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WILDLIFE AND BIOLOGICAL DIVERSITY IN ARKANSAS FORESTS

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INTRODUCTION

Certain interest groups have expressed concern about the loss of wildlife habitat following application of forest management practices. Politicians are listening to their concerns and are proposing legislative action to restrict certain practices. Some of these groups feel, in particular, that even-aged management is very detrimental to some wildlife species. However, some foresters claim that even-aged management will increase forest productivity and may also increase biological diversity and provide improved wildlife habitats. Which viewpoint is correct? Is forest management good or bad for wildlife?

Wildlife is obviously important to Arkansas. The state was once known as the "Bear State." Place names such as Bear, Bearden, Birdeye, Birdsong, Crows, Falcon, Fox, and others suggest the importance that wildlife has here.

Arkansas is richly diverse in soils, topography, forest types, and wildlife. It is estimated that 366 species of birds frequent the state (17)[3], there are 8 orders and 72 naturally occurring species of mammals (25); in addition there are 79 species of reptiles and 56 species of amphibians in Arkansas (1), and 2,469 species of plants (26).

Species once abundant in Arkansas such as the passenger pigeon, ivory-billed woodpecker, red wolf, elk, and buffalo are no longer present. Many existing species of plants and animals are in rare or endangered categories. A large portion of Arkansas wildlife depends partly or wholly on forestsfor its livelihood.

Forests benefit from Arkansas in other ways. Today, sport hunting is a major activity and industry in Arkansas. Many citizens plan their vacations to coincide with the opening of their favorite hunting season. The first day of gun deer season is treated almost like a state holiday. There also is a vast army of citizen conservationists who just love to be in the forest to hike, bird watch, and enjoy nature. Fall foliage colors are also a special attraction. Arkansas forests are indeed beautiful, and they attract out-of-state tourists as well as Arkansans. Today Arkansas is known as "The Natural State."

The basic concern addressed in this paper is whether forest management is compatible with maintaining the biological diversity that contributes to these and other values. This is of concern to all Arkansans – not just one special interest group or one profession. The consequences of not maintaining biodiversity may not be felt immediately. Eventually, however, a major decline in diversity could adversely affect the lives of all our citizens (21).

DEFINITIONS AND BASIC PRINCIPLES

Wildlife includes not only game species of mammals and birds, but all terrestrial vertebrates (animals with spinal columns) and many other species such as frogs, turtles, and marine animals.

Biodiversity is the variability among living organisms and ecological complexes in which they occur (22). It can be expressed mathematically as a function of the number of different species present and their relative frequencies.

Biodiversity can be measured at different scales. *Alpha-diversity* is diversity within a particular stand

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3.Numbers in parentheses identify the particular reference resource in the 'LITERATURE CITED' section.

or treatment area. *Beta-diversity* is diversity within several stands, forest units or compartments. *Gamma-diversity* is the diversity over a larger geographic area, such as an entire region (31).

Biota is the plant and animal life (flora and fauna) of an area. A *community* is the collection of all living organisms of all species in a given area (11).

Forest succession is the orderly, natural replacement of one community with another. A *sere* is a stage in the successional process. The *climax* stage is the final community or stage in succession that is able to perpetuate itself, barring disturbance.

A *forest type* is a distinct community, such as the oak-hickory type of loblolly pine-shortleaf pine-oak type. Each will have a distinct collection of animal species that prefer that type as habitat. And each successional stage of a give forest type will constitute a distinct community of plants and wildlife.

Success occurs because plant species differ in their ability to compete with each other for limited resources such a light, nutrients, and water. The plant species that compete most successfully for limited resources will eventually dominate an ecosystem over time.

An important correlate of plant succession is succession of the animal community. As a forest community changes, so do the number and types of habitats available for animal inhabitants of that forest. For example, in a very young even-aged pine stand, there will be many bird species that prefer the open canopy, but then as the trees grow and the crowns close, these species will seek new locations When the land manager thins a forest stand, there will be an increase in abundance of these open-canopy obligates again. As forest succession progresses towards the climax stage, bird species richness generally increases (20). Thus each seral stage in a forest's succession is inhabited by a unique set of wildlife species.

Succession begins when an ecosystem is disturbed and one or more openings are created. Disturbance has always occurred in ecosystems from windstorms, floods, fires, insects, diseases, and countless other causes. Before Europeans came to North America, Native Americans often burned the forest and cleared and cultivated agricultural fields (7). Thus man has been a part of North American ecosystems and an agent of disturbance for thousands of years.

Stand, or alpha-diversity, normally is greatest in mature forests. These offer a high degree of structural diversity; that is, their canopies generally have multiple layers. Mature climax forests also usually have abundant snags, dead and down woody material, broken tree tops, and cavities in living trees.

On most Arkansas soils, the shade-tolerant hardwoods such as hickory, many oaks, maple, and ironwood, tend to be the climax species. Hardwood-dominated forests tend to have a richer biota than pine-dominated forests. Hardwoods have broader leaf surfaces and more irregular branching patterns thereby providing more foraging surfaces. Hardwoods have more cavities than do pines (18).

Hunter (14) notes that throughout the world there is always one local community that has more diversity than any other local community. However, he felt it would be a mistake to allow this community to monopolize a region. Landscape (gamma) diversity will be greatest in a region with forests that differ in species composition and structural form.

EFFECTS OF FOREST MANAGEMENT

The effects that a forestry practice has on diversity depend on the scale of diversity under consideration, the type of community being treated, and the relative rarity of that community within the landscape. Ironically, a forestry practice implemented within one stand can affect alpha-diversity in one way while affecting beta- and gamma-diversity differently. For example in a large hardwood-dominated forest, converting a stand to pine would reduce alpha-diversity but increase gamma-diversity (5).

Forest regeneration – Foresters manipulate forest succession through silvicultural practices such as clearcutting, seed-tree, shelterwood, and selection reproduction cuttings. These silvicultural practices usually increase beta-diversity. Where all or a large portion of the overstory is removed, much more sunlight reaches the forest floor and generally more

soil moisture and nutrients become available to ground vegetation. This usually results in a profusion of grasses, herbs, forbs, and sprouts. Although species dependent on mature forests amy decline, this early flush of vegetation provides preferred habitat for many other species of wildlife. Browsing animals such as deer and rabbits will multiply. Birds such as white-eyed vireos, common yellowthroats, yellow-breasted chats, prairie warblers, indigo buntings, cardinals, quail, and others will be attracted to this early successional stage (6, 8, 9).

Various types and intensities of *site preparation* are often applied to help assure satisfactory survival and growth of economically preferred timber species. Types included prescribed fire, chemical, mechanical, or a combination of these.

Site preparation affects wildlife communities by further altering the plant community. Cover, soft mast production, and populations of arthropods, birds, and some mammals have been shown to be inversely related to the intensity of site preparation (19). Intensive mechanical site preparation, such as drum chopping or KG blading, generally removes more vegetation than other methods and destroys the root systems of most woody vegetation (28). A light site preparation method, such as prescribed fire, that does not destroy root stocks yet prepares a seedbed, can often enhance species diversity (30) and the quality of forage (29).

Thinnings – Foresters prescribe thinnings of forest stands to reduce competition and promote growth of desirable trees. Thinning permits more light to reach forest layers below the upper canopy, often resulting in increased plant vigor and greater diversity of plants and animals (2, 3, 24). As light intensity increases, the level of digestible energy in leaf matter also increases (4).

Thinning a forest canopy enhances vertical diversity and stimulates growth of all plant strata. After a period of time, the increased growth will close the canopy again. Therefore, the intensity of the thinning and the frequency of thinnings will be important factors in types of plants and animals favored.

Prescribed fire – Prescribed burning in Arkansas is generally limited to pine forests. Such burning tends to retard succession by reducing understory hardwoods and shrubs, and favoring growth of herbaceous and grassy vegetation (10). Prescribed burning tends to reduce coverage of understory woody vegetation, thereby temporarily reducing soft mast production. However, top-killed woody plants sprout and increase the amount of tender browse within reach of grazing animals.

Repeated annual summer burns can greatly reduce ground cover and alter the composition of the forest understory. Understory woody vegetation will be replaced by forbs and grasses and the stand will develop into an open park-like condition. Burning alters the habitat, and in turn, the variety and quantity of wildlife that will follow.

Fire has long been a management practice used to favor habitat for ground-feeding birds such as bobwhite quail and wild turkey (27). However, fire is seldom used in hardwood forests because hardwood bark does not adequately protect the tree's cambium, and fire damage can make entrance points for wood decay organisms that may gradually progress up the tree.

Herbicides – Herbicides are chemicals used to control unwanted vegetation long enough for a preferred trees species to get a good start. The effect of herbicides on vegetation varies with the method and time of application, and the chemical used. Herbicides reduce understory biomass, but the effects of most herbicide applications seem temporary. Diversity of plant species seems to be most reduced by broadcast application of herbicides; however, even here, species composition appears to return to pre-treatment status within one or two growing seasons (15, 16). Repeated application of herbicides could greatly reduce the coverage of woody vegetation. However, the benefits generally would not be worth the cost; therefore, repeated applications are seldom made.

Only herbicides approved by the Environmental Protection Agency are used in forest management applications. Most have very low toxicity to humans and other animal life. In addition, because of their high cost in relation to returns, they are used at very low volumes per acre and usually only once or twice during the life of a stand. Their short-term effect depends on the size of the area treated, the season

applied, and the type and quantity of chemical used. The wildlife community is affected by the subsequent change in the plant community.

Edge effect – Some wildlife species tend to prefer edges between different forest types and different age classes. For these species, forest managers can improve the amount of edge by keeping treatment areas relatively small and of irregular shape. Recently, however, wildlife biologists have voiced certain concerns about edges. Some studies have shown that predation rates may be high in them (12).

Some species of plants and animals prefer forest interiors as places to live (23). For these interior-dwelling species, manager should maintain large stands of older forest and link smaller stands with corridors such as streamside management zone buffer strips retained to protect the quality of surface waters.

RESEARCH NEEDS AND OPPORTUNITIES

Many questions about forest management-biodiversity relationships remain unanswered. For example, greater research is needed on the effects of:

- application of various herbicides at varying rates and seasons.
- complete wildfire exclusion
- prescribed fires of varying intensities, seasons, and intervals.
- timber product removals at varying rates and spatial distributions
- soil compaction by logging equipment
- non-management of wilderness areas
- forest recreational activities
- streamside management zone buffers of varying widths
- acid rain and global warming.

The list is a long one. The more we learn, the more we need to learn to take advantage of the many multiple-use opportunities of Arkansas forests.

SUMMARY

Is forest management good or bad for wildlife? The answer to this question must always be, "It depends." It depends upon the wildlife species in question, the forestry practices used, and the context in which they are applied. Forestry should be labeled as either "good" or "bad;" it is neither a panacea nor a poison. As with any science, its value depends upon how and where it is used.

Forestry is not incompatible with maintaining biodiversity in Arkansas. In many instances, forest management can be used to introduce more diversity into a landscape or into individual stands. For example, in the Ozark Region where 74% of the forests are oak-hickory, development of pine and pine-hardwood forest types has enhanced diversity.

Arkansas has abundant biodiversity. Approximately half of its land area remains in forests. As of 1988, 6.9% of our total forest was in pine plantations, 17.4% in natural pine stands, 17.7% in mixed oak-pine, 42.1% in upland hardwoods and 15.9% in bottomland hardwoods (13).

Cooperative management of this diverse resource by forestry and wildlife professionals will assure a continuing flow of economic, ecological, and social benefits for residents and visitors to "The Natural State."

FURTHER INFORMATION

This briefing paper is one of a series prepared and published in the public interest by the 250-member Arkansas Division of the Society of American Foresters ("SAF"). These are not policy position statements. They are summaries of relevant knowledge developed through research, surveys, and documented experience under Arkansas or similar conditions. Their purpose is to help Arkansas become better informed about Arkansas forests, forestry issues, and professional practice as applied under Arkansas conditions.

Two editions are available on each topic – a detailed technical briefing paper ("TBP"), which includes a list of source materials (such as this one), or a one-sheet popular-style briefing paper ("BP"). They are available from: James Geisler, Public Affairs and Communications, Arkansas Division, SAF, PO Box 391, Little Rock, AR 72203. Telephone (501) 671-2186.

Publications are now available on these subjects:

1) Clearcutting in Arkansas Forests BP-1 and TBP-1
2) Uneven-aged Management of Arkansas Forests, BP-2 and TBP-2
3) Wildlife and Biological Diversity in Arkansas Forests, BP-3 and TBP-3

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