Southern Appalachian Ecosystem Restoration Focus Areas

The natural diversity and rich heritage of the Southern Appalachians are reflected in the numerous ecological communities that characterize the varied landscapes of these mountains. This complex diversity of species and settings has also made it challenging to develop a widely supported restoration focus for dealing with the climatic changes[1] and growing demands that threaten to alter the ecosystems of this region. While perspectives on how to protect and restore forest communities of the Southern Appalachians are often are as diverse as the landscape itself, recent discussions have revealed a great deal of common ground on the overall importance of restoration and a desire to identify some key focus areas and work together toward accomplishing mutual goals.

The following five focus areas for ecosystem restoration are a reflection of many of the major issues and conditions affecting Southern Appalachian forests today. They address a common desired vision shared by a variety of public and private land managers, researchers, stakeholders, and interested individuals. While management of National Forest lands was the initial focal point for developing an overall restoration direction, these focus areas represent desired conditions that are applicable to state and private forests as well as National Forests and other public lands. Our expectations are that these key focus areas will continue to evolve over time, but the end result will be a more widely-supported and focused approach to accomplishing ecosystem restoration activities across the Southern Appalachian Mountains.

The five ecosystem restoration focus areas identified for Southern Appalachian forests are:

- Restoration of healthy stream systems within healthy watersheds
- Restoration of rare native communities
- Restoration of fire-dependent ecosystems
- Restoration of diversity in low-diversity forest stands
- Restoration of viable native plant communities by controlling invasive species

Each of the five focus areas are broadly described below based on ideas from various groups and individuals. Discussions of potential activities, information needs, and next steps represent possible courses of action and are provided to help explain the restoration focus area, not represent final determinations of specific projects. This summary document is intended to generate further discussions, ideas, and collaborative opportunities as well as guide the direction of future implementation activities.

1. Restoration of Healthy Stream Systems within Healthy Watersheds

Across all interest groups, restoration of healthy stream systems within healthy watersheds represented the most widely-supported and one of the highest-priority focus areas for landscape-scale restoration activities. Healthy stream systems were identified as a desired condition that encompassed several important restoration goals, including improvement of water quality and enhancement of riparian habitats. The streams and surrounding watersheds of the Southern Appalachians shape the landscape of the area and were recognized as part of the defining character of the mountain ecosystems. Broad objectives for stream system restoration cover both

[1] Minor changes have been made to this summary of results of December 13-14, 2007 meeting that identified potential ecosystem restoration focus areas for southern Appalachian forests. These changes were made to incorporate climate change considerations.

instream and surrounding riparian environments and include: (1) reduced sedimentation, (2) improved habitat for aquatic species, (3) protection of high-value occurrences of hemlock and replacement species for declining hemlocks on riparian sites, and (4) mitigation of harmful acid deposition from abandoned mines. In addition to supporting important biodiversity needs, the protection and restoration of healthy stream systems also reflected concerns about potential effects of extreme variations associated with climate change and growing impacts from urban expansion. By incorporating a watershed-level focus for restoration activities, there could be a synergistic effect that addresses multiple restoration goals at an appropriate scale.

Potential restoration activities for reducing sedimentation sources include (1) establishing a sustainable road system that can be adequately maintained into the future [this includes incorporating appropriate road repairs, maintenance activities, and closing or decommissioning of roads]; (2) mitigating erosion at dispersed and developed recreation sites through re-design or closures of damaging sites; (3) decommissioning or re-designing user-created trails; (4) preventing illegal off-road vehicle use; and (5) expanding the use of best management practices for land-disturbing activities. Aquatic habitat improvement projects could range from replacing culverts and improving stream crossings to re-stocking native species such as brook trout and introducing large woody debris where appropriate. As hemlocks continue to die from the spread of hemlock wooly adelgid and a changing climate, potential restoration activities could include expanded protection measures for key stands of hemlock as well as replacement with other species to restore the ecological function of degraded hemlock stands in riparian areas. Possible activities to improve acid mine drainage areas could involve limestone dosing along streambanks and roadways, filtration systems, and removal of refuse piles. Other actions to support restoration goals under this focus area could include acquisition of private lands along headwaters and undeveloped waterways and the initiation of citizen workshops, Adopt-a-Stream cleanups, "Kids in the Creek" educational opportunities, and other volunteer partnerships to promote healthy streams.

Potential barriers to restoring healthy stream systems include funding; private land ownership; uncontrolled sedimentation sources; increasing regional development; traditional use of Forest Service roads for access to inholdings, recreation opportunities, scenic drives, and other local uses; and the sheer magnitude of the problem. Information needs center on watershed-scale assessments of roads and streams to identify highest priority areas and the synthesis of existing data. Research needs range from surveys of native aquatic populations and pilot studies on hemlock replacement to long-term assessment of anticipated climate change impacts on stream conditions and riparian species. Evaluation of white pine stands that have already become established in riparian areas would provide an excellent opportunity to more quickly assess the potential for white pine as a replacement species for hemlock.

Potential next steps: Conduct simplified watershed assessments on each Forest to identify top priorities; survey road systems to determine current conditions, sediment sources, and greatest problem areas; inventory streams for highest priority aquatic passage improvements; look for stewardship opportunities tied to other vegetation work; develop new partnerships or community involvement projects on each National Forest for stream cleanups, monitoring, or education; and build on the nation-wide Forest Service focus on water, kids, and climate change as overarching issues important to the Chief.

2. Restoration of Rare Native Communities

Rare native communities were recognized as increasingly vulnerable components of the unique character of the Southern Appalachian Mountains. This restoration focus for rare communities would be twofold: (1) to re-establish fire or other disturbances to habitats such as bogs, balds, canebrakes, and cliffs and (2) to correct problems with hydrologic function on hillside bogs and montane alluvial wetlands and forests. Restoration programs would also consider caves, rock outcrops, serpentine barrens, spruce/fir forests, shortleaf pine stands, and other less common ecosystems.

Possible restoration activities could involve burning, cutting, mowing, grazing, control of non-native invasive species (NNIS), land acquisition, experimental plantings, installation of boardwalks, and closure orders. It will also be important to identify examples of rare communities where ecosystem dynamics are functioning well to use as reference areas in rare ecosystem restoration. In addition to active restoration activities, other practices such as protection of existing relatively intact areas of high ecological integrity should be part of the overall strategy for ensuring the continued existence of rare native communities. Potential barriers include smoke management, damage to cultural sites, funding, beaver conflicts, geographic isolation/access, wilderness designations, lack of economies of scale, reluctance to do active management, and need for repeat burning. Anticipated research needs would focus on the communities and habitat relationships that we understand the least including information on the role of fire in balds, bogs, and canebrakes; habitat needs of neotropical migratory birds; mapping of rare communities; and effects of disturbance on rare plants.

Potential next steps: Find partners to identify the areas most at risk and begin developing demonstration projects for the highest priority areas. Identify priorities by Forest, identify priorities for NNIS control, find funding sources, find additional partners, design demonstration projects, look for ties to state wildlife action plans, and update surveys. It was noted that when American chestnut seedlings become available in appreciable quantities, restoration of this species should be a top priority.

3. Restoration of Fire-Dependent Ecosystems

As noted by Southern Research Station scientists, one of the factors that in recent years has been missing in the mosaic of soils, aspects, elevations, weather patterns, and other disturbances that contributes to the diversity of plants communities in the Southern Appalachians is fire. Climate change and long-term wildfire fuel accumulation has and will continue to increase future fire risk and occurrence. The objective of this focus area is to restore and maintain fire-dependent ecosystems and, as a corollary, strive to do no harm. Potential activities could include restoration of fire to open areas like meadows and balds, fire-dependent pine stands such as Table Mountain and pitch pine, and xeric oak systems and oak savannahs. Other projects could include understory burns to control laurel and rhododendron and prescribed fires to enhance habitat for threatened and endangered species, control invasives, and reduce fuel loads and initiate recovery in areas impacted by Southern Pine Beetle. Pilot studies could evaluate growing season burns, establish restoration burn cycles versus long term maintenance needs, evaluate the use of fire in wilderness areas, and create small burns for public information and education. Monitoring design should include (1) monitoring in ecosystems that are not clearly fire dependent and (2) monitoring of effects from different fire returns to get a better understanding of how to apply fire both spatially and temporally.

Potential barriers include smoke and air quality issues; small windows available for prescribed burning, particularly with continuing drought conditions; public health concerns; safety and management challenges with heavy fuel loadings; costs; media and public perceptions; fragmentation and diversity of land ownership; wildland/urban interface constraints; availability of qualified resources; and the need for a clearer understanding of fire-dependent ecosystems. Research and information needs include oak regeneration studies, appropriate fire intervals for Table Mountain pine regeneration and other fire-dependent, climate-change tolerant species, use of fire to mimic natural processes, synthesis of human health issues, mapping of high priority areas, more definitive smoke models, and a better understanding of the effects of fire on control of invasive species.

Potential next steps: Develop joint, cross-boundary projects with partners; more support to Fire Learning Networks; public education on smoke management and prescribed fires; completion of wilderness fire plans; initial focus on pilot projects in areas of clear agreement; strategic prioritization of restoration treatments; monitoring design to answer research questions as well as treatment effects; and Green River research with and without mechanical treatment.

4. <u>Restoration of Diversity in Low-Diversity Forest Stands</u>

The objective of this restoration focus area is to increase diversity in species composition and structure of low-diversity forest stands. Many forested areas that were re-planted or naturally regenerated after timber harvesting and other disturbances have become dominated by even-aged single species such as white pine, yellow poplar, or loblolly pine and do not provide the diverse habitat that typifies native communities in the Southern Appalachians. The intent of this focus area is to restore species and structural diversity to low-diversity, virtually monoculture stands. Other objectives in restoring diversity include consideration of hydrologic functions (since many sites were barren when reforested), use of site-adapted species, and consideration of long-term economics.

Potential activities that could restore diversity include demonstration projects, thinnings or release of desired stems, prescribed fires, stewardship contracts, demonstration of alternative logging systems that have low impact, consideration of wildlife value, potential for future insect and disease infestations, uneven aged management or group selection where practicable, commercial and pre-commercial thinning, development of a restoration template, utilization of timber stand improvement dollars, and treatment of non-native invasives as part of the prescription when thinning. Possible barriers may involve public objections to the harvest of trees from public lands, aesthetic impacts, economics of harvest opportunities, markets for the wood, ecological constraints, lack of advanced regeneration, degraded site quality, availability of planting stock from nurseries, accessibility to monoculture stands, and workforce or infrastructure capability for small diameter harvests. Research or information needs include site information such as FSVeg data, silviculture prescriptions, list of desired tree species, descriptions of desired future ecological conditions, site capability (soil productivity) maps, current research on succession, marketability now and in the future, geospatial mapping of all monoculture stands, NatureServe information, and a whole suite of ecological information.

Potential next steps: Identify site-specific projects, get internal and external buy-in and support, survey markets for wood needs, and involve partners along the way.

5. <u>Restoration of Viable Native Plant Communities by Controlling Invasive Species</u>
Although associated with several other focus areas, control of non-native invasive species was identified as a separate and significant factor in restoring the viability of native plant communities in the Southern Appalachians. Objectives included (1) preventing new infestations from being established, (2) treating high risk stands or plant communities, (3) protecting "clean" areas or areas of high value or ecological sensitivity (such as riparian areas, bogs, and rare species habitat), and (4) starting control in the backcountry and working toward the edges. Proposed activities could include having Forests complete the planning exercise from the Region 8 Invasive Species Strategy, conducting watershed assessments to determine the most critical situations, requiring weed-free hay for all livestock uses, requiring equipment cleaning for vehicles moving into and out of infestations, and working with relevant industries to acquire sources of clean hay and gravel. Activities could also include the increased use of native species in re-vegetation efforts and wildlife openings wherever possible and the use of seed mixtures uncontaminated by invasive species. Possible barriers include the spread of infestations across multiple land ownerships and jurisdictions, lack of knowledge or concern by the public, detection efforts are too slow to enable tactical responses, multi-year treatments needed to achieve results, unsuitability of many herbicides for use in riparian areas, and lack of landscape-scale coordination. Additional information is needed on infestations on private lands, finer-resolution data on more species, an integrated set of priorities, success stories and effective treatments, new treatment options, responses to global climate change, and early detection.

Potential next steps: Conduct outreach and education for the general public, do risk assessment/threat matrix (including support of ongoing efforts on the Cherokee, Nantahala-Pisgah, Chattahoochee-Oconee, and Sumter National Forests), do advance planning for potential gypsy moth spread, and conduct outreach to nurseries, landscapers, and crafter industries.

Who To Involve
Common to all focus areas is a need to involve a variety of partners, advisors, and interested groups in accomplishing restoration goals. These include: US Fish and Wildlife, state wildlife agencies, state and private forestry, state air quality and smoke management agencies, state heritage agencies, native plant societies, garden clubs, Southern Appalachian Mountains Joint Venture, Ruffed Grouse Society, national Wild Turkey Federation, Ducks Unlimited, State Departments of Transportation, The Nature Conservancy, private landowners, county commissioners, Eastern Band of Cherokee Indians, local governments and county administrators, outfitters, boaters, ATV groups, local watershed associations, conservation NGOs, colleges and universities, US Army Corps of Engineers, NRCS, TVA, EPA, timber industry, Prescribed Fire Training Center, Southern Blue Ridge Fire Learning Network, Central Appalachian Fire Learning Network, Southern Research Station and other research groups, volunteer fire departments, Prescribed Fire Training Center, home building industry, crafts folks, non-traditional contractors, Great Smoky Mountains National Park, SAMAB, water districts, chemical manufacturers, local schools, and regular folks.

Following pages discuss three additional restoration topics that were brought up by Forest Service Research Scientists at a previous meeting and may also be of interest to you

Restoring American Chestnut in the Southern Appalachian National Forests

Prepared by John Stanturf; material contributed by David Loftis, Henry McNab, Steve McNulty and Dana Nelson (Version 2.0; June 26, 2008)

Narrative Description:

American chestnut (*Castanea dentata*) was decimated by chestnut blight (*Cryphonectria parasitica*) in the early part of the twentieth century, and by 1950 was present only in the understory of forest stands as sprouts from the old root systems of trees that were once in the overstory. Due to its historical stature and cultural value, there is great interest in restoring American chestnut to our forests. Increasing amounts of putative blight-resistant American chestnut seedlings will become available to the National Forest System after 2010. Initially, these seedlings will need to be field-tested for both blight resistance and survival in the wild. To effectively use this material, the national forests should begin the process of identifying sites on which the latest chestnut seedlings can be planted for initial survivability tests and eventually for re-introduction.

What are the specific restoration objectives to be achieved?

To re-establish and maintain a significant and increasing American chestnut component in the forests of the Southern Appalachians where it once was an ecological keystone species.

What are the specific management actions that could be used?

(1) Identify and prioritize sites for testing of the initially limited blight-resistant plant material, based on the known former range and inferred site adaptations of chestnut. These initial plantings are best considered in the "testing phase" and their value needs to be proven on many forest sites over the next 5-10 years.
(2) Collaborate with those developing plant material to ensure that it is site-adapted to the Southern Appalachian Mountains
(3) Develop silvicultural techniques for re-introduction, establishment, and management leading to self-perpetuating populations of chestnut and associated species
(4) Partner with R&D to test techniques and material on a limited number of high-priority sites prior to full-deployment

What are the barriers to achieving these objectives?

The most significant barrier is the current lack of suitable plant material. There is uncertainty about the timing of availability and amount of plant material. Both traditional breeding and genetic modification approaches are underway to develop blight-resistant *C. dentata*. A breeding program by The American Chestnut Foundation, based on backcrossing with blight-resistant Chinese chestnut, has considerable promise. Although this program has broad support, it is not clear that the parent material is from Southern Appalachian sources, or that advanced propagation techniques are well enough developed to ramp-up production of blight-resistant seedlings. University scientists are pursuing an alternative strategy to transfer genetic material directly from blight-resistant species to native *C. dentata*. The acceptance by the public of Genetically Modified Organism (GMO) chestnut is unknown. Once blight-resistant material has been developed and tested, advanced propagation methods should be developed and used to mass-produce suitable planting stock with appropriate levels of genetic diversity. Container-grown seedlings, although more expensive than traditional bare-root seedlings, show promise for shortening the time needed for producing plantable seedlings in large quantities.

Another barrier to chestnut restoration is the lack of specific silvicultural knowledge of the species. An approach to identifying the best sites for early planting has been developed. Based on FIA plots in western NC, it appears that sites with dry moisture regimes should be among those considered as better suited for chestnut restoration. A larger data set, for example from the mountain regions of all states in the Southern Appalachians, would provide a more complete picture for ranking sites to consider for restoration of American chestnut on the forested landscape.

We are beginning to investigate artificial regeneration strategies that could be used to restore American chestnut when blight-resistant seedlings are available, and to understand the natural regeneration ecology of chestnut. Emphasis on artificial regeneration necessarily precedes work on natural regeneration, although understanding of the regeneration ecology will inform our expectations for outplanted seedlings and the site preparation and stand manipulations needed for successful artificial regeneration. Climate change and variability will complicate the reestablishment of chestnuts. Seedlings of the 21st century will be facing very different environmental conditions from the 19th and 20th centuries. Improved understanding of how climate change will impact forest regeneration is needed if chestnut reestablishment is to be successful. Initial indications are that chestnuts may flourish under global warming because the American chestnut is a drought-tolerant species, native to the region.

What scientists, specialists, or organizations could help?

The American Chestnut Foundation (MOU with the Forest Service), The Nature Conservancy, Society for Ecological Restoration (another MOU with the Forest Service, although mostly western-focused to date), FS scientists in SRS-4157, SRS-4156, SRS-4160, and university scientists (e.g., Charles Maynard and Bill Powell at SUNY-ESF; Scott Merkle at UGA), Stacy Clark (SRS- 4157) and the coalition of which she is a part.

Restoring Ecohydrologic Function in Riparian Areas Impacted by Hemlock Woolly Adelgid

Prepared by Jim Vose and Chelcy Ford, Coweeta Hydrologic Lab, rev. June 25, 2008

Introduction

Hemlock woolly adelgid (HWA) is a non-native invasive insect that impacts eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*Tsuga caroliniana*). HWA was first reported in the 1950's in the northeastern U.S., and has now spread to the southern Appalachian region of northern Georgia, western North Carolina, and southern Virginia. Without control, hemlocks typically die within 5 to 7 years after infestation. Although chemical control of HWA is successful on small spatial scales and on short time scales (2–3 years), chemical control on a large landscape scale is impractical. To date, neither natural predators nor host resistance have been able to stop the spread of HWA. Hemlock trees serve important ecological roles in the southern Appalachians. Their evergreen foliage and high leaf area provides year-round cover. As such, they are a keystone species in near-stream areas (Ellison et al. 2006), providing critical habitat for birds and other animals, and shading streams to maintain cool water temperatures required by trout and other aquatic organisms. Recent research (Ford and Vose 2007) also shows that hemlock has a strong influence over southern Appalachian forest water budgets, including soil moisture and stream flow dynamics, especially during the fall, winter, and spring.

While scientists and land managers are hopeful that biological and chemical controls will be successful, it is likely that large areas of the southern Appalachians will experience significant HWA mortality. Land managers will be faced with developing management strategies to restore forest health in stands with significant levels of mortality. Without management, it is unlikely that any other evergreen overstory species will replace hemlock in the near or mid-term. Instead, areas will be dominated by deciduous species such as birch, red maple, and yellow poplar (Ford and Vose 2007), as well as rhododendron where present. These species will not fill the ecohydrological role played by hemlock in riparian ecosystems.

Restoration Objectives

The primary restoration objective is to provide overstory evergreen cover in areas impacted by HWA. This cover is critical for shading streams and providing wildlife habitat, but also influences soil moisture and stream flow dynamics.

Management Actions

We recommend that eastern white pine be evaluated for use in restoring degraded hemlock stands. White pine has several desirable characteristics: (1) it is native to the southern Appalachians, (2) it can grow in riparian areas (Fowells 1965), (3) it is among the most shade tolerant pine species and capable of growing in mixed species stands, and (4) it has high leaf area (Vose and Swank 1990) and hence, can provide wildlife habitat and shading. A recent study (Ford et al. 2007) also suggests that seasonal water use patterns of eastern white pine are comparable to eastern hemlock, and hence may provide similar controls on soil moisture and stream flow.

It is likely that a combination of planting and competition control will be required to establish white pine in degraded riparian areas. We recommend that a minimum of four seedlings be planted in the vicinity of dead and dying large hemlocks (e.g., > 12 inches dbh) and saplings and small stems within a 15 ft radius of the seedlings be removed by chainsaw. Where rhododendron is present, more aggressive control measures may be required.

Barriers

We are unaware of any studies that have evaluated the ecohydrological role of eastern white pine in riparian zones. Hence, our recommendation is based on expected results based on the best available science. As such, we recommend that these activities be initiated in a series of small scale pilot studies that can be monitored and practices adapted as necessary.

Supporting Literature

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Fowells, H.A. 1965. Silvics of forest trees of the United States. USDA Forest Service, Agriculture Handbook No. 271, USDA, Washington, D.C. 20250.

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Restoring/Maintaining Oak Forests

Version 2.0; June 26, 2008. Prepared by David Loftis, Bent Creek Experimental Forest, with contributions from Steve McNulty.

Narrative Description:

Scarlet, black, chestnut, white, and northern red oaks are either dominant or prominent on more than 75% of the forested landscapes of the Southern Appalachians. In addition to the commercial value associated with oak species, the provision of significant ecological functions (e.g., wildlife food resources) usually elevates perpetuation of oaks on forested landscapes to a primary objective of forest management. Across a broad range of site and stand conditions, however, the perpetuation (regeneration) of oaks may be difficult to achieve. Problems regenerating oak on moist, productive sites are well-documented. Oak regeneration failures may also occur, however, across the whole range of sites on which oak occurs as a result of the absence of regeneration sources--advance reproduction and potential stump sprouts--in existing stands that would be competitive when released by either natural disturbance or silvicultural activity.

What are the specific restoration objectives to be achieved?

The restoration objective is to maintain an oak component across the landscape sufficient to provide the multiple ecological and natural resource benefits.

What are the specific management actions that could be used?

- Collection of data from stands that are candidates for oak regeneration and application of existing models to assess regeneration potential in stands within landscapes under global warming
- Application of existing (and emerging) silvicultural prescriptions that can increase oak regeneration potential when existing potential is inadequate to satisfy management objectives
- These prescriptions may include activities that alter light regimes in stands to enhance development of advance reproduction, and the potential use of fire to alter stand structure and to control competing species
- The application of promising artificial regeneration strategies

What are the barriers to achieving these objectives?

- Inadequate understanding of the fundamentals of regeneration ecology in hardwood systems, resulting in the failure to provide for the collection of necessary data to project outcomes of regeneration activities
- Institutional processes that do not provide the flexibility in timing and type of silvicultural treatments necessary to achieve desired outcomes
- Some unresolved issues dealing with where various silvicultural practices to enhance oak regeneration potential are most appropriately applied
- Climate change that prevents the development of sustainable environmental conditions necessary for oak seedling establishment

Which scientists, specialists, or organizations could help?

SRS-4157, SRS-4156 and some university scientists