

4.3.1 Bogs and Fens

4.3.1.1 Ecosystem Description

Mountain and Piedmont 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, fires, 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. Fens occur on high pH (basic) soils, but otherwise have the same vegetative zones as bogs; only one Southern Appalachian fen is known in North Carolina (in Ashe County).
- Swamp forest-bog complex types occur along streams and are dominated by trees, but may have boggy herbs and sphagnum moss in canopy openings.

The 2005 WAP described bogs and associated wetlands (mountain bogs) as a priority habitat in the Southern Blue Ridge Mountains ecoregion (see Chapter 5) (NCWRC 2005).

4.3.1.2 Location of Habitat

Mountain bogs (including fens and ‘wet meadow’ bogs) are distributed throughout the Mountains and upper Piedmont of North Carolina, with examples as far east as Forsyth and Gaston Counties. Most of the known occurrences of Southern Appalachian bogs and fens are situated above the Blue Ridge escarpment, in the northwestern (Ashe and Alleghany) and southern (Henderson, Transylvania) counties. On the other hand, ‘wet meadow’ bogs can be found in the western half of the Piedmont and throughout the Mountain counties. Over 60% of the wetlands identified in the Southern Appalachian Assessment (SAMAB 1996 in NCWRC 2005) occurred on privately owned lands and it is likely that overall, the percent of mountain bog habitat in private ownership is even greater.

4.3.1.3 Problems Affecting Habitats

Invasive Species. 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, Multiflora Rose, and Asian Dayflower. Many of these communities contain pines, hemlocks, or spruces, which are susceptible to insect pests.

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.

Climate Impacts. 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. Droughts would have significant effects on competitive relationships among species and on the community as a whole. 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).

Fragmentation. The most common types of fragmentation occur when streams are impounded to form lakes, highways are built across inhabited wetlands, and wetland habitat units are drained for agricultural use or development. Roads that bisect Bog Turtle wetlands are the single most detrimental threat to turtle populations. Highway mortality is high in areas where turtles must cross roads to get from one wetland to another (Somers et al. 2000).

Successional Conversion. Bog communities can undergo ecological succession, from open canopy fens and bogs to closed canopy swamps (where hydrologic conditions do not change), leading to the loss of habitat suitable for Bog Turtles and other species dependent on these types of wetlands (Klemens 1993; Herman and Tryon 1997; Rosenbaum et al. 2007).

4.3.1.4 Climate Change Compared to Other Threats

Comparing climate change to other ecosystem threats can help define short- and long-term conservation actions and recommendations. While climate change is not the most severe threat, a combination of synergistic effects with other existing conditions could stress these systems to the point where several species are unable to persist.

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 4.15 summarizes the comparison of climate change with other existing threats.

TABLE 4.15 Comparison of climate change with other threats to mountain bogs and fens

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
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.

4.3.1.5 Impacts to Wildlife

Appendix G provides a list of SGCN and other priority species for which there are knowledge gaps and management concerns. Appendix H identifies SGCN that depend on or are associated with this habitat type. Some of the wildlife species associated with mountain bogs require open, herbaceous habitat (e.g., Bog Turtles, Golden-winged Warblers, Meadow Voles, Meadow Jumping Mice, Bog Lemmings) while others prefer closed canopy wetlands (salamanders). In fact, for the Bog Turtle and the Southern Bog Lemming, bogs are the primary or sole habitat type in the state.

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 community's habitat type and surrounding upland and intact forest corridor habitat. Loss of wetland habitat in general is a significant problem for these species.

Beavers represent an additional unknown factor in mountain bogs and fens. Beaver impoundments may kill bog plants and flood habitats used by wildlife, 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. However, some characteristic species, such as Bog Turtles, may have benefitted from Beaver activity in the long run.

4.3.1.6 Recommendations

Bogs and fens occur as small, widely separated patches in certain landscapes and 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.

Surveys. Priorities for conducting distributional and status surveys need to focus on species believed to be declining or mainly dependent on at-risk or sensitive communities (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.

Monitoring. Monitoring of taxa is critical to assessing species and ecosystem health and gauging the resilience of organisms to a changing climate. These monitoring efforts will inform future decisions on how to manage species. Long-term monitoring is needed to identify population trends and to assess

performance of conservation actions. Monitoring plans should be coordinated with other existing monitoring programs where feasible.

- Given the limited availability and number of threats facing mountain bog habitat, considerable effort needs to be expended to determine if populations are increasing, decreasing, or remaining stable.
- Monitor amphibian populations to detect incidence of fungal and viral infections (e.g., iridoviruses, chytridiomycosis).
- Monitor connectivity of populations separated by fragmentation.
- If Beaver activity is detected in nearby streams, monitor to detect problems from flooding or inundation.

Research. Most species and their interrelationship associated with this habitat are poorly understood. Research topics that facilitate appropriate conservation actions include habitat use and preferences, reproductive behavior, fecundity, population dynamics and genetics, feeding, competition, and food web dynamics. Research must also be conducted to determine vulnerability of priority species to specific threats and studies should provide recommendations for mitigation and restoration. Species propagation is an area of current and ongoing research. Developing techniques for propagation may become critical for preserving species and their genetic stock, particularly those that are rare, at high risk of extinction or extirpation, and difficult to propagate in a laboratory setting.

- 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.
- 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. Management practices that reduce impacts and work synergistically with other conservation actions are needed to enhance the resilience of natural resources. Particular needs include preserving biodiversity, protecting native populations and their habitats, and improving degraded habitats.

- 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).
- Use clearing methods that create the least impacts; avoid use of chemicals. Where appropriate, use prescribed burning to control encroachment by hardwoods. If mowing, limit to once a year or less and set blade height between 1 and 2 feet to avoid destroying nesting bird and small mammal habitat. If using heavy equipment, disturb only one patch of the site at a time and minimize ruts and compaction of soils and vegetation to the extent possible (Somers et al. 2000).
- If livestock grazing is allowed, limit number of animals to one per acre and allow light to moderate seasonal (winter only) grazing where possible (Somers et al. 2000).
- Provide native vegetation buffers around wetlands to filter pollutants and benefit wild- life (Somers et al. 2000).
- Limit application of fertilizers and lime to lawns and fields surrounding wetlands (Somers et al. 2000).

Conservation Programs and Partnerships. Conservation programs, incentives, and partnerships should be utilized to the greatest extent possible to preserve high-quality resources and protect important natural communities. Protective measures that utilize existing regulatory frameworks to protect habitats and species should be incorporated where applicable. Land conservation or preservation can serve numerous purposes in the face of anticipated climate change, but above all, it promotes ecosystem resilience.

- Focus habitat protection measures on utilizing existing regulatory frameworks to protect both the habitat and these species (e.g., state and federal endangered species laws, wetland protection laws, etc.).
- Fully utilize government conservation programs and incentives (e.g., Farm Bill programs) and partnerships with private landowners to stem the conversion of suitable bogs to other uses.
- Actively pursue conservation ownership through acquisition of mountain bogs in concert with state and federal agency partners (e.g., US Fish and Wildlife Service [USFWS], US Forest Service, National Parks Service, Natural Resources Conservation Service, NC Division of Parks and Recreation, NC Natural Heritage Program, local governments, etc.) as well as private conservation partners (e.g., The Nature Conservancy, land trusts).