Bogs and associated wetlands

Southern Blue Ridge Mountains

This habitat type is a complex of multiple natural communities found throughout the western portion of the state. These include: swamp forest-bog complex, Southern Appalachian bog, Southern Appalachian fen, Hillside seepage bog, high elevation seep, and meadow bogs. In addition, these wetlands can be contained in landscapes of montane/piedmont alluvial forest and contain floodplain pool communities (Schafale and Weakley 1990). In some areas, beavers play a significant role in shaping the hydrologic and vegetative characteristics of these wetlands. Various ecologists, botanists, biologists and others can and do distinguish among these various communities, depending upon the species composition, hydrology, soils, or structure of the vegetation. Because of the complex nature of these communities, the interspersion of them, and the fact that they support many wildlife species in common, they are treated similarly under the habitat category of bogs and associated wetlands, and will be henceforth commonly referred to as "mountain bogs," regardless of whether they occur in the southern blue ridge or upper piedmont physiographic provinces.

Mountain bogs are among the rarest communities in the Southern Appalachians and in North Carolina. Unlike northern bogs of glacial origin, mountain bogs form in poorly drained depressions or on gentle slopes, generally in relatively flat valley bottoms that are not subject to flooding. They are often small (less than 2 acres), dispersed, and hydrologic regimes are quite varied from site to site. Most often they are fed by seepage or springs, however some are associated with beaver activity and thus impoundment of surface waters. Small remnant bog communities can also be found in the headwater areas of some artificial impoundments as well. Some are permanently wet, some intermittently dry, and still others contain both wetter and dryer areas. Generally, they are underlain by wet organic or mucky mineral soils, which are very acidic, though a few can be relatively basic (NCNHP 2001).

Vegetation is quite variable in mountain bogs. True Southern Appalachian bogs contain a very diverse mix of herbaceous and woody vegetation. Other types of mountain bogs are dominated by herbaceous vegetation only. The exact composition of vegetation is dependent upon numerous factors including, but not limited to: hydrology, soils, geographic location, disturbance history, current land use activities, and other factors. In fact, the hydrology and current land use of particular sites may be the most important factors that determine the current vegetation composition and structure of mountain bogs. For some, natural hydrologic factors result in what appears to be a relatively stable plant community (at least in the short term) dominated by herbaceous vegetation and sphagnum. Others seem to be more subject to natural successional processes that may, over time, shift the communities from open, herbaceous dominated areas towards more wooded communities like swamp forests or alluvial forests. Beavers have played a significant role in the formation and maintenance of many mountain bogs (Somers *et al*. 2000). While the role of beavers in creating and maintaining wetlands across the regional landscape can be debated in terms of its historical extent and impact, it is certain that they have had a role in shaping the availability of various wetland types across the Southern Appalachian landscape. Human activities such as livestock grazing play a major role in the current vegetation makeup of mountain bogs.

The variability of the sites, their hydrology, and their current condition make a listing of plant species difficult, and potentially misleading, since each site can be quite different. However many species of plants, in various combinations, are associated with mountain bogs. Shrub species common to many mountain bogs include rhododendron, alder, rose, and poison sumac. Tree species may include red maple, white pine, hemlock, pitch pine, river birch, and occasionally red spruce. Herbaceous vegetation commonly includes many species of *Juncus* and sedge along with numerous herb species, and sphagnum mats. At least four federally endangered plants are associated with mountain bogs. Numerous other herbaceous plants and several animal species that are state-listed or rare are also associated with mountain bogs, including the bog turtle, mole salamander, four-toed salamander, and alder flycatcher. Mountain bogs, though very limited in their distribution and availability across the landscape are one of the most significant habitat types of the state for rare plants and animals (TNC and SAFC 2000), and they support a disproportionate amount of the overall composition of plants and animals found here as well. A list of priority species of conservation concern that may use bogs and associated wetlands is provided in Table 1.

Table 1. Priority species associated with mountain bogs and wetlands.

Group	Scientific name	Common name	State status* (Federal status)
Birds	*Empidonax alnorum*	Alder Flycatcher	SR
	Empidonax traillii	Willow Flycatcher	
	Vermivora chrysoptera	Golden-winged Warbler	SR
Mammals	*Microtus pennsylvanicus*	Meadow Vole	
	Zapus hudsonius	Meadow Jumping Mouse	
Amphibians	*Ambystoma maculatum*	Spotted Salamander	
	Ambystoma opacum	Marbled Salamander	
	Ambystoma talpoideum	Mole Salamander	
	Eurycea guttolineata	Three-lined Salamander	
	Hemidactylium scutatum	Four-toed Salamander	
Reptiles	*Clemmys muhlenbergii*	Bog Turtle	
	Thamnophis sauritus sauritus	Common Ribbonsnake	

*Abbreviations
SR Significantly Rare

Location And Condition Of Habitat

As defined, mountain bogs encompass many diverse habitats throughout the western portion of the state. Historically, more attention has been paid to bogs and wetlands of the mountain region than those of the piedmont, with a few exceptions. Many of the bogs (of various types) within the mountains have been identified and studied, owing to the number of rare plants and animals associated with them. However several upper piedmont bogs and wetlands have been identified and studied as well. Perhaps less well studied have been piedmont region wetlands that fall outside the known range of rare species, or in other wetland habitats found more commonly throughout the piedmont, such as piedmont alluvial forests, swamps, and upland pools. A map of this habitat is not provided due to scale and sensitivity issues.

Within the Southern Blue Ridge province, the Southern Appalachian Assessment (SAMAB 1996) identified over 72,000 acres of wetlands. This figure represents less than 1% of the Southern Appalachian landscape. Certainly, not all of these wetlands can be considered mountain bogs, however, depending upon numerous factors and processes, much of that acreage could support similar suites of plants and animals most often associated with mountain bogs. In addition, many mountain bogs were not included in the Southern Appalachian Assessment due to their small size and their inability to be detected through the remote sensing tools applied in the assessment (Landsat imagery). The US Fish and Wildlife Service (2002) estimates that at one time there were 5,000 acres of bogs in North Carolina. Depending upon the classification methods used for wetlands or bogs, estimates of mountain bog habitat availability are quite variable. Nevertheless, mountain bogs comprise a small fraction of the landscape of the region.

Mountain bogs (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 of them are situated along (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 SAA wetlands identified (SAMAB 1996) occurred on privately owned lands. It is likely that overall, the percentage of mountain bog habitat in private ownership is even greater than that.

The condition of mountain bogs is quite variable. What is clear, however, is that significant amounts of mountain bog habitat have been converted to other uses, primarily through draining, filling, or impoundment. Some estimates indicate that fewer than 500 acres of mountain bogs in North Carolina remain (USFWS 2002). Again, regardless of how they are defined, mountain bogs have suffered dramatic declines at the hand of humans. There are examples of various types of mountain bogs remaining that provide a reference for the "natural" condition of these habitats, however there is much debate as to what constitutes natural conditions due to both anthropogenic and other forces involved. 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. In general, some bogs support a mix of open and closed canopy, maintained by hydrology, elevation, and other natural factors. Others may be open canopied (dominated by herbaceous vegetation) due to active management of vegetation or other land uses (grazing). Many are certainly affected by hydrologic changes (i.e. ditches or drains), but retain some of the functional qualities and wildlife habitat of their former states.

Problems Affecting Species And Habitats

Many things have had an impact upon the availability of mountain bogs. Certainly, a significant number of bogs have been destroyed to make way for industrial, commercial and residential development. Agriculture in North Carolina, both historically and currently, plays a significant role in the availability and condition of mountain bogs. Numerous bogs have been destroyed by agricultural practices including draining, filling, or pond creation. However, many of the remaining mountain bogs are located on agricultural lands dominated by livestock grazing. In fact, most of the more productive bog turtle sites that remain today are found upon grazed lands. This could be due to many factors, though certainly grazing by livestock retards or even

stops the successional process in some wetlands, therefore maintaining the open conditions that bog turtles and other bog species require. Mowing and prescribed burning of certain bogs has had similar effects in some cases. This is not to suggest that agricultural management should be prescribed for all mountain bogs. Clearly some activities are detrimental, though agricultural practices can be helpful tools in managing mountain bog habitats in some situations.

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. Whether for agriculture or other types of development (roads, housing, or other development), significant amounts of mountain bog habitat have been destroyed. In some cases destruction has been complete removal of the habitat from an area. In other cases, it has been focused on altering the hydrology through ditches or pipes, or even conversion to small ponds. In addition to the direct impact of habitat loss on the species occupying sites that are destroyed, there are secondary impacts upon populations of such species associated with them becoming more isolated from each other. Many mountain bogs are small in size, though often situated upon the landscape in such a manner as to be hydrologically connected. These connections support important movement corridors for wildlife from one small site to another, thus creating local populations of particular species not associated with a single site, but a larger complex of sites within the drainage. Therefore, loss of even small sites within a local population can have an impact, which in turn can affect the overall population of the particular species.

A significant problem for some mountain bogs, or at least for some species associated with them (i.e. bog turtle), is secondary succession of the plant communities at particular sites. This is not a problem at all sites, however succession does change community composition of certain sites, in terms of both the plants and animals found there. 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). Many species are found in mountain bogs with mixtures of open areas and shrubby areas, with a few trees. When succession is allowed to proceed open areas often become shrubby, followed over time by the development of closed canopy swamp forests. Regardless of the factors responsible for allowing succession to proceed (fire suppression, hydrologic diversion, or other disturbance factors), many bogs that formerly provided either open or mixed open/shrub habitat are becoming closed canopy swamps, thus becoming unsuitable for many mountain bog dependent species of wildlife.

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, for the most part (mole, four-toed, marbled, three-lined, and spotted salamanders) require pools of water 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. Nevertheless, loss of wetland habitat in general is a significant problem for these species.

Species And Habitat Conservation Actions and Priorities For Implementation

First and foremost we must establish frameworks for gathering the information required to substantiate all conservation actions that we might undertake. The baseline surveys, population trend data, and habitat relationships are the foundation of knowledge upon which all future conservation actions must be undertaken. That does not mean that other conservation measures are not needed immediately. On the contrary, given what we do know about the limited availability and threats facing mountain bogs, we need to begin now with both information gathering as well as habitat protection measures.

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.). 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. Since those measures are not available or effective for all species or situations, aggressive steps to acquire conservation ownership 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). Recently completed soil survey mapping efforts may assist partners in identifying wetland soils, to prioritize potential restoration sites (considering size, adjacency, and other factors).

As conservation ownership of mountain bogs increases, we must devise programs or processes to facilitate the dissemination of information and guidance, as well as implementation of actual land management practices upon such lands to effectively maintain suitable habitat for the species dependent upon mountain bogs. Specific bog management needs 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 take of rare bog-related species (e.g., bog turtle). We already know that passive management of these sites can lead to their loss through succession. We must establish the framework and means to ensure that management of these sites takes into account all the habitat needs of the species, and focuses upon providing for those needs in a cost effective, sustainable manner into the future. In some cases, habitat protection and management may not be sufficient to sustain populations or re-establish them. Measures necessary to re-introduce species at specific locations, under proper management scenarios may need to be examined and implemented to ensure healthy geographic and genetic populations are sustained.

Priority Research, Survey, And Monitoring

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. Once we have completed surveys to determine the distribution and status of these priority species,

efforts must shift immediately towards long term monitoring of their populations. In some instances it may take years of study to determine the complete distribution and status of a given species. Specific research needs are innumerable regarding these species and their habitat relationships.

- **Surveys**
  - Prioritize species that are state or federally listed as endangered, threatened, or special concern (bog turtle, mole salamander, four-toed salamander), or those often utilizing mountain bog habitats (Alder flycatcher).
  - Secondarily prioritize species facing significant threat, thought to be declining, or those for which we have limited information on their distribution and status (golden-winged warbler, willow flycatcher, American woodcock, rails, meadow jumping mouse, spotted salamander, marbled salamander, three-lined salamander, common ribbonsnake).
  - Work to develop a model to predict habitat for bog turtles, based on characteristics at known localities; this could lead to additional survey sites for other bog herpetofauna.
- **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.
  - 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.
- **Research**

  Genetics
  - 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.
  - Genetic studies of other priority species to examine degree of isolation.

  Habitat use
  - Document the habitat relationships of priority species; for most species, we do not know how dependent they are upon mountain bog habitats, relative to other habitat types.
  - Determine of the microhabitat preferences and requirements of species utilizing mountain bogs. We must document whether specific hydrological and biological requirements of these priority species are being met under current management regimes, and to do that we must understand how these species are utilizing the habitat.

Management practices

- Examine the effects of different management strategies upon various taxa to document effective measures to manage these habitats into the future (e.g., determine the impact of various controlled grazing regimes or physical removal of woody vegetation).
- Investigate the potential of beavers to create bogs and associated wetlands when previously none occurred; or where beavers were removed, research the possibility of reintroducing the species to these habitats to create wetland habitat.

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