

A LONG-TERM VIEW OF OLD-GROWTH DECIDUOUS FORESTS

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Abstract—Lowland old-growth forests in the Southeastern United States and Eastern Europe (Poland) survived because of accidents of history, topography, and ownership until they came under governmental protection. Such old-growth stands are the similar the world over; they have trees of many ages, patchy distribution of habitats, and a variety of microhabitats, all of which result from the death and fall of trees. Species diversity is high for both plants and animals. Old-growth forests constitute important habitat for many carnivores and for some endangered species; they are places for ecological research and for recreation and enjoyment. Science has shown that management, as well as protection, is necessary and can improve conditions.

INTRODUCTION

These remarks primarily concern old-growth deciduous forests in the lowlands of two areas: the Southeastern United States and Poland. My own experience in old growth has been in bottomland forests of the Southeastern States (Tanner 1942, 1986).

LOCATIONS OF OLD-GROWTH FORESTS

Where are old-growth deciduous forests today, particularly in the Southeastern United States, and why are they there? The answer lies partly in the history of the logging industry, the events of which did not occur uniformly over all areas. For example, logging interests grew faster in Georgia than in South Carolina. In the former, no old-growth bottomland forests survived, but in the latter two areas are now preserved, largely as a result of the action of conservationists: one in the Congaree Swamp National Monument, of Richland County, and the other in Four Holes Swamp, of Berkeley and Dorchester Counties. Four Holes Swamp is now the Francis Beidler Forest. In the Mississippi Delta, logging began in Missouri and progressed southward. Later, it started in southern Louisiana and moved northward. The two movements met in northern Louisiana at the Singer Tract, Madison Parish, then the largest tract of remaining bottomland forest (Tanner 1942). This occurred unfortunately at the beginning of World War II, when hardwood timber was in high demand and funds for conservation were reduced. The Singer Tract was logged, but some similar old-growth bottomland forest was preserved several kilometers to the east in the Delta National Forest in Mississippi; Devall and Ramp (1992) describe three Research Natural Areas there.

Old-growth forests persisted in other areas because of stand inaccessibility and the difficulties of logging. For example,

old-growth forest remains in the remote Great Smoky Mountains. In both the Okefenokee Swamp and the Everglades, hardwood or cypress stand as islands in vast expanses of marshland that have kept loggers at bay. These two areas now are preserved as a National Wildlife Refuge and a National Park, respectively. Noss (1991) described a somewhat similar situation where a hardwood forest in a Florida hammock persisted because it was isolated in a pine forest. In the Southeast larger old-growth forests remain because of accidents of history and topography that delayed and eventually prevented logging. Many small stands, albeit not forests, have survived because family-owned farms have brought protection, notably in the upper Mississippi valley (Parker 1989).

In Poland, however, as Tomiałojc (1991) describes, an old-growth forest survives today because it once was a hunting preserve for royalty. The same is true of Denmark's forests; and in Japan I visited old forests that remained only because they were Shinto shrines.

CHARACTERISTICS OF OLD-GROWTH

Old-growth forests have survived in two ways. One is by history of not having been changed by human action nor destroyed by natural accident. This implies that an old-growth forest is the terminal stage of a plant succession (Barnes 1989). Because almost no forest has been unaffected by human activity (Tomiałojc 1991), we need a definition based on observable forest characteristics of the forest.

Participants at the 1989 symposium, "Characteristics, management, and restoration of old-growth temperate deciduous forests in the Southern United States," 16th

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² Editors note: This contribution originally was prepared for a 1989 Natural Areas Conference symposium on old-growth deciduous forests. Dr. Tanner's untimely death in early 1991 prevented publication of the manuscript with others in that symposium (Natural Areas Journal in volume 11, 1991, and volume 12, 1992). It is presented here in abridged form as a tribute to Dr. Tanner whose work on old-growth bottomland hardwoods in the Mississippi Alluvial Valley stands as a tribute to the persistence of the man and the value of biodiversity in the Mississippi Alluvial Valley.

Natural Areas Conference, 18 October 1989, Knoxville, TN, and the authors of notable publications (Barnes 1989, Parker 1989) generally agree on the characteristics of old-growth forests. They contain trees of all ages, from saplings to large individuals. These trees form at least a two-layered canopy. Tree distribution is patchy; and there are openings where trees have fallen. Standing-dead and dead-topped trees are present, and on the ground are large and small logs and exposed root masses. Details of these characteristics as observed in the Polish Białowieża Forest are described by Tomiałojc (1991).

Old-growth forest characteristics result from the death of individual trees and from small-scale disturbance. Tree death produces the standing dead trees, fallen logs, upturned root masses, and small canopy gaps. Small-scale disturbance events (a very relative term) include windfalls or blow-downs, mortality from insects and disease, flooding, and fire (Dickson 1991, Runkle 1991). All such natural processes produce patchiness and the microhabitats so important to species inhabiting old-growth forests.

A general characteristic of old-growth forests (Dickson 1991, Tomiałojc 1991) is that they contain a high diversity of species, both plant and animal, but often with a low number of individuals of each species. Much more has been written about the diversity of animals than of plants. Important to animals is the typical horizontal patchiness resulting from a mixture of habitats, each with a relatively small area. Noss (1991) discusses in detail the relation between patchiness and the well-known "edge effect," where adjacent habitats may provide different animal necessities. Noss (1991) also points out that patchiness can produce a variety of microclimates within a small area.

Several kinds of microhabitats are more abundant in old-growth than in young forests, e.g., hollow, standing snags and prostrate logs, broken and tangled limbs of fallen trees, and upturned roots of fallen trees. Animal groups that use such microhabitats are woodpeckers, other hole-nesting birds, flying squirrels (*Glaucomys* Thomas sp.), bats, and carnivores that need dens for sleeping or reproduction. Especially important to woodpeckers are dead and dying trees that provide habitat for wood-boring insects. These are all examples of how tree death is such a significant process in old-growth. Details of these relations are reinforced by Dickson (1991), Hamel and Ford,³ Pelton (personal communication, 1989. M.R. Pelton. Professor Emeritus. Dept. of Forestry, Wildlife & Fisheries, University of Tennessee, P.O. Box 1071, Knoxville, TN 37901–1071), and Tomiałojc (1991); other examples are given by Carey (1989).

Authors who remark on the abundance of carnivores in old-growth forests are Dickson (1991), Hamel and Ford 1989 (see footnote 3), and Tomiałojc (1991). Higher abundance probably results from a combination of the microhabitats that provide dens and the greater diversity of animal species that may constitute prey.

³ Hamel, P.B.; Ford, Robert P. 1989. Unpublished report on file with: Research Wildlife Biologist. USDA Forest Service, P.O. Box 227, Stoneville, MS 38776.

Old-growth forests have a greater supply of some foods than young forests. In deciduous forests large oaks (*Quercus* L. sp.), hickories (*Carya* Nuttall sp.), and other mast-producing trees are heavier producers than younger trees; and in an evergreen forests the old conifers produce more seed than younger ones (Carey 1989).

Some outstanding exceptions exist to the proposition that old-growth forests are characterized by a diversity of species and patchiness. For example, pine forests (*Pinus* L. sp.) of the Southeastern United States (Dickson 1991) and the pine and other coniferous forests of the Rocky Mountain region (Moir and Dieterich 1988) present an almost monotonous scene because of the few tree species, and the often unbroken extent of forest. Animal diversity also is low. In some respects, however, such forests of old trees are the best producers of seed, which is food for several animal species. Their dying and dead trees provide food for woodpeckers and nesting or denning places for several kinds of birds and mammals. Indeed, in longleaf pine (*Pinus palustris* Miller)-wiregrass (*Aristida stricta* Michaux) communities regularly disturbed by fire, the diversity of herbaceous plants and of fauna dependent on burrows of gopher tortoises [*Gopherus polyphemus* (Daudin)] is especially high (Wharton 1978).

In both the Southeastern and Rocky Mountain coniferous forests, fire has been vital in establishing and maintaining evergreen forests. This raises an interesting question: Are these coniferous stands true "old-growth," or are they patches created by disturbance within a larger forest? Any answer will depend on definitions and interpretations of scale, but I [Dr. Tanner] believe that such forests should be considered old-growth because they provide important habitat for some animal and plant species.

PRESERVATION OF OLD-GROWTH

A compelling reason for preserving old-growth forests is to prevent the extinction of endangered species. In North America, examples of rare species that lived in mature forests are the ivory-billed woodpecker [*Campephilus principalis* (Linnaeus), which now may be extinct], red-cockaded woodpecker [*Picoides borealis* (Vieillot)]; Dickson 1991], red wolf (*Canis niger* Bartram; now extinct in its original range), Florida cougar (*Felis concolor* Linnaeus), and northern spotted owl [*Strix occidentalis* (Xantus)]. Rare species surviving in the primeval Białowieża forest of Poland are listed by Tomiałojc (1991). However, there is danger in discussing forest preservation only in terms of endangered species and not the entire habitat. Our objective should be to preserve the whole forest, which in its diversity is the habitat of many species, including some that may be rare.

Some old-growth stands are now being preserved in the Research Natural Areas (RNA's) program of the USDA Forest Service, described by Devall and Ramp (1992), who explain the objectives of the program and describe three established areas in Mississippi. Greene (1988) describes this program as it operates in Washington and Oregon. Within RNA's, old-growth forests are the focus for ecological research. We know that woodland species evolved in mature forests long before humans entered their habitat. We need

examples of the original habitat if we are to understand the evolution and ecology of the native species.

Tomiałojc (1991) lists a number of research projects conducted in the Białowieża Forest. In one such study, Walankiewicz (1991) found that the conclusions about nesting in highly modified forest habitats, including the addition of nesting boxes, are not supported by results of studies in the old-growth forest of Poland. There are differences between the two habitats other than the nature and number of nesting cavities.

Moore and Swank (personal communication. 1989. Wayne T. Swank. Scientist Emeritus. Coweeta Hydrologic Laboratory, 3160 Coweeta Lab Rd., Otto, NC 28763) report on the movement of plant nutrients through precipitation, soil, biomass, and streams in old-growth forests of the Great Smoky Mountains. Their work is highly relevant to our understanding old-growth hardwood forest ecology. The insight from their work may have its greatest application in understanding differences between the nutrient dynamics of temperate forests and those of less-studied tropical rain forests such as are found in the Amazon Basin. We do not know enough to understand the ecology of rain forests and not nearly enough to plan intelligently for the tremendous human changes occurring in tropical regions.

Although one definition of old growth is "climax forest," which implies a steady state, Tomiałojc (1991) has observed changes in the Białowieża Forest and Barnes (1989) in mature forests of the Great Lakes region of the United States. Possible and widely different causes of such changes are (1) a protracted plant succession, (2) effects of browsing mammals or of insects, (3) climatic change, and (4) air pollution (including acid rain). Each possible cause is both a very interesting ecological problem and a process significant to humankind. We submit that old-growth forests are needed as places for studying vital problems.

A final reason for preservation of old-growth forests, and to some the most important, is their aesthetic beauty. The inherent worth of them is difficult to put into words, but its reality is proven by the number of visitors to the Białowieża Forest (Tomiałojc 1991), to trails of the Great Smoky Mountains, and to the Congaree Swamp in South Carolina and Mahogany Hammock in the Everglades National Park.

MANAGEMENT OF OLD-GROWTH FORESTS

The two most often discussed subjects concerning old-growth forests are their characteristics and their management. Management goals and practices are discussed by Devall and Ramp (1992), Noss (1991), Runkle (1991), Tomiałojc (1991), and Wellbaum and Doyle (personal communication. 1989. Wellbaum, E.M. Forester. Tennessee Valley Authority. Land Between the Lakes, Golden Pond, KY 42211-9001). Earlier discussions were published by Thomas and others (1988), Barnes (1989), and Parker (1989). At one extreme is the hands-off policy, holding that old-growth forests should be preserved and not managed. This approach has proven to be impractical; experience has shown that such forests benefit from procedures such as selective cutting, control of non-native species, and the re-introduction of extirpated species. To

accomplish the goal that old-growth forests should be used for research and education requires management, as described for the Polish forest by Tomiałojc (1991). For years the U.S. Department of Interior's National Park Service (NPS) has been charged with conflicting responsibilities: to preserve and protect natural areas while, at the same time, making them open to the public. Almost every management decision the NPS makes is a compromise.

A most troubling problem concerning conservation of old-growth has to do with size. Old-growth forests constitute a variety of habitats resulting from random storms, floods, and other disturbances. To realize the ecological benefits of such incidental events, large areas are needed. Large areas reduce the effects on habitat wrought by boundaries with cut-over or cultivated lands, mitigating the encroachment of invasive plant species. Also, some animals, especially carnivores, need large home ranges or territories. Unfortunately, many, if not most, old-growth forests in the United States and similarly developed regions are only remnants, too small to foster successful conservation. This has led several ecologists to apply principles of island biogeography (MacArthur and Wilson 1967) to the planning and management of forest preserves (Frankel and Soule 1981, Harris 1984).

Finally, another question remains: Can management produce the many characteristics by which we recognize an old-growth forest, thereby effectively reconstructing an old-growth ecosystem? During the planning process we must know what we are trying to restore. Preservation of existing old-growth stands will be necessary to provide the model. Papers (from the 1989 Symposium; Smith and Hamel 1991) that address the question of reconstruction include that by Runkle (1991) and the unpublished remarks of Wellbaum and Doyle (personal communication. 1989. Wellbaum, E.M. Forester. Tennessee Valley Authority. Land Between the Lakes, Golden Pond, KY 42211-9001). On the Tensas River National Wildlife Refuge, which is the old Singer Tract in Louisiana, managers have begun to restore some areas to at least resemble an old stand of bottomland timber. Whether such efforts succeed remains to be seen.

ACKNOWLEDGMENTS

Dr. Tanner's final words are prophetic; they presage the current work by a dozen years, and the current symposium by 6 years. His contributions to our understanding of the ecology of old-growth stands, particularly in bottomland hardwoods, will not diminish with time. His junior author thanks Margaret Devall and Wayne Swank for their thoughtful reviews.

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