

Ecosystem Description

Montane bogs are among the rarest natural communities in the Southern Appalachians and in North Carolina. Unlike northern bogs of glacial origin, Southern Appalachian bogs form in poorly drained depressions or on gentle slopes, generally in relatively flat valley bottoms which are not subject to flooding. They may vary from being permanently wet to intermittently dry and are generally fed by seepage. They are underlain by wet organic or mucky mineral soils, which are very acidic.

The factors responsible for creating and maintaining bog communities are not well known. Grazing has been nearly universal in bogs, and few examples exist in pristine condition. Most are experiencing invasion of shrubs or trees at the expense of the herbaceous zones. This tendency toward rapid succession suggests that some form of periodic or chronic natural disturbance, now disrupted, may have kept the bogs open. Potential past disturbances include flooding by beavers, grazing by herds of large mammals, fire, and clearing by Native Americans.

There are three community types within this ecosystem: Southern Appalachian bog, Southern Appalachian fen, and swamp forest- bog complex. The Southern Appalachian bog and Southern Appalachian fen types have a mosaic or zoned pattern of shrub thickets and herb dominated areas, mostly underlain by sphagnum mats. Trees may be scattered throughout or may dominate on the edges. The shrub and herb layers of the bog, while not highly diverse, are uniquely adapted to the acidic, nutrient-poor environment of the bog and may include numerous rare species. Swamp forest- bog complex types occur along streams and are more dominated by trees, but have boggy herbs and sphagnum in openings.

The 2005 Wildlife Action Plan (WAP) described Bogs and Associated Wetlands (mountain bogs) as a priority habitat in the Southern Blue Ridge Mountains ecoregion (see Chapter 5A). Mountain bogs (including fens and ‘meadow’ bogs) are distributed throughout the mountain and upper piedmont of North Carolina, with examples as far east as Forsyth and Gaston Counties. Most of the known occurrences are situated both above and below the Blue Ridge escarpment, or in the northwestern (Ashe and Alleghany) and southwestern (Cherokee, Macon, Clay) counties. Over 60% of the wetlands identified in the Southern Appalachian Assessment occurred on privately owned lands and it is likely that overall, the percent of mountain bog habitat in private ownership is greater than that (SAMAB 1996 in 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 5 at the end of this report identify the species of conservation concern and priority species that use habitats in this ecosystem.

Many species are found in mountain bogs with mixtures of open areas and shrubby areas, with a few trees. Some of the wildlife species associated with mountain bogs require open, herbaceous habitat (bog turtle, golden-winged warbler, meadow vole, meadow jumping mouse, bog lemming) while others prefer closed canopy wetlands (salamanders).

The priority amphibians associated with mountain bogs are all salamanders, though there certainly are a much larger number of amphibians found in mountain bogs. These salamanders, (mole, four-toed, marbled, three-lined, and spotted salamanders) for the most part require pools of water, preferably without fish, for breeding purposes. They are associated with mountain bogs, to the extent that mountain bogs (as defined here) often contain pools of water that are utilized as breeding habitat. Their association with mountain bogs is less related to the bog being spring fed, muddy, or with specific plant associations than many of the other priority mountain bog species. These species are more suited to treatment of their threats/problems within the depression communities habitat type and surrounding upland and intact forest corridor habitat. Loss of wetland habitat in general is a significant problem for these species. (NCWRC 2005).

Beavers represent an additional unknown factor in mountain bogs and fens. Beaver impoundments may kill bog plants, including rare species. Situations such as beaver control and fire suppression by humans may not have occurred at all mountain bog sites, but their indirect impact upon mountain bog habitats through facilitation of secondary succession certainly has occurred at some sites (NCWRC 2005). However, some characteristic species, such as bog turtles, may have benefitted from them in the long run.

Climate Change Compared to Other Threats

Climate change effects such as droughts and severe flooding may be particularly problematic in these communities. Climate change, however, is not likely to be as detrimental compared to impacts caused by a number of immediate threats that can cause more drastic destruction than climate change is likely to. The largest scale problem affecting mountain bogs and wetlands in general has been and continues to be the conversion of these habitats to other land uses.

Table 7 summarizes the comparison of climate change with other existing threats.

Table 7. Comparison Of Climate Change With Other Threats

| Threat | Rank Order | Comments |
|--|------------|---|
| Development | 1 | Significant amounts of mountain bog habitat have been destroyed by development (roads, housing, or other development). Ongoing residential and commercial development and conversion to pasture or agriculture continues to destroy or degrade examples, through direct and indirect effects. Conservation of riparian buffers will benefit these communities as well as aquatic communities of the streams. |
| Conversion to agriculture/silviculture | 1 | Mountain bog habitat has been converted to other uses, primarily through draining, filling, or impoundment. Protection of upland buffers around bogs, to reduce the impact of runoff, is also important. |
| Invasive Species- | 2 | Droughts in the present climate appear to have exacerbated the ongoing invasion of upland and generalist wetland plants in some bogs. Protected examples are subject to ecological problems such as invasion by woody plants or by exotic species. |
| Groundwater Depletion | 2 | Caused by hydrological alteration that includes loss of ground water input or entrenchment/channelization of streams that lowers water tables. Drainage, water diversion, and ground water depletion make these wetlands more vulnerable to drought and increased temperatures than they would otherwise be. |
| Flood Regime Alteration | 3 | Many bogs are located in bottomland locations that do not regularly flood but which would flood in extreme events. Damaging floods, scouring, and nutrient/sediment input are threats to mountain bogs and fens. |
| Impoundments | 4 | Beaver control measures should be considered at sites where potential loss of rare species may occur due to the creation of impoundments or use of certain rare plants as food by the beavers. These measures include use of pond levelers, protective screening of rare plants, or as a last resort, removal of the beavers. Where extirpation of rare species is not expected, however, development of beaver pond complexes should be allowed, particularly where it may lead to restoration of higher water tables or clearings that favor the regeneration of wetland herbs and shrubs |
| Climate Change | 5 | The level of threat posed by climate change is unclear, while the other threats are ongoing and result in more drastic effects. Drought is likely to exacerbate ongoing problems and warmer temperatures may as well. |

Summary and Recommendations

Bogs and fens occur as small, widely separated patches. They will not be able to migrate in response to climate change. They occur in specialized hydrological environments that are not driven primarily by climate. Much of their biota ranges far to the north and little, if at all, to the

south. Because the composition and suite of rare species associated with each site varies dramatically, it is important to protect many examples, and to manage appropriately.

Protecting the remaining unprotected examples and conducting appropriate management in the protected examples are the most important actions for these communities. This includes determining the best vegetation management practices and understanding and correcting artificial alterations to hydrology.

Recommended Actions

- Surveys
- Establish frameworks for gathering the information required to substantiate all conservation actions that we might undertake. These baseline surveys, population trend data, and habitat relationships are the foundation of knowledge upon which all future conservation actions must be undertaken. (NCWRC 2005).
 - For many of the priority species associated with mountain bogs, we do not have a clear understanding of their current distribution within the state. We must undertake surveys to gather baseline information on the distribution and status of most of these species. (NCWRC 2005).
- Monitoring
- Given the limited availability and threats facing mountain bog habitat, considerable effort needs to be expended to determine if populations are increasing, decreasing, or remaining stable. (NCWRC 2005).
 - Particularly for species that are state or federally listed or thought to be declining, we must establish long-term monitoring efforts to learn what is happening not only within local populations, but on a regional or range-wide basis. It will be imperative to have this information both for planning conservation measures as well as gauging the success of measures undertaken. (NCWRC 2005).
 - Monitor amphibian populations to detect incidence of fungal and viral infections (*e.g.*, iridoviruses, chytridiomycosis).
- Research
- Genetic studies to determine degree of gene flow between populations and to assess overall population health for species restricted to this habitat (*i.e.*, bog turtle), given the isolated nature of mountain bogs. (NCWRC 2005).
 - Study amphibian movements to and from breeding habitats and examine upland habitat use (*e.g.*, ambystomatid salamanders, Junaluska Salamander, Mountain Chorus Frog).
 - Investigate minimum hydroperiods needed by priority amphibian species that utilize ephemeral pools and wetlands. Results can be used to determine when supplemental or interventive measures are needed to support breeding periods and metamorphosis during drought periods.

- Establish a captive breeding program for bog turtles and work with land conservation partners to identify sites for population augmentation.

Management Practices

- Specific bog management needs to include the control of woody encroachment and succession, the maintenance (and where necessary, restoration) of natural surface water and groundwater hydrology (using ditch plugs, temporary dams, level spreaders, or other engineering devices), the restoration of herbaceous vegetation, and the prohibition of taking rare bog-related species (*e.g.*, bog turtle). (NCWRC 2005).

Land Protection

- Habitat protection measures necessary throughout the planning horizon need to focus upon utilizing existing regulatory frameworks to protect both the habitat and these species (*e.g.*, state and federal endangered species laws, wetland protection laws, etc.). (NCWRC 2005).
- Government conservation programs and incentives (*e.g.*, Farm Bill programs) and partnerships with private landowners need to be fully utilized to stem the conversion of suitable bogs to other uses. (NCWRC 2005).
- Conservation ownership through acquisition of mountain bogs should be actively pursued in concert with state and federal agency partners (*e.g.*, US Fish and Wildlife Service, US Forest Service, National Parks Service, Natural Resources Conservation Service, NC Division of Parks, NC Natural Heritage Program, local governments, etc.) as well as private conservation partners (*e.g.*, The Nature Conservancy, land trusts). (NCWRC 2005).

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References

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Table 1. Predicted Impacts of Climate Change

| Climate Change Factor | Comments |
|-------------------------|---|
| Flooding | Besides stream flooding, overland runoff from adjacent uplands during severe storms would be a problem in many bogs. The nutrient input and potential scouring of severe floods would be detrimental to bog communities. |
| Drought | Droughts would have significant effects on competitive relationships among species and on the community as a whole. |
| Acreage Change | Many bogs may reduce in size if margins dry out due to drought. Some estimates indicate that fewer than 500 acres of mountain bogs in North Carolina remain (USFWS 2002 in NCWRC 2005). |
| Exotic species invasion | Invasive species are already a problem in some areas and may increase with drought and warmer temperatures. Some bogs are subject to invasion by exotic plants such as Japanese stiltgrass (<i>Microstegium vimineum</i>), multiflora rose (<i>Rosa multiflora</i>), and Asian dayflower (<i>Murdannia keisak</i>). Many of these communities contain pines, hemlocks, or spruces, which are susceptible to insect pests. |
| Compositional Change | Drought and warm temperatures may allow generalists and upland species to invade. Many of the rare species associated with mountain bogs and fens are herbs and are vulnerable to competition from woody species and more aggressive habitat generalists. If changes in hydrology make these sites drier, this problem is likely to be exacerbated. |

Table 2. Bird Species Utilizing

| Species | Common Name | Element Rank | Endemic | Major Disjunct | Extinction/Extirpation Prone | US/NC/WAP* | Comments |
|------------------------------|-----------------------|--------------|---------|----------------|------------------------------|------------|----------|
| BIRDS | | | | | | | |
| <i>Empidonax alnorum</i> | Alder Flycatcher | | | | | /SR/P | |
| <i>Empidonax traillii</i> | Willow Flycatcher | | | | | | |
| <i>Vermivora chrysoptera</i> | Golden-winged Warbler | | | | | /SR/P | |

Table 3. Mammal Species Utilizing

| Species | Common Name | Element Rank: | Endemic | Major Disjunct | Extinction/Extirpation Prone | US/NC/WAP* | Comments |
|--------------------------------|----------------------|---------------|---------|----------------|------------------------------|------------|----------|
| MAMMALS | | | | | | | |
| <i>Microtus pennsylvanicus</i> | Meadow Vole | | | | | | |
| <i>Zapus hudsonius</i> | Meadow Jumping Mouse | | | | | | |

Table 4. Reptile Species Utilizing

| Species | Common Name | Element Rank | Endemic | Major Disjunct | Extinction/Extirpation Prone | US/NC/WAP* | Comments |
|-------------------------------|-----------------------|--------------|---------|----------------|------------------------------|------------|----------|
| REPTILES | | | | | | | |
| <i>Glyptemys muhlenbergii</i> | Bog Turtle | G3/S2 | | YES | | T(S/A)/T/P | |
| <i>Thamnophis sauritus</i> | Northern Ribbon Snake | G5/S4 | | | | / /P | |

Table 5. Amphibian Species Utilizing

| Species | Common Name | Element Rank: | Endemic | Major Disjunct | Extinction/Extirpation Prone | US/NC/WAP* | Comments |
|-------------------------------|------------------------|---------------|---------|----------------|------------------------------|------------|----------|
| AMPHIBIANS | | | | | | | |
| <i>Ambystoma maculatum</i> | Spotted Salamander | G5/S5 | | | | / /P | |
| <i>Ambystoma opacum</i> | Marbled Salamander | G5/S5 | | | | / /P | |
| <i>Ambystoma talpoideum</i> | Mole Salamander | G5/S2 | | | | /SC/P | |
| <i>Eurycea guttolineata</i> | Three-lined Salamander | G5/S5 | | | | / /P | |
| <i>Hemidactylium scutatum</i> | Four-toed Salamander | G5/S3 | | | | /SC/P | |

Table 6. Invertebrate Species Utilizing

| Species | Common Name | Element Rank | Endemic | Major Disjunct | Extinction/Extirpation Prone | US/NC/WAP* | Comments |
|---------------------------------|-----------------------|--------------|---------|----------------|------------------------------|------------|----------|
| INVERTEBRATES | | | | | | | |
| <i>Apamea mixta</i> | A noctuid moth | GU/S1S2 | | | | /SR/ | |
| <i>Euphydryas phaeton</i> | Baltimore checkerspot | G4/S2 | | | | /SR/ | |
| <i>Euphyes bimacula</i> | Two-spotted skipper | G4/S2 | | | | /SR/ | |
| <i>Gabara distema humeralis</i> | An owlet moth | G4T4/S3? | | | | /W3/ | |
| <i>Macrochilo louisiana</i> | Louisiana owlet moth | G4/S2S3 | | | | /SR/ | |
| <i>Meropleon diversicolor</i> | An owlet moth | G4/SU | | | | /W3/ | |

*** 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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