DRAFT – Mountain Cove Forest

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Ecosystem Description

Cove forests are some of the most well-known and recognized community types in the mountains, occurring on sheltered, moist, low to moderate elevation sites. They are characterized by a dense forest canopy of moisture-loving trees. There are three community types in this ecosystem: rich cove forest, acidic cove forest, and basic mesic forest. The 2005 Wildlife Action Plan describes Southern Blue Ridge Mountains Cove Forest as a priority habitat (see Chapter 5A).

The rich cove forest type, occurring in the most fertile sites, has a lush herb layer and relatively few shrubs. The high diversity in all vegetation layers makes this forest of great interest to botanists and ecologists.

The acidic cove forest, which occurs in less fertile but otherwise similar sites to those occupied by rich cove forests, is dominated by the more acid tolerant species, and has undergrowth dominated by ericaceous shrubs such as rhododendron, rather than by herbs. Canada hemlock forests have similarly dense shrub layers and relatively few herbs.

The basic mesic forest (montane calcareous subtype) is a geologically restricted community that occurs on rare outcrops of limestone, marble, or dolomite, and are dominated by trees that favor high pH soils. These communities are naturally relatively stable, uneven-aged climax forests, with trees up to several centuries old.

Table 1 at the end of this report provides of 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.

Appalachian cove hardwood forests represent some of the most diverse ecosystems in the world outside of tropical zones (Hunter *et al.* 1999). An amazing assortment of trees and herbaceous vegetation, coupled with topographic, microclimatic, and soil characteristics combine to provide an extremely productive habitat for numerous mammals, amphibians, and birds. High numbers of endemic salamanders are present (Petranka 1998), and population densities of these animal groups in cove hardwood forests make these extremely important habitats.

Junaluska and Tellico salamanders are highly restricted to habitats within this ecosystem group. Both occupy extremely small global ranges and are likely to be strongly affected by increased

drought, fire, or storm-created openings in the canopy. Several other salamanders with extremely limited global ranges also have significant amounts of habitat within this community and are also likely to be threatened by the same set of climate change factors. The same is true for several species of Lepidoptera associated with mesic habitats and that occur in the Southern Appalachians as major disjuncts from the North (NCWRC 2005).

Problems of individual species associated with cove hardwood forests include isolation or extremely limited ranges of populations (*e.g.,* cerulean warbler, crevice salamander). That could lead to increasing chances of genetic depression or stochastic events having negative consequences for the sustainability of populations. Some bird species which require a diverse understory may be impacted by the aging of stands, which can result in decreased plant diversity until the stand reaches age classes sufficient to produce canopy gaps (Hunter *et al.* 2001 in NCWRC 2005).

Some high elevation cove forests now serve as refugia for species for which the current climate in lower areas in NC is not suitable. They are likely to continue to do so, but warming temperature and changed moisture regimes may make some of them less hospitable to some of these species. At the same time, these communities may become refugia for additional species that are currently common, if the regional climate becomes unsuitable for them. They may be crucial for the survival of some species in the state.

Climate Change Compared to Other Threats

The effect of a changed climate is likely to vary widely among examples of these communities, depending on topographic sheltering, configuration of rocks, soil depth, and amount of overland runoff. Unprotected examples of these forests are most threatened by development and logging.

Table 6 summarizes the comparison of climate change with other existing threats.

Table6 . Comparison Of Climate Change With Other Threats

Threat	Rank Order	Comments
Invasive Species	1	Exotic species represent a growing threat, including the hemlock wooly adelgid, gypsy moth, and beech scale, as well as several non-native plants (NCWRC 2005). Hemlock wooly adelgid is already causing widespread devastation in Hemlock Forests. Emerald ash borer and several other destructive insects represent large potential threats. Invasive plants are a serious and growing problem in lower elevation examples, particularly in those that are disturbed by logging or that occur near developed areas. Invasive plants, such as garlic mustard (*Alliaria petiolata*) and oriental bittersweet (*Celastrus orbiculatus*), are likely to increase regardless of climate change. Oriental bittersweet is already a significant problem in some cove forests in the mountains and has greatly altered vegetation composition and structure.

Table6 . Comparison Of Climate Change With Other Threats		
Threat	**Rank Order**	**Comments**
Logging/Exploitation	1	Logging causes more drastic alteration of structure and composition than climate change is expected to. Timber harvesting and conversion to other forest types (white pine) or other uses on private lands in certain areas can also decrease the availability of this habitat in the future (NCWRC 2005).
Development	1	Development can cause indirect effects as well as outright destruction of these communities, creating edge effect and developing seed sources for invasive species. Residential development in mountain coves often differs from development in other habitats of the region, in that homes and associated spaces are often interspersed within the forest. The result may be that direct habitat loss as a result of the houses and associated structures may be more limited than other types of development. However, the reduction in quality of the habitat by virtue of being bisected by roads and driveways, other infrastructure, and domesticated plants and animals can certainly have significant impact upon the wildlife species of the forest (Rosenberg et al. 2003 in NCWRC 2005)
Climate Change	2	Climate change poses several threats, including loss of area in more marginal sites, alteration by increased wind, flood, and fire disturbance, and increased problems with invasive plants. For some protected examples, this is the most severe threat.

Summary and Recommendations

Rich Cove Forests host a great diversity of trees and herbs, and provide habitat for a large number of rare plant species in NC. Climate change is not expected to be a major threat to these species overall. While many examples of cove forests are protected from development and logging, protecting more examples would help these communities weather climate change. It would reduce the loss of acreage as protected examples shrink, and would allow larger, more robust populations of their species to survive. Landscape connectivity will become more important as individual patches become smaller.

Recommended Actions

Surveys

- Initial efforts need to be directed towards surveys to determine current baseline distribution and status of species associated with cove hardwood forest for which that information is lacking (NCWRC 2005).
- Focus initial survey efforts on state-listed species, and others that may be declining (*e.g.*, Cooper's hawk, sharp-shinned hawk, brown creeper, black-billed cuckoo, cerulean warbler, yellow-bellied sapsucker, green salamander, seepage salamander, pigmy salamanders, Tellico salamander, and zigzag salamander) (NCWRC 2005)

- Conduct surveys to understand current status of species believed to be more common, from which we can measure future population changes (e.g., Swainson's warbler, silver-haired bat, long-tailed weasel, woodland jumping mouse, Eastern mole, smoky shrew, masked shrew, spotted salamander, marbled salamander, ravine salamander, Eastern hognose snake, Eastern box turtle, and eastern smooth earth snake) (NCWRC 2005).

Monitoring

- Protocols and procedures developed during surveys for these various taxa should subsequently provide a means to convert from a baseline survey mode, to a long-term population trend monitoring mode at all times of the year. Long-term population trend monitoring will be critical for planning conservation measures, setting goals, and measuring achievements.

Research

- Studies of bird, amphibian, reptile, and vegetation responses to gap management or specific timber harvest regimes (e.g., cerulean warbler, Swainson's warbler, yellow-bellied sapsucker, and various reptiles and plethodontid salamanders).

Management Practices

- With the vast majority of cove hardwood habitat in mid-successional stages, efforts should be directed towards increasing older age classes of cove hardwoods by both lengthening harvest rotation recommendations for timberland owners, and exploring whether we can mimic old growth gap dynamic conditions through selective harvesting techniques in mid- to late-successional cove hardwood stands. (NCWRC 2005).
- Protection of riparian areas and control of impervious surfaces and stormwater runoff will reduce flood damage to cove forests in altered watersheds, as well as protecting the aquatic systems.
- Protection from severe wild fire during drought periods may be necessary to prevent catastrophic disturbance of some cove forests. In more favorable periods, prescribed burning of surrounding landscapes would help reduce the risk of controllable wild fires, as well as benefitting the upland communities.

Land Protection

- Add to our base of conservation ownership for future generations of the wildlife species associated with the habitat, as well as the use and enjoyment of them by future generations of North Carolinians. (NCWRC 2005).
- It is most important to protect examples in the most sheltered sites, and those that serve as landscape connections to other patches.

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Table 1. Predicted Impacts of Climate Change	
Climate Change Factor	**Comments**
Flooding	Flash flooding will disturb a limited portion of cove forests near streams.
Wind Damage	The topographic setting of coves provides some shelter from storm winds. Increased wind damage will change the structure of forests to some degree, creating more gaps and leading to a younger average age of trees.
Mild Winters	Mild winters may allow some invasion in high elevation coves of species usually associated with lower elevations; these may outcompete the species associated with the high elevation sites.
Increased Temperature	Warmer temperatures may stress some species adapted for high elevation, cooler sites, especially if combined with drought. Increased temperatures may increase the rate at which hemlock wooly adelgid invades natural areas.
Fire	Drought may increase the potential for wild fire. There is potential for significant damage to some cove forests, but probably only a limited portion. In many places, cove vegetation appears to have expanded into more marginal sites in decades of fire suppression. Fire effects are likely to be particularly extreme in these areas, but loss of cove forests in them may represent a return to more natural conditions. Fire in acidic cove forests dominated by Rhododendron may reduce the shrub layer, causing important shifts in the bird communities that depend on shrubs.
Drought	Most of these communities occur in topographically sheltered sites that receive runoff from surrounding areas. Droughts may cause some areas around the margins to dry out and shift to drier communities, but the interior of most coves should generally remain stable despite the changed climate. Drought may increase the potential for wild fire.
Structural Change	Increased wind damage will create more gaps and lead to younger overall tree age.
Exotic species invasion	Increased disturbance and warmer temperatures may facilitate exotic species invasion. Most cove forests are not currently prone to significant invasion, but those at the lowest elevations sometimes are. Tree of heaven (*Ailanthus altissima*), princess tree (*Paulownia tomentosa*), Japanese honeysuckle (*Lonicera japonica*), and Japanese stilt grass (*Microstegium vimineum*) are all likely to become problems through much of the range of cove forests. A number of insect pests are also potential threats to cove forests, but it is unclear how climate change will affect them.
Compositional Change	Increased wind and fire may increase disturbance-following species at the expense of more stable species.
Acreage Change	Increased drought, especially if coupled with wild fire, is likely to shift the boundary of cove forests, changing outer, marginal portions to drier communities. This will result in some acreage change, but it is likely to be limited. The more interior portions of most cove forest patches are unlikely to change. Some marginal areas on the edges of cove forests likely represent unnatural expansion in the absence of fire, so that some acreage loss is appropriate. In addition, cove forests will likely spread to some higher elevation areas now occupied by northern hardwood forests.

Table 2. Bird Species Utilizing Mountain Cove Forests							
Species	**Common Name**	**Element Rank**	**Endemic**	**Major Disjunct**	**Extinction/ Extirpation Prone**	**US/ NC/ WAP***	**Comments**
BIRDS							
Accipiter cooperii	Cooper's Hawk					/W2/P	This was downgraded to Watch List 2.
Accipiter striatus	Sharp-shinned Hawk					/SR/P	
Certhia americana	Brown Creeper					/SC/P	
Coccyzus americanus	Yellow-billed Cuckoo					/ /P	
Coccyzus erythropthalmus	Black-billed Cuckoo					/SR/P	
Colaptes auratus	Northern Flicker					/ /P	
Contopus virens	Eastern Wood-pewee					/ /P	
Setophaga cerulea	Cerulean warbler	G4/S2B				FSC/ SC/P	
Helmitheros vermivorous	Worm-eating Warbler					/ /P	
Hylocichla mustelina	Wood Thrush					/ /P	
Limnothlypis swainsonii	Swainson's warbler	G4/S3B				/W2, W5/P	Acidic cove rhododendron thickets
Geothlypis formosus	Kentucky warbler	G5/S4B				/ /P	Small streams.
Picoides villosus	Hairy Woodpecker					/ /P	
Sphyrapicus varius	Yellow-bellied Sapsucker					/SC/P	Breeding population; above 3000 feet elevation
Setophaga citrina	Hooded Warbler					/ /P	

Table 3. Mammal Species Utilizing Mountain Cove Forests							
Species	**Common Name**	**Element Rank:**	**Endemic**	**Major Disjunct**	**Extinction/ Extirpation Prone**	**US/ NC/ WAP***	**Comments**
MAMMALS							
Microtus chrotorrhinus carolinensis	Smoky Mountain rock vole	G4T3/S3				FSC/SC /P	
Mustela frenata	Long-tailed Weasel					/ /P	
Napaeozapus insignis	Woodland jumping mouse	G5/S4				/ /P	
Scalopus aquaticus	Eastern Mole					/ /P	
Sorex cinereus	Masked shrew	G5/S4				/ /P	
Sorex dispar	Long-tailed shrew	G4/S3				/SC/P	
Sorex fumeus	Smoky shrew	G5/S4				/ /P	

Table 4. Reptile Species Utilizing Mountain Cove Forests							
Species	**Common Name**	**Element Rank**	**Endemic**	**Major Disjunct**	**Extinction/ Extirpation Prone**	**US/ NC/ WAP***	**Comments**
REPTILES							
Heterodon platirhinos	Eastern Hog-nosed Snake					/ /P	
Terrapene carolina	Eastern box turtle	G5/S5				/ /	
Virginia valeriae valeriae	Eastern Smooth Earthsnake					/ /P	

Table 5. Amphibian Species Utilizing Mountain Cove Forests							
Species	**Common Name**	**Element Rank:**	**Endemic**	**Major Disjunct**	**Extinction/ Extirpation Prone**	**US/ NC/ WAP***	**Comments**
AMPHIBIANS							
Ambystoma maculatum	Spotted Salamander	G5/S5				/ /P	
Ambystoma opacum	Marbled Salamander	G5/S5				/ /P	
Ambystoma talpoideum	Mole Salamander	G5/S2				/SC/P	
Aneides aeneus	Green Salamander	G3G4/S2				FSC/E /P	
Desmognathus aeneus	Seepage Salamander	G3G4/S3				FSC/S R /P	
Desmognathus folkertsi	Dwarf Blackbelly Salamander	G2/S1	YES		YES	/SR/	Restricted to a tiny global range in the mountain of northern GA, SC, and extreme southwestern NC.
Desmognathus organi	Northern Pigmy Salamander	G3/SNR					
Desmognathus santeetlah	Santeetlah Dusky Salamander						
Desmognathus wrighti	Southern Pigmy Salamander	G3G4/S2S 3				FSC/S R/P	
Eurycea guttolineata	Three-lined Salamander	G5/S5				/ /P	
Eurycea junaluska	Junaluska Salamander	G3/S2	YES		YES	FSC/T /P	Restricted to an extremely small range located on the border of NC and TN
Eurycea longicauda	Longtail Salamander	G5/S1S2				/SC/P	
Plethodon amplus	Blue Ridge Gray-cheeked Salamander	G1G2/ S1S2	YES		YES	/SR/	Restricted to an extremely small range in the southern Blue Ridge Escarpment in NC.
Plethodon aureolus	Tellico Salamander	G2G3/S2	YES		YES	/SR/P	Restricted to an extremely small range in the Unicoi Mountains

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AMPHIBIANS							
							on the border of NC and TN.
Plethodon chattahoochee	Chattahoochee Slimy Salamander	G2G3Q/ S2?				/SR/P	
Plethodon cheoah	Cheoah Bald Salamander	G2/S1	YES		YES	/SR/	Restricted to the vicinity of Cheoah Bald in NC.
Plethodon glutinosus	Northern Slimy Salamander	G5/SU				/W4 /P	
Plethodon jordani	Jordan's Salamander	G3/S3?				/W3/	
Plethodon longicrus (=yonahlossee pop. 1)	Crevice Salamander	G4T1Q/S1 S2	YES		YES	/SC /P	
Plethodon meridianus	South Mountain Gray-cheeked Salamander	G1G2/ S1S2	YES		YES	/SR/	Endemic to the South Mountains in NC.
Plethodon richmondi	Southern Ravine Salamander	G5/S3				/W2/ P	
Plethodon shermani	Red-legged Salamander	G2/S2?				/SR/	
Plethodon ventralis	Southern Zigzag Salamander	G4/S1				/SC/P	
Pseudacris brachyphona	Mountain Chorus Frog	G5/S1				/SC/P	Known in NC only from an extremely small area in Cherokee and Clay Counties
Pseudotriton montanus	Mud Salamander	G5/S5				/ /	

Table 6. Invertebrate Species Utilizing Mountain Cove Forests							
Species	**Common Name**	**Element Rank**	**Endemic**	**Major Disjunct**	**Extinction/ Extirpation Prone**	**US/ NC/ WAP***	**Comments**
INVERTEBRATES							
Abrostola ovalis	A looper moth	G4/SU				/W3/	
Autochton cellus	Golden banded-skipper	G4/S2				/SR/	
Celastrina neglectamajor	Appalachian azure	G4/S3S4				/W2/	
Celastrina nigra	Dusky azure	G4/S2?				/SR/	
Eupithecia cimucifugata	A moth	GNR/ S1S2				/W2/	
Lithophane joannis	A noctuid moth	G4/SU		YES		/W3/	Ohio Valley species recorded a few times in the NC mountains
Papaipema astuta	Yellow stoneroot borer moth	G2G4/ SH		YES		/SR/	Northern species known from a single specimen collected in the Black Mountains.
Papaipema polymniae	Polymnia borer moth	G4/SU		YES		/W3/	Northern species known only from one record in NC from GSMNP
Papilio cresphontes	Giant swallowtail	G5/S2				/SR/	
Polygonia faunus smythi	Smyth's green comma	G5T3T4/S2				/SR/	
Pyreferra citromba	A moth	GNR/ S1S2				/W2/	
Scopula ordinata	A wave (moth)	G5/S2S3				/W3/	
Speyeria diana	Diana fritillary	G3G4/ S3S4				FSC/ W2/	

*** 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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