other Florida ecoprovinces during the same time period.

Management Implications:

- As Florida's population continues to increase, so will the economic cost of wildfires.
- As forests become more fragmented due to urbanization, anthropogenic wildfire risk will continue to increase.
- As the wildland urban interface expands, fire control forces are concentrating on structure protection at the expense of fire suppression, which results in larger fires.

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