CONSERVING BIOLOGICAL DIVERSITY THROUGH THE RECONSTRUCTION OF HISTORICAL FOREST CONDITIONS[1]

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Abstract—The loss of biological diversity can often be traced to the disappearance of structural and compositional components. Interest has grown in the restoration of presettlement conditions, in part because of the presumption that successful efforts may facilitate species recovery. This paper reports on a preliminary reconstruction of shortleaf and loblolly pine stands in southern Arkansas. Structural attributes like basal area, diameter distributions, species composition, understory and forest floor conditions, spatial patterns, and other biological legacies were "sampled" from early research and historical descriptions and photographs to approximate presettlement conditions. Historical basal area was usually less than contemporary old-growth, with fewer hardwoods. Diameter distributions, average stand age, and the frequency of heart rot have also changed notably. Modern pine stands have evenly spaced trees and are dominated by hardwood, shrub, and vine understories, a well-developed litter layer, and limited dead wood, while virgin old-growth was more irregular and open, with scattered patches of exposed mineral soil and abundant woody debris.

INTRODUCTION

The reduction in biological diversity can often be traced to the disappearance of critical structural and compositional components. Old-growth forests have largely vanished from the southern United States, and with them the attributes upon which many species depend. For example, the decline of the red-cockaded woodpecker (*Picoides borealis* Vieillot) has been linked to the loss of mature, open pine forests with abundant red heart fungus (*Phellinus pini* Ames) (Lennartz 1988, Steirly 1952). Interest has grown in the restoration of presettlement conditions, under the assumption that successful reconstruction facilitates the recovery of endangered species. This paper reports on the early stages of an effort directed at producing old-growth-like shortleaf (*Pinus echinata* Mill.) and loblolly pine (*Pinus taeda* L.) stands in the Upper West Gulf Coastal Plain of southern Arkansas, and how this effort may contribute to the conservation of biodiversity.

METHODS

The overall objective of this project is to physically restore a mature pine-dominated upland stand that is functionally consistent with similar virgin forests. While broad, this goal provides both the flexibility to operate in existing stands and the specificity needed to focus restoration efforts.

The first step in this effort was the delineation of reference stand conditions for a desired period (in this case, pre-1900). While presettlement old-growth conditions can be difficult to identify (Hunter 1989), an abundance of historical documentation for the pinelands of southern Arkansas facilitated this effort. References were examined for their relevance and

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the quality of their information. Early trade journals, for example, often contain articles on early lumbering operations that include descriptions of the forest conditions and pictures of large trees or impressive stands of timber (e.g., Anonymous 1904, Anonymous 1909). Other accounts of the virgin pine forests of southern Arkansas were gathered from early travelers or settlers in the region (e.g., Rowland 1930, Ashley County Genealogical Society 1995), early scientific or technical reports (e.g., Chapman 1913, Morbeck 1915, Olmsted 1902, Record 1910), promotional literature (e.g. Anonymous 1892), the original General Land Office survey reports, or historical photographs from the archives of the USFS Crossett Experimental Forest and the Crossett City Library. Recent literature on local preserves (e.g, Cain and Shelton 1994) was also consulted, but due to decades of change, these efforts were primarily used to contrast with presettlement accounts. Structural attributes like basal area, diameter distributions, species composition, understory and forest floor conditions, spatial patterns, and other biological legacies were "sampled" from these early descriptions to approximate presettlement conditions. Any relevant qualitative and quantitative information from these sources was recorded.

RESULTS

Literally, scores of references were found to assist this stage of the restoration (more than are conceivable to list in this extended abstract). Below is a summary of some of the well-documented key features. While this is an incomplete listing, they provide a set of achievable goals towards the reconstruction of presettlement-like stand conditions.

Stand Density And Diameter Distributions

Preliminary evidence suggests that historical basal area was lower than in modern examples of old-growth (< 23 m^2/ha versus > 34 m^2/ha, respectively), with few merchantable-sized hardwoods (Cain and Shelton 1994, Olmsted 1902, Reynolds 1980). Diameter distributions have changed noticeably, with fewer large trees in contemporary preserves. Virgin stand volume tended to be lower than intensively managed forests or current old-growth, with a considerable portion of the biomass concentrated in a handful of big trees (Morbeck 1915, Olmsted 1902).

Stand Age

Average stand age has also dropped sharply in the managed forests of southern Arkansas, with most managed stands harvested at 30 to 50 yrs. Contrast this to virgin forests, where the canopy trees often exceeded 150 yrs (Chapman 1913) and some pines approached 400 yrs old (Mattoon 1915). Presettlement virgin pine forests in the southern United States were usually considered irregularly uneven-aged (Forbes and Stuart 1930), while most contemporary pine stands are even-aged.

Spatial Pattern

Trees in managed stands are usually evenly distributed to maximize growth, while presettlement old-growth was more spatially heterogeneous. Chapman (1912) developed an approach to estimate stand yield using mapping of three broadly defined categories (immature, maturing, and veterans). When Chapman evaluated a small tract in Ashley County, AR, veteran (overmature) trees were scattered in a matrix of immature and maturing timber. Wide inter-tree spacing is also commonly observed in historical photographs of virgin pine forests of southern Arkansas (e.g., Anonymous 1904, Anonymous 1909).

Red Heart Occurrence
The frequency of red heart in maturing second-growth southern pine is noticeably less than that in old (> 100 yrs) stands (Mattoon 1915), which limits the nesting habitat available for red-cockaded woodpeckers (Lennartz 1988, Steirly 1952). Trees infected with heart rot are more likely to gradually accumulate in slow growing stands, but modern management practices tend to select against unproductive trees with signs of decay (Steirly 1952).

Understory, Litter, And Large Woody Debris Patterns
Unless treated with chemicals or regularly burned or grazed, managed southern pine forests are usually dominated by hardwood, shrub, and vine understories, with well-developed litter layers and sparse dead wood. Contemporary unmanaged old-growth may develop similar understories and litter accumulations, but have considerably greater volumes of dead wood (Cain and Shelton 1994). Virgin forests were more open, with scattered patches of exposed mineral soil and abundant dead wood (Olmsted 1902, Morbeck 1915).

DISCUSSION

The few remnant old-growth pine-dominated stands currently found in northern Louisiana and southern Arkansas are small, have been periodically salvaged, and were subject to fire suppression and other changes to their development during their decades of protection. With few exceptions, these stands probably differ so noticeably from presettlement virgin forests as to be of little value in restoration efforts.

The lack of quality old-growth remnants to serve as a framework for ecosystem reconstruction is not necessarily a limitation to the restoration of upland pine communities in southern Arkansas. Fortunately, a considerable quantity of historical information is available and sufficiently descriptive to develop reference conditions.

Knowing the nature of virgin pine forests should assist in the conservation of biological diversity in southern landscapes. This is especially important to non-game or threatened/endangered species whose success depends upon mature forest conditions. Regrettably, the lack of old, open pine forests, coupled with increasing production pressure on privately owned timberlands in the South, makes it unlikely that diversity goals will be emphasized.

CONCLUSIONS

Providing structural and compositional features for the ecosystems found before Euroamerican settlement is critical to the conservation of biological diversity. Developing composites of presettlement features as templates for virgin forests and continued management of desirable characteristics should help restore old-growth pine forests to southern Arkansas.

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