Partners in Flight
Bird Conservation Plan
for
The Southern Blue Ridge
(Physiographic Area 23)

American Bird Conservancy

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SOUTHERN BLUE RIDGE BIRD CONSERVATION PLAN
EXECUTIVE SUMMARY

Over 155 bird species nest in the Southern Blue Ridge. Widespread and representative species include dark-eyed junco, northern cardinal, black-throated blue warbler, Carolina wren and blue-headed vireo. Appalachian populations of Bewick's wren, yellow-bellied sapsucker, northern saw-whet owl, and black-capped chickadee, as well as golden-winged, Swainson's and cerulean warblers are rare or uncommon, have very specific habitat requirements and serve as umbrella, or focal, species for conservation planning efforts. Of these birds, a large proportion is nearctic-neotropical migrants dependent on mature forest. Examples include Louisiana waterthrush, Acadian flycatcher, veery, ovenbird and Canada warbler. Furthermore, species associated with frequently disturbed and/or early successional habitats like prairie warbler, field sparrow, and northern bobwhite have also suffered significant population declines in the recent past and warrant conservation attention.

The Southern Blue Ridge Physiographic Area (SBR) includes the Central Blue Ridge, Southern Blue Ridge and Metasedimentary Mountains subsections of the Southern Appalachians which covers portions of Northern Georgia, Western North Carolina, Northwestern South Carolina, Eastern Tennessee and Southern Virginia. Topography consists of tall mountains with long broad ridges, steep slopes, deep ravines and wide intermountain valleys. The combinations of landform, elevation, and soils, along with the area's humid and temperate climate, make the Southern Blue Ridge one of the most biologically diverse areas in North America. The region supports large numbers of plant and animal species including the highest diversity of salamanders in the world, extremely rich forests with a tremendous diversity of tree and herbaceous species, and very high densities of breeding birds.

Six forest types and 3 general habitat categories have been identified as important bird habitats. These include spruce-fir, high-elevation (including northern) hardwoods, hemlock-white pine, cove (mixed mesophytic) hardwoods, Appalachian oak hardwoods, and southern yellow pine forests, as well as, early successional habitats, lowland riparian woodlands and urban/suburban "backyards"/rural woodlots. Bird species have been scored according to the Partners in Flight prioritization process and grouped into three broad suites associated with: (1) high-elevation forests, (2) habitat conditions associated with frequently disturbed forests, and (3) mature forests of all types. Conservation opportunities and management recommendations have been described and suggested for each habitat type.

Specific landscape habitat recommendations for the Southern Blue Ridge include: (1) protecting and restoring imperiled spruce-fir and Table mountain/pitch pine forest communities, (2) increasing the amount of late successional northern hardwoods, hemlock-white pine, cove hardwoods, southern yellow pine forests, (3) improving structural complexity for presently closed canopy, mid-successional stands in all forest types for understory and canopy dependent forest species, (4) protecting and restoring sensitive mountain wetlands and bald communities, (5) increasing the amount of early successional, shrub scrub habitat in high-elevation (again including northern) hardwoods, Appalachian oak, and southern yellow pine forests, and (6) improving the condition and increasing the amount of lowland riparian habitats.

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Acknowledgments

This is an advanced plan, identified as Version 1.0, to help define bird conservation initiatives for the Southern Blue Ridge physiographic area. The following recommendations and objectives remain open for comments, discussion and review.

Implementation recommendations are based upon several assumptions that require research, monitoring or adaptive management techniques in order to be verified. The amount, condition, landuse and ownership percentages of the habitats discussed above need to be accurately described and verified. Responses of specific bird species to management recommendations need to be monitored and/or tested. Therefore, aggressive implementation of recommendations should only follow rigorous testing of assumptions and should be followed by equally rigorous monitoring the responses of both target and non-target species.

Many peope have assisted with the writing and ideas of this plan, and lively discussions have helped with the thoughts towards better conservation. Those people included Dave Buehler, Laura Mitchell, Chuck Nicholson, Fred Alsop, Dave Lee, Jim Woehr, Chris Haney, The Southern Appalachian Forest Coalition, the Southern Regional office of The Nature Conservancy, and many others.

Section 1: The Planning Unit

Background

The Southern Blue Ridge Physiographic Area (SBR) encompasses about 3.7 million ha (9.1 million acres) in Georgia, North Carolina, South Carolina, Tennessee and Virginia (Figure 1), and includes the Central Blue Ridge, Southern Blue Ridge, and Metasedimentary Mountains subsections of the Southern Appalachian Assessment area (SAMAB 1996). The area topography is characterized by rugged mountains, long broad ridges, steep slopes, and deep ravines. The area includes the highest mountains east of the Mississippi River, many peaks reach over 1,830 m (6,000 feet). The high-elevation forests of the SBR are referred to as the "High Peaks" Region to distinguish them from similar forests of the Central Appalachians or the Rocky Mountains (White *et al*. 1993). Wide valleys, containing large areas of open level ground, occur as low as 305 m (1,000 feet). The climate is temperate and humid with the mean annual temperature ranging between 10^{o} C (50^{o} F) and 15.6^{o} C (60^{o} F) (SAMAB 1996). Average annual precipitation, occurring as either rain or snow, is between 100 cm - 125 cm (40 in - 50 in) and can range up to 150 cm (60 in) at the highest elevations. Primary and secondary streams occur throughout the area. Headwaters for the Apalachicola, Mobile, New, Savannah, and Tennessee Rivers are located here.

Nearly 80% of the region is covered by forest vegetation in some state of regeneration, the remaining 20% is being utilized for agriculture or, increasingly, for urban/suburban development and occurs typically in the valleys between mountain ranges (Figure 2). The forest is currently made up of a mosaic of stands ranging in age from a few to over 180 years old, and in some places, old-growth forests well over 200 years old still occur. The majority of these forests are in a mid-successional age class (between 41 - 80 years old) with smaller amounts in early (0 - 10 years), sapling/pole (11-40) and late (91+ years) successional age groups (SAMAB 1996).

Dominant forest communities important to avian species conservation include "High Peaks" spruce-fir-northern hardwood forests, pure northern hardwood, hemlock-white pine-hardwood, cove hardwood, Appalachian oak, southern yellow pine, and lowland riparian woodlands. The distribution of these forest types is dependent upon elevation, soil conditions, aspect, other landform features, and

disturbance regimes that occur across the landscape (Figure 3, Kendeigh and Fawver 1981). Forests composed of red spruce and Fraser fir occur at the highest elevations, usually above 1667 m (5,000 ft). Pure stands of Fraser fir can occur at or above 1830 m (6,000 ft). Spruce-fir grades down to northern hardwood forests (yellow birch, sugar maple, American beech) or hemlock-white pine forests on steep, north-facing slopes above 1500 m (4,500 ft.) and Appalachian oak forests (usually dominated by northern red and white oak) on drier sites. Appalachian oak forests are by far the most ubiquitous forest type in the area (SAMAB 1996, Stephenson et. al. 1993). These forests typically consist of a mixture of northern red, scarlet, black, white, and chestnut oaks, as well as other dominant tree species like hickories. Tree species distribution and abundance vary in relation to soil moisture and elevation (see Stephenson et. al. 1993).

Mixed mesophytic hardwood forests (or cove hardwoods) occur on more mesic sites, typically on lower slopes and in protected coves and ravines at low to mid-elevations. Here, mesophytic tree species like tulip poplar, eastern hemlock, sugar maple, American basswood, yellow buckeye, and white and red oaks dominate the canopy with white pine growing in areas containing more coarse textured soils. Southern yellow pine forests include shortleaf, pitch, table mountain, and Virginia pine. These forests occur on dry ridge tops at various elevations and are associated to some extent with fire. Pitch pine is associated with lower elevation ridges often among Appalachian oak forests, while Table Mountain pine occurs on high elevation, xeric ridges where fire was prior to 1930 most frequent. Riparian or streamside forests occur at higher elevations within the major forest types described above and at lower elevations within the valleys where they are often surrounded by agriculture or development. Intermountain basins typically contain forest patches, composed of oaks (scarlet, white, blackjack and post) and pines (Virginia and short-leaf), that vary in size from smaller urban/suburban "backyards" to larger rural woodlots and abandoned fields.

Disturbance has played an important role in shaping the structure and composition of these forest communities. Historically, fire from lightening strikes helped maintain table mountain and pitch pine forests, as well as possibly high elevation, early-successional communities like grass and heath balds (Buckner and Turrill 1999, White *et al*. 1999). Furthermore, fire has influenced the development and structure of upland oak forest communities on drier, south and southwesterly facing slopes

(SAMAB 1996, Delcourt and Delcourt 1997, Buckner and Turrill 1999). Herbivore grazing (e.g. large herds of bison and elk) and beaver affected the structure and composition of the forests by creating and maintaining early successional grass communities and mountain wetland complexes like bogs and beaver ponds (Lee and Norden 1996, White *et al.* 1999). Wind, snow, ice, and heavy precipitation are currently the most common forms of natural disturbance within the region. Blowdowns, from strong thunderstorms and hurricanes, and crown damage from severe winter ice storms, open up the canopy and affect the forest's structure.

Human caused disturbance undoubtedly started with Native Americans cutting and burning small areas to produce timber and forage for game and domestic animal stocks. This type of land use continued until European settlers began widespread clearcutting in the late 1800's. Since then, much of the forest has been actively managed for timber production, either on private industrial lands or within public landholdings. The remaining privately held forestland has either been left to regenerate naturally or has been commercially developed. Fire suppression since the 1930's has affected the composition and structure of forest types adapted to periodic large scale burns. The lack of naturally occurring fires has changed the amount and distribution of important early-successional habitats (Buckner and Turrill 1999).

Introduced pathogens and exotic pest invasions have greatly affected the health and structure of SBR forests (SAMAB 1996). American chestnut, once a dominant tree species in the Appalachian oak forests, has almost all been eliminated by Chestnut Blight. The balsam woolly adelgid has impacted high-elevation spruce-fir forests by damaging the majority of older Fraser Firs (SAMAB 1996). Future infestations of the hemlock woolly adelgid, gypsy moth, other exotic pests, plants, and diseases will further alter the forests of the SBR.

Conservation Issues

Breeding Bird Surveys (BBS) analysis indicates that about 30% of the species known to breed in the SBR have declined sharply in the last 30 years, and an additional 18% have shown possible declining trends. The number of species showing declines in the SBR exceeds that found in any other physiographic area within the Southeast (James *et al.* 1993, Hunter *et al.* 1993) and include resident

species, nearctic-temperate migrants, and neartic-neotropical migrants. However, many species experiencing the steepest declines are nearctic-neotropical migrants that travel to South America, Mexico, Central America, and the Caribbean during the non-breeding season. Population declines among nearctic-neotropical migrants in a landscape with apparently increasing habitat seems to lend evidence that the cause may lie in tropical wintering habitats. However, steep population declines among resident and temperate migrant species contradicts this notion. The question remains: why would so many species associated with mature forests, regardless of migration status, show steep declines within a physiographic area experiencing an apparent expansion of optimal habitat?

Downward population trends are difficult to explain since patterns and causes of bird population change are complex. For species typically classified as nearctic-neotropical migrants, the evidence still suggests destruction of many important tropical winter habitats as one potential cause (Robbins *et al*. 1989, Terborgh 1989). One alternative is the negative impacts associated with heavy forest fragmentation and intensive timber management (Blake and Karr 1987, Robinson *et al*. 1995). However, the declines documented in the SBR are not likely a direct result of either of these two potential causes.

A possible explanation is that BBS routes are conducted along roadsides. These counts detect more forest-edge than forest-interior species and in the SBR the development pressure is greatest along these routes (Nicholson 1997). For example, the Southern Blue Ridge, Northern Cumberland Plateau, and Ohio Hills are all heavily forested physiographic regions where detection rates of forest-interior species are similar. However, significant bird population declines have occurred only in the SBR (Hunter *et al*. 1995, in prep.). Furthermore, only the SBR has experienced a tremendous surge in development coinciding with the BBS. Since this expansion of development is occurring along the roads sampled by the Breeding Bird Survey, the declining population trends seem to be real but caused by other factors. Increasing urban development, an overall change in the amount and condition of important habitats (C. Haney, J. Woehr, in lit. Appendix I), and effects from pollution (James *et al*. 1996) have all been identified as potential causes of declines. With these in mind, specific conservation objectives will need to account for the amount, location, condition and health of the various habitat types important to priority bird species.

Perhaps the most important and challenging conservation issue is the conservation and restoration of the High Peaks spruce-fir-northern hardwood forests. Late successional spruce-fir-northern hardwood forests are relics from the last glacial advance and provide habitat for a group of birds more commonly associated with the boreal forests of northeast North America and the Rocky Mountains. For many of these birds, the SBR represents the extreme southern limit of their distributions. In addition, several species appear to represent long-isolated endemic populations which may be genetically distinct from populations elsewhere (Lee and Browning in press, Milling *et al*. 1997). Therefore, stabilizing or increasing those populations is a primary objective regionally, and perhaps nationally. Spruce-fir forests have been declining naturally for 10,000 years, although changes in the health, structure, and composition of these forests have been accelerated from timber management, large scale wildfires, exotic pests, and air pollution during the 20th Century. Continued decline of this habitat may result in the complete loss of some of these species from the region.

Most recent bird species extirpations are associated with habitats subjected to frequent and extensive disturbances that are either natural (*i.e.*, storm, fire, or grazing) or man-made (*i.e.*, forestry or agricultural practices). The amount of early-successional habitat has been reduced since the 1930's as regenerating forests matured, fire suppressed, grazing herds eliminated, and even-aged timber management decreased. As a result, many early-successional species in this physiographic area have experienced declines. Early-successional habitats of the SBR at middle and high elevations and dependent species are subject to disappearing almost completely in a similar fashion to what is projected for the Northeast U.S. (Litvaitis 1993).

Furthermore, recent studies have highlighted the importance of early-successional habitat to post fledgling mature forest species (Anders et al. 1998, Vega Rivera et. al. 1998). These findings contradict the notion that mature forest species are truly dependent upon forest interiors to ensure reproductive success after the young have fledged. However, these findings may reflect the condition of the mature forests themselves rather than a dependence upon widely scattered patches of early - successional habitat from natal areas.

The SBR is among the most heavily forested physiographic areas in the Southeast, yet many of the forest communities currently lack the structural characteristics that provide quality habitat for many

birds. An estimated 40 - 60% of the hardwood forests are in the mid-successional stage of regeneration (SAMAB 1996). Many of these stands have formed closed canopies which inhibits the development of structurally complex understory and subcanopy layers. This lack in vertical structure reduces habitat quality for many understory species and has been identified as one of the main contributors to declines of many forest interior birds over the past 30 years (C. Haney, J. Woehr, in lit. Appendix I). Structure amenable for both canopy and understory species will likely develop as these forests mature, but this may require decades or centuries. Furthermore, stands in this condition tend to be less affected by natural disturbances, like wind damage, which would open the canopy and allow for some understory development. Improving structural complexity of these forests through silviculture may forestall continued losses to understory species. Substantial opening of static closed canopies should also improve habitat for species requiring complex canopies, but these assumptions must be subjected to rigorous testing.

Many species undergoing population declines are mature forest species that require a high percentage of forest cover, as well as large areas of mature forests for breeding. However, even within largely forested physiographic areas, such as the SBR, the importance of late successional forests compared with mid successional forests for mature forest species is not well understood. Late successional forests, especially those exhibiting "old-growth" characteristics (*i.e.*, trees in all size and age classes, a multilayerd canopy, standing snags, downed coarse woody debris, and the presence of shade-tolerant species) would seem to provide good quality habitat conditions for mature forest species associated with all vegetative layers. However, these conditions currently occupy a small percentage of the SBR landbase (SAMAB 1996).

Large patches of mature hemlock-white pine, northern hardwoods and mixed mesophytic (cove) forests are especially uncommon as a result of almost complete harvesting during the first half of this century (SAMAB 1996). Late successional hemlock-white pine-hardwood forests currently cover only about 4% (40,000 acres) of the forest type and 0.5% of the SBR landbase. In addition, older stands of northern hardwoods and mixed mesophytic cove forests, high quality habitat for a number of key mature forest species, only cover about 4.7% (83,000 acres) of these forest types and 1% of the SBR landbase (SAMAB 1996). Since future hardwood sawtimber production will likely be based

upon mid-successional cove, and to some extent northern, hardwoods, increasing and maintaining late successional acreage for these, and other forest types will be among the most complex and challenging conservation issues from an economic standpoint within the SBR.

Low elevation forests, especially in riparian areas, provide important habitat for a variety of avian species, but typically occur where urbanization and agriculture have proliferated. As a result, these forests have been broken up into patches that vary in size and condition. Fragmentation is highest in these areas and may result in higher rates of nest predation and cowbird parasitism. The size, condition and shape of patches as well as the width and extant of riparian areas are therefore of particular concern in lower elevation forests.

Land use trends in the SBR have been changing for the past 100 years. Overall, the amount of farmland has been reduced and the amount of forest cover has increased (Stephenson et. al. 1993). Although the amount of developed land is still low (<5%), recent studies indicate that urban/suburban development has substantially increased over the past two decades. Developments near high elevation natural areas for recreational resorts (*e.g.,* golf and skiing) and the construction of second homes have increased throughout the region (SAA 1996, Stephenson et. al. 1993). If more forests are converted to developments, effects from fragmentation (*i.e.,* higher predation and parasitism rates) may have severe impacts on the breeding success and survival rates of many species. Fragmentation effects become amplified if the large contiguous forests of the SBR act as population "sources" by producing surplus individuals which maintain populations in smaller, non-productive forests or "sinks" occurring throughout the East (Donovan et al. 1995, 1997, Pulliam 1988). As a result, future commercial development must take into consideration the surrounding landscape and attempt to minimize any impacts that may be associated with external landscape-level factors such as the percent of forest cover or habitat patch size.

Appendix I provides letters and commentaries based on previous drafts and ongoing discussions directly related to the formation of this plan. To the degree possible, these comments are addressed here, but a wide range of opinions exists on some topics. These letters and commentaries attempt to capture this range of opinion, not otherwise adequately captured in the body of this plan.

Conservation opportunities

There are several options for conserving birds in the Southern Blue Ridge, but region-level planning and management decisions will be complex. Land ownership is not evenly distributed across the region and several land management agencies have different objectives that need to be considered. However, the relatively high percentage of land (compared with other southeasetern physiographic areas) in public ownership is the single most important opportunity for charting a proactive bird conservation strategy within the Southern Blue Ridge (Figure 4). This is followed by the relatively low percentage of non-forested or otherwise developed lands within this physiographic area (<15%; SAMAB 1996).

Over 30% of all forest land in the SBR is in public ownership, compared with 23% of the forest land Southern Appalachian Assessment Area (SAMAB 1996). The largest landholders include the Forest Service, followed by the National Park Service, and then State Parks and other public lands. Because of the high percentage of public land in the SBR, there is also a high degree of public interest in the management and future of especially National Forests, but also National Parks and other areas.

Two broad themes emerge for actively managed lands in the SBR in relation to bird conservation. The first is to promote the return of old-growth forests in especially spruce-fir-northern hardwood, hemlock-white pine, and cove (mixed mesophytic) harwood forest types (Milling *et al.* in press, Nicholas *et al.* 1999, Haney and Schaadt 1996, Haney and Lee in prep.). The second is to return large-scale and relatively frequent disturbance regimes in southern pine, Appalachian oak, mountain wetlands (bogs and fens) and high elevation balds (Abrams and Ruffner 1995, White *et al.* 1993, Delcourt and Delcourt 1997, Buckner and Turrill 1999). Some present day stands of northern and cove hardwoods that have expanded in the absence of disturbance also should be included within the second theme (White *et al.* 1993, Buckner and Turrill 1999).

Implementing ecosystem conservation measures based on either theme would not be without controversy. Nevertheless, management to ensure the healthy future of most high priority birds must be based on merging old-growth dynamics and frequent, large-scale disturbances. The key to successfully accomplishing sound bird conservation under these conditions will require determining where and under what conditions old-growth dynamics should be allowed to continue or develop. At

the same time, where and under what conditions existing forests should be subjected to intensive management should be determined. Such decisions may be guided by slope, aspect, elevation, and edaphic conditions (see Figure 3).

Opportunities to consider management options like those described above are greatest on public lands. Since the bulk of publically owned forests are currently in a state of natural regeneration, management should favor the maintenance of large areas of older age-class forests. First, this includes identifying areas of late-successional forests to determine whether they can exhibit structural complexity and are otherwise suitable or optimal for supporting healthy populations of priority mature forest species. The existing network of National Parks, Wilderness Areas, and other protected areas provide imporant sites for expanding late-successional forest acreage and therefore promoting future expansion of old-growth conditions. Where late successional forest stands are in areas considered suitable for harvest, managers should continue to identify and conserve forests that currently exhibit old-growth characteristics while developing management guidelines for extracting timber products.

Second, managers should improve potentially important mid-successional forests (*e.g.*, cove and northern hardwoods) that lack structural heterogeneity due to years of benign neglect after clearcutting early during the 20th Century. Third, increase the percentage of early-successional habitat, where appropriate, by setting back succession through silviculture or other (*e.g.*, fire) management techniques. Fourth, attempt to preserve and restore habitats (if possible) that were once more widespread just prior to European colonization, but are currently under-represented or rare (*i.e.*, spruce-fir, hemlock-white pine, table mountain pine, mountain wetlands).

Although a relatively high percentage of the SBR is in public ownership compared with other physiographic areas throughout the Southeast, industrial and non-industrial private lands still make up a major portion of the forested landbase, about 2% (6% SAA area overall) and 66% (70% SAA area overall), respectively. Any management recommendations intended for private lands must be integrated with the objectives of the landholder to be successful, and specific options for conserving birds should be readily available to those who want to manage their resources with birds in mind. Nevertheless, maintaining blocks of late successional forests, as well as patches of early successional habitats, are still reasonable objectives for these lands. The maintenance and restoration of low elevation riparian

woodlands and mountain wetlands are extremely important and may be totally dependent upon opportunities undertaken on private lands.

Forests surrounded by increasing development during the last 50 years within the SBR show similar declines of migratory songbirds found in other regions (J. Holt unpubl. data). However, defining patch size as a first level for reducing problems associated with fragmentation is an inferior approach when compared to conducting a physiographic area-wide analysis. This latter approach should be used to detect those areas (*e.g.*, hexagons covering 864 km^2 or about 75,000 acres; Donovan *et al.* 1997) that may have problems for breeding birds by falling below some acceptable percent of forest cover (*e.g.*, 70 percent).

Once those areas are identified, steps can be made to determine conservation measures consistent with landowner objectives to reforest areas or otherwise design adjacent forest management with more attention paid to hostile conditions. In addition, heavily forested areas under increasing development pressure (*e.g.*, subdivision for secondary homes, ski slopes, and associated support services) can be identified for concentrating efforts of various partners working with private lands to develop conservation easements. The Nature Conservancy, State Natural Heritage agencies, and local land trusts could focus efforts on identifying high priority lands considered most vulnerable to further development pressures and/or are most likely available for restoration to minimize the likelihood of problems affecting nesting birds there and on adjacent public lands.

Landowner incentives, conservation easements, and education are potential tools that can be used to help provide habitat to sustain bird populations. Increasing the public's awareness about the region's natural history is perhaps the best way to foster the regional pride and conservation ethics necessary to conserve communities of birds and other organisms whose populations are distributed over entire landscapes. Conservation at this scale will require new partnerships among an array of government agencies, private conservation organizations, landowners and citizens. The Southern Appalachian Man and the Biosphere (SAMAB) accomplishes this task in part by bringing regional Federal and State agencies together to better coordinate management actions and resolve potential conflicts. However, much more work needs to be done to coordinate management needs with the private sector. The Southern Appalachian Assessment (SAMAB 1996) sponsored by SAMAB and

cited frequently in this treatment is a significant step forward in combining data and other information from across the region and is relied upon here to establish habitat goals for the Southern Blue Ridge physiographic area.

The Southern Appalachian Assessment provides an inventory of acreage by forest type (roughly coinciding with types identified as major bird habitats), proportional distribution of seral stages, land ownership and ownership trends. Additional work is needed to categorize this information by physiographic area and state within Southern Appalachian Assessment area. Each state Partners in Flight Working Group will then be able to determine public and private land opportunities as well as local roles and responsibilities for achieving the habitat goals outlined below.

Section 2: Avifaunal Analysis

Background

Over 155 bird species nest in the Southern Blue Ridge (Appendix II). This diversity reflects the wide variety of habitats resulting from the various geologic and topographic features present within the area. Species range from habitat generalists like the American Robin, American Crow, Blue Jay, and Mourning Dove, which are associated with a wide range of environmental conditions, to extreme habitat specialists like the Red Crossbill, Cerulean Warbler, and Louisiana Waterthrush, that require very specific conditions for breeding and survival. Many species are distributed along elevational gradients and occur either below or above certain elevational limits (Noon and Able 1978). Other species are found at all elevations. Nearly 62% of all species are associated with forest habitats ranging in size from small woodlots and groves at lower elevations to large, extensively forested tracts at mid to high elevations. Birds found in forests at lower elevations may include any of the 6 common woodpecker species, Great Crested Flycatcher, Carolina Chickadee, Cedar Waxwing and Northern Cardinal. Larger forest patches at higher elevations may contain Blue-headed Vireo (formerly Solitary Vireo), Black-throated Blue Warbler, Scarlet Tanager, and Dark-eyed Junco. Approximately 23% of these species are also known to use mid to late successional spruce-fir forests as breeding or foraging habitat (Hamel 1992).

Birds that utilize early successional habitats, and those commonly found in more developed areas, constitute about 19% of all species in the SBR. Habitat types present at low-to-mid elevations include parks, old fields, croplands, forest-edge ecotones, and regenerating forests in the grass-forb and shrub-scrub stages of succession (especially pine and mixed pine-hardwood forests). Typical species found in these areas may include Carolina Wren, Eastern Bluebird, White-eyed Vireo, Eastern Towhee, Prairie Warbler, Yellow-breasted Chat, and several species of swallow and sparrow. At higher elevations, smaller patches of early successional forest (usually deciduous), forest-edges, maintained wildlife openings, seeded roads, roadsides, as well as grass and heath balds are typical habitat types found within larger areas of mature forests. Species in these habitats include Gray Catbird, Golden-winged Warbler, Chestnut-sided Warbler, and Indigo Bunting.

The remaining 19% of birds that breed in the SBR are dependent upon wetland habitats. Typical species in open water habitats include Great Blue Heron, Hooded Merganser, Canada Goose, and Belted Kingfisher. Species requiring forested wetlands or riparian habitats include Wood Duck, Green Heron, Common Yellowthroat, Acadian Flycatcher, and Louisiana Waterthrush.

Approximately 69 species or 44% are classified as neotropical migrants (Hamel 1992). Of those, 49 or 72% are forest dependent (both species typically thought of as edge-tolerent and those often considered forest-interior species) compared with 19 species or 28% associated with early successional habitats. Fourteen species or 20%, from both forest and early successional groups, are associated with wetland or riparian habitats. Nearly 70% of nearctic-neotropical migrants breeding in mid-to-late successional forests have at least shown signs of decline since1966 (26% significantly). Nearly 80% of early successional nearctic-neotropical migrants have also shown downward trends within the same period of time (over 50% significantly). Plus, an additional 31% of wetland and riparian neotropical migrants have also declined. As noted, reported declines for some species are not significant, rely on data from a limited number of BBS routes, or are otherwise unconfirmed. Thus, care should be taken when interpreting these percentages.

Priority Species:

Breeding species were ranked according to the Partners in Flight prioritization process (Hunter

et al. 1993, Table 1, Appendix II). This process identifies species in the greatest need of conservation attention and, in turn, helps guide the development of effective conservation strategies. It can also indicate where gaps of information occur and is flexible enough to allow for modifications when more information becomes available (Hunter et. al. 1993, Carter *et al*. in press).

The priority list is made up of 63 species broken into 7 categories. Species were ranked according to their total PIF priority scores, area importance and population trend concern scores and, when data was available, the percent of their BBS population found in the SBR. Some species are included in other categories because they may represent additional conservation interests. Planning efforts must insure that nationally ranked high priority species (*e.g.*, PIF WatchList or U.S. Fish and Wildlife Service's Species of Management Concern List) are not favored at the expense of high priority physiographic area species, if these are different. In addition, some species that appear to have stable populations in the SBR still may be higher priorities than other species of at least local interest that are in decline. The solution for many apparent conflicts in priorities from different spatial scales is to build from species lists general groups of priority species as will be discussed below in more detail. Category I consists of 31 species of high concern which are divided into two sections. The highest priority species under Section Ia. received PIF scores of 28 or greater. With the exception of 2 warblers and the likely extirpated Red-cockaded Woodpecker, all are taxa below species level but are likely isolated and represent endemic Southern Appalachian populations (see discussion below).

With one exception, all are associated with either mid-to-late successional spruce-fir-northern hardwood forests or with disturbed forests (Table 2). Section Ib. includes 20 high priority species that have scores ranging from 22-27. The majority are often considered area-sensitive and/or forest-interior species, but because of the largely forested context of the SBR are simply referred to as mature forest species here. Three high priority species require early successional habitats, two are riparian forest specialists, and one is an important game species.

Category II contains 13 species that are of moderate conservation concern. All have priority scores between 19-21 with combined area importance and population trend scores of 8 or above. These are important species in terms of their distribution and abundance within the SBR, and they tend to be of high local interest (*i.e.*, high area importance score). In addition, most have declined since

monitoring began (*i.e.*, high populations trend score). Some species have declined significantly. This category contains various species that use different habitat types, including early successional habitats and mid-to-late successional forests. One bird, Northern Bobwhite, is an important game species and another, Peregrine Falcon, is currently being reintroduced into many parts of the SBR in an attempt to recover eastern populations.

Category III contains 3 species that are currently on the PIF WatchList because their populations have declined significantly over their entire North American ranges (Pashley et al. 1997, Carter et al. in press) . All have fairly high total PIF scores, ranging from 18 to 21, but are not listed in Category II because of a relatively low relative abundance in the SBR compared with elsewhere (*i.e.*, low area importance scores). Wherever these species occur, however, populations should be considered for monitoring attention and possibly managed for.

Six species are listed in Category IV. All have declined significantly but remain abundant in the SBR as well as other physiographic regions. They have total scores ranging from 14 to 18 with high area importance and population trend scores. All six birds can commonly be found in rural and suburban settings that contain some forest patches, parks and fields. The Blue-headed Vireo is the only species in Category V. Category V species are those that have high percentages (>5%) of BBS populations in the region, not otherwise already a priority species, calculated from the area of species' range, and weighted by their BBS relative abundance (Rosenberg and Wells, pers. comm.), and also includes species that are very abundant. A form of the Solitary Vireo, these songbirds can be one of the most abundant species in mid-to-high elevation mixed forests of the SBR. Although its population is likely stable, the Blue-headed Vireo remains an important species to monitor. Federally listed threatened and endangered species, if they are not already included in the previous categories, make up Category VI. No birds are currently listed in this category.

Category VII consists of 9 species that either: (1) are of high local interest, or (2) have high priority status in other physiographic areas within the region and are therefore of some regional interest. These species have total scores ranging from 11 to 21 and vary with respect to their area importance and population trends. Of the nine birds, one is an early successional species, one is generally found in almost all habitat types, and seven are forest birds, two of which are associated with riparian forests.

All are low priority species within the SBR but vary in importance within different states and should be at least the subject of local monitoring attention.

Priority Species Suites:

Three broad species suites emerge from the priority species list. First are species associated primarily with mature spruce-fir-northern hardwood forests. Second are species dependent upon frequent and large-scale disturbances. Disturbed habitats range from regularly burned or otherwise disturbed southern pine and hardwoods, to naturally occurring mountain wetlands and high-elevation balds, to early-succession created through clearcutting, abandoned farmland, and maintenance of utility corridors. Third are species best grouped together as dependent upon mature forests, many species of which occur in good numbers in more than one specific forest type (Hamel 1992).

Priority Taxa Below Species Level:

Since the inception of Partners in Flight and the use of the species prioritization process, the Southeast Working Group has recognized certain taxa below the species level that warranted conservation attention equal to that afforded to full species. Most of these are federally listed as endangered or threatened, or were identified by the U.S. Fish and Wildlife Service as candidates for listing prior to 1996 and now referred to as regional "species at risk". Within the Southern Appalachian physiographic areas, and specifically the Southern Blue Ridge, the Appalachian Bewick's wren was recognized as a taxa that should be treated as a species for conservation planning, even though it may already be extirpated from the region (or extinct throughout its historical range).

Several reviewers of previous draft plans and priority species lists noted that a number of locally occurring species associated with high-elevation forests in the SBR (as well as the Allegheny Mountains of West Virginia) appear to represent long-isolated populations and their declining status is representative of the decline in the integrity and acreage of these forests during the 20th Century (Tanner 1952, Hubbard 1971, Rabenold *et al.* 1998, Tamishiro 1996, Milling *et al.* 1997, Delcourt and Delcourt 1998). Some of these taxa are described subspecies (Yellow-bellied Sapsucker, Black-capped Chickadee, Brown Creeper, Winter Wren; AOU 1957), but others are not (Northern Saw-

whet Owl, Red-breasted Nuthatch, Golden-crowned Kinglet). Even among the described subspecies, there is inconsistency among the taxa in terms of distribution with yellow-bellied Sapsucker restricted to the SBR proper and other taxa variously undergoing transition to more northern subspecies in the area where Maryland, West Virginia, Pennsylvania, and Ohio intersect. In addition, the difficult taxonomic treatment of Red Crossbill needs resolution, but two types are known to occur in the SBR, one of which is possibly endemic (Groth 1988).

For local purposes, these taxa are all treated as high priority "species" and are referred to as Southern Appalachian populations and are high priority "species" for conservation planning purposes. Other Southern Appalachian bird species with described subspecies include Ruffed Grouse, Black-throated Green Warbler, Black-throated Blue Warbler, and Dark-eyed Junco, but these species are relatively widespread among SBR habitats and are not considered in need of conservation attention above what they are scored for as full species. Whether this treatment is accepted at national planning levels is the subject of continuing debate and work is underway to better clarify the taxonomic status of these and other Southern Appalachian populations (Lee and Browning in prep.).

Section 3: Habitats and Objectives

Spruce-Fir-Northern Hardwood (High Peaks) Forests

Status and importance

The red spruce-Fraser fir forests of the SBR are ranked as the second most endangered ecosystem in the United States (Noss *et al.* 1995). In part, this ranking is due to unique combinations of habitat conditions, fauna, and flora that are more reminiscent of Canada than the southeastern United States (Hubbard 1971, White *et al.* 1993, Nicholas *et al.* 1999). Furthermore, a relatively high level of endemism attracts conservation attention to the SBR and to the spruce-fir forests specifically, especially Fraser fir communities. The extreme deterioration of this ecosystem now garners the most attention from conservationists.

Currently, spruce-fir occurs in an archipelago of island-like forest patches scattered across the SBR (Figure 5, Rabenold *et al.* 1998; also Nicholas *et al.*1999). These high-elevation spruce-fir forests occur only at the highest elevations in the SBR and are referred to as High Peaks forests. They are globally unique, especially when associated with highly vulnerable biotic communities, such as grass and heath balds and rock/cliff outcrops (White *et al.* 1993). These communities are separated from the somewhat similar forests of the Allegheny Mountains of West Virginia ("Central Appalachians"), which occur at lower elevations but at a higher latitude. Both are widely separated from the vast boreal forests of southern Canada and northern New England by a gap starting north of the Maryland-Pennsylvania border.

The High Peaks forest communities came about from a lack of complete glaciation during the Pleistocene. During this period, mountain ranges and river valleys were divided and separated, allowing ancestral forms to evolve into the present-day Appalachian taxa, including many rare and endemic species, like the Fraser fir. Spuce-fir forests occurred through a much larger portion of the Southeast United States, even towards the South Atlantic Coast (Hubbard 1971, Tamashiro 1996, Delcourt and Delcourt 1998) and only during the last 10,000 years has Appalachian spruce-fir forests become highly isolated from boreal forests.

Typically, a combination of red spruce, mixed spruce-fir, and spruce-fir/northern hardwood mixed stands are all considered as the High Peaks forest type. Red spruce begins to occur within northern hardwood forests at around 1405 m (4500 ft.) and becomes more dominant with increasing elevation. Fraser fir increases above 1720 m (5500 ft.) and can occur in pure stands over 1875 m (6000 ft.). Common understory shrubs include blackberry, hobblebush, and mountain cranberry (SAMAB 1996, Rabenold et al. 1998).

The total acreage for the High Peaks spruce-fir forest ecosystem (which includes spruce-northern hardwood mixed stands) as about 56,000 ha (140,000 acres) prior to the late 1800's (Table 3). Substantial logging of spruce-fir did not begin until 1905 but quickly spread across the region and lasted until about 1930 (Pyle and Schafale 1988). Very few stands were spared from major modifications. Only a few areas in what is now the Great Smoky Mountain National Park (GSMNP) remained unaffected. Many stands still show the impacts from logging, including the removal of the

overstory from clear-cutting, a higher susceptibility to wildfires which killed much of the remaining understory and seedlings, and extensive soil erosion (Nicholas *et al*. 1999). Conservation efforts in the1920s and 1930s lead to 90% of the remaining spruce-fir being placed into public ownership. After spruce was logged, fir and/or various northern hardwood species expanded into areas formerly dominated by spruce.

High Peaks spruce-fir forests have suffered massive losses of mature Fraser fir from infestations of the exotic woolly adelgid during the last 30 years. Including stands of dead and dying fir, the current total acreage is estimated to be less than 28,000 ha (70,000 acres), with other spruce-fir sites now occupied by northern hardwoods or developed as ski resorts or other tourism outlets (Dull *et al*. 1988, Nicholas *et al*. 1999).

Six major areas and several smaller areas make up the existing or potential sites supporting these forests. Of this, about 85% is located on national and state park lands, most occurring within the GSMNP and along the southern highlands of the Blue Ridge Parkway. Approximately 10% is on Forest Service lands, and the remaining 5% is on private lands (SAMAB 1996). Nearly 80% of all spruce-fir is classified in late succession. This includes all spruce-fir forests on park lands as well as 39% of those found on national forests. There is currently no late successional spruce-fir forests on private lands not otherwise already under conservation protection. Not included in the total acreage are Christmas tree farms which may include about 4,453 ha (11,000 ac) in the sapling/pole and mid-successional stages. These younger forests on private lands are mainly planted and heavily managed Fraser fir and are assumed to support few if any priority species.

Despite protection, the community has continued to deteriorate. Most stands infested with the exotic balsam woolly adelgid have experienced almost complete mortality of mature fir trees. In the absence of proper adelgid controls, continued loss of fir will lead to more alterations in the forest's structure including less canopy cover and a developed understory. Tree fall gaps and wind damage will increase. It is not clear whether fir saplings in affected areas will reach reproductive age, or whether Fraser fir will disappear completely from the landscape.

In addition to prior forestry practices and exotic insect infestations, there is concern that spruce-fir forests are also suffering from higher levels of air pollution, in particular ozone pollution and

acid deposition, resulting from human activities beyond the Southern Blue Ridge (White1984, Nicholas *et al.* 1999). Despite documentation that air quality has declined and acid deposition has increased over the last several decades, it is difficult to demonstrate that this is causing changes in the growth and vigor of spruce-fir independent of other factors (Nicholas *et al.* 1999). Direct effects of pollution on red spruce and Fraser fir mortality are unknown; however, reduced growth of spruce from exposure to acid deposition has been documented (Eagar and Adams 1992). Over time, the effects of pollution may result in increased susceptibility to insects and pathogens, reduced growth, or an inability to respond to changes in the environment (Nicholas *et al.* 1999).

Priority species, species suites, and habitat requirements

Breeding season species were grouped according to the following: birds that occur regularly, birds that have recently spread into the SBR, birds of irregular occurrence, birds that occur in other forests as well as high elevation forests, and birds associated with large openings or disturbed areas (Table 5; editing by Hunter based on Hamel [1992] and Simpson [1992]).

The highest priority species most directly sensitive to further losses of spruce-fir is Red Crossbill. This Crossbill, possibly endemic to the SBR, is dependent upon spruce cone and conifer crops at high elevations for food and is associated with mid-to-late successional High Peaks forests. The Northern Saw-whet Owl, Black-capped Chickadee, Red-breasted Nuthatch, Brown Creeper, Winter Wren, Golden-crowned Kinglet, and other lower priority species are of particular conservation concern and may be affected by future changes in the High Peaks forest. All the birds mentioned above, with the exception of the Red Crossbill and Northern Saw-whet Owl, have declined measurably on mountains where adelgid infestations caused dramatic changes in the forest's structure (Rabenold *et al.* 1998). Data are lacking for the Red Crossbill and Saw-whet Owl, but both are usually assumed to have declined or at least are vulnerable (Groth 1988, Milling *et al.* 1997).

Although many of these species overall are still widespread, all appear to be represented by taxa below species level, endemic, and isolated from the larger populations in the boreal forests of northeastern North America. These birds probably represent remnants of wider ranging populations once distributed across the Southeast during the last glacial period (Hubbard 1971, Tamashiro 1996,

Lee and Browning in press). Recent research on Northern Saw-whet Owls has identified SBR birds more genetically diverse than birds in other parts of its range and therefore the SBR population may represent the ancestral form from which other populations differentiated (Tamahiro 1996, Milling *et al*. 1997). Findings like this has propelled most of the Southern Appalachian endemic populations associated with High Peaks forests to the top of the priority list and clearly indicates the need to investigate the genetic make up of these species.

The highest priority neotropical migrants associated with late successional spruce-fir canopies include the Black-throated Green and Blackburnian Warblers. The Olive-sided Flycatcher no longer appears to be a common breeder in the Southeast (Simpson 1992, Buckelew and Hall 1994). The Canada Warbler, Veery and Black-throated Blue Warbler are high priority species associated with understory vegetation.

Several high-elevation bird species appear to be expanding into the southern spruce-fir zone. These range expansions may be because of the maturing of some spruce stands, the opening of spruce-fir canopies, and subsequent understory development. Increases of Yellow-rumped and Magnolia Warbler may be attributable to the maturing of some spruce-fir. Higher occurrences of Swainson's and Hermit Thrush and Mourning Warbler may also be a response to understory development. In addition, populations of priority understory and early successional species like Black-throated Blue, Canada, and Chestnut-sided Warbler as well as species like Eastern Towhee appear to be stable or increasing in areas where spruce remains in high densities, but fir has declined (Rabenold et al. 1998). However, canopy species such as Blackburnian, and possibly, Black-throated Green Warblers seem to be declining.

Northern Saw-whet Owl and then Black-capped Chickadee are considered the most vulnerable and therefore the best umbrella species for determining acreage restoration goals and for the future of High Peaks Forests. Status surveys, research on breeding and dispersal, and taxonomic relationships of Southern Appalachian Northern Saw-whet Owls have been conducted by (M. Rowe, F. Alsop, pers. comm.). Upon review of a number of studies (*e.g.*, Tanner 1952, Rabenold *et al*. 1998), Black-capped Chickadee appears to be the most susceptible of group 1 species to extirpation from habitat deterioration and the least likely species to become reestablished in areas having recovered

since the 1930's. Red Crossbill should also be considered, but using this species as a conservation umbrella would be difficult due to very confusing taxonomy (Groth 1988) and erratic occurrence at any one location. Brown Creeper may also be a good species to use, but association with peeling loose bark and trees with large diameters makes this species better suited for defining habitat condition and not so much for setting spatial restoration goals.

Extrapolation of survey findings in Milling *et al.* (1997) results in a likely cumulative total of no more than 500 owl pairs persisting within the SBR (Table 6). The total number of chickadees may be as low as 5,682 pairs, but as high as 28,416 pairs. Given the rapid recent decline of habitat and the extirpation of chickadee populations (Rabenold *et al.* 1988) on Mount Collins, the lower estimates, especially outside the Park, may be more realistic.

Habitat and population objectives

The primary habitat goal is to maintain all existing healthy stands of late successional and old growth spruce-fir habitat. Unfortunately, the future of these forests and the birds that depend on them is, for the most part, beyond the control of local managers. This is despite protection of all existing stands on public and private lands. This habitat type is facing increasing pressures from a variety of sources and may continue to decline as the global climate changes. Any impacts from local factors must be minimized. This includes mitigating impacts from humans and grazing livestock on all public lands which may include, for example, reducing the amount of spruce-fir habitat used for recreational purposes and prohibiting, or at least regulating, the collection of Fraser fir cones on all public lands.

Whatever the magic number should be for ensuring viability of an isolated population, it is clear that more successfully breeding individuals is better than less and the more interchange between subpopulations the better likelihood for at least short-term viability and perhaps even long-term viability. Using any measure, the present local long-term persistence of High Peak populations of Northern Saw-whet Owl and Black-capped Chickadee populations is in serious doubt through most of the Southern Blue Ridge. Indeed “subpopulations” of Black-capped Chickadee outside of the Great Smoky Mountains National Park appear highly isolated from each other (Tanner 1952) and from populations elsewhere (*i.e.*, Central Appalachians, where the Appalachian subspecies becomes common and

widespread in West Virginia). Assuming some exchange of Northern Saw-whet Owls from one subpopulation to another within the Southern Blue Ridge, increasing the habitat would effectively increase the number of breeding individuals within each subpopulation. Therefore, increasing the security of High Peaks populations may be achievable. If, however, each owl subpopulation is isolated from others, then no amount of effort will be enough to avoid local or complete loss of this species within the SBR.

Obviously future research on dispersal capabilities for these two species is required to better frame the intensity of needed conservation efforts. In addition, reestablishing potential for connections also should be looked into between High Peaks and Central Appalachian populations. However, the situation for the Central Appalachians is even bleaker than for the High Peaks with an estimated loss of red spruce and balsam fir estimated to be upwards to 90 percent from 100 years ago (White *et al.* 1993).

Spatial considerations. Nicholas *et al.* (1999) state that the High Peaks Forest ecosystem occurs today in "less than half of its former area because of failed regeneration due to site degradation following logging." If this area estimate is correct, then a restoration goal of over 28,000 ha (70,000 acres) for spruce and spruce-northern hardwood would bring the total High Peaks Forest to over 56,000 ha (140,000 acres) within the SBR. About 25% reduction of this ecosystem occurred prior to 1930's within the Great Smoky Mountains National Park (see Nicholas *et al.* 1999). Therefore, a Park restoration goal of 6,500 ha (16,250 acres) for pure spruce or spruce-northern hardwood mixed stands is recommended (Table 7).

In order to meet objectives, restoration of another 23,600 ha (59,000 acres) would come from the other sites, approximately 8,800 ha (22,000 acres) from national forests and adjacent private conservation lands. A review of site conditions would be best for ultimately allocating acreage goals among sites. An existing model (Rick Odum, U.S.D.A. Forest Service, Clemson, South Carolina) for the Great Balsams should be tested and its applicability to other High Peaks sites should be evaluated.

Long-term population objectives for northern saw-whet owl for the SBR probably cannot be more than 1000 pairs and for Black-capped Chickadee about 10,000 pairs (see Table 7). However,

suggested short-term restoration acreage objectives among major sites totaling 4,080 ha (10,200 acres) would result in modest population increases. A population objective of 1000 pairs of Northern Saw-whet Owls in the High Peaks forests may not be enough to ensure long-term viability for this population, even with healthy interchange among subpopulations within the High Peaks region. To maintain viable, but isolated populations, the number of breeding individuals usually estimated to be needed ranges from 500-1000, though this number has recently been shown to be likely too low on theoretical grounds (Thomas 1990, Lande 1995, Culotta 1995). However, by increasing the acreage of late successional and old-growth conditions within hemlock and cove hardwood stands, forests may increase the overall effective population size of SBR Northern Saw-whet Owls, although overall densities and reproductive output is substantially lower than within high-elevation forests. The possibility that additional pairs of owls and increased connections among subpopulations would occur with increasingly older forests, plus the present genetic diversity presently demonstrated within SBR populations compared with other owl populations (Tamashiro 1996), suggest that this population can persist during long-term restoration efforts. Finally, restoration efforts and increasing connections with Central Appalachian populations should be considered equally important for increase population security throughout the Southern populations.

Habitat condition objectives. Many of the group 1 species are cavity nesters and many of these have an affinity for late successional yellow birch, again illustrating the importance of mature mixed stands. Actual habitat restoration should revolve around two main themes: (1) increasing the stocking level of red spruce trees for all restorable stands and (2) diversifying structural complexity of stands. For the former theme, general guidelines should include maintaining or increasing red spruce stems upwards to 10 percent of total stocking for stands between 1,067 to 1,341 m (3500 and 4400 feet), at least 25 percent of stocking between 1405 and 1650 m (4400 and 5000 feet), at least 50 percent of stocking between 1650 and 1875 m (5000 and 6000 feet). For the latter theme, appropriate silvicultural treatments should be employed to release red spruce saplings from the understory and to increase the size of northern hardwoods by removing competing stems. Red spruce density increases should be accomplished by underplanting existing northern hardwoods and conversion of hardwood patches to

pure spruce stands, where deemed appropriate. Care should be taken to not disrupt existing northern flying squirrel territories nor replace sites with vigorous fir sprouts. In some areas, such as in the Mt. Rogers-Whitetop sites, restoration may involve conversion of open areas to forests through direct planting.

The specifics for macrosite restoration still need to be determined by silviculturists and species experts. Experience, such as with the 80-year-old planted red spruce stands at Unaka Mountain, may provide valuable lessons for restoring red spruce at a larger scale. Nevertheless, the optimal placement for, and percentage of, pure red spruce stands compared with spruce-northern hardwood mixed will require detailed site-by-site inspections. Furthermore, better knowledge of the territorial behaviors of owls, chickadees, and flying squirrels must be acquired to efficiently expand the number of territories and improve the quality of territories. While integrating bird conservation recommendations, other microsite considerations include:

increasing down coarse debris for salamanders (especially, pigmy and Weller's) and their invertebrate food,

promoting specific conditions (types of moss) necessary for supporting spruce-fir moss spider (but where spiders are known, now only in fir dominated sites, no conversion to spruce is recommended),

maintaining appropriate mix of vegetated ground cover and openness to support adequate small mammal numbers and increase owl foraging efficiency respectively, and maintain dense midstory patches (*e.g.*, rhododendron thickets) for daytime roosting owls.

Special management recommendations. Bird population and habitat objectives, as stated above, that require late successional forest conditions may require a century or more to be realized under passive management and natural succession. Therefore, active management efforts in maturing stands may provide increased numbers of birds. For example, Northern Saw-whet Owls may demonstrate a decided preference for old Northern Flicker nest holes (Bent 1937). However, Flickers are noticeably scarce today above 1,220 m (4000 feet) in the Southern Blue Ridge and avoid dense forests. Stupka (1963) mentions this woodpecker during the 1930's through to the 1950's as favoring trees at the

margins of high-altitude grass balds and forest openings at elevations over 1,524 m (5000 feet).

The use of nest boxes is for now essential for stabilizing owl populations (*e.g.*, no noticeable decline since 1970's). Presumably, restored stands with nest boxes may more readily allow for new owl territories and should be liberally employed (observations suggest two or more boxes should be used per territory as nesting owls are not known to use individual boxes two years in a row). Natural cavities are likely to increase over time as larger numbers northern hardwood tree species become more susceptible to storm damage with appropriate silvicultural practices.

Black-capped Chickadees chisel their own cavities and show a preference for overmature yellow birch within the Southern Blue Ridge (Tanner 1952). Tanner experimented with appropriately sized nest boxes within the Great Smoky Mountains, but chickadees clearly avoided these artificial nest sites. Tanner also speculated that the absence of chickadees from a number of High Peak sites, that otherwise seemed of suitable quality at the time of his study, were lacking in widespread availability of mature yellow birch when compared with occupied habitats within the Great Smoky Mountains National Park. Greater availability of mature yellow birch at sites where chickadees are rare or absent would seem better today than at the time of Tanner's study, thus the possibility for reintroducing chickadees to these sites should be actively investigated. The source population would have to come from the Great Smoky Mountain National Park. Chickadee-sized nest boxes may receive greater use where appropriate trees for cavity excavation remain scarce. Stabilizing chickadee populations using nest boxes may be essential while appropriate silviculture and natural disturbances work towards greater numbers of overmature yellow birch.

Similar to other species' preferences for older and larger trees, Brown Creepers perhaps have an even greater affinity for large diameter trees and peeling loose bark for nest sites. Artificial flaps (tar paper) may be used to mimic preferred creeper nest sites and has been used successfully for bats requiring similar conditions.

In addition to nest site management recommendations, increasing recreational development is an important concern. For example, recent clearing of habitat for increasing tourism support services has resulted in at least one less occupied owl territory. Repeated abandonment of owl nest sites where overnight camping or other concentrated recreational activities have been expanded recently provides

additional evidence of increasing conflicts with bird conservation goals. A moratorium on future recreational developments would be beneficial for owls. Management agencies and private landowners should be strongly encouraged to minimize or avoid new recreational developments in high elevation forested areas. A workshop is needed to increase the public's sensitivity to this issue.

Present and future proposals for high-elevation major highways should be discouraged. In addition to potentially fragmenting owl territories, housing and support development along these highways often results in detrimental cumulative effects from the spread of exotic or invading "native" species.

The practice of harvesting Fraser fir for Christmas tress from public lands should be reviewed. Until the solution is found for adelgid infestations, these trees are unlikely to mature, but their role in providing patches of at least dense midstories may be important for owls and other species.

Implementation recommendations and opportunities

High Peaks forest loss, after 75 years of land protection, is due to a variety of factors, including past land use practices, exotic pest invasions, and increased air pollution. Solutions will require the development of policies regionally and nationally. Nevertheless, a plan needs to be developed that will address local management issues. Nicholas *et al.* (1999) put forth a call for action to identify the need for developing and implementing an ecosystem management strategy for the southern spruce-fir. Their plan framework could be used with different regional organizations, like SAMAB or Southern Appalachian Mountain Initiative (SAMI), providing leadership.

Most proposed habitat restoration focused on the most recent decline of Fraser fir (Nicholas *et al.* 1999). Additional recommendations for partial restoration of spruce and spruce-northern hardwood stands are provided below.

(1) Focus initial restoration attention on red spruce and spruce-northern hardwood mixed stands (while allowing research to continue on problems affecting Fraser fir).
    (a) Suggested short-term target of 2,000 acres within the Great Smoky Mountains National Park, long-term target of 16,250 acres.
    (b) Suggested short-term target of 8,200 acres spread over other High Peak sites, long-term target of at least 53,750 acres..

(c) Review local conditions and existing models (*e.g.*, Rick Odum's) for developing site specific restoration recommendations.
(d) Mixed stands, by definition, should be stocked with at least 25% red spruce.
(e) Thin competing stems, favoring more rapid growth of dominate trees, greater structural complexity, and release sapling (including planted) red spruce.

(2) Focus species management and population monitoring primarily on Northern Saw-whet Owl and Black-capped Chickadee, other boreal species as appropriate.
(a) Conduct detailed surveys and adjust baseline population sizes (Table 4) as necessary.
(b) Upon improved survey data and refined acreage objectives, adjust population objectives as necessary (Table 5).
(c) Focus special attention on Great Smoky Mountains National Park populations and determine feasibility for using Black-capped Chickadee population as a source for reintroduction efforts elsewhere in the High Peaks Region.
(d) Provide nest boxes (or artificially drilled cavities?) as appropriate for owl expansion and chickadee reintroduction (also northern flying squirrel?).
(e) Where Brown Creepers are now scarce, consider use of "flaps" to mimic loose peeling bark and monitor for nesting response.
(f) Discourage future development of recreational facilities within existing and restored high-elevation forests, continue monitoring existing picnic and camping areas and develop management guidelines to minimize disturbances of active owl nest sites.
(g) No more major highways across the High Peaks Region cutting through existing or potential boreal forests.
(h) Review practice (policy?) of harvesting sapling Fraser fir and seeds for Christmas trees from public lands when these remaining stems and seed sources must be available once solutions are discovered to combat the woolly adelgid infestation.

(3) Establish a High Peaks Forest Bird working group to focus attention on the plight of this the second most endangered ecosystem within the United States. Broaden the participation by other ecosystem and faunal and floral experts and agencies/organizations with interests in this ecosystem:

(4) Organize a symposium (perhaps through Southern Appalachian Man and the Biosphere [SAMAB] cooperative) to highlight the plight of the High Peaks Forest and its associated fauna and flora.

(5) Develop outreach materials (*e.g.*, slide show, etc.) to illustrate how interesting this ecosystem is, the problems (past, present, and future), and the solutions for problems that can be addressed now (like those described above) and the longer term solutions needed for problems that cannot be addressed now (like adelgid and air quality problems). Include preparation of short papers for outlets like "Bird Conservation," "Living Bird," and "Birder's World" (Matt Rowe, Fred Alsop, and Chuck Hunter to take lead).

(6) Develop a means to publicly recognize ongoing and past efforts to improve or save elements of this ecosystem.

Evaluation of assumptions

The conservation of avian species associated with High Peaks forests is based on several assumptions. Each assumption will require future research to be verified. The most important assumption is that spruce-fir forests, especially Fraser fir, can be restored. However, it is unlikely that full ecosystem restoration is possible until controls for the woolly adelgid and acid deposition are developed and implemented. Assumptions more proximate to the present discussion include raising levels of red spruce within suitable northern hardwood forests. Particularly important, the National Park Service will be required to aggressively implement management at a large scale using intensive techniques to increase spruce as they are developed to accelerate overall bird population objectives in the SBR. In any case, the response of sensitive flora and fauna to habitat change should continue to be monitored.

The assumption that many of the endemic spruce-fir species are genetically distinct from larger northern populations should be verified and taxonomic issues resolved through continued research.

The assumption that understory species are increasing while canopy species are declining requires additional study. Populations of Canada and Blackburnian Warblers in spruce-fir could be monitored. In addition, the winter distribution of these two species broadly overlap, so differences in trends on their breeding grounds are probably associated more to conditions in breeding than in wintering habitat.

The possibility that the Christmas tree industry, through the collection of cones and management of Christmas tree plantations, is contributing to spruce-fir decline must be verified. In addition, the use of Christmas tree farms by birds needs to be investigated, as these areas may provide habitat for species that are otherwise declining or vulnerable elsewhere in the SBR.

Specific research recommendations are listed below.

(1) Promote publication of past and ongoing research.
   (a) Gain recognition of Southern Blue Ridge populations of Northern Saw-whet Owl as a described subspecies.

(b) Publish pertinent information from past owl research.

Produce and publish taxonomic survey of Southern Appalachian birds tied into the unique historical biogeography of the region and link up issues involving both High Peaks and Central Appalachian boreal birds.

(2) Continue or initiate investigations into the following topics:

(a) Potential for dispersal of owls from one subpopulation to another.

(b) Refine restoration recommendations based on owl prey and foraging behavior.

Develop capture and care protocols for Black-capped Chickadees and follow with reintroductions into formerly occupied areas (*e.g.*, Mt. Mitchell, Roan Mountain) and new areas, such as Unaka Mountain.

(d) Expand work with lower elevation old-growth sites and determine potential for these and future old-growth hemlock, white pine, and cove hardwood stands to provide suitable to optimal habitat for many of the species otherwise largely restricted to boreal forest conditions. Present occurrence of Red-breasted Nuthatch, Winter Wren, Golden-crowned Kinglet, and even Northern Saw-whet Owl at sites as low as 2000 feet elevation in very low numbers and with no definitive evidence of actual breeding requires further investigation. Specific conservation relevancy may hinge on addressing two questions: (1) as low elevation sites move towards old-growth conditions do numbers and reproductive success of boreal birds approach that found at higher elevations and (2) can presently isolated subpopulations become connected through expansion of old-growth lower elevation forests concurrent with proposed spruce and spruce-northern hardwood restoration efforts?

(d) Define scope and frequency of disturbance factors (storm, fire, and grazing) that should restore habitat conditions for Appalachian Yellow-bellied Sapsucker and Golden-winged Warbler (possibly also Northern Flicker, especially if an important source for owl nest cavities), while avoiding conflicts with spruce and spruce-northern hardwood restoration efforts.

High Elevation Hardwoods

Status and importance

This section covers all high-elevation hardwood dominated forests not otherwise treated under the previous section. Northern hardwoods, specifically, occur throughout the SBR on slightly protected coves, flats and slopes with northerly aspects at mid- to high-elevations. Species like American beech, yellow birch, sugar maple, and yellow buckeye dominate the canopy in varying amounts, with basswood, white ash, and black cherry also present (SAMAB 1996). Common mid-story species

include striped and mountain maple, hophornbeam, mountain ash and cucumber magnolia. A fairly sparse to moderately dense shrub layer is common, and the forest floor is usually covered by a dense, diverse herb layer.

Northern hardwood forests grade into spruce-fir and heath and grassy balds at high elevations (SAMAB 1996). Red spruce commonly can be found in high elevation northern hardwood sites and becomes more prominent upslope. These forests can grade into Appalachian oak forests on drier, more exposed sites, especially white and northern red oak forests along drier ridge tops at high elevations (Schafale and Weakley 1990), or down to cove (mixed mesophytic) hardwoods usually below 1220 m (4000 ft.) on more sheltered, mesic sites.

Northern hardwood forests are subject to wide scale disturbances, but much less frequently than more oak dominated habitats on south and western facing slopes. Ice storms are perhaps the most common natural disturbance to this community and can damage trees over large areas. Fires are uncommon in these moist communities, but occasional fires may have dramatic impacts, as many of the dominant tree species have thin bark and are highly susceptible to burns (Schafale and Weakley 1990). Past logging practices have had the most lasting impacts, as almost all northern hardwood forests have been harvested this century. As a result, few old-growth and late succession northern hardwood sites exist.

Approximately 86,000 ha (212,000 ac) of high elevation forests dominated by hardwoods occur in the SBR (SAMAB 1996). Although the percentage of high elevation hardwood dominated forests on public lands in the SBR is undoubtedly higher than for the Southern Appalachians as a whole, the percentage breakdown among owerships and successional stages is assumed to be otherwise similar. More than two-thirds of all existing northern hardwood forests in the Southern Appalachians are on non-industrial private land, where 5% is classified as late successional and about 1.5% is in early succession. Private industrial lands support an extremely small amount, less than 0.5%. About 26% occurs on public land, 30% of this is in late succession and very little (< 1%) is in early succession. The majority of northern hardwoods (nearly 68%, mostly on National Park Service lands) in the Southern Appalachian Assessment area is in mid-succession, with over 80% in this condition within the Blue Ridge proper.

Priority species, species suites, and habitat requirements

The suite of priority birds found in high-elevation hardwoods is similar to spruce-fir-northern hardwood mixes. Many species associated with spruce-fir also occur in pure mid-to-late successional northern hardwood stands. In fact, over 30,000 ha (75,000 acres) of high-elevation hardwoods should be restored to spruce-hardwood mix. Nevertheless, several priority species may increase their use of these forests as the hardwood component increases over pure spruce. For example, northern hardwoods provide optimal habitat for Veery, which appears to have greatly declined rangewide in the past 20 years, though local SBR trends are unclear due to low BBS sample sense. In addition, late successional stages provide important habitat for Black-throated Blue Warbler, Rose-breasted Grosbeak, Blue-headed Vireo, Dark-eyed Juncos and Black-billed Cuckoos.

The two most important priority species associated with high-elevation hardwood forests are Yellow-bellied Sapsucker and Ruffed Grouse. The sapsucker is the only recognized subspecies strictly endemic to the SBR (AOU 1957) and the grouse (recognized as a Southern Appalachian subspecies) is an economically important game species. Both appear to prefer a mixture of mature hardwood forests, but with large patches of early successional to sapling stage stands produced by frequent large scale disturbances and each has suffered significant declines throughout the SBR (Stupka 1963, SAMAB 1996, Nicholson 1998).

The endemic Appalachian subspecies of Yellow-bellied Sapsucker is perhaps the rarest and most vulnerable of extant endemic subspecies within this physiographic area. The habitat for this species within the Southern Blue Ridge is typically described by Stupka (1963) as "in excess of 3500 ft., their nesting . . . in deciduous groves of mature trees where openings have been brought about by such destructive forces as lumbering, fire, windthrow, chestnut blight, etc." Hamel (1992) describes habitat as "high-elevation forests that are open with dead trees, such as near burns, diseased areas, woodland borders, and blowdowns." Also, see Nicholson (1997) where two of three Tennessee Atlas observations were in or near sapling to pole-sized stands.

Due to past management decisions, or lack thereof, most disturbance factors have been all but eliminated. The pressure to eliminate fire and preserve forests occurred as a reaction to a period, 1880-1930, when lack of any policy resulted in extremely destructive exploitation. In fact, the present

rarity of Appalachian Yellow-bellied Sapsuckers in the Great Smoky Mountains National Park appears closely related to the almost complete loss of fairly large openings since the 1930's and 1940's (Nicholson 1998). A similar situation exists for Yellow-bellied Sapsucker populations in the Allegheny Mountains, though at lower elevations, with extirpation nearly complete (Hall 1983, Buckelew and Hall 1994).

Habitat and population objectives

For the SBR, about 54,400 ha (136,500 acres) of hardwood dominated high-elevation forests would exist, compared with 84,800 ha (212,000 acres) that actually exists today, if there was full restoration of spruce and spruce-northern hardwood as discussed above. Thus, about 30,400 ha (76,000 acres) should be dedicated for restoring spruce as at least a co-dominate species (see Tables 3, 7).

The Appalachian Yellow-bellied Sapsucker may be the most vulnerable "forest" bird restricted to elevations above 1,067 m (3500 feet) but not associated necessarily with large patches of mature forest. In fact, most accounts suggest the sapsucker is best associated with heavily disturbed forests, unlike what is recommended for other high-elevation forest species. To support 5000 sapsucker pairs, the best information suggests about 29,060 ha (72,650 acres) of highly disturbed high-elevation forests will be required. This estimate is based on data from the Allegheny Mountains where 17 males per 100 ha in both black cherry and cutover mature hardwood forests, and 7 males per 100 ha in "virgin" spruce-northern hardwood (Hall 1983). Perhaps the main reason this species, which does require mature trees for nesting, is associated with disturbed forests is its preference for young stems for drilling holes, exuding sap, and harvesting both the sap and invertebrates trapped in the sap for feeding young. In addition, many observations of breeding season Yellow-bellied Sapsuckers in the SBR have been in or near stands also supporting relatively high densities of Golden-winged Warblers (*e.g.*, Simpson 1992, D. Buehler and N. Klaus unpubl. data).

Implementation recommendations and opportunities

Presently, about 12%, or 26,316 ha (65,000 ac), of all northern hardwoods in the Southern

Appalchain region is in the late successional age class and only about 1% or 3036 ha (7,500 ac) is in early succession (see Table 4). The main goal for northern hardwoods is to increase these amounts throughout the Southern Appalachians. Increasing late succession habitat would benefit species like Blackburnian Warbler. In addition, opening closed canopy, mid-succesional stands using forest habitat management techniques, such as thinnings, may improve the structural complexity of these stands and increase the amount of understory habitat for species like Black-throated Blue Warbler and Veery. Augmenting the amount of early-successional northern hardwood forests may be very important for the Golden-winged Warbler (Hunter 1997) and Ruffed Grouse (J. Woehr, in lit. Appendix I), as well as, some fledging mature forest species who may use these habitats after dispersing from their nest territories (see studies by Anders *et al.* 1998 and Vega Rivera *et al.* 1998 on wood thrush).

Opportunities to increase early-successional and late-successional northern hardwood habitat appear to be decreasing on non-industrial private lands. More than 70% of northern hardwood occurs on non-industrial private land within the Southern Appalachians. Future development in and around these areas will likely determine the amount and extent of habitat available for vulnerable species. Development of high elevation for secondary homes may allow for more marginal, mid-to-late succession habitat, as most people are unlikely to remove the forests around their homes (J. Woehr, in lit. Appendix I). In addition, continued development for recreational uses (i.e. ski resorts) is not likely to provide high quality early successional habitat. In contrast , managing for early successional as well as disturbed late successional habitat may be more likely on national forest lands where active forest management (*i.e.*, clearcutting, shelterwood cutting and prescribed burning) can be accomplished. Standing snags should be left wherever possible for cavity nesters (e. g. Yellow-bellied Sapsucker). Improvement of mid-successional northern hardwoods using these techniques can also be conducted on national forest lands.

Allocation of high-elevation forests is the key for making sure habitat requirements best associated with late successional associated species versus those associated with early successional disturbed forests are not in direct conflict with each other. About 56,600 ha (141,500 acres) of all high-elevation forests should be dedicated for managing late successional to old-growth conditions, with emphasis on north facing slopes at lower elevation areas. Of the remaining 54,600 ha (136,500 acres)

of future hardwood dominated forests, considerations for passively managing sensitive communities (such as Beech Gaps), public lands already set aside (National Parks, Wilderness Areas, etc.), and known occupied sites for endangered species (particularly northern flying squirrel) should take precedence for encouraging late successional to old-growth conditions. On lands outside of passively managed zones, up to 29,060 ha (72,650 acres) of high-elevation forests should be managed more aggressively for Appalachian Yellow-bellied Sapsucker, Golden-winged Warbler, and associated disturbance dependent species.

Whether or not up to 25 percent of all high-elevation forests, or about 50 percent outside of spruce and spruce-hardwood restoration areas, are ever managed for disturbance dependent species is yet to be determined. Many questions remain regarding level and frequency of disturbance necessary to support sapsucker populations and associated species while not conflicting with species more dependent upon mature forest conditions. Management attention will need to come from a combination of National Forest (37,000 acres) and private lands (45,000 acres) to perpetuate the necessary habitat conditions within the SBR. Applying landscape ecosystem classifications should help delineate sites with greatest potential for restoring spruce and spruce-hardwood forests and old-growth conditions for other forest types, while differentiating these sites from forests most suitable for frequent disturbance-based management practices (*e.g.*, Katz 1997, R. Odum unpubl. data).

Evaluation of assumptions

This description contains estimates on the amounts and conditions of northern hardwoods and generally all high-elevation hardwood dominated forests. The information was taken from the Southern Appalachian Assessment (SAMAB 1996), which lacks coverage and age class information specific to the SBR. Before management actions can be implemented, more current and accurate information should be obtained.

High-elevation hardwood forests are assumed to have been subject to more large scale disturbances in the past than they are currently. This seems certain for oak dominated areas and perhaps less certain for northern hardwoods. These disturbances likely provided and maintained habitat conditions necessary for several bird species. However, disturbance regimes in these forests

are poorly understood, and need to be studied.

Recommendations for high-elevation hardwood forests are based on several assumptions that require continued monitoring or experimentation in order to be verified. In particular, the response of early and late successional species to increased amounts of these habitats needs to be investigated. Also, if an extensive effort is undertaken to improve mid-successional stands, then a predicted positive response from species like Veery and Black-throated Blue Warbler should be verified. Furthermore, land-use trends on privately held northern hardwood forests should be monitored to determine if suitable habitat is being maintained on these lands.

Hemlock-White Pine

Status and importance

Perhaps representing the second most important, but most expansive, restoration challenge in the SBR is for old-growth hemlock dominated forests along with white pine and hardwood mixed habitats at middle elevations. Remnant old-growth hemlock or mixed hemlock-white pine communities occur in scattered and often small stands along north-facing slopes at elevations between about 762-1220 m (2500-4000 ft.), with the best remnant stands persisting in the Great Smoky Mountains (Stephenson *et al*. 1993). Hemlock-white pine may also be found with mixtures of other hardwood species, especially yellow poplar, at lower elevations in other areas throughout the SBR. These hemlock forests are restricted to mesic ravines and other protected low-to-mid elevation riparian sites. Thickets of rhododendron and laurel frequently form a dense understory, which is important for many neotropical migrant species, especially Black-throated Blue Warbler (Kendeigh and Fawver 1981, Bartlett 1995). White pine can be found in pure stands (from purposeful planting) or as a co-dominant at middle elevations with hemlock and various hardwoods. Both hemlock and white pine were commercially important species into the 1900s. Today, white pine remains an economically important species, but stands are rarely maintained into late-successional stages.

There are approximately 250,000 ha (618,000 ac) of hemlock and/or white pine forests in the

Southern Appalachians (see Table 4). The vast majority of this acreage, across all major land owners, is commercial white pine either in sapling/pole and mid-successional stages or natural regeneration from expansion into formerly hardwood forests with the last 50 or more years of fire suppression. These commercial and invading acreages should be separated from present and potential acreage more suited for supporting old-growth conditions for both hemlock and white pine. Currently, only 4%, or about 10,000 ha (25,000 ac), of this forest type is classified as late succession within the Southern Appalachians overall, most of which occurs in the SBR. About 42% of late succession hemlock-white pine occurs on public land, the majority on national forests. The remaining 58% is on private non-industrial lands.

Late successional hemlock-white pine forests are currently under represented across the landscape due to extensive cutting early during the 1900's and a slow rate of recovery, even on lands no longer harvested. Unfortunately, hemlock may soon be subject to further decline, due to spreading infestation from the north of another woolly adelgid species (C. Haney, in lit. Appendix I). White pine can also be affected by white pine blight rust. In addition, effects from ozone and acid deposition are currently unknown but may make hemlock-white pine forests more susceptible to these and other threats. Decline of these habitats may add stress to stable forest interior and more vulnerable species, especially those dependent on coniferous trees. As with spruce-fir, controls for exotic pests and changes in air quality need to be found before mature hemlock, in particular, and associated (non-plantation) white pine forests are dramatically altered.

Priority species, species suites, and habitat requirements

Mature hemlock-white pine-hardwood mixes support many different bird populations. Priority neotropical migrant species include Blackburnian, Black-throated Blue, Canada and Swainson's Warblers. Black-throated Green Warbler, Northern Parula and Blue-headed Vireo are lower priority species, but locally important. Blackburnian warbler, Black-throated Green Warbler and Northern Parula are obligate canopy species. Blue-headed Vireo is associated with midstory layers, while Black-throated Blue, Swainson's and Canada Warblers are restricted to stands with dense understory, often rhododendron (H. LeGrand in lit. Appendix I). Blackburnian and Canada Warblers are found

primarily at the higher elevations along with significant populations of Black-throated Blue Warblers. Swainson's Warbler usually occurs in dense rhododendron thickets at elevations below 915 m (3000 ft.).

There is evidence that two types of Red Crossbills are dependent upon Southern Appalachian conifers. Birds referred to as Type I utilize spruce-fir and hemlock/white pine forests, while those classified as Type II are yellow pine specialists (Groth 1988). Although the distribution and ecology of these birds are not completely understood, declines in high elevation conifer forests in the Southern Appalachians may be affecting the long-term conservation of at least the Type I Red Crossbill, which appears to be an endemic subspecies (Groth 1988, Lee and Browning in prep.). In fact, the elimination of white pine as a dominant species in northeastern North America is hypothesized to have greatly influenced the present distribution of various Red Crossbill "species" (Dickerman 1987).

In addition, several widespread species associated with high-elevation spruce-fir may have had larger distributions within the SBR when more late successional hemlock-white pine occurred prior to 1880 (C. Haney, in lit. Appendix I). In fact, some species, like Northern Saw-whet Owl may have been more abundant when extensive old-growth hemlock-white pine dominated more of the SBR at mid to lower elevations, especially in mesic coves. Additional, examples include Red-breasted Nuthatch, Golden-crowned Kinglet, and possibly Brown Creeper, which may be restricted now to late successional and old-growth hemlock or white pine stands in Georgia (and perhaps South Carolina), where there is no spruce-fir.

Habitat and population objectives

To provide quality habitat for these species, the amount of late succession hemlock and hemlock-white pine mixed stands should be increased on as many acres as possible for this type, especially on public lands. This will most likely occur on public parks, forests and designated wilderness areas, as much of this current acreage is in the sapling/pole and mid-successional age groups. However, the amount and extent of hemlock-white pine within passively managed landuse categories needs to be assessed before determining whether more should be set aside to mature into older age classes. For example, the amount of late successional white pine acreage to be encouraged is

more problematic given the vast acreage of white pine under commercial or otherwise "off-site" conditions today. Either way, landuse trends on private non-industrial lands need to be monitored.

The importance of early successional hemlock-white pine forest also needs to be investigated, but is unlikely to be a major focus for bird conservation compared with early successional habitats in more appropriate forest types for active management at mid to low elevations (*i.e.*, Appalachian oak, southern yellow pine). Bartlett (1995) found a large number of species using seedling/sapling stages of hemlock-white pine stands in Tennessee. He also obtained high occurrence and density values for Hooded Warbler, Red-eyed Vireo and Indigo Bunting. Currently, 11% or 27,508 ha (68,000 ac) of all hemlock-white pine forests in the Southern Appalachians are in an early stage of regeneration. The vast majority of this is on private non-industrial lands and national forests and may not all be in the SBR. Regardless of where it occurs, the amount of early successional hemlock-white pine is predicted to decline, as the forests are developed or allowed to mature.

Population objectives overall should be focused on mature forest associated species. Of special attention among nearctic-neotropical migrants are Blackburnian Warblers in the canopy layer, and Black-throated Blue and Swainson's Warbler in the understory. Optimal denisties for these species in late succession and old-growth conditions still need to be determined and nesting success investigated for the SBR, though it is assumed here that the density should be among the highest found rangewide (Haney and Schaadt 1996, Haney unpubl. data). Modest densities are more likely for Black-throated Blue Warblers (Graves 1997) and very locally for Swainson's Warbler (Graves unpubl. data). Hamel (1992) reports maximum density for Blackburnian Warbler as 22 pairs per 40 ha (100 acres). Hemlock-White Pine is considered suitable habitat for Black-throated Blue Warblers and a target mean density for maturing stands would be 36 pairs per 40 ha (100 acres).

High Peaks Forest birds dependent upon higher elevation forests, but also occur in very low densities in late successional and old-growth hemlock-white pine, should also receive some additional attention. These species include Red-breasted Nuthatch, Golden-crowned Kinglet, Brown Creeper, Winter Wren, and possibly Northern Saw-whet Owl. Optimal densities for these High Peaks species should be determined and nest success documented to determine possible gene flow among High Peak subpopulations.

Implementation recommendations and opportunities

About 25% of all available hemlock-white pine forests within the Southern Appalachian Assessment area occurs on national forest lands, with less than 5% found on other public lands. Therefore, the Forest Service has a significant opportunity to augment the amount of late successional hemlock-white pine habitat as well as maintain only if determined necessary a small percentage in the early-successional stage.

Attempts should be made to work with landowners to manage their hemlock-white pine forests. Information on the importance of these and other habitats to avian species should be made available to private land owners who are managing their lands for timber or other uses. The aesthetic value of mature hemlock and white pine trees could be emphasized especially to landholders who may develop their lands for residential purposes.

Evaluation of assumptions

The assumption that more late successional hemlock stands would augment breeding populations of high priority species (*e.g.,* Red Crossbill Type I, Blackburnian and Swainson's Warblers) needs to be studied. This is especially true for spruce-fir species that are assumed to have had larger distributions when more mature hemlock-white pine was available. Initial efforts are now underway to survey the importance of relict old-growth hemlock stands in Georgia, Tennessee, and North Carolina (Haney unpubl. data). In contrast, any effects on birds from the loss of early successional habitat should also be verified.

Perhaps the most important assumption that requires immediate attention is the impending impact on these habitats from the hemlock woolly adelgid. Declines of priority mature forest nearctic-neotropical migrants and spruce-fir species as a result of the loss of these habitats will have to be assessed. If the predicted extent of damage to mature hemlocks is in anyway comparable to that of Fraser Fir, then the above recommendations for late succession hemlock will be ineffective. In the face of such a threat, a comprehensive management plan should be developed and implemented to conserve and maintain as much mature hemlock-white pine forest as possible.

Cove (Mixed Mesophytic) Hardwoods

Status and importance

The Southern Appalachian cove hardwood forests are the most biologically diverse habitats in the United States. They contain 1) the largest numbers of co-occurring broadleaf tree species and herbaceous plants in the New World outside of the tropical zones, 2) the most species of salamanders in the world, with many endemic species, and 3) very high densities of breeding birds, especially mature forest-dependent nearctic-neotropical migrants (Hinkle *et al.* 1993).

Variations of this forest type can be found throughout the Southern Appalachians at elevations from 305 to 1372 m (1000 to 4500 ft) (Hooper 1978). As the name "cove" implies, they are typically found in mesic sites on concave landforms and ravines, or on protected north- and eastern-facing slopes at low elevations. The content and composition of these forests can vary dramatically based upon soil conditions (Schafale and Weakley 1990, SAA 1996). On rich (basic) sites, a diverse mixture of mesophytic tree species dominate the canopy including tulip poplar, basswood, sugar maple, yellow and sweet birch, cucumber magnolia, yellow buckeye, black cherry, eastern hemlock, American ash, northern red, white and chestnut oak, magnolia, black gum, black walnut, American beech, red maple, and several hickory species. These sites tend to have open, diverse understories with open to sparse shrub layers allowing for a lush, very diverse, herb layer to cover the forest floor. As soils become more acidic, however, canopy and understory tree diversities decline. Species like hemlock, yellow poplar, sweet and yellow birch, red maple and northern red oak become more important. A dense shrub layer dominated by rhododendron begins to develop and the herbaceous layer becomes sparse (Hooper 1978, Schafale and Weakly 1990). Cove hardwoods grade upwards to northern hardwoods and hemlock-white pine in higher elevation mesic sites, or into Appalachian oak forests on drier, more exposed slopes and ridges.

Because these forests occur in cool, moist and sheltered sites, frequent large scale disturbances are uncommon. Tree fall gaps and windthrow are likely the most common forms of natural disturbance in older cove forests, producing uneven-aged stands that are structurally complex. Fire is not a likely source of disturbance in these forests.

As with all forests of the Southeast, very few virgin cove hardwood stands remain. However, remnant virgin stands, as well as late succession second-growth forests, still support very high levels of biotic diversity. Surveys conducted earlier this century, for example, obtained densities ranging from 230 to 430 pairs of breeding birds per 40 ha (100 acres) in hemlock dominated cove stands and 183 to 370 in hardwood dominated coves (Fawver 1950, Odum 1950, Holt 1974). Results of these and other studies highlight the importance of these forests to bird populations in the SBR as well as other physiographic regions.

The Southern Appalachian cove forests are presumably well represented and protected on public lands. Approximately 1,170,000 ha (2,800,000 acres) of mixed mesophytic hardwoods occur in the Southern Appalachians (see Table 4). Over 400,000 ha (1,000,000 acres) are in the SBR, more than any other physiographic area covered in the Southern Appalachian Assessment. Unfortunately, the current successional status of cove hardwood in the SBR is not clear because the published version of the Southern Appalachian Assessment merged seral data for cove hardwoods with that of other forest types (*e.g.*, oak-hickory, hemlock-white pine, and northern hardwoods). Most of the cove hardwoods on public lands are assumed to be in a mid successional stage of regeneration and in good health.

Priority species, species suites, and habitat requirements

Many priority species are associated with late succession cove hardwoods in the Southern Appalachians. Species with the highest conservation priorities include Swainson's and Cerulean Warblers. Cove hardwoods also provide optimal habitat for other priority species including Black-throated Blue Warbler, Acadian Flycatcher, Worm-eating Warbler, Hooded Warbler, Scarlet Tanager, Ovenbird, and Blue-headed Vireo (Hamel 1992). All of these species are forest-dependent nearctic-neotropical migrants, many of which require high percentages of forest cover (> 70%) spread over large areas. Several build nests on or near the ground.

The most inland and northerly populations of Swainson's Warbler are in the Southern Appalachians. Most of these occur within lower elevation cove hardwood sites with dense understories, usually dominated by rhododendron along streams (H. LeGrand, in lit. Appendix I).

However, some populations extend into mixed hemlock-hardwood dominated stands at their lower elevation limits. Swainson's Warblers appear most numerous along the Blue Ridge Escarpment within the headwaters of the Savannah River. The relationship between mountain Swainson's Warbler populations and the more common and abundant populations found in Piedmont (of Georgia) and South Alantic Coastal Plain is unclear, but is under investigation (G. Graves, pers. comm.).

Mature and virgin stands of mixed mesophytic hardwood forests within the Northern Cumberland Plateau and Ohio Hills support the highest densities of Cerulean Warblers in the Southeast. Cerulean Warbler occurs locally in much lower numbers among some of the oldest cove hardwood stands of the SBR, as well as the Mid-Atlantic Ridge and Valley, between 457 - 1220 m (1500 and 4000 ft). The presence of Cerulean Warbler seems to be associated with a high percentage of relatively few but very large ("super emergent") trees, less canopy cover but with complex structure (Nicholson unpubl. data). Often tulip poplars and white oaks make up a high percentage of stocking in cove hardwood stands occupied by Cerulean Warblers. Cerulean Warblers are highly area-sensitive in at least some physiographic areas, requiring at least 4,000 ha (10,000 ac) of continuous forested habitat to support a sustainable population (Hamel 1992), but this may not be an important factor in the heavily forested landscape of the SBR. Instead forest conditions seem to be the most important factor associated with the species occurrence in the SBR.

Mature cove hardwood forests are cool, moist and tend to be structurally complex which sustains high bird abundances and diversities. Like the Swainson's Warbler, several species are associated with the shaded, well developed shrub layer common in these forests. Black-throated Blue Warbler occurs in most forest types within the SBR but reach their highest densities in mature cove hardwood stands at middle and higher elevations (Kendeigh and Fawver 1981, Wilcove 1988). Hooded Warbler is typically found at low-to-mid elevations on moist hillsides and ravines that contain a dense understory (Robinson 1990, Hamel 1992). Similar habitat requirements have been identified for Worm-eating Warbler (Robinson 1990, Hamel 1992, Bartlett 1995). Ovenbirds spend most of their time on or near the ground, but unlike the other species mentioned, it seems that Ovenbird, at least in the SBR, can be found in many different forest habitat types at various elevations. However, they tend to favor mature forests with more open shrub layers on drier sites (Odum 1950, Kendeigh and Fawver

1981, Katz 1997). Some "rich" cove sites in the SBR with sparse shrub layers undoubtedly provide optimal habitat for Ovenbirds.

Like Cerulean Warbler, several other priority species are associated with the diverse canopy layers of mature cove hardwood stands. Blue-headed Vireos is abundant in a variety of habitat types throughout the SBR, but attain highest density, abundance, and percent occurrence in late succession cove forests (Kendeigh and Fawver 1981, Wilcove 1988, Katz 1997), especially those containing many hemlock trees (Holmes and Robinson 1981, Katz 1997). Acadian Flycatchers is often found in older stands with large sized trees and a moderate to open understory along small streams at lower elevations (Smith 1977, Hamel 1992, Bartlett 1995). Scarlet Tanager has been recorded in a number of mature forest habitat types, but had high breeding densities in older cove forests in the GSMNP (Kendeigh and Fawver 1981, Wilcove 1988).

Habitat and population objectives

Several priority species in the SBR are mature forest dependent nearctic-neotropical migrants that require either a dense shrub layer or a diverse mid-story and canopy. These conditions become more prominent as cove hardwood stands increase in age. Thus, the amount of mid and, especially, late succession cove hardwood forests should be sustained at current levels, at the very minimum, and increased whenever possible. This objective needs to be tempered by the fact that much of the most commercially important timber, especially on public lands, is in the same coves that now support dense populations of many priority bird species. It is, thus, necessary to determine the compatibility of various harvest practices with the maintenance of healthy bird populations.

Population objectives for three key species involve two different measures. Total future populations of 5000 pairs for Cerulean Warbler throughout the SBR and Swainson's Warbler principally along Blue Ridge Escarpment within the headwaters of the Savannah River should be achieved with maturing cove hardwoods under appropriate management regimes (including moving stands towards old-growth conditions. Cove hardwoods are optimal habitats for Black-throated Blue Warblers with a maximum density estimate of 45 pairs per 40 ha (100 acres). Reproductive output data would be preferred to assure that these are regional source populations for all these species.

Implementation recommendations and opportunities

Cove hardwoods on public lands, other than on national forests, are for the most part set aside and should largely consist of mid and late successional stages. Once the actual amount of this acreage is determined for the SBR, it may be necessary to allow some cove hardwood habitat on national forest land to succeed into later stages in order to achieve the objectives stated above. Thus, national forest planning efforts will be very important for the future of this habitat. Plans are currently being revised for all the national forests within the Southern Appalachian Assessment Area, except for the Nantahala/Pisgah National Forests in North Carolina. Specific management recommendations for forest dependent, mid-to-late successional birds have been drafted and provide management options that cover many of the priority species associated with cove hardwood forests (*e.g.*, Mitchell 1998).

The vast majority of cove hardwood forests likely occur on private non-industrial lands in the SBR. Additional understanding of the status of cove hardwoods on these and other public and private lands will improve knowledge of the context within which objectives are established for each national forest in each state. Private landuse trends need to be monitored, as conversion of forest tracts to developed land will undoubtedly continue and the amount of suitable cove hardwood forests for priority species will likely decrease. This becomes especially important if productive mature cove hardwood habitats are determined to act as sources for priority birds, supplementing other less productive habitats.

Evaluation of assumptions

Questions persist regarding the importance of the SBR as a source for mature forest species and whether National Parks are more productive lands for mature forest birds than more actively managed National Forests. With many populations sampled from SBR National Forests, Graves (1997) argues that the percentage of older male Black-throated Blue Warblers found in SBR forests compared with populations in northeastern North America is an indication of a source population within this physiographic area.

A few studies have looked at the differences among bird populations in different seral stages of cove hardwood forests (Odum 1950, Holt 1974, Bartlett 1995). In young forests, the composition of

bird species can be vastly different than other older stands (Odum 1950) and contain many species associated with early succesional habitats. Bartlett (1995) recorded more species in seedling/sapling cove hardwoods than in pole and sawtimber stands in Tennessee. Additionally, Odum (1950) and Holt (1974) found population densities and species richness in pole and sawtimber second-growth plots similar to those in virgin forests. Although these studies do not address causal relationships of management practices on bird communities, they indicate that certain forest management techniques in cove hardwood plots may be compatible with maintaining mature cove hardwood bird communities (see Hooper 1978 for a discussion of management options). Specifically, an important observation regarding Cerulean Warbler is the persistence or, even if temporary, expansion of populations for this species into cove hardwood stands subjected to severe storm damage or thinning to shelterwood forest habitat improvement, though systematic surveys are still needed (W. Hunter, D. Buehler, N. Klaus, and many others, pers. observ.).

Along with the above studies and observations, conservation objectives for bird species associated with cove hardwood forests are based on several assumptions which require further study. These assumptions include:

There is a sufficient amount of mid-to-late succession forest on public lands to support priority species for the long term.

That certain types of silvicultural practices will be compatible with conserving populations of forest-interior, area sensitive species such as Cerulean and Swainson's Warblers.

The amount of cove hardwood forests will decrease in response to an increase in human population and development on private lands.

That passively managed cove hardwoods on National Park Service lands serve as sources for mature forest species within and beyond the SBR, independently of or in addition to more actively managed National Forest lands within the SBR.

Appalachian Oak Hardwoods

Status and importance

Oak-dominated upland forests historically (along with American chestnut) covered much of the Southeast. Today, Appalachian oaks are best represented within the SBR and in adjacent portions of the Southern (Tennessee) and Mid-Atlantic Ridge and Valley (north through Maryland into the Northeast), and locally on the Northern Cumberland Plateau, physiographic areas. These forest types, marked by extreme variation in tree species composition and structural complexity, provide important habitats for species dependent on mature hardwoods because of the sheer number of hectares they cover. They also produce vast amounts of hard mast (i.e. acorns and hickory nuts), that provide essential food for a variety of wildlife species.

Appalachian oak forests are composed of Northern red, chestnut, white, and black oaks, which occur in combination with many other species, especially pignut and mockernut hickory and red maple. The composition and complexity of oak forests vary along elevation, slope and moisture gradients. They typically occur at elevations from 250 m (820 ft.) to 1375 m (4510 ft). Mature forest types can range from oak-pine forests that occur on extremely dry, exposed, south and western facing slopes and ridges at mid to low elevations to red oak forests on more mesic north facing slopes at high elevations (Stephenson et al. 1993). These forests may grade to cove hardwood, northern hardwood or hemlock-white pine on more mesic, northeasterly facing slopes and ravines or to southern yellow pine forests on more xeric, south and western facing slopes and ridges. All oak-hickory associations occur on drier and more exposed sites than those supporting cove (mixed mesophytic) hardwoods (Stephenson *et al*. 1993). Understory and shrub layer densities are highly variable and depend on site conditions and past disturbances. Chestnut sprouts are common and abundant throughout many oak forests, indicating the former importance of this species.

Oak-dominated forests have had a long history of natural and human disturbances. Oaks are generally shade intolerant and will not regenerate in large numbers where other trees dominate the canopy. Historically, large scale disturbances such as fire, windthrows, and crown damage from severe storms opened up the forests which resulted in oaks attaining dominance over other hardwoods.

Regularly occurring small fires and grazing by herbivores likely slowed succession and restricted competing vegetation to the understory during the last 10,000 years (Table 8; Buckner and Turrill 1999). Nearly all of the virgin Appalachian oak forests were harvested by 1920, with nearly 30% of the harvested sites converted to crop production and pasture (Stephenson *et al*. 1993). In addition, the chestnut blight had virtually eliminated American chestnut as a dominant canopy species by the late 1920's and early 1930's, leaving only saplings in the understory to grow until they succumbed to the blight (SAMAB 1996).

Presently, the SBR is the most forested region in the Southeast because areas harvested around the turn of the century, as well as vast acres of retired or abandoned agricultural lands, now support mature second growth forests (Stephenson *et al*. 1993). However, the suppression of fire and the harvesting of only select mature oak trees, especially on non-industrial private lands, is affecting the composition of these oak forests. Over 70 years of fire suppression led to the possible widespread replacement of oaks with more shade tolerant species like red maple (SAMAB 1996). In addition, stands from which oaks were selectively harvested may become dominated by other faster-growing hardwoods such as sweetgum and tulip poplar.

Future impacts to the SBR Appalachian oak forests will likely consist of increased human population pressures, including the development of natural lands for second homes and recreational resorts which may lead to higher forest fragmentation, especially at lower elevations, and increased levels of air and water pollution, which may make oak forests more susceptible to other exogenous factors. Limestone, marble, slate, gypsum, mica, gold, copper, iron, and zinc are all mined in the SBR, which impacts the surrounding forests and downstream water quality. Furthermore, the future health of all Appalachian oak forests is severely threatened from the expansion of exotic pests like the gypsy moth and oak wilt fungus. Gypsy moths, in particular, have had devastating impacts on oak forests in the north and are projected to infest the entire SBR by 2020 (SAMAB 1996, Cooper and Marshall 1998).

Over 1,620,000 ha (4,000,000 ac) of oak forest currently occur in the SBR (see Table 4). For the Southern Appalachian Assessment area as a whole, about 25% of Appalachian oak is on public land with about half of this classified as late succession. The amount and condition of oak forests

in the SBR appear to reflect these proportions so an estimated 405,000 ha. (1,000,350 ac) occur on public land and 202,500 ha (500,175 ac) is in late succession. In contrast, only about 10% of the privately held Appalachian oak is in late succession. However, it is unclear whether the successional status of private lands in the SBR is reflective of this. Approximately 50% of Appalachian oak forests across all land ownerships in the Southern Appalachians is in mid-succession and much smaller amount (about 5%) is in early succession.

The high percentage of public lands in the SBR supporting Appalachian oak forests would suggest that large amounts of this habitat will be maintained for the long term, providing habitat for those species dependent upon this forest type. Southern Blue Ridge forest bird population trends are largely reflective of trends within the Appalachian oak forest, which is the most widespread forest type in the physiographic area. Large, forested areas at higher elevations should provide the minimum amount habitat needed to sustain populations of forest-dependent. However, oak forests at low elevations may be more fragmented and thus may not support area-sensitive species. The fact that most BBS survey routes in the SBR are within or adjacent to these fragmented areas may explain some recent population trends, especially for some area-sensitive neotropical migrants showing local declines.

Priority species, species suites, and habitat requirements

Appalachian oaks make up about 50% of the forested area in the SBR. The sheer extent of this habitat type is important for many bird species. Mature cove (mixed mesophytic) hardwood forests, discussed in the subsection above, can provide important habitat for vulnerable species even in smaller stands as a result of typically having the greatest structural complexity of any southeastern forest type. Dry-mesic to xeric oak-dominated forests, in contrast, are not as complex and have been shown to support lower bird densities and fewer species (Bond 1957, Smith 1977, Katz 1997). However, oak forests are important to many mature forest species because they contribute to high percentages of forest cover throughout the SBR. Large areas of late successional oak forests provide suitable and optimal habitat for almost every species of woodpecker that occurs in the SBR as well as many species of hawk (Hamel 1992). They also support large numbers of Wood Thrush and Ovenbird in the understory, Black-and-white Warbler in the midstory and Scarlet Tanager and Eastern Wood-pewee

in the canopy (Kendeigh and Fawver 1981, Hamel 1992, Stephenson et al. 1993, Bartlett 1995). Riparian stretches within oak woodlands provide important habitat for Kentucky and Hooded Warbler, Louisiana Waterthrush, and Acadian Flycatcher (see subsection on lowland riparian forests, below). In addition, grass/forb and seedling/sapling stages of oak forest regeneration have also been shown to provide quality habitat (nesting and foraging) for many early successional bird species including, Golden-winged, Prairie and Chestnut-sided Warblers, Northern Bobwhite, Field Sparrow, Yellow-breasted Chat and Indigo Bunting (see early succession subsection, below).

Habitat and population objectives

To provide habitat necessary to support the myriad of species that rely upon the extent, condition and variation of Appalachian oak forests, the current proportions of early and late successional stands within the SBR should be maintained and, whenever possible, augmented with appropriate disturbances reintroduced into the system. A clear definition is unavailable by which oak dominated forests can be considered old-growth, but relatively frequent disturbances are often necessary to perpetuate healthy oak regenation (*e.g.*, fire plays and important role; White *et al.* 1993, White and White 1996). As our present understanding allows, restoration of fire influenced oak forests (savannas?) should be pursued on appropriate sites (Table 9; Buckner and Turrill 1999). In most areas this approach will likely require substantial reduction of presently high stocking levels and careful introduction of fuel reduction protocols. More open oak forests along with higher fire frequency would likely increase herbaceous ground cover.

Furthermore, mid-successional stands that are determined to be in poor condition (i.e. over stocked, closed canopy stands in the stem exclusion stage), and are likely providing only marginal habitat for a select few species should be improved through thinnings or shelterwood silvicultural techniques.

Problems associated with forest fragmentation have not been clearly demonstrated within the SBR, especially at higher elevations (J. Woehr, in lit. Appendix I). Within these highly forested areas, management should focus on maintaining >70% of the area in forest cover. However, impacts on breeding success from forest fragmentation may be prevalent at lower elevations, especially near areas

with higher human populations and more agriculture (Robinson *et al*. 1995). Indeed, fragmentation effects will likely become more widespread as people continue to move into the region and develop land. Thus, it is important that landscape context is emphasized for the future management of Appalachian oak forests and the birds associated with them, especially at lower elevations. In areas where fragmentation is, or may become, a problem, (determined by GIS analysis, cowbird sightings, parasitism and depredation reports) large patches of forest should be maintained, medium sized patches should be, at the very least, maintained and increased in size whenever possible, small patches should be enlarged or managed to provide adequate habitat for transient species, and finally, the percent of total forest cover should be augmented.

With the high proportion of SBR forest in Appalachian oak, maintaining 70 percent or more forest cover should be the primary habitat objective. Maintaining high reproductive output among all species under these conditions would constitute the most appropriate population goal.

Implementation recommendations and opportunities

Opportunities to maintain mid and late successional oak forests are greatest on public lands (National Park Service and National Forests) as well as on non-industrial private lands whose owners want to live within a forested landscape. Early successional habitat will continue to be created on private land, especially on industrial timber lands. However, efforts to maintain late successional forest on industrial private land and to increase early successional habitat in National Forests also needs to be encouraged. In addition, improving stand quality and increasing the understory component through thinning of mid-successional stands should be intensified on both National Forests and private lands where deemed necessary and feasible.

Strategies for controlling the future loss of oak forests to development, exotic pests, or replacement by other forest types need to be investigated and developed. Minimizing the loss and fragmentation of oak forests to development is paramount. Sites currently not managed should be identified and attempts made to work with the landowner to manage those sites for either early-successional or forest-interior species. A combination of both uneven-aged and even-aged timber management can provide stability for mature forest species and some early-successional species

depending on the intensity of timber harvest and the objectives of the landowner. However, the effects on forest-interior bird nesting success from uneven-aged and combined silvicultural approaches are harder to predict and may require greater monitoring efforts to correct problems as they arise than with even-aged silvicultural approaches. Opportunities to donate these sites to cooperative timber management programs, provide conservation easements or purchase them outright to supplement federal, state and private conservation lands, should be utilized whenever possible. Recommendations for the prevention and management of the gypsy moth need to be developed and should be based on the objectives of the landowner and the potential severity of the damage (see Cooper and Marshall 1998). To restore oak dominance in areas where they are being replaced by other hardwoods, even-aged timber management (i.e. clearcut or shelterwood), group-selection cuts and/or prescribed burning could be employed. However, implementation of such techniques will be difficult, especially on public lands, as they are not generally supported by the public- at-large.

Maintaining and improving healthy game bird populations is also an important issue for Appalachian oak forests and should be considered when plans are developed for the conservation of early successional habitat for nongame species. Management of Ruffed Grouse, for example, can be addressed with that of Golden-winged Warbler, as both have some overlap in habitat requirements and have persistently low numbers. In fact, persistence of Golden-winged Warbler is in question at many locations today where Ruffed Grouse are declining.

Meeting the objectives above will not be easy for such an extensive and important forest type. For lower elevation Appalachian oak forests, partnerships among wildlife professionals, local landowners and public land managers will need to be developed. Such partnerships could focus on landuse patterns beyond any specific property. This would allow maximum flexibility for achieving each partner's primary objectives, while achieving larger community objectives that could include supporting forest-dependent species. The importance of regional assessments (such as Southern Appalachian Assessment) and state and local planning efforts are critical for developing sound environmental recommendations for both private (urban, industrial, residential, and rural) and public lands. The success of these efforts will ultimately be judged by their ability to stabilize populations of many breeding bird species and other plants and animals in this important physiographic area.

Evaluation of assumptions

Conservation plans for birds associated with Appalachian oak forests have been based on several assumptions that require verification. These include:

the extent, ownership and condition of Appalachian oak forests within the SBR occur in similar proportions as they do across the entire Southern Appalachian Assessment Area (further identification and delineation of these forests in the SBR is required, especially within lower elevation areas),

the current composition and health of oak forests is changing as a result of many external pressures (*i.e.*, development, replacement, pollution, and lack of appropriate disturbance factors) and may be drastically affected in the future, thus negatively impacting bird populations,

public lands can provide enough late successional oak forest habitat to sustain priority forest-interior, area-sensitive species,

early successional habitats will continue to be produced and maintained on private land,

forest fragmentation will likely increase at lower elevations which may affect bird populations,

improving mid-successional stands in poor condition will create better quality habitat for many species (monitoring the response of understory species such as wood thrush and ovenbird could verify the effectiveness of these efforts).

Early-succession, shrub-scrub, balds

Status and importance

Early successional habitats in the SBR provide important, and in some cases, essential foraging and nesting habitat for a wide variety of wildlife species. They become particularly important in late summer and early fall when the plants produce abundant supplies of "energy rich" soft mast food resources. Recent research on Wood Thrush highlights the importance of these habitats to fledging mature forest-dependent neotropical migrants during the post-dispersal period (Anders *et al.* 1998, Vega Rivera *et al.* 1998).

The early-succession, shrub-scrub, balds category contains a wide variety of habitat types that occur throughout the SBR at all elevations and topographic positions. It includes early stages of forest regeneration, old and abandoned fields, high-elevation grass and heath balds, mountain wetlands, and agricultural cropland and pastures. Early-successional herbaceous and shrub habitats are defined by the Southern Appalachian Assessment as "non-cultivated areas with predominant vegetative cover of herbaceous plants and shrubs covering at least 25 percent of the area" and includes high-elevation balds, abandoned agricultural fields and areas of early forest regeneration. If trees are present, less than 25% of the area must be covered by their canopies. In general, agricultural croplands and pastures are intensively managed for fruit and vegetable food crops and livestock grazing. Mountain wetlands are non-tidal wetlands with at least 25% of the area covered by emergent hydrophilic vegetation, mosses, lichens, shrubs and trees whose canopies cover less than 25% of area (SAMAB 1996).

Naturally occurring early-successional "shrub-scrub" and grassland habitats originate and are maintained by frequent, large scale natural disturbances including grazing from hoofed animals, tornadoes, hurricanes, ice storms, and, most notably, fire. The elimination of bison and elk soon after European colonization in eastern North America and, most importantly, the active suppression of fire after the 1930's has led to the loss of most natural shrub-scrub and grassland habitat.

This loss was temporarily replaced by small farms, with less efficient farming practices, and regeneration of forests were much more common and widespread towards the beginning of this century and provided essential habitat for many early-successional bird species. Naturally occurring shrub-scrub communities, lost during the same time period, had been replaced by fallow and abandoned agricultural fields, as well as shrub-scrub hedgerows. These conditions allowed for expansion and abundance of species now facing extirpation or extinction (*e.g.*, Golden-winged Warbler and Appalachian Bewick's Wren, respectively). Since the early 1900's, these habitats have been lost to development (*i.e.*, housing subdivisions), more efficient "clean" farming practices with few hedgerows, and succession which has resulted in much less early-successional habitat and more upland forests occurring in the SBR overall (Stephenson et al. 1993.). Similar landuse patterns and trends are

discussed for New England by Livaitis (1993).

High-elevation ”mountain” wetlands (including bogs, fens, seeps and increasingly beaver ponds) are extremely vulnerable communities that are small in area and have not been well-inventoried. These communities collectively support many federal and state protected plant and animal species as well as many candidates for federal protection (SAMAB 1996). Historically, wetlands were found throughout the Southern Appalachians and undoubtedly provided semi-permanent habitat for early successional bird and other vulnerable species (*e.g.*, bog turtles; Lee and Norden 1996). However, past landuse practices, increasing development pressures and the disruption of normal hydrologic processes have resulted in considerable losses of these sensitive habitats. The effects of these losses on bird populations are not well understood.

Habitats similar in structure to natural shrub-scrub communities can be produced through even-aged silvicultural techniques over large areas. However, there is a trend away from some even-aged management techniques, especially large clearcuts on public (National Forests) and non-industrial private lands throughout the South. In fact, there is growing consensus that declines of so many early-successional species may be related to this trend as areas harvested in the 1960’s and early 1970’s have reverted back to forests (J. Woehr, in lit. Appendix I). Early-successional forests are, by design, transitory and move into later stages of succession quickly unless maintained by some sort of disturbance (*e.g.*, fire, grazing). The use of fire in maintaining early-successional conditions, however, is not well understood or endorsed by the public. Unless massive education is employed burning will not likely be conducted on public land a large enough scale to restore appropriate ecosystem processes. Therefore, the reduction in natural or simulated ecosystem functions involving regular disturbance will continue to allow succession to proceed and forests to mature. Unless more active management approaches are adopted, early-successional habitats and the species associated with them are expected to decline, a process similar to that described for migratory birds and mammals in the Northeast (Litvaitis 1993).

An estimated 607,287 ha (1,500,000 ac) of the Southern Appalachian Assessment Area currently contains semi-permanent grass/shrub and old field cover deemed suitable for early-successional species (SAMAB 1996). Between 5-10% of the Southern Appalachian forests are in the

grass/seedling/shrub stage. In addition, nearly 3,238,866 ha (8,000,000 ac) of cropland and pastures and 29,150 ha (72,000 ac) of wetlands are also present, but the value to early-successional species is not well known. Recent findings indicate that current trends of using nonnative cool season grasses on pasture lands are not providing suitable habitat for many grassland birds species and are thus contributing to their declines (Titus and Haas 1998).

Although under-representation of late successional forests is all but certain in the SBR, the same is almost certainly true for early successional forests, especially above 915 m (3, 000 ft). The extent, condition and ownership of forests in the grass/seedling/shrub or sapling/pole stages in the SBR, however, is difficult to determine from the SAA, but the majority undoubtedly occurs on private lands at lower elevations and in physiographic areas other than SBR. Thus, the amount of maintained and recently created early successional habitat that is present in the SBR is probably less than in other Southern Appalachian physiographic areas. About 1 percent of the entire SBR, or about 40,486 ha (100,000 ac), consists of semi-permanent early-successional habitat, occurring as balds, barrens, mountain wetlands and old fields.

Priority species, species suites, and habitat requirements

Populations of birds associated with early successional habitats are in decline throughout the Southeast, including the SBR. Only one species, the Blue Grosbeak, is definitely increasing. The highest priority species within the SBR are the Golden-winged Warbler and Appalachian Bewick's Wren, with PIF priority scores of 30 and 35, respectively. The Golden-winged Warbler is largely restricted in the Southeast to the SBR. It is a habitat specialist that uses early successional shrub-scrub, mixed with grass, at elevations between 610 and 1220 m (2000 and 4000 ft) (Hamel 1992). Historically, the warbler was most likely associated with high elevation wetlands, balds, old fields and forest edges that were subject to frequent disturbances which maintained the structural habitat characteristics necessary for this species (Short 1963). Today, these birds are often associated with mid to high elevation clearcuts, which may temporarily mimic conditions likely to have been more frequent prior to present-day fire suppression practices.

The mysterious and almost complete disappearance of the Appalachian subspecies of the

Bewick's Wren may be related to changes in landscape patterns. The 1000's of acres of regenerating forest, abundant small farms with many brushpiles and hedgerows that occurred early in this century have been replaced by large tracts of mature forest on public lands and increased clean farming and rural housing developments on private lands. Wren populations are currently showing steep declines in other areas in the East where similar changes in landscape patterns have occurred.

Other early successional species, such as Chestnut-sided and Prairie Warblers also may be in need of conservation attention. Although both remain much more common today than they were towards the turn of the century, they have nonetheless declined in many areas in recent years from their mid-century population peaks. These species have relatively small ranges and may continue to decline if semi-permanent early- successional habitat is lost. The Prairie Warbler appears to be associated with shrub-scrub understories of regularly disturbed habitats in the SBR, including southern yellow pine forests and eastern red cedar-pine glades (Nolan 1978). Early seral stages of mixed pine-hardwood and oak-hickory forests have also been identified as optimal breeding habitats by Hamel (1992). The loss of these habitats through fire suppression during this century appears to be mitigated by the concurrent increase in old fields and regeneration of forests from clearcutting. However, recent losses of shrub-scrub in managed landscapes may be contributing to the decline of not only Prairie Warbler, but also Field Sparrow and Northern Bobwhite.

Chestnut-sided Warbler populations are largely restricted in the Southeast to mid to high elevations within the Southern Blue Ridge. They commonly occur in a variety of habitat types and successional stages but are most often associated with regenerating oak-hickory and northern hardwood stands. Chestnut-sided Warbler has declined as a result of the reduction of disturbance management and the overall maturing of forests. However, it seems that roadside edges are presently providing apparently suitable habitat for Chestnut-sided Warbler, but the quality of this habitat in terms of reproductive success is not known.

Ruffed Grouse, Carolina Wren, Gray Catbird, Yellow-breasted Chat, Indigo Bunting, Chipping and Vesper Sparrow are other early successional species that warrant continued population monitoring because they are considered locally important by state agencies or are suffering significant population declines regionally in the recent past.

Habitat and population objectives

The main objectives for early successional species are to 1) protect, maintain, and where necessary, restore sensitive early successional habitats such as mountain wetlands and high elevation balds, 2) where even-aged timber management is employed (industrial private lands and state and national forests), increase the size of early successional forest patches while maintaining the number of smaller patches, and 3) in larger tracts of forest, maintain a shifting mosaic of early, mid and late successional habitats with forest cover remaining above 70%. Before attempting to establish habitat and population objectives for early successional species, however, the amount of habitat presently available and the amount of habitat that will be available on a sustainable basis must be fully understood. Specifically, the amount and condition of silviculturally produced early successional and semi-permanent habitat available to support vulnerable shrub-scrub species must be determined. In addition, a landscape approach including patch size should be considered.

If even aged management is determined to be a feasible way to create early successional habitat, then patches should be between 8-40 ha (20-100 ac) as limited data indicates that patches of this size are more likely to support source populations of many early succesional species than are smaller ones (Confer 1992). In addition the use of prescribed burning or intermittent farming on these sites may be necessary for some species (e.g. Golden-winged Warbler) and should be investigated (Confer 1992, Hunter 1997). Standing snags should also be retained to provide habitat for cavity nesters (especially for Appalachian Yellow-bellied Sapsucker). Proposed objectives for shrub-scrub species must be balanced against the amount of habitat needed for species dependent upon later successional stages, because it takes much less time to shift to early-successional cover from mature forest than the reverse.

Population objectives for Golden-winged Warbler in part may be achieved concurrently with suggested management for Appalachian Yellow-bellied Sapsucker as discussed above under High Elevation Hardwoods above 1,067 m (3500 feet). Most Golden-winged Warblers appear to exist today above 915 m (3000 feet), but can still be found in at least small numbers down to 610 m (2000 feet). Most Golden-winged Warblers are concentrated apparently in southwestern North Carolina, with none known to remain during the breeding season in Georgia, South Carolina, and Virginia within

the SBR. Present best estimate for numbers of pairs in Tennessee's portion of the SBR is no more than 20 (F. Alsop and W. Hunter pers. observ.).

Tentative population objectives for Golden-winged Warbler would be to maintain 3,000 pairs in southwestern North Carolina (present stronghold). An additional 500 pairs each should be maintained in west-central and northwestern North Carolina, eastern Tennessee, and in north Georgia for a grand total of 5000 pairs in the SBR. Reproductive rates should be maintained well-above that needed for local replacement (average 4 fledged young per successful nest as one parameter, D. Buehler and N. Klaus unpubl. data).

Implementation recommendations and opportunities

There are many opportunities to enhance the availability of early successional habitat in the SBR. First, determine the actual quantity of silviculturally produced early successional and semi-permanent habitat using the SAMAB or a similar approach. Second, review and change management recommendations when needed to protect and restore semi-permanent habitats such as balds, barrens, and mountain wetlands (a process currently underway on National Forests). This includes protection of these areas on public and private lands from development pressures, tourism/recreation, and poorly managed agricultural activities by 1) controlling access to prevent damage from vehicular traffic, recreational activities and domestic hoofed stock (e.g. through fencing), 2) monitoring and managing adjacent habitats to sustain microclimatic requirements for sensitive plant species, and 3) using appropriate water structures to restore natural hydrologic processes to mountain wetlands. In addition, active management activities such as prescribed burning, mowing, grazing, hand and machine clearing as well as herbicide treatments could also be employed, where needed, to set back succession and reduce hardwood encroachment. Third, set specific objectives (i.e. amount, condition, patch sizes, rotation ages, burning schedules), for the creation and maintenance of a steady amount of early successional habitat within each appropriate forest type (e. g. southern yellow pine, oak-hickory, northern hardwoods), especially on public and private lands where such activities can be undertaken.

Additional opportunities may come from the use of incentives for agricultural set asides (through Farm Bill, Land Trusts, The Nature Conservancy, etc.). Management recommendations for the

persistence of healthy game populations will also provide opportunities, especially on private land, for early successional habitat for nongame species. Furthermore, investigations into the use of Christmas Tree Farms and powerline right-of-ways, especially those maintained by the Tennessee Valley Authority and cooperating-State utilities, by early successional species may provide opportunities at middle to lower elevations to implement and assess specific management actions. However, dependence upon these situations to support Golden-winged Warblers is risky as these same areas typically also harbor the highest rates of depredation and cowbird parasitism in an otherwise largely forested physiographic area. In addition, Blue-winged Warbler appears to be expanding at the expense of Golden-winged Warblers at these elevations and habitat conditions, with many sites in north Georgia formerly supporting the latter now supporting only the former (W. Hunter pers. obser.)

Recommendations and objectives should be implemented through state Partners in Flight Working Groups, especially participating public and private land managers (forest products industry, TNC, county and city governments, and Southern Highlands and other land trusts). In addition, benefits to many vulnerable species can be produced through cooperative agreements with private landowners who currently have mountain wetlands and other early successional habitats on their lands.

Evaluation of assumptions

Management recommendations for early successional habitats were derived from and based on several assumptions listed below.

Early successional bird species have declined in the SBR as a result of changes in landuse including the loss of habitat from fire suppression, maturation of abandoned farm fields and reduction in even-aged timber management. Trends will need to be verified through further research and population monitoring efforts.

Mountain wetlands and high elevation balds are important habitats for priority shrub-scrub species like the Golden-winged Warbler. Nest productivity studies are needed.

Even-aged timber management along with other management prescriptions such as burning can create habitat that will be used by priority early successional birds. Overall

affects on populations of mature forest species needs to be documented at the landscape scale, but these may be positive given the use of early successional habitats by fledged young of some species. An expected positive response from Golden-winged Warbler and perhaps Ruffed Grouse should be verified, while populations of priority mature forest species also dependent on disturbed conditions, like Yellow-bellied Sapsucker, are monitored.

4. The Appalachian Bewick's Wren may be extirpated from the region. Extensive surveys should be conducted to locate any remnant populations.

5. Patches of early successional habitat between 8-40 ha (20 -100 acres) can sustain source populations of early successional species. Detailed studies investigating minimum patch size, habitat use and reproductive success are needed.

Southern Yellow Pine

Status and importance

Yellow pine forests important to birds in the SBR are dominated by shortleaf, Virginia, pitch and Table Mountain pines. They are found on the driest, most exposed southwesterly facing slopes and ridges at low to intermediate elevations. Stands dominated by Table Mountain Pine usually occur above 862 m (3000 ft). Other hardwood species associated with yellow pines include chestnut, scarlet, blackjack, post, and turkey oaks as well as hickories, sourwood, sassafras, and black gum.

Southern yellow pines occur throughout the Southern Appalachians, but are local in the mountains. Sizable stands in the southern and western portions of the SBR formerly supported remnant family groups of Red-cockaded Woodpecker and possibly small populations of Bachman's Sparrow, neither of which presently occur within the physiographic area.

Composition of this group, in general, varies along an elevational gradient and depends upon past disturbance history, landuse, and topographic features (SAMAB 1996). Stands of shortleaf pine occurring below 732 m (2,400 ft) grade into stands of pitch pine which dominate up to around 854 m (2,800 ft) after which Table Mountain Pine becomes more prominent (SAMAB 1996). These sites can

have well developed, often dense, shrub layers composed of mountain laurel, huckleberry, blueberry and other ericaceous species which vary along the same gradients as canopy species. However, some areas may have a more open, park-like understory with a well developed herbaceous layer. Yellow pine forests can grade into more common upland oak-hickory forests on less dry and exposed sites and, in some cases, may grade into heath balds at high elevations.

The composition and structure of these forests were historically produced and maintained by periodic disturbances, including heavy winter storms which produced large blowdowns especially in stands of Virginia pine and, most importantly, fire which opened seed beds and allowed shade-intolerant species like pitch and Table Mountain Pines to regenerate (Schafale and Weakley 1990). Table Mountain Pine is particularly dependent upon high intensity fires as its serotinous cones will not open without being exposed to very high temperatures. The natural fire regime needed to maintain these communities is not well understood. A recent analysis of Table Mountain Pine growth rings indicate, however, that fires occurred approximately every 10 years in the study area before ownership by the Forest Service in the 1930's, when fire suppression was initiated (Sutherland et al. 1993).

Southern pine beetles have also affected mountain yellow pine forests. Beetle outbreaks have occurred cyclically in the South throughout recorded history (SAMAB 1996). However, impacts from beetle outbreaks are much less severe in the SBR as compared with the Piedmont and Coastal Plains because pine forests are less common in the SBR. Nonetheless, Table Mountain Pine forests can be devastated by a single beetle outbreak, as they will not regenerate in the absence of fire.

Past land use practices dominated by agricultural activities at lower elevations were important in influencing species composition and structure of yellow pine forests, especially in stands of Virginia, shortleaf and loblolly pine. Loblolly pine, in particular, has been extensively planted in some areas.

In the absence of disturbance (*i.e.*, fire), yellow pine stands become dominated by hardwoods. Effective fire prevention and suppression practices have been in place on all public and most private lands in the Southeast for over 70 years. As a result, many southern yellow pine communities dependent on periodic fires, especially pitch and Table Mountain Pines, are in jeopardy of being replaced by more shade-tolerant, hardwood species (Buckner and Turrill 1998)

Approximately 270,000 ha (650,000 ac) of southern yellow pines make up less than 8% of all

the forest cover within the SBR (see Table 4). Presumably, the highest proportions of late succession yellow pine stands are on public lands with most of the early succession stands occurring on private lands. Furthermore, the majority of pine forests on private lands within the SBR are in the sapling/pole and mid-successional stages, as reported for the Southern Appalachians as a whole.

Priority species, species suites, and habitat requirements

The value of mountain yellow pine habitats for vulnerable birds, other than early successional species, is poorly understood, as few studies have been conducted in these areas. Bartlett (1995) found that mature yellow and mixed pine-hardwood stands were less diverse and supported fewer migrant and resident bird species than other deciduous upland forest types in the mountains of Tennessee. However, some mature yellow pine forests, especially those mixed with hardwoods or containing a dense shrub layer, undoubtedly provide optimal breeding habitat for several vulnerable species that occur in other mature forests in the SBR including Ovenbird, Eastern Wood-pewee, Chuck-will's-widow, as well as several lower priority woodpecker species. Recently harvested pine stands, (along with young oak hardwood regeneration) provide essential habitat for many priority early successional species, including the Prairie Warbler, as well as locally important populations of Ruffed Grouse, Northern Bobwhite and Wild Turkey. In addition, the type II subspecies of Red Crossbill (Groth 1988) may depend on stands dominated by yellow pines at middle elevations during some years, but more information is needed on whether these forests are equivalent to hemlock, white pine, and spruce as important food sources.

Southern yellow pine forests may provide important winter habitat for several high priority resident and short distance migrant species. Hamel (1992) identified late successional mixed-pine hardwoods as optimal habitat for Yellow-bellied Sapsucker, Brown Creeper, Red-breasted Nuthatch and Golden-crowned Kinglet, but these are mostly from northern populations that are not otherwise vulnerable. Mature Virginia pine stands were also identified as optimal habitats for Red-breasted Nuthatch and Golden-crowned Kinglet. It is unclear, however, if these forest types are important to these species in the SBR specifically. Studies addressing the use of yellow pine forests by these, and

other, species during the winter months would help clarify their importance.

Habitat and population objectives

Where not otherwise managed for commercial production, mature southern yellow pine forests should be maintained at current levels and increased wherever possible. This means instituting an active fire management program, otherwise maintenance of current or increased pine acreage would be a very low bird conservation priority. In stands that are overstocked or have closed canopies, improvement techniques such as thinning, along with periodic prescribed burns, may be necessary to improve habitat for species associated with more open canopy conditions and dense understories. Such practices may be extremely important for restoring pitch and Table Mountain Pine communities as well as other areas appearing to be replaced by hardwoods. Failure to take any active management approach will likely result in the permanent loss of these communities within the SBR, the effects of which on avian species is unknown (*e.g.* option 1 in Figure 6; Buckner and Turrill 1998).

For early successional species, the amount of early-successional yellow pine habitat would appear unnecessary to perpetuate at any level higher than minimal levels. Nevertheless, commercial production is likely to continue. Therefore, the priority for southern yellow pine should be on the use of various harvesting techniques and prescribed burning to create and maintain grass/forb and shrub-scrub conditions in the understory of late successional pine forests. Such practices may create suitable habitat for species like prairie warbler within more mature forests. To set realistic management objectives for this, however, the current amount and condition of early, mid and late successional yellow pine forests available in the SBR needs to be determined.

Potential restoration of habitat appropriate for at least Bachman's Sparrows and possibily Red-cockaded Woodpecker should be investigated, but again only with active use of fire on a landscape level as a management tool.

Implementation recommendations and opportunities

Opportunities to augment and improve mid and late successional pine forests appear to be restricted to national and state forests and cooperating non-industrial private lands. National parks will

continue to passively manage their forests so late succession will continue to increase; however, without appropriate fire management, much of this forest will be replaced with hardwood-dominated forests in the years to come, a phenomenon already occurring in the GSMNP (Buckner and Turrill 1998).

Industrial lands will continue to be managed for timber products, which will likely result in a very small percentage of late succession yellow pine being sustained on these sites over the long term. Participating industrial landowners could focus on providing and improving early successional habitat by clearcutting in fewer, larger areas according to the Sustainable Forestry Initiative (SFI) guidelines and using fire in older stands to aid pine regeneration. Promotion of hardwood understories, especially in sapling/pole stands with well established pines, may also benefit some species. In addition, plans developed for nongame bird management should also consider the needs of game populations.

Evaluation of assumptions

Before specific management recommendations are developed and implemented certain assumptions should be tested and verified regarding management of Southern Yellow Pine forests. There is little question that fire is an important naturally occurring component in the ecology of southern yellow pine stands. However, using prescribed fire to manage mountain yellow pine communities is still not well understood. Further research regarding the use of fire is needed (see options 1 through 3 in Figure 6; Buckner and Turrill 1999). In addition, it is assumed that habitat for birds associated with yellow pine stands can be created, maintained and improved by reintroducing fire into the SBR; however little, if any, research addressing this question has been conducted for this physiographic area.

The importance of these habitats to vulnerable bird species during the breeding season and throughout the year should be clarified. Monitoring efforts with cooperative landowners may help determine if these species respond positively to the practices recommended above, if implemented.

Lowland Riparian Woodlands

Status and importance

Maintaining vegetation along streamsides is universally considered essential by natural resource managers to minimize erosion from upslope areas and preserve high water quality (National Association of Conservation Districts 1994). The importance of minimizing erosion through maintenance of riparian habitats (also referred to as "greenbelts," "stream corridors," "streamside management zones," or "streamside buffers") is most important in areas being developed for residential or industrial use. Keeping riparian vegetation adjacent to areas mined, farmed, or timbered is also necessary to reduce runoff and erosion, and to minimize environmental contamination from applied chemicals and turbidity. Disagreement on how riparian woodlands should be managed frequently occurs among natural resource managers, and usually centers around four main issues: (1) optimum vegetative structure, (2) desired plant species composition, (3) maximum active management advisable within riparian habitats, and (4) the standard minimum width of riparian habitats necessary to be effective in minimizing erosion within a variety of landscapes.

Restoration and management of streamside habitats may be more important to other wildlife species than to birds. Maintaining narrow strips of riparian forest a minimum of 7.5 m (25 ft) on each side provides only marginal benefits to nongame birds unless these restoration efforts are a part of a much larger focus area, but nonetheless, still constitutes high priority conservation actions. Minimum buffers necessary to improve stream water quality, usually covered in Best Management Practices recommendations, are also necessary for the benefit of many rare and declining aquatic invertebrate and fish species throughout the Southeast. Many of these species are dependent on high water quality and shading provided by overhanging riparian vegetation as well as woody debris imputs from the surrounding forests.

Threats to riparian habitats, which may contribute to larger problems downstream, include obstructions (*e.g.*, dams, channelization), point and non-point contaminant discharge as well as development, agriculture, and poor forest land use practices. Conservation of riparian habitats should focus on minimizing these threats and improving impacted and degraded aquatic systems. Such actions

should also strive to maintain associated riparian and upland forests which provide important habitat for salamanders and forest-dwelling birds.

In the SBR, upland riparian habitats are usually imbedded within dominant forest types, such as northern and cove (mixed mesophytic) hardwoods, hemlock-white pine and Appalachian oak forests. They are not normally distinguished from the surrounding forests because they tend to have similar structure and species compositions. The Southern Appalachian Assessment treats some riparian habitat under the elm-ash-cottonwood forest type or as bottomland hardwoods. These woodlands are either relatively isolated or otherwise distinguishable from upland forest types. Most riparian areas were cleared decades ago for farmland, residential areas, businesses, and roads. The forests that do still occur consist of streamside groves and thickets or narrow bands of trees along a stream (H. LeGrand, in lit. Appendix I). Approximately 27,000 ha (65,000 acres) of riparian habitat is currently present within the Southern Blue Ridge (see Table 4). Over 90% of this occurs at low elevations on private lands surrounded by agriculture or commercial/residential development (SAMAB 1996). Most stands within the Southern Appalachians are in sapling/pole (mainly on industrial lands) or mid successional (mainly on non-industrial private lands) age classes.

Priority species or species suites, and habitat requirements

The highly vulnerable Cerulean Warbler and the usually rare Swainson's Warbler are largely restricted to (and are certainly most common in) riparian habitats within largely forested landscapes. The Acadian Flycatcher and Louisiana Waterthrush are always more common and widespread than the two species above, but are rarely found away from streamside habitats in most physiographic areas.

Riparian areas appear to serve as optimal habitat for transient neotropical migrants as they move through the Southeast. This appears to apply to riparian areas within the Southern Blue Ridge, particularly those in otherwise nonforested landscapes.

Streamside habitats do not always support more species or numbers of birds than adjacent non-riparian forests (*e.g.*, Smith 1977, Gates and Giffen 1991, Murray and Stauffer 1995). Nevertheless, many of the most vulnerable species occurring in the Southeast occur in forested riparian habitats including several sensitive neotropical migrant species from section 1b. in Table 1.

Maximum numbers of Acadian Flycatcher and Louisiana Waterthrush consistently appear when streamside management zones are at least 46-91 m (150-300 ft) wide (including both streamsides and the stream itself), with a somewhat open understory, adjacent to recently regenerated pine plantations (Dickson *et al.* unpubl. manu., Tassone 1981, Melchoirs and Cicero 1987, Tappe *et al.* 1994). In agricultural landscapes, maximum numbers of the most area-sensitive species peaked in streamside management zones of at least 91 m (300 ft) in width (Keller *et al.* 1993, Hodges *et al.* 1995).

Habitat and population objectives

Natural resource managers frequently target avian species when developing guidelines for implementing streamside management zones within riparian habitats. Maintaining the width of riparian habitats using the oft repeated concept that "bigger is better" would provide for an optimum strategy for many vulnerable, area-sensitive birds, if this group of species constituted the only consideration for making management decisions (Dickson and Warren 1994). Effective conservation in most managed landscapes, however, requires that the best information be made available to balance economics with the needs of wildlife.

Wigely and Melchoirs (1994) and Melchoirs (in press) comment on management opportunities and wildlife use of retained riparian vegetation in actively managed landscapes. Melchoirs (in press) organized existing data into three categories particularly useful for developing management recommendations: (1) streamside management zones in managed (usually short-rotation pine) forest stands, (2) riparian forest habitats in otherwise agricultural or developed landscapes, and (3) moisture/elevation gradients in largely forested landscapes. Current understanding of bird-habitat relationships within largely forested landscapes, especially in mountainous areas ("3" above), indicates that forested riparian habitat is indeed important for supporting many species. It is unclear whether local implementation of wider streamside management zones in heavily managed landscapes would provide suitable or optimal habitat for many vulnerable birds, despite occurrences of these and other species in relatively high numbers. Reproductive success may be low in riparian zones surrounded by agriculture or development from higher rates of nest predation and parasitism. On the other hand, streamside management zones, if widely implemented across a landscape, could be effective in

supporting at least some vulnerable species. The goal for managers concerned with the plight of species depending on healthy forested riparian habitat should be to avoid causing presently stable source populations to become population sinks or to suffer extirpations.

Flexibility in managing riparian habitats is also advantageous when large landscapes are under cooperative management. Relative width recommendations, for example, could depend on the topography and nature of dominant landuse patterns. Narrow streamside zones may be adequate where adjacent lands are dominated mostly by mature or maturing stands on flat landscapes. In areas with steeper slopes, these zones should be expanded. Forests dominated by short-rotation plantation forest management, with many early regeneration patches present during every decade, would more likely require moderate to wide zones, especially in areas with varied topographic conditions. Finally, agricultural areas would require the widest zones if vulnerable forest dependent landbirds were an important management priority.

Implementation recommendations and opportunities

Landowner objectives largely define the role of streamside management zones in the conservation of neotropical migrants in larger landscapes (Melchoirs in press). The importance of wider management zones will likely continue to be debated without additional research. It is clear, however, that riparian habitats provide the best, if not the only, opportunities to support many vulnerable birds away from large forested wetlands, which are very rare in the SBR. Focusing on the most vulnerable bird species likely to occur in an area can assist land managers or interested landowners in making appropriate decisions on the width and condition of riparian habitats maintained in streamside management zones.

Partners need to consider a few important points when developing management plans for their lands. In areas with highly variable topography, like the SBR, a landscape perspective is important. First, the width of riparian buffers should increase downslope towards the lower end of a watershed. Second, narrow streamside management zones on ephemeral or intermittent streams can be extremely important and may contribute to the overall diversity of the avian community in a managed forest (Melchoirs, in press). Third, important habitat features may not always be encompassed by fixed-width

streamside management zones, especially in areas with diverse landform features and habitats (Melchoirs and Cicero 1987). Finally, flexibility in management is imperative from an operational perspective (Wigley and Melchoirs 1994). Such flexibility is important, as the economic costs and benefits of streamside management zones and their role in meeting timber production and bird conservation objectives remain largely conjectural and in need of further validation.

For better management of aquatic systems, Capel *et al*. (1994) recommended restoration and maintenance (including fencing and reforestation) of at least 250 miles of riparian buffers throughout the Southeast. They also recommended establishing 750,000 miles (or around 1,214,500 ha) of filter strips (emphasizing mixed herbaceous vegetation, not monocultures of fescue or Bermuda grasses) one-half chain in width on lands adjacent to agriculturally-impaired streams. These recommendations are focused on reducing erosion and preventing contaminants from entering watersheds in which the most vulnerable aquatic fauna are now found and remain under extreme threat of extinction.

Costs in maintaining wide streamside management zones where timber production is the landowner's only or primary objective can be considerable. Fortunately, many wood producing industrial landowners and an increasing number of non-industrial landowners make maintenance of high water quality and wildlife, specifically landbirds, a high priority. Nevertheless, optional recommendations for streamside management zones should be presented to private landowners if management concerns are beyond those outlined in state-sanctioned Best Management Practices (which are usually considered minimally adequate for imperiled aquatic fauna).

Efforts to provide financial incentives, conservation easements, and partnerships formed through public-private programs are critical for stabilizing or enhancing aquatic habitats throughout the Southeast and should be emphasized. Important examples include various the Farm Bill's Forest Stewardship and riparian restoration provisions (U.S.D.A. Natural Resources Conservation Service and Forest Service) and Partners for Wildlife (U.S. Fish and Wildlife Service). These efforts accomplish conservation by encouraging landowners to become personally involved in improving water quality. Implementing even the minimum streamside management zone widths may prevent a number of aquatic species from being lost to extinction and other species from becoming imperiled through continued deterioration of aquatic habitat.

Ongoing efforts to improve watershed management (including riparian habitat condition) through data collection and outreach within the Southern Blue Ridge are currently underway on the New River (NC, VA), Little Tennessee River (NC, TN), Chattooga River (NC, SC, GA), Conasauga River (TN, GA), and Hiawassee River (TN). All these efforts involve both public and private interest groups.

Evaluation of assumptions

Positive responses by vulnerable species (whether birds, salamanders, or fishes) to improved riparian management practices have been assumed and should be monitored through joint monitoring efforts developed by cooperating landowners.

Lowland riparian habitats may act as important stopover sites during migration and may provide essential habitat for species that are uncommon in other habitats throughout the SBR (e.g. Warbling Vireo, Baltimore Oriole). Migration monitoring routes would seem most productive along riparian habitats and would add valuable information to timing and degree of transient passage throughout the Southern Blue Ridge physiographic area.

Urban/suburban "backyards" and rural woodlots

Status and importance

Mature woods maintained in "non-forested" or developed areas may still provide important bird habitats, particularly for transient neotropical migrants. The Southern Appalachian Assessment defines about 2% of the area as developed and about 10% as agriculture (mostly pasture). It is important to note that much reduction in nesting habitat for forest-dependent birds in the Southern Blue Ridge is due to a rapid increase in second home construction and expansion of supporting communities. This trend is likely to continue.

Priority species, species suites, and habitat requirements

Woodlands within developed areas may serve as suitable habitat for many transient neotropical migrants as they move through the Southeast. These species may concentrate in isolated woodlots or in woodlands within more developed areas, especially where fleshy fruiting trees and shrubs are available during peak southbound (and perhaps northbound) movement periods.

Habitat and population objectives

Ecology of transients away from coastal areas is poorly understood. However, providing adequate vegetative cover, food (in the form of mostly native fleshy fruiting trees and shrubs), and fresh water in landscaping plans could potentially enhance survivorship of migrating landbirds as well as resident bird species, especially during the winter months. Monitoring use of these habitats by transients may allow for developing habitat management guidelines.

Implementation recommendations and opportunities

Promoting "backyard habitat" programs and increasing incentives for more rural landowners to improve woodland habitat would be cumulatively beneficial. This would undoubtedly aid transient birds, as well as breeding species where mostly forested landscapes exist. The greatest opportunity to get the local public involved and interested in bird conservation issues within the Southern Blue Ridge may involve backyard and community efforts as described in the Partners in Flight Bird Education Center Program.

Evaluation of assumptions

The importance of rural woodlots and backyard habitats to migrating birds as well as priority species needs to be investigated. In addition, the effects of suburban expansion and development on bird populations should be monitored within these areas. Monitoring populations of cowbirds and nest predators may provide an “early alert” for growing fragmentation problems associated with such development in the SBR.

Establishment of migration monitoring routes within wooded habitats in developed areas would

add valuable information about the timing and degree of transient passage throughout the Southern Blue Ridge physiographic area.

Section 4: Implementation Recommendations and Summary

The following summary includes goal statements and objectives for major habitat types in the Southern Blue Ridge. Population and numerical habitat objectives are provided for specific bird species in need of priority conservation attention. Of primary concern for bird conservation is the status of and future for species restricted mostly to high elevation forests in the Southern Blue Ridge, especially "high peaks forests," with a total of about 275,000 acres in both public and private ownership. Also of primary concern is the future of many species dependent upon disturbance regimes that mostly have been eliminated after European settlement. For most other forested habitats, structure and composition become more important considerations than total number of acres or forest patch size *per se*. The two major conservation themes, based upon local edaphic conditions, are (1) intensifying management of southern and western facing slopes towards grassy savanna or otherwise disturbed conditions and (2) working on increasing understory and canopy complexity (towards "old growth-like" conditions) in mid successional forests along north and east facing slopes and coves.

High Peaks Forests (spruce-fir-northern hardwoods)

Goal - Protect 100% of all remaining spruce-fir forest; restore spruce and functionally double existing acreage of High Peaks forest; control recreation, minimize impacts from livestock, prohibit or regulate collection of young fir and cones; work through research and policy development to improve stands where exotic pathogens and air quality are affecting forest health and structural diversity; resolve taxonomic issues for "endemics."

Objectives - Refine taxonomic treatment and ecological requirements of northern saw-whet owl, red crossbill (type 1), black-capped chickadee, and olive-sided flycatcher. Restore habitat to support at

least 1000 northern saw-whet owl pairs (about 500 are thought to exist today) in one interchanging Southern Blue Ridge population. This population objective will require restoration of over 50,000 acres of spruce and spruce-northern hardwood over and above existing acreage of Fraser fir, spruce-fir, spruce, and spruce-northern hardwood stands combined (over 66,000 acres). Priority areas for restoration should be areas formally supporting red spruce or spruce-northern hardwood mixed stands, but now dominated by mid successional northern hardwood stands. In addition, reestablish black-capped chickadee populations in the Black Mountains (and presumably in the Unicoi, Unaka, and Roan Mountain areas as well) and stabilize populations in the Grandfather Mountain and Virginia Balsams areas.

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High Elevation Hardwood Forests (northern hardwood and Appalachian oak)

Goal - Outside of areas selected for increasing High Peaks forests, increase proportion of both late successional stands as well as heavily disturbed (including early successional condition) stands within existing acreage; improve stand quality where needed (mostly mid successional stands) for the benefit of understory species in north and east facing sloped forests.

Objectives - Determine status and ecological requirements of breeding Appalachian yellow-bellied sapsucker. Restore habitat to support 5000 Appalachian yellow-bellied Sapsucker pairs (less than 200 are thought to exist today). This population objective will require some level of disturbance to over 72,000 acres of northern hardwood and Appalachian oak stands that are presently overstocked for supporting this and other high-elevation disturbance-dependent species (*e.g.*, golden-winged warbler, ruffed grouse). Disturbances may range from shelterwood to clearcuts (with retention of snags especially near edges, minimum height of 30 feet high and 15 inches dbh) and may include use of prescribed burning in Appalachian oak dominated areas. Emphasis for disturbance management should be on stands in intermediate to xeric conditions along the moisture gradient.

Of the remaining 87,000 acres of high elevation hardwoods not otherwise set aside or already in late succession, forest habitat improvement activities should be employed to move stands (especially on

north and east facing slopes) towards more old-growth like conditions (including increasing canopy complexity and understory diversity) for black-throated blue warbler, blackburnian warbler, Canada warbler, rose-breasted grosbeak, veery, and dark-eyed junco. Thinning and uneven-aged regeneration may be the most appropriate protocols to improve habitat conditions. Supporting on average 36 pairs of black-throated blue warblers per 100 acres serves as a population objective. These conditions may also prove important for dispersal and overwinter survival of northern saw-whet owls in the same dense thickets used by breeding warblers.

Hemlock-White Pine Forests

Goal - Protect 100% of all remaining mature hemlock and hemlock-hardwood stands; otherwise increase proportion of late successional hemlock and white pine stands within existing acreage; work closely with private landowners and provide information about the importance of this forest type to wildlife species.

Objectives - Supporting a minimum average of 22 blackburnian and 36 black-throated blue warbler pairs per 100 acres serve as population objectives. These conditions may also prove important for dispersing (and possibly breeding) high peak forest species. Other species to monitor include Swainson's warbler, Worm-eating warbler, wood thrush, Canada warbler, black-and-white warbler, and hooded warbler.

Cove (mixed mesophytic) Hardwood Forests

Goal - Sustain and increase current proportions of late and mid successional stands within existing acreage; determine the best timber management practices that are compatible with or improve conditions for mature forest-dependent species (complex canopy structure and dense understory) on lands managed for timber production.

Objectives - Support 5000 cerulean warbler pairs in mature cove forests with very tall trees (80 feet or more), large dbh, with stand characteristics generally no more than 70 ft^2 basal area and less than 80 percent canopy cover. Support 5000 Swainson's warbler pairs, most along the Blue Ridge Escarpment forming the Savannah River drainage, with most in rhododendron thickets. Support an average minimum of 45 black-throated warbler pairs per 100 acres of mature cove hardwood forests throughout physiographic area. Other species to monitor include Louisiana waterthrush, Acadian flycatcher, worm-eating warbler, wood thrush, Canada warbler, black-and-white warbler, and hooded warbler.

Appalachian Oak Hardwood Forests

Goal - Sustain current proportions of early and late successional stands; increase large-scale use of fire, improve stand quality where needed (mostly in mid succession); develop strategies for controlling the future loss of oak forests from development, exotic pests (gypsy moth) and diseases (oak wilt), and replacement by other forest types.

Objectives - Many Appalachian oak stands are today overstocked when compared to pre-settlement forests and are less susceptible to natural disturbances from fires or storms. In order to restore pre-settlement conditions, extensive thinning followed by prescribed fire likely will be necessary throughout the Southern Blue Ridge. With reestablishment of pre-settlement fire regimes, some stands now dominated by northern or cove hardwood species may be converted back to oak, while reduction of oaks that have invaded table mountain and pitch pine stands also should be expected. Regional average in forest cover should not fall below 70 percent within managed landscapes. Monitoring species for stable or increasing populations below 3500 feet elevation (yellow-bellied sapsucker above this elevation treated under high elevation hardwoods) should include data for cerulean warbler, worm-eating warbler, wood thrush, yellow-throated vireo, eastern wood-pewee, ovenbird, black-and-white warbler, and scarlet tanager. Other species that may be associated with stands subjected to more frequent disturbances are treated below.

Early-Succession, Shrub-Scrub, Balds, Mountain Wetlands

Goal - Restoration and management of remaining mountain wetlands and bald edges in suitable to optimal condition for supporting disturbance dependent species, especially golden-winged warbler populations, should be priority to the extent possible, but consistent availability of appropriately managed early successional forests, wide powerline right-of-ways, and retired farmland are also necessary.

Objectives - Determine status and ecological requirements of breeding Appalachian Bewick's wren now close to or actually extinct throughout its historical range. Restore habitat to support 5000 golden-winged warbler pairs, with 3000 in southwestern North Carolina, 500 each in west central and northwestern North Carolina, eastern Tennessee, and northern Georgia. This population objective requires over 70,000 acres of disturbed habitat at any one time (about 35,000 acres either moving into appropriate or out of appropriate condition, or 10-20 years after last disturbance).
Increasing amounts of early successional habitat by protecting, maintaining, and restoring habitats such as mountain wetlands and high elevation bald edges requires capability to regularly provide disturbance management. At best full restoration and management of remaining mountain wetlands, bald edges, wide powerline right-of-ways, and managed habitats on former farmland will provide only a fraction of habitat required to achieve golden-winged warbler population objectives, but can serve as consistent source areas for subpopulations by being repeatedly disturbed every 10 to 20 years as deemed appropriate. Therefore providing early successional forest patches between 25-40 acres is also necessary, especially Appalachian oak, yellow pine, and to a lesser extent northern and cove hardwoods. Assuming at least half of the early successional habitat objective will need to be provided through active forest management, an average of 25 acres per treatment equates to about 1,500 patches each decade (an average of 40 acres equates to 875 patches). In order for early successional habitat to be optimal for golden-winged warblers, disturbance factors beyond timber harvest (including prescribed burning) may be necessary to provide and maintain an appropriate mix of saplings and herbaceous cover required by this species.

In areas where mature forest management focus is primarily on promoting old-growth conditions, selection of specific areas for focusing early successional species management and treatment on 10-20 year rotations, again with 25-40 acres per patch likely would be compatible for mature forest species as well in the Southern Blue Ridge given the high overall percentage of forest cover in this physiographic area (often over 70 percent). Actually mature forest species may be benefitted by interspersing such patches permanently maintained in an early successional shrub-scrub condition in areas otherwise dominated by late successional forests as these birds are in need of protective cover and rich food supplies for post-fledging young and molting adults.

Southern Yellow Pine

Goal - Maintain and increase current levels of mid and late successional forests; replace Virginia pine with shortleaf, while restoring disturbance regimes (*i.e.,* fire) to improve pitch and table mountain pine stands as well as ground cover and understory habitat; minimize proportion of early successional habitat outside of loblolly plantations.

Objectives - Determine potential for restoring red-cockaded woodpecker, Bewick's wren, and Bachman's sparrow populations now all presumed to be extirpated from the Southern Blue Ridge. Potential also exists for supporting golden-winged warbler populations with a return of regional prescribed burning practices. Monitoring species for stable or increasing populations include eastern wood-pewee, red crossbill (type II), prairie warbler, and brown-headed nuthatch (at least in Georgia and South Carolina).

Lowland Riparian Habitat

Goal - Protect and enhance the quality of existing streamside woodlands; create additional riparian buffers wherever feasible; augment or restore streamside management zones; provide optional recommendations for concerned private landowners that go beyond state BMPs.

Objectives - Priority areas for streamside forest maintenance and restoration should be in association with priority areas for endangered aquatic fauna. In largely agricultural areas streamside zone width for breeding birds should be at least 300 feet (150 feet on each side of narrow stream, 300 feet on each side of larger rivers). These width recommendations are similar to those given to landowners interested in maintaining wild turkey populations. Where landowners are not willing to commit to wide zones throughout their lands, strategic connections may suffice and at minimum narrow zones needed for maintaining water quality will likely support transient landbirds during migration. Larger zones may support Acadian flycatcher and Louisiana waterthrushes; moderate zones support hooded and Kentucky Warblers; and narrow zones have potential for all transient species. In the widest zones, Swainson's and cerulean warblers may be found. Finally, several species specifically associated with lowland riparian areas should be monitored for occurrence and stability and include willow flycatcher, warbling vireo, yellow warbler, and northern oriole.

Urban/Suburban "Backyards" and Rural Woodlots

Goal - Enhance private "backyard habitats" by encouraging adequate cover, food (especially with native fleshy-fruit bearing trees and shrubs), and water in landscaping plans. Minimize potential for lighted structures to impede landbird migration during inclement weather.

Objectives - Work with communities, native plant societies, etc., to encourage use of native fleshy-fruit bearing plants. Work with the communication industry to find solutions to the ongoing spread of towers and other obstructions causing significant bird mortality during inclement weather events.

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Table 1. Entry criteria for identifying priority species, with indications for why the species is considered to be of conservation interest (definitions below).

Priority Entry Criteria	Species	Total PIF Priority Score	Concern Scores		Percent of BBS Population
			Area Importance	Population Trend	
Ia.	Bewick's Wren Appal. subsp.	35	5	5	9.1
	Yellow-bellied Sapsucker S. App. pop.	33	5	5	
	Northern Saw-whet Owl S. App. pop.	32	5	4	
	Red-breasted Nuthatch S. App. pop.	30	5	4	
	Brown Creeper S. App. pop.	30	5	4	
	Winter Wren S. App. Pop.	30	5	4	
	Golden-crowned Kinglet S. App. pop.	30	5	4	
	Golden-winged Warbler	30	4	5	2.3
	Red Crossbill Types I & 2	30	5	4	
	Swainson's Warbler	29	4	4	3.1
	Black-capped Chickadee S. App. pop.	28	5	5	
Ib.	Black-throated Blue Warbler	26	5	4	10.9
	Cerulean Warbler	26	3	3	
	Louisiana Waterthrush	26	5	5	5.7
	Acadian Flycatcher	26	5	5	5.0
	Worm-eating Warbler	25	5	2	7.9
	Wood Thrush	24	4	5	2.3
	Kentucky Warbler	24	3	5	1.3
	Yellow-throated Vireo	23	4	5	
	Brown-headed Nuthatch (GA)	23	3	3	

Table 1 (continued).

Priority Entry Criteria	Species	Total PIF Priority Score	Concern Scores: Area Importance	Concern Scores: Population Trend	Percent of BBS Population
Ib. (cont.)	Blackburnian Warbler	23	4	4	
	Canada Warbler	23	5	3	3.2
	Ruffed Grouse	22	3	5	
	Eastern Wood-Pewee	22	5	5	
	Blue-winged Warbler	22	3	3	
	Chestnut-sided Warbler	22	4	5	
	Prairie Warbler	22	3	4	
	Yellow-throated Warbler	22	5	3	7.0
	Black-and-white Warbler	22	5	5	
	Hooded Warbler	22	5	2	7.1
II.	Peregrine Falcon	21	3	5	
	Chimney Swift	21	4	4	
	Black-throated Green Warbler	21	5	3	
	Scarlet Tanager	21	5	4	
	Northern Bobwhite	20	3	5	
	Ruby-throated Hummingbird	20	4	5	
	Ovenbird	20	4	4	
	Field Sparrow	20	3	5	
	Eastern Phoebe	19	5	4	
	Carolina Wren	19	4	5	
	Blue-gray Gnatcatcher	19	5	5	
	Gray Catbird	19	4	5	
	Yellow-breasted Chat	19	3	5	
III.	Prothonotary Warbler	21	2	3	
	Chuck-will's-widow	19	2	3	
	Red-headed Woodpecker	18	2	3	
IV.	Downy Woodpecker	18	5	5	
	Indigo Bunting	18	5	5	
	Northern Flicker	17	4	5	
	Chipping Sparrow	17	4	5	
	Blue Jay	16	4	5	5.2
	Barn Swallow	14	4	5	
V.	Blue-headed Vireo	19	5	2	5.7

Table 1 (continued).

Priority Entry Criteria	Species	Total PIF Priority Score	Concern Scores: Area Importance	Concern Scores: Population Trend	Percent of BBS Population
VI.	NONE				
VII.	Olive-sided Flycatcher	21	2	5	
	Rose-breasted Grosbeak	21	3	4	
	Black-billed Cuckoo	20	3	4	
	Veery	19	4	3	
	Warbling Vireo	19	2	4	
	Northern Parula	19	5	2	
	Baltimore Oriole	19	2	4	
	Vesper Sparrow	17	2	5	
	Alder Flycatcher	16	2	3	
	Dark-eyed Junco	15	4	3	
	Common Raven	11	2	1	

I. Species with total score above 22. Ordered by total score. Consider deleting species with AI $\leq$ 2 confirmed to be of peripheral occurrence and not of local conservation interest, but retain species potentially undersampled by BBS or known to have greatly declined during this century. Divide species scoring 28+ as highest priority species (I a), with 22-27 as high priority species (I b).

II. Slightly lower score total 19-21 with PT+AI=8+. Ordered by total score. These are moderate priority species.

III. Add WatchList species (Global scores, minus AI, of 18+), not already listed in either I or II, with AI=2+. Order by total score. Consider deleting species with AI=2 if confirmed to be of peripheral occurrence and not of local conservation interest, but retain if a local population is viable and/or manageable.

IV. Abundant but declining species, AI+PT=9 or 10, not already listed in I, II, or III. Ordered by total score. Among Southeast physiographic areas, Northern Flickers, Common Yellowthroats, Indigo Buntings, and Chipping Sparrows are frequently included under this criterion and though still abundant and widespread these species probably deserve more monitoring attention at a regional or national level. In a number of physiographic areas, however, species meeting this criterion include starlings, grackles, cowbirds, blue jays, and house sparrows, species for which conservation interest is only on how their populations negatively effect higher priority species.

V. High percent of Breeding Bird Survey (BBS) population (>5% in physiographic areas <200,000 km^2, >10% in physiographic areas >200,000 km^2) if not already listed above. Ordered from highest to lowest percentages, also include species with exceptionally high relative abundance (detection rates on BBS routes). These are likely secure species, but are still designated “High Responsibility” within physiographic area.

VI. Federal listed species if not already included above. Appropriate legal obligations to protect and monitor these species still apply. Only Bald Eagle meets this criterion in some Southeast physiographic areas.

VII. Local interest species includes game or nongame species identified by State Working Groups. Also, may include species often meeting criteria for I or II within other physiographic areas and therefore of regional interest for monitoring throughout the Southeast. These are low priority species within physiographic area, but may be more important within one or more States.

Include for each species: Total Score, AI, PT, and, when data available, percent of BBS population.

Table 2. Species suites for focusing conservation action. Once species are grouped into the above tiers (Table 1), then habitats and species suites are identified to look for patterns within and among habitats and species suites, within each physiographic area. Species are drawn from tiers I, II, and VII in Table 1. Overall level of conservation action needed is identified (as defined at end of table).

Species Suite Entry Criteria	Species	Total PIF Priority Score	Concern Scores		Overall Conservation Action
			Area Importance	Population Trend	
High Peaks Forest					
Ia.	Northern Saw-whet Owl S. App. pop.	32	5	4	I
	Red-breasted Nuthatch S. App. pop.	30	5	4	V
	Brown Creeper S. App. pop.	30	5	4	III
	Winter Wren S. App. Pop.	30	5	4	V
	Golden-crowned Kinglet S. App. pop.	30	5	4	V
	Red Crossbill Type I	30	5	4	III
	Black-capped Chickadee S. App. pop.	28	5	5	II
VII.	Olive-sided Flycatcher	21	2	5	II
Disturbed Forest					
Ia.	Bewick's Wren Appal. subsp.	35	5	5	I
	Yellow-bellied Sapsucker S. App. pop.	33	5	5	I
	Red-cockaded Woodpecker	30	2	5	II
	Golden-winged Warbler	30	4	5	II

Table 2 (cont.).

Species Suite Entry Criteria	Species	Total PIF Priority Score	Concern Scores: Area Importance	Concern Scores: Population Trend	Overall Conservation Action
Disturbed Forest (cont.)					
Ib.	Bachman's Sparrow	25	2	3	II
	Brown-headed Nuthatch (GA)	23	3	3	V
	Ruffed Grouse	22	3	5	III
	Chestnut-sided Warbler	22	4	5	IV
	Prairie Warbler	22	3	4	IV
II.	Peregrine Falcon	21	3	5	II
	Northern Bobwhite	20	3	5	III
	Field Sparrow	20	3	5	V
	Gray Catbird	19	4	5	V
	Yellow-breasted Chat	19	3	5	V
VII.	Vesper Sparrow	17	2	5	V
	Alder Flycatcher	16	2	3	V
	Common Raven	11	2	1	VI
Mature Forest					
Ia.					
	Swainson's Warbler	29	4	4	III
Ib.	Black-throated Blue Warbler	26	5	4	III
	Cerulean Warbler	26	3	3	II
	Louisiana Waterthrush	26	5	5	V
	Acadian Flycatcher	26	5	5	V
	Worm-eating Warbler	25	5	2	VI
	Wood Thrush	24	4	5	IV
	Kentucky Warbler	24	3	5	V
	Yellow-throated Vireo	23	4	5	V
	Blackburnian Warbler	23	4	4	III
	Canada Warbler	23	5	3	IV
	Eastern Wood-Pewee	22	5	5	IV
	Yellow-throated Warbler	22	5	3	IV
	Black-and-white Warbler	22	5	5	IV
	Hooded Warbler	22	5	2	VI

Table 2 (cont.).

Species Suite Entry Criteria	Species	Total PIF Priority Score	Concern Scores: Area Importance	Concern Scores: Population Trend	Overall Conservation Action
Mature Forest (cont.)					
II.	Chimney Swift	21	4	4	III
	Black-throated Green Warbler	21	5	3	IV
	Scarlet Tanager	21	5	4	IV
	Ruby-throated Hummingbird	20	4	5	V
	Ovenbird	20	4	4	IV
	Eastern Phoebe	19	5	4	IV
	Carolina Wren	19	4	5	V
	Blue-gray Gnatcatcher	19	5	5	V
VII.	Rose-breasted Grosbeak	21	3	4	V
	Black-billed Cuckoo	20	3	4	V
	Veery	19	4	3	VI
	Warbling Vireo	19	2	4	V
	Northern Parula	19	5	2	VI
	Baltimore Oriole	19	2	4	V
	Dark-eyed Junco	15	4	3	IV

Overall Conservation Action:

I. **Crisis recovery(*e.g.*, many but not all endangered species or otherwise non-listed but extremely vulnerable species).**

II. **Immediate management and/or policy action needed for population stabilization, part of rangewide effort (*e.g.*, Bachman's Sparrow, Golden-winged Warbler, Cerulean Warbler).**

III. **Management to reverse, stabilize, or increase populations in the physiographic area (*e.g.*, Brown-headed Nuthatch, Painted Bunting, Bicknell's Thrush).**

IV. **Long-term planning and responsibility in the physiographic area (*e.g.*, monitoring species with high percent of BBS population, with unclear or stable population trends).**

V. **Investigations (Survey/Inventory or Research) to better determine status or level of threat (*e.g.*, high scoring but poorly monitored species such as Swallow-tailed Kite, Henslow's Sparrow, Swainson's Warbler, Southern Appalachian populations of some spruce-fir forest birds).**

VI. **Monitor potentially encouraging population trends or expansions (*e.g.*, Swainson's Hawk, Prothonotary Warbler, Worm-eating Warbler).**

Table 4. Acreages among habitat and ownerships and percentage of seral stages (among forest types). All figures are subject to refinement as several data sources were used to compile these data. The primary source is from the Southern Appalachian Assessment (1996), especially data used to develop Tables C-1 for Southern Appalachians (S. App.) as a whole and C-3 for Southern Blue Ridge (SBR) specifically. Some numbers were corrected in consultation with Assessment authors where computation errors were detected (mostly with C-1) and revised acreage figures were estimated for Southern Blue Ridge split from Northern Blue Ridge (Section Group 6 in Table C-3, with about 3/4 of all acreage within the former area). Data from Great Smokey Mountains National Park variously were not compatible with data for most other ownerships, with exception of spruce-fir and high-elevation hardwoods. Mixed mesophytic (cove) hardwood was variously combined with high-elevation hardwoods, hemlock, and Appalachian oak categories, so treatment here is a construct based on discussions with Assessment authors, again data from Great Smokey Mountains National Park could not be included under "Other Public" lands; for this reason some underestimation of late successional stage forest is likely here.

			Percentage within Seral Stages within S. App. (SBR)			
	Total Estimated Acreage					
Forest Type/ Ownership	S. App.	SBR	Grassland/ Seedlings/ Shrub	Sapling/ Pole	Mid-Successional	Late Successional
Spruce-Fir	84,961	66,252	0.0	7.4	13.5	79.1
National Forests	11,700		0.0	3.8	57.1	39.1
Other Public	62,684		0.0	0.0	0.0	100.0
Industry	5,824		0.0	100.0	0.0	0.0
Non-Industrial	4,807		0.0	0.0	100.0	0.0
High Elevation Hardwoods	525,773	212,000	1.4 (3)	18.2 (8)	67.8 (81)	12.6 (8)
National Forests	91,313		1.0	7.7	73.8	17.4
Other Public	47,079		0.0	23.5	10.8	65.7
Industry	1,812		69.3	0.0	30.7	0.0
Non-Industrial	385,570		1.4	20.1	73.5	5.0

Table 4 (cont.).

Forest Type/ Ownership	Total Estimated Acreage		Percentage within Seral Stages within S. App. (SBR)			
	S. App.	SBR	Grassland/ Seedlings/ Shrub	Sapling/ Pole	Mid-Successional	Late Successional
White Pine-Hemlock-Hardwoods	617,687	400,000 450,000	10.9 (8)	39.7 (38)	45.4 (51)	4.0 (4)
National Forests	155,444		15.2	42.1	36.6	6.1
Other Public	13,949		0.0	41.8	50.4	7.8
Industry	16,352		12.0	58.8	29.2	0.0
Non-Industrial	431,898		9.6	38.1	49.0	3.3
Mixed Mesophytic (Cove) Hardwoods	2,810,084	1,000,000	4.0	19.0	74.0	3.0
National Forests	423,887		1.0	13.0	74.0	11.0
Other Public	67,439		6.0	0.0	94.0	0.0
Industry	67,493		6.0	34.0	60.0	0.0
Non-industrial	2,251,265		4.0	20.0	74.0	2.0
Appalachian Oak	15,570,829	4,000,000	5.2 (5)	20.5 (15)	53.9 (62)	20.4 (18)
National Forests	2,545,208		2.3	6.1	44.1	47.5
Other Public	1,178,697		2.9	11.4	29.4	56.3
Industry	529,470		8.0	36.5	45.2	10.3
Non-industrial	11,291,118		6.0	24.0	59.2	10.8

Table 4 (cont.).

Forest Type/ Ownership	Total Estimated Acreage		Percentage within Seral Stages within S. App. (SBR)			
	S. App.	SBR	Grassland/ Seedlings/ Shrub	Sapling/ Pole	Mid-Successional	Late Successional
Mixed Oak-Pine	4,043,833	700,000	10.1 (9)	31.8 (29)	40.5 (49)	17.6 (13)
National Forests	939,544		1.6	6.2	48.3	43.9
Other Public	243,682		2.5	27.0	31.2	39.3
Industry	271,984		29.6	55.0	15.4	0.0
Non-industrial	2, 588,326		11.8	38.9	41.1	8.2
Southern Pine	3,454,237	650,000	16.6 (7)	17.5 (10)	54.6 (65)	11.3 (18)
National Forests	395,331		7.5	11.3	27.5	53.7
Other Public	146,975		15.2	3.6	44.1	37.1
Industry	550,166		37.2	31.9	30.7	0.2
Non-industrial	2,361,765		13.4	15.9	65.1	5.6
Elm-Ash-Cottonwood	320,755	65,000	5.0	48.7	40.2	6.1
National Forests	850		6.8	9.9	49.3	34.0
Other Public	3,304		0.0	0.0	95.5	4.5
Industry	141,138		0.0	94.8	5.2	0.0
Non-industrial	175,476		9.1	12.7	67.3	10.9

Table 4 (cont.).

Forest Type/ Ownership	Total Estimated Acreage		Percentage within Seral Stages within S. App. (SBR)			
	S. App.	SBR	Grassland/ Seedlings/ Shrub	Sapling/ Pole	Mid-Successional	Late Successional
All Forest Types	27,401,550	7,643,252	7.7 (6)	22.6 (18)	51.5 (60)	18.2 (16)
National Forests	4,563,277		3.2	8.0	43.6	45.2
Other Public	1,763,809		3.7	13.1	29.6	53.6
Industry	1,584,239		21.7	44.2	30.4	3.7
Non-industrial	19,490,225		7.9	25.2	57.5	9.4
Early-successional (Non-forest)	1,713,543	100,000	100.0			