# Habitat Restoration, Longleaf Pine Forests, and the Flatwoods Salamander

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## Goals of Today's Talk

- Introduce you to the science of Restoration Ecology.
- Give you examples of the theory and processes behind this field here in our own back yard.
- Show you the reality of this work through a local example of restoration.
- Take home message that this problem impacts all types of careers not just those in science (legal, political, economics).

## Habitat Restoration

- Habitat alteration and restoration has been ongoing since humans first arrived on the scene.
- However, in the last 300 years habitat destruction has increased at a catastrophic rate.

## Habitat Restoration

- Habitat loss is the leading cause of species extinctions and ecosystem declines.
- Habitat restoration has become a critical tool to stem the loss of biodiversity on our planet.
- A relatively new scientific discipline has been created to address these issues.

## Restoration Ecology

- Fairly new science.
- The foundations of Restoration Ecology were first laid out in the late 1980s by John Aber and William Jordan.
- So what is Restoration Ecology?

## Restoration Ecology

Any intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity, and sustainability.

-Society for Ecological Restoration, 2004

# Restoration Ecology

- Fairly new science.
- The foundations and name were first laid out in the late 1980s by John Aber and William Jordan.
- So what is Restoration Ecology?
- Though a subdiscipline of Conservation Biology, some have tried to draw contrasts between the two.

## Conservation Biology

- Attempts to preserve and maintain existing habitat and biodiversity.
- Zoological bias.
- Focus on endangered species.

## Restoration Ecology

- Attempts to reverse the impact of human habitat destruction and alteration.
- Botanical bias.
- Focus on ecosystems.

## Conservation Biology

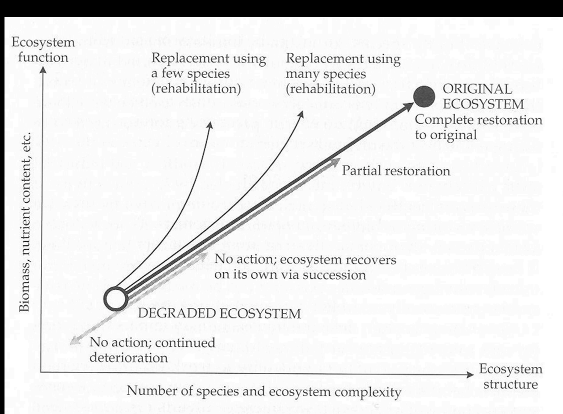
- Genetic/population level dynamics.
- Tend to have descriptive, comparative, and unreplicated studies.

## Restoration Ecology

- Landscape level dynamics.
- Tend to have studies with repeatability and more rigorous hypothesis testing.

# Approaches to Habitat Restoration

- No action
- Replacement
- Rehabilitation
- Enhancement
- Partial restoration
- Full restoration




# Important Concepts in Restoration Ecology

- Disturbance
- Fragmentation/Edge Habitat
- Succession
- Ecosystem Function
- Reference State
- Ontogeny

## Disturbance

Disturbance: a change in the environmental conditions that interferes with the biology of a system.

- Can be natural or manmade
- Important to understand and minimize the difference between the two.
- Often necessary to restore natural disturbance in ecosystem restoration.

## Fragmentation/Edge Habitat

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- Can limit gene flow.
- Drastically increases edge habitat.
- Edge habitat has a different set of environmental conditions than interior habitat, which can be ripe for invasive species.

## Succession

Succession: change in species composition in a system over time.

- Succession is a natural process.
- Natural disturbances limit the succession that occurs in some systems.
- Human disturbance can speed up or even prevent succession.

## Ecosystem Function

Ecosystem Function: the underlying foundations of a system.

- Includes things such as biomass, nutrient cycles, energy exchange, etc.
- In cases of severely degraded habitat, these factors must be addressed first before any successful project can be undertaken.

## Reference State

Reference State: an example that serves as the the goal for restoration.

- Very difficult in some instances.
- As a result, sometimes the best we can wish for is replacement or enhancement of a habitat.

## Ontogeny

Ontogeny: the idea that an organism's habitat needs change or shift as it grows and develops.

- A very real issue that has sometimes been neglected in restoration projects.
- Underscores the need for complexity in restoration projects (e.g. foraging grounds, breeding sites).

## Criticisms of Restoration Ecology

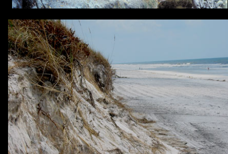
- We can't recreate natural systems.
- Mitigation fallacy.
- Just to complex to do properly.
- In order to restore something you need to know what it was (reference state, modern bias, what processes for what functions)?

## Terrestrial Restoration Projects

- Erosion control
- Reforestation/revegetation
- Removal of non-native species
- Control of invasive species
- Reintroduction
- Soil rehabilitation
- Fire management

## Erosion Control

- Loss of riparian habitats
- Siltation of rivers and streams
- Beach and dune erosion



## Reforestation/revegetation

- Prevents erosion
- Helps restore soil nutrients and other ecosystem functions.
- Should use native plants

# Kudzu (*Pueraria lobata*)

# Removal of Non-native species

- Perhaps the most difficult thing to do in habitat restoration
- Florida is home to more than 100 established, exotic vertebrate species and countless exotic plants

# Control of Invasive Species

- Invasive species are not necessarily exotic, but those that thrive in new and disturbed areas.
- Rehabilitating a damaged habitat often serves to control or eliminate invasive species

# Reintroduction

- Often requires the habitat to be at least partially restored before successful
- Serious issues concerning disease and gene pools

# Soil Rehabilitation

- Often necessary first step in the restoration process to restore ecosystem function
- Common in mine reclamation

# Fire Management

- Fire is a form of natural disturbance
- Some ecosystems require fire to prevent succession
- Longleaf Pine forests rely on fire in the southeastern U.S.

# Aquatic Restoration Projects

- Prevent drainage
- Reverse channelization
- Dam removal
- Removal of invasive species
- Reintroduction
- Fire management

# Prevent Drainage

- Many wetlands have been drained for agricultural land
- Perhaps the most famous example is the Everglades of South Florida

# Reverse Channelization

- Many waterways have been widened and deepened for economic reasons
- The Cross Florida Barge Canal project on the Ocklawaha River of central FL

# Dam Removal

- Most major river systems have some level of damming
- Damming prevents water from reaching other habitats
- Dammed water ways can lead to sediment buildup and eutrophication

# Removal of exotic/invasive species

- Perhaps even more difficult in aquatic environments
- Often requires herbicides, pesticides, or biological controls
- Sometimes political resistance

# Reintroduction

- Success depends on condition of habitat and species being reintroduced
- Often difficult due to other introduced species
- Issues with fishery hatched species

# Fire Management

- Fire can be just as essential to wetland habitats as it is to some terrestrial systems

# Longleaf Pine System

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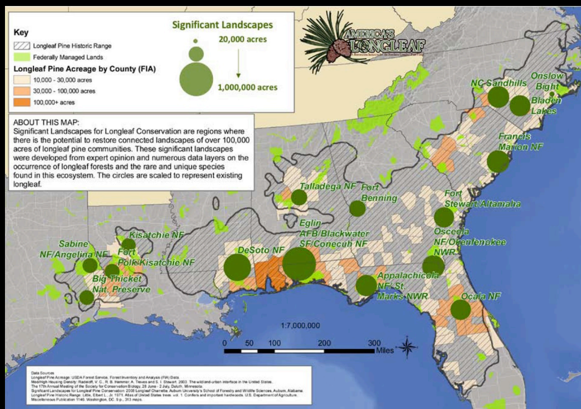
- However, intense logging, silviculture of other species, and fire suppression has relegated longleaf pine ecosystem to less than 5% of the original pre-settlement range.
- Fire is a natural disturbance that the system requires to exist.

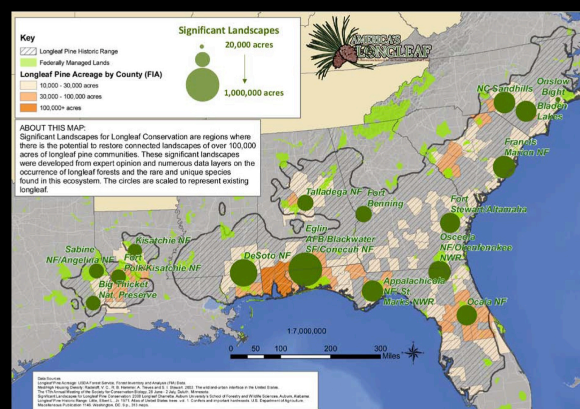



# Longleaf Pine Restoration

- With better understanding of the importance of fire in ecosystem management and political acts (such as the Federal Endangered Species Act, 1978), efforts have been made to restore the longleaf pine ecosystem.
- Problem: How exactly do we restore this long ago damaged system?

# Reference States

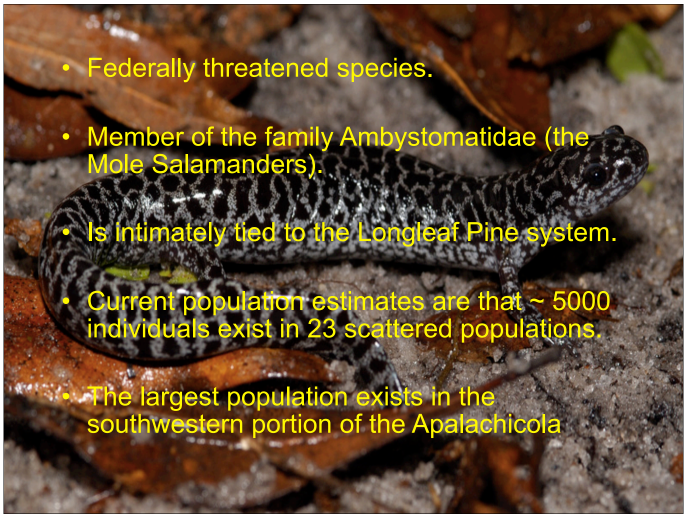
- Old photos
- Natural History notes (e.g. John Muir, William Bartram)
- Small tracts that received fire management (e.g. Wade Tract, Thomas County, GA)




# Apalachicola National Forest

- The largest and best managed tract of longleaf pine forest in existence.
- Primarily due to this being public land that has received a consistent burn regime.

# Flatwoods Salamander (*Ambystoma cingulatum*)




## So, what is happening to the Flatwoods Salamander?!

- Phylogenetic split?
  Now two species
- Disease?
  No evidence
- Road mortality?

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- Phylogenetic split?
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- Disease?
  No evidence
- Road mortality?
  Yes, but probably low impact
- Habitat degradation?
  Among the best managed Longleaf Pine Flatwoods we have!

## ANF Burn History

- The forest is burned on a 1-3 year cycle in the west and 3-6 year cycle in the east (largely due to politics).
- Historically, the compartments are burned during the winter time because it is easier to control the burn.
- Historically, fire breaks were placed around the wetlands to prevent their destruction.

## Pond Succession due to Improper Burning

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## Florida Comprehensive Management Plan Flatwoods Salamander

Restore pine flatwoods and savanna habitat, including native groundcover and wetland breeding sites, through habitat restoration, especially through use of growing-season burns (May - September), in areas where flatwoods salamanders used to occur but do not now.

## Florida Comprehensive Management Plan Flatwoods Salamander

Maintain or restore the landscape-level features that encourage natural metapopulation processes and genetic diversity and increase the likelihood of long- term survival of flatwoods salamander populations.

## Florida Comprehensive Management Plan Flatwoods Salamander

Re-establish or establish additional flatwoods salamander breeding sites and populations throughout its Florida range.

## Sekerak, 1994

- Spent two years quantifying overstory, understory, and faunal components of 10 healthy Flatwoods Salamander ponds.
- This work served as a reference state for what constitutes restoration of a healthy pond.

# Experimental Design

- Chose 19 random ponds at various levels of degradation from the southwest portion of the ANF.
- Ponds were previously classified as very likely, likely, or not likely as breeding sites for the salamander.
- Data was collected on the Sekerak variables prior to experiment.
- 10 ponds were chosen to be burned during the growing season with the assistance of the US Forestry Service.

# Experimental Design

- After one year of growth, all 19 ponds were resampled for the same variables.
- Pre and post-treatment data sets were then compared to each other.

# Preliminary Results

- Overstory more open in burned ponds.
- A higher diversity of understory plant species in burned ponds.
- A higher percentage of certain plant species in overall ground coverage.
- Amphipods increased and isopods decreased in burned ponds.

# Preliminary Results

- Overall, these results indicate a shift in our experimental ponds towards the “ideal” pond conditions from Sekerak’s earlier work.
- However, this is a complex data set and will need to be examined in much more detail.
- Furthermore, long term monitoring of these ponds is needed to be sure fire alone can return them to a natural state.

# Future Work

- Examining population genetics of Flatwoods Salamanders.
- Reintroduction of Flatwoods Salamanders into areas where they have disappeared, but where the habitat has been restored.