

Ecosystem Description

The natural communities in coastal plain depressions occur in various kinds of small basins in Coastal Plain uplands. The basins, which may be limesink depressions, Carolina bays, or swales between recent or older sand dunes, hold standing water for at least substantial parts of the year. Water levels usually fluctuate over the course of a season and also from year to year. Basin communities differ in overall hydroperiod, in soil, in slope, and in depth. Hydroperiod is the length of time that there is standing water at a particular location; it can also be defined as the number of days per year that an area of land is dry (Gaff *et al.* 2000).

The vegetation is often strongly zoned, with zones reflecting the variation in length of flooding along the sloping edges. Vegetation varies widely, perhaps partly because the isolation of individual basin clusters limits dispersal between them. Despite this, however, many plant species are shared with small depression communities from Massachusetts to Florida.

A variety of community types are included in this ecosystem: interdune ponds, small depression ponds, cypress savannas, vernal pools, and small depression pocosins. Table 1 at the end of this report provides a summary of expected climate change impacts to these natural communities. The 2005 WAP identified nonalluvial mineral wetlands, pocosin, small wetland communities, and tidal swamp forest and wetlands as priority habitats that are components of Coastal Plain depression communities (see Chapter 5A) (NCWRC 2005).

Table 1 at the end of this report provides a summary of predicted climate change effects and responses for this ecosystem.

Predicted Effects to Wildlife Species

Tables 2 through 5 at the end of this report identify the species of greatest conservation need (priority species) that use habitats in this ecosystem.

This analysis of climate change impacts covers only those species who occupy terrestrial habitats, at least part of the year. Purely aquatic species associated with isolated pools are currently not well addressed in this analysis. Many species associated with the habitats in this ecosystem are dependent on the combination of wet conditions and frequent fire that define these communities. Changes in climate that reduce frequency of fire or degree of moisture could cause extinction of the rarest species and extirpation within NC of others.

The majority of the animal species associated with this ecosystem are highly vulnerable to the effects of drought, since they require shallow, isolated pools for breeding. While they are adapted to poor reproductive success in occasional dry years, droughts spanning several years in a row are likely to cause extirpation from certain areas, with little opportunities for recovery.

Depression communities such as small pools and wetlands are flooded for only a portion of the year which makes them important breeding sites for amphibians, particularly ambystomid salamanders. Several salamanders are identified as priority species in North Carolina, and are sensitive to the timing of vernal pool formation and precipitation cues for breeding. For amphibians that are highly tied to ephemeral pools for breeding, prolonged droughts can have a severe effect on long-term population viability. Droughts may cause complete loss of reproduction in some years, and short-lived species may be extirpated following several consecutive years with no reproduction.

Additionally, many species of pond-breeding amphibians often thrive where clusters of wetlands with different hydroperiods occur, allowing them to migrate to suitable ponds in a given year, depending on conditions. Development and pond degradation has already reduced the number of breeding ponds on many landscapes and it is likely that increased drought would further reduce metapopulation dynamics of pond-breeding amphibians. Drought conditions in the uplands may also affect the adult stage of their life cycle and reduce overall amphibian populations.

Climate Change Compared to Other Threats

Comparing climate change to other ecosystem threats can help define short-term and long-term conservation actions and recommendations. In this comparison, the greatest threat to depression communities is likely to be habitat conversion. Habitat conversion occurs for various reasons, including suppression of natural fire regimes, development, and land use changes. In protected examples, alteration of hydrology and effects of fire suppression are usually the most serious threats. Drier basins are destroyed by development or conversion to pine plantations, while wetter ones are degraded by these activities on the surrounding uplands.

Climate change is likely to exacerbate existing effects, increasing the number and severity of droughts and increasing the amount of evaporation even in years of normal rainfall. If increased drought and severe weather reduces the ability to conduct prescribed burning, this may reduce fire even in the few examples that are getting burned.

Table 6 compares climate change with other existing threats.

Threat	Rank Order	Comments
Development	1	Development has destroyed or degraded many interdune ponds, small depression ponds, and vernal pools, and threatens many others. Degradation is often indirect, caused by destruction of the surrounding uplands, alteration of ground water levels, destruction of adult habitat for amphibians, and alteration of fire regimes. Increased

Table 6. Comparison Of Climate Change With Other Threats

Threat	Rank Order	Comments
		development will continue to make it more difficult for managers to implement prescribed burning on the landscape because of risk to property and smoke issues. Roads near breeding sites for amphibians cause high mortality rates.
Land Use Conversion	1	Many cypress savannas have been planted or invaded by loblolly pines; it is unknown whether conversion continues.
Fire	1	Fire suppression is a major factor affecting the survival of the plant species associated with depression ponds. Growing season (or summer) prescribed fires are important for maintaining open-canopy small depression ponds. Fires may become more difficult or risky with drought conditions and encroachment of development. A build-up of fuel loads and prolonged drought conditions will contribute to hard to control, catastrophic fire events when they do occur. Fire-fighting methods can damage wetlands when heavy equipment is used to plow fire lines.
Climate Change	2	Increases in prolonged droughts -- extending over multiple years -- is likely to have a severe impact on amphibian populations.
Groundwater Depletion	2	Water level in depression communities of all kinds reflects the water table, and depletion by pumping or drainage reduces or eliminates their hydroperiod. Increases in drought will exacerbate problems associated with water table draw down. For interdune ponds, ground water depletion may be accompanied by salt water intrusion.
Fragmentation	3	As the landscape becomes fragmented, prescribed fire becomes more difficult to use as a management tool because of smoke management concerns and safety issues around urban areas.

Summary and Recommendations

Because so few examples remain, and many rare species are associated with this habitat, protecting remaining examples is crucial with or without climate change. Protection is more critical for complexes with a diversity of community types or basin morphologies. Having more examples and a diversity of different basins will improve the prospects for survival for these rare communities and their species.

Many Coastal Plain depression communities are likely to be resilient to climate change effects. Most of their component plant species range well to the south of North Carolina. These plants are tolerant of fire and wind, but drought may present more problems. 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.

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. Protecting large blocks of land with clusters of these habitat types (especially small depression ponds and vernal pools) would increase the likelihood of pond-breeding amphibians being able to adapt to climate change. 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.

Recommended Actions

- Surveys
- Surveys are needed to document the distribution, relative abundance and status of many wildlife species associated with the components of depression communities.
 - Priorities need to focus on species believed to be declining, at risk, or mainly dependent on specific habitat types.
- Monitoring
- Monitoring systems need to be expanded and/or targeted to be able to assess current population status and trend information for all wildlife species associated with this habitat.
 - Early detection and control of invasive exotic species (such as Red Bay Wilt) 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.
- Research
- Investigate the potential to create vernal ponds for the benefit of wildlife, particularly amphibians.
 - Additional study is needed to determine the importance of regional drainage and ground water consumption on these systems.
- Management Practices
- Begin prescribed burning programs before droughts become severe will be important, as reducing fuel loads safely while avoiding ecological damage takes time. As an alternative, initiate management that will mimic the effects of fire at sites where birds, mammals, reptiles and amphibians are being monitored.
 - The maintenance of contiguous gradients between wetland and adjacent upland sites is critical for seasonal migration and dispersal of amphibians; roads, agriculture, or other land use operations between complimentary sites may still render them ineffective at supporting amphibian and reptile populations.
 - Recommendations on how to construct borrow pits during private road construction to benefit amphibians should be developed.
 - Allow prescribed fire in uplands to burn into and/or through depression wetlands during dry seasons or dry years is recommended. Burns should not be so frequent or intense, however, as to consume the woody debris needed

as shelter for the amphibians that depend on these pools as breeding habitat.

- Plowed firelines along transition zones between habitats should be rehabilitated (smoothed over) where possible. New firelines should be constructed when necessary. These areas should be maintained as a permanent narrow opening by discing with a tractor or by wetting with water or foam prior to a burn (NCWRC 2005).

Land
Protection

- Downed snags, logs, rocks, and other structures that are important for basking reptiles should be retained or restored wherever possible.
- Protection of sites and surrounding areas through land acquisition or easements and cooperation with land trusts is a critical conservation need.
- While these distinctive communities cannot be connected across the landscape, protecting the connection to the uplands around them is important. The amphibians that use these basins need adult habitat and need the ability to migrate to the ponds during breeding season.

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Table 1. Predicted Impacts of Climate Change

Climate Change Factor	Comments
Fire	Some of these systems would benefit from an increase in growing-season fire that would reduce shrubs and canopy trees. Many amphibians and rare plants <i>require</i> open-canopy ponds. However, consumption of large woody debris and standing snags from fires would reduce habitat quality for breeding amphibians and birds. The ash produced by fire in these communities tends to raise the pH in the water, which benefits amphibians.
Drought	Hydroperiods are naturally variable but prolonged drought may result in change in community structure and eventual habitat loss for species that rely on standing water during some part of the year.
Severe Storms	Frequency and severity of storm events will contribute to wind damage and flooding events.
Temperature	An increase in average annual temperatures would contribute to milder winters.
Sea Level Rise	Interdune ponds may be completely inundated by rising coastal waters. Species adapted to fresh water will be killed or displaced by salt-water intrusion.
Exotic Species Invasion	Warmer temperatures may favor invasive species and diseases from the south. Fire ants are already a serious cause for concern for many of the animal species that inhabit cypress savannas. The development of multi-queen colonies, resulting in greatly increased hive densities, should be regarded as a major threat to savanna ecosystems. High hive densities are already a serious problem along the Gulf Coast and may spread northward aided by decreased winter severity.
Compositional Change	Increased drought could allow more species that prefer drier site conditions.
Structural Change	Wind damage could create canopy gaps that allow other species to invade.

Table 2. Bird Species Utilizing Coastal Plain Depression Communities

Species	Common Name	Element Rank	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/NC/WAP*	Comments
BIRDS							
<i>Ammodramus nelsoni</i>	Nelson's Sharp-tailed Sparrow					/ /P	
<i>Anhinga anhinga</i>	Anhinga					/SR/P	
<i>Botaurus lentiginosus</i>	American Bittern					/SR/P	
<i>Circus cyaneus</i>	Northern Harrier					/SR/P	
<i>Cistothorus platensis</i>	Sedge Wren					/ /P	
<i>Coturnicops noveboracensis</i>	Yellow Rail					/SR/P	
<i>Dendroica virens waynei</i>	Wayne's Black-throated Green Warbler					/ /P	
<i>Egretta caerulea</i>	Little Blue Heron					/SC/P	
<i>Egretta thula</i>	Snowy Egret					/SC/P	
<i>Gallinula chloropus</i>	Common Moorhen					/ /P	
<i>Haliaeetus leucocephalus</i>	Bald Eagle					T/T/P	
<i>Helmitheros vermivorous</i>	Worm-eating Warbler					/ /P	
<i>Himantopus mexicanus</i>	Black-necked Stilt					/SR/P	
<i>Ixobrychus exilis</i>	Least Bittern					/ /P	
<i>Laterallus jamaicensis</i>	Black Rail					/SR/P	
<i>Limnothlypis swainsonii</i>	Swainson's Warbler					/ /P	
<i>Melanerpes erythrocephalus</i>	Red-headed Woodpecker					/ /P	
<i>Mycteria americana</i>	Wood Stork					E/E/P	
<i>Nyctanassa violacea</i>	Yellow-crowned Night-heron					/ /P	

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BIRDS							
<i>Nyctanassa violacea</i>	Yellow-crowned Night-heron					/ /P	
<i>Oporornis formosus</i>	Kentucky Warbler					/ /P	
<i>Plegadis falcinellus</i>	Glossy Ibis					/SC/P	
<i>Porzana carolina</i>	Sora					/ /P	
<i>Rallus elegans</i>	King Rail					/ /P	
<i>Rallus limicola</i>	Virginia Rail					/ /P	
<i>Wilsonia citrina</i>	Hooded Warbler					/ /P	

Table 3. Mammal Species Utilizing Coastal Plain Depression Communities

Species	Common Name	Element Rank:	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/NC/WAP*	Comments
MAMMALS							
<i>Condylura cristata</i>	Star-nosed Mole					/SC/P	
<i>Corynorhinus rafinesquii</i>	Rafinesque's Big-eared Bat					//P	
<i>Cryptotis parva</i>	Least Shrew					//P	
<i>Lasiurus intermedius</i>	Northern Yellow Bat					//P	
<i>Lasiurus seminolus</i>	Seminole Bat					//P	
<i>Mustela frenata</i>	Long-tailed Weasel					//P	
<i>Myotis austroriparius</i>	Southeastern Bat					//P	
<i>Neotoma floridana</i>	Eastern Woodrat					//P	
<i>Peromyscus gossypinus</i>	Cotton Mouse					//P	
<i>Sylvilagus palustris</i>	Marsh Rabbit					//P	
<i>Synaptomys cooperi helaletes</i>	Southern Bog Lemming					/SR/P	

Table 4. Reptile Species Utilizing Coastal Plain Depression Communities

Species	Common Name	Element Rank	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/NC/WAP*	Comments
REPTILES							
<i>Cemophora coccinea copei</i>	Northern Scarletsnake					/ /P	
<i>Clemmys guttata</i>	Spotted Turtle					/ /P	
<i>Crotalus horridus</i>	Timber (Canebrake) Rattlesnake					/ /P	
<i>Deirochelys reticularia</i>	Eastern chicken turtle	G5/S3				/SR/P	
<i>Elaphe guttata</i>	Corn Snake					/ /P	
<i>Eumeces laticeps</i>	Broad-headed Skink					/ /P	
<i>Farancia abacura abacura</i>	Eastern Mudsnap					/ /P	
<i>Heterodon platirhinos</i>	Eastern Hog-nosed Snake					/ /P	
<i>Kinosternon baurii</i>	Striped Mud Turtle					/ /P	
<i>Lampropeltis calligaster rhombomaculata</i>	Mole Kingsnake					/ /P	
<i>Lampropeltis getula getula</i>	Eastern Kingsnake					/ /P	
<i>Lampropeltis triangulum elapsoides</i>	Scarlet Kingsnake					/ /P	
<i>Masticophis flagellum</i>	Eastern Coachwhip					/ /P	
<i>Ophisaurus mimicus</i>	Mimic Glass Lizard					/ /P	
<i>Regina rigida</i>	Glossy Crayfish Snake					/SR/P	
<i>Rhadinaea flavilata</i>	Pine Woods Littersnake					/ /P	
<i>Seminatrix pygaea</i>	Black Swamp Snake					/SR/P	
<i>Sistrurus miliarius</i>	Pigmy Rattlesnake					/ /P	
<i>Tantilla coronata</i>	Southeastern Crowned Snake					/ /P	

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Species	Common Name	Element Rank	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/NC/WAP*	Comments
REPTILES							
<i>Thamnophis sauritus sauritus</i>	Common Ribbonsnake					/ /P	
<i>Virginia valeriae valeriae</i>	Eastern Smooth Earthsnake					/ /P	

Table 5. Amphibian Species Utilizing Coastal Plain Depression Communities

Species	Common Name	Element Rank:	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/NC/WAP*	Comments
AMPHIBIANS							
<i>Ambystoma mabeei</i>	Mabee's salamander	G4/S3				/SR/P	
<i>Ambystoma tigrinum</i>	Eastern tiger salamander	G5/S2			YES	/T/P	NC populations are currently all small and highly isolated. Increased droughts may have a major impact on the breeding success of this species.
<i>Ambystoma maculatum</i>	Spotted Salamander						
<i>Ambystoma opacum</i>	Marbled Salamander						
<i>Bufo quercicus</i>	Oak Toad					/SR/P	
<i>Desmognathus auriculatus</i>	Southern Dusky Salamander					/ /P	
<i>Eurycea quadridigitata</i>	Dwarf salamander	G5/S2				/SC/P	
<i>Hemidactylium scutatum</i>	Four-toed Salamander					/SC/P	
<i>Hyla andersonii</i>	Pine Barrens Treefrog					/ /P	
<i>Hyla gratiosa</i>	Barking tree frog	G5/S3S4				/ /P	
<i>Pseudacris nigrita nigrita</i>	Striped Southern Chorus Frog					/ /P	
<i>Pseudacris ornata</i>	Ornate chorus frog	G5/S3				/SR/P	
<i>Rana capito</i>	Carolina Gopher Frog					/T/P	Recent surveys by NCWRC indicate that Gopher Frogs may occur at less than 10 isolated populations in the Coastal Plain.

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Species	Common Name	Element Rank:	Endemic	Major Disjunct	Extinction/Extirpation Prone	US/NC/WAP*	Comments
AMPHIBIANS							
<i>Stereochilus marginatus</i>	Many-lined Salamander					/ /P	
<i>Scaphiopus holbrookii</i>	Eastern Spadefoot					/ /P	
<i>Siren intermedia intermedia</i>	Eastern Lesser Siren					/ /P	

*** 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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