# Ecological Considerations for Forested Peat Wetlands: Meeting Biological Objectives at the Landscape Scale

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# Overview

- Introduction
  - Landscape conservation design
  - Proxy species as tool to develop objectives
- Habitat condition and spatial targets for forested wetland species indicators
- Management tools for to meet habitat targets
  - Fire
  - Hydrology
  - Forestry

  } Emerging carbon markets to facilitate delivery
- Summary

# Landscape-Scale Conservation Design (LCD)

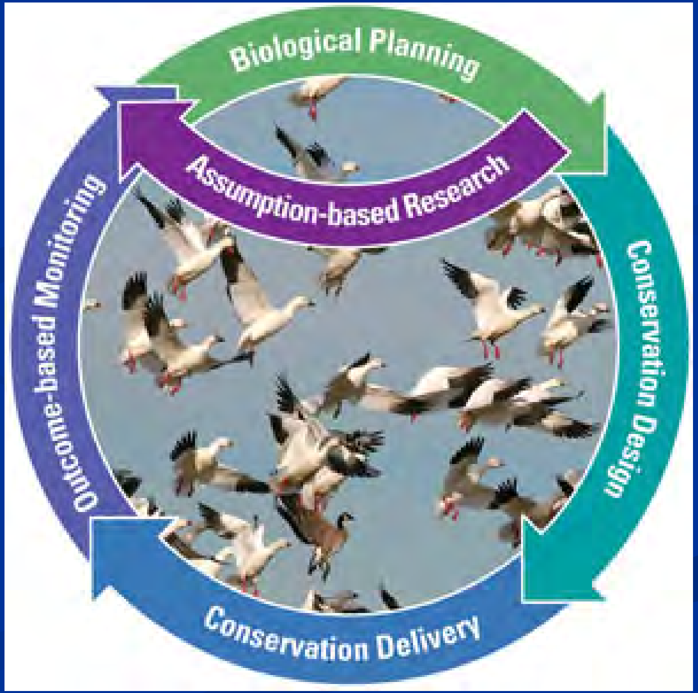
- **Goal**: Functioning landscapes that support sustainable fish and wildlife populations in viable ecosystems now and into future
- **Challenges**:
  - Water and energy demands
  - Anticipated climate change impacts
  - Habitat loss
  - Economic realities

**HOW? Focus resources on biological outcomes to maximize conservation results**

# Finding Efficiencies: Conservation by Proxy

*Surrogate species (e.g., focal, umbrella, indicator, representative, keystone)*

- With partners, establish conservation objectives for priority species and their habitats
- Target conservation actions to meet objective
- Measure outcomes
- Adaptive management




Strategic Habitat Conservation Elements: Credit: USFWS.

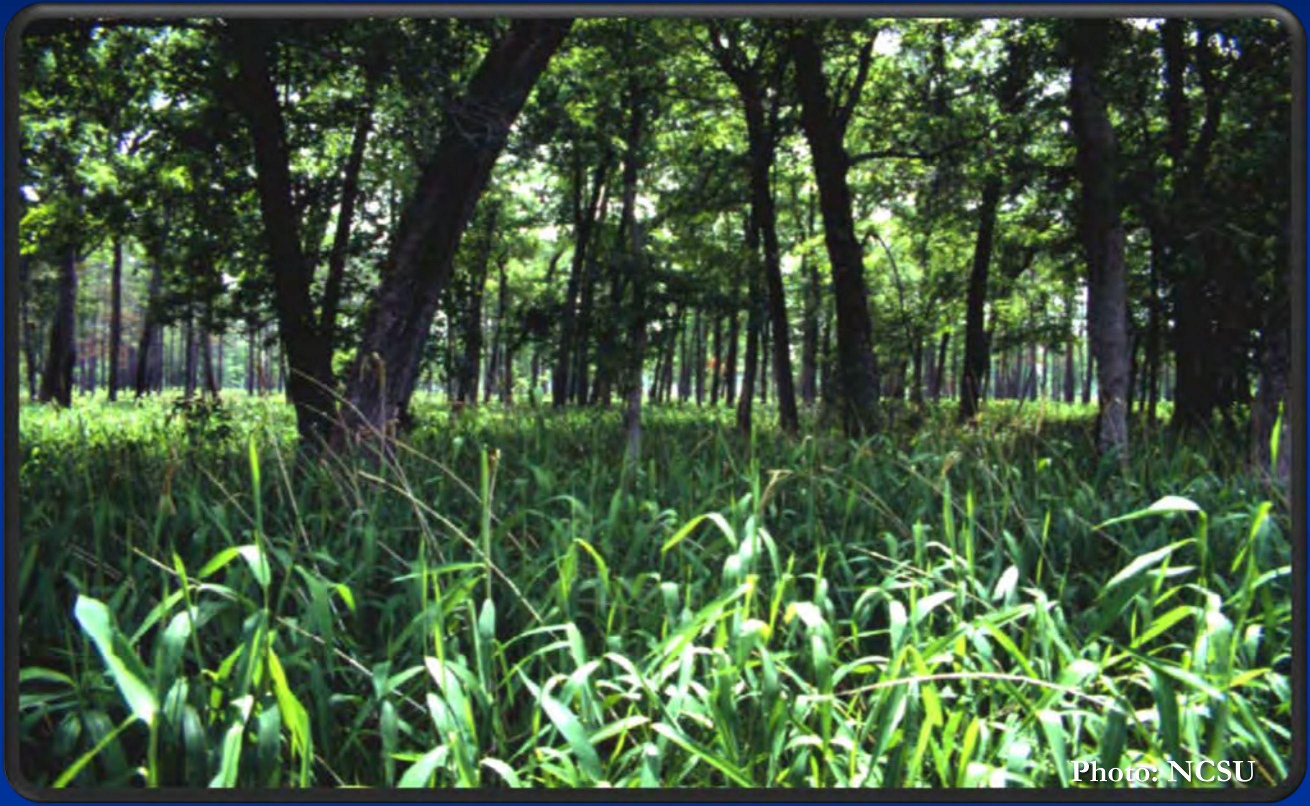
# Implications for forested wetlands: how do we choose how much to do what and where?

- Recovery Plans for Threatened and Endangered Species
- Migratory Bird Conservation Plans (NAWMP, Flyway, PIF, Shorebirds, Waterbirds)
- State Wildlife Action Plans, TNC Ecoregional Plans, etc.
- Landscape Conservation Collaboratives (emerging blueprint, resource indicators/targets)

# Non-Alluvial Forested Wetlands

Photo: D. Suiter, USFWS

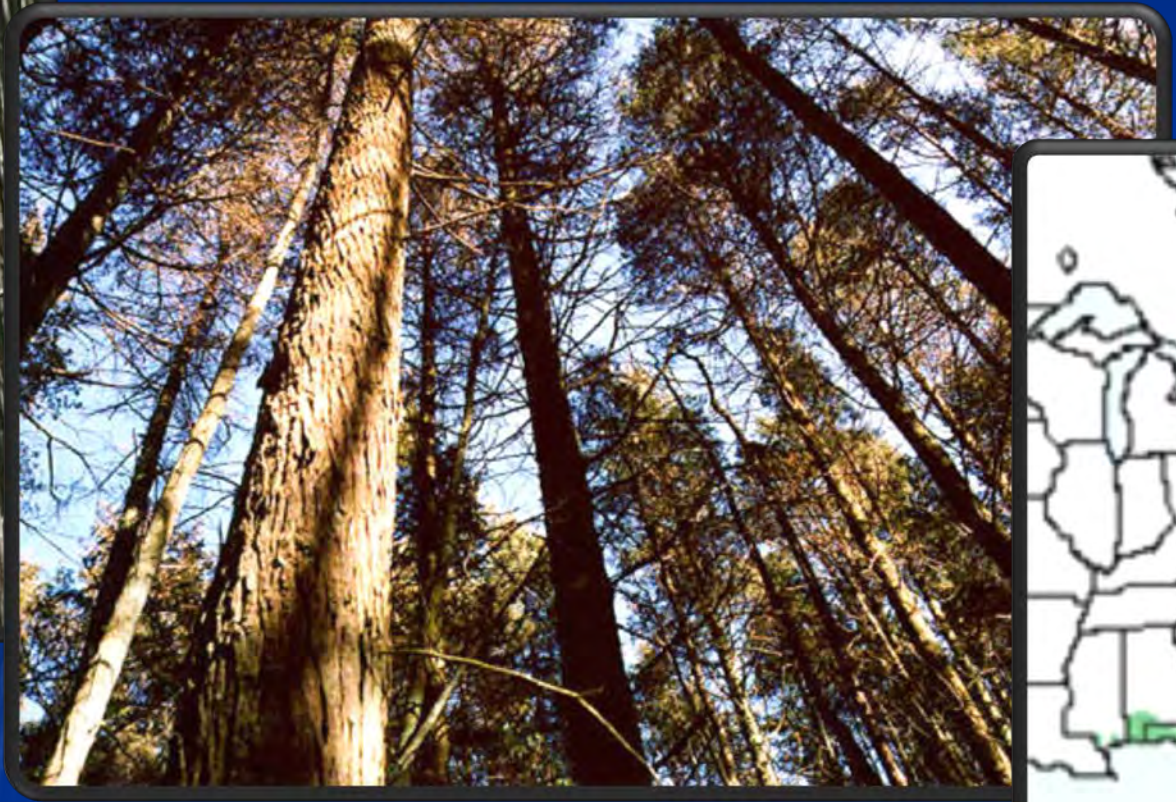
# Canebrake



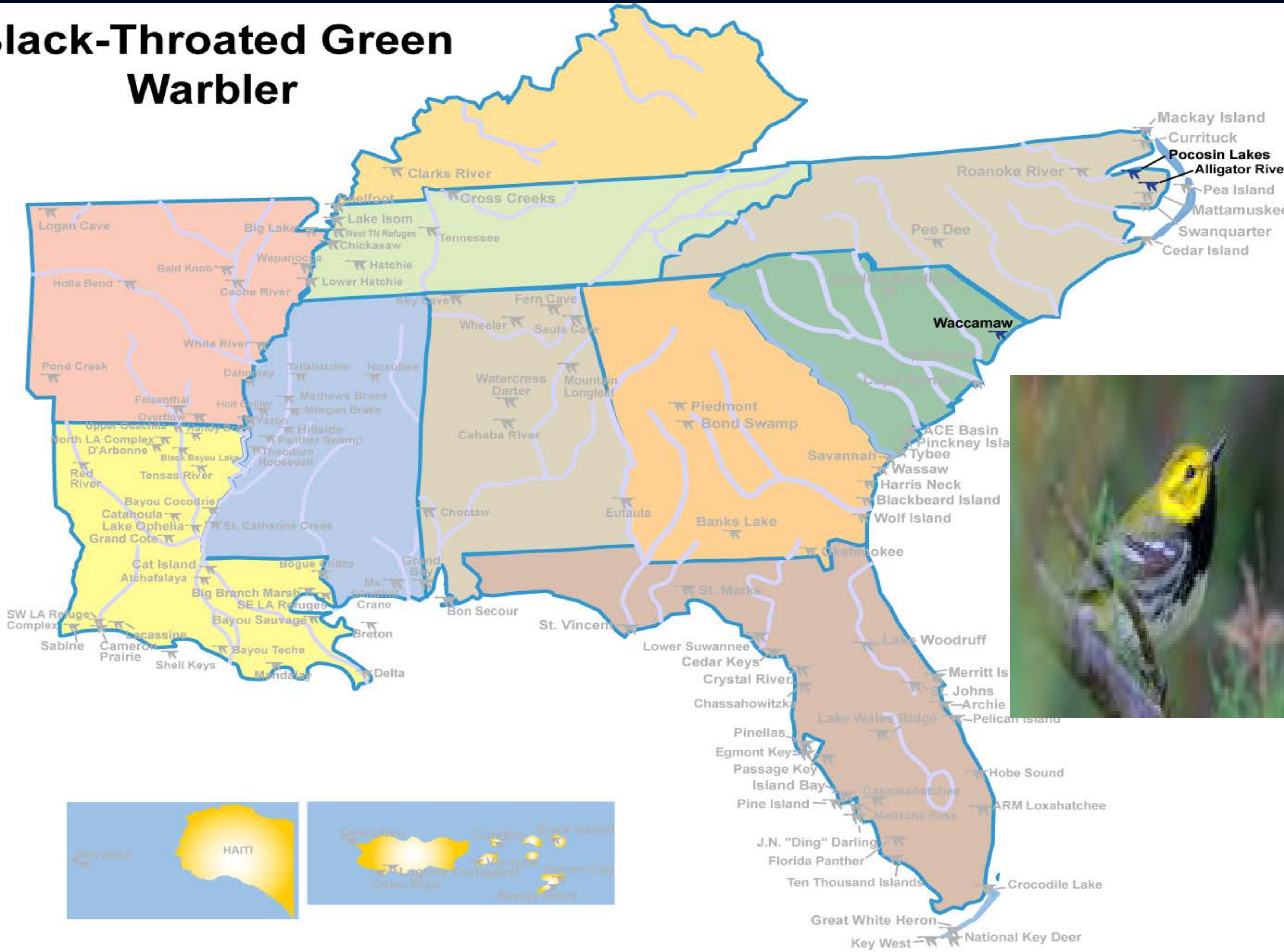
# Bay Pocosins

# Swainson's Warbler

# Atlantic White Cedar Forest



# Black-Throated Green Warbler



## Ecological Suites

## Habitat Spatial Targets

**Swainson's Warbler**
Prothonotary Warbler
Hooded Warbler
Wood Thrush
Acadian Flycatcher

**Goal: 500 Pairs**

Forest Blocks **10-20,000 acres**, assuming substantial unsuitable habitat is included in estimate

**Black-throated green warbler**
Cerulean warbler
Kentucky Warbler
Summer Tanager
Yellow-billed Cuckoo
Eastern Wood-Pewee

**Goal: 500 Pairs**

Forest Blocks **20-100,000 acres**
same as above

**Red-shouldered Hawk**
Swallow-tailed Kite
Broad-winged Hawk
Pileated Woodpecker
Cooper's Hawk

**Goal: 80-100 Pairs**

Forest Blocks **100-400,000 acres**


# Pond Pine Pocosin

# Habitat spatial targets for other priority open pine woodland species

Goal: 500 pairs/coveys/family groups

| | | |
|---|---|---|
| Red-cockaded Woodpecker | > 125,000 acres* | Pond Pine Pocosin |
| Red-headed Woodpecker | ~ 25,000-50,000 acres | Pond Pine Pocosin |
| Brown-headed Nuthatch | ~ 15,000-30,000 acres | Pond Pine Pocosin |
| Bachman's Sparrow | ~ 15,000-30,000 acres | |
| Northern Bobwhite | ~ 10,000-20,000 acres | |

* Acreages assume substantial areas included that are unsuitable for these species

# What about bears?

# Black Bear

Mackay Island
Currituck
Pocosin Lakes
Alligator River
Roanoke River
Pea Island
Mattamuskeet
Swanquarter
Cedar Island
Pee Dee
Clarks River
Cross Creeks
Lake Isom
West TN Refuges
Chickasaw
Hatchie
Lower Hatchie
Tennessee
Logan Cave
Big Lake
Wapanocca
Bald Knob
Holla Bend
Cache River
White River
Pond Creek
Dale Bumpers
Tallahatchie
Noxubee
Mathews Brake
Morgan Brake
Felsenthal
Holt Collier
Yazoo
Overflow
Hillside
Panther Swamp
North LA Complex
D'Arbonne
Black Bayou Lake
Theodore Roosevelt
Red River
Tensas River
Bayou Cocodrie
Catahoula
Lake Ophelia
St. Catherine Creek
Grand Cote
Cat Island
Atchafalaya
Bogue Chitto
Big Branch Marsh
SE LA Refuges
Bayou Sauvage
SW LA Refuge Complex
Sabine
Lacassine
Cameron Prairie
Shell Keys
Bayou Teche
Mandalay
Delta
Breton
Crane
Grand Bay
Bon Secour
Key Cave
Fern Cave
Wheeler
Sauta Cave
Watercress Darter
Mountain Longleaf
Cahaba River
Choctaw
Eufaula
Piedmont
Bond Swamp
Banks Lake
Waccamaw
ACE Basin
Pinckney Island
Savannah
Tybee
Wassaw
Harris Neck
Blackbeard Island
Wolf Island
Okefenokee
St. Marks
St. Vincent
Lower Suwannee
Cedar Keys
Crystal River
Chassahowitzka
Lake Woodruff
Merritt Island
St. Johns
Archie Carr
Pelican Island
Lake Wales Ridge
Pinellas
Egmont Key
Passage Key
Island Bay
Pine Island
Caloosahatchee
Matlacha Pass
Hobe Sound
ARM Loxahatchee
J.N. "Ding" Darling
Florida Panther
Ten Thousand Islands
Crocodile Lake
Great White Heron
Key West
National Key Deer
HAITI

# Black bear habitat and area requirements (Rudis and Tansey 1995 JWM)

## Habitat Conditions

- Forested wetlands and surrounding uplands
- Adequate den sites (large trees or dry ground with very dense understory)
- Forest openings to support adequate soft mast production

## Habitat Spatial Targets

**Goal: 50 Adults**
**18,000 to 200,000 acres**

**Goal: 200 Adults**
**70,000 to 800,000 acres**

**Goal: 1,000 Adults**
**350,000 to 4,000,000 acres**

# Red Wolf

# Red wolf habitat and area requirements

## Habitat Conditions

- Forested wetlands and surrounding uplands
- Adequate den sites (open view from den, higher ground)
- Conditions that support prey base (whitetail deer, small mammals)
- Tolerant human interaction

## Habitat Spatial Targets

**Goal: 220 Adults**

Spatial need unknown, but bear spatial targets* suggest:

**More than 800,000 acres**

* Significant bear/wolf differences:

- Social structure
- 2 canids in landscape
- Prey base
- Human interactions

# Management tools to deliver population-level habitat targets

Fire

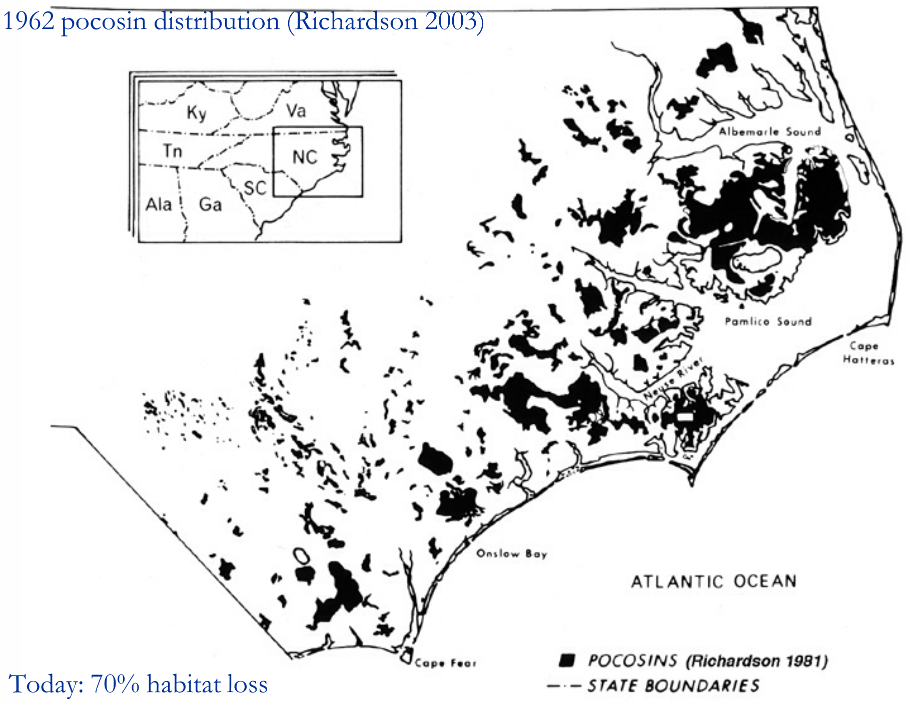
Hydrology

Forestry

# Pre-alteration pocosin fire

- Frequency: return interval determined by soil type, depth, water table and plant community among other factors
- Severity: mostly above ground fire; water table protective effect

1962 pocosin distribution (Richardson 2003)




Today: 70% habitat loss

# CELLS 33-64: SEVERELY NUTRIENT-LIMITED SITES

**AWC forest**

## FIRE FREQUENCY (in Frost, 1995[1])

| ⇓ ORGANIC MATTER DEPTH | | 1-3 YEARS | 4-6 YRS | 7-12 YRS | 13-25 YRS | 26-50 YRS | 51-100 YRS | 100-300 YRS | NEVER BURNED |
|---|---|---|---|---|---|---|---|---|---|
| | Seasonally wet mineral soils<br>ROW 1 | Species-rich wet prairie sim. cell 1. ARST, PLTE, SPTE, CTAR, TORA<br>CELL 33 | Species-rich wet prairie, dwarf shrubs<br>CELL 34 | Wet prairie, MYCE, ILGL<br>CELL 35 | Thicket of dense, small PISE, PIEL, NYBI, bay forest/shrubs<br>CELL 36 | Dense ACRU,NYBI, LIST, PISE, PIEL/MAVI, PEPA/Shrubs<br>CELL 37 | PISE forest, PIEL, ACRU, LIST/MAVI, PEPA/ ferns<br>CELL 38 | TADI, ACRU, NYBI, swamp herbs<br>CELL 39 | TADI, NYBI, ACRU<br>CELL 40 |
| | Soils with thin organic layers, 10-30 cm thick<br>ROW 2 | Diverse wet prairie and bog graminoids, forbs, and insectivorous plants<br>CELL 41 | Wet prairie with insectivorous plants and dwarf shrubs<br>CELL 42 | Low or medium pocosin<br>CELL 43 | Medium pocosin<br>CELL 44 | Tall pocosin, PISE forest, bay forest<br>CELL 45 | PISE forest, NYBI & ACRU forest, bay forest<br>CELL 46 | TADI, NYBI/ swamp herbs<br>CELL 47 | TADI, NYBI/ swamp herbs<br>CELL 48 |
| | Shallow histosols, 30-100 cm thick<br>ROW 3 | Open bog with pitcher plants, dwarf shrubs, graminoids<br>CELL 49 | Low pocosin with pitcher plants, other bog species.<br>CELL 50 | Low or medium pocosin<br>CELL 51 | Scrubby PISE/ medium pocosin<br>CELL 52 | PISE-GOLA forest, bay forest with PEPA, MAVI ACRU<br>CELL 53 | Patch mosaic: PISE-GOLA forest, CHTH forest, TADI/ ACRU, NYBI forest, bay for.<br>CELL 54 | Patch mosaic: CHTH forest, TADI/ACRU forest, NYBI forest, bay forest<br>CELL 55 | TADI in wet swamps, cycling ACRU forest in peatlands (hypothetical)<br>CELL 56 |
| | Deep histosols, peat deeper than 1 m<br>ROW 4 | Open bog with pitcher plants, grasses and sedges, dwarf shrubs<br>CELL 57 | Low pocosin, with pitcher plants, other bog species<br>CELL 58 | Low pocosin<br>CELL 59 | Low pocosin<br>CELL 60 | Low or medium pocosin<br>CELL 61 | Medium pocosin (hypothetical)<br>CELL 62 | Tall pocosin, PISE-GOLA forest, bay forest (hypothetical)<br>CELL 63 | TADI in wet swamps, cycling red maple forest in peatlands (hypothetical)<br>CELL 64 |

SPECIES ACRONYMS: **ACRU**: Acer rubrum (Red Maple), **ANGL**: Andropogon glomeratus, **ARGI**: Arundinaria gigantea (Cane), **ARST**: Aristida stricta (Wiregrass), **CHTH**: Chamaecyparis thyoides (Atlantic White Cedar), **CLJA**: Cladium jamaicense (Sawgrass), **CLMO** Cliftonia monophylla (Black Titi), **CTAR**: Ctenium aromaticum (Toothache Grass), **CYRA**: Cyrilla racemiflora (Titi), **FRCA**: Fraxinus caroliniana (Water Ash), **FRPE**: Fraxinus pennsylvanica (Red Ash), **GOLA** Gordonia lasianthus (Loblolly Bay), **ILGL**: Ilex glabra (Gallberry), **LIST**: Liquidambar styraciflua (Sweet Gum), **MAVI**: Magnolia virginiana (Sweet Bay), **MYCE**: Myrica cerifera (Wax Myrtle), **NYAQ**: Nyssa aquatica (Tupelo or Water Gum), **NYBI**: Nyssa biflora (Swamp Black Gum), **PEPA**: (Persea palustris (Red Bay), **PIEL**: Pinus elliottii (Slash Pine), **PITA**: Pinus taeda (Loblolly Pine), **PLTE**: Picea tenuifolia, **SPTE**: Sporobolus teretifolius, **TAAS**: Taxodium ascendens (Pond Cypress), **TADI**: Taxodium distichum (Baldcypress) **TORA**: Tofieldia racemosa (False Asphodel).

[1]Frost, Cecil C. 1995. Presettlement fire regimes in southeastern marshes, peatlands, and swamps. Pg 39-60 in S.I. Cerulean and R.T. Engstrom, eds. Fire in wetlands: a management perspective. Proc. of the Tall Timbers Fire Ecol. Conf., No. 19. Tall Timbers Res. Station, Tallahassee, FL.

# CELLS 1-32: MODERATELY FERTILE SITES

**Canebrake**

## FIRE FREQUENCY

| ⇓ ORGANIC MATTER DEPTH | 1-3 YEARS | 4-6 YRS | 7-12 YRS | 13-25 YRS | 26-50 YRS | 51-100 YRS | 100-300 YRS | NEVER BURNED |
|---|---|---|---|---|---|---|---|---|
| Seasonally wet mineral soils<br>ROW 1 | Species-rich wet prairie with graminoids and grass-leaved forbs<br>CELL 1 | Species-rich wet prairie, with dwarf shrubs<br>CELL 2 | ANGL, ARGI, CLJA, ILGL, CYRA, CLMO tree saplings<br>CELL 3 | Small ACRU, NYBI, LIST, PISE, PITA, PIEL, TAAS<br>CELL 4 | Dense ACRU, NYBI, TAAS, LIST, PISE, PITA, PIEL/ ARGI, Shrubs<br>CELL 5 | PITA, PIEL, TAAS, QUMI, PISE, ACRU, LIST/ sparse ARGI, ferns<br>CELL 6 | TADI, FRPE, LIST, ACRU, NYBI, QUMI other bottomland oaks/mesophytic herbs<br>CELL 7 | TADI, NYBI, FRPE, LIST, ACRU, bottom-land oaks<br>CELL 8 |
| Soils with thin organic layers, 10-30 cm thick<br>ROW 2 | Wet prairie and bog graminoids and forbs, patches of ARGI, ANGL<br>CELL 9 | Dense canebrake<br>CELL 10 | Alternating canebrake and pocosin<br>CELL 11 | PISE, ACRU, PITA, PIEL, TAAS, LIST/ ARGI<br>CELL 12 | PISE, PITA, PIEL, TAAS, LIST, NYBI/ PEPA, MAVI<br>CELL 13 | PISE forest, PITA, PIEL, TAAS, bottomland hardwoods, bay forest<br>CELL 14 | TADI, NYBI, FRPE, LIST, PITA/ ACRU, FRCA/ Carex, swamp herbs<br>CELL 15 | TADI, NYAQ, NYBI/ ACRU, FRCA, ULAM/ swamp shrubs, herbs<br>CELL 16 |
| Shallow histosols, 30-100 cm thick<br>ROW 3 | Open bog with dwarf shrubs, graminoids, pitcher plants, short cane, mosses<br>CELL 17 | Dense canebrake<br>CELL 18 | Alternating canebrake and pocosin<br>CELL 19 | PISE/ canebrake, alternating with PISE-ACRU tall pocosin<br>CELL 20 | Patch mosaic: PISE forest, ACRU forest, CHTH forest, bay forest with PEPA, MAVI<br>CELL 21 | Patch mosaic: CHTH forest, TADI/ACRU forest, PISE forest, NYBI forest, bay for.<br>CELL 22 | Extensive CHTH forest and patch mosaic as in Cell 22<br>CELL 23 | TADI in wet swamps, cycling ACRU forest in peatlands (hypothetical)<br>CELL 24 |
| Deep histosols, peat deeper than 1 m<br>ROW 4 | Open bog with low shrubs, pitcher plants, grasses and sedges<br>CELL 25 | Canebrake or Low pocosin with ANGL, and bog herbs<br>CELL 26 | Alternating canebrake and pocosin, or medium to tall pocosin<br>CELL 27 | Tall pocosin with PISE, GOLA, ACRU; PISE forest, bay forest, CHTH patch mosaic<br>CELL 28 | Patch mosaic of types seen in Cell 22<br>CELL 29 | Extensive CHTH forests and patch mosaic of types seen in cell 22<br>CELL 30 | Extensive old growth CHTH forests and patch mosaic of types in cell 22<br>CELL 31 | TADI in wet swamps, cycling ACRU forest in peatlands (hypothetical)<br>CELL 32 |

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# Eastern NC umbrella species in forested wetlands: range of fire return cycles

Older-growth with 50-300 year return interval (e.g., Atlantic white-cedar)

- Black-throated Green Warbler

Require dense understories, likely 25-100 year return (both pond pine and bay pocosin, cane or hardwood)

- Swainson's Warbler
- Hooded Warbler

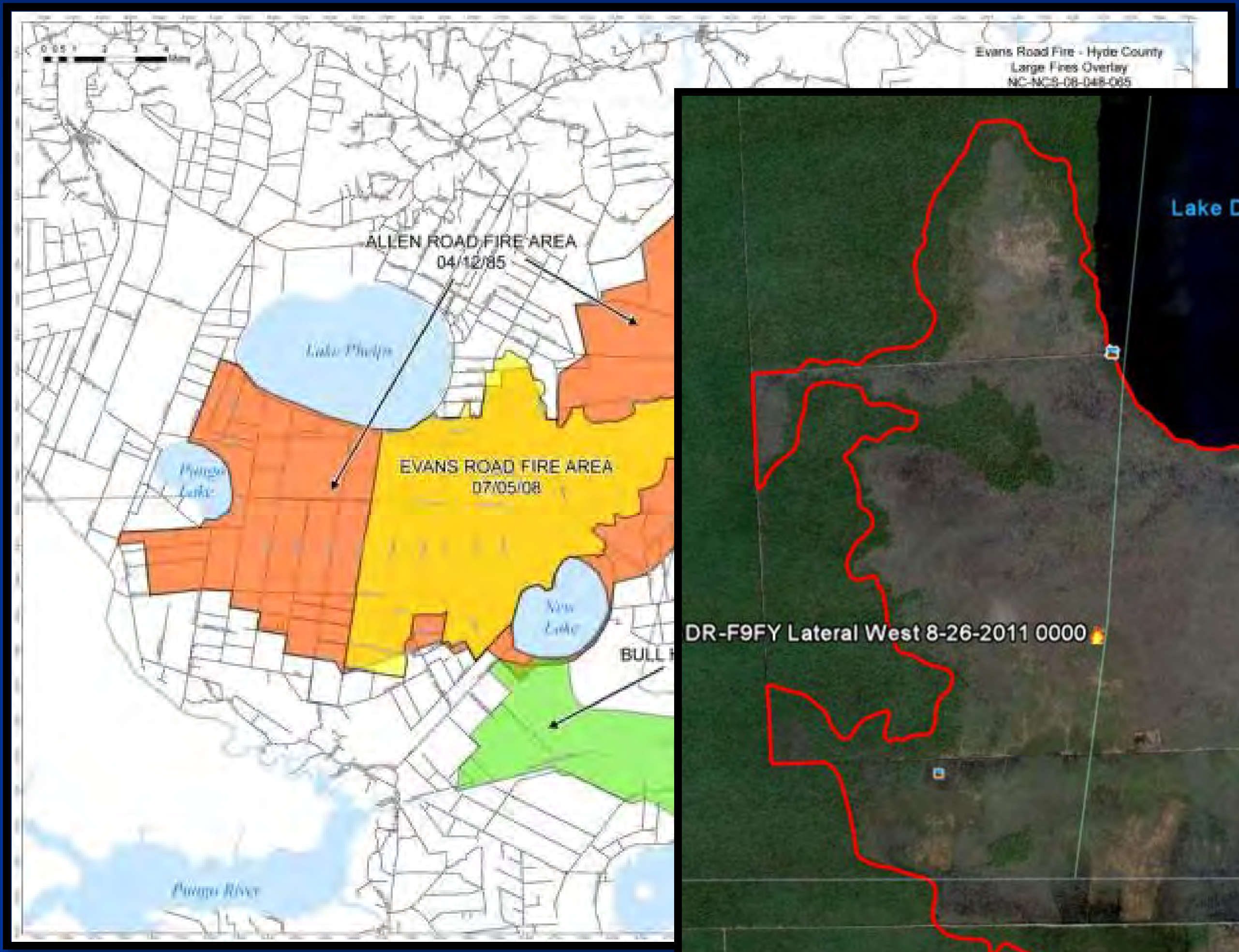
Require dense cover for denning and recent burns for prey

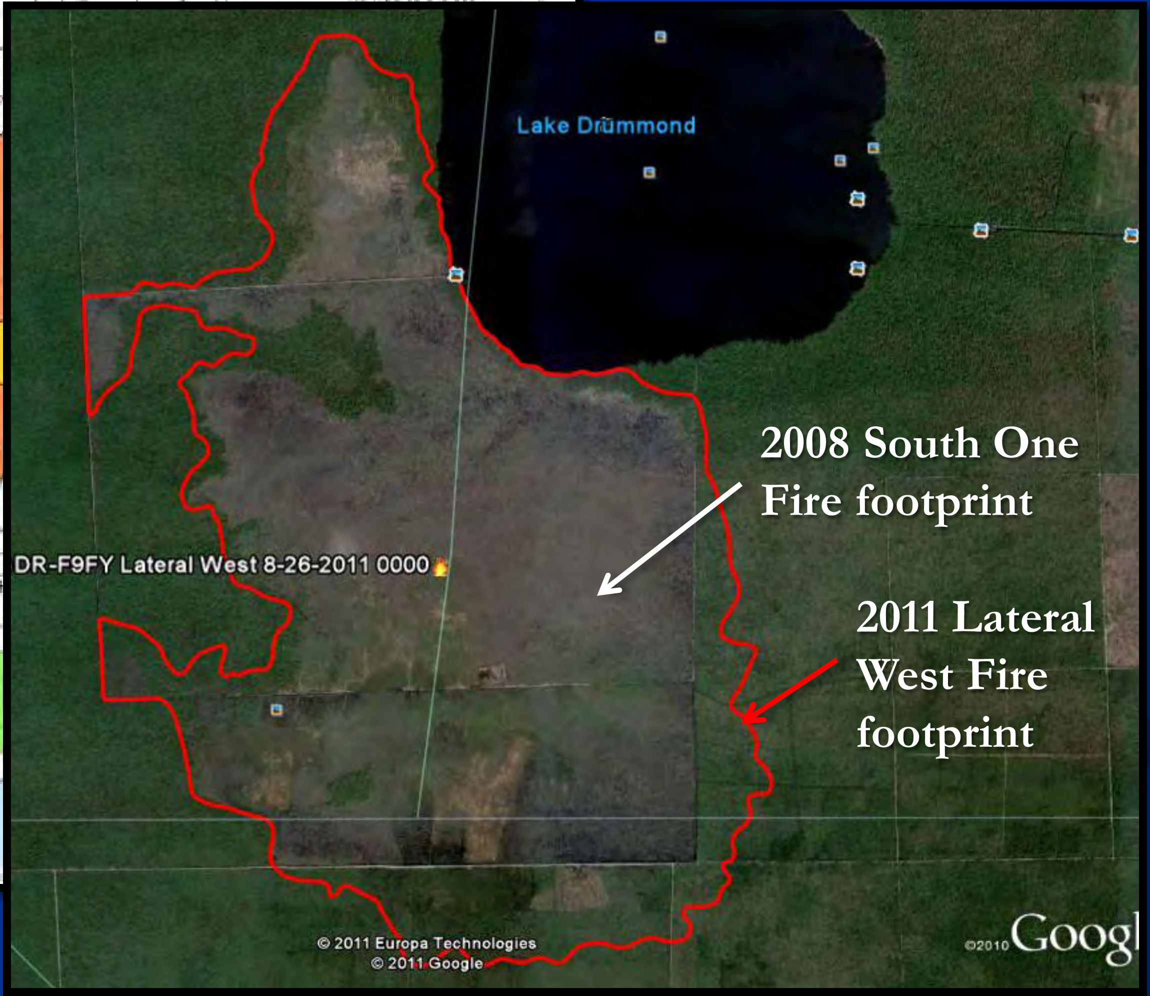
- Black Bear
- Red Wolf

Require pond pine clear of hardwoods in canopy (26-100 yrs)

- Red-cockaded Woodpecker
- Brown-headed Nuthatch
- Red-headed Woodpecker

# Wildfire frequency/severity greater than pre-alteration regime



# Why??

<u>In a word…drainage!</u>

- Historically:
  - Summer water table drawdown (up to 1 m+[1]) in domed peat caused some peat fire; rewetting regularly occurred
  - Seasonal soil saturation limited ground fire potential; allowed vegetation to burn (necessary in pocosin ecosystems)
- Now:
  - Extensive drainage network limits duration of seasonal flooding
  - Water table is lowered; peat is aerated/drier
  - Drainage prevents even significant rainfall (tropical) retention on landscape
  - Much more frequent ground fire; significant soil loss

# Management tools to deliver population-level habitat targets

Fire

Hydrology

Forestry

# Above ground fuel reduction not always enough…need to address fire vulnerability of peat soils


Hydrology restoration

- Raises water table
- Allows water storage before (prevention) and during (suppression) wildfires
- Permits above ground fire for habitat and fire management with less risk

# Water Management Capability

<u>Approach</u>:

- Install water control structures and culverts
- Use raised roads along the canals as levees
- Re-saturate historically drained areas via rainfall
- Manage to desired conditions


# Peatland Restoration Stops Soil Carbon Loss

| Drained Condition | → | Restored Condition |
|---|---|---|
| Loss of carbon by oxidation<br>(SOURCE) | | Carbon sequestration<br>(SINK) |

*Carbon partnerships can accelerate our restoration efforts*

# Emerging C Markets for "Rewetted" Peatlands

- In NC, sequestration driver is amount of carbon retained that would be lost via oxidation without restoration ("stop loss")
- We used literature to derive site-specific sequestration estimates

200 lb/ac/year of N

6500 lb/ac/year of C


Photo: DUWC

*To date, restoration at Pocosin Lakes NWR sequesters ~194,000 metric tons of $CO_2$/yr*

# Management tools to deliver population-level habitat targets

Fire

Hydrology

Forestry

# Management tools: forestry

## Young Forest

Dense canopy, small diameter trees, little understory

## Maturing Forest

Some canopy opening, more understory diversity

How do we move young forest structure to more old forest structure faster?

# Other forestry considerations

- AWC reintroduction
- Pine plantations – conservation lands of future?
- Potential for carbon sequestration to be tool to advance scale and delivery of projects

Photo: E. Hinesley, NCSU

# Summary

- Population objectives for umbrella species can inform landscape conservation design
- With spatial targets in place, manage for biologically-driven range of habitat conditions
- Fire and hydrology management should be considered in concert to meet goals
- Market-based incentives (e.g., carbon sequestration) as emerging tool to meet future landscape goals

Photo: USFWS

Photo: SSEC

# Thanks!

www.partnersinflight.org/bcps/pl_03sum.htm

www.waterbirdconservation.org/southeast_us.html

www.fws.gov/raleigh/pdfs/PeatlandRestoration_CSeqBenefits_Jan2010.pdf

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Photo: Ward, USFWS