RESEARCH WORK UNIT DESCRIPTION Ref: FSM 4070	1. Number SRS-4104	2. Station Southern Research Station
	3. Unit Location Athens, Georgia 30602-2044	

4. Research Work Unit Title
Disturbance and the Management of Southern Pine Ecosystems

5. Project Leader (Name and address)
John Stanturf, Forestry Sciences Laboratory, 320 Green Street, Athens, GA 30602-2044

6. Area of Research Applicability	7. Estimated Duration
Southern United States	Five (5) years

8. Mission
Increase understanding and develop applications of disturbance to sustain the productivity and functions of southern pine ecosystems.

9. Justification and Problem Selection
The unit is co-located with other Research Work Units (RWUs) at the Athens Forestry Sciences Laboratory on the campus of the University of Georgia. One scientist and support personnel are located at Clemson University. The unit has responsibility for the Calhoun Experimental Forest near Union, SC and the Hitchiti Experimental Forest near Macon, GA, which is also the focus of the Brender Demonstration Forest operated under a cooperative arrangement with the Georgia Forestry Commission.

The geographic and disciplinary scope represented offers significant opportunities for collaboration contributing to the SRS Cross-Cutting Theme, "Sustainability and Productivity of Southern Pine Ecosystems." That scope includes elements and expertise from the following former RWUs: SRSE-4104, Ecology and Genetics of Southern Pine Ecosystems, Macon, GA; SRSE-4105, Mixed Pine-Hardwood Management in the Piedmont, Clemson, SC; SRSE-4106, Intensive Management Practices Assessment Center, Gainesville, FL; SRSE-4403, Smoke Management, Macon, GA; and SRSE-4701, Utilization of Southern Timber, Athens, GA. Ongoing and proposed work contributes to three broad strategic areas: (1) managing our resources for sustained and enhanced environmental quality and productivity; (2) understanding ecosystem structure, function, and processes; and to a lesser degree, (3) measuring and monitoring forest resources.

10. Approach to Problem Solution (Start at conclusion of item 9.)

Signature	Title	Date
Recommended:	Assistant Director for Research	
	Assistant to Staff Director	
	Staff Director	
Approved:	Station Director	
Concurred:	Deputy Chief for Research	

The research also contributes to the following Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests: Criterion 1, Conservation of biological diversity; Criterion 2, Maintenance of productive capacity of forest ecosystems; Criterion 5, Maintenance of forest contribution to global carbon cycles; and Criterion 6, Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies.

There is ample scientific evidence to establish that southern pine ecosystems are early-seral stages that have evolved in the presence of disturbance. Southern pines are both fire-tolerant and shade-intolerant: optimal germination and establishment occur on disturbed soil. Much is known about the autecology of pine species, but knowledge is scant about the influence of disturbance regimes on previously ignored ecosystem components and their importance to the overall health and productivity of the systems. Fire and other natural disturbances, such as storms (ice, hurricanes, tornados, floods), insects and diseases may have either positive or negative influences, depending on the specific ecosystem component. Season may be a particularly important variable to which little attention has been given relative to any ecosystem component. We know that the traditional season and weather conditions for prescribed burning do not coincide with the natural fire regimes under which southern pine ecosystems evolved. Hence, for example, to restore and perpetuate the longleaf pine-wiregrass complex, perhaps growing-season burns, rather than the traditional dormant-season prescribed fires, are necessary. Similarly, season of harvesting disturbance and post-harvest prescribed burn operations have been shown to dramatically influence the initial species composition of naturally regenerated stands in the Piedmont oak-pine and Upper Coastal Plain pine-hardwood types. Stand-replacement prescribed fires have been suggested to restore pine ecosystems of the Appalachian mountains, but it is not known if these fires will produce suitable habitat for key species. The ability to meet human needs and maintain ecological integrity is shaped by stochastic processes (fire, insects, diseases, invasive species, human activity, etc.) and extreme events that results from these processes. Disturbances can be sources of loss or opportunity in the aggregate. Management systems interact with multiple natural disturbance profiles and, in terms of their ecological effects, management systems in some ways substitute for natural disturbances. Deeper understanding of these processes, their interactions, and their effects may reveal opportunities for more effective management strategies. There is also much controversy and public misunderstanding about disturbance processes and the inevitable role of human behavior in these processes: residential development, recreation, infrastructure development, and other activities have not been well integrated into an overall theory or framework for disturbance assessment, response, planning and management. Knowledge is needed about the influence of natural disturbance regimes and their relationships to anthropogenic disturbances in southern pine and associated ecosystems in order to understand how to sustain their productivity and functions. Sustaining ecosystem productivity and functions requires better understanding of the role of disturbance in southern pine ecosystems (Problem 1).

Southern pine management relies primarily on prescribed disturbance regimes that produce some of the desired effects of natural disturbances. Such practices include classical regeneration cuts and modifications of them, thinnings, herbicides, mechanical site preparation, and prescribed burning. The techniques have traditionally been focused on timber production, game habitat and fuel reduction with little knowledge about their influence on other ecosystem components. There is a need to know how traditional practices affect tradeoffs among all the benefits and values and to consider a broader array of alternative practices. Questions even persist regarding use of some techniques for optimal timber production. For example, prescribed fire -- long used to control competition and reduce wildfire damage or losses -- is suspected on occasion to cause root damage and associated growth loss. Demographic and political considerations also drive the need for knowledge beyond direct resource management or of ecological effects and their trade-offs. Ecosystem restoration using stand-replacement fires has not been attempted on steep slopes: prescription guidelines are needed to ensure both ecosystem health and worker safety. Although fire may be the desired form of disturbance from the standpoint of commodity or direct ecological effects, smoke problems may dictate that alternative practices be devised for use near developed areas. Herbicidal vegetation control may easily minimize risk of erosion, but prudent

mechanical treatments may be more acceptable at the urban-forest interface. Hence, there is also a need to define the degree to which disturbance techniques may substitute for each other in an array of applications. Improved management practices that more fully emulate desirable influences of natural disturbance regimes are needed to attain productivity and sustainability objectives (Problem 2).

Prescribed burning is increasingly recognized as necessary to restore and maintain the health of southern forest ecosystems that have evolved under regimes of recurrent fire. Southern growing conditions favor rapid buildup of readily flammable forest fuels, which can be economically reduced through prescribed fire. However, the climate is also conducive to tourism and population growth, exacerbating concerns about the effects of fire on air quality. Reduced visibility from smoke has resulted in multi-car pileups, numerous injuries, heavy property damage and fatalities. Retirement communities attract a populace with above average respiratory problems and little understanding of forestry practices. Many developers use nearby forest land as a selling point -- the big back yard -- creating a dilemma for forest managers. They must burn more frequently to reduce wildfire risk to homes and businesses, thereby increasing the threat to air quality, or preserve air quality by not burning and increase the risk of destructive wildfire such as occurred during 1998 and 1999 in Florida. Widespread interest in restoration of fire-dependent communities, such as the diverse longleaf pine-wiregrass complex, compounds the problem. Unless more prescribed burning is done during marginal burn conditions, increasing use of prescribed fire for ecosystem management will add to smoke from traditional management. There will be either increased atmospheric loading of smoke during the most favorable burn periods or less extensive burning overall, because different organizations within a given locale will have to compete for available burn times. The probability of smoke incidents rises either from more prescribed burning or more wildfires. Thus, the smoke problem jeopardizes restoration and sustainability of fire-dependent forest ecosystems as well as does the increasing populace at the urban-forest interface. More reliable smoke prediction models that can be easily used by federal, state, and private land managers would expand allowable prescribed burn periods: this would permit burning a higher proportion of the desired acreage for all objectives within acceptable air quality standards. Land managers need tools to reliably predict smoke movement and dispersion in southern forests (Problem 3).

Southern forest management covers a broad spectrum of disturbance regimes to fulfill an array of demands. The effects of these cultural practices on wood anatomical, physical, and mechanical properties is not completely understood. Two extremes in disturbance regimes are represented by the ecological model that treats timber as one component of diverse ecosystems and the agronomic model, which treats timber as crop. It is expected that the ecological model used on national forests and some other lands will produce less volume, but higher wood quality, while the agronomic model used on industrial and some nonindustrial private land will produce greater volume but lower quality for many products. Quantifying the trade-offs between quality and volume for the full spectrum of management regimes and end uses is critical to sustaining pine productivity and realizing maximum utilization potential. Preliminary research shows that wood properties traditionally attributed to different species are heavily influenced by environment and management. For example, when loblolly pine and slash pine are grown at the same location under the same management, wood specific gravity and age of transition from juvenile to mature wood formation are very similar. Physiographic location has been found to have a strong effect on wood properties. However, this type of information is quite limited. To meet productivity and sustainability objectives, the effects of within tree, stand, environmental and forest management factors on southern pine wood properties need to be better understood (Problem 4).

10. **Approach to Problem Solution**

Problem 1. Sustaining ecosystem productivity and functions requires better understanding of the role of disturbance in southern pine ecosystems.

Because of their extent and importance, respectively, much attention will be devoted to the loblolly pine type and to the diverse longleaf pine ecosystem. Similarly, because of the importance of fire in many forest ecosystems, a significant effort will be focused on the role of this most common disturbance. The loblolly pine type occurs on 136 million acres across the South, much of it on nonindustrial private ownerships. The fire-dependent longleaf pine ecosystem occupies less than five percent of its original area and its continued decline risks the myriad life forms characteristic of, and largely dependent on, this system. Studies will concentrate on the following areas: the dynamics of coarse woody debris and its influence on biodiversity in immature loblolly pine sawtimber stands; influence of the type and scale of disturbance on regeneration and coarse woody debris in the longleaf pine ecosystem; influence of spatial heterogeneity and crown closure on plant and small-vertebrate community turnover in young longleaf pine-hardwood stands; the history of fire and its influence on southeastern forest ecosystems; long term effects of alternative fire regimes on site productivity, biological diversity and maintenance of old growth; the role of feeder-root damage in apparent fire-related tree mortality; the role of fire in regenerating table mountain, pitch, and Virginia pines; influence of soils, landforms and fire variables on regeneration of the endangered smooth coneflower; and the influence of season and intensity of harvesting disturbance on species composition and stand structure in Piedmont and Upper Coastal Plain mixed types.

Accomplishments expected within the next five years.

1. Complete study of longterm effects of dormant-season fire return intervals on arthropod and small mammal dynamics in the Coastal Plain.

2. Publish longterm effects of dormant-season fire return intervals on vegetative structure and composition in longleaf pine stands.

3. Continue research on the seasonal distribution and frequency of lightning to determine probable natural fire regimes that historically shaped the longleaf pine ecosystem; results will be disseminated via several outlets.

4. Continue research on the regeneration role of lightning-caused gaps in the longleaf ecosystem; results will be disseminated via several outlets.

5. Publish effects of defoliation on longleaf pine survival and growth.

6. Publish longterm effects of slash pine and loblolly pine defoliation.

7. Publish changes in mature, Piedmont loblolly pine structure and composition 10 years after dormant and growing-season fire treatments.

8. Expand research and publish three papers on the response of the endangered smooth coneflower to disturbance, including landscape-level burning.

9. Expand research on disturbance and the regeneration of table mountain pine/pitch pine stands in the Southern Appalachians to include: stand replacement fires, fire intensity effects on mycorrhizae, seedbed conditions, status of Appalachian pine communities, and a photo series for estimating Appalachian fuels. Results will be disseminated via a variety of outlets.

10. Complete joint final report with USGS on the effects of the 1998 Florida wildfires.

11. Establish a study to examine how an array of fuel conditions affected pine ecosystems during the 1998 Florida fire season.

12. Publish a chronosequence of coarse woody debris loading by Piedmont ecotype (Forest Ecology and Management).

13. Publish decomposition rates of loblolly pine and red oak coarse woody debris on xeric, mesic, and hydric sites in the Upper Coastal Plain.

14. Publish coarse woody debris dynamics in Upper Coastal Plain immature loblolly pine sawtimber stands.

15. Publish species composition and structure of naturally regenerated stands 20 years after dormant season and growing season whole-tree harvesting in the oak-pine type.

Environmental consideration: The studies in this problem area are expected to have little or no potential for soil movement, water quality degradation, or impact on sensitive resource values, and are, therefore, covered under FSH 1909.15 Chapter 30, "Categorical Exclusion from Documentation in an EIS or EA." Where environmental concerns exist regarding particular studies, these will be evaluated within individual study plans, or by Environmental Assessments or Environmental Impact Statements prepared with and approved by cooperating District or Forest staffs.

Problem 2. Improved management practices that more fully emulate desirable influences of natural disturbance regimes are needed to attain productivity and sustainability objectives.

This problem is closely related to Problem 1, but features research that has more direct and immediate application to management regimes. Some of the work builds on past silviculture research oriented towards timber production but expands on that work to examine the effects of the practices on multiple benefits and values. Because of increasing demands, timber production must actually be increased while providing for other benefits and values. Research topics include: effects of herbicides, site preparation, and mechanical fuel reduction on plant species diversity and on tree survival and growth; effects of mixed-species and landscape-scale management patterns on an array of benefits; effects of red-cockaded woodpecker habitat management on neotropical migratory bird habitat; implications of presettlement disturbance regimes for fire as a contemporary management tool in the Piedmont and Coastal Plain; site-specific guidelines for prescribed fire by Piedmont ecoclass; effects of fire variables on tree growth; understanding health, maintenance and restoration in the longleaf pine ecosystem; and effects of high intensity fires versus clearcutting on understory vegetation, pine regeneration, snags, and coarse woody debris in the sand pine scrub with implications for sustainability of this unique ecosystem.

Accomplishments expected within the next five years.

1. Establish landscape-level studies of ecosystem health tradeoffs between prescribed fire and other fuel reduction treatments in the southeastern Coastal Plain and in the Piedmont as components of a national study of prescribed fire and its surrogates for fuel reduction (contingent on Joint Fire Science Program funding).

2. Continue research quantifying the characteristics of sand pine communities regenerated by catastrophic fires to determine if similar productivity is sustained in stands regenerated by clearcutting and direct seeding; results will be disseminted via various outlets.

3. Publish fuel consumption and emission models for major southern fuel types.

4. Establish a Joint Fire Science Program-funded research site to examine smoldering combustion products from coarse woody debris.

5. Develop and publish a classification of fuel-loading characteristics by ecotype in the Upper Coastal Plain.

6. Establish research on dry sandhills, flatwoods, and savannahs to develop mechanical/herbicide/fire treatments for restoring the structure of fire-deprived longleaf communities to healthy functioning systems.

7. Expand longleaf pine restoration research at the Savannah River Site, SC to include reintroduction of associated species and determine the significance of canopy gaps.

8. Present early stand development of planted longleaf pine following silvicultural treatment (Society for Ecological Restoration).

9. Present impact of thinning and understory removal in longleaf pine stands (International Vegetation Management Conference).

10. Complete measurements and publish ten-year results on mixed-species management techniques for biological diversity in the Piedmont and Upper Coastal Plain.

11. Establish demonstration areas on the Calhoun Experimental Forest, SC for two-aged and unevenaged mangement of Piedmont pine and pine-hardwood mixtures (in cooperation with the Francis Marion-Sumter NF).

12. Publish 10-year loblolly pine growth resulting from various Piedmont site preparation treatments.

13. Publish effects of six levels of site preparation on survival and growth of loblolly pine in the Piedmont.

14. Expand research to include the influence on understory vegetation and loblolly pine growth of six levels of site preparation in combination with precommercial thinning versus no thinning 20 years after stand establishment.

15. Publish floristic diversity eleven years after chemical site preparation and planting (Canadian Journal of Forest Research).

16. Publish effects of root configuration on survival and growth of planted loblolly pine seedlings (Canadian Journal of Forest Research).

17. Expand research on root configuration to include planted slash pine and loblolly pine on both Coastal Plain and Piedmont sites.

18. Publish comparison evaluation of treatments designed to maintain habitat for the endangered red-cockaded woodpecker.

19. Present crown development within loblolly pine stands (International Symposium on Canopy Research).

Environmental consideration: Most of the studies in this problem area are expected to have little or no potential for soil movement, water quality degradation, or impact on sensitive resource values and are therefore covered under FSH 1909.15, Chapter 30, "Categorical Exclusion from Documentation in an EIS or EA." For research involving the use of herbicides, environmental considerations will be

evaluated within individual study plans, or by Environmental Assessments or Environmental Impact Statements prepared with and approved by cooperating District or Forest Staffs. If any of these studies have the potential to affect a plant or animal species that is Federally listed as endangered or threatened or proposed for such listing, the RWU will consult with the U.S. Fish and Wildlife Service as per Section 7 of the Endangered Species Act of 1973, as amended.

Problem 3. Land managers need tools to reliably predict smoke movement and dispersion in southern forests.

Research will be focused on two different efforts: computer modeling and validation to predict nighttime smoke movement into low-lying areas; and development and validation of daytime smoke movement and dispersion models.

Night Smoke Movement Models

The philosophy behind PB-Smoke, the general nighttime model, is to simplify the smoke prediction problem by modeling only those weather phenomena that force movement of smoke near the ground at night under clear, nearly calm conditions. PB-Smoke is a system that is considerably more than a computer wind/smoke model; it includes the necessary programs to decode, correct, select, and process weather data downloaded from the Internet. The system contains software enabling a user to interactively select the model domain from digital elevation model data surrounding a prescribed burn site. Hence, it is important that users understand how to run PB-Smoke and that their computer systems are adequate for the model; this requires a substantial technology transfer effort by the Smoke Management Team. Furthermore, airborne light-enhanced remote sensing/image analysis is the only means by which an entire smoke plume can be tracked at night. This validation method combines cutting edge technology in night remote sensing with proven image analysis techniques. The Smoke Management Team will continue design modifications and refinements to the remote sensing platform and imaging optics for a night sensing video camera equipped with GPS; the camera is mounted on an aircraft supplied and operated by Region 8 personnel. An additional outcome of this work may be a new operational technology by which forest managers can routinely monitor smoke movement by air in starlight.

The nighttime smoke models are designed to be applied locally to specific physiographic areas of the South. Three versions are envisioned: PB-Piedmont, PB-Coastal Plain and PB-Mountains. PB-Piedmont will be applicable for the Piedmont and into the Coastal Plain to locations approximately 10 miles away from the Atlantic and Gulf coasts. The Piedmont model is designed for terrain consisting of shallow stream basins and stream valleys with ridges rising no more than 150-200 feet above the streams. PB-Coastal Plain is needed to predict smoke movement in those forests located within approximately 10 miles of the Atlantic and Gulf coasts. Unique atmospheric circulation may be generated near coastlines caused by differing temperatures, drag, and moving water. These circulations can move smoke in unexpected directions. PB-Mountains is needed where elevation differences between valleys and ridge tops are greater than 200 feet. Two factors unique to this terrain are buoyancy (associated with steep slopes) and pressure fields (generated by weak winds over high mountains that influence flow in nearby valleys). The Piedmont, Coastal Plain, and Mountains models will be developed in that order.

PB-Piedmont has been installed for testing by a limited number of users. Although there has been a concerted effort to develop and test the model under various conditions, terrain, and real and analytical data, users will undoubtedly encounter flaws in the model code as it is applied to specific conditions. Thus, unit personnel will need to correct code and upgrade the model as these errors are discovered. Further needed development includes: improved land use parameterization; locate, acquire, process, and format the required data sources for user-specific needs; extend the model to alternate computer

operating systems; and develop additional code to calculate smoke concentrations in addition to locations.

PB-Coastal Plain will require major additions to the existing PB-Piedmont. Sea breezes and nocturnal land breezes that form near the coast are of a smaller scale than is measured by the standard National Weather Services network. Modifications in the model are necessary to account for land breezes and sea breezes and their effects on smoke movement. River/tidal currents can also affect smoke movement because weak surface drag and slight downslope flow with moving water can transport smoke relatively rapidly along waterways. River currents at a given location are fairly constant except for periods of high water. Tidal currents, however, are constantly changing over both space and time. Dealing with the fluctuations will require development of a second model to predict tidal flow. The modifications noted for PB-Piedmont will also be necessary.

PB-Mountains will require a series of model simulations with empirical data and with actual conditions matched with direct observations to determine the conditions under which the fundamental model assumptions break down. These tests should reveal whether PB-Piedmont can be used in the mountains, modified, or abandoned altogether in favor of more complex three dimensional mesoscale models. These models do not lend themselves easily to the kinds of smoke movement problems usually encountered by users nor are they user-friendly. PB-Piedmont will at the very least have to be modified to account for slopes greater that 15% and the wave flow and shear generated by weak winds over high mountains. The modifications noted for PB-Piedmont will also be necessary for PB-Mountains.

Accomplishments expected within the next five years:

1. Complete and disseminate models for monitoring smoke movement at night (the greatest threat to transportation) that are being developed for the Piedmont and Coastal Plains of the Southeast.

2. Develop a model for monitoring smoke movement at night for the mountainous areas of the Southeast.

3. Convert all models into predictive smoke models by coupling with predicted weather data from National Weather Service models.

4. Develop critical evaluation data sets for night models using light-enhancing video camera mounted on aircraft.

Day Smoke Management and Dispersion Models

Daytime smoke models have existed for some time and are generally much less complex than nighttime models must be. The following elements would, however, lay the groundwork for improved model development and application that can be easily used by regulators and state and private landowners: investigate smoke dispersion as a function of plume structure; collect data on smoke production and dispersion for validation of smoke dispersion models; develop baseline smoke concentration criteria based on objective measurements for input into State smoke management plans; and develop a daytime version of PB-Piedmont smoke models for easy access by users and regulators and make it predictive.

Accomplishments expected within the next five years.

1. Design a project to investigate smoke dispersion as a function of plume structure
   - Radar and/or lidar measurements of concentration
   - Nephelometer baseline measurements of concentration.

2. Collect a smoke production and dispersion data set for validation of smoke dispersion models
   - National application of data
   - Include weather, fire parameters, smoke plume structures.

3. Develop baseline smoke concentration criteria based on objective measurements for input into state smoke management plans.

4. Develop a daytime version of the PB-Smoke models for easy access by users and regulators and make it predictive.

Environmental consideration: The studies in this problem area are expected to have little or no potential for soil movement, water quality degradation, or impact on sensitive resource values, and are, therefore, covered under FSH 1909.15 Chapter 30, "Categorical Exclusion from Documentation in an EIS or EA." Where environmental concerns exist regarding particular studies, these will be evaluated within individual study plans, or by Environmental Assessments or Environmental Impact Statements prepared with and approved by cooperating District or Forest staffs.

Problem 4. To meet productivity and sustainability objectives, the effects of within tree, stand, environmental and forest management factors on wood properties need to be better understood.

The emphasis of this research is on relating basic wood properties to within tree, stand, environmental and management factors that affect southern pine wood formation. Juvenile/mature wood, sapwood/heartwood and earlywood/latewood content, specific gravity, tracheid length and microfibril angle are related to dimensional stability, strength, stiffness and grade of pine products. Understanding the effect of wood formation factors on wood properties will provide knowledge to develop forest management practices targeted to development of specific wood properties and modeling to predict basic wood properties. Research efforts in this area will rely on the availability of trees with a known history, thus utilize material from Forest Service, university, and industry studies and other well-documented stands across the South. Research will concentrate on: determining the influence of intensive silvicultural practices such as vegetation control, fertilization and genetically improved seedlings on basic wood properties and on primary lumber grade, strength and stiffness; quantifying the effects of ecosystem management strategies on species composition, heartwood formation for red-cockaded woodpecker cavity habitat, and product quality for pine stands in the Piedmont and Coastal Plain; development of a user-friendly tree grading system for pine; and development of taper functions for FIA estimates of southern tree species stem volumes.

Accomplishments expected within the next five years.

1. An easy to apply, visual tree grading system for estimating lumber and veneer grade yields from young and mature southern pine will be available for National Forests, FIA, industry and NIPL.

2. Form-class segmented profile functions for estimating stem diameter at a known height, height at a known diameter and volume between any two heights will be developed for southern tree species for FIA volume estimation.

3. Guidelines for applying ecosystem management practices to increase heartwood formation for red-cockaded woodpecker cavity habitat and species diversity will be available for Piedmont and Coastal Plain National Forests.

4. Knowledge on the effect of within tree, stand competition, geographic location (rainfall and growing season length) and intensive management practices on basic wood properties will provide

forest managers with guidelines for managing for specific feedstock wood properties.

5. Equations will be available to predict whole core and annual ring specific gravity, percent latewood, tracheid length, micro fibril angle and length of juvenility using geographic location, site index, soil class, rainfall, temperature, tree and stand characteristics as independent variables.

Environmental consideration: The studies in this problem area are expected to have little or no potential for soil movement, water quality degradation, or impact on sensitive resource values, and are, therefore, covered under FSH 1909.15 Chapter 30, "Categorical Exclusion from Documentation in an EIS or EA." Where environmental concerns exist regarding particular studies, these will be evaluated within individual study plans, or by Environmental Assessments or Environmental Impact Statements prepared with and approved by cooperating District or Forest staffs.

11. **STAFFING AND BUDGET**

This research program will require 7 scientists per year long term. Distribution of SY's through the 5-year term is as follows:

Problem Area	Scientist Years For Each Year Of RWUD				
	1	2	3	4	5
1	3	3	2.5	2.5	2.5
2	3	3	2.5	2.5	2.5
3	1	1	1	1	1
4	1	1	1	1	1

The scientific staff is currently 7 permanent scientists, one of whom is the Project Leader, and one postdoctoral position. Currently there are 6 permanent fulltime professional/technical support positions, 2 clerical positions, and 6 temporary FTEs.

Full implementation of this Research Work Unit Description would require the following budget:

FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
1,804,000	1,865,000	1,929,000	1,994,000	2,062,000

The FY 2000 President's budget request is $1.789 million, which is within 1% of estimated needs. The yearly increases are based on permanent salary increases of 4% per annum and an inflation rate of 2%. Funding below these levels would force concentration towards three or four study areas, based on various criteria. Evidence is accumulating that fire is much more important in Piedmont and Appalachian ecotypes than has been recognized: there is so little past research in this area that the payoff is likely to be high for the funds invested. As the urban-forest interface grows in extent and complexity, there will be a critical need for alternatives to prescribed fire in all ecotypes. Smoke models are in high demand by the National Forest System, other federal agencies, and Southern States; there is little financial support from this clientele, although in-kind contributions are substantial and there is a high level of political support. There are continual requests from industry and consultants for wood properties research results; this area has a solid record of using appropriated funds to leverage sponsored funding, and should continue to deliver a high return on Forest Service funds invested. Activities that would receive lower priority with limited funding include prescribed fire in the Coastal Plain, multiple use/ecological effects of silvicultural practices in the loblolly pine type, and demonstrations on the Calhoun Experimental Forest in South Carolina.