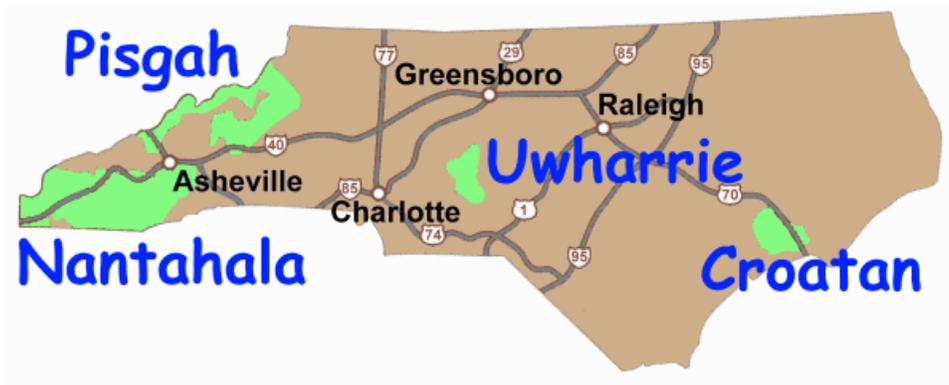




National Forests in North Carolina

United States Department of Agriculture

MONITORING & EVALUATION REPORT FY 1998



An Annual Look at Implementation and Effectiveness
of the Forest Plans

Introduction

The National Forests in North Carolina are comprised of 1.2 million acres of public forestland. These lands are sustainably managed to provide outdoor recreation, timber, water, wildlife and fish, and wilderness, to add to the quality of life for all citizens. Pisgah and Nantahala National Forests are in the western mountains of the state, while the Uwharrie National Forest is in the piedmont and the Croatan National Forest is on the coastal plain. Land and Resource Management Plans (LRMPs) guide the management activities that occur on these forests.

Monitoring and evaluation programs are specifically designed to ensure the goals and objectives set out in the Forest Plans are being achieved; directions are being followed and standards adhered to; and environmental effects are occurring as predicted. The cumulative effect of all management activities on the National Forests in North Carolina should be to move the forests toward the desired future conditions specified in the plans.

Monitoring is conducted by field reviews of projects and by inventory and survey work conducted by Forest Service resource specialists, universities, State resource agencies, and contract specialists.

Forest Supervisor's Statement

I have evaluated the monitoring results and recommendations in this Report. I have directed that the Action Plan developed to respond to these recommendations be implemented according to the time frames indicated, unless new information or changed resource conditions warrant otherwise. I have considered funding requirements in the budget necessary to implement these actions.

JOHN F. RAMEY
Forest Supervisor

DATE

Summary of Monitoring and Evaluation Results and Report Findings

While there is room for improvement in Forest Plan implementation, monitoring does not indicate the need for corrective actions or operational shifts. Differences between what was expected in the Plans and what has occurred are generally a result of the smaller workforce and fewer dollars to do the job. The budgets for the National Forests in North Carolina began to decline in real dollars in 1993. From 1993 through 1998 the budget decreased by over 37 percent in actual dollars. The result is that goods and services are provided at a level lower than anticipated.

Key findings are summarized below.

ECOSYSTEM CONDITION, HEALTH, AND SUSTAINABILITY

- For Nantahala and Pisgah National Forests, creation of early successional habitat through timber harvest and regeneration is below LRMP expectations. To achieve the desired condition would require harvest and regeneration of approximately 3267 acres annually, primarily through two-aged regeneration. Regeneration harvest in FY 1998 was 40 percent of the desired level. The ability to create early successional habitat through other means is very limited, and good quality, secure early successional habitat is also limited on private land.
- During the past 8 years, we have documented over 500 new occurrences of rare species on the NFsNC.
- The red-cockaded woodpecker population on the Croatan National Forest has increased 53% since 1991.
- A look back at 10 years of fisheries monitoring data suggests that natural forces such as floods and droughts have a greater impact on fish populations than forest management activities. For all aquatic management indicator species, no successive year-class failures were found on any stream for any species.
- Of the 3,750 miles of streams and rivers on the Nantahala and Pisgah National Forests, only 10.2 miles (0.27 percent) are identified as impaired. These impaired segments are due to sediment from historical roads to dwellings that were originally built adjacent to streams.
- Water quality monitoring of 139 sites shows the following results: 62% excellent, 24% good, 9% good-fair, and 5% fair.
- In the area of forest health, non-native invasive plants are an increasing concern. Forest Service records indicate, of the approximately 1418 plant species on Nantahala and Pisgah National Forests, 152 are identified as non-native and of these 14 are considered invasive. Non-native invasive species include kudzu, oriental bittersweet, multiflora rose, Japanese honeysuckle, privet, and others. Vegetative plot sampling

reveals the two most frequently occurring are *Microstegium vimineum* (a grass found in 1.8% of plots) and Japanese Honeysuckle (a vine found in 1.4% of plots).

- Currently, all portions of Nantahala, Pisgah, Croatan, and Uwharrie National Forests met air quality standards for pollutants such as nitrogen oxides and volatile organic compounds. Visibility in the mountains, however, is often poor during the summer months due to airborne sulfate particles.

SUSTAINABLE MULTIPLE FOREST AND RANGE BENEFITS

- All recreation projects reviewed during FY 1998 were appropriate for achieving the desired conditions set forth in the LRMPs. These included site renovations and construction to meet accessibility standards; a dispersed recreation plan for the Curtis Creek area; a customer survey for the Tsali recreation area; and trail improvements at the Upper Tellico and Brown Mountain Off Highway Vehicle sites.
- The timber volume offered for sale during FY 1998 was approximately 57% of the allowable sale quantity. Two-aged and uneven-aged regeneration methods were used 87 percent of time, and even-aged regeneration was used 13 percent of the time.
- During FY 1998, 514 archeological sites were identified and protected through surveys of 9,423 acres of forest.
- Increasing populations resulting in more recreational use continues to tax existing roads, trails, and facilities. From 1990 to 1997 the populations of counties containing national forest land in North Carolina increased by an average of 10 percent. While the fastest rate of growth was in Macon County (19.3%), the greatest numerical increases occurred in Buncombe (16,344) and Randolph (15,004) Counties. The highest degree of urbanization occurred in Craven County, home to the Croatan National Forest.

ORGANIZATIONAL EFFECTIVENESS

- As mentioned above, reduced budgets and fewer personnel are currently the greatest challenges to organizational effectiveness.
- Numerous emerging issues pose even more complex challenges each year. Even so, the National Forests in North Carolina continue to provide goods and services to the public through the principles and practice of sustainable multiple-use forest management.

Issue 1. Ecosystem Condition, Health and Sustainability

Sub-Issue 1.1 Biological Diversity

a. Determine if the regeneration of desired tree species are being achieved.

a. Determine if the regeneration of desired tree species are being achieved.

Most forest regeneration (81% in FY 1998) occurs after harvest and site preparation, utilizing naturally occurring seedlings and saplings, and sprouting from stumps and roots. Most of the natural regeneration was hardwood forest types with a small portion of natural regeneration of pines on the Uwharrie National Forest. A smaller percentage, 19%, was regenerated by planting of hardwood and pine seedlings.

Table 1-1 displays district, stand establishment method, and acres of regeneration, from the Timber Activity Control System (TRACS) records for regeneration established in FY-98.

| DISTRICT | REGENERATION METHOD | ACRES |
|-------------|---------------------|-------|
| Cheoah | Artificial | 125 |
| | Natural | 773 |
| Croatan | Artificial | 0 |
| | Natural | 0 |
| Grandfather | Artificial | 80 |
| | Natural | 214 |
| Highlands | Artificial | 183 |
| | Natural | 344 |
| Pisgah | Artificial | 64 |
| | Natural | 148 |
| Appalachian | Artificial | 0 |
| | Natural | 321 |
| Tusquitee | Artificial | 104 |
| | Natural | 126 |
| Uwharrie | Artificial | 7 |
| | Natural | 162 |
| Wayah | Artificial | 0 |
| | Natural | 295 |

b. Determine if the vegetation is being managed according to the Plan's requirements and making progress toward

Fewer acres are being regenerated annually than anticipated in the plans. Approximately 1572 acres of lands suitable for sustained timber production were regenerated in FY-98. The LRMP for Nantahala and Pisgah National Forests (Amendment 5) provides for early successional habitat (0-10 years of age) in management areas 1B, 2A, 3B, 4A, and 4D to a maximum of 10% in management areas 2 and 4, and up to a maximum of 15% of the total acres for management areas 1 and 3. The Croatan and Uwharrie LRMP does not establish a standard for the level of early successional habitat. Tables 1-3 and 1-4 display accomplished regeneration/early successional wildlife habitat, by Forest, in acres and percent of forested acres, and suitable acres. The last column of each table displays percentage of 0-10 year age

achievement of the DFC(s) for vegetation.

class assuming the level of regeneration completed in FY-98, remains constant for the 10 year period.

TABLE 1-3. Early Successional Habitat Compared To Total Forested Acres

| National Forest | Total Forested Acres | Regeneration/early successional habitat established in FY-98 | 10 year equivalent |
|-----------------|----------------------|--|--------------------|
| N/P | 1,000,138 | 1296 acres or .13% | 1.3% |
| Uwharrie | 48,327 | 212 acres or .44% | 4.4% |
| Croatan | 155,414 | 64 acres or .04% | 0.4% |

TABLE 1-4. Early Successional Habitat Compared To Acres Suitable For Sustained Timber Production

| National Forest | Suitable Acres | Regeneration/early successional habitat established in FY-98 | 10 year equivalent |
|-----------------|----------------|--|--------------------|
| N/P | 275,798 | 1296 acres or .47% | 4.6% |
| Uwharrie | 39,263 | 212 acres or .54% | 5.39% |
| Croatan | 79,722 | 64 acres or .08% | 0.8% |

c. Determine if the desired diversity of plant and animal communities is being achieved.

The Nantahala/Pisgah Land and Resource Management Plan complies with to the National Forest Management Act (NFMA) and Forest Service Manual (FSM) 2670 direction concerning plant and animal community diversity. The general direction is to "maintain viable populations of existing native and desired non-native vertebrate species in the planning area". The assumption is that maintaining species viability will allow us to achieve our desired diversity of plant and animal communities. The NP Plan also directs that unique communities be protected such as rock outcrops, barrens and glades, balds, and seeps and to provide site specific analysis of occurrence and effects on proposed, endangered, threatened, and sensitive species and Forest-listed species at the project level to comply with the Endangered Species Act and FSM 2670. The Plan also identifies Management Indicator Species to be used in monitoring the effects of management activities on vertebrate species. Furthermore, the Biological Evaluation in the NP LRMP states that "no decision will result in loss of species viability or create significant trends toward Federal listing". The Croatan and Uwharrie also follows this policy.

During plan implementation, we have complied (except for minor exceptions) with the direction to complete BEs and develop and implement mitigation measures to reduce impacts to sensitive and Forest-listed species. Unique communities have also generally been protected from ground disturbing activities. Land allocations for the NP and Croatan/Uwharrie Plans, such as Wilderness Areas, have also helped to ensure that little impact will occur to a majority of the plant and animal communities on the Forests thus maintaining their representation throughout the planning area. Lastly, our cooperators, environmental and conservation organizations have helped identify when we are not in compliance with Plan standards or Plan direction. The Forest has responded to this input and we have improved our environmental coordination and project planning efforts.

Permanent Plots

As stated in the FEIS, page III-48, permanent points will be established to monitor; aquatic invertebrates, woodland salamanders, breeding birds, and herbaceous understory plants. Exotic Invasive and rich cove plant species will be monitored in conjunction with the vegetative plot sampling design. (LRMP, Amendment 5, appendix D-7).

Aquatic Invertebrates - North Carolina Department of Environmental Management (NCDEM) - Division of Water Quality has established permanent Benthic Macroinvertebrate sites across the state. There are 139 sites either on the Nantahala & Pisgah National Forests or on private lands bordering National Forest where the majority of the watershed is Forest Service lands. NCDEM rates the water quality based on "EPT" (Ephemeroptera + Plecoptera + Trichoptera) taxa richness and abundance. Although some sites have only been sampled once, the majority have been sampled at least 3 times. The results for the 139 sites are; 62% excellent, 24% good, 9% good-fair, and 5 % fair. Only one site was rated as poor. In addition to these permanent macroinvertebrate sites, there are more than 80 sites across the forest that have been sampled for air and water quality assessment for multiple years. The macroinvertebrate samples taken at these sites, along with the water chemistry samples have not been compiled in a final report as yet and may be added to the MIS file upon completion of the analysis. Mussel surveys have been completed by the NC Wildlife Resource Commission (NCWRC), Non-Game Division and the US Forest Service. The mussel surveys are completed by river basin or where a known sensitive or T&E mussel species has been recorded. The reports of these surveys for the past 3 years are on file.

Herbaceous Understory Plants – About 1915 North Carolina vegetative inventory plots have been established over the past 20 years utilizing a sampling methodology and coverclass system devised by the North Carolina Vegetation Survey. In September 1994 a community classification was completed using the plots recorded (Ulrey 1999), a copy of this final report is on file. These plots are representative of both open and forested conditions across the forest and define the herbaceous plant component representative of each community.

Exotic Invasive Plants - There are 14 species of non-native invasive recorded on the Nantahala & Pisgah National Forests. Vegetative plots, established across the forest, document the presence of 11 species of these plants within plots. The highest occurrence is shown to be *Microstegium vimineum* (35 or 1.8% of the plots) and *Lonicera Japonica* (26 or 1.4% of the plots). Both of these species have been recorded in North Carolina at least 10 years prior to any other non-native invasive species. While very little is known about their biology yet, they are found on highly disturbed bottomland sites, such as pastures and old home sites.

Rich Cove Plants - There are 226 North Carolina vegetative inventory plots representing this community classification. The top three indicator species have the highest constancy levels indicative of rich cove sites; *Arisaema triphyllum*, *Caulophyllum thalictroides*, and *Cimicifuga racemosa*. Composition of the total species found on these plots were 13% trees, 10% shrubs, 74% herbaceous plants, and 4% vines.

Salamanders - In 1991 and 1992, a network of permanent biodiversity monitoring points were established in the Craggy Mountains (Appalachian Ranger District) and the Steeles Creek Watershed (Grandfather Ranger District), Pisgah National Forest. As part of a much larger comprehensive monitoring effort, salamander inventories were conducted at all points. A representative sample were reinventoried in the summer of 1999. Points will be monitored and reinventoried on a three year cycle to provide a database from which to monitor long-term

changes in salamander diversity and abundance.

Breeding Birds - In the late 1980's, concern started to surface over evidence of long-term population declines of many neotropical migratory birds (NTMB). The evidence of these declines came primarily from the analysis of data collected from the USFWS Breeding Bird Survey (BBS) routes between 1966 and 1987. Two primary factors have been advanced to explain these population declines: (1) loss of breeding habitat due to habitat fragmentation and habitat loss from changes in the land-use in the US and Canada; and, (2) loss of wintering habitat in Latin America and the Caribbean. The conservation of NTMB's temperate birds and resident birds that will support populations at desired levels for the long-term that are stable, healthy, and sustainable. An important part of the overall regional strategy is a landbird monitoring program. The Southern Region developed a regional landbird monitoring program in 1996 that will allow Southern National Forests to assess and track the status of forest breeding bird populations and their habitats at different hierarchical levels over time.

In 1996, a network of permanent landbird monitoring points was established across all ranger districts on the Nantahala and Pisgah National Forests. Points were selected and established to represent all major forest types and successional conditions. Permanent monitoring points are run each year, with 1999 representing the third year of monitoring. Point-counts are run as outlined by P. Hamel et al "A Land Manager's Guide to Point Counts of Birds in the Southeast". Bird point-count data is currently being reviewed, and will be entered into a regional database for analysis. Population trend information is also derived from USFWS Breeding Bird Survey data. Several BBS routes are located on national forest lands and run by Forest Service personnel. Additional BBS routes may be added in the future in order to provide additional coverage of under represented habitat types.

d. Determine if the habitat for the Management Indicator Species is being maintained and improved to the degree consistent with the objectives established in the Forest Plan.

The Final Supplement to the Final Environmental Impact Statement (FEIS), Volume I for the Nantahala and Pisgah National Forests was completed and published February 1994. Several plant communities were to receive special attention (FEIS, III-48 and Land & Resource Management Plan (LRMP), Amendment 5, Appendix D, page 7). The habitats were identified and abundance estimated using the Continuous Inventory of Stand Conditions (CISC) and it will also be utilized for 1999 comparison. The Southern Appalachian vegetation dataset includes 1915 plots, and were measured using the North Carolina vegetative protocol. These data were recently used to classify vegetative communities (Ulrey 1999) and can now be utilized to identify the initial FEIS communities which were defined entirely by forest overstory communities. The permanently established points included herbaceous understory plants in the FEIS and were further defined in the LRMP, Amendment 5, (D-7) as the tool to be used to monitor rich cove and exotic invasive plants. The North Carolina vegetative inventory plot classification utilizes all strata of vegetation, including herbaceous plants, which will now provide a more precise habitat for rich coves and exotic invasive.

| Special Habitats | 1993 data | 1999 data | Change |
|-----------------------|---------------|------------|-------------|
| Cove Forest | 305,700 ac | 303,561 ac | - 2,139 |
| Xeric Yellow Pine | 27,800 ac | 30,095 ac | 1/+ 2,295 |
| Red Spruce/Fraser Fir | 8,500 ac | 8,579 ac | +79 |
| Grassy & Heath Balds | *3,900 ac | *3,900 ac | |
| Bogs | uninventoried | 2/ 32 | inventoried |

| Estimated Habitat | 1993 data | 1999 data | |
|---------------------------|-----------|-------------|---------|
| Change | | | |
| Yellow Pine | 39,300 ac | 38,605 ac | 695 |
| Grass/Forb | *2,500 ac | 3/ 2,392 ac | - 108 |
| Early Successional (0-10) | 56,800 ac | 24,900 ac | -31,900 |

*approximate acreage

1/ - Error in 1993 figures, did not include Table Mountain Pine

2/ - identified by soil type, 20 not yet field checked

3/ - Acreage as recorded by the North Carolina Wildlife Commission

Cove Forest - FEIS characterized by yellow poplar, basswood, sugar maple, birch, beech, black cherry and magnolia. The community is dominated by a diversity of trees associated with moist and rich sites with a diverse herb layer and a higher diversity in all strata. In the 1994 FEIS these forest inventory Continuous Inventory of Stand Conditions (CISC) codes were used to identify acreage across the forest; 08 - Hemlock/hardwood, 41 - Cove hardwoods/White Pine/Hemlock, 46 - Bottomland hardwood/Yellow pine, 50 - Yellow Poplar, 55 - Northern Red Oak, 56 - Yellow Poplar/White Oak/Red Oak. In 1996 the Forest Service exchanged land in what was called the Alarka land exchange which included approximately 1888 ac of Forest Service land in the vicinity of Fontana Lake. Most of this acreage was a cove forest-type classification and has been removed from CISC inventory, which shows a decrease in acreage since 1993. The land acquired in this exchange has not been inventoried for the CISC database.

Xeric Yellow Pine - This community was identified in 1994 as CISC types; 15 - Pitch pine/oak, 20 - Table Mountain pine/hardwood, 38 - Pitch Pine, 39 - Table Mountain Pine. This habitat quality is dependent on historical fire occurrence and prescribed burning. Burning has been done over the past several years to maintain this habitat type and sensitive species plant populations associated with it. The plant communities have been inventoried pre and post burns to monitor both the effectiveness and seasonal response of burning. Prescribe fire cannot be used as a tool in all of the Xeric Yellow Pine communities due to remote locations and accessibility. A study was completed in 1997 by Welch on the "Response of southern Appalachian Table Mountain Pine, *Pinus pungens*, and Pitch Pine, *P. rigida* stands to prescribed burning". One of the sites for study the response in table mountain pine was the Grandfather Ranger District on the Pisgah National Forest. The study found that this community type, in the absence of fire, was dominated by hardwood species. Prescribed burning did not return the community to pine as the burning was not hot enough to expose mineral soils for pine regeneration or reduce the deciduous canopy closure enough to allow for seedling growth. Frequent prescribed burning needs to be studied to verify whether canopy closure can be reduced over the long term to re-establish table mountain pine dominance. As the unburned stands age or are damaged from wind, insects, or disease, they are changing to sparse yellow pine with an understory of *Acer rubrum*, *Quercus coccinea*, and *Quercus montana*. This community does not appear to be as susceptible to Southern Pine Beetle as Yellow pine forests, but, evidence can be found where SPB activity occurred in this community. There are 159 vegetative plots in this community and of the total species identified on these plots, the community was composed of 21% trees, 19% shrub, and 57% herbaceous species. The 1993 inventory inadvertently left out Table Mountain Pine, a difference of 2,100 acres.

Red Spruce/Fraser Fir - This community was identified in 1993 as CISC types; 06 - Fraser Fir, and 07 - Red Spruce/Fraser Fir. Forest type 17, Red Spruce - Northern Hardwoods was added to the 1994 inventory as it is habitat for the indicator species listed in the LRMP. This community is home to the Carolina northern flying squirrel where it is found at the ecotone between the conifer and northern hardwoods, reports on this species monitoring efforts is included in the MIS file. The nest box surveys and efforts have increased with the creation of the northern flying squirrel habitat model which has proven to be reliable in defining where the squirrel exists across the forest. Fraser Fir and Red Spruce are two of the species that slowly take over a grassy bald if efforts are not done to maintain the bald in a grassy state. There are 83 North Carolina vegetative inventory plots established in this forest community and 15 additional plots were established in successional Red Spruce/Fraser Fir communities to monitor the effects of succession.

Grassy & Heath Balds - There have been 15 North Carolina vegetative inventory plots established on grassy balds and 43 on heath/shrub balds. In addition, 824 monitoring plots were established on the Roan Mountain bald complex to monitor the effects of various methods of maintenance used to maintain the grassy bald community. The analysis and summaries of this monitoring effort include herbicide, mowing, prescribed fire, and grazing, maintenance treatments and can be found in the MIS file. One exotic invasive plant species, *Rumex acetosella*, is present in the community but, as yet, not a dominant component. The bald acreage inventory is in the process of completion. The Southern Appalachian Highlands Conservancy and the Nature Conservancy are studying the balds and hope to begin inventory proposals in the near future.

Bogs - Periodic surveys are conducted by Dennis Herman, NC State Museum, to monitor bog turtle populations and habitat conditions. Survey results are reported by the Non-Game Division, NC Wildlife Resource Commission. The presence/absence of bog turtles and soil information can be good indicators of potential bog sites. Utilizing these key soil association types, an additional 32 sites have been identified as potentially suitable bog turtle habitat. Field checks of the 32 sites were started in 1999. Currently, 7 of the potential sites are not bogs..

Southern Appalachian wetlands, which includes bog habitat, are being lost each year on private lands in western North Carolina. Potential bog turtle habitat can be modified or lost due to changes in hydrologic conditions, invasion of undesirable plants, livestock grazing, natural plant succession, and habitat conversion. The Forest has been surveying known bog sites across the two forests to determine condition and restoration/management needs. In 1992, slashing of encroaching woody vegetation improved habitat for bog turtles and a rare plant (*Platanthera flava var. hericola*). In 1999, a prescribed burn was attempted to further reduce woody stem competition with little success. Subsequent attempts to utilize fire as a tool to reduce competing woody stems will be made in 2000.

Estimated Habitat

The FEIS, Volume I, page III-40 describes how other management indicator species (MIS) may be used at a local level in association with biological communities or structural component to evaluate projects. The FEIS, Volume II, Appendix L, page 9, lists those MIS selected and the community or structural component where they may be used to analysis affects on a project level basis. The FEIS lists many communities across the forest, however, only the following three communities are to be tracked using the forest inventory database (Vol I, page 48).

Yellow Pine Forest - FEIS characterized by shortleaf, pitch, table mountain, Virginia pine and pine/oak heath areas. However, when the community was further defined in acreage and associated management indicator species, the community was listed as shortleaf/Virginia pine. Table Mountain pine and Pitch pine were inventoried as Xeric yellow pine which is identified as a special habitat (FEIS, III-48).

The CISC forest type included in the yellow pine inventory, both in 1994 and 1999, are; 32 - Shortleaf pine, 33 - Virginia pine, 12 - Shortleaf pine/oak, 16 - Virginia pine/oak. This habitat has been affected by Southern Pine Beetle an in 1988 - 1990 beetle activity resulted in mortality on 1,494 acres of yellow pine. During the fall of 1998, Southern Pine Beetle activity appeared to be on the increase and may amount in approximately the same acreage impacts as ten years ago. The affected stands do not always regenerate into yellow pine forests without the aid of prescribed burning to expose a seed bed of mineral soil. Many of the affected stands are on steep slopes and inaccessible therefore, burning has not been an option. The affected stands regenerate in a sparse condition of yellow pine with a dense understory of rhododendron and mountain laurel. Pine Warbler is one of the management indicator species (MIS) that district biologist may use for site specific analysis to demonstrate affects of manipulating this habitat (FEIS, Vol I, page III-49).

Grass/Forb - The Forest is in the process of putting this habitat on a separate GIS coverage and each district is collecting GPS data on its maintained grass/forb habitat. Until this process is complete we are relying on the habitat records and acreages from the NC Wildlife Resource Commission (NCWRC), who are instrumental in maintaining the openings across the Forest. Eastern Wild Turkey rely on this habitat type for summer brood range that provides bugging areas for their young. Eastern Meadowlark and rabbits can also be used as MIS by the district biologists in analyzing the affects of modifying or creating this habitat component on project level analysis (FEIS, Vol. I, pg III-51).

Early Successional (0-10) - As the figures indicate, this habitat has been reduced by approximately 60% since the 1994 inventory. Populations of animal species who require early successional habitat for part of their lifecycle are expected to be surviving under stress as demonstrated by the NCWRC white-tailed deer population trend.

e. Monitor the population trends of the Management Indicator Species, and their relationships to habitat changes | Habitat and population status data will be collected at the forest level for the following species; black bear, white-tailed deer, eastern wild turkey, and trout in conjunction with the North Carolina Wildlife Resource commission (NCWRC) as stated in the Nantahala and Pisgah National Forests FEIS, III-48 and Land Resource Management Plan (LRMP), Amendment 5, Appendix D, page 7).

Black Bear: | The three most recent North Carolina Wildlife Resource Commission (NCWRC) annual reports on the status of black bear in North Carolina are in the MIS file. These reports compile surveys of hard mast, soft mast, and bait stations and the harvest data sets include both harvest and mortality by county. The 1999 population trend report as filed by the NCWRC Black Bear Project Leader, Mark. D. Jones states that black bear populations are currently stable or increasing in North Carolina. National Forest lands provide the majority of occupied black bear habitat in the Mountains and the populations and habitat have increased since the 1970's.

White-tailed Deer: | Deer population trend information is derived through a compilation of annually reported legal harvest, non-harvest mortality, and other biological data collected by the NCWRC. An analysis of data, assessment of population trends, and summary reports are provided annually by the NCWRC. The 1999 report indicates that white-tailed deer populations have been relatively stable in the central and southern mountains. Deer numbers have been increasing on private lands while there has been an apparent population decline on national forest lands. The decline in early successional habitat on national forest lands has been implicated as a possible contributing factor to the decline in deer numbers.

Trout: | A summary of the NCWRC - Fisheries Division report is in the Forest MIS files. The chart found on page 20 of this summary shows the populations and trends of Brook Trout, Brown Trout, Rainbow Trout, and Blacknose Dace, in mountain streams from 1988 through 1998. There was an apparent drop in all populations between 1996 and 1997 however, fish communities exhibit cyclic patterns and are affected by catastrophic events, such as prolonged drought.

Eastern Wild Turkey: | Population trend information is derived through a compilation of various population and harvest survey datasets, which includes reported legal spring harvest, annual summer turkey brood surveys, and observation information. A summary and analysis of this data for 1996 through 1999 is provided by the NCWRC. A vigorous restoration effort over the last ten years has restored the eastern wild turkey to all suitable habitat on national forest lands. Turkey populations are currently on an upward trend statewide, with the greatest population increases occurring in the western part of the state.

Non-game Wildlife Species Status | The FEIS for the Nantahala and Pisgah National Forests states that the following species will be monitored; northern flying squirrel, cave-dwelling bats, and peregrine falcons (Vol I, page III-48). Monitoring for these species is a collaborative effort among federal and state agencies.

Carolina Northern Flying Squirrel: | The northern flying squirrel, *Glaucomys sabrinus*, has a wide and largely continuous distribution in North America. The two subspecies of the central and southern Appalachians, *G. sabrinus fuscus* and *G. sabrinus coloratu*, respectively, are separated from this main

population and occupy increasingly disjunct islands of suitable habitat as it approaches the southern limits of the species range. Because of their perceived rarity and potential vulnerability, the U.S. Fish and Wildlife Service listed both subspecies as endangered in 1985 and initiated the development of a formal recovery plan and a series of field surveys in the southern Appalachian region.

A study of the squirrel population at Roan Mountain began in 1986. The study continued through 1991 and resulted in documenting an estimated population of 15-35 animals. Many characteristics of the species, including; population ecology, food habits, climatic factors, and squirrel movement and home range. The final report of the study was compiled by Dr. Peter D. Weigel, Wake Forest University.

Dr. Weigel initiated a second study in September 1994 to analyze the effect of roads on northern flying squirrel population movements in the Unicoi Mountains. Survey work, telemetry and various types of analyses were carried out at ten sites near the Cherohala Skyway. The initial findings of this study indicate that it appears the roadway supports small, highly discontinuous populations of the endangered flying squirrel and that the roadway, Cherohala Skyway, is acting as a barrier to these mammals.

Since 1995, the NCWRC, Non-Game Division, has carried out field surveys whose primary objective was to test the accuracy of a model developed for predicting northern flying squirrel habitat. The community classification model (Odom, 1995) predicted plant community types, as defined by Schafale and Weakley (1990), within the study area based on topographic features. The overall intent of this project was to determine if this model of predicted communities could also be used to delineate occupied northern flying squirrel habitat. The final year of checking the nest boxes is 1999, so analysis of the data and a final report are not yet available. Previous years results indicate an increase in both numbers of squirrel captures and number of nest box occupancy using the model.

In 1999, efforts to expand the surveys of predicted suitable habitat have been made. Nest boxes are being established in predicted communities on the Craggy Mountains and Highlands Ranger District by the Forest Service and NCWRC and will be monitored beginning in January 2000.

Peregrine Falcon

North Carolina Wildlife Resource Commission, Non-Game Division, began a restoration project with its primary emphasis on locating and protecting nest sites and assessing annual reproduction in 1991. The Forest Service and volunteers, work with NCWRC each year in the monitoring efforts. The chart below illustrates the results of this effort through 1998. The 1999 summary report is not yet available but the preliminary report was 9 pairs were present at monitored sites that resulted in 3 pair producing 8 young. There were historically (pre-1964), 10 sites in North Carolina and we are very close to maintaining these numbers of pairs. However, the reproductive rate is very low and studies continue to try and determine the cause. In 1999, the Peregrine Falcon was downlisted from endangered by the US Fish & Wildlife Service. However, the species is still listed by the state of North Carolina as endangered and the US Forest Service as sensitive which allows for nest site protection to continue.

Beth Bockoven, a graduate student at Western Carolina University completed research in conjunction with NCWRC on various aspects of peregrine falcons in the southern Appalachians, including studies in North Carolina. Her final report is expected to be available in 1999 but preliminary analysis are as follows; studies of the egg shells to determine if their thickness was influenced by chemical use were negative; prey remains gathered at nest sites did not indicate a cause for low reproductive rates; GIS studies, using 17 habitat variables, comparing the 54 historic sites in NC, SC, TN, WV, VA, AL, and GA versus present day sites do not provide a correlation or explanation but are highly variable.

Cave-Dwelling Bats

In 1990, the US Fish and Wildlife Service collected all the records of caves with bats in Western North Carolina resulting in survey contract in conjunction with NCWRC for many of the caves. Surveys of caves on national forest lands, known to be used by hibernating bats, are conducted every two-three years as a cooperative effort with US Fish & Wildlife Service and NCWRC. Population trend information is somewhat erratic and inconclusive.

Literature cited

Odom, Richard H., Jr. 1995 Application of an ecological landscape classification procedure to identify Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*) habitat in the Great Balsam Mountains of Western North Carolina. NC Small Grants Project #94SG09. North Carolina Wildlife Resources Commission. Raleigh, North Carolina. 24pp.

Schafale, Micheal P. and Alan S. Weakey. 1990 Classification of the natural communities of North Carolina: Third approximation. North Carolina Natural Heritage Program. Raleigh, NC. 325 pp.

f. Determine the progress toward recovery objectives for T&E species and conservation objectives for sensitive species.

There are 31 threatened or endangered species that occur or may occur on the NFsNC. About one-third of these have at least one documented occurrence on the NFsNC. All but one of these species have approved or draft recovery plans developed by the USDI Fish and Wildlife Service. Recovery objectives for those species that occur in the mountains are listed in Amendment 5 of the Nantahala/Pisgah LRMP. Recovery objectives for species that occur in the Piedmont and Coastal Plain are listed in the individual recovery plans. Although recovery objectives vary by the individual species needs, the overall tasks include: (1) protection of known habitats that support T&E species, (2) inventory and documentation of species occurrence, (3) restoration of suitable habitat, (4) coordination with USDI Fish and Wildlife Service (FWS) in determining specific habitat needs, and (5) providing support to universities or other specialists in completing status surveys.

There are nearly 400 sensitive species that occur or may occur on the NFsNC. Over one-half

of these have at least one documented occurrence on the NFsNC. The Biological Evaluation (BE) for the Nantahala/Pisgah LRMP identifies a conservation strategy for these species. The Croatan/Uwharrie Plan was completed before the service-wide emphasis on biological evaluations and currently follows the NP plan direction on sensitive species conservation. The Croatan/Uwharrie plan does direct protection for 15 sensitive species and management objectives to prevent species decline "such that federal listing is necessary". For the NFsNC, sensitive species conservation includes: (1) documenting occurrences of sensitive species that could be affected by activities implemented by the Plan, (2) continuing ongoing inventories with the NC Natural Heritage Program, (3) integration of data bases with The Nature Conservancy's Biological and Conservation Data (BCD) system, (4) coordination with adjacent national forests, national parks, State agencies, and private landowners to develop conservation strategies, (5) ensuring that all NFsNC proposed projects have a completed Biological Evaluation, (6) mitigate all potential adverse effects to ensure that no decision would result in loss of species viability or create significant trends toward Federal listing.

So how have we done? For the past 8 years, one of the primary goals of the T&E, Wildlife, and Fisheries programs has been completing BEs and developing measures to reduce potential impacts to sensitive species. During this period, more than 100 BEs per year have been completed. For 3 years, all BEs were reviewed in the supervisors office to ensure completeness, consistency in viability analysis, and to tract forest-wide impacts to sensitive species. After this period of monitoring compliance with the LRMP conservation strategy for sensitive species, BE's were no longer reviewed by the SO unless a direct impact to a species was being proposed or when there was a concern for species viability. During the past 8 years, we have documented over 500 new occurrences of rare species on the NFsNC, protected numerous sensitive species populations through avoidance or a change in the type of project activity, and have learned a great deal about the habitat requirements for rare plant species. We now have a data base of rare species occurrences that is tied to GIS that provides the basis for monitoring population trends in the future.

Budget constraints have limited progress toward fully meeting recovery objectives for all T&E species as well as monitoring species population size, health, and vigor. We emphasize monitoring, and recovery and conservation efforts only for those T&E species at the greatest risk of direct impact or habitat loss. Nevertheless, much progress has been made in restoring T&E species habitat, reintroduction of T&E plants to suitable unoccupied sites, protecting sensitive habitats, and completing status surveys.

Population monitoring intensity is also dependent upon budgets and the risks to species. The NFsNC have the only red-cockaded woodpecker population on National Forest lands in the Southeast that is 100% banded. For the past 9 years, this has allowed us to monitor population growth, hatchling survival, dispersal events, and to determine important demographics of this species and potential effects of management activities. With the implementation of a new management strategy in 1991, the population has increased 53% in size. Similarly, for the past 8 years, intensive monitoring of Mountain Golden Heather populations that includes tracking individual plants has allowed us to determine population trends (they are upward) and response of habitat restoration efforts. Other T&E species with ongoing monitoring efforts include: Swamp Pink, Heller's Blazing Star, Schweinitz's Sunflower, Spottfin Chub, Northern Flying Squirrel, and Rock Gnome Lichen.

Table 1-6 summarizes the major progress toward meeting recovery objectives for T&E species on the NFsNC and some general findings of monitoring and habitat improvement work.

TABLE 1-6.

| Scientific Name | On NFsNC? | Common Name | Progress toward Recovery Objectives |
|--|-----------|-------------------------|-------------------------------------|
| <i>Aeschynomene virginica</i> | no | Sensitive Jointvetch | none |
| <i>Alasmidonta heterodon</i> | no | Dwarf Wedge Mussel | none |
| <i>Alasmidonta raveneliana</i> | no | Appalachian Elktoe | coor. with FWS,TVA monitoring |
| <i>Canis rufus</i> | no | Red Wolf | none |
| <i>Cyprinella monacha</i> | yes | Spotfin Chub | coor. with FWS, TVA monitoring |
| <i>Echinacea laevigata</i> | no | Smooth Coneflower | none |
| <i>Falco peregrinus</i> | yes | Am. Peregrine Falcon | yearly monitoring, 1/ |
| <i>Felis concolor cougaur</i> | future | Eastern Cougar | none |
| <i>Geum radiatum</i> | yes | Spreading Avens | protection, reintroduced 1997 2/ |
| <i>Glaucomys sabrinus coloratus</i> | yes | Car. N. Flying Squirrel | habitat monitoring, surveys 3/ |
| <i>Gymnoderma lineare</i> | yes | Rock Gnome Lichen | 2 years monitoring of all sites 4/ |
| <i>Haliaeetus leucocephalus</i> | yes | Bald Eagle | monitoring Uwharrie lakes 5/ |
| <i>Helianthus schweinitzii</i> | yes | Schweinitz s Sunflower | site restoration 6/ |
| <i>Helonias bullata</i> | yes | Swamp Pink | monitoring 3 subpopulations 7/ |
| <i>Hexastylis naniflora</i> | no | Dwarf-flw Heartleaf | none |
| <i>Houstonia montana</i> | yes | Mountain Bluet | site protection |
| <i>Hudsonia montana</i> | yes | Mt. Golden-Heather | 7 yrs. habitat restore., monitor 8/ |
| <i>Isotria medeoloides</i> | yes | Small Whorled Pogonia | site protection |
| <i>Liatris helleri</i> | yes | Heller's Blazing Star | protection,reintroduce 1994 9/ |
| <i>Lysimachia asperulifolia</i> | yes | Rough-leaf Loosestrife | habitat restoration 10/ |
| <i>Mesodon clarki nantahala</i> | yes | Noonday Globe | site protection |
| <i>Microhexura montivaga</i> | yes | Spruce-fir Moss Spider | inventoried Roan Mt. 1998 11/ |
| <i>Myotis sodalis</i> | no | Indiana Bat | surveying suitable habitat 1999 |
| <i>Pegias fabula</i> | yes | Ltl-wing Pearly Mussel | coor.with FWS,TVA monitoring |
| <i>Picoides borealis</i> | yes | R-cockaded Woodpecker | habitat restoration, monitor 12/ |
| <i>Plecotus townsendii virginianus</i> | yes | Virginia Big-eared Bat | site protection |
| <i>Sagittaria fasciculata</i> | no | Bunched arrowhead | suitable habitat protection |
| <i>Sarracenia oreophila</i> | no | Green Pitcher Plant | suitable habitat protection |
| <i>Sisyrinchium dichotomum</i> | no | White Irisette | none |
| <i>Solidago spithamaea</i> | yes | Blueridge Goldenrod | site protection |
| <i>Spiraea virginiana</i> | yes | Virginia Spiraea | inventory 1998 13/ |

1/ one new eyrie in 1998 pigeon river gorge, one new eyrie in 1999 @ victory wall on Pisgah, 2/ several hundred plants reintroduced at Roan Mountain, 3/ occurs in habitats thought to be unsuitable, population larger than earlier estimates, 4/ small populations, some in poor condition and apparently declining but too early to tell, 5/ no nesting on NFsNC, only winter use, 6/ no natural seeding in of species from adjacent occupied site, 7/ largest population known (globally) is stable, apparent decline in 1 of 2 other populations at pink beds, 8/ population is stable to increasing at 3 sites, trampling still occurring at Table Rock, 9/ 100's of plants reintroduced at Table Rock, 10/ condition of habitat in ecotones improving, many others need prescribed burning, 11/ more common than thought, habitat preference is moss on rocks, 12/ increasing population although expansion into new territories is slow, 13/ no new plants found

Supplemental Information on the Fisheries Resources of the Nantahala and Pisgah National Forests

INTRODUCTION

The National Forest Management Act (NFMA) lists monitoring and evaluation requirements for biological resources pertaining to topics such as ecosystem condition, health and sustainability, with particular attention to biological diversity. Specific reporting requirements of the NFMA include the following for biological resources (with reference to fisheries resources), which will be addressed in this document:

1. Determination if the desired diversity of animal communities is being achieved (36 CFR 219.26, 219.27(a)(5)&(g)),
2. Determination if the habitat for aquatic Management Indicator Species (MIS) is being Maintained and improved to the degree consistent with objectives established in the Forest Plan (LRMP) (36 CFR 219.27 (a)(6)),
3. Monitoring population trends of aquatic MIS and their relationships to habitat changes (36 CFR 219.19(a)(6)), and
4. Determine progress towards recovery objectives for aquatic threatened and endangered (T&E) species and towards conservation objectives for aquatic sensitive (S) species (36 CFR 219.19(a)(7)).

AQUATIC RESOURCE DESCRIPTION

The Nantahala and Pisgah National Forests (hereafter, the Forests) encompass approximately 1.2 million acres in 17 counties of western North Carolina. Fisheries resources within this area are diverse, ranging from small headwater streams to large rivers and reservoirs. This diversity in aquatic resource types found on the Forests, by its very nature, supports a high diversity of aquatic species.

Table 1-7 summarizes conservative estimates of the amount and type of fisheries resources on the Nantahala and Pisgah National Forests.

Table 1-7. Aquatic resource estimates for the Nantahala and Pisgah National Forests.

| Resource Type | Amount |
|---------------------------------------|---------------|
| Mountain streams | 3,500 miles |
| Mountain lakes, ponds, and reservoirs | 25,000 acres |
| Large streams and rivers | 250 miles |

AQUATIC SPECIES DIVERSITY ON THE NANTAHALA AND PISGAH NATIONAL FORESTS

Species diversity is a measure of both species richness (number of species) and relative abundance and can be calculated using any of a number of acceptable diversity indices. The Forests maintain an extensive data library for aquatic species which contains data of all types (e.g. qualitative, quantitative, etc.) that has been and is collected for various reasons and objectives. Because of the diversity of collection methods used to obtain this information and reasons for collecting the information, it is near impossible to calculate overall aquatic species diversity on the Forests. Rather, this report will focus on species richness, with an emphasis on what the Forests do to manage rare and indicator aquatic species.

Freshwater Fish

There are 131 freshwater fish species known to occur on or adjacent to the Forests, of which 30 (23%) receive protection under State, Federal, or Forest Service laws or regulations. It is thought that this species richness is strongly related to the diversity of aquatic habitat types on the Forests and is among the highest on public lands in the United States.

Fish species distribution has been documented from approximately 80% of the streams, rivers, lakes, ponds, and reservoirs on the Forests. These surveys are conducted by all resource agencies having jurisdiction or management responsibility in western North Carolina and are summarized in Table 1-8. This document is a synthesis of information collected by these agencies and organizations.

Table 1-8. Resource agencies involved in collecting and sharing data from aquatic resources on the Nantahala and Pisgah National Forests.

| Agency Name | Type |
|--|----------------|
| U.S. Forest Service | Federal |
| U.S. Fish and Wildlife Service | Federal |
| National Park Service | Federal |
| Tennessee Valley Authority | Federal |
| N.C. Wildlife Resources Commission, Inland Fisheries | State |
| N.C. Wildlife Resources Commission, Nongame | State |
| N.C. Division of Environmental Management, Bioassessment | State |
| Power Companies: Duke, CP&L, NP&L, etc. | Private |
| Various universities and research organizations | Public/Private |

Surveys of fish populations in resources where no recent data existed occurred during FY98 across the Forests. Similar inventories will be conducted each year to strengthen knowledge of aquatic resources Forest-wide.

The agencies and groups listed in Table 1-8 share information freely, and during FY98, the Forest Service began compiling a comprehensive data storage facility that includes all available data (including historic records) from these cooperators and that will allow the integrated use of GIS technology. Draft versions of this database are already being used by resource agencies and a final version will be complete by late FY99 or early FY00.

Freshwater Mussels

There are 21 freshwater mussel species known to occur on or adjacent to the Forests, of which 17 species (81%) receive protection under State, Federal, or Forest Service laws or regulations. It is recognized that this group of species is among the most imperiled in the world, with over 50% of the approximately 300 species known to occur or to have occurred in the United States being listed as threatened, endangered, generally rare, or extinct.

Mussel populations across the Forests are generally restricted to larger river systems such as the Hiwassee River, Little Tennessee River, Nolichucky River, and Catawba River. However, recent mussel surveys of smaller rivers such as the Tuckasegee River, upper Johns River, and larger tributaries to these systems have expanded our knowledge of the range of freshwater mussels in western North Carolina.

The Forest Service actively participates in the monitoring of threatened, endangered, and sensitive freshwater mussel communities with the United States Fish and Wildlife Service and North Carolina Wildlife Resources Commission Nongame Division to ensure their continued and successful (i.e. reproducing) existence on federal lands.

During FY98, Forest Service mussel surveys expanded the known distribution of mussels within the Johns River basin upstream approximately 5 miles to include Forest Service property. Forest Service mussel distribution surveys will continue in the Johns River basin in FY99 and will include Mulberry Creek and more of the upper Johns River. FY98 mussel surveys also expanded the known distribution of mussels in the Tuckasegee River approximately 7 miles to include Forest Service property. Forest Service mussel distribution surveys within the Nolichucky basin will also continue during FY99 and will include public lands in the North and South Toe River watersheds.

Recent surveys done by the TVA located dead shells of several species from the upper French Broad River watershed, but they were unable to locate any live mussels. They could also not determine how long the shells had been in the river, if they originated from the area, or if were brought in by muskrats. During FY98, Forest Service mussel surveys of the upper French Broad River watershed failed to locate any live specimens. The USFWS, NCWRC, and NCDOT also conducted mussel surveys in the upper French Broad River basin during FY98 with similar results. During FY99, these agencies and the Forest Service will continue to look for live mussels in the French Broad River basin.

During FY98, extensive mussel surveys in the Hiwassee River and Little Tennessee River were conducted by the Forest Service, USFWS, NCWRC, and NCDOT. These efforts worked towards refining mussel community composition, distribution, and range in these systems.

Other Aquatic Invertebrates

Until recently, inventories of aquatic insect and crayfish populations on the Forests were sporadic and not aimed towards the objective of defining species and community distribution. Now, aquatic insects are being used to monitor land use effects and establish stream health indices on a more regular basis. To date, approximately 500 aquatic insect samples have been taken across the Forests, and the data from these samples is in various stages of identification and analysis. Until this analysis is complete, accurate estimates of the number of aquatic insect species are not feasible. And even then, any estimates must be considered conservative until all stream types have been adequately sampled. It is anticipated that approximately 100 samples will be collected annually across the Forests to contribute towards project-specific monitoring and species/community distribution mapping. During FY99, data compilation and analysis efforts focused on freshwater fish. It is hoped that this same level of effort can be put towards aquatic insect data collection and analysis during FY00 and FY01.

Aquatic Amphibians

Currently, two amphibian species that spend their entire life cycle in water are known to occur on or adjacent to the Forests. These species are the hellbender (*Cryptobranchus alleganiensis*) and the mudpuppy (*Necturus maculosus*). Distribution of these species is well known on the Forests, and population inventory continues to refine this distribution.

AQUATIC MANAGEMENT INDICATOR SPECIES ON THE NANTAHALA AND PISGAH NATIONAL FORESTS

The LRMP for the Nantahala and Pisgah National Forests identifies six aquatic species and two communities as management indicators. These species were chosen to represent the various habitat types across the Forests and are listed in Table 1-9. At least one of these species occurs in most streams, rivers, lakes, ponds, or reservoirs on the Forests. If none of these species are present, site-specific management indicator species are chosen from the representative aquatic fauna during project analysis.

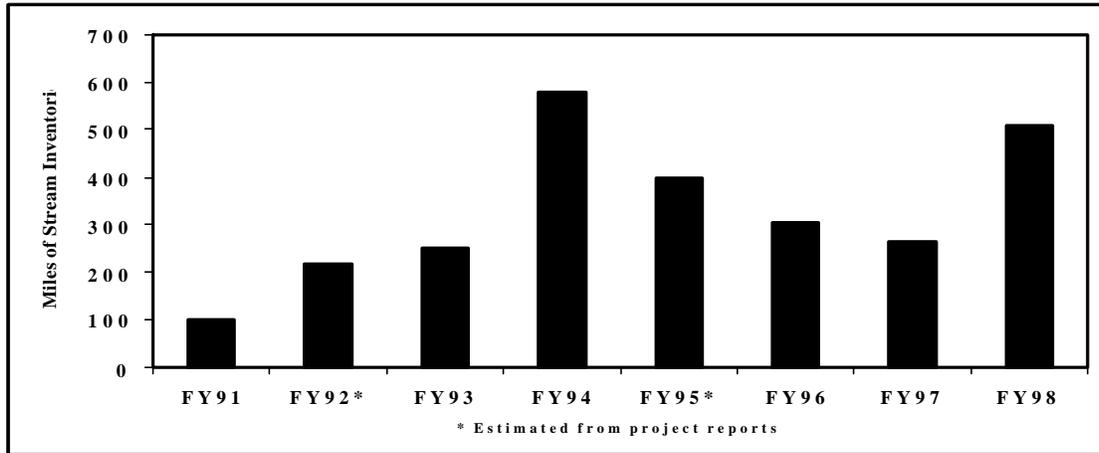
Table 1-9. Aquatic management indicator species for the Nantahala and Pisgah National Forests, as identified in the LRMP.

| SPECIES | Habitat Type(s) Represented |
|----------------------------------|--|
| Blacknose dace | Mountain streams |
| Bluegill | Large rivers, lakes, ponds, reservoirs |
| Brook trout | Mountain streams |
| Brown trout | Mountain streams |
| Freshwater mussels (all species) | Large streams, rivers |
| Largemouth bass | Large rivers, lakes, ponds, reservoirs |
| Rainbow trout | Mountain streams |
| Redhorse suckers (all species) | Large rivers |

Inventory and Monitoring of Aquatic MIS Habitat

Since 1990, project-specific analysis of potential effects of management activities on aquatic resources has been conducted. Figure 1 shows the miles of streams inventoried for MIS habitat during project analysis since 1990. These inventories identify suitable habitat for aquatic MIS within individual project analysis areas. They also allow a visual estimate of the quality of this habitat using key habitat elements such as pool: riffle ratio, presence of large woody debris (LWD), substrate composition and embeddedness employing a modification of the Basin-Wide Visual Estimation Technique (BVET). These surveys have focused on mountain streams since it is the dominant resource type on the Forests and since the LRMP states specific standards for these parameters. During these inventories, stream reaches not meeting habitat objectives stated in the LRMP are noted. Also, cases where proposed management activities have the potential to reduce habitat quality or quantity are noted. Habitat improvement projects are then designed for these stream reaches and incorporated into project implementation. During FY98, habitat improvement was prescribed and implemented on Pit Branch, Curtis Creek, Big Creek, and Searcy Creek on the Pisgah National Forest. Additional habitat improvement needs were identified on Cold Springs Creek and Hurricane Creek, but these projects will be implemented in FY99.

Figure 1-1. Stream miles inventoried using a modified BVET since 1990, as stated in annual WFRP Reports.



Aquatic habitat is monitored on the Forests using the BVET as it was originally designed since it is more quantitative than the modification used for routine inventory. While a fairly extensive database from across the Forests has been collected since 1990 using this technique (quantitative inventory towards the objective of identifying aquatic habitat types on the Forests), it was only recently that this tool was employed to monitor habitat changes as a result of management activities. In FY98, the BVET was used to monitor habitat changes associated with horse trail use on six streams in the Big Ivy area, to monitor the effects of an oil spill (train wreck, not Forest service management) on one stream, and to monitor the effects of grazing on two streams.

During FY98, the BVET was used in extensive inventories of aquatic habitat on approximately 65 miles of stream in two watersheds on the Nantahala and Pisgah National Forests (upper Nantahala River and Steels Creek drainages). This information is being used to develop aquatic community-habitat relationships on the Forests and to facilitate aquatic ecosystem classification.

Also during FY98, the Forest Service and NCWRC inventoried shoreline habitat on Nantahala Lake to assess largemouth bass and bluegill spawning habitat and shoreline cover for these species. This inventory resulted in the implementation of spawning structure improvement and cover addition on approximately 160 acres of shoreline habitat in Nantahala Lake. Similar efforts were conducted on Santeetlah Lake in FY97, and are planned for Fontana Lake and Hiwassee Lake in FY99. These inventories and habitat improvements are on a 3-year rotation. The Forest Service, NCWRC, and TVA using SCUBA surveys are monitoring habitat improvements.

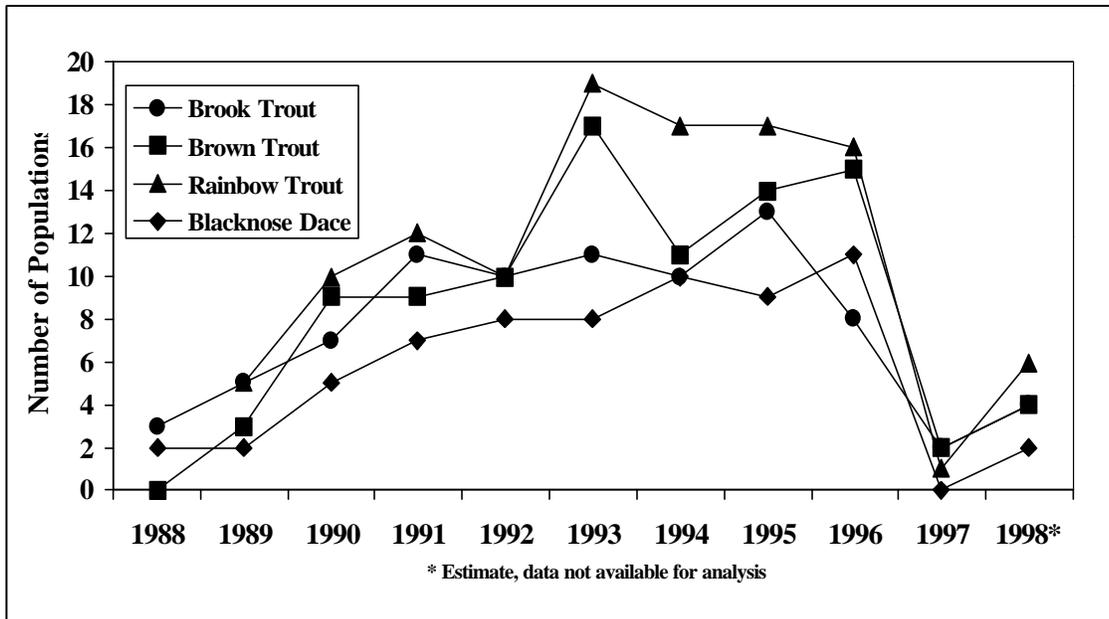
Techniques for inventorying and monitoring habitat in large rivers and small lakes, ponds, and reservoirs are currently being developed for use on the Croatan National Forest. Once established, it is possible that these techniques will be adapted for large river systems on the Nantahala and Pisgah National Forests and that monitoring objectives for these systems will be established.

Inventory and Monitoring Aquatic MIS Populations

Since 1988, fish populations have been monitored quantitatively on 63 streams (150+ sites) across the Forests cooperatively by the Forest Service and NCWRC. An additional 10-15 large streams and rivers are monitored semi-quantitatively across the Forests by the NCDEM and TVA. Of the 63 streams monitored since 1988, 48 (76%) support one or more of the aquatic MIS for mountain streams (brook trout, brown trout, rainbow trout, and blacknose dace). This report will focus on this subset of the overall fish population monitoring effort. Figure 1-2 summarizes the monitoring efforts for aquatic MIS in mountain streams by the Forest Service and NCWRC since 1988.

Figure 1-2 shows a sharp decline in the number of populations monitored in 1997, which coincides with the NCWRC's shift in emphasis to reservoir assessment in the mountain region and with the end of fishing regulation change monitoring. Beginning in 1998, the Forest Service took a more active role in mountain stream population monitoring, which is reflected in the increase in the number of mountain stream populations monitored from 1997. This trend is expected to continue as the Forest Service updates and improves its role in stream monitoring efforts during the NCWRC's management emphasis on reservoirs.

Figure 1-2. Summary of aquatic MIS populations monitored in mountain streams since 1988.



Reservoir Population Monitoring (largemouth bass, bluegill)

Forest Service and NCWRC monitoring data for mountain reservoirs is currently being entered and analyzed, and is not presented here. It is important to note that largemouth bass and bluegill populations within 7 large reservoirs on the Forests have been monitored annually since 1990 by the Forest Service, NCWRC, TVA, and various power companies. These reservoirs include: Bear Creek Lake, Chatuge Lake, Lake Cheoah, Fontana Lake, Hiwassee Lake, Nantahala Lake, and Lake Santeetlah. This data will be summarized and presented in the FY99 NFMA Monitoring Report.

Large Stream and River Population Monitoring (largemouth bass, bluegill, redhorse suckers, freshwater mussels)

Fish population analyses are currently being done on populations of largemouth bass, bluegill, and redhorse suckers found in the large streams and rivers across the Forests (e.g. French Broad River, Little Tennessee River, Hiwassee River, Nolichucky River, and Cheoah River) using TVA and NCDEM monitoring data. Again, this information will be presented in the FY99 NFMA monitoring report.

Please refer to the section titled "Freshwater Mussels" on page 6 for a description of monitoring efforts for freshwater mussels.

Mountain Stream Population Monitoring (brook trout, brown trout, rainbow trout, blacknose dace)

Figures 1- 3 through 1-7 summarize monitoring results for aquatic MIS in mountain streams since 1988.

Figure 1-3. Aquatic MIS (mountain streams) population trends, 1988-present, on the Nantahala and Pisgah National Forests. Results from 1998 surveys are not available from the NCWRC for analysis yet.

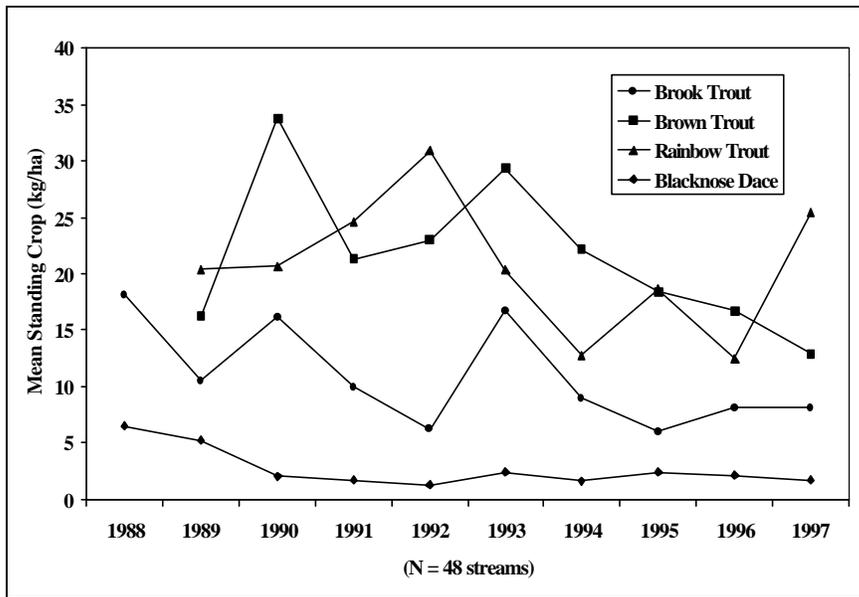
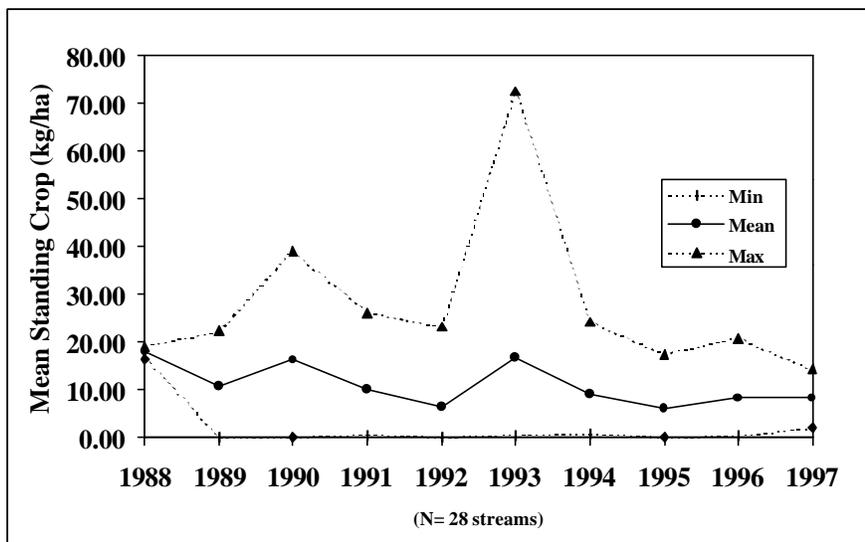


Figure 1-4. Standing crop (kg/ha) of brook trout, 1988-present, from a total of 28 streams across the Nantahala and Pisgah National Forests (not all streams were sampled each year). Results from 1998 surveys are not available from the NCWRC for analysis yet.

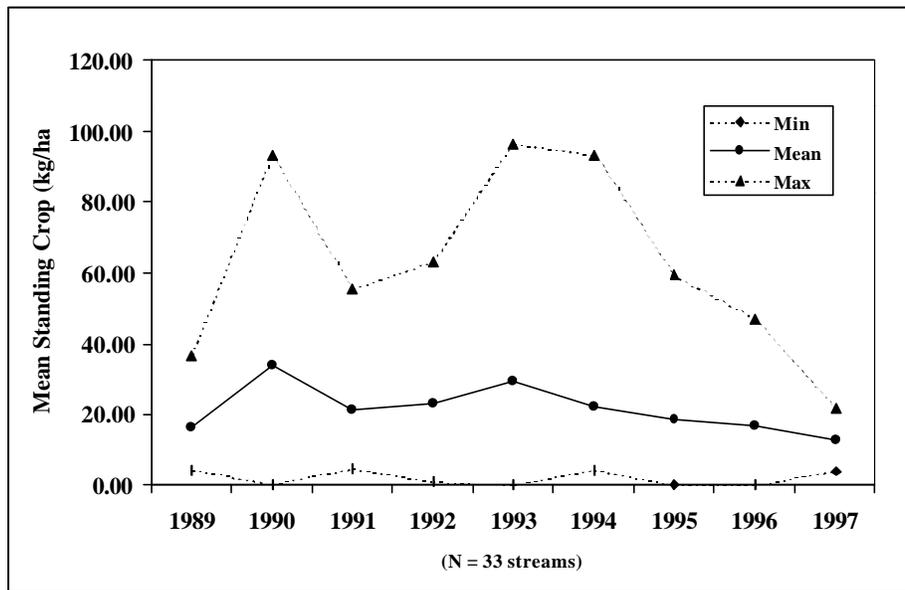


Brook trout mean standing crop has ranged from 5.98 kg/ha to 18.15 kg/ha since 1988, with a mean standing crop over this time period of 10.89 kg/ha. Sixty percent of annual estimates are within one standard deviation of this estimate (e.g. between 6.40 kg/ha and 15.38 kg/ha), indicating that there is not much annual variability in overall

brook trout standing crops over time. There is, however, evidence of high annual variation in the age class structure of brook trout populations across the Forests. This appears to be due mostly to high variation in young-of-the-year standing crops. Further evaluation of this variability will be addressed in the NCWRC trout stream monitoring report.

In 1993, brook trout standing crop estimates ranged from 0.47 kg/ha to 72.60 kg/ha, with a mean of 16.72 kg/ha. This wider than normal range of values is thought to be attributable to the stocking program the NCWRC implements on some area streams, and that large brook trout were stocked that year in larger numbers than usual. It would not take more than a couple of these large fish to skew the annual population estimates. Also, during these years, monitoring efforts were at their peak and there were more streams sampled (see Figure 1-2), which may account for this variability. These issues will be analyzed further by the NCWRC in their trout stream monitoring report.

Figure 1-5. Standing crop (kg/ha) of brown trout, 1989-present, from a total of 33 streams across the Nantahala and Pisgah National Forests (not all streams were sampled each year). Monitoring results from 1998 are not available from the NCWRC for analysis yet.

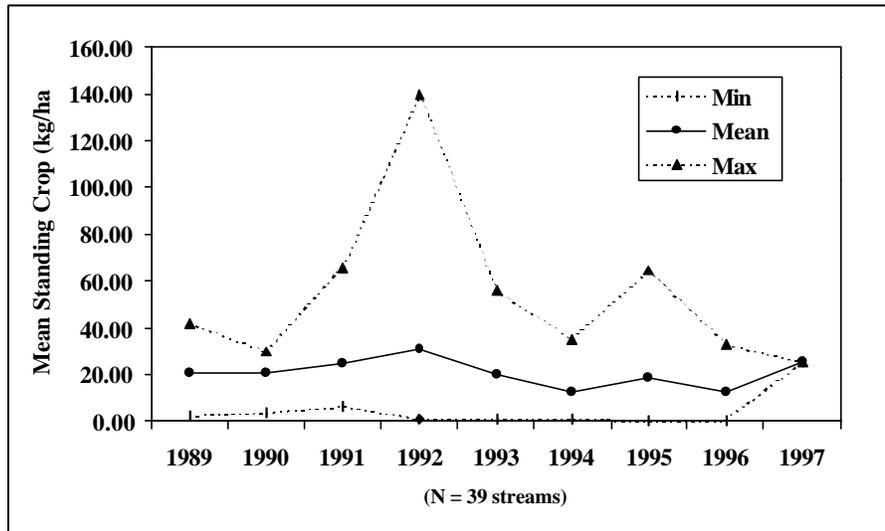


Brown trout mean standing crop has ranged from 12.95 kg/ha to 33.80 kg/ha since 1989, with the mean standing crop over this time period of 21.57 kg/ha. Sixty-seven percent of the annual estimates are within one standard deviation of this estimate (e.g. between 14.98 kg/ha and 28.16 kg/ha), indicating that there is not much annual variability in brown trout standing crops over time. There is, however, evidence of high annual variation in the age class structure of brown trout populations across the Forests. This appears to be due mostly to high variation in young-of-the-year standing crops. Further evaluation of this variability will be addressed in the NCWRC trout stream monitoring report.

In 1993 and 1994, the range of brown trout standing crop estimates was larger than in other years. This wider than normal range of values is thought to be attributable largely to the stocking program the NCWRC implements on some area streams, and that on average, brown trout grow to larger sizes than brook and rainbow trout of the same age. It would not take more than a couple of these large fish to affect the annual population estimates. Also, during these years, monitoring efforts were at their peak and there were more streams sampled (see Figure 1-2), which may account for this variability. These issues will be analyzed further by the NCWRC in their trout stream monitoring report.

Figure 1-6. Standing crop (kg/ha) of rainbow trout, 1989-present, from a total of 39 streams

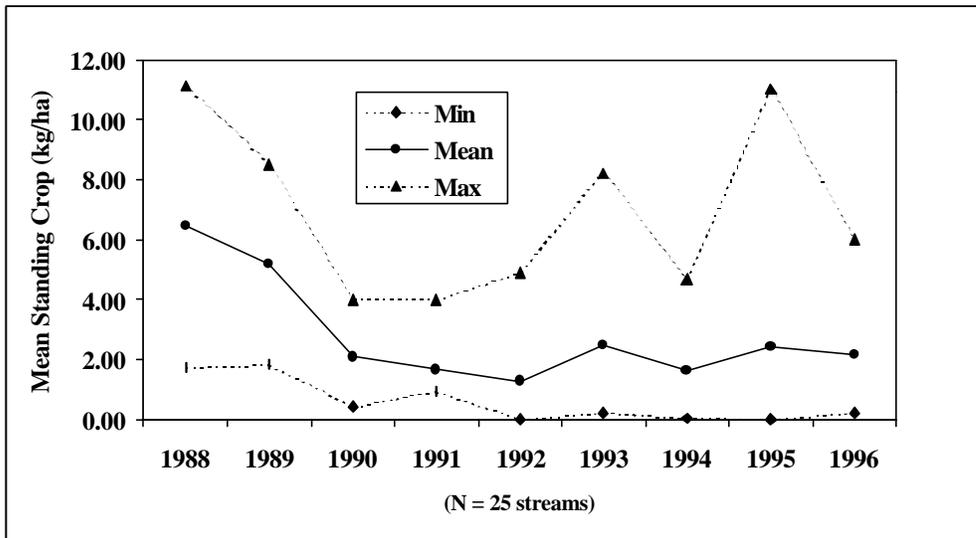
across the Nantahala and Pisgah National Forests (not all streams were sampled each year). Monitoring results from 1998 are not available from the NCWRC for analysis yet.



Rainbow trout mean standing crop has ranged from 12.48 kg/ha to 30.94 kg/ha since 1989, with the mean standing crop over this time period of 20.69 kg/ha. Sixty-seven percent of the annual estimates are within one standard deviation of this estimate (e.g. between 14.80 kg/ha and 26.58 kg/ha), indicating that there is not much annual variability in rainbow trout standing crops over time. There is, however, evidence of high annual variation in the age class structure of rainbow trout populations across the Forests. This appears to be due mostly to high variation in young-of-the-year standing crops. Further evaluation of this variability will be addressed in the NCWRC trout stream monitoring report.

In 1992, rainbow trout standing crop estimates ranged from 1.00 kg/ha to 139.13 kg/ha. This range is considerably larger than other years, and is thought to be attributable to the wild trout feeding program the Forest Service and NCWRC implemented during this period. Rainbow trout responded positively to artificial feeding which resulted in much higher rainbow trout standing crop estimates on fed streams when compared to unfed streams. On streams within this study (i.e. South Toe River, Curtis Creek, Looking Glass Creek, and Kimsey Creek), data from artificially fed sections was eliminated for this analysis. However, in Kimsey Creek, two large rainbow trout were found outside of the feeding area that had been previously captured in the fed section (instream movement of fish is normal when there are no barriers to this migration). These fish are thought to have skewed 1992 annual estimates of standing crop. Also, during these years, monitoring efforts were at their peak and there were more streams sampled (see Figure 1-2), which may account for this variability. These issues will be analyzed further by the NCWRC in their trout stream monitoring report.

Figure 1-7. Standing crop (kg/ha) of blacknose dace, 1989-present, from a total of 25 streams across the Nantahala and Pisgah National Forests. Monitoring results from 1998 are not available from the NCWRC for analysis yet.



Blacknose dace mean standing crop has ranged from 1.30 kg/ha to 6.46 kg/ha since 1989, with the mean standing crop over this time period of 2.82 kg/ha. Eighty percent of the annual estimates are within one standard deviation of this estimate (i.e. between 1.05 kg/ha and 4.59 kg/ha), indicating that there is not much annual variability in blacknose dace standing crops over time. This is especially true when overall community structure is relatively stable.

Figures 1-4 through 1-7 show that fish populations are not static over time, but rather that a range of population levels oscillate around some mean value. Some species support higher standing crops (amount of fish flesh per unit area) when environmental conditions are suitable or lower standing crops when conditions are adverse. Aquatic community structure is opportunistic in that as standing crops of one species or age class (of that species) decline, standing crops of other species or age classes (of that species) increase depending on their habitat requirements and the new habitat available from the declining stock. This give and take has proven to be cyclic, and that in the absence of catastrophic events (e.g. prolonged drought, successive floods, long-term sedimentation), fish communities will exhibit this cyclic pattern.

In the absence of catastrophic events affecting populations of the above species, there appears to be no difference in population dynamics across the Forests (i.e. across management areas), and that fish populations are more affected by natural forces such as floods and droughts than by forest management activities. It is important to remember that different streams have the inherent capability to support varying population levels, and that ultimately habitat quality and quantity and environmental variables control the fate of fish populations. Management activities may have the potential to affect a part of a fish population (e.g. spawning success may be affected by sedimentation). These effects may be long- or short-term, depending on the intensity and duration of the management activity. It is possible to lose a year-class of brook trout if spawning habitat is temporarily reduced during a poorly timed culvert installation, as well as during a spring flood. Very rarely does the loss of one year-class affect long-term population stability. The successive loss of year classes, however, can result in long-term declines in fish standing crops. It is important to note that environmental variables such as drought and flood cycles and result can cause successive year-class failures in natural declines in population levels. When these declines coincide with forest management activities, it is nearly impossible to determine the causal factor.

The streams surveyed during this long-term monitoring effort are located across the Forests, within different drainage basins and stream types. This contributes to some of the variability in mean standing crops reported above. Streams

(and sites along those streams) that are monitored were chosen because they represent the most typical stream types across the Forests and are spread across the landscape, within different forest management areas.

Based on monitoring efforts since 1988, it does not appear that any stream or its populations have suffered long-term effects of land management (or of natural forces for that matter). A closer look at the data reveals year-class failures for all aquatic MIS in one stream or another at some point, but successive year-class failures were not found on any stream for any species.

THREATENED AND ENDANGERED SPECIES

There are three threatened or endangered aquatic species known to occur on or adjacent to the Forests. One of these species, the spotfin chub (*Hybopsis monacha*) is listed as threatened. The other two species, the Appalachian elktoe (*Alasmidonta raveneliana*) and little-wing pearly mussel (*Pegius fabula*) are listed as endangered. All of these species have approved recovery plans issued by the USFWS.

The Forest Service actively participates in the monitoring of threatened, endangered, and sensitive fish and freshwater mussel communities with the United States Fish and Wildlife Service and North Carolina Wildlife Resources Commission Nongame Division to ensure their continued and successful (i.e. reproducing) existence on federal lands. During FY98, the Forest Service participated in extensive surveys of the Nolichucky River and Little Tennessee River, actively participating in the implementation of recovery plans for threatened and endangered mussel and fish species. Results of these surveys are not yet available.

SENSITIVE SPECIES

Currently, there are 19 aquatic species listed by the Regional Forester that occur on or adjacent to the Forests.

The Forest Service is working towards establishing conservation strategies for freshwater mussel and crayfish species on the Forests. During FY98, the first step of this process, collecting and assimilating existing information on mussel and crayfish distribution across the Forests was initiated. It is hoped that these strategies will be completed and implemented by the end of FY00.

SUMMARY OF MONITORING EFFORTS

The following is a summary of monitoring efforts for aquatic species on the Nantahala and Pisgah National Forests during FY98:

1. Qualitative surveys of fish species distribution continued in FY98. Approximately 80% of Forests' aquatic resources (fish only) have been surveyed. This effort will continue until documentation of fish species distribution on the Forests is complete.
2. The Forest Service began compiling a comprehensive computer database that includes all fish population data available from cooperators and that will allow the use of GIS and other analysis tools. Draft versions of this database are already being used and a final version is expected to be complete by late FY99 or early FY00.
3. The Forest Service participated in mussel surveys that expanded the known distribution of mussels within the Johns River, Tuckasegee River, Hiwassee River, and Little Tennessee River.
4. Forest Service mussel surveys failed to locate any live mussels in the upper French Broad River system. This was consistent with efforts made by other resource agencies that year.

5. Approximately 100 aquatic insect samples were taken to document species distribution and effects of land management. No evaluation of this data is currently available.
6. Over 500 miles of stream habitat was inventoried using a modification of the BVET.
7. Habitat surveys resulted in the planning and implementation of habitat improvement projects on at least 4 streams.
8. Approximately 70 miles of aquatic habitat was mapped to monitor effects of land management.
9. Populations of aquatic MIS were monitored in 16 mountain streams on the Forests in FY98.
10. Populations of aquatic MIS were monitored in 7 reservoirs, lakes, and ponds on the Forests in FY98.
11. Shoreline habitat improvement was implemented on approximately 160 acres of Nantahala Lake during FY98.
12. Data analysis for populations of aquatic MIS for large streams and rivers was initiated.
13. Data analysis for populations of aquatic MIS for reservoirs, ponds, and lakes was initiated.
14. Preliminary analysis of monitoring data from mountain streams revealed no significant correlation between fish population dynamics and land use. This analysis will continue and be included in the FY99 NFMA Monitoring Report and the NCWRC Trout Stream Monitoring Report.
15. The Forest Service actively participated in the implementation of recovery plans for the spotfin chub, Appalachian elktoe, and little-wing pearly mussel on the Nolichucky and Little Tennessee Rivers by monitoring known populations and surveying potential habitat in the upper French Broad River basin.
16. The Forest Service actively inventoried and monitored habitat and populations of sensitive species on the Forests.
17. The Forest Service initiated conservation strategies for freshwater mussels and crayfish on the Forests.

**END OF SUPPLEMENTAL
REPORT ON THE FISHERIES RESOURCE**

Issue 1. Ecosystem Condition, Health and Sustainability

Sub-Issue 1.2. Forest and Range Health

a. What is the ambient monitoring data telling us about air quality?

Monitoring for the impact of air pollution on visibility continued near Shining Rock Wilderness in 1998. Monitoring the amount of light scattering, and the amount and type of fine aerosols (particulate matter) found near Shining Rock Wilderness has been occurring since July 1994. The primary type of visibility impairment (based upon the monitoring data through 1996) within the Forest is caused by a uniform haze that reduces how far a person can see, as well as how clearly a person can see color and textures in distant views. The uniform haze appears as a white or gray veil, and indicates that sunlight is being scattered. The visibility impairment is greatest in the summer months, whereas the best visibility conditions usually occur in the winter (Figure 1-8). The picture below was generated using a computer model (called WinHaze) which predicts what a scene would look like if a particular visibility measurement was inputted into the model. The results below show the average deciview (dv) for the winter and summer season when using the light scattering data (measured with a device called a nephelometer) plus the light absorption data (measured with a device called an aerosol sampler). The results from the aerosol monitoring data reveal that sulfate particles comprise the majority of the fine particle mass and are thought to be responsible for causing most of the visibility reductions in western North Carolina. Measurements at the Shining Rock Wilderness monitoring site are expected to continue in the future as this site will be part of a national network to measure the Nation's progress towards improving visibility at this Class I area.

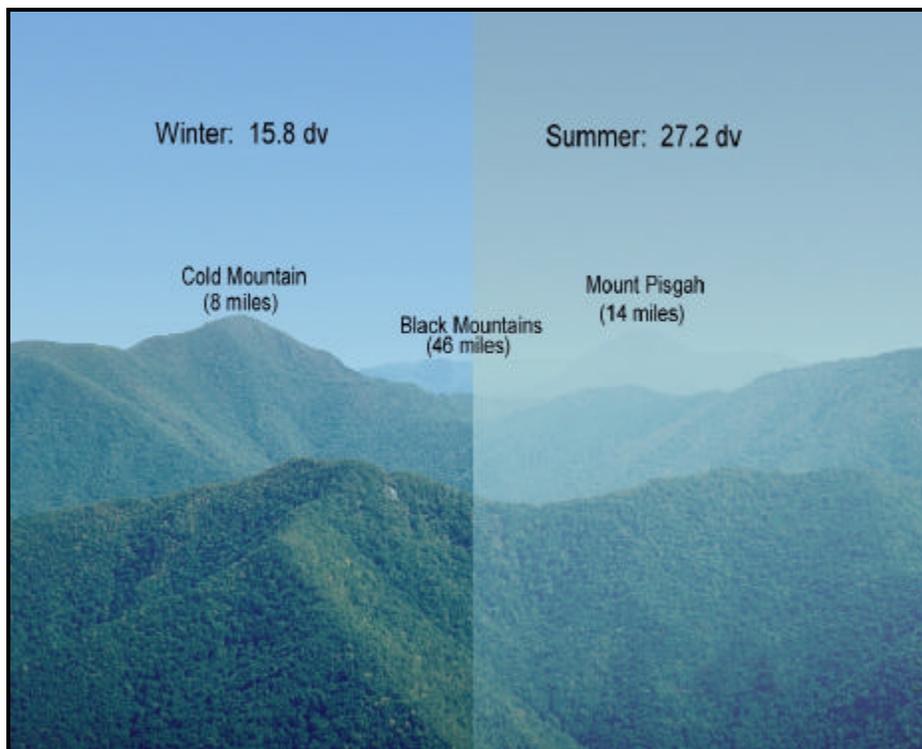


Figure 1-8. Visibility is poorest in the summer months when sulfate particles have their greatest abundance. The distances listed for the three mountains are the distance from the camera to the mountain.

Near Shining Rock Wilderness, Linville Gorge Wilderness, and the Bent Creek Experimental Forest we have been cooperating with the State or Local Air Pollution control agency at monitoring ground-level ozone. High or chronic exposures to ozone can harm people involved in vigorous outdoor activities, people with respiratory illnesses, and harm vegetation. The response of some plants to chronic or acute exposures can be seen as a red stippling of the upper leaf surface (Figure 1-9).



Figure 1-9. The red stipple on this foliage of blackberry shows severe injury from ground level ozone. The photographs was taken in Graveyard Fields in mid-July 1998.

Figure 1-10 shows one type of summary for the ozone monitoring data. The Bent Creek (about 2000 feet elevation) site and Linville Gorge Wilderness (about 3240 feet elevation) reveal the average ozone exposures for each hour begin to increase about 7:00 A.M. and the maximums occur in the afternoon between 12:00 and 5:00 P.M. Conversely, vegetation at the higher elevations (the Shining Rock site is about 5280 feet elevation) are exposed to more ozone because the ozone does not decrease during the night (9:00 P.M. to 6:00 A.M.). Consequently, vegetation at the higher elevations are exposed to more ozone than vegetation growing at the middle or lower elevations.

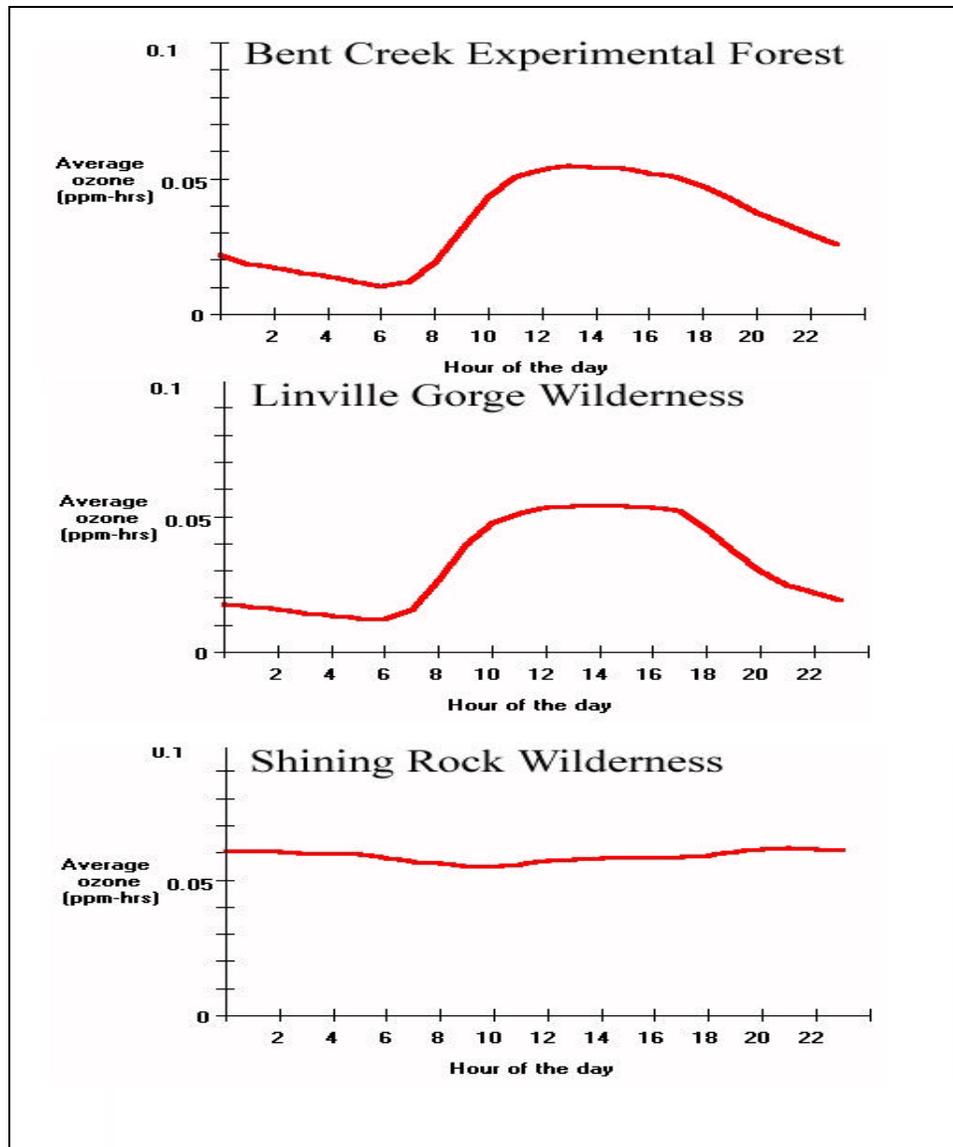


Figure 1-10. Average ozone exposure for each hour of the day during April through October 1998. The monitoring site at Shining Rock shows the high elevations in western North Carolina are receiving greater ozone exposures than the mid-elevation (Linville Gorge), or low-elevation (Bent Creek) portions of the forest.

High levels of ozone exposures are of concern because they may be reducing the growth and consequently the health of susceptible forest vegetation. There is uncertainty in what can be said about how ozone is impacting vegetation because numerous environmental factors have an impact on the health of vegetation. Work performed for the Southern Appalachian Mountains Initiative (SAMI) presents numbers for ozone exposures that may result in a 10 percent growth loss to several plant species (Table 1-10). Table 1-10 allows a comparison of the results found at the three monitoring sites and the results listed in the SAMI report. Growth losses to vegetation are most likely to occur when there is both high seasonal ozone exposures (W126 values) and there is a frequent occurrence when ozone exposures are greater than or equal to 100 parts per billion (N100). Taking the two parameters into consideration there is a possibility the extremely sensitive individuals, sensitive individuals, and the moderately sensitive individuals at the high elevations could have had growth reductions in 1998; whereas, at lower elevations the extremely sensitive,

and sensitive individuals may have had a 10 percent growth loss in 1998. Assuming other environmental factors were favorable for ozone uptake into the leaves then continued exposures could have some impact on the health of individual plants that are sensitive.

Table 1-10. Seasonal ozone exposures at three monitoring sites in western North Carolina and ozone exposures needed to cause a 10 percent growth loss for four broad groupings of species. Growth losses are likely to occur when both conditions for the W126 and N100 are met at a monitoring site.

| Test Species | | Maximum | W126 | N100* |
|---------------------|-------------------------------------|---------|---------|-------|
| Bent Creek | | .127 | 38.172 | 13 |
| Linville Gorge | | .106 | 30.728 | 1 |
| Shining Rock | | .101 | 104.243 | 43 |
| extremely sensitive | black cherry and yellow poplar | | ≥6.51 | ≥1 |
| sensitive | whorled-wood aster and black cherry | | ≥7.68 | ≥10 |
| moderate | yellow poplar | | ≥24.21 | ≥33 |
| resistant | red maple | | ≥85.35 | ≥245 |

* Number of hours greater than or equal to 100 parts per billion

b. Is any portion of the Forest located in an area designated as non-attainment of the National Ambient Air Quality Standards (NAAQS)?

Currently, all portions of the Croatan, Pisgah, Nantahala, and Uwharrie National Forests are designated as attainment for all six criteria pollutants. A portion of the Uwharrie National Forest (Davidson County) is part of a Maintenance Area and therefore all Forest Service management activities that emit nitrogen oxides or volatile organic compounds are subject to Conformity Determination. However, the standards for ground-level ozone have recently changed and it is possible that larger portions of North Carolina will be designated as non-attainment for ozone (Figure 4). Designation of non-attainment areas will be based upon the 1997 through 1999 monitoring data. Consequently, small portions of the Pisgah and Uwharrie National Forests may be subject to Federal Conformity, and any proposed actions (which emit nitrogen oxides or volatile organic compounds) will have to be reviewed and approved by the appropriate State or Local air pollution control agency.

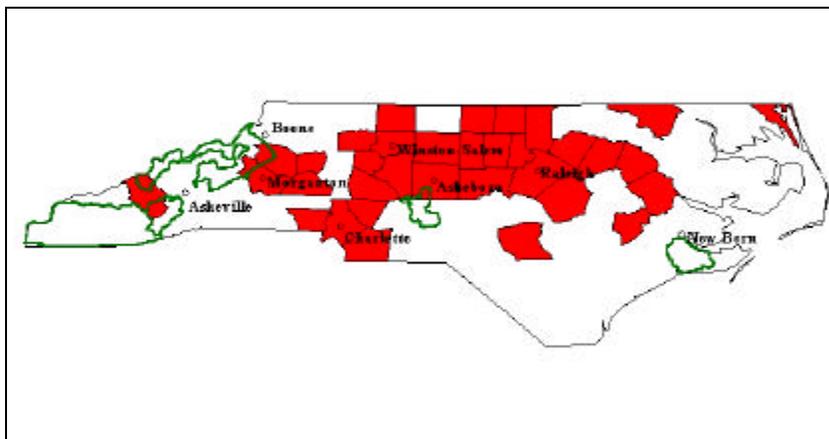


Figure 1-11. Areas of North Carolina that could violate the National Ambient Air Quality Standard for ground-level ozone in 1999 based upon the data collected in 1997 and 1998.

b1. How many applications for new sources of air

The Forest Service is required under the Clean Air Act Amendments of 1977 to advise the appropriate State or Local air pollution control agency if any Class I areas under its management will be adversely impacted by a new source of pollution. The Class I areas

pollution were reviewed in 1998?

managed by the National Forests in North Carolina are Joyce Kilmer/Slickrock Wilderness, Linville Gorge Wilderness, and Shining Rock Wilderness. These three areas, along with other Class I areas in the United States, are to receive the greatest protection from new sources of air pollution, adverse impacts are not to occur to the air quality related values, and there is a National goal to protect and improve visibility in these area.

The Forest commented on three Prevention of Significant Deterioration (PSD) applications in 1998. The emissions of nitrogen oxides and volatile organic compounds were low enough that the atmospheric modeling results indicated that no adverse impacts were likely to occur to the air quality related values at the Class I areas. The no impact determination provided to the State Air Regulatory agencies was based upon adding the modeled values from the new source to ambient monitoring data and then determining if the new value exceeds any of the air quality related values screening level values.

A discussion of how the air quality related values are evaluated can be found at the Internet Web site: <http://svinet2.fs.fed.us/r6/aq/natarm/document.htm>, and then download the document entitled "Preliminary Air Quality Related Screening Values for Three Class I Areas in North Carolina and Tennessee ." This document was produced to assist PSD applicants learn what the Forest Service expected in an analysis. The screening documents was also prepared as part of an Memorandum of Understanding that the Regional Forester made with the Governor's of North Carolina and Tennessee. The Memorandum of Understanding on "Permitting Procedures Document for Class I Areas" is an important agreement reached that will assist in expediting the review of PSD applications. Further information on the Memorandum of Understanding can be found at the Internet Web site: <http://daq.state.nc.us/AQ/News/flmhunt.html>, or <http://www.state.tn.us/environment/epo/strike2.htm>

c. Determine if insects, disease, and noxious weeds have increased to damaging levels.

Forest Health Protection (FHP) is a unit of State and Private Forestry within the Southern Region. The Asheville, NC FHP Field Office has been a partner with the National Forests in North Carolina in monitoring and evaluation of insect and disease conditions and has recently taken a role in evaluating the impact of weeds on forest ecosystem health. Strictly speaking, the term "noxious weed" has USDA regulatory connotations. In the context of this report, however, the term applies to regulated or unregulated non-native invasive species of plants (NIS) that are currently, or have the potential to disrupt national forest management objectives. These objectives include maintenance and enhancement of native biodiversity, wildlife habitat, recreation opportunities, and timber management.

The insects and diseases currently found within NF's in NC boundaries with the potential to disrupt management objectives include southern pine beetle (SPB), gypsy moth, and oak decline. Others with similar potential found nearby NC national forests but not yet known to be within forest boundaries include hemlock woolly adelgid and beech bark disease. NIS plants pose perhaps the greatest forest health challenge to national forest land managers and yet less is known about area affected or effective control measures than for insects or pathogens.

Monitoring Efforts and Trends for Major Insect, Disease and NIS Plant Pests:

Southern Pine Beetle:

Outbreak forecasting is done by sampling populations of the insect and its chief predator, the checkered beetle. The relative abundance of the two insects indicates whether SPB populations are expected to increase, remain stable, or decrease. Table 1-11 shows the predicted and actual population trends for SPB on four districts where monitoring has been conducted since 1992.

Forecasting was nearly always accurate. The cyclical pattern of southern pine beetle outbreaks is illustrated for the Uwharrie, with developing outbreaks in 1992 and again in 1995-96; and for the Grandfather, with a developing outbreak in 1994-95. Minor discrepancies between predicted and actual population trends occurred in 1993 and 1997. However, both population level and trend were seriously underestimated for the Croatan in 1997 and 1998. High, increasing populations in 1997 (contrary to predictions of low and decreasing populations) were probably due to Hurricane Opal damage in 1996 followed by drought the following year leaving trees unusually susceptible. The 1998 error might be due to a combination of changes in trapping methods and weather. Supply problems necessitated a change in the turpentine lure and spring was unusually wet and cool, perhaps reducing attractiveness. Trap catches indicated a low and decreasing population but actual populations were moderate.

Table 1-11. Southern pine beetle outbreak trend for selected districts, National Forests in North Carolina. Shaded cells indicate where actual differed from predicted.

| | Uwharrie | Croatan | Grandfather | Tusquittee |
|--------------|-------------|------------|-------------|------------|
| 1992 | | | | |
| Predicted | Moderate /\ | Low /\ | Low 0 | Low \ |
| Actual | Moderate /\ | Low /\ | Low 0 | Low \ |
| 1993 | | | | |
| Predicted | Low /\ | Low \ | Low 0 | Low /\ |
| Actual | Low \ | Low \ | Low 0 | Low \ |
| 1994* | | | | |
| Predicted | Low \ | Low \ | Moderate /\ | Low \ |
| Actual | Low \ | Low \ | Moderate /\ | Low \ |
| 1995* | | | | |
| Predicted | Mod. /\ | Low /\ | Moderate 0 | Low 0 |
| Actual | Mod. /\ | Low /\ | Moderate 0 | Low 0 |
| 1996* | | | | |
| Predicted | Moderate /\ | Low \ | Low \ | Low 0 |
| Actual | Moderate /\ | Low \ | Low \ | Low 0 |
| 1997 | | | | |
| Predicted | Low \ | Low \ | Moderate 0 | Low \ |
| Actual | Low \ | High /\ | Low \ | Low \ |
| 1998 | | | | |
| Predicted | Low 0 | Low \ | Low 0 | Low 0 |
| Actual | Low 0 | Moderate \ | Low 0 | Low 0 |

/\ = increasing population trend; 0 = static population trend; \ = decreasing population trend

*Outbreaks occurred on districts without trapping programs. Cheoah in '94-'96; French Broad (Appalachian) in '95.

Oak Decline:

|| Oak decline can be monitored through the use of OAKHAZ, a risk rating system that uses

CISC inventory data. Conditions can be summarized at the forest, district, landscape, or project scale. Table 1-12 shows the distribution of area in the Pisgah and Nantahala National Forests by risk class, as summarized in the Southern Appalachian Assessment. CISC is a database that changes continuously as stand inventories are updated. The date that this baseline was established is somewhat uncertain but is estimated to represent conditions as of 1995.

Table 1-12. Oak decline status in 1995 for the Pisgah and Nantahala National Forests, by District from OAKHAZ risk rating system. (Data source: Southern Appalachian Assessment).

| | | Acres Decline Damage | Acres Other Damage | Acres Unaffected | Acres Vulnerable | Acres Non-Forest | Acres Insufficient Data | Acres Total |
|------------------|-------------|----------------------------|--------------------------|---------------------|---------------------|---------------------|-------------------------------|----------------|
| Pisgah | Appalachian | 12182 | 1065 | 113187 | 17793 | 2152 | 5982 | 152361 |
| | Grandfather | 17377 | 2225 | 122967 | 26652 | 1075 | 17062 | 187358 |
| | Pisgah | 28182 | 2008 | 89422 | 25629 | 1387 | 8608 | 155236 |
| | Subtotal | 57741 | 5298 | 325576 | 70074 | 4614 | 31652 | 494955 |
| | | | | | | | | |
| Nantahala | Cheoah | 15025 | 1648 | 92685 | 9305 | 1532 | 358 | 120553 |
| | Highlands | 5889 | 590 | 72312 | 21087 | 1852 | 3664 | 105394 |
| | Tusquittee | 14841 | 2935 | 121015 | 16440 | 463 | 1788 | 157482 |
| | Wayah | 42056 | 1454 | 81400 | 13861 | 398 | 6979 | 146148 |
| | Subtotal | 77811 | 6627 | 367412 | 60693 | 4245 | 12789 | 529577 |
| | | | | | | | | |
| Total | | 135552 | 11925 | 692988 | 130767 | 8859 | 44441 | 1024532 |

These data represent a snapshot in time. Temporal trends are not meaningful due to the short period since the Southern Appalachian Assessment and the relatively slow pace of change for oak decline. Changes in the structure of the vegetation database for national forests are proposed within the next 2-5 years. OAKHAZ should be run again on an updated CISC database before conversion to new systems takes place, and the model modified to run using new data so that the baseline for monitoring historic trends can be preserved.

Gypsy Moth:

Gypsy moth monitoring is accomplished with pheromone-baited traps that lure male moths. This method has been used on all districts of the National Forests in North Carolina since 1982 with the exception of the Highlands District during 1991 and 1992. North Carolina National Forests are outside the generally infested APHIS quarantine zone, so outbreaks are eradicated when detected. There have been three outbreaks detected on North Carolina National Forests and adjoining private lands. The first was detected in 1985 on the Tusquittee District followed by one on the Appalachian (Toecane) District in 1993 in the Carolina Hemlocks Recreation Area. Most recently, an outbreak was detected on the Highlands District in 1996.

Temporal trends are difficult to establish with only three introductions to National Forest lands in NC, but two have occurred during the past 5 years. As the generally infested area encroaches closer to National Forests in NC, detections and subsequent eradication projects can be expected to increase. The Croatan is presently the Forest closest to the limit of the

generally infested area. Male moths have been trapped regularly in the area but levels have not indicated an established population requiring eradication. At present spread rates and present gypsy moth management regimes, the generally infested area is expected to include the Croatan by the year 2005, the Uwharrie by 2010, and the Pisgah-Nantahala by 2020 (USDA Forest Service, Southern Region, FHP. Forest Health Atlas). The role of a fungal pathogen of gypsy moth larvae (*Entomophaga maimaiga*) in apparent biocontrol of established infestations within the quarantined area has fueled discussion about the need to reconsider historic spread rates. A change in this assumption would delay the predicted date of infestation for each of NC's national forests. Entomologists require at least several more years of continued gypsy moth suppression by *E. maimaiga* before historic estimates of spread rate are reduced.

NIS Plants:

Awareness of the ecological threats posed by NIS plants is only now awakening. As a consequence, monitoring is in its infancy and consists mainly of identification of threatening species found within the boundaries of NF's in NC. Most species threaten native plant biodiversity, and by extension, wildlife habitat. However, a few (e.g. oriental bittersweet and kudzu) may impact timber management by hindering regeneration of desirable native species. Botanists estimate that there are 1418 plant species on the Nantahala and Pisgah National Forests. There are 152 non-native species among these, 14 of which are considered NIS plants. Table 1-13 shows these 14 species with the potential to adversely affect management objectives. Vegetative plots, established across the forest, document the presence of 11 species of these plants within plots. The highest occurrence is shown to be *Microstegium vimineum* (35 or 1.8% of the plots) and *Lonicera Japonica* (26 or 1.4% of the plots). Both of these species have been recorded in North Carolina at least 10 years prior to any other non-native invasive species. While very little is known about their biology yet, they are found on highly disturbed bottomland sites, such as pastures and old home sites.

Table 1-13. Non-native invasive species (NIS) of plants found in NF's in NC with the potential to disrupt management objectives, 1998.

| Scientific Name | Common Name | Forest | Habitat Affected |
|------------------------------|----------------------|-------------------|-----------------------------------|
| <i>Ailanthus altissima</i> | tree-of-heaven | Nantahala, Pisgah | forest openings, gorges |
| <i>Albizia julibrissin</i> | silk tree | all | forest openings, gorges |
| <i>Celastrus orbiculata</i> | oriental bittersweet | Nantahala, Pisgah | forest openings, mesic hardwood |
| <i>Glechoma hederacea</i> | ground ivy | Nantahala, Pisgah | mesic hardwood |
| <i>Ligustrum sinense</i> | privet | Nantahala, Pisgah | bottomland, riparian |
| <i>Lonicera japonica</i> | Japanese honeysuckle | all | forest openings, mesic hardwood |
| <i>Microstegium vimineum</i> | | Nantahala, Pisgah | bottomland, riparian |
| <i>Miscanthus sinensis</i> | | Nantahala, Pisgah | bottomland, riparian |
| <i>Paulownia tomentosa</i> | princess tree | Nantahala, Pisgah | rocky, dry cliffs |
| <i>Poa compressa</i> | Canada bluegrass | Nantahala, Pisgah | rocky, wet cliffs |
| <i>Pueraria montana</i> | kudzu | all | lower elevation forest |
| <i>Rosa multiflora</i> | multiflora rose | Nantahala, Pisgah | mesic hardwood |
| <i>Rumex acetosella</i> | sheep sorrel | Nantahala, Pisgah | grassy balds |
| <i>Spirea japonica</i> | Japanese spirea | Nantahala, Pisgah | rocky cliffs, hardwood understory |

Other Monitoring Efforts:

FHP works as a partner with the state of North Carolina and with other federal agencies (e.g. USDI National Park Service, Dept. of Defense) in monitoring work that could have a direct bearing on national forests in the state. Monitoring efforts are currently underway involving hemlock woolly adelgid, beech bark disease, butternut canker, and dogwood anthracnose in addition to SPB, gypsy moth, oak decline, and NIS plants discussed above.

Butternut canker and dogwood anthracnose have changed little in distribution in NC over the past 2 years. Beech bark disease is still limited to the Great Smoky Mountains National Park, but infestations of the beech scale as well as disease symptoms have intensified. It is only a matter of time before the scale and the disease spread into beech stands on the Nantahala National Forest. Distribution of the hemlock woolly adelgid has increased during the last 2 years, but does not directly threaten NF's in NC lands yet. Stokes, Surry, Rockingham, and Forsyth Counties were infested prior to 1997. In that year, Caswell County became infested, and in 1998, Alleghany County. All known infestations are limited to ornamental hemlocks at this time.

CURRENT MANAGEMENT PRACTICES INFLUENCING PEST DAMAGE

Southern Pine Beetle:

Once significant SPB activity is detected, suppression efforts are initiated. The “cut-and-leave” method is used when infested areas are small, inaccessible, or non-commercial but still pose a threat to resources. When commercial volume can be salvaged in accessible areas, “cut-and-remove” is used. Chemical insecticides are used only when extremely high-value resources are at risk, such as in seed orchards, ornamentals, or red cockaded woodpecker nest sites. Both cutting methods have been used in North Carolina National Forests in the past. Table 1-14 summarizes SPB suppression efforts since 1992.

Table 1-14. Summary statistics for southern pine beetle suppression on National Forests in North Carolina , 1992-1998 (volume in ccf).

| Suppression Method | Measure | Treatment Year | | | | | | |
|--------------------|---------|----------------|------|------|------|------|------|------|
| | | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
| Cut and Remove | Acres | 7 | 107 | 201 | 104 | 26 | 125 | 58 |
| | Volume | 49 | 1055 | 1191 | 450 | 209 | 2198 | 1236 |
| Cut and Leave | Spots | 0 | 1 | 1 | 10 | 12 | 50 | 19 |
| | Acres | 0 | <1 | <1 | 26 | 35 | 133 | 28 |

Clearly, cut-and-remove was the preferred management response to SPB outbreaks. The variation in acres and/or volume treated indicates the years when outbreaks were underway. The data for 1997 show the response to the large outbreak on the Croatan. This outbreak was likely due to damage caused by Hurricane Opal in 1996, followed by growing season drought in 1997 that left storm-damaged pines more attractive to SPB. Timely management of storm damage just after it occurred may have helped in dampening the outbreak. The outbreak could have been more extensive and the losses far greater were suppression not conducted in 1997.

Reducing stress in pole- and sawtimber size stands by thinning is a pro-active management practice that reduces SPB risk by increasing resistance to attack. While thinning is a standard forest management practice in pine stands on NC national forests, we are unaware of any situations where thinning was prescribed for this purpose, or where this benefit was claimed. Commercial concerns drive the thinning decision in most cases but the collateral effect of reducing SPB risk is often accomplished. Assessing SPB risk before and after thinning is a tool that could be used to monitor the effects of this management practice on the potential of SPB damage.

Oak Decline:

The progress of decline diseases is slow, but decline status of forest landscapes can change with or without management action. Actions that can reduce decline risk include cutting practices that alter age class distribution and/or species composition. However, the same practices can increase damage when misapplied. Without action, decline risk changes slowly as stands age and become more vulnerable to stress. Assessing oak decline risk with OAKHAZ before and after management actions is a tool that could be used to monitor these effects, but such summaries are not available.

Gypsy Moth:

Eradication of gypsy moth infestations with chemical insecticides or pheromones for mating disruption are the management responses when such infestations are found outside of the APHIS quarantine zone. Table 1-15 summarizes gypsy moth eradication projects for outbreaks detected on the forests since 1987.

Results of the post-treatment trapping conducted in the summer of 1998 indicated that gypsy moths were more widespread in the Highlands area than initially anticipated. In fact, moths were trapped across the NC border in GA and adjacent to SC. Mating disruption treatments are prescribed for 4522 acres on NF's in NC (included in acreage estimates in Table 1-14) and an additional 2369 acres on the Chattahoochee NF in GA (not included above).

Pro-active management to decrease impacts in the future when gypsy moth becomes established in NC national forests consists of thinning to reduce the oak component (reducing susceptibility), and thinning to improve stand vigor by removing trees that are likely to die if they become defoliated (reducing vulnerability). Management plans do not consider these options at this time.

Table 1-15. Gypsy moth detection and eradication for National Forests in North Carolina.

| Year Detected | District | Years Treated | Acres Treated |
|---------------|------------|-------------------|---------------|
| 1985 | Tusquittee | 1987 and 1988 | 14925 |
| 1993 | Toecane | 1994 | 160 |
| 1996 | Highlands | 1995 | 1492 |
| " | " | proposed for 1999 | 12022 |

NIS plants:

The best method for limiting the effects of NIS plants is to prevent establishment. This can be accomplished in some areas of the Croatan by restoration of native longleaf pine forests by harvesting loblolly pine stands on historic longleaf sites, replanting longleaf, and eventually reintroducing fire. Frequent fire on these xeric, relatively infertile sites is enough to prevent the establishment of many NIS plants, as well as native plants that have excluded other desired native species in the absence of fire.

This is not a feasible option in other ecosystems and, unfortunately, most NIS plants go largely unnoticed until it's too late. Costly and sometimes marginally effective herbicide or mechanical methods then become necessary. In many cases, the research basis for extending existing herbicide labels to new plant species is lacking. Suppression funds have been requested for control of kudzu and oriental bittersweet on some sites in the Nantahala National Forest, but the proposals were not funded. In other cases, K-V funds have been used for control of oriental bittersweet and Japanese spirea.

Recommendations

* Routinely use OAKHAZ and other appropriate hazard rating systems as part of stand examinations and compartment prescription landscape analyses.

*Run OAKHAZ and other appropriate hazard rating systems before and after management actions (such as timber harvest, thinning, sanitation, and salvage) to determine the effects of management practices on pest risk at the stand and landscape levels.

*Work with FHP personnel to develop systems for gathering these change data in a way that can be reported annually. Presently, summary statistics for SPB management actions can be gathered by SPBIS (**S**outhern **P**ine **B**eetle **I**nformation **S**ystem), but a method is needed for monitoring the effects of other forest management practices not specifically undertaken against an existing pest condition (e.g. thinning that has the collateral effect of reducing SPB risk; altering species composition in hardwood stands that also reduces gypsy moth or oak decline vulnerability).

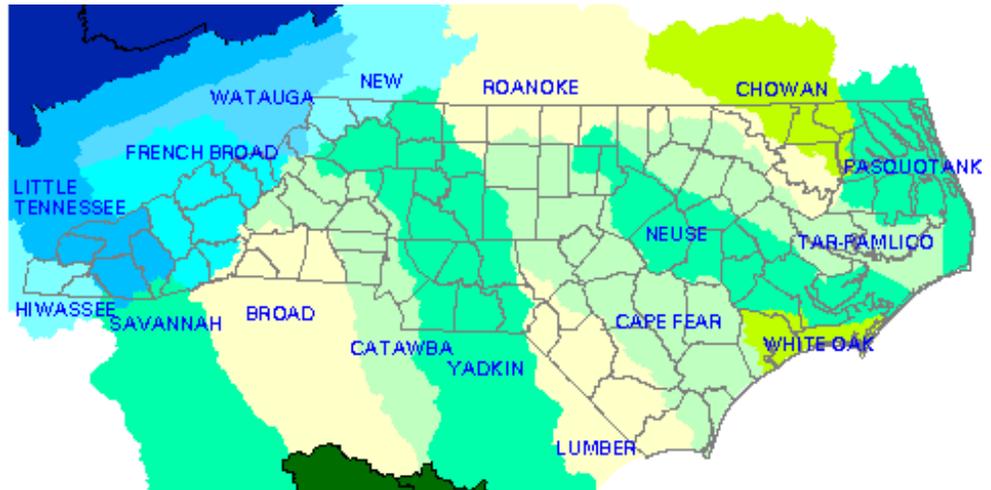
*Determine the area affected by the various NIS plants and the resources at risk; evaluate available treatments; and determine the need for new control methods, including local use labeling of existing herbicides.

Issue 1. Ecosystem Condition, Health and Sustainability

Sub-Issue 1.3 Watershed Conditions

FIGURE 1-12

North Carolina's 17 Major River Basins



a. Determine if the conservation of soil and water resources are being ensured and the permanent impairment of site productivity is being avoided.

For timber sales, inspections occur throughout the harvest operation to ensure compliance with contract requirements for on site soil and water conservation. Contractor operations are not approved until all required conservation measures have been completed and approved by the sale administrator and signed off by the line officer.

b. Determine if the desired water quality and quantity objectives are being achieved.

See Figure 1-13. Efforts to attain clean water in the State of North Carolina primarily involve the control and prevention of water pollution from two sources: point sources, such as municipal and industrial wastewater discharges; and nonpoint sources that originate from agricultural drainage, urban runoff, land clearing, construction, mining, forestry, septic tanks and land application of waste. For more information concerning water quality in North Carolina, visit the following website: <http://h2o.enr.state.nc.us/>. Figure 1-12 and Figure 1-13 in this section were provided by the State Division of Environment and Natural Resources.

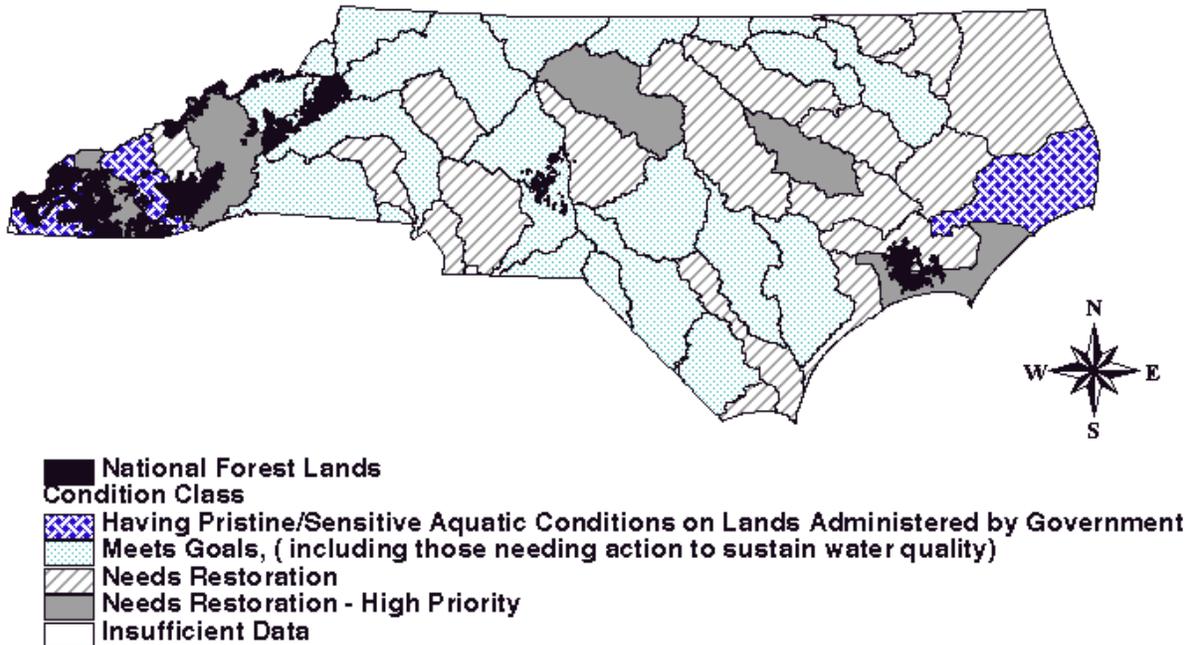
The State of North Carolina Department of Environment and Natural Resources has classified the watersheds (8-digit hydrologic units) of the state according to the categories in Figure 1-13. National Forest land makes up approximately 1.3 million of the 33.7 million acre total area of the state. No watershed contains exclusively federal land. Approximately

15 of these watersheds contain a combination of private and National Forest land. Of these 15 watersheds, four are classified as "pristine," six "meet goals," three "need restoration," and two are "high priority" for restoration.

Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or which have impaired uses. North Carolina has 405 freshwater stream segments on its list for a total of 2,814 mile of streams identified as impaired. Only 10.2 miles of these impaired segments are within national forest boundaries: 4.2 miles of Wash Creek and 6.0 miles of Hurricane Creek in the French Broad River Basin. There are approximately 3,750 miles of streams and rivers on the Nantahala and Pisgah National Forests, so the percent of stream segments identified as impaired is 0.27 percent. The major sediment source for Wash Creek is listed as "urban runoff," while the major sediment source for Hurricane Creek is listed as "general erosion (road erosion)." In both cases, open roadways were built decades ago to provide access to remote communities, and the roadbeds were located right next to the streams. These roads continue to be a source of sediment to the adjacent stream segments. A watershed analysis/planning effort is currently underway for the Hurricane area and this should result in recommendations for specific watershed restoration projects.

FIGURE 1-13

Condition Categories of North Carolina Watersheds, with National Forest Lands Superimposed



c. Ensure compliance with State water quality requirements, monitor the effect and adequacy of the BMPs.

North Carolina Department of Environmental Management (NCDEM) - Division of Water Quality has established permanent Benthic Macroinvertebrate sites across the state. 139 sites are either on the Nantahala & Pisgah National Forests or on private lands bordering National Forest where the majority of the watershed is Forest Service lands. NCDEM rates the water quality based on "EPT" (Ephemeroptera + Plecoptera + Trichoptera) taxa richness and abundance. Although some sites have only been sampled once, the majority have been sampled at least 3 times. The results for the 139 sites are; 62% excellent, 24% good, 9% good-fair, and 5 % fair. Only one site was rated as poor. In addition to these permanent macroinvertebrate sites, there are 80+ sites across the forest that have been sampled for air and water quality assessment for multiple years. The macroinvertebrate samples taken at these sites, along with the water chemistry samples have not been compiled in a final report as yet and may be added to the MIS file upon completion of the analysis. Mussel surveys have been completed by the NC Wildlife Resource Commission (NCWRC), Non-Game Division and the US Forest Service. The mussel surveys are completed by river basin or where a known sensitive or T&E mussel species has been recorded. The reports of these surveys for the past 3 years are in the Forest MIS file.

d. Determine the effects of management actions on soil quality and site productivity.

Baseline inventories are underway. During FY 1998, 23,569 acres were surveyed.

e. Determine the effects of management actions on riparian values, soil and water quality, and streambank stability.

Riparian areas are monitored during Integrated Resource Reviews, during which a landscape area, typically one or more 5th level watersheds, is studied in the field to review recent project implementation and patterns of use, and to evaluate the existing conditions in relation to the desired conditions. Reviews during FY 1998 indicates that while projects such as timber sales generally adhere to riparian area standards, some problems exist regarding long-standing patterns of recreational use. Dispersed campsites next to streams can become compacted and result in eroded streambanks denuded of vegetation. Corrective actions are taken by the districts as time, funding, and public sentiment allow. Corrective measures may include hardening sites and streambanks, closing sites for rehabilitation, and allowing camping only in designated sites. All these can impact the availability of dispersed campsites for the recreating public at a time when more and more people want this opportunity.

Another emphasis area is trails adjacent the creeks. Trails which had light use in the past by hikers are now in high demand by bikers, equestrians and OHV riders. Most trails were not built originally to withstand heavier impact. Many trails were also created over years of use by anglers and hunters and on old road grades and may be contributing sediment to the nearby creeks. Budgets to maintain our trail systems are just now beginning to catch up with the increased demand and use. For years the forest has relied on volunteer groups to help us carry out the maintenance program.

During FY 98 the Forest received \$165,312 of 10% Road and Trail Funds:

Seven districts received money to work on projects in watersheds or sub-watersheds.

Most of the work centered on trail rehabilitation, although 6 miles of road were rockered.

f. Determine if temporary roads are being revegetated within 10 years of contract or permit termination.

About 750 waterbars were built along trails and 3 miles of trail were ditched and armored.

This work contributed to a reduction of 140 tons of sediment per year, and 600 acres of riparian improvement.

Integrated resource reviews have not noted any cases where revegetation did not occur.

Issue 2. Sustainable Multiple Forest and Range Benefits

Sub-Issue 2.1 Outdoor Recreation Opportunities

a. Determine if the desired recreation uses, opportunities, and aesthetic values are being achieved.

Yes. All recreation related management activities reviewed during FY 98 were appropriate for achieving the desired conditions set forth in the Land and Resource Management Plans. The following projects are good examples.

Forest-wide

- Began using Global Positioning System (GPS) equipment to locate all the trails on the forest. This is input into the Infrastructure system and will give us condition information to help in prioritizing maintenance work. District personnel are being trained in use of the GPS trail inventory program designed on forest, and Arc View. This will enable the Forest to do ongoing trail monitoring.
- All recreational renovations and construction are reviewed for accessibility compliance. Examples include Tideland Trail on the Croatan, Davidson River water system on the Pisgah District, Nantahala River Takeout on the Wayah District, and Canebreak Horse Camp on the Uwharrie.
- The forest received about \$170,000 in 10% Road and Trail Funds for watershed restoration projects. Most of the districts received a portion and the projects included trail maintenance and reconstruction along streams to correct problems brought out through past monitoring.

Grandfather District

Continued work on dispersed recreation plan for Curtis Creek. This work is a prototype for future district wide watershed planning along heavily used streams.

Cheoah District

Began customer survey of mountain bikers at the Tsali recreation area. This is being done in conjunction with FS researchers in Athens, GA and community partners. The results will give us input on customer satisfaction, demand for other facilities/amenities, condition of the facilities, and will help prioritize expenditure of fee demo money collected at the site.

b. Determine if Forest Plan visual quality objectives are being met.

During project level scenery analysis, all trails, water bodies, use areas, open roads and closed roads used for trail opportunities are evaluated for viewpoints and potential visual impacts. The acceptable degree of change in landscape characteristics is determined by the assigned visual quality objective for each management area. Visual quality objectives used in the Forest Plan are preservation, retention, partial retention and modification. Levels of allowable change range from "imperceptible" to "dominant", and must be achieved within a specified period of time. For example, an activity proposed in partial retention must remain subordinate to the characteristic landscape, and must meet those criteria within two growing seasons. Proposed activities are analyzed from specific viewpoints and necessary visual mitigation is determined for each view and activity area. Implementation and effectiveness of visual mitigation is successful in most cases. When mitigation is not followed or proves ineffective, Forest Plan visual quality objectives may not be met.

While there is no comprehensive program in place to systematically monitor the results of scenery mitigation on the Nantahala and Pisgah National Forests, interdisciplinary resource reviews do address scenery impacts within selected watersheds. Informal field reviews are conducted periodically by a landscape architect, but all projects are not routinely reviewed for compliance with visual quality standards. Informal reviews of recently completed projects were done on the Wayah, Cheoah, Highlands and Grandfather Ranger Districts. There was only one project observed in which activities failed to meet assigned visual quality objectives.

c. Monitor OHV use to determine if planned use levels and management requirements are sufficient to protect the land and other resources, promote public safety, and minimize conflicts with other uses of NFS lands.

Many of the projects accomplished with the 10% Road and Trail Funds were on the OHV trail systems. Upper Tellico on the Tusquitee and Brown Mountain on the Grandfather both made trail improvements with these funds.

The Tusquitee has begun an inventory and planning process to improve watershed quality of the drainages in the Upper Tellico OHV system.

The Uwharrie District implemented a seasonal closure on the Badin Lake OHV system that coincides with winter wet periods. This closure reduced sedimentation to the creeks, protected previously done trail rehab work, and allowed trail segments to "rest".

Sub-Issue 2.2 Infrastructure

a. Ensure that any roads constructed are designed according to standards appropriate to the planned uses.

The current amount of road construction is less than 10 miles per year. Emphasis now is on road reconstruction and rehabilitation. Road construction design utilizes environmental analysis and mitigation measures to ensure appropriate standards for intended use.

Sub-Issue 2.3 Human Influences (Population,/Demographics, Urbanization, Environmental Justice, etc.)

Population/ Demographics:

The local and visitor populations affect the National Forests in North Carolina. From 1990 to 1997, the estimated population has increased by 9.9 percent. Of this, almost three-quarters have been the result of in-migration (Table 2-1). Only one county, Jones, has had a declining population.

Population increases ranged from 0.5 percent in Montgomery County to 19.3 percent in Macon County. The population is expected to continue to increase in size, which will put pressure on the national forests to provide more services, particularly recreation.

Table 2-1. Population Changes 1990 to 1997 and Estimates of Migration.

| Forest | County | 1997 Estimate | 1990 Census | Change | Percent | Migration Change | Migration Percent |
|---------------------------|---------------|------------------|------------------|----------------|-------------|---------------------|----------------------|
| Nantahala/ Pisgah | Avery | 15,460 | 14,867 | 593 | 4.0 | 399 | 2.7 |
| | Buncombe | 191,122 | 174,778 | 16,344 | 9.4 | 13,908 | 8.0 |
| | Burke | 83,143 | 75,740 | 7,403 | 9.8 | 5,002 | 6.6 |
| | Caldwell | 74,728 | 70,709 | 4,019 | 5.7 | 1,582 | 2.2 |
| | Cherokee | 22,416 | 20,170 | 2,246 | 11.1 | 2,232 | 11.1 |
| | Clay | 8,066 | 7,155 | 911 | 12.7 | 1,044 | 14.6 |
| | Graham | 7,504 | 7,196 | 308 | 4.3 | 253 | 3.5 |
| | Haywood | 51,267 | 46,942 | 4,325 | 9.2 | 4,425 | 9.4 |
| | Henderson | 79,148 | 69,326 | 9,822 | 14.2 | 10,588 | 15.3 |
| | Jackson | 29,142 | 26,846 | 2,296 | 8.6 | 1,866 | 7.0 |
| | McDowell | 39,424 | 35,681 | 3,745 | 10.5 | 3,038 | 8.5 |
| | Macon | 27,664 | 23,499 | 4,165 | 17.7 | 4,542 | 19.3 |
| | Madison | 18,330 | 16,953 | 1,377 | 8.1 | 1,355 | 8.0 |
| | Mitchell | 14,729 | 14,433 | 296 | 2.1 | 406 | 2.8 |
| | Swain | 11,994 | 11,268 | 726 | 6.4 | 523 | 4.6 |
| | Transylvania | 27,845 | 25,520 | 2,325 | 9.1 | 2,224 | 8.7 |
| Watauga | 40,862 | 36,952 | 3,910 | 10.6 | 3,084 | 8.3 | |
| Yancey | <u>16,349</u> | <u>15,419</u> | <u>930</u> | <u>6.0</u> | <u>763</u> | <u>4.9</u> | |
| Forest Total | | 759,193 | 693,454 | 65,739 | 9.5 | 57,234 | 8.3 |
| Croatan | Carteret | 59,057 | 52,553 | 6,504 | 12.4 | 5,682 | 10.8 |
| | Craven | 88,475 | 81,613 | 6,862 | 8.4 | 627 | 0.8 |
| | Jones | <u>8,988</u> | <u>9,414</u> | <u>-426</u> | <u>-4.5</u> | <u>-533</u> | <u>-5.7</u> |
| Forest Total | | 156,520 | 143,580 | 12,940 | 9.0 | 5,776 | 4.0 |
| Uwharrie | Davidson | 140,442 | 126,677 | 13,765 | 10.9 | 9,100 | 7.2 |
| | Montgomery | 24,473 | 23,352 | 1,121 | 4.8 | 125 | 0.5 |
| | Randolph | <u>121,550</u> | <u>106,546</u> | <u>15,004</u> | <u>14.1</u> | <u>10,479</u> | <u>9.8</u> |
| Forest Total | | 286,465 | 256,575 | 29,890 | 11.6 | 19,704 | 7.7 |
| NFsNC Total | | 1,202,178 | 1,093,609 | 108,569 | 9.9 | 82,714 | 7.6 |
| North Carolina | | 7,431,161 | 6,632,448 | 798,713 | 12.0 | 502,758 | 7.6 |

Urbanization:

The NFsNC also are affected by the degree of urbanization in the region. The urban population is more demanding of recreation opportunities. Table 2-2 shows the degree of urbanization in the region as of the 1997 population estimates.

The Croatan National Forest is the most influenced by municipal residents. The Forest interfaces with the urban population to the east and south and almost one-half of the regional population lives in municipalities. This population will continue to increase and put more recreational demands on the Forest. The Nantahala, Pisgah, and Uwharrie National Forests also will be affected by the urban population, but to a lesser degree than the Croatan.

Table 2-2. Population and Municipal Population, 1997 Estimate.

| Forest | County | Population | Municipal Population | Percent Municipal |
|------------------------------|---------------|----------------|----------------------|-------------------|
| Nantahala/ Pisgah | Avery | 15,460 | 2,575 | 16.66 |
| | Buncombe | 191,122 | 83,295 | 43.58 |
| | Burke | 83,143 | 28,674 | 34.49 |
| | Caldwell | 74,728 | 34,819 | 46.59 |
| | Cherokee | 22,416 | 3,385 | 15.10 |
| | Clay | 8,066 | 382 | 4.74 |
| | Graham | 7,504 | 837 | 11.15 |
| | Haywood | 51,267 | 15,186 | 29.62 |
| | Henderson | 79,148 | 16,823 | 21.26 |
| | Jackson | 29,142 | 3,289 | 11.29 |
| | McDowell | 39,424 | 6,038 | 15.32 |
| | Macon | 27,664 | 4,519 | 16.34 |
| | Madison | 18,330 | 2,977 | 16.24 |
| | Mitchell | 14,729 | 2,244 | 15.24 |
| | Swain | 11,994 | 1,106 | 9.22 |
| | Transylvania | 27,845 | 6,528 | 23.44 |
| Watauga | 40,862 | 15,873 | 38.85 | |
| Yancey | <u>16,349</u> | <u>1,570</u> | <u>9.60</u> | |
| Forest Total | | 759,193 | 230,120 | 30.31 |
| Croatan | Carteret | 59,057 | 24,699 | 41.82 |
| | Craven | 88,475 | 53,048 | 59.96 |
| | Jones | <u>8,988</u> | <u>1,395</u> | <u>15.52</u> |
| Forest Total | | 156,520 | 79,142 | 50.56 |
| Uwharrie | Davidson | 140,442 | 37,064 | 26.39 |
| | Montgomery | 24,473 | 8,325 | 34.02 |
| | Randolph | <u>121,550</u> | <u>43,094</u> | <u>35.45</u> |
| Forest Total | | 286,465 | 88,483 | 30.89 |
| NFsNC Total | | 1,202,178 | 397,745 | 33.09 |

| | | | |
|----------------|-----------|-----------|-------|
| North Carolina | 7,431,161 | 3,791,030 | 51.02 |
|----------------|-----------|-----------|-------|

Sub-Issue 2.4 Roadless Areas/Wilderness/Wild & Scenic Rivers

a. Ensure that visitor use in Wilderness areas is within the estimated maximum level, which allows natural processes to operate freely and not impair the values for which wilderness areas were established.

Directions for wilderness are being followed and management activities are maintaining wilderness values. Use levels continue to be higher than desired in Shining Rock and Linville Gorge. Solitude is sometimes compromised in these Wildernesses. Some trail maintenance problems are surfacing in our wilderness areas. Backcountry areas outside of wilderness are being emphasized to relieve some of the use pressure.

The Grandfather District began a customer survey of hikers in the Linville Gorge Wilderness to gain information on their experience and perceptions. This complements the current GPSing of the trails in the wilderness, which will assess the trail conditions and provide basis for a more accurate map of the area.

As an offshoot of an air quality study being conducted in Joyce Kilmer/Slickrock, Shining Rock and Linville Gorge Wildernesses, we will gain some information on concentrated use areas, and be able to monitor over time the change in ground disturbance.

Sub-Issue 2.5 Timber

a. Determine if timber resource sale schedule is within the Forest Plan's ASQ.

The allowable sale quantity (ASQ), volume cut, volume offered and volume sold is displayed in Table 2-3.

TABLE 2-3

| Allowable Sale Quantity (ASQ) | Volume Goal for FY 98 | Volume Cut FY 98 | Volume Offered FY 98 | Volume Sold FY 98 |
|-----------------------------------|-----------------------|------------------|----------------------|-------------------|
| Nantahala/Pisgah 6.6 MMCF/year | 5.17 MMCF | 3.39 MMCF | 3.40 MMCF | 2.949 MMCF |
| Uwharrie/Croatan 1.8 MMCF/year | 2.01 MMCF | 1.36 MMCF | 1.73 MMCF | 1.48 MMCF |
| Totals = 8.4 MMCF/Year | 7.18MMCF | 4.75 MMCF | 5.14MMCF | 4.47MMCF |

b. Determine if silvicultural practices are in compliance with the Forest Plan.

The Nantahala and Pisgah Land and Resource Management Plan, dated March, 1994 provides for regeneration methods including group selection, shelterwood, two-age shelterwoods or shelterwoods with reserves, intermediate harvests (thinning), salvage harvest of damaged stands, and clear cutting when stand conditions warrant. Tables 2-4 AND 2-5 compares the projected regeneration methods from the LRMP with actual harvests for FY-98.

TABLE 2-4**Acres of Regeneration Methods in FY-98 with LRMP projections for Nantahala/Pisgah NFs**

| REGENERATION METHOD | LRMP PROJECTIONS | FY-1998 HARVESTS |
|----------------------------------|------------------|------------------|
| Clearcut/shelterwood (even-aged) | 235 | 127 |
| Two-Aged | 2532 | 654 |
| Uneven-Aged | 500 | 515 |
| TOTALS | 3267 | 1296 |

Regeneration accomplishments did not reach the acreage level projected for even-aged and two-aged methods. For the uneven-aged method the accomplishments were just over that projected by the LRMP. This was primarily the group selection method using conventional ground based harvesting equipment. Of all the community types, the availability of the early successional community type has the greatest bearing on presence/absences of associated wildlife MIS. If reduced regeneration continues declining as it has for the past 3 years, the forest will be unable to sustain the existing wildlife diversity.

Table 2-5**Acres of Regeneration Methods in FY-98 for Croatan/Uwharrie NFs**

| REGENERATION METHOD | LRMP PROJECTIONS | FY-1998 HARVEST |
|----------------------------------|------------------|-----------------|
| Clearcut/shelterwood (even-aged) | 729 | 135 |
| Two-Aged | 0 | 141 |
| Uneven-Aged | 0 | 0 |
| TOTALS | 0 | 276 |

c. Determine if harvested lands are adequately restocked within 5 years.

All areas regenerated in FY-93 have been adequately restocked either by planting or by natural regeneration from existing seedlings or by coppice methods.

d. Determine if maximum harvest unit size limits are being met and should be continued.

Maximum harvest unit size varies by management area for the Nantahala/Pisgah National Forest and for the Uwharrie/Croatan National Forests. For Management areas suitable for sustained timber production on the Nantahala/Pisgah the maximum opening size is limited to 40 acres except in MA 4d where the opening size is limited to 25 acres. The Uwharrie/Croatan LRMP limits opening size for Southern yellow pine to 80 acres and other species to 40 acres. However, most harvest areas are kept below the 40-acre threshold. Data from the Continuous Inventory of Stand Conditions (CISC) over the past 5 years (1994 to present) indicates a range in opening size for the Nantahala/Pisgah Forest from 1 to 40 acres with an average size of about 19 acres. For the Uwharrie/Croatan the range of opening size is from 3 acres to 41 acres with an average of 23 acres.

e. Ensure that no timber harvesting occurs on lands classified as not suited for timber production, except for salvage sales or sales necessary to protect other multiple-use values where the Forest Plan establishes that such actions are appropriate.

No known harvesting occurred on lands unsuitable for timber production other than to meet other resource objectives or for the purpose of salvage and forest health.

f. Determine if lands identified as not suitable for timber production have become suitable.

No lands unsuitable for sustained timber production have been identified by the districts as candidates to become suitable for timber management.

Sub-Issue 2.6 Forage

a. Determine if the desired forage production objectives are being achieved.

The only grazing on the National Forests in North Carolina is done with the objective of maintaining high-elevation balds. There are no forage production objectives.

Sub-Issue 2.7 Other Products

The Forest has a sizable Special Forest Products Program that includes the collection of moss, Galax, Fraser Fir seedlings and cones, shrubbery, and Ginseng roots. In FY-98 the Forest issued a total of 1,351 permits for special forest products with the largest number issued by the Appalachian district on the Pisgah National Forest. The Uwharrie and Croatan issued no permits in FY-98. Table 2-6 displays the total number of permits issued for the collection of special forest products, by Forest, for each quarter of FY-98.

TABLE 2-6**Number OF SPECIAL FOREST PRODUCTS ISSUED IN FY-98 BY FOREST**

| Quarter | NANTAHALA | PISGAH | UWHARRIE | CROATAN |
|---------|-----------|--------|----------|---------|
| 1 | 73 | 171 | 0 | 0 |
| 2 | 50 | 231 | 0 | 0 |
| 3 | 72 | 218 | 0 | 0 |
| 4 | 235 | 301 | 0 | 0 |
| TOTALS | 430 | 921 | 0 | 0 |

Sub-Issue 2.8 Heritage Resources

a. Ensure the protection of significant cultural resources from degradation and destruction

In FY 98, 9,423 acres were surveyed in compliance with Section 106 of the National Historic Preservation Act (NHPA), NEPA and the Archeological Resources Protection Act (ARPA). In this Forestwide survey, 518 archeological sites were identified, recorded and evaluated for significance. These figures brought Forest totals to date of inventoried acres to 154,123 and sites to 4,275.

Thirty (30) archeological sites regarded as susceptible to vandalism or looting, potential impact from project implementation, visitor use, and/or storm damage were visited and formally assessed and recorded.

Several sites on the Uwharrie show continued adverse impacts from illegal Off Highway Vehicle (OHV) use. Law enforcement patrols and surveillance need to be implemented. Three sites on the Croatan are subject to continued erosion from storms but the data is being preserved by data recovery excavations. In the previous year, 10 sites on the Croatan were eroding after Hurricanes Bertha and Fran.

One site on the Pisgah has been monitored several times. It is in an area prone to high visitor use and flooding. Erosion needs to be stopped. Plans are being developed to bring a solution to this problem.

At least 2 sites on every district within a project implementation area have been visited and monitored. Two sites were found to have adverse impacts from project implementation, timber sale skid road construction, and access for hanggliding. A road exposed very few artifacts and actually buried the more preserved portion of the site. The access for hanggliding was subsequently used by illegal OHV users. It is imperative we better coordinate site protection needs during all project implementation.

A badly looted site was assessed for damage and patrolled. The activity has since ceased, although no arrests have yet been made.

One site was bulldozed by unauthorized activities. An ARPA assessment and investigation was conducted. The court dismissed the charges in favor of a plea bargain and the Forest did not receive restitution.

Recommendation:

Law enforcement activity should focus on those areas where sites may incur damage from looting and vandalism.

Issue 3. Organizational Effectiveness

Sub-Issue 3.1 Economics

a. There is a need to document costs associated with carrying out the planned management prescriptions, as compared with the costs estimated in the Forest Plan. Evaluate radical deviations between planned and budgeted costs.

The estimated costs of managing the national forests were developed for each of the forest plans. The estimated cost for the Croatan and Uwharrie was \$3,171,000 (in 1978 dollars) and the cost for the Nantahala and Pisgah was estimated to be \$9,460,000 (in 1978 dollars) for a total of \$12,631,000 for the National Forests in North Carolina. Table 3-1 compares the forest budgets in actual and deflated 1978 dollars from 1986 to 1999.

The budgets for the National Forests in North Carolina almost approximated the planned budgets from 1986 to 1990. The peak year was 1992 and budgets declined until 1999, both in actual dollars and real (1978) dollars.

The implications for management are that the NFsNC have not been providing planned services since the forest plans were implemented. This is particularly true for road construction and timber harvest. Part of this reduction in outputs reflects a change in direction nationally indicated by the dramatic decrease in budgets beginning in 1995.

Table 3-1. Actual and deflated (1978 dollars) budgets for the National Forests in North Carolina 1986-1999. Includes Older Americans and Job Corps.

| Year | Actual Budget | Deflation Factor (1978) | Deflated Budget |
|------|---------------|-------------------------|-----------------|
| 1986 | \$20,505,817 | .613 | \$12,570,066 |
| 1987 | \$20,189,861 | .596 | \$12,033,157 |
| 1988 | \$21,734,856 | .575 | \$12,497,542 |
| 1989 | \$22,114,371 | .550 | \$12,162,904 |
| 1990 | \$22,298,658 | .529 | \$11,795,990 |
| 1991 | \$25,968,733 | .506 | \$13,140,179 |
| 1992 | \$27,887,565 | .492 | \$13,720,682 |
| 1993 | \$27,903,684 | .480 | \$13,393,768 |
| 1994 | \$25,936,250 | .471 | \$12,215,974 |
| 1995 | \$17,942,812 | .462 | \$8,289,579 |
| 1996 | \$17,232,263 | .453 | \$7,806,215 |
| 1997 | \$17,139,446 | .444 | \$7,609,914 |
| 1998 | \$17,484,454 | .434 | \$7,588,253 |
| 1999 | \$21,021,741 | .424 | \$8,913,218 |

Sub-Issue 3.2 Evaluating New Information

a. Identify emerging issues, concerns and opportunities that need to be addressed.

The list of emerging issues below is categorized according to the three primary monitoring issues.

Issues associated with ecosystem condition, health and sustainability:

- Controlling invasive exotic plant and animal species;
- Monitoring populations of management indicator species;
- Monitoring watershed conditions - specifically site productivity;
- Sedimentation of stream from recreational trails use;
- Spraying for gypsy moth- method or outbreak treatment
- Access management - road closure for resource protection conflicts with public desires for open roads.
- Effectiveness of Prescribed Fire.

Issues associated with sustainable multiple forest and range benefits:

- Leave-basal-area in 2-aged regeneration harvest areas - public perceives as virtual clearcuts;
- Use of linear wildlife openings by horses and bike riders;
- Sustainability of special forest products such as moss, galax, ginseng and other medicinals and ornamentals.

Issues associated with organizational effectiveness:

- Impacts of increased prescribed fire - workforce and NEPA;
- Increasing requests for special use permits - workforce for administration;
- Decreased ability to complete land exchange;
- Increasing FOIA requests and project appeals diminishing time available for actual fieldwork such as monitoring.

b. Determine when changes in RPA, policies, or other direction would have significant effects on Forest Plans.

No changes were identified for FY 1998.

c. Determine if conditions or demands in the area covered by the Plan have changed significantly.

No significant changes in conditions or demands were identified for FY 1998.

d. Evaluate the effects of National Forest

The single largest effect of National Forest Management is that the national forests draw people to the area as tourists and as new residents. People find the scenery attractive and the environment to their liking, so they visit and

Forest management on land, resources, and communities adjacent to or near the National Forest; and the effects upon National Forest management of activities on nearby lands managed by other Federal, State, or local government agencies.

sometimes move here. Management of the national forest resources such as timber and wildlife has occurred simultaneously with the continuous influx of more and more people and is a good indication that multiple-use management is a sustainable long-term proposition on these forests. Timber from national forests contributes to the local economy as well as providing raw material to support our American lifestyle. Reduced harvesting over the past three years has reduced raw materials available to support the local economy.

National Forests also serve as virtual fresh water factories, contributing to the availability of fresh water supplies for adjacent landowners and communities.

One unique event during FY 1998 that directly impacted a community was the manhunt for fugitive Eric Robert Rudolph. Rudolph was (and still is) believed to be hiding out in Nantahala National Forest, and Federal law enforcement agencies have set up a headquarters in Andrews, North Carolina, that has been in operation for well over one year.

Each year the Forest Service returns to the State Treasury Office 25 percent of the money received from production of goods and services on national forest lands. The treasury office then distributes these funds to county school systems. The amount is spread on a pro-rated basis by national forest acreage per county. The Bureau of Land Management also pays 75 cents per acre to North Carolina counties with Federal land. See Table 3-2..

TABLE 3-2

| FY 1998 PAYMENTS TO COUNTIES | | | | |
|-------------------------------------|------------------|------------------|--------------------|--------------------|
| COUNTY | ACRES | 25% FUND* | PILT** | TOTALS |
| Avery | 28,328 | \$8,924 | \$21,431 | \$30,335 |
| Buncombe | 31,464 | \$9,912 | \$24,651 | \$34,563 |
| Burke | 47,946 | \$15,104 | \$35,134 | \$50,238 |
| Caldwell | 49,391 | \$15,559 | \$35,870 | \$51,429 |
| Carteret | 56,776 | \$48,193 | \$48,037 | \$96,230 |
| Cherokee | 93,173 | \$44,421 | \$67,574 | \$111,995 |
| Clay | 65,717 | \$31,331 | \$47,659 | \$78,990 |
| Craven | 63,068 | \$55,533 | \$45,739 | \$99,272 |
| Davidson | 958 | \$905 | \$695 | \$1,600 |
| Graham | 113,251 | \$52,993 | \$82,135 | \$130,128 |
| Haywood | 68,821 | \$21,510 | \$95,148 | \$116,658 |
| Henderson | 17,295 | \$5,448 | \$12,734 | \$18,182 |
| Jackson | 76,930 | \$36,677 | \$57,881 | \$94,558 |
| Jones | 39,989 | \$33,944 | \$29,001 | \$62,945 |
| McDowell | 68,102 | \$21,454 | \$50,044 | \$71,498 |
| Macon | 152,700 | \$72,801 | \$110,675 | \$183,476 |
| Madison | 54,752 | \$17,248 | \$39,668 | \$56,916 |
| Mitchell | 18,615 | \$5,964 | \$13,801 | \$19,665 |
| Montgomery | 39,891 | \$37,695 | \$28,930 | \$66,625 |
| Randolph | 9,340 | \$8,826 | \$6,774 | \$15,600 |
| Swain | 22,201 | \$10,585 | \$173,820 | \$184,405 |
| Transylvania | 86,683 | \$28,040 | \$63,600 | \$91,640 |
| Watauga | 393 | \$124 | \$6,772 | \$6,896 |
| Yancey | 38,225 | \$12,042 | \$28,363 | \$40,405 |
| TOTAL | 1,243,469 | \$594,133 | \$1,126,136 | \$1,720,269 |

*25 percent of national forest receipts are returned to local school systems.

**Payment in Lieu of Taxes (PILT): 75 cents paid to counties for each acre of national forest and national park land.

1999 Monitoring and Evaluation Action Plan

The following actions are recommended for implementation during FY 1999:

1. Initiate tracking system for Supervisor's Office to evaluate stocking levels of naturally regenerated timber stands.

Responsibility: Forest Silviculturist

Completion Date: 9/30/2000

2. Continue the monitoring efforts at permanent points for salamanders, vegetation, and breeding birds to build the forest database that will allow trend information to become available.

Responsibility: Planning and Ecosystems Staff Officer

Completion Date: 9/30/2000