Biophysical Indicators of Longleaf Pine Sandhill Change

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Sandhills

- **Species**
  - Long-leaf pine
  - Turkey oak
  - Wiregrass
  - Extremely rich herbaceous layer

- **Soils**
  - Sandy entisols
  - Leached

Source: [http://www.southernsustainableforests.org/restore/longleaf.html](http://www.southernsustainableforests.org/restore/longleaf.html)
Sandhills

- Naturally burn every 1 – 10 years
  - Especially adapted to fire
    - Longleaf pine grass stage
    - Masting
    - Wire grass
- Management is a key goal
  - Endangered species
    - Gopher Tortoise
    - Red Cockaded Woodpecker
Savannah

- Open canopy
- Relatively open mid-story
- Wiregrass groundcover
Photographed in Croatan National Forest, North Carolina on October 23, 1995

Source: http://persweb.direct.ca/blevins/savannah.htm

Longleaf Pine Sandhills
Longleaf regeneration in the "grass" stage.

Source: http://www.forestry.auburn.edu/samuelson/dendrology/pinaceae_pg/longleaf_pine.htm

Longleaf Pine Sandhills 16 October 2002
Grass Stage
Fire

- Periodic, recurring fires, represent a major selective force on plant characteristics, community structure, and function

- Surface Fires
  - Relatively Cool, fast-moving fires, where lightweight fuels are available and $O_2$ supply is high.
  - Damage to mature trees is usually minimal
Fire

- Brush burns intensely
- Longleaf pine (both the larger trees and younger ones) barely get scorched

Source: http://www.southernsustainableforests.org/restore/longleaf.html
Sandhill Succession

- Without regular fires sandhills generally succeed into hammocks
  - 10 years without fire
- Leaf Area Index (LAI) and productivity increase
  - Healthy sandhill LAI 0.5 to 2.0
  - LAI could be indicator of succession
- Soil fertility and CEC increase
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2 years

7 years

18 Years
Sandhill Succession

- In addition to fire suppression
  - Habitat fragmentation
  - Plantation forestry – conversion to other southern pines
  - Logging
  - Clearing for crops
- In Florida and Georgia
  - 90% of sandhill area lost in last 65 years
Prescribed Burns

- Officially, “it is the careful application of fire to vegetative fuels according to a written prescription and under specified environmental conditions” Florida Statutes (FS) Section 590.125
  - Reduces the risk of wildfire by decreasing shrub and herbaceous vegetation and accumulated dead fuels,
  - Improves wildlife or grazing habitat,
  - Promotes successful forest regeneration,
  - Cycles nutrients for healthy ecosystems, and
  - Maintains fire-dependent species.
Florida’s Prescribed Fire Act

- Prescribed burning reduces naturally occurring vegetative fuels
  - Reduces the risk of catastrophic wildfire
- Public education program in necessary to make citizens aware
- As Florida’s population grows, pressures from liability issues inhibit prescribe burning
  - Greater liability protection
Florida’s Prescribed Fire Act: Liability Protection

“No property owner or his/her agent, conducting a prescribed burn pursuant to the requirements of this subsection, shall be liable for damage or injury caused by fire or resulting smoke, unless negligence is proven.”
Media Reaction

- For the first time in Florida history, the state wants to mandate that some landowners burn brush on their property every few years - a key to preventing the wildfires that scorched homes this summer.

--St. Petersburg Times, Aug 6, 1998
Sandhill Habitat

- USGS critically endangered ecosystem
- Covered up to 34 million hectares
- Stretched from southern Virginia to eastern Texas
- Only about 2% remain
Native range

Source: http://www.forestworld.com/wow/wowonline_home.html

Longleaf Pine Sandhills

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Sandhill Area

Historic Distribution of Longleaf Pine

Approximately 25-34 million ha

Current Distribution of Longleaf Pine

< 2% of Historic Distribution

Source: Longleaf Pine Restoration Project 16 October 2002
Katherine Ordway Preserve

- 3,694 ha (9,500 acres)
- 42 km east of Gainesville, Florida
- Funded by $5.25 million grant in 1980
- Maintained by University of Florida to conserve native ecosystems, promote ecological knowledge
The Katharine Ordway Preserve occupies 3,642 hectares (approx. 9,500 acres) in the northwest corner of Putnam County, Florida.
Remotely sensed data

- Landsat Thematic Mapper (TM; WRS 17/39)
  22 March 1997
TM (4,3,2)
Mar 22, 1997

Ordway Preserve

Longleaf Pine Sandhills
Methods

● Burn map
  - Digitized into GIS

● Two categories
  - Frequency of burns in previous ten years
    - Two, one, zero burns
  - Years since last burn
    - 0 – 6, 7 – 9, and >= 10 years
Methods

- Random points generated using GIS
  - Program to extract weighted brightness values
- LAI computed with ANNs
- Anova
  - Tukey’s post-hoc test
Methods

- Artificial Neural Network
  - Backpropagation

![Diagram showing an Artificial Neural Network with labels for Brightness Values, Hidden Layer, and LAI connected to Bands 1 to 7.](image)
## Time Since Last Burn

<table>
<thead>
<tr>
<th>Time since last burn (years)</th>
<th># points</th>
<th>Average estimated LAI</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 6</td>
<td>159</td>
<td>1.05</td>
<td>0.66</td>
</tr>
<tr>
<td>7 – 9</td>
<td>367</td>
<td>1.21</td>
<td>0.52</td>
</tr>
<tr>
<td>&gt;= 10</td>
<td>197</td>
<td>1.93</td>
<td>1.18</td>
</tr>
</tbody>
</table>
Estimated LAI

Years Since Last Burn

0 - 6  1.05
7 - 9  1.21
>= 10  1.93
### Frequency of Burns

<table>
<thead>
<tr>
<th>Frequency of burns in last 9 years</th>
<th># points</th>
<th>Average estimated LAI</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>113</td>
<td>1.02</td>
<td>0.71</td>
</tr>
<tr>
<td>1</td>
<td>250</td>
<td>1.26</td>
<td>0.62</td>
</tr>
<tr>
<td>0</td>
<td>197</td>
<td>1.93</td>
<td>1.18</td>
</tr>
</tbody>
</table>
Estimated LAI

Burn Frequency in Last Ten Years

LAI
0 0.5 1 1.5 2

1.02 1.26 1.93

2 1 0
Post-Hoc

- Years since last burn
  - Differences between
    - 0 – 6 and >=10
    - 7 – 9 and >=10
  - No difference between
    - 0 – 6 and 7 – 9

- Frequency of burns
  - Differences between all groups
Post-classification change detection

- Land cover classification of two images into four spectrally-similar feature classes
  - Landsat Multispectral Scanner (MSS; WRS 16/39) 10 October 1972
  - Landsat Thematic Mapper (TM; WRS 17/39) 22 March 1997
TM (4,3,2)
Mar 22, 1997

Ordway Preserve

Longleaf Pine Sandhills
Land cover classification

- Sandhills (longleaf pine forest)
- Mixed hardwood forest
- Water
- Edge
1997 Land Cover
- sandhills
- mixed forest
- water
- edge

Katharine Ordway Preserve, Putnam Co., Florida
Source: classified Landsat TM, Mar 22, 1997
1972 Land Cover
- sandhills
- mixed forest
- water
- edge

1997 Land Cover
- sandhills
- mixed forest
- water
- edge

Katharine Ordway Preserve, Putnam Co., Florida
Source: classified Landsat MSS, Oct. 13, 1972
Source: classified Landsat TM, Mar. 22, 1997

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Results

- Changes from longleaf pine almost three times greater than changes to pine
- 18.1% of 1972 pine area lost in 25 years
Changes, 1972-1997
- from sandhills (18.1%)
- to sandhills (6.1%)
- other changes (8.8%)
- unchanged (67.0%)

Katharine Ordway Preserve, Putnam Co., Florida
Source: post classification change detection

Longleaf Pine Sandhills
### Matrix of land cover change (hectares), 1972 - 1997

<table>
<thead>
<tr>
<th>Class</th>
<th>1972</th>
<th>1997</th>
<th>Total</th>
<th>Total Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandhills</td>
<td>1,233</td>
<td>660</td>
<td>1,900</td>
<td>667 (18.1%)</td>
</tr>
<tr>
<td>Mixed forest</td>
<td>190</td>
<td>980</td>
<td>1,252</td>
<td>272 (7.4%)</td>
</tr>
<tr>
<td>Water</td>
<td>13</td>
<td>71</td>
<td>377</td>
<td>139 (3.8%)</td>
</tr>
<tr>
<td>Edge</td>
<td>23</td>
<td>91</td>
<td>164</td>
<td>142 (3.8%)</td>
</tr>
<tr>
<td>Total</td>
<td>1,459</td>
<td>1,802</td>
<td>3,694</td>
<td></td>
</tr>
<tr>
<td>Total Gains</td>
<td>226 (6.1%)</td>
<td>822 (22.3%)</td>
<td>39 (1.0%)</td>
<td>133 (3.6%)</td>
</tr>
</tbody>
</table>
Mixed forest changes

- unchanged (26.5%)
- to (22.3%)
- from (7.4%)
- other (43.9%)

Katharine Ordway Preserve, Putnam Co., Florida
Source: post classification change detection

Longleaf Pine Sandhills

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Changes

- Longleaf pine decreased, fragmented
- Mixed hardwood forest encroached
Possible causes

- Misunderstanding
- Delay in application and policy to catch up with knowledge
- High-profile failures
Media coverage

- Burning plans must be published
- Failures to control, damages reported
- Successes not reported
Public perception

- Fire in natural settings is always bad
- Controlled burns aren’t controlled
Los Alamos Fire

Source: http://www.disasterrelief.org

Longleaf Pine Sandhills
First Poster

Smokey Says -
Care will prevent 9 out of 10 woods fires!

Remember, Only YOU Can Prevent Forest Fires!

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Smokey

- Enormous advertising success
- Name and image recognition second only to Santa Claus
- Fire suppression is his only message
Future Research

- Sandhill study sites
  - South Carolina
  - North Carolina
  - Alabama

- Other variables
  - # of hardwoods
  - Proximity of hardwood ecosystems
  - Landscape structure
References