

Ecosystem Description

The communities in wet pine savannas are Coastal Plain mineral soil wetlands that under natural conditions were frequently burned. With frequent fire they have an open canopy dominated by longleaf or pond pine over a grassy herb layer. Shrubs are short and sparse with frequent fire, but become dense if fire is suppressed for more than a couple of years. There are three community types in this ecosystem group: pine savanna, Sandhill seeps, and wet pine flatwoods.

The pine savanna type occurs in flat areas that are saturated or even slightly flooded during the wetter parts of the year. The herb layer is dominated by grasses and sedges and a variety of low shrubs may be present, but are low and open if the savanna is frequently burned. The herb layer usually contains many showy composites, orchids, and insectivorous plants. One of the most notable features of Pine Savanna communities is their tremendous plant diversity at small scales.

Sandhill seeps occur on sloping seepage areas, where the wettest parts are essentially permanently saturated. They share many species with the pine savanna type but are more heterogeneous and more bog-like in character. In frequently burned seeps, grassy and sedgy areas can have a high diversity of plants, rivaling the Pine Savannas in species richness at small scales.

Wet pine flatwoods communities usually occur in flat areas, though sloping areas are possible. They resemble pine savannas in general structure, with an open pine canopy over a grassy ground cover with low shrubs. Wiregrass is always the dominant herb. Shrubs become dense if fire is excluded. Unlike pine savannas, the herb diversity is low. In many cases, only one to five species may be present in a square meter.

The 2005 Wildlife Action Plan describes Mid-Atlantic Coastal Plain Wet Pine Savannas as a priority habitat (see Chapter 5A) (NCWRC 2005). Green Swamp, Holly Shelter Game Lands, Sandhills Game Lands, and Croatan National Forest are good examples of this habitat (NCWRC 2005).

Table 1 at the end of this report provides a summary of expected climate change impacts to these natural communities.

Predicted Effects to Wildlife Species

Tables 2 through 6 at the end of this report identify the species of conservation concern and priority species that use habitats in this ecosystem.

These habitats are particularly important for reptiles and amphibians where ponds are embedded in savannas or flatwoods; however, little is known about herpetofauna in these areas. Three species of insects are endemics or near-endemics to wet pine savanna habitats in North Carolina. Five others are major disjuncts, with their next nearest populations in New Jersey, Florida, or in the case of *Papaipema eryngii*, the tallgrass prairies of the Midwest. *Apamea mixta* appears to have a highly disjunct population in the coastal savannas but also occurs in the Southern Appalachians.

While all of these species are associated with fire-maintained habitats, the majority depend on having a metapopulation structure to cope with fire, as well as other environmental perturbations. Five of these species have substantially lost their metapopulation structure and have become highly vulnerable to the effects of single catastrophic events, including wildfires. Because many examples of this habitat are now fragmented and isolated, uncontrolled fire that burns whole patches is a significant threat to many insect populations.

Fire suppression and a lack of growing-season prescribed burning has caused a thick shrubby understory to develop which shades out grasses and herbaceous ground vegetation and greatly reduces overall plant and animal diversity (NCWRC 2005). Microhabitats and ecotones have been lost due to fireline construction, and a lack of woody debris particularly impacts reptiles, amphibians, and small mammals. Many of the bird species of highest conservation concern inhabit these communities and depend on frequent fire to create suitable habitat conditions (e.g., red-cockaded woodpecker, Bachman's sparrow, Henslow's sparrow, brown-headed nuthatch, American kestrel, prairie warbler) according to Partners in Flight (Hunter *et al.* 2001b and Johns 2004).

Red-cockaded woodpeckers also use these habitats since they typically have a sparse overstory and open midstory that is preferred by the woodpeckers. Increased wind storm damage could affect canopy structure. Because of the slow reproductive rate and long life span of longleaf pine, increased wind mortality would reduce average age and might reduce natural canopy density. This would be detrimental to red-cockaded woodpeckers and other species that depend on older longleaf pine trees.

Climate Change Compared to Other Threats

The greatest threats to this system do not come from climate change. Intensively managed pine plantations, urban development, a lack of fire, and subsequent habitat fragmentation continue to threaten these communities (NCWRC 2005). Climate change may exacerbate some of these problems.

Table 7 compares climate change with other existing threats.

Threat	Rank Order	Comments
Development	1	Conversion for subdivisions, businesses, and golf courses permanently reduces available habitat and increases stormwater runoff
Conversion to agriculture/ silviculture	2	The threat of agricultural conversion has reduced in recent years (having greatly reduced habitat historically), but pine plantation conversion continues.
Logging/Exploitation	2	Many of the drier areas have been cleared for agriculture, converted to intensive forestry operations or development. Increased habitat fragmentation can create islands that become population sinks. Conversion of pine production to biofuel production will increase rotation periods and remove slash debris.
Fire	3	In the current settled landscape, these systems depend on prescribed burning for the fire they need. Inadequate fire is the greatest threat to protected examples. Severe wild fires in droughts, burning in excessive fuel loads, may cause ecological damage. Because many examples are now fragmented and isolated, uncontrolled fire that burns whole patches is a significant threat to many insect populations. Prescribed burning is crucial for retaining these systems in both the present and the expected future climate. Smoke management becomes a n issue along with wildfires that result from unsafe landowners burning debris. Firefighting methods can damage the habitats through use of heavy equipment and fire suppression chemicals.
Climate Change	4	Wet Pine Savannas are likely to be resilient to climate change effects. With drought, fuel loads could increase and contribute to catastrophic fire events. Increased high wind storm events causes wind throws that damage tree stands.

Summary and Recommendations

Protection of remaining examples and restoration of degraded examples would help the Coastal Plain landscape adapt to future climates, as well as provide benefits under the current climate. Keeping or restoring fire to these systems, through prescribed burning, is crucial to their long term survival in both the present and any future climate.

Most of their component species range well to the south of North Carolina. They are tolerant of drought, fire, and wind. Many have broad tolerance of varying moisture and nutrient conditions. However, they have been drastically reduced by conversion to other uses and degraded by lack of fire. This makes them more vulnerable to loss of species and degradation both by climate change and by other threats.

Recommended Actions

- Surveys
- Conduct priority species surveys to document the distribution, relative abundance and status of many wildlife species associated with these habitats. Priorities for conducting surveys need to focus on species believed to be declining, at risk or mainly dependent on these communities (NCWRC 2005).
 - Secondary priority for surveys should be for species for which current distribution information is already available or for species that are considered common (NCWRC 2005).
- Monitoring
- Long term monitoring should be initiated once baseline surveys have been conducted. Focus should begin with herpetofauna and bird species in decline, or for which little is known about the population fluctuations and demographics (NCWRC 2005).
- Research
- Determine better ways to construct fire lines and better ways to burn around populated areas where smoke would otherwise be a concern when burning.
 - Determine how to effectively restore altered portions of this habitat type and develop methods to manage them without fire.
- Management Practices
- Establish examples of well-maintained and burned savannas as demonstration sites for landowners to emulate. Burning should be accomplished without placing firelines in transition zones from uplands to wetlands and with the fire allowed to burn through transition zones (NCWRC 2005).
 - Habitat restoration should primarily occur through growing season prescribed burning, to develop and maintain the herbaceous layer and open pine stands. Where growing season burns can not be administered, winter burns can be constructive. Burning should be accomplished without placing firelines in transition zones from uplands to wetlands and with the fire allowed to burn through transition zones (NCWRC 2005).
 - Snags should be retained during logging operations to increase the numbers available for cavity-using wildlife species (NCWRC 2005).
 - Maintain sufficient levels of woody debris in stands for reptiles, amphibians and small mammals (NCWRC 2005).
 - Create barrow sites or ponds for breeding use by amphibians. Otherwise, amphibians are scarce in most flatwoods and savannas devoid of pools or open water (NCWRC 2005).
 - Watch for arrival of cogon grass (*Imperata* sp.) and other new invaders and control promptly.

Land
Protection

- Land acquisition and easements should be promoted through cooperation with local conservation organizations and state and federal agencies (NCWRC 2005).
- Protecting and restoring landscape connections is important to allow movements of mobile species and to improve the viability of small populations.

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Table 1. Predicted Impacts of Climate Change

Climate Change Factor	Comments
Invasive Species/ Exotics	Although no invasive exotic plants are a serious problem in these systems now, early detection and control of invasive exotic species (such as cogon grass) will reduce the ecological damage caused by invasives and the cost of controlling them. Preventative measures such as forbidding sale and transport of invasive species will help reduce the risks and cost. Fire ants are already a serious cause for concern for many of the animal species that inhabit savannas.
Drought	These systems occur mostly in low-lying areas that are unlikely to become extremely dry even in droughts. Sandhill Seeps are probably more vulnerable than other community types in this group because they depend on movement of shallow ground water. Droughts would dry them up, perhaps enough for plants to experience water stress. Many species excluded from them at present by wetness may be able to invade with drought.
Fire	Increased drought conditions and increased thunderstorm intensity may lead to more wild fires. These systems depend on fire and are often degraded by lack of fire. An increase in wild fires may allow some occurrences to burn in a way that is ecologically beneficial. However, wild fires in drought may be more likely to be too intense or extensive and to harm some species.
Compositional Change	If droughts are frequent enough, species of drier communities that are currently excluded by wet periods may be able to establish in them. While species of dry longleaf pine communities are presumably excluded from wet pine savannas by moisture, most other species are excluded more by frequent fire. Composition is unlikely to change much for sites that can be burned.
Latitudinal Change	These systems range well to the south of North Carolina. They and their component species are well adapted to warm temperatures. Increased temperatures might increase the range of these systems in the northern Coastal Plain and in Virginia. Most plants in these systems have limited dispersal ability even locally, so any influx of native species from the south is likely to be slow. The widespread conversion of potential sites in this region, the fragmented distribution of examples, and their dependence on fire make natural expansion difficult.
Structural Change	Increased plant productivity with a longer growing season may allow trees to become large faster. However, nutrient limitation will likely limit increased productivity in these systems. Wind damage

Table 1. Predicted Impacts of Climate Change

Climate Change Factor	Comments
Wind Damage	Longleaf pines are among the least susceptible trees to wind destruction, and it is unclear how significant increased wind will be to them. General forecasts suggest an increase in severe storms which may cause more wind damage to canopy trees.
Mild Winters	Flammability of pines varies with season and a change in seasonal phenology that makes them flammable earlier in the season would limit prescribed burning in savannas. Changes in phenology can disrupt pollinator and predator-prey relationships. Warmer temperatures may allow an increase in their abundance or rate of spread of fire ants and other invasive species. Mild winters, with decreased cold damage, may allow species from the south to move into North Carolina.

Table 2. Bird Species Utilizing Wet Pine Savannas

Species	Common Name	Element Rank	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/NC/WAP*	Comments
BIRDS							
<i>Aimophila aestivalis</i>	Bachman's Sparrow					/SC/P	
<i>Ammodramus henslowii</i>	Henslow's Sparrow					/SR/P	
<i>Colaptes auratus</i>	Northern Flicker					//P	
<i>Colinus virginianus</i>	Northern Bobwhite					//P	
<i>Dendroica discolor</i>	Prairie Warbler					//P	
<i>Falco sparverius</i>	American Kestrel					//P	
<i>Melanerpes erythrocephalus</i>	Red-headed Woodpecker					//P	
<i>Picoides borealis</i>	Red-cockaded Woodpecker					E/E/P	
<i>Sitta pusilla</i>	Brown-headed Nuthatch					//P	

Table 3. Mammal Species Utilizing Wet Pine Savannas

Species	Common Name	Element Rank:	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/NC/WAP*	Comments
MAMMALS							
<i>Mustela frenata</i>	Long-tailed Weasel					//P	

Table 4. Reptile Species Utilizing Wet Pine Savannas

Species	Common Name	Element Rank	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/ NC/ WAP*	Comments
REPTILES							
<i>Crotalus adamanteus</i>	Diamonded-back rattlesnake	G4/S1				/E/P	
<i>Elaphe guttata</i>	Corn Snake					/ /P	
<i>Eumeces laticeps</i>	Broad-headed Skink					/ /P	
<i>Heterodon platirhinos</i>	Eastern Hog-nosed Snake					/ /P	
<i>Lampropeltis calligaster rhombomaculata</i>	Mole Kingsnake					/ /P	
<i>Lampropeltis triangulum elapsoides</i>	Scarlet Kingsnake					/ /P	
<i>Ophisaurus attenuatus longicaudus</i>	Eastern Slender Glass Lizard					/ /P	
<i>Ophisaurus mimicus</i>	Mimic glass lizard	G3/S2				FSC/SC/P	
<i>Rhadinaea flavilata</i>	Pine woods snake	G4/S3				/W2/P	
<i>Sistrurus miliarius</i>	Pigmy Rattlesnake					/SC/P	

Table 5. Amphibian Species Utilizing Wet Pine Savannas

Species	Common Name	Element Rank:	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/NC/WAP*	Comments
AMPHIBIANS							
<i>Ambystoma mabeei</i>	Mabee's Salamander					/SR/P	
<i>Ambystoma tigrinum</i>	Eastern Tiger Salamander					/T/P	
<i>Bufo quercicus</i>	Oak Toad					/SR/P	
<i>Eurycea quadridigitata</i>	Dwarf Salamander					/SC/P	
<i>Hyla andersonii</i>	Pine Barrens Treefrog					//P	
<i>Hyla gratiosa</i>	Barking Treefrog					//P	
<i>Plethodon glutinosus sensustricto</i>	Northern Slimy Salamander					//P	
<i>Pseudacris brimleyi</i>	Brimley's Chorus Frog					//P	
<i>Pseudacris nigrita</i>	Southern chorus frog	G5/S4				//P	
<i>Pseudacris nigrita nigrita</i>	Striped Southern Chorus Frog					//P	
<i>Pseudacris ornata</i>	Ornate Chorus Frog					/SR/P	
<i>Rana capito</i>	Carolina Gopher Frog					/T/P	
<i>Scaphiopus holbrookii</i>	Eastern Spadefoot					//P	

Table 6. Invertebrate Species Utilizing Wet Pine Savannas

Species	Common Name	Element Rank	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/NC/WAP*	Comments
INVERTEBRATES							
<i>Acronicta sinescripta</i>	A dagger moth	G3G4/S1S3				/SR/	
<i>Agrotis carolina</i>	A dart moth	G2G3/S2S3	YES			FSC/SR/	May be re-synonymized with <i>A. buccholzi</i> , in which case its status changes from Endemic to Major Disjunct
<i>Amblyscirtes alternata</i>	Dusky roadside-skipper	G2G4/S2				/SR/	
<i>Amblyscirtes carolina</i>	Carolina roadside-skipper	G3G4/S3S4				/W2/	Should benefit from increased spread of fire-maintained cane meadows.
<i>Amblyscirtes reversa</i>	Reversed roadside-skipper	G3G4/S3				/SR/	Should benefit from increased spread of fire-maintained cane meadows.
<i>Apamea mixta</i>	A noctuid moth	GU/S1S2		YES		/SR/	Primarily and northern and montane species with disjunct populations in coastal savannas.
<i>Argyrostromis quadrifilaris</i>	Four-lined chocolate (moth)	G4/S3?				/W3/	
<i>Arphia granulata</i>	Southern yellow-winged grasshopper	G5/S2S4				/W3/	
<i>Atrytone arogos arogos</i>	Arogos skipper	G3T1T2/S1		YES	YES	FSC/SR/	Extremely vulnerable to wildfires due to drastic reduction in number of populations, loss of meta-population structure

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Species	Common Name	Element Rank	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/NC/WAP*	Comments
INVERTEBRATES							
<i>Atrytonopsis loammi</i>	Loammi skipper	G1/SH		YES	YES	FSC/SR/	Possibly already extirpated from this region, probably due to loss of metapopulation structure.
<i>Calephelis virginiensis</i>	Little metalmark	G4/S2				/SR/	
<i>Cyclophora n. sp. (culicaria of authors)</i>	A geometrid moth	G3/S2S3		YES	YES	/SR/	Apparently confined to the Boiling Spring Lakes area, either as a disjunct population or possibly a separate taxon.
<i>Eotettix pusillus</i>	Little eastern grasshopper	G2G3/ S2?				/SR/	
<i>Eubaphe meridiana</i>	The little beggar (moth)	G4/S2S3				/SR/	
<i>Exyra fax</i>	Purple pitcher-plant moth	G4/S3?				/W3/	Sandhill populations may have become nearly completely extirpated outside of Fort Bragg, primarily due to loss of metapopulation structure combined with alterations in natural fire frequencies.
<i>Exyra ridingsii</i>	A pitcher-plant moth	G2G4/ S3?				/W3/	Sandhill populations may have become nearly completely extirpated outside of Fort Bragg, primarily

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INVERTEBRATES							
							due to loss of metapopulation structure combined with alterations in natural fire frequencies.
<i>Exyra semicrocea</i>	A pitcher-plant moth	G3G4/S2S3				/SR/	
<i>Gabara distema humeralis</i>	An owlet moth	G4T4/S3?				/W3/	
<i>Grammia placentia</i>	Placentia tiger moth	G4/S2S3				/SR/	
<i>Hemipachnobia subporphyrea</i>	Venus flytrap cutworm moth	G1/S1?	YES		YES	FSC/SR/	Except for a single Maryland population, all known populations are from flytrap containing savannas in NC. This species appears to be drastically affected by loss of metapopulation structure and is likely to be vulnerable to increases in the severity and extent of wildfires.
<i>Hesperotettix viridis brevipennis</i>	Green-striped grasshopper	G5T5/SU				/W3/	
<i>Lagoa pyxidifera</i>	Yellow flannel moth	G4G5/S2S3				/SR/	
<i>Leptostales laevitaria</i>	A wave	G4/SU				/W3/	

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INVERTEBRATES							
<i>Melanoplus decorus</i>	Decorated spur-throat grasshopper	G3G4/S2S3	YES			/SR/	
<i>Melanoplus nubilus</i>	A short-winged melanoplus	G2G3/S2S3	YES			/SR/	
<i>Papaipema appassionate</i>	Pitcher-plant borer moth	G4/S2S3				/SR/	Sandhill populations may have become nearly completely extirpated outside of Fort Bragg, primarily due to loss of metapopulation structure combined with alterations in natural fire frequencies.
<i>Papaipema eryngii</i>	Rattlesnake-master borer moth	G1G2/S1		YES	YES	/SR/	Only a single population is known from the entire Atlantic Slope. May be highly vulnerable to increased environmental perturbations due to near complete loss of metapopulation structure. May, in fact, be already extirpated.
<i>Schinia carolinensis</i>	Carolinja schinia (moth)	G3/S2S3				/SR/	
<i>Spartiniphaga carterae</i>	Carter's noctuid moth	G2G3/S2S3		YES		FSC/SR/	
<i>Tornos cinctarius</i>	A gray (moth)	GNR/S2?				/SR/	

*** US/ NC/ WAP Abbreviations (species are subject to reclassification by USFWS, NHP, or WRC).**

E	Endangered	SC	Special Concern	P	WAP Priority Species
T	Threatened	SR	Significantly Rare		
FSC	Federal Species of Concern	W	Watch Category		
T(S/A)	Threatened due to Similarity of Appearance				

NatureServe Element Rank: <http://www.natureserve.org/explorer/ranking.htm>

USFWS Endangered Species Listing Status: http://www.fws.gov/raleigh/es_tes.html

NC Natural Heritage Program Status:
<http://www.ncnhp.org/Images/2010%20Rare%20Animal%20List.pdf>

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