Journal of the Iowa Academy of Science: JIAS

Volume 104 | Number Article 5

1997

Forest Research in Iowa's State Parks - The Values of Natural Diversity

Donald R. Farrar
Iowa State University, dfarrar@iastate.edu

Jour. Iowa Acad. Sci. 104(2):39–42, 1997

Forest Research in Iowa's State Parks—The Values of Natural Diversity[1]

DONALD R. FARRAR

Department of Botany, Iowa State University, Ames, IA 50011

Approximately 3% of Iowa's forests are contained in state parks and preserves. In addition to aesthetics and recreation, these protected forests provide a vital service in the unique opportunities they provide for forest research. As intact ecosystems where natural ecological processes dominate, they provide standards by which we measure the effects of livestock pasturing, methods of timber harvest, and other manipulations of managed forests. A number of current studies and public programs emphasize the importance of natural diversity in forests. They rely on state parks and preserves to provide a measure of potential diversity for a given region of the state. Future generations of Iowans will inherit the many benefits of naturally diverse old-growth forests, provided we safeguard the forests in our state parks and preserves that we have inherited.

INDEX DESCRIPTORS: forest ecology, forest management, park management

We most commonly associate State Parks with recreation, but our parks have many other values as well. In this paper I discuss the value of parks and preserves in forest research. First I present two examples of why research in Iowa forests is needed. Then I describe three current research projects involving park forests. Finally, I emphasize the unique benefits and services provided by our state parks and preserves. These comments are intended to help guide the management of our protected forests through recognition of future services only they can provide.

Why research is needed

The black walnut (*Juglans nigra* L.), on a per unit basis, is our most valuable timber tree, prized for the beautiful color and figure of its wood. Iowa grows only 5% of the nation's black walnut (Powell et al. 1993), but Iowa's black walnut is well known for its exceptionally fine quality. Black walnut is described as "requiring a deep, well drained, nearly neutral soil with a generous supply of moisture and nutrient material" and reaching its "greatest size and value on moist, fertile sites, generally along streams and at the base of north- or east-facing slopes." "Black walnut matures in about 150 years, but may live 250". These are the published characteristics of black walnut, however they are based on research conducted in Indiana, Illinois, Missouri and other midwestern states, not in Iowa (Fowells 1965). Do these statements fully describe the natural requirements and growth characteristics of black walnut in Iowa? Does black walnut have the same characteristics in all parts of Iowa? These questions can best be answered by research conducted in Iowa. Knowledge of the natural ecology of black walnut, or of any other species, must form the basis for management, and natural ecology, obviously, must be studied where the trees grow, reproduce, and die naturally.

The "oak-hickory" community is the most common forest community in the east-central U.S., and the most important (Braun 1964, Harlow et al. 1996). Though other species may be more valued for special uses, oaks, especially white oak (*Quercus alba* L.) and red oak (*Quercus borealis* Michx.), because of their superior wood properties and because of their abundance, are our most important hardwood timber source. Oaks are also far and away the most important native food source supporting wildlife (Martin et al. 1951).

But there is growing concern on the part of foresters and wildlife managers that oak-hickory forests are being replaced by forests composed of maple and other shade tolerant species (Abrams 1992). It is quite apparent as one walks through an upland forest in eastern Iowa that beneath the tall, canopy-forming oaks is a subcanopy of sugar maple (*Acer saccharum* Marsh.) trees, often 6 to 12 inches in diameter and 40 to 50 feet tall. Also noticeable in these forests is an absence of young oaks. Logical analysis of this situation leads to the conclusion that when the old oaks die, they will likely be replaced by the already present maples (Abrams 1992).

The history of our oak forests, including recent changes in oak dominance, is well documented, but as with black walnut, reviews of the published literature (see Abrams 1992) notably include no studies conducted in Iowa. To encourage regeneration of oak rather than maple, various harvesting methods and management practices are being tested, including periodic burning of ground litter to kill fire sensitive maples and open the understory to light-requiring oaks (Jacobs and Wray 1992). We need to complement these studies with carefully recorded long-term observations of forest change in unmanaged Iowa forests. We do not yet know with certainty what natural replacement of the oak canopy in eastern Iowa will yield. The still dominant oaks have not reached the limits of their natural life span. We *do* know that in central Iowa, maples are not common and are not increasing in the understory of oak forests, *and* we know this because of the opportunity to conduct long-term studies in Ledges State Park (Johnson-Groh 1985; Sin 1996) and other central Iowa parks and preserves (Farrar and Raich 1994).

Documenting the natural development and interaction of forest species in forests where these processes are allowed to proceed without human intervention strongly enhances our understanding of forest biology. Combined with experimental studies, these observations can lead to better management of forest resources.

Ongoing research

Permanent forest plots. In 1986, the Preserves and Ecological Services Bureau of the Iowa DNR began documenting the vegetation in Io-

[1] Presented at the 75th Anniversary of Iowa State Parks. A joint meeting of the Iowa Department of Natural Resources and the Iowa Academy of Science.Proceedings of the symposium are available from the Iowa D.N.R.

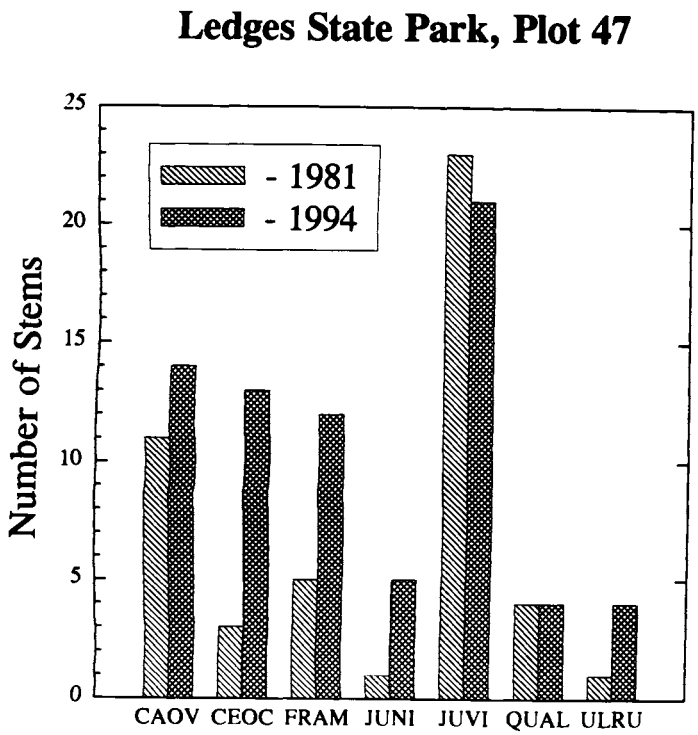

Fig. 1. Change in the number of individuals (> 3cm dbh) of common trees in a permanent forest plot in Ledges State Park from 1981 to 1994. This plot is located on a southeast-facing slope in a portion of the park acquired in 1979. Prior to acquisition, this forest was pastured. CAOV = *Carya ovata,* CEOC = *Celtis occidentalis,* FRAM = *Fraxinus americana,* JUNI = *Juglans nigra,* JUVI = *Juniperus virginiana,* QUAL = *Quercus alba,* ULRU = *Ulmus rubra.*

wa's forested state preserves (Farrar and Raich 1994). Permanent plots, each 20m × 50m, are located in representative community sites in selected preserves. In each plot, each tree is recorded as to species and size and mapped for future measurements. This study addresses three important issues. First, it documents the current forest composition in each preserve, providing a basis for interpretation and management. Second, it provides precise information on changes over time, documenting, for example, the rate at which trees grow, which trees die, and which species change in abundance. These changes can then be correlated with environmental variables such as soil moisture, deer population numbers, and oak wilt disease to name a few. Third, forest species and communities can be compared in different areas of the state. The last is particularly important in Iowa where climate changes dramatically from east to west.

Permanent plots of this type were placed in Ledges State park in 1981 (Johnson-Groh 1985). Comparison of the vegetation in one of these plots between 1981 and 1994 (Figure 1) indicates some of information to be gained from this type of study. In this previously pastured (until 1979) plot, the few, dominant white oaks (QUAL) have remained constant in number while other species have gained or lost individuals as natural succession has progressed in the absence of disturbance (livestock grazing). Computer analysis of changes in 38 plots in Ledges State Park (Sin 1996) indicate which forest communities are changing most, which are stable, which species are most involved in the changes, and why.

Birds vs forest diversity. Iowa State University, in conjunction with the Wildlife Diversity Unit of the Iowa DNR and the Iowa Chapter of The Nature Conservancy, has conducted a study analyzing the use of forests in northeast Iowa by neotropical migrant birds (most of our common summer-resident songbirds). This study compares the bird use of 46 forest tracts of different size, composition, and current management. The diversity standard to which these forests and their birds are being compared are forests now located in our state parks and preserves. These are the Iowa forests most resembling the forests in which the behavioral patterns of these birds evolved. The result of this study will be a much clearer understanding of the kinds of forest structure and plant species the birds find attractive. Such studies are imperative to developing forest management practices which can alleviate the dramatic decline in the abundance of these birds that is occurring throughout North America (Robbins et al. 1989).

Iowa Woodland and Forest Initiative (IWFI). This project involves nothing less than all of the woodlands and forests in Iowa. This effort draws upon resources of the Iowa DNR Division of Forestry, Iowa State University Departments of Botany and Forestry, The Iowa chapter of The Nature Conservancy, Trees Forever, The Iowa Natural Heritage Foundation, and private individuals. It seeks to quantitatively evaluate existing Iowa forests and to promote outreach programs to assist private woodland owners in managing for improved health of their forests while at the same time reaching specific objectives they hold for their wooded lands. The underlying philosophy of the initiative is the doctrine that maximum benefits from a forest are derived when that forest contains the maximum natural biodiversity that is consistent with the primary objective of its management, whether that objective is timber production, wildlife support, watershed protection, etc., or a combination of objectives. This philosophy rests on a comprehensive view of forests, recognizing the multiple benefits derived from forests and how each of these is enhanced through promotion of diversity. The IWFI recognizes the following values of natural biodiversity.

VALUES OF FOREST DIVERSITY

Enhanced Forest Productivity

1. *Sustained timber production.* Managed harvest allows sustainable reproduction from the existing understory and seed trees. Low diversity forests (e.g. pastured forests) lack an understory capable of continued production of valuable timber trees, and promote growth of trees with poor growth form and low timber value.
2. *Improved resistance to disease.* Spread of disease among trees of a species is usually not as rapid or complete in a community of mixed species. Forests can sustain loss of a species from disease without loss of forest structure in a diverse forest where other species can replace the trees lost.
3. *Enhanced watershed protection.* Diverse forests with a well structured forest floor community are superior in water retention and soil erosion control. They maintain a productive forest soil, remove water-borne pollutants, retain moisture and release moisture directly to the atmosphere, and retard downstream sedimentation and flooding.
4. *Greater resiliency.* A diverse forest will more likely contain species adaptable to changes brought about by human activity or by nature (*e.g.* increased nitrogen levels, global climate change, *etc.*). It is not possible to know now what changes will occur or what services we will ask of our forests in the future.
5. *Air quality enhancement.* Trees filter pollutants from the air, improving air quality. The taller and more structurally diverse the forest, the greater the potential for atmospheric interaction.
6. *Sequestering of carbon.* Conversion of timber to long-lived products (housing, furniture, *etc.*) as well as maintaining vigorous forest growth removes CO2 from the atmosphere and retains it over

decades, thereby mitigating CO2 emissions from industry, utilities, automobiles, *etc.*

7. *Benefits of fallen trees and dead logs.* Tip-up mounds and pits formed by fallen trees create topographic diversity and help to mix the soil. Rotting logs increase the overall moisture holding capacity of the forest ecosystem, release mineral nutrients and organic matter to the soil, and provide a carbon substrate for nitrogen-fixing microbes. Fallen trees provide additional carbon storage. Logs in streams reduce stream velocity and capacity for erosion.

Research

1. *Demonstration forests.* A highly diverse old-growth forest indicates the potential for forest development for that region where it occurs. It provides a standard by which to measure the effects of management in other forests in the region.
2. *Repositories of ecological processes.* Naturally diverse forests provide opportunity to study the dynamics of individual species and community interactions. Our knowledge of most woodland species, including our most valuable timber trees, is based largely on studies conducted elsewhere. Their behavioral characteristics in Iowa are often undocumented.
3. *Growth limitations.* Many species of the eastern and northern deciduous forest ecosystem reach the edge of their range in Iowa. Iowa forests provide special insight into the biological and physical factors limiting their occurrence.
4. *Genetic resources.* Species and genotypes in Iowa forests are uniquely adapted to their specific area. For example, the green ash of northwestern Iowa undoubtedly possesses drought resistance superior to that of eastern varieties.
5. *Historical perspective.* Through their species composition, structure, and age, natural forests provide a window into their history and that of the local area. Tree form, age, and growth rates record influences over their lifetime (up to 400 years in our oldest trees). Species composition may hold evidence of climate and vegetation changes over thousands of years. Absence of old-growth forests limits our knowledge of the past and diminishes our ability to predict the future.

Wildlife

1. *Diversity.* Numerous studies show a direct correlation of animal diversity to plant diversity. Many non-game species found in high quality forests are not sustained by game management practices which promote development of forest edge and early succession habitats.
2. *More diversity.* Standing dead trees are required by a large number of cavity nesting birds and mammals. They also provide an important food source through their decay organisms, and they provide foraging perches for birds of prey.
3. *Still more diversity.* Decaying logs on the forest floor support animals, plants, and fungi not present in the absence of dead logs. Dead logs in streams create favorable habitat for invertebrates and fish, and enhance stream productivity and diversity.
4. *Requirement for diversity.* Most of our plants and animals evolved in and are therefore adapted to naturally diverse forests. Many species require elements of natural diversity which we cannot yet identify and do not fully understand. We do know that these species are not found in low diversity forests.

Aesthetics

1. *Quality of life.* Through their beauty and serenity, highly diverse old-growth forests provide an aesthetic value that is impossible to measure, but cannot be overestimated. The changing seasons bring out different characteristics in tree, wildflower, fern and moss species of a diverse forest, giving the area a constantly changing, always interesting aesthetic appeal. Old, big trees inspire and humble and provide perspective to our own lives. The atmosphere of naturally diverse forests provides a place for escape from a production oriented society and a place for renewal of spirit. Warm feelings generated by nature are feelings of well-being no different from those generated by music, art, and literature. Naturally diverse forests provide "quality of life" values that are integral to the quality of life that is Iowa.

Clearly biodiversity does not mean just diversity of species, but includes the equally important diversity of sttucture. In woodlands, the latter refers in particular to the living vegetation layers of canopy (overstory trees), subcanopy (understory trees), shrubs and vines, and the forest floor carpet of herbaceous vegetation. Diversity also includes non-living snags, logs, and forest floor litter. All of these are intimately tied to support of the maximum animal diversity as well as to landscape level concerns such as protection of soil erosion and water quality.

It is important to reiterate that the Iowa Woodlands and Forests Initiative does not advocate a particular primary management objective for landowners (*e.g.* timber production *vs* preservation), only the maintenance of maximum biodiversity consistent with the landowner's primary objective.

How do state parks and preserves fit into the IWFI program. Very simply, they provide the key to answering the question "What *is* the potential natural diversity for any given region of Iowa". Forests of our parks and preserves that are freed from livestock grazing and timber cutting for decades provide the standards (examples) for what forest community species and structure can be expected in a given area of the state. They are the best biological measures of plant and animal response to that particular combination of soils and climate. Our monitoring study of state preserve forests thus dovetails with this broad goal of enhancing our state's forest resources.

Old-Growth Forests

Old-growth forests may be defined as forests old enough that the tree dominants have reached their natural longevity, died of natural causes and been replaced through natural succession. By this definition, Iowa does not have old-growth forests. Most of our forests are less than 70 years old. Our oldest forests, about 150 years old, are in state parks and preserves. Our most valuable and most common trees have normal life spans of 200 to 300 years. This is why we cannot state with certainty that eastern Iowa oaks will be replaced entirely by maples, or know what species, if other than oaks, will replace the magnificent white oaks on the upland ridges and flats of Ledges State Park in Central Iowa. Iowans of the 21st century can learn the answers to these questions, provided they inherit our currently 150 year old forests.

We need old forests, undisturbed by livestock grazing or timber cutting, to study natural forest processes and to provide standards of forest development in Iowa. This is not to say that old-growth should be the goal of a major portion of the nearly two million acres of Iowa forests. Old-growth can, however, be well justified as a management goal of the best portions of the 3% of Iowa's forests now in state parks and preserves.

We owe a great debt to the Iowans whose foresight placed these forests into our park system. We cannot know what values our great grandchildren will place on the forests of their time. We can, with dedication, assure that they inherit many of the very best of Iowa's forests in their state parks and preserves.

LITERATURE CITED

ABRAMS, M. D. 1992. Fire and the development of oak forests. Bioscience 42:346–353.

BRAUN, E. L. 1964. Deciduous forests of Eastern North America. Hafner, New York.

FARRAR, D. R. and J. W. RAICH. 1995. Heritage plots: Permanent forest plots to monitor Iowa's state preserves. Report of research to the Iowa DNR.

FOWELLS, H. A. 1965. Silvics of Forest Trees of the United States. Agriculture Handbook 271. USDA Forest Service, Washington, D. C.

HARLOW, W. M., E. S. HARRAR, J. W. HARDIN and F. M. WHITE. 1996. Textbook of Dendrology. McGraw-Hill, New York.

JACOBS, R. D. and R. D. WRAY. 1992. Managing oak in the Driftless Area. Minnesota Extension Service, University of Minnesota, St. Paul.

JOHNSON-GROH, C. L. 1985. Vegetation communities of Ledges State Park, Boone County, Iowa. Proc. Iowa Acad. Sci. 92:129–136.

MARTIN, A. C., H. S. ZIM and A. L. NELSON. 1961. American wildlife and plants, a guide to wildlife food habits. Dover, New York.

POWELL, D. S., J. L. FAULKNER, D. R. DARR, Z. ZHU and D. W. MACCLEERY. 1993. Forest Resources of the United States, 1992. USDA Forest Service General Technical Report RM-234. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

ROBBINS, C. S., J. R. SAUER, R. GREENBERG and S. DROEGE. 1989. Population declines in North American birds that migrate to the Neotropics. Proceedings of the National Academy of Sciences 86:7658–7662.

SIN, E. 1996. A resurvey of permanent forest plots in Ledges State Park. MS Thesis. Iowa State University, Ames.