THE BIOLOGICAL POTENTIAL AND ECOLOGICAL FACTORS OF SMALL WOODLOT ECOSYSTEMS IN NORTH CAROLINA

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FOREWORD

On May 2, 1978, the Honorable James B. Hunt, Jr., Governor of North Carolina, convened his Advisory Task Force on Small Woodlot Management. The purpose of the Task Force was to help the citizens of North Carolina realize the potential of their forest resources.

North Carolina ranks fifth among the states in area of commercial timberland. Over 245,000 small woodlot owners own eighty percent of the forestland, but these lands are producing only forty percent of their potential.

Reforestation, good management, and selective cuttings are difficult to practice on small woodlots, especially, when so many owners are involved. In addition, marketing opportunities plus social and technical factors compound the problem.

The subject-matter covered in both Parts I and II is a general descriptive analysis and evaluation of the biological potential and ecological factors of small woodlot ecosystems. Part I serves as an introduction, which also includes a statement of objectives and recommendations for the consideration of the Task Force. Part II is a general descriptive essay on small woodlot ecosystems.

This report was presented for review, evaluation, and use by the Task Force in the preparation of its final report and recommendations which were presented to the Governor on October 3, 1978.

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What is wood?

"To the botanist, wood is xylem. To the physicist, it is a stiff, fibrous jelly or gel. To the chemist, it is ligno-cellulose which a dash of minerals caught up in water from the roots. To the archaeologist, wood is man's first building material and possibly his first tool. To Noah, it was buoyant salvation; to Joyce Kilmer, a miracle still. For the violinist, the archer, or the architect, this oldest of structural materials is still in many ways the best--and getting better: sturdy, rich, natural, elegant, eminently workable, strong for its weight (with a higher ratio of crush strength to density than iron or steel), yet just elastic enough to resonate for the violinist or pianist or--for the architect--to bend a little and recover without breaking during an earthquake. And the clincher: wood is renewable, the one renewable building material nature provides to humankind." (Courtesy of a brochure provided by The Kopper Company)

SMALL WOODLOT ECOSYSTEMS

Position Statement

Biological Potential and Environmental Factors

of Small Woodlot Ecosystems[1]

PART I

Each woodlot is a collection of physical and chemical environments, trees, shrubs, small plants, animals and people. It may possess natural or planted stands of trees in which one or more tree species make up half or more of the growing stock. Stands within each woodlot may occupy different habitats with each habitat exhibiting a different biological potential for producing timber and other forest benefits.

The biological potential of the woodlot forest is the basis for its attractive economic and environmental values. The total tree contribution to these values includes not only the interior stem which provides fiber and lumber, but bark, flowers, fruits, roots, and leaves which provide food and shelter for many types of animals and prevent erosion and contribute to water quality. These assemblages also create aesthetic landscapes that lift one's mind and spirit and expands the total value of a woodlot.

By being firmly rooted in the ground, the tree has an interrelationship with the soil, air, and water which further enhances the quality of life of all living things. Thus the woodlot should be treated as an ecological unit or ecosystem.

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[1]The subject covered here is treated in greater detail in specific references in the attached document: Biological Potential for Timber Production on Small Woodlots in North Carolina, Part II.

As the living (biological things) and non-living (soil, air, water) components of the woodlot ecosystem interact with one another, many changes occur in the plant and animal populations. Even the soil, water, and air undergo changes. As a result, there are many types of woodlot ecosystems in North Carolina. The following are the most common: Loblolly Pine, Pond Pine, Shortleaf Pine, Virginia Pine, Oak-Pine, Upland Hardwood, and Bottomland Hardwood. Of these, the upland hardwood and bottomland woodlot ecosystems appear to be the most stable under the prevailing natural conditions (soil and climate) in the state. Once these two woodlot forests are established, they undergo little appreciable change in growth forms, even when managed for timber.

The hardwood forest woodlot is the most favored by the environment. Nature is constantly pressuring all the other woodlot forests to change in that direction. Thus, the hardwood woodlot maintenance cost will be minimal, while that of the pine woodlot will be high.

On the other hand, the pine forest woodlots are among the most productive within the state. They are of a forest type most closely tied to the industrial complex in the North Carolina economy. Historical records show that a goodly portion of the virgin hardwood forest was in pine forests, which were believed to have been originated and maintained by Indians and naturally caused fires.

Associated with the various types of pine-forest-woodlot ecosystems, as well as the hardwood types, is a diversity of plant and animal life, which makes North Carolina one of the outstanding natural areas in the nation. Within this diversified forest cover are found many kinds of game and non-game animals, all interrelated and interdependent upon one another and upon the vegetation. Some of the plants and animals have national recognition. The State recognizes ninety-one endangered or threatened species of plants, twenty-three species of birds, three mammals, and ten amphibians and reptiles. Among some of those that have gained national attention is the red-cockaded woodpecker of the loblolly pine woodlot forest, Bachman's warbler and the southern bald eagle of the bottomland hardwood forest, and the sweet pitcher-plant in the bogs of the upland hardwoods.

Like a patchwork quilt, the small woodlot ecosystems representing all stages of pines and pine-hardwood cover the State. Their distribution and arrangement provide an environmental complex highly suitable for multiple-use management. They consist of a network unit of many types of forests, which, when combined, can provide the maximum benefits of timber, wildlife, water, recreation, and landscape.

The management of this diversified woodlot-forest complex, for its maximum benefits to the State's economy and citizens' needs, is probably one of the greatest challenges facing land managers of the 20th Century. Yet, the problem is unique because these small woodlot forests have individual owners. To compound the situation, most of these owners have neither the professional training nor the economic motivation to manage their woodlots, either on an individual basis or as a member of a network management-unit complex. The present woodlot owners are not of the same socio-economic status as past owners. Records show that the present majority of forest woodlots are the result of fallow farmland that has been allowed to revert to pine forests. The land has passed through several ownerships since it was first used for farming.

Regardless of the forgoing conditions, the need for motivating the present woodlot owner is strongly indicated. Analysis of woodlot ownerhips throughout the State shows that the majority of owners are professional people - doctors, lawyers, teachers, business people, and others. Generally, these people do not look upon woodlots as management units for income purposes. It is more likely that they consider these woodlots as property to hand-down to heirs, or as long-term real estate investments. Some may use their woodlots for the location of second homes and leisure activities.

The majority of the present woodlot-owner generation seems to have deep and abiding appreciation for the environment. Most of them have developed a strong environmental ethic that says use the natural renewable resources, but do so in such a manner and by such means as to protect the environment.

With a well-planned and professionally directed orientation program, these owners can be motivated to manage their property as part of a Network Management-Unit Complex (NMUC) of multiple uses as previously described. Herein then lies the challenge for the State government and industry to develop such a relationship. The ultimate benefit is that the State can retain its outstanding natural heritage and experience economic growth through utilizing a policy that has been developed and implemented by its own people.

STATEMENTS OF OBJECTIVES AND RECOMMENDATIONS

Objective

Service foresters and extension specialists are to communicate to small woodlot owners the importance of their property as a natural heritage and also its contribution to the State's economic growth.

Recommendations:

1. Conduct workshops for landowners to provide orientation programs on the ecological and economic potential of their property.

2. Provide through various media a general educational and public relations program on the ecological and economic significance of various woodlot types. This would include:

   (a) Providing a simplified explanation and demonstration of the ecosystem concept and how it is applicable to the individual woodlot type.

   (b) Emphasizing the importance of maintaining a diversity of woodlots for the multiple-use aspect.

   (c) Full explanation of being a participant in NMUC: the economic benefits, short- and long-term.

   (d) Full indoctrination on the environmental benefits to the State and its citizens.

Objective

To develop a pilot project of NMUC's throughout the State. Each NUMC will consist of a cluster of different small woodlot types (different stages from pine to hardwood forests) that will provide for maintaining the State's environmental integrity, and simultaneously provide the maximum benefits of timber, wildlife, water, recreation, and landscape.

Recommendations:

1. The State's universities can use the woodlot complex as outdoor laboratories for the study of silviculture, forest ecology, endangered and threatened species, watershed management, recreational pursuits, and a host of other activities.
2. The NMUC's can be used as demonstration areas to show and explain the State and landowner cooperative relationships and its results.

SMALL WOODLOTS IN NORTH CAROLINA

(Biological Potential for Timber Production)

PART II

Objective

To provide for the maximum timber production in specific woodlot ecosystems that is compatible with maintenance of wildlife, water, recreational pursuits, and rare and endangered species.

Woodlots as Ecosystems

Each woodlot is a collection of physical and chemical environments, trees, shrubs, small plants, animals, and people. It may be natural or planted stands of trees in which one or more tree species make-up half or more of the growing stock. Each woodlot has a range within which the stands occupy certain habitats, and each habitat has a biological potential for producing timber and other forest benefits. Thus, the woodlot is an ecological unit-system or more commonly termed as an ecosystem (Boyce 1975b).

As the living and non-living (substrate and climate) components of the woodlot ecosystem act and interact with each other, various dynamic changes will occur in the developing plant and animal populations as well as their associated physical environment. The accumulative results of this system of changes move toward an equilibrium characterized by increasing stability between the increasing populations and their physical environment. The ultimate trend is for the system to attain a long-term stability which is chacterized by low productivity, constant species composition, and little or no structural change in plant and animal communities.

By applying the foregoing concept, some woodlots will be managed as simplified systems which contain one or two tree species, but will have high productivity. The natural tendency will be for this system to move toward the increasing equilibrium stability unless maintenance is applied to prevent invasion of plants and animals and to maintain soil fertility. When other management strategies of a woodlot require a more diversified assemblage of plants and animals to provide specific benefits, the equilibrium pressure will remain, but it will be less severe, and maintenance less costly. Productivity of a particular species of tree will be lower. These environmental conditions will continually confront the woodlot manager. For example, the 1974 North Carolina Timber Survey (Knight and McClure 1974) reported that the majority of small woodlots consisted of mixtures of both hardwoods and softwoods as a result of natural regeneration. Although the encroachment of hardwoods tends to reduce the more commercially favored pine, they and their associated shrubby and herbaceous species tend to promote an ecological stability to the system. Various studies have shown that ecosystem stability increases as natural succession progresses (Odum 1969, Whittaker 1970, and Drury and Nisbet 1973).

As stability increases in the pine-hardwood ecosystem, the frequency of insect infestation and destructive pathogens generally decreases. While on the contrary, these conditions are more likely to occur at a higher frequency in the less diversified single-tree species stands (Elton 1977).

Woodlot ecosystems, whether managed as a single tree species or as a natural regenerating stand of several tree species, will represent in part and collectively the state's natural environment. Some woodlots, because of their historic development and location, can be managed intensively for maximum timber yields. Others that now contain assemblages of plants and animals, that contribute to the State's outstanding recreational and natural resources, will require diversified management to provide timber, and yet retain their environmental integrity.

Woodlot Ecosystem as an Island

Because of their small size and distributional pattern throughout the State, woodlot ecosystems are similar to island ecosystems. They may be surrounded by an entirely different environment such as a city, pasture, or cropland. Some may abut or be contiguous to outstanding natural features such as parks or natural preserves. Thus, they come under the ecological influence of these adjacent systems and in like manner, they may exert their own influence on the neighboring environment. They are subject to pollution, wildfires, and invasions of both beneficial and harmful organisms. They are dynamic, developing systems that are subject to change.

Analogous to island ecosystems (Pickett 1976) the woodlot ecosystems vary in the speed of invasions, population sizes and dynamics, species richness, and successional stage development as determined by proximity of woodlots of greater age. They are under the influence of the total environmental complex.

Woodlots vary from pure pine stands to stands of pine and hardwood mixture to stands of pure hardwoods. Within the State the following seven major "island-like" woodlot ecosystems can be distinguished (Chaiken 1973): (1) Loblolly Pine; (2) Pond Pine; (3) Shortleaf Pine; (4) Virginia Pine; (5) Oak-Pine; (6) Upland Hardwood; and (7) Bottomland Hardwood.

Biological Potential of Woodlots

The biological potential of a forest has been defined by Boyce (1975a) as the total organic matter production. Later he (Boyce 1975b) provided a comprehensive explanation of the concept. He states that "the total amount of organic matter produced in a forest is the gross primary production" (Figure 1). A large part of the organic matter is used by the green plants for respiration. The remainder is the net primary production that goes into wood, bark, flowers, fruits, roots, and leaves of both timber and non-timber species. Some of this material provides food and shelter for animals. Organic matter going into timber is limited by the amount of net primary production of timber species, by diversions of non-timber parts of trees, and by material eaten by animals and damaged by diseases, weather, fire, and other agents.

The accumulated fraction of net primary production expected to become timber is the biological protential for timber production. This can be stated as the amount of timber, limited only by biological constraints, that can be expected in a given time with specified silvicultural practices. This definition recognizes that timber is a fraction of ecosystem production and that silviculture can divert production of the ecosystem to or from timber, wildlife, or other segments of the system.

Because of the various types of woodlot ecosystems, the biological potential for timber production will vary across the mountain, piedmont, and coastal provinces of the State. Some woodlots will be capable of high timber production, while others, although a timber source, will provide opportunities for recreation, wildlife, and aesthetic landscape. The management of woodlots on the multiple use basis is now being done with computer modeling. These cybernetic exercises utilize the ecosystem resources data base to guide woodlot management to maintain specific population levels of plants, wildlife, and provide timber (Boyce 1977).

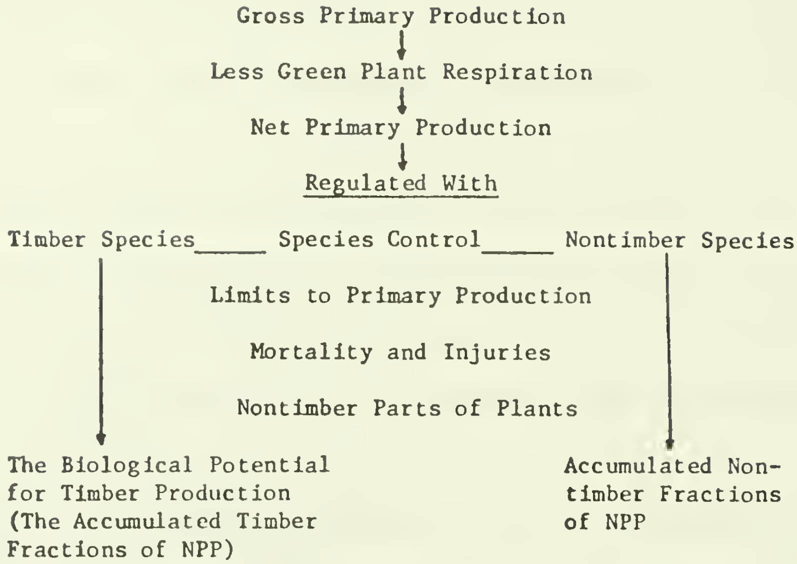

Figure 1. The relationship of the biological potential for timber production to ecosystem production. Arrows indicate potential partitioning of organic matter. Boyce (1975b)

Management of Woodlot Ecosystems for Their Biological Potential

If woodlot ecosystems are to attain the biological potential to produce timber, and yet retain the benefits of wildlife, water, recreation, and endangered and threatened species, they will require intensive multiple use management. In most woodlot systems it is not likely that all of the foregoing benefits can be achieved for one particular type woodlot unless a large acreage is available. However, on the other hand, in following the island ecosystem concept, groups of small acreage lots that are contiguous or within close proximity of one another, could be managed as a single-unit-network to meet most or all the resource needs.

The unit-network management technique is an application of the holistic concept in ecology that recognizes each woodlot system to be an interrelated and interdependent unit of a common group of systems that function as one. In like manner a woodlot of large acreage, i.e. of optimum size, can provide all the benefits because it too is a combination of a variety of systems.

The foregoing environmental strategy is manifested in natural succession throughout the coastal, piedmont, and mountain provinces of the State. Consider the various stages of community or system developments that occur in producing a loblolly pine woodlot ecosystem. When agricultural land is retired, or a similar disturbance exposes mineral soil, a plant successional pattern is initiated that favors pine establishment. Oosting and Humphries (1940), after studying old fields in the piedmont, found that these areas were first invaded by a series of herbaceous plants which were later followed by broom sedge grass. Later in the next stage of invasion and establishment (seral), the loblolly pine appeared and dominated as a shrub-small tree for ten years.

On reaching maturity within thirty-forty years, the loblolly pine may be considered at its optimal ecological development. This assumption has value if one looks back and evaluates each of the seral stages in their order of succession. As each stage developed, an increase in the number of plant species and associated animal life occurred simultaneously. This increase in different life forms was possible because with each seral stage more available habitats were created. Therefore, as succession progresses, the species diversity increases, which brings greater stability to each stage or community. As a larger number of organisms are able to occupy the same site, and yet while some compete with others for the specific environmental needs, the majority are developing into a complementary association. Thus as succession progresses and species diversity increases, the developing systems show greater stability in the plant and animal populations. Associated with the developing stages are greater soil stability, ground water, local climate amelioration, and landscape values. By the time the pine stand has formed, the horde invasions and sharp competitive replacements that characterize the earlier serals has decreased.

By reviewing the various stages of developments from a retired cropland to the pine forest, it is readily noted that each stage has a combination of resource benefits that are unique, and that could meet a specific management objective. Where several woodlot sites are aggregated, it would be possible to manage them as a unit-network, wherein each could provide a seral stage benefit that reflects the change from a grassland-forb community to a pine forest. It is also possible to convert any part of a large pine woodlot to any one of the earlier seral stages.

The loblolly pine woodlot ecosystem is also unstable. It, too, is subject to dynamic ecological change unless specific management practices are employed. The potential natural (climax) vegetation for the three provinces in North Carolina is hardwood forest. Thus the prevailing climatic condition and other associated ecological factors keep the successional trend moving forward until a long-term stability in the system occurs.

Oosting and Kramer (1946) found that the replacement of pine by hardwoods was primarily the result of light competition. In the pine woodlot ecosystem, or where an opening occurs in the hardwood forest, invasion of hardwood species occur rather quickly. Here several stages occur where the hardwood trees increase and pine trees decline, until eventually the stand is dominated with hardwood species. Species diversity continues to increase as the final stage of succession is approached.

Endangered Species

Each woodlot has a unique assemblage of plant and animals that characterize its specific benefits. Some species, because of their rarity, have become endangered or threatened mainly because a particular stage of the successional pattern has not been preserved or maintained. The variety of ecosystem woodlots found throughout North Carolina and their associated seral development can provide an assortment of habitats for endangered species. The management of woodlots to provide these diversified habitats will be a challenge for the manager.

A list of the endangered and threatened vascular plant species in North Carolina are shown in Tables 1 and 2. Table 1 has been compiled from both the state and national lists.

The national list (Ayensu and DeFilipps 1978) reports 20 endangered species for North Carolina. However, on reviewing the national list and comparing it with the state list, the following discrepancies were found:

Table 1. Numbers of Endangered Plant Species in North Carolina - National and State Lists

Number on National List[1]

Endangered	Threatened	Extinct	Total
20	55	2	77

Number on North Carolina's List[2]

Endangered Endemic	Endangered Throughout	Endangered Disjunct	Threatened Endemic	Threatened Throughout	Threatened Disjunct	Extinct	Exploited	Total
20	14	13	4	31	3	6	9	91

Endemic---- native only to N. C., and possible adjacent parts of neighboring states; found in small areas

Disjunct--- rare segment in N. C., separated by several hundred miles from main area of distribution (other states or countries)

Extinct --- endemic species known to have existed in N. C. during earlier times, but no longer found in the state

Exploited - collected for private and commercial uses

[1]Ayensu and DeFilipps (1978)

[2]Hardin et al (1977)

Table 2. Location of 19 Endangered Plant Species in North Carolina - National List

Species	Common Name	County(ies)[1]	Major Woodlot Ecosystems in County(ies)[2] (plants may or may not be in forest type--data insufficient)
Cardamine micranthera	Small-anthered Bittercress	Pitt	-swamp seeps
Carex biltmoreana	Biltmore Sedge	Buncombe	Upland Hardwood
		Haywood	Upland Hardwood -heath balds
		Macon	Upland Hardwood
		Rutherford	Upland Hardwood
Geum geniculatum	Bent Avens	Avery	Upland Hardwood
		Mitchell	Upland Hardwood -heath balds
		Watauga	Upland Hardwood
Geum radiatum	Spreading Avens	Ashe	Upland Hardwood
		Avery	Upland Hardwood
		Buncombe	Upland Hardwood -cliffs, grass, & heath balds
		Caldwell	
		Mitchell	Upland Hardwood
		Stokes	Upland Hardwood; Oak-Pine?
		Watauga	Upland Hardwood
		Yancey	
Glyceria nubigena	Smoky-mountain Mannagrass	Avery	Upland Hardwood -balds
		Swain	Upland Hardwood
Hexastylis naniflora	Dwarf-flowered Heart Leaf	Cleveland	Oak-Pine? -deciduous communities
		Lincoln	Oak-Pine
Hudsonia ericoides ssp. montana	Mountain Golden Heather	Burke	Upland Hardwood?; Oak-Pine -cliffs
Isotria medeoloides	Small Whorled Pogonia	Harnett	Loblolly Pine? Hardwoods or Oak-Pine?
		Henderson	Upland Hardwood; Oak-Pine?
		Surry	Upland Hardwood; Oak-Pine? -stream border of deciduous communities

Table 2 (con't)
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Kalmia cuneata	White Wicky	Bladen	Pond Pine; Bottomland Hardwood
		Cumberland	Pond Pine; Bottomland Hardwood
		Hoke	Bottomland Hardwood
		Moore	Oak-Pine?-ecotones of bays & savannahs, bogs, pocosins
		Pender	Pond Pine; Bottomland Hardwood
		Richmond	Shortleaf Pine
		Scotland	Bottomland Hardwood
Lindera melissaefolia	Southern Spicebush	Bladen	Loblolly Pine? Pond Pine;Bottomland Hardwood
		Cumberland (?)	-wet flats, sandy sinks, pond margins
[3]Lindernia saxicola	Rock False Pimpernel	Cherokee	Shortleaf Pine; Oak Pine -stream bed of Hiwassee River
Portulaca smallii	Small's Portulaca	Cabarrus	
		Forsyth	Shortleaf Pine; Virginia Pine
		Franklin	Loblolly Pine -granite outcrops
		Granville	Loblolly Pine; Shortleaf Pine; Oak-Pine
		Rowan	Shortleaf Pine; Oak-Pine
		Wake	Loblolly Pine; Oak-Pine
Pyxidanthera barbulata var. brevifolia	Wells' Pyxie-moss	Brunswick	
		Harnett	Loblolly Pine -xeric woodlands,pocosin, pine barrens
		Hoke	
		Moore	Loblolly Pine; Oak-Pine
Sagittaria fasciculata	Bunched Arrowhead	Buncombe(extirpated)	Upland Hardwood - Swamps
		Henderson	Upland Hardwood
Sarracenia jonesii	Sweet Pitcher-plant	Henderson	Upland Hardwood
Sedum rosea var. runensis	Roseroot	Caldwell	
		Mitchell	Upland Hardwood
		Yancey	
Shortia galacifolia	Oconee Bells	Burke(var. brevistylis)	Upland Hardwood; Pine-Oak -Stream Margins
		McDowell (var. brevistylis)	Upland Hardwood?
		Macon(not native)	
		Swain(not native)	
		Transylvania	Upland Hardwood

Table 2 (con't)
Page 3

Thalictrum colleyi	Cooley's Meadowrue	Brunswick	Loblolly Pine; Pond Pine - Savannahs
		New Hanover	Loblolly Pine; Pond Pine
		Onslow	Loblolly Pine; Pond Pine
		Pender	Loblolly Pine; Pond Pine
Trillium pusillum var. virginianum	Carolina Trillium	Nash	
		Pender	Loblolly Pine; Pond Pine -Low hardwoods, savannahs
		Wake	Loblolly Pine; Oak Pine

[1] Hardin (1977)

[2] Chaiken (1973)

[3] Species listed as extirpated by Hardin et al; Pittillo believes it to be extinct

List and localities compiled with the assistance of Dan Pittillo, Western Carolina University, Cullowhee, NC 28723

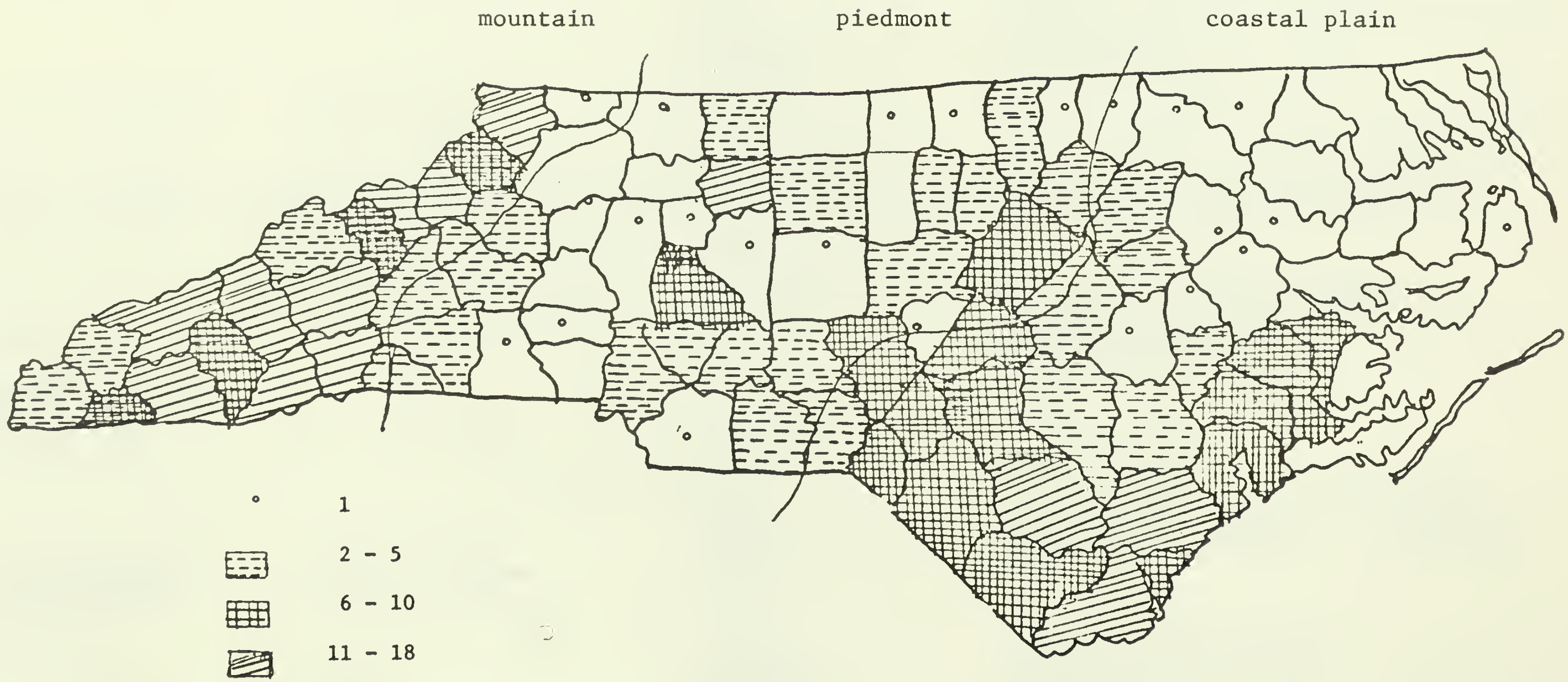

Figure 2. Distribution of the 91 extinct, endangered, or threatened plant species, as indicated by the number of species in each county.

(1) the national list shows an endangered grass Panicum mundum which is not in the North Carolina list, and it also is not listed in the state flora; (2) the species Shortia galacifolia var. brevistyla in the national list is not recognized as a separate variety from Shortia galacifolia. In addition, the national list does not report Sedum rosea var. roanense as endangered. Therefore 19 species are shown on the national list in Table 2. However, it is readily noted that the state lists 57 species as being endangered. The distribution of the state's 91 extinct, endangered, and threatened plant species are shown in Figure 2.

Locations of the 19 endangered plants are shown by county in Table 2. The woodlot ecosystem forest types for the county are also shown, however, this does not indicate that the endangered species necessarily inhabits this vegetation type. The purpose is to alert woodlot managers of the plant's presence in the county. Also woodlot managers may want to help propagate the species in their management program.

The endangered bird species in North Carolina by woodlot ecosystem forest types, are shown in Figure 3.

General Description of Major Woodlot Ecosystems

Loblolly Pine Woodlot Ecosystem

The loblolly forest is the largest vegetation type in the State, occurring mostly in the coastal province. Meyers and Johnson (1978) have provided the following description of the vegetation and its associated bird fauna:

The loblolly pine forest may occur separately or with shortleaf pine, but generally it comprises fifty percent (50%) or more of the canopy. Other tree associates in smaller numbers are oak, hickory, and sweet gum.

BIRDS OF WOODLOT ECOSYSTEMS

	Woodlot Ecosystems						
Bird Species	Loblolly Pine	Shortleaf Pine	Virginia Pine	Pond Pine	Oak-Pine	Upland Hardwood	Bottomland Hardwood
Brown Nuthatch	—	—	—	—			
Golden Crown Kinglet	—	—	—	—			
Woodthrush	—	—	—	—	—	—	
Magnolia Warbler	—	—	—	—			
Blackburnian Warbler	—	—	—	—			
Pine Warbler	—	—	—	—			
Hooded Warbler					—	—	
Parula Warbler							—
*Bachman's Warbler							—
Rufus-sided Towhee	—	—	—	—	—		
Dark-eyed Junco	—	—	—	—			
Cardinal	—	—	—	—	—		
Yellow-breasted Chat	—	—			—	—	
Summer Tanager					—	—	
Carolina Wren	—	—			—	—	
Carolina Chickadee	—	—			—	—	
Blue-gray Gnatcatcher					—	—	
Tufted Titmouse	—	—			—	—	
Yellow-throated Vireo					—	—	
Red-eyed Vireo					—	—	
Yellow-billed Cuckoo					—	—	—
*Red-cockaded Woodpecker	—	—	—	—			
Pileated Woodpecker							—
Red-bellied Woodpecker	—	—			—		—
Swamp Sparrow							—
Acadian Flycatcher							—
Wood Duck							—
Green Heron							—
Great Blue Heron							—
Black-crowned Night Heron							—
*Southern Bald Eagle							—

Figure 3. Dark lines indicate those woodlot ecosystems where a bird species is more likely to be found. Data from both winter and breeding populations. (Information from Meyers and Johnson (1978) and Sanders USFS personal communication).

* Endangered Species

As previously described, the loblolly system is considered to be a developmental stage in a successional sere that climaxes in a hardwood forest (oak-hickory). Earlier historical accounts indicate that extensive parts of the original hardwood forest were covered with pine forest, because of fire and agricultural activities of the Indians.

The general successional pattern on old fields consists of first a herb and grass stage which lasts about five years. In second stage, pines invade and begin to shade out the broom sedge grass. Occurring along with pine are various shrubs and small deciduous trees until the canopy closes (Oosting 1942, Johnston and Odum 1956). Within twenty years the pine closes leaving small clumps of ground stratum plants. In the later stages a shade tolerant hardwood understory occurs that by sixty to one hundred years later is well developed. Eventually these hardwoods will replace the original pine forest. Many different types of habitats develop during this transition.

There are numerous bird species associated with the various seral stages of the loblolly woodlot ecosystem. Some of those most likely to be seen in this type forest are shown in Figure 3.

As the pine-hardwood phase of the system begins to develop, numerous bird habitats are provided by the forest stratification. Three vertical strata are recognized: a ground story, a shrub story, and an overstory. Lightning strikes, red heart diseases, the southern pine beetle, and various other factors cause openings that create uneven age classes, which further add to the habitat diversity and increase of bird species. This relationship of forest stratification and increase of breeding bird species has been reported by other investigators (MacArthur and MacArthur 1961).

As the pine forest grows older and mature stands occur, it becomes the habitat for the red-cockaded woodpecker, which is now on both the state and national endangered species list (Figure 3). The red-cockaded woodpecker breeds in open, mature pine stands. In most instances the nest tree is infected with red heart disease, but it is mature and living. In providing suitable nesting sites for the red-cockaded woodpecker, managers will have to use a rotation period that will maintain mature trees. It is not likely that this endangered species can survive where all trees over thirty-five years are harvested. However, where the multiple-use policy provides for a diversified age class, then not only can the red-cockaded woodpecker survive, but the benefits of timber, water, wildlife, and recreation can also be realized.

There are many reasons to believe that wildfire helped maintain a high species diversity in the primeval hardwood-pine forest. The red-cockaded woodpecker has been observed feeding near fire lines of controlled burns. Although it is now questionable whether controlled burns are favorable, it is still possible to stimulate high species diversity through harvesting and silviculture methods.

Oak-Pine Woodlot Ecosystem

The oak-pine forest type varies in percentage of both dominant trees. Generally the classification is satisfactory if the total coverage percentage of each growth form (oak-pine) is given. Evans (1978) provides the following description of the vegetation and bird fauna of this ecosystem:

The oak-pine forest type is seral to the oak-hickory. It may also occur when disturbances occur in the oak-hickory forest and pine invades the open area. The successional pattern follows pretty much that as previously described for the loblolly pine ecosystem.

Oak-pine forests that develop in the piedmont province may contain considerable amounts of black gum and yellow poplar. After forty years, the oak-hickory forest components begin to dominate if disturbances do not occur (Oosting 1942, Johnston and Odum 1956).

After an oak-pine forest is clearcut, the entire range of oak-pine forest components will occur in the various successional stages of development within the cleared area. This large variety of tree species and levels of forest stratification creates a diversity of habitats for many species.

One of the most useful seral stages for wildlife support is the "brush stage" that developes in the first ten or fifteen years after a regeneration cut. To manage this ecosystem for its full biological potential for both timber and wildlife will require a full vegetation complement consisting of mature trees, dead trees, shrub layers, and a wide edge effect.

Soil conditions have been found to affect both the structural and species composition of the developing oak-pine forest. Specific soil types and fertility have a high influence on the quality and quantity of food and cover.

It has been estimated that three hundred to four hundred species of birds may use this area in the southeast United States either as migrants, for breeding, or wintering purposes. A list of some of those species one is likely to see in this forest type in North Carolina is shown in Figure 3.

Upland Hardwood Woodlot Ecosystem

This forest type is found from one thousand to forty-five hundred feet, and it covers various landforms such as coves, ravines, and moist slopes. Its phenotypic profile is probably more characterized by the cove forests. Hooper (1978) has provided the following description of the vegetation and bird fauna of this ecosystem:

The cove forests are rich in tree species. Over thirty species are known to occur, and as many as six or eight may dominate one stand (Braun 1967, Davis 1930, Whittaker 1956). Some species such as yellow poplar, black walnut, black cherry, and white pine have high commercial value. Some virgin stands still exist in the Great Smoky Mountains National Park, and these have been the subject of considerable ecological study (Whittaker 1956).

Cove forests vary in several cover types. These cover types grade from oak to oak-hickory, and oak-pine communities on less mesic sites. At the cooler and more humid higher elevations, common cover types are beech-birch, northern red oak, and spruce-fir. In ravines and valleys along stream courses the Canadian hemlock dominates.

Several tree and shrub strata may be recognized in these forests, primarily the result of a regenerating stand. Various height classes of all dominant tree species are available for bird habitat. These and the shrub stratum of rhododendron and other species continue to add to the habitat's richness. The opportunity for niche openings are numerous, and as a result the animal fauna is rich. Many game animals such as deer, bear, squirrel, and turkey are present. The cove forests have high stability, and readily recover from various disturbances in canopy openings by man or natural disaster.

Sixty-two bird species are found throughout the various seral stages of the forest cover types. A list of those birds likely to be found in the upland hardwood ecosystem is shown in Figure 3.

Generally, because of their high stability and also their ability to recover from timber harvesting, these forest types could be one of the most productive of woodlot ecosystems. In the same manner, they offer considerable wildlife, water, and recreational opportunities.

It is reported that stand rotations on a hundred year basis would provide most all bird habitats now found in a virgin stand. There is some reason to believe that rotations of seventy to eighty years on specific sites could provide similar results. Clearcuts of one to twenty-five acres are capable of providing successional stage habitats for nearly sixty species of birds.

The cove forests offer challenging management opportunities to maintain plant and animal species diversity while providing timber and other benefits. The various successional stages of vegetation, that follow clearcuts or selective harvesting, provide a variety of habitats for numerous species.

Bottomland Hardwood Woodlot Ecosystem

The bottomland hardwood ecosystem probably has one of the most productive and unique species assemblages of all the woodlots. Dickson (1978) has provided an extensive account of the vegetation and bird fauna which is recounted below:

Physiographically, the various forest types cover two major lifeforms. The first lifeform is a broad bottomland, which was formed by the present river system. This area is subject to periodic flooding which devastates some plant life, but brings high nutrient content to the soil for the advantage of others. Terraces are the second landform that formed from the original drainage system. These high ridges or bluffs do not become inundated during normal periodic flooding.

The physiographic features and their associated soil types support a large variety of trees and shrubs. Because of the periodic flooding of the bottomland area, the herbaceous ground story there does not have the species richness of that in the bluff forest.

Dickson (1978) has described the forest types of this ecosystem in greater detail than those found in the previous ecosystem descriptions. Eight bottomland hardwood forest types have been recognized. These are as follows: (1) Sweetgum-water oak which is found on terrace flats, bottom flats, and ridges; (2) White oak-red oak on bottom ridges; (3) Hackberry-elm-ash on low ridges, flats, and sloughs; (4) Overcup oak-bitter pecan on wet flats and sloughs; (5) Cottonwood on land ridges and dry flats; (6) Willow on low flats; (7) Pecan, sycamore, elm-ash-hackberry on all front lands except sloughs and swamps; and (8) Cypress-tupelo on low flats, deep sloughs, swamps and river estuaries.

This high composition of tree and shrub species and their diverse stratification creates a rich habitat environment for many faunal types. The bottomland forests are well-known for their variety of game animals such as deer, squirrel, and turkey (Stransky and Hall 1968). There are many non-game birds. Some, such as the rare Bachman's warbler and the southern bald eagle, are on the national and state endangered species lists (Figure 3). These forest types tend to support large populations, probably surpassing the cove forests. One study of a bottomland hardwood forest in east Texas revealed that the bird density there was greater than that in a pine or a pine-hardwood forest type (Anderson 1975).

Habitat management of this system will require a complex scheme to maintain its species diversity and habitat richness. Consider the following conditions: (1) Wood ducks which feed on hardwood mast are common; (2) the yellow-billed cuckoo is a high canopy dweller; (3) the parula warbler builds its nest in Spanish moss, a plant species that festoons trees in moist habitats; and (4) the Bachman's warbler whose nesting habits are associated with bottomlands and swamps, which are flooded for short periods (Hooper and Hamel 1977). To maintain or increase species diversity, managers should manipulate stands for plantings, thinnings, and harvesting that provide a variety of foliage layers. In addition, they must provide for natural or periodic floodings, which are natural perturbations which maintain these forest systems.

Extension and Research

The small woodlot ecosystem, when managed under a policy of self-renewal and species protection, will not only be productive, but will also preserve and promote the State's natural heritage. Some, because of their unique natural features, will become outdoor laboratories for scientific research and educational pursuits.

The management of small woodlots for their biological potential will require an extensive information base on the various resources. Although considerable data are now available, these will need to be accumulated, synthesized, and projected. Implementation of the ecosystem concept will require additional data, and above all a bold commitment for managers to change some well-entrenched practices of forest management. The average woodlot owner will need considerable advice and assistance from the extension service. The transfer of the information will involve more of an educational approach, rather than that of direct application. For example, extension assistance should be given more on the empirical approach, so that the woodlot owner will have a general understanding of the technical and scientific reasoning for specific recommendations.

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