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Abstracts:

Managing Wildlife for Sustainable Forests

Managing Forests for Sustainable Wildlife

A conference held in Indianapolis, Indiana March 3-5, 2005

Organized by Today's Forest and Wildlife Managers for Tomorrow's Stewards of this Vital Hoosier Resource

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Supporting Organizations

The following organizations were instrumental in the conception and planning of this conference:

- DNR – Division of Fish and Wildlife
- DNR – Division of Forestry
- Purdue University Department of Forestry and Natural Resources
- Indiana Society of American Foresters
- Indiana Chapter The Wildlife Society
- The Nature Conservancy
- Hoosier National Forest
- Indiana Hardwood Lumbermen's Association
- Indiana Woodland Owners Association
- Indiana Farm Bureau
- I.U. School of Public and Environmental Affairs
- Indiana Fish & Wildlife Advisory Council

Conference Planning Committee

The following individuals were responsible for organizing and conducting this conference.

Mr. Dean Zimmerman, Chair, IDNR – Division of Fish and Wildlife

Mr. Gary Dinkel, Hoosier National Forest

Mr. Dan Ernst, Indiana Department of Natural Resources, Division of Forestry

Dr. Burney Fischer, IDNR – Division of Forestry

Mr. Pete Hanebutt, Indiana Chapter Ruffed Grouse Society

Ms. Beth Hippensteel, IDNR – Division of Fish and Wildlife

Mr. Lee Huss, Indiana Society of American Foresters

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Dr. Brian Miller, Purdue University, Department of Forestry and Natural Resources

Mr. Ray Moistner, Indiana Hardwood Lumbermen's Association

Mr. Charlie O'Neill, Indiana Fish and Wildlife Advisory Council

Mr. John Seifert, Purdue University, Department of Forestry and Natural Resources

Mr. John Shuey, The Nature Conservancy

Financial Sponsors

The conference organizers wish to express their appreciation for the financial support provided by the following organizations:

- Indiana Chapter The Wildlife Society
- Indiana Farm Bureau
- Indiana Hardwood Lumbermen's Association
- Indiana Society of American Foresters
- Indiana University School of Public and Environmental Affairs
- Indiana Wildlife Federation
- Indiana Woodland Owners Association
- National Wild Turkey Federation
- The Nature Conservancy
- Purdue University, Department of Forestry and Natural Resources
- Ruffed Grouse Society
- U.S. Fish and Wildlife Service
- U.S. Forest Service

Chip Morrison

Preface

The forests of the Central Hardwoods Region and the wildlife populations that live in them face challenges today that have not been experienced throughout our history. During the past century, land cover throughout Indiana has gone full circle. Prior to the turn of the 20th century, the southern part of our state was predominately forested. This land was soon cleared and put into agricultural production. After the depression, much of this land was abandoned as agricultural land and returned to forest cover. Today, we are blessed with an oak-hickory forest covering much of southern Indiana. Many of these forests are now approaching maturity.

Management and ownership patterns of our forest land has also changed over time. Much of the agricultural land abandoned in the early – mid-1900's was placed in state and federal ownership and actively managed for timber and recreational opportunities. Private ownership also existed in larger blocks of forest cover and were managed for timber production. The even-aged harvest management strategies applied to these forest lands (clear cutting and group selection cutting) somewhat mimicked natural disturbances (wind, fire, and disease) creating a mixture of early, mid- and late-successional forests on our landscape. The wildlife populations living in our forests also represented a mixture of species requiring each of these successional stages.

Today, private ownership patterns of forest land have changed. While the number of forestland acres in Indiana remained relatively the same between 1978-1994, the average parcel size of private forest acres declined to 22 acres while the number of private forestland owners tripled. The smaller parcels, held by more landowners (60 percent of forest landowners own less than 9 acres) no longer receive the same level of active timber management as larger tracts. The forests in public ownership are also being managed with less even-aged harvest strategies. The result is that our Indiana forests are aging. The amount of early successional forest habitat is declining as are the wildlife species that depend on this habitat component.

The composition of our forests are also changing. As forests age under our current management strategies, trees species composition is shifting from oak dominated forests to forests dominated by sugar maple. Changing wildlife populations are also influencing the vegetative composition of our forests. For example, increased deer populations are suppressing tree regeneration and are reducing some native herbaceous species in our forests. The prevalence of invasive plant and insect species are also exerting strong influences on our forest composition. As a result, wildlife species are also beginning to shift in response to this change in food resources.

Natural resource managers and concerned citizens are constantly struggling to achieve a balance in our changing forest and wildlife populations. Some wildlife species are threatened or endangered and now enjoy special management priorities designed to protect them and the habitat on which they depend. Other previously abundant wildlife species are now declining as new management practices are followed and forest age and species composition change.

Scientists and natural resource managers depend on sound scientific research-based information on which to make future management decisions that will **"manage our forest for sustainable wildlife and manage our wildlife for sustainable forests."** This conference was planned by a collection of organizations and agencies throughout Indiana to assemble a panel of experts to focus on this critical resource management issue in our state. The distinguished speakers assembled at this conference will summarize past research and articulate the current state of knowledge in their topic areas. Speakers will also identify questions yet to be answered and will identify a research agenda yet to be pursued.

This conference is designed to facilitate audience interaction and discussion with scientific experts. It is the hope of the conference planners that an enlightened and thoughtful dialogue that begins here will continue in the months and years ahead. We encourage our elected officials and agency managers to embrace the assembly of scientific findings presented here and use it as a foundation for a continued dialogue process. It is only by working together and applying scientific principals that future policy and management decisions in Indiana will result in **forests that support sustainable wildlife populations and in wildlife populations that support sustainable forests.** It is through the accomplishment of this objective that Hoosiers will be able to enjoy our forest and wildlife legacy left us by our forefathers for generations to come.

Brian K. Miller
Extension Wildlife Specialist
Purdue University, Department of Forestry and Natural Resources

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Managing Wildlife for Sustainable Forests – Managing Forests for Sustainable Wildlife

Workshop Program

Thursday, March 3, 2005

11:45 – 3 **Registration**

12:45 – 12:50 **Welcome**

12:50 **Conference Perspective**
DNR Director, Indiana Department of Natural Resources

1:00 **Keynote Address**
Keynote: Professor John Ottensmann, IUPUI

1:30 – 2:45 **State Trends in Forest/Wildlife Issues**
Moderator – Dr. Vicky Meretsky, IU School of Public and Environmental Affairs

- Dr. Burney Fischer – Director, Indiana Division of Forestry
- Glen Salmon – Director, Indiana Division of Fish & Wildlife
- Ken Day – Supervisor U.S. Forest Service, Hoosier National Forest
- Jeff Keifer – U.S. Fish & Wildlife Service
- Dr. Shorna Broussard – Professor, Purdue University, Dept. of Forestry & Natural Resources
- Pat Walker – Forester, Pike Lumber Company

Q & A – 15 minutes

2:45 **Break**

3:00 – 5:30 **Forest Sustainability**
Moderator – John Seifert, Purdue University Extension Forester

- *Changes in Indiana's Forest Species Mix*. Dr. Steve Shifley, U.S. Forest Service, Columbia, MO
- *Upland Oak Ecology: A Synthesis*. Dr. Marty Spetich, U.S. Forest Service, Hot Springs, AR
- *Value of Forest Communities in Indiana*. Allen Pursell, The Nature Conservancy, Blue River Project
- *A GIS Look at Forest and Habitat*. Brenda Huter, Forest Stewardship Coordinator, IDNR Division of Forestry

6:30 **Dinner at Marriott Hotel**

7:30 **Professional Society Meetings**

8:30 – 11:00 **Social Time at Marriott Hotel**

Friday, March 4, 2005

8:00 – 10:00 **Endangered Species and Species of Concern: Implications for Forest Management**
Moderator – Dr. John Dunning, Purdue University, Dept. of Forestry & Natural Resources

- *Officiating the Photosynthesis Tournament: An Overview of Forest Wildlife Species Issues Influencing Contemporary Central Hardwood Forest Management*. Dr. Paul Hamel, U.S. Forest Service, Stoneville, MS
- *The Indiana Bat: What We Know About Their Habitat Needs and Implications for Forest Management*. James Kiser, Wildlife Biologist, Daniel Boone National Forest, Whitley City, Kentucky
- *The Cerulean Warbler: A Case Study of Issues on the Horizon*. Cindy Basile, Hoosier National Forest
- *Following the Endangered Species Act: Opportunities to Protect Forested Species in Managed Forest*. Scott Pruitt, U.S. Fish & Wildlife Service, Bloomington, IN

10:15 – 11:45 **Early Successional Habitat Needs: Winners and Losers**
Moderator – Dr. Brian Miller, Purdue University Extension Wildlife Specialist

- *Ruffed Grouse and Woodcock: In Decline*. Dan Dessecker, Ruffed Grouse Society Biologist
- *Trends in Shrubland and Forestland Songbirds in the Central Hardwood Region*. Dr. Harmon Weeks, Purdue University, Dept. of Forestry and Natural Resources
- *Simulated Effects of Land Management Alternatives on Woodland Wildlife Species on the Hoosier National Forest*. William Dijak, U.S. Forest Service

11:45 **Lunch** (Box Lunch at Government Center)

12:30 – 2:15 **Oak Regeneration**
Moderator – Dr. Doug Jacobs, Purdue University, Hardwood Tree Improvement and Regeneration Center, Department of Forestry and Natural Resources

- *Oak Regeneration: Even & Uneven Age Systems*. Dr. Doug Jacobs, Purdue University
- *Understanding Ecological Process in Regenerating an Oak Forest*. Henry Schumacher, University of Pittsburg, Pittsburg, PA

- *Stump Sprouting of Oaks*. Dr. Dan Dey, U.S. Forest Service, Columbia, MO
- *Wildlife Effects on Oak Regeneration*. Dr. Rob Swihart, Purdue University

2:15 **Break**

2:30 – 3:30 **Invasives**

Moderator – Ellen Jacquart, The Nature Conservancy

- *Invasive Plant Impacts on Forests*. Ron Rathfon, Extension Forester, Purdue University
- *Invasive Plan Impacts on Wildlife*. Victoria Nuzzo, Natural Area Consultants, Richford, NY

3:30 – 5:00 **Achieving a Balance**

- Each session moderator (6) will have 5-8 minutes to summarize their session
- *Discussion/Question and Answer Period*
- *Session Summary*. John Shuey, The Nature Conservancy

Saturday, March 5, 2005

7:30 – 8:00 **Registration**

8:00 – 8:15 **Welcome/Introduction**

Michael Goergen, CEO, Society of American Foresters

8:15 – 9:45 **Selected Presentations To All**

- *Overview of Trends from Thursday and Friday Sessions*. Dr. Vicky Meretsky, IU-School of Public & Environmental Affairs
- *Declines in Early Forest Succession Species*. Brian MacGowan, Purdue University Dept. Forestry and Natural Resources
- *Understanding Scale with Respect to Wildlife Habitat*. Gary Langell, IDNR Division of Fish & Wildlife
- *Invasive Plants and Their Harmful Effects*. Ellen Jacquart, The Nature Conservancy

9:45 **Break**

10:00 – 10:45 **Concurrent Session #1**

- *Making Money from Trees and Wildlife*. John Seifert, Purdue University Dept. of Forestry and Natural Resources
- *Forest Wildlife Population Trends*. John Castrale, IDNR Division Fish & Wildlife
- *Managing Woodlots for Wildlife*. Bill Hunyadi, Ruffed Grouse Society
- *Getting Assistance: Advice & Financial*. Dan McGuckin, IDNR Division of Fish & Wildlife

10:45 – 11:30 **Concurrent Session #2**

- *Hunting Leases and Landowner Liability*. Steve Meng, President, Base Camp Leasing, Fishers, IN
- *Making Money from Trees and Wildlife*. John Seifert, Purdue University Dept. Forestry and Natural Resources
- *Managing Woodlots for Wildlife*. Bill Hunyadi, Ruffed Grouse Society
- *Developing Your Management Plan*. Janet Eger, District Forester, IDNR Division of Forestry

11:30 – 12:15 **Concurrent Session #3**

- *Hunting Leases and Landowner Liability*. Steve Meng, President, Base Camp Leasing, Fishers, IN
- *Developing Your Management Plan*. Janet Eger, District Forester, IDNR Division of Forestry
- *Getting Assistance: Advice & Financial*. Dan McGuckin, IDNR Division of Fish & Wildlife
- *Fire as a Management Tool*. Charlie Keller, Fire Coordinator, IDNR Division of Forestry

Summary and Closing **Dr. Burney Fischer** – IDNR, Division of Forestry

Chip Morrison

Urban Sprawl, Forests and the *Luci2 Urban Simulation Model*

Dr. John R. Ottensmann
Center for Urban Policy and the Environment
Indiana University-Purdue University Indianapolis

Urban sprawl—the conversion of increasing amounts of land around major urban areas to urban uses—poses threats to the existence of some forested areas and to the ability of other areas to continue to serve effectively as wildlife habitat. Data from the National Resource Inventory and land cover data developed from satellite imagery by the Center for Urban Policy and the Environment allow examination of changes in the area of forest land cover in Indiana and the conversion of forest land cover to urban uses in the recent past. Looking toward the future, the *luci2 Urban Simulation Model* simulates future patterns of urban development for a 44-county region in central Indiana and reports consequences of that development. One of those results is the area of forest land cover predicted to be converted to urban uses. The *luci2 Model* allows the user to create alternative scenarios reflecting various policy choices and varying assumptions about future trends that would affect patterns of urban development. These choices include restrictions of development in areas of special interest, including agricultural land, wetlands, riparian buffers, steeply-sloped land, and areas of forest land cover of at least 20 acres. Other policy choices address issues such as the provision of water and sewer utility service and the density of new residential development. A series of scenarios are developed and used to examine the effects of some of these choices on patterns of urban development in the region through 2040 and the effects of that development on forested areas. This type of analysis can provide insight into the feasibility of various policy alternatives. The results also demonstrate how choices made in one policy area can have significant effects on other outcomes of concern, such as the conversion of forested areas to urban uses. One conclusion is that people interested in preserving forested areas need to become more generally involved in broader discussions of land use policy to best pursue their goals.

Further information on the LUCI model can be found at http://luci.urbancenter.iupui.edu/.

State Trends in Forest/Wildlife Issues

Dr. Burnell C. Fischer
Director, Indiana Division of Forestry

Rural forestland in Indiana covers about 20 percent of the state with Northern FIA Unit at 9.4 percent, Lower Wabash 23.1 percent, Knobs 43.4 percent and Upland Flats 40.6 percent. The percentages have held fairly constant for the past 20 years with private land making up about 83 percent of the total forest acreage. What has changed is that the forest continues to grow between each measurement period both in volume and average overstory tree size. Forest stands are mostly classified as large diameter (11″ and greater) and fully to medium stocked. This change in forest condition is the result of the relatively same forest management system – High Forest Canopy Management with Single-Tree Selection Regeneration Harvesting, which is practiced widely in Indiana where esthetics is the dominant objective. The system has no real research basis, and is designed to maintain the presence of a high forest canopy, and is best applied by a very experience foresters or woodsman. The practice extends the rotation of the current overstory for the benefit of the current landowner and results in stands with big trees and only limited shade tolerant regeneration. A second and very positive trend regarding Indiana forestland is that an increasing acreage is being placed under conservation agreements. The most common form of this agreement is the Classified Forestland Program which now totals over 450,000 acres or about 12 percent of the private forestland in Indiana. Added to this total is rapid growth of land trusts and other programs to protect and conserve forestland. A third and negative trend is the increasing impact of invasive exotic insects and plants on our forests. The Gypsy Moth, despite our best efforts to slow the spread, is at our borders with Michigan and Ohio. We will begin to start seeing defoliations and some tree mortality (think oak-hickory forests) over the next 5-10 years. Emerald Ash Borer has suddenly arrived in NE Indiana and could result in the total elimination of ash trees over the next couple of decades adding to our previous loss of American Elm and Chestnut species from our forests. Sudden Oak Death could be next. The wildlife implications appear huge but are undocumented. Finally, the onslaught of invasive plants like ailanthus, various species of honeysuckles, autumn olive, multiflora rose, garlic mustard, etc. will change our forests and the wildlife that inhabit them forever.

State Trends in Forest/Wildlife Issues

Glen Salmon
Director, Indiana Division of Fish and Wildlife

Forest wildlife issues for Indiana are important in the minds of many stakeholders. Lack of active timber management in larger woodland acreages is a detriment to early successional species and loss of vegetative diversity. For deer hunters, the single largest resource issue of the next 10 years will be loss of access for deer hunting followed by the probable emergence of CWD within the state's deer resource. Continuing urbanization both as it leads to land development and as it isolates hunters from personal contact with landowners will fuel loss of access. Increasing ownership fragmentation of woodland/forested tracts reduces the ability to harvest timber and provide critical habitat for early successional wildlife populations in an economical manner. Ownership fragmentation decreases the ability to manage forest dependent species at the landscape level. Ownership fragmentation has also decreased the amount of land available to hunting and the number of hunters gaining access to the land. This in turn reduces our ability to effectively manage wildlife populations, such as deer.

Forest management in terms of timber harvest has been nonexistent on FWA's for more than 10 years by order of the DNR Executive Office. Historically timber harvests on FWA's have been undertaken to benefit wildlife by encouraging growth of mast producing trees rather than for fiber production. Concerns over take of the federally endangered Indiana bat and/or destruction of its habitat has complicated and confused woodland management plans on DFW owned properties.

Forest acreage on DFW owned land is increasing along with tree size. Property management crews are trying to arrest succession as equipment and manpower allow to create or reclaim upland wildlife habitat. This has been a losing battle in recent years.

Other major problems:

- Achieving a balance of habitats (forests, grasslands, wetlands) on small properties
- Balancing the needs of many species and the lack of knowledge in how to best do that
- Small size (and private inholdings) of some properties limits management opportunities
- Inhospitable habitat outside of properties resulting in island effects
- Changes in oak/hickory to sugar maple forests

State Trends in Forest/Wildlife Issues

Kenneth G. Day
Supervisor, U. S. Forest Service, Hoosier National Forest

The Hoosier National Forest is currently revising the Land and Resource Management Plan. Implementing regulations for the National Forest Management Act provides direction on biodiversity that states: "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area." The Hoosier contracted with the North Central Research Station and Pangaea Technologies, Inc. to create GIS-based habitat suitability models for 19 species to evaluate the effects of proposed management alternatives. The 19 species represent ten principal habitat types found on the Hoosier. GIS-based habitat suitability index (HSI) models can be used to guide decisions in habitat conservation initiatives and provide a tool for natural resource managers to evaluate wildlife-habitat relationships, especially at the landscape level. This presentation provides a brief overview of modeling results for the cerulean warbler, Indiana bat, and ruffed grouse. In addition to planning, the Forest Service has partnered with the U. S. Fish and Wildlife Service to monitor aquatic species in streams on the Hoosier National Forest. As a result of last summer's effort, six new species to science have been identified; a sculpin and five crayfish species. Over the last three years the Hoosier National Forest has contracted with Lewis and Associates, LLC to inventory subterranean fauna. Six new species have recently been described and 26 new species to science are currently in progress of being described.

State Trends in Forest/Wildlife Issues

Jeff Kiefer
Indiana Private Lands Coordinator, U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service has as its primary conservation focus species and habitats that fall under the umbrella of federal trust resources, which in Indiana encompasses primarily migratory birds and federally threatened and endangered species. While the array of federal trust resources and the habitats on which they depend is quite varied, forested habitats, both upland and wetland, constitute a significant component of the conservation effort by the Service through the various lands and programs under its purview. Indiana's three National Wildlife Refuges comprise more than 63,000 acres, but only one refuge (Patoka River NWR) is continuing to acquire additional land. More than 38,000 acres, or 60 percent of the total, is in forest land, with approximately half of this acreage in more mature forest, and the remainder in a mix of early-mid successional stages. Forest fragmentation and connectivity are primary issues of concern, and both active and passive reforestation is occurring in old fields and on marginal farmland to enlarge forested blocks and connect existing stands. In particular, Patoka River NWR has a goal of restoring 5,000 acres of bottomland hardwood forest on prior converted cropland within the refuge. Forest-dependent species of concern within the refuge system in Indiana include the Indiana bat, cerulean warbler, prothonotary warbler, red-headed woodpecker, wood duck, and copperbelly watersnake, and research and monitoring is ongoing for a number of these species. Over the last two decades, conservation programs on private lands have enjoyed a steady increase in interest as well as funding.

The Service's Indiana Private Lands Office coordinates the Partners for Fish and Wildlife (PFW) habitat restoration program for private landowners, and assists other agencies (e.g. USDA) in the implementation of federal Farm Bill programs, (i.e. the Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP)), which have provided opportunities for significant reforestation on private lands. Since the late 1980's, more than 36,000 acres have been planted to hardwood trees under these programs, with the majority planted under the CRP. In addition, nearly 8,000 acres of existing forest land has been protected under permanent conservation easements through the WRP and Floodplain Easement Program (FEP). Reforestation under federal Farm Bill programs (especially CRP) has declined in recent years, although the potential exists to significantly increase future tree planting acreage on private lands through these programs. Future efforts will likely be more targeted, and will require monitoring and demonstration of intended benefits (e.g. water quality, wildlife response). The Ecological Services Office addresses forest resource issues (primarily through the conservation of federally threatened and endangered species) in connection with federal actions or other activities that may impact listed species, and also the protection of forested wetland habitats through involvement with various permitting processes (e.g., Section 404). In addition, the Service's contaminants program is often involved with issues having the potential to negatively impact forest resources, such as oil spills and acid mine drainage in southwest Indiana watersheds.

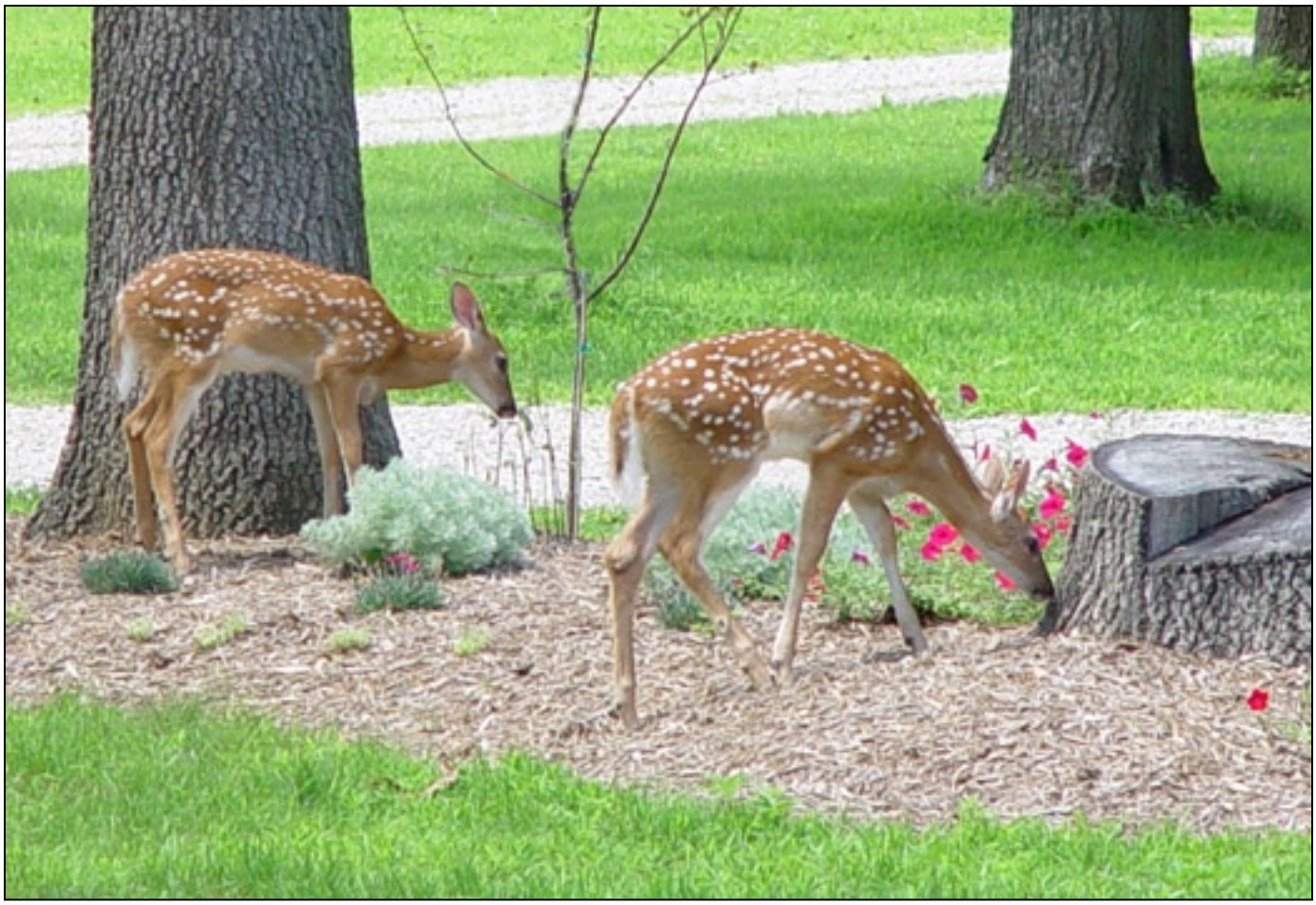
State Trends in Forest/Wildlife Issues

Dr. Shorna R. Broussard
Purdue University, Professor, Dept. of Forestry and Natural Resources

Over 150,000 private forest owners own 83.4 percent of timberland in Indiana, which accounts for 3.80 million acres of land. There are 4.55 million acres of forest land in Indiana, 97 percent of which is classified as timberland. However, ownership as well as landscape fragmentation threatens the sustainability of two important resources: landowners and their forests. Private forest owners in the on to nine acre class hold only seven percent of the total land area, yet represent 60.3 percent of ownerships according the preliminary results of the most recent Woodland Owner Survey conducted by the Forest Service. The trend in ownership fragmentation is evidenced by the following figures for the change in number of landowners and acreage owned from 1978 to 1994. In 1978 there were 48,100 forest owners in Indiana owning 3.7 million acres of forestland and in 1994 the number of private forest owners rose to 151,300 with 3.78 million acres of forestland. To ensure forest sustainability, landowners must make informed decisions regarding the management of their forests; however, very few landowners have a management plan (3.58 percent in north-central Indiana). Additionally, only about half (53 percent) of landowners surveyed in north central Indiana indicated that they consider anything beyond the current year when making decisions about their land. One value that is important to forest landowners in Indiana is wildlife, particularly for nonconsumptive recreation and as part of their conservation ethic. Wildlife related values are highest among resident landowners, those owning riparian forestland, and those who actively manage their land. A strategy that holds utility in conserving private forests is the idea of coordinated management whereby landowners communicate with each other about woodland management decisions to achieve outcomes such as information exchange and decisions with benefits beyond the property boundaries. In fact, interest in and awareness of outcomes associated with coordinated management was higher among north-central Indiana landowners who have engaged or plan to engage in management activities such as tree planting and timber improvement.

State Trends in Forest/Wildlife Issues

Pat Walker
Forester, Pike Lumber Company



Darla Morrison

Changes in Indiana's Forest Species Mix 1967–2003

Stephen R. Shifley
Research Forester, USDA Forest Service, North Central Research Station, 202 Anheuser-Busch Natural Resources Building, University of Missouri

Indiana's forest resources were inventoried in 1950, 1967, 1986, 1998, and 2003. Over that 53-year period the area of timberland increased slightly from 4 to 4.3 million acres and now covers 19 percent of the state's land base. Over that same period the volume of standing timber more than doubled from 2.6 to 6.9 billion cubic feet and from 11 to 26 billion board feet (International ¼-inch scale).

In the past 50 years the species composition has also changed gradually but relentlessly. The latest state inventory found 2.2 billion trees of 83 different species that were at least one-inch in diameter at breast height (dbh). Sugar maple now comprises 15 percent of all trees 1-inch dbh and larger. The hard-mast producing species that are most abundant are black oak, white oak, and shagbark hickory which each comprise 2 percent of all trees 1-inch dbh and larger. For the 600 million trees that are at least 5 inches dbh, the picture changes somewhat because the focus is on trees that have survived the intense competition of their early years. In this size class, sugar maple is still the most abundant species (11 percent of all trees), followed by yellow-poplar (7 percent), white ash (6 percent), white oak (5 percent), black cherry (5 percent), sassafras (4 percent), American elm (4 percent), red maple (4 percent), black oak (4 percent), and eastern redcedar (4 percent). Together these species comprise 50 percent of trees that are 5 inches dbh and larger. Species in the white oak group and the red oak group still dominate in dbh classes larger than 14 inches, but inventory statistics over the past 35 years show that sugar maple and yellow-poplar trees have flourished in small diameter classes and are increasing in number and size at the expense of trees in the red oak and white oak species groups.

The current trajectory of forest species change in Indiana is the consequence of past disturbance regimes. Extensive (and often exploitive) timber harvesting in the late 1800s and early 1900s followed by periodic burning and grazing created an environment favorable for the establishment of oaks and hickories. Over the past fifty years, declines in the frequency and severity of disturbance events have provided a favorable environment for establishment and growth of sugar maple, beech, and yellow-poplar. Absent significant changes in the rate and types of forest disturbance, yellow-poplar and sugar maple will continue to increase in dominance at the expense of oaks and hickories. Significant changes to this trajectory of species composition change will require a prolonged (decades) commitment to altering management practices and disturbance regimes to favor other species.

For further information see Indiana's previously published forest inventory reports (listed below) or go online to summarize, map and/or analyze Indiana's 1986, 1998, and 2003 forest inventories using the U.S. Forest Service Forest Inventory and Analysis (FIA) mapmaker (http://ncrs.fs.fed.us/pubs/databases/). Past forest inventory reports and other Forest Service publications are available at http://ncrs.fs.fed.us/pubs/.

Woodall, Christopher; Brand, Gary; Vissage, John; Gallion, Joey. 2004. *Indiana's forest resources in 2003.* Resource Bulletin NC-238. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 33 p.

Schmidt, Thomas L.; Hansen, Mark H.; Solomakos, James A. 2000. *Indiana's Forests in 1998.* Resource Bulletin NC–196. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 139 p.

Spencer, John S., Jr.; Kingsley, Neal P.; Mayer, Robert W. 1990. *Indiana's timber resource, 1988: An analysis.* Resource Bulletin NC-113. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 85 p.

Spencer, John S., Jr. 1969. *Indiana's timber.* Resource Bulletin NC-7. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 61 p.

U.S. Forest Service. 1953. *Forest statistics of Indiana.* Forest Survey Release No. 15. Columbus, OH: U.S. Department of Agriculture, Forest Service, Central States Forest Experiment Station. 36 p.

Upland Oak Ecology: A Synthesis

Dr. Marty Spetich
U.S. Forest Service, Hot Springs, AR

Chip Morrison

Value of Forest Communities in Indiana

Allen Pursell
The Nature Conservancy, Blue River Project

Indiana Bat, fire, timber, wild game, and preservation are some commonly traded commodities by natural resource managers. Together they contribute to the cumulative wealth or value of Indiana's forests. Economic measures used for valuing the forest are tangible, but there are other measures of value that obviously cannot be quantified. Forest values are traded through management and policy decisions everyday. These trades result in a series of relatively positive and negative outcomes. Of course some trades have produced unexpected results due to incomplete information, misjudging risk, or underestimating the law of unintended consequences. Current management trends along with the implications they may have for the future values of our forests will be explored in light of the past.

A GIS Look at Forests and Habitat

Brenda Huter
Forest Stewardship Coordinator, DNR, Division of Forestry

GIS (Geographic Information Systems) has become a useful tool for forest and wildlife managers. GIS is being used for applications ranging from making simple resource related maps to doing complex analyses of multiple factors and the relationships among them. Below are two examples of how GIS is being used for resource management and conservation in Indiana.

Indiana Spatial Analysis Project is a joint effort between Purdue University, Indiana Division of Forestry and the U.S. Forest Service. The objective of the project is to develop a GIS model to identify Indiana's important forest and the non-forest areas (good reforestation potential) most suitable for restoration and stewardship to achieve regional, state, and local conservation goals. These goals include but are not limited to water quality protection, sustainable forest products, and sustainable forest ecological communities. The first step of the project is the creation of a map layer and associated database of the private forestlands that have an existing stewardship (management) plan. The second step is to determine the areas where forest conservation efforts will be most effective. This step considers forest resource threats (development risk, fire risk, insect/disease risk) and resource potential (wetlands, forest patch size, slope, site index, proximity to publicly protected lands, threatened and endangered species, classified forests, riparian corridors, public water supply areas, and priority watershed). Each of the factors is assigned a weighting factor. A composite map is created and private forestlands are categorized as having high, medium, low conservation potential. Overlaying the stewardship plan layer over the composite map, will help determine where efforts have taken place and help direct future conservation efforts. For more information, contact Brenda Huter at bhuter@dnr.IN.gov.

Another state-wide, GIS-based conservation process is the Indiana Conservation Tool developed by the Indiana Biodiversity Initiative. The Conservation Tool produces maps of areas with high potential to conserve biodiversity. One map is created for each of seven natural regions. The first phase of the process uses information on major plant communities, wetlands, rare plants and rare plant communities to select areas with high conservation potential for plant species and plant communities. In the second phase, a group of representative "umbrella" animal species is identified, and areas that meet their habitat needs– both in terms of habitat types and in terms of habitat area– are identified. The major existing legally protected areas (state and national forests and parks, etc.) are automatically included in both phases work so that existing conservation areas are accounted for. The last step identifies possible corridors to link conservation areas. The recommendations produced by the Conservation Tool are only intended as a possible first step for planners. Local knowledge will be needed to fit recommendations to up-to-date conditions, and some planning needs will be more specific than the Conservation Tool. For more information, contact Vicky Meretsky at meretsky@indiana.edu or Forest Clark at forest_clark@fws.gov.

Officiating the Photosynthesis Tournament: An Overview of Forest Wildlife Species Issues Influencing Contemporary Central Hardwood Forest Management

Dr. Paul B. Hamel
Center for Bottomland Hardwoods Research, Stoneville, MS

That forest wildlife species might influence contemporary Central Hardwood forest management presents a considerable opportunity. The opportunity may conceal the dilemma between managing the land for self-supporting outputs of commercially viable products or maintaining appropriate populations of the range of wildlife species typical of the forest. The dilemma is a real one. Starting from the large scale, the crucial issue in forest management may be assuring the continued existence of forest on the landscape. This implies that a sustainable supply of desired resources be produced by the forest ownership. What are those desired resources is determined by the manager's interaction with the capability of the land, the availability of markets, and the selection of objectives harmonious with these. The manager's task is to implement practices that can produce forest structures which achieve the stated objectives. The activities will all require an initial outlay of capital, an investment that pits managerial expertise against the vagaries of a changing nature. One issue is that these activities be designed in such a way that they pay for themselves, that management actions reimburse the time and equipment costs required. In management strategies for species of concern, these costs can be substantial. To envision mechanisms to avoid subsidizing the production of desired resources may be difficult. One costly process is the development of common terminology and understanding of strategies so that, for example, those knowledgeable of the habitat characteristics or habitat requirements of the species of concern are able to articulate that knowledge in such a way that those knowledgeable of the manipulations to achieve those characteristics can produce them. A difficult paradox exists here, in that the activities implemented, from aggressive use of fire and timber harvest, to vigorous protection and visitor management, all involve treatment of the entire vegetative complex, and are thus de facto multiple species management actions, whose intent may be the production of appropriate populations of a single species, in but one season of the annual cycle. Monitoring the effects of management will require a careful approach to gathering enough of the correct kind of information to provide sufficient feedback to allow the manager to maintain an adaptive course toward the objectives through time. Viewed from this philosophical position, those issues important to maintenance of appropriate rare species in the forest can be examined: sustainability, fragmentation and source-sink population dynamics, desirability of forest lands for recreation, balancing regeneration and early successional species needs against those of the older forest, economic viability, remediation of systems beset with invasives that may impede production of desired resources, and the secure knowledge that factors outside an ownership may overshadow local managerial action. Incentive programs of government, appropriately rewarding compliance with the public good, may be part of the problem or of the solution. A pair of case studies of specific management activities for individual warbler species of concern provide illustrative material. Officiating the photosynthesis tournament requires clear knowledge of the game being contended, so that effective intervention can keep it going smoothly.

The Indiana Bat: Habitat Needs and Forest Management

James D. Kiser
USDA Forest Service, Daniel Boone National Forest, Whitley City, KY

The endangered Indiana bat (Myotis sodalis) occurs throughout forested regions of the eastern and midwestern United States. During the winter, caves and abandoned underground mines provide habitat for the Indiana bat, while sloughing bark of dead, dying, and live trees is used during the spring, summer, and autumn. Management of winter habitat often involves designating a protection buffer zone, gating cave entrance, fencing, posting signs, and/or monitoring human disturbance at caves used as hibernacula. Due to the large summer range and the use of sloughing bark trees by reproductive Indiana bats, most forest management activities are perceived as a conflict with protecting the species. Recent information suggests that more trees don't necessarily mean better Indiana bat habitat. Ideal summer habitat must contain some large diameter trees with sloughing bark that are exposed to solar radiation. Summer roosts, especially those used by maternity colonies, have been found in hog-lots, beaver ponds, edge of fields, recently logged forest, mature forest, and even under protective covering on utility poles in right-of-ways. This diversity in roosts provides great opportunities to manipulate the forest while creating favorable conditions for the Indiana bat.

While developing a new Land and Resource Management Plan (Forest Plan) for the Daniel Boone National Forest (DBNF) in Kentucky, the U.S. Forest Service considered the Indiana bat as a priority and developed numerous forestwide standards to help protect the species. These standards still allowed land managers to manage the DBNF for multiple-uses. In addition, many of the goals and objectives of the Forest Plan provide for habitat manipulations that will improve the overall summer habitat for Indiana bats on the DBNF. This presentation will discuss those goals and objectives within the DBNF Forest Plan and provide evidence of how management activities such as thinning and burning within overstocked forest, and building wildlife ponds, will improve Indiana bat summer habitat.

The Cerulean Warbler: A Case Study of Issues On the Horizon

Cynthia M. Basile
Wildlife Biologist/Karst Coordinator, Hoosier National Forest

Like many forest-nesting Neotropical migrants, the Cerulean warbler *(Dendroica cerulea)* is a species of conservation concern due to long-term population declines on breeding grounds. North American Breeding Bird Survey data indicate that from 1966 to 1987, Cerulean warblers have declined precipitously, more so than any North American wood warbler. Two apparent trends are apparent in the decline of the Cerulean warbler population: overall the population has declined, but the more startling trend is the elimination of some populations within the core of the breeding range. Although the Cerulean warbler has been classified as a species of high conservation concern, little is known about its life history. Conservation and management efforts directed toward protecting forested landscapes on the breeding and non-breeding grounds, that incorporate specific habitat requirements this species prefers, are paramount. Yet, there is little specific quantitative data regarding the pertinent structure in which the Cerulean warbler successfully breeds. Cerulean warblers may exhibit foraging preferences for certain tree species which may be attributed to a varying abundance of arthropods and floristic characteristics. Shifts in forest composition from oak-hickory to maple-beech may be of conservation importance for this species. Possible sensitivity to fragmentation and other factors associated with patch size may further disadvantage this warbler. Further research into all of these areas is urgently needed to determine management practices that will benefit the Cerulean Warbler. Within the state of Indiana, several studies are being conducted on the Hoosier National Forest and Big Oaks National Wildlife Refuge which assess nest success, territory size, and habitat selection. However, these studies are not focusing on research priorities identified by the Cerulean Warbler Technical Group, including response to silviculture and other land management, and developing an understanding of post-fledging habitat use. Recently, the establishment of a large-scale, long-term project has been developed in portions of this warbler's range, and several partners have come together to discuss implementation of this project in Indiana.

Following the Endangered Species Act: Opportunities to Protect Forested Species in Managed Forest

Scott Pruitt
U.S. Fish and Wildlife Service, Bloomington, IN

Image taken from FNR-172 *Conserving Endangered and Threatened Species on Private Land*

Ruffed Grouse and American Woodcock in Decline: Reason For Concern?

Dan Dessecker
Senior Wildlife Biologist, Ruffed Grouse Society

Ruffed grouse were historically found throughout Indiana where sufficiently large tracts of forest existed. Young forest and other early-successional habitats were sustained through time by Native American agricultural practices, windstorms, and by fires of both "natural" and Native American origin. The onset and expansion of post-European settlement agriculture in the state drastically reduced suitable forest habitats and, today, ruffed grouse are largely restricted to a small portion of south-central Indiana. American woodcock breed at relatively low densities throughout Indiana where suitable habitats exist.

Populations of ruffed grouse and American woodcock in Indiana have declined by 73 percent, and 81 percent, respectively, over the past several decades. These continuing declines are concurrent with and largely a result of significant declines in seedling-sapling deciduous forest. Indiana has lost 56 percent of its young deciduous forests since the mid 1980s. These young forest habitats are essential to ruffed grouse, American woodcock, and numerous other species, including the seriously imperiled golden-winged warbler, which is listed as state-endangered in both Indiana and Ohio. The loss of young forest habitats is due to significant reductions in the use of even-aged habitat management practices.

Breeding Bird Survey data for Bird Conservation Region 24 (Central Hardwoods) show that since 1980, 41 percent of the bird species that nest in shrub-dominated or young forest habitats have decreased, whereas only 10 percent of the bird species that nest in mature forests have decreased during this period. Conversely, 36 percent of the species that nest in mature forests have increased, while only 18 percent of the species that nest in young forests have increased. These data do not suggest that we ignore the demonstrated conservation needs of species characteristic of mature forest habitats. However, these data clearly document the need to address the ongoing declines of young forest habitats and dependent wildlife.

Loss of young forest habitats in or adjacent to riparian areas is especially problematic for ruffed grouse and American woodcock. Woodcock feed primarily in soils where moisture is sufficient to keep earthworms available near the surface. Ruffed grouse commonly use riparian area habitats as these sites support abundant succulent herbaceous vegetation, an important food source for grouse throughout the year. In addition, riparian areas are often characterized by a relatively cool microclimate, which benefits ruffed grouse, particularly in the southern portions of their range. Although riparian areas unquestionably warrant special protections, broad-brush policies that preclude habitat management activities from these sites are ecologically unjustifiable and merely exacerbate declines of ruffed grouse, American woodcock, and other wildlife of young forests.

Hunter participation drops as populations of game wildlife decline. Deer hunter numbers are relatively stable across the United States as a result of abundant white-tailed deer. Turkey hunter numbers are increasing as turkeys become more widespread and more numerous. However, small game hunter numbers have declined by 50 percent since the mid 1980s as populations of quail, ruffed grouse, American woodcock, and other small game wildlife have, likewise, declined.

Hunter days increased by 19 percent in the 1990s on National Forests in Region 9. Similar increases occurred in five of the other nine Forest Service regions. Hunting is the primary form of dispersed recreation on many tracts of public land and will remain so as access to private lands becomes increasingly restricted. Resource professionals responsible for the management of public lands must recognize the unique role these lands play in protecting our hunting heritage.

The ongoing, precipitous declines of ruffed grouse, American woodcock, and other wildlife of young forests in Indiana and elsewhere throughout our central hardwood forests are inconsistent with agency mandates and legal and moral obligations. It is irresponsible to allow these declines to continue.

Trends in Shrubland and Forestland Songbirds in the Central Hardwood Region

Dr. Harmon P. Weeks, Jr.,
Purdue University, Department of Forestry and Natural Resources

For more than 25 years there has been concern regarding the decline of songbirds, especially neotropical migrants, in eastern North America. Since the concern over this phenomenon largely corresponded temporally with the recognition of fragmentation of mature forests as a negative factor in avian reproduction, the two become perceptionally, and occasionally erroneously, linked and influenced management decisions. Subsequently, focused experimentation has revealed some basic truths that are important when management alternatives are considered: 1) patterns of avian decline are dynamic, varying by species and region and in temporal pattern; 2) while some mature woods species are declining, shrubland species appear to be in greater trouble in general; and 3) mature woods species that have been investigated make considerable use of seral woodlands (shrublands) as post-fledging habitat, similar to the pattern known for woodland gamebirds.

Simulated Effects of Land Management Alternatives on Woodland Wildlife Species on the Hoosier National Forest

William Dijak, North Central Research Station, USDA; Forest Service, Columbia Missouri;
Chadwick Rittenhouse, University of Missouri, Columbia, Missouri;
Frank Thompson, North Central Research Station, USDA; Forest Service, Columbia Missouri;
Stephen Shifley, North Central Research Station, USDA; Forest Service, Columbia Missouri;
Joshua Millspaugh, University of Missouri, Columbia, Missouri

Forest landscapes are dynamic, changing in the presence or absence of land management and natural disturbance. We used the LANDIS model to simulate landscape change in response to four land management alternatives on the Hoosier National Forest. LANDIS predicts changes in tree species and age classes across the landscape in response to tree harvest, natural disturbances, and succession. We developed landscape-scale habitat suitability models for nine species: American Woodcock, Cerulean Warbler, Henslow's Sparrow, Indiana Bat, Northern Bobwhite, Ruffed Grouse, Wood Thrush, Worm-eating Warbler and Yellow-breasted Chat. We applied the habitat suitability models to maps of forest age classes and dominant tree species that were produced by LANDIS along with GIS layers for other attributes such as roads and water to predict habitat suitability under the four management alternatives. A software package, Landscape HSImodels, is available for the habitat suitability models.

Oak Regeneration: Even and Uneven Age Systems

Dr. Douglass F. Jacobs and Marcus F. Selig
Hardwood Tree Improvement and Regeneration Center, Department of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907-2061

Oaks *(Quercus spp.)* have been a dominant species of the Central Hardwood Forest Region (CHFR) since pre-settlement times, supplying valuable timber, wildlife food, and non-timber forest products. While mature stands in the CHFR still commonly carry abundant proportions of oaks in their canopy, natural oak regeneration often proves difficult. Regeneration failure is commonly attributed to anthropogenic influences such as fire suppression and silvicultural harvesting systems. Numerous studies have examined the use of even-aged (i.e., clearcutting and shelterwood methods), and uneven-aged (i.e., single tree and selection cuttings) systems to combat the diminishing oak component, yielding mixed results. The common trend among all of these studies is the importance of site-specific management decisions and the presence of advanced oak regeneration at the time of harvest. When adequate oak advanced reproduction exists, even-aged management is often the best regeneration method. Several studies have observed successful oak regeneration following clearcutting on poorer quality sites where more stress-tolerant oaks are able to withstand harsh environmental conditions that associated species cannot. On higher quality sites, more favorable environmental conditions and the productive soils indicative of the CHFR often allow faster-growing pioneer species to outcompete oaks. In areas containing insufficient advanced oak reproduction it may be necessary to implement partial-cutting regimes. Use of shelterwood or group selection harvests should target the creation of a micro-climate favorable to the growth of oaks while limiting factors that promote dominance of competing species. Therefore, the selection of a proper silvicultural system for a specific site and environmental condition is essential to oak regeneration success. The presence of an adequate oak understory is often necessary, particularly under even-aged systems, and selected silvicultural systems must positively interact to foster development of this understory. In many situations it may be necessary to conduct pre-harvest operations involving thinning, release, or other timber stand improvements that will help support invaluable advanced oak regeneration. Similar silvicultural inputs may also prove useful for reducing competition of oak crop trees several years after harvest. Both even and uneven-aged harvesting regimes may prove successful for regeneration of oaks in the CHFR when proper silvicultural management regimes are matched to appropriate sites.

Understanding Ecological Process in Regenerating an Oak Forest

Dr. Walter Carson, University of Pittsburgh; Henry Schumacher, University of Pittsburgh;
Beth Adams, USDA Forest Service, Northeastern Research Station; Rachel Collins, Swarthmore College

Oak species have been dominant and widespread throughout eastern deciduous forests for the last ten thousand years, yet the last century has seen a dramatic decrease in oak abundance and large-scale failure of oak regeneration, especially on more mesic sites. Failed oak regeneration has led to widespread replacement of oaks by mixed-mesophytic species and attempts to regenerate oaks on mesic sites have generally met with limited success. Continued oak regeneration failure could lead to a dramatic and irreversible population reduction of this valuable timber species, and the subsequent loss of the oak acorn mast may cause serious declines in both the size and diversity of wildlife populations.

We currently have underway two long-term, large-scale, parallel experiments to simultaneously test three major hypotheses proposed to explain failed oak regeneration and associated shifts in the species composition of eastern deciduous forests. These hypotheses include: **1. The fire hypothesis:** Periodic fires promote diversity and the regeneration of a suite of fire tolerant species, particularly oaks. **2. The herbivory hypothesis:** Over-browsing by deer prevents oaks and other palatable species from establishing or entering the sapling size class. **3. The gap hypothesis:** Oaks and other species that are intermediate in shade-tolerance require large canopy gaps to regenerate. Our experimental design expands upon previous investigations of these hypotheses by incorporating both the individual and interactive effects of these three key factors and by following these treatment effects from the seedling through sapling stages.

Our results suggest that deer may function as a keystone species throughout a wide range of eastern temperate forest, acting as a primary driving force behind both the failure of oak regeneration and the corresponding shift in forest species composition. In the absence of deer browsing, both tree-fall gaps and understory fire disturbances increased seedling diversity and tree-fall gaps also increased oak seedling abundance. However, the presence of pervasive deer browsing masked the beneficial effects of tree-fall gap and fire disturbances on oak seedling regeneration and overall seedling diversity. This extensive effect of over-browsing by deer suggests that a complex management regime (including both canopy tree-fall and understory fire disturbances) in the absence of deer may be required to maintain tree species diversity and the presence of oaks in many eastern forests.

The Role of Stump Sprouts for Sustaining Oak Forests in Indiana

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Sustaining oak forests in Indiana is a priority management issue. Oaks regenerate from acorns as new seedlings, from advance reproduction, and as sprouts from the stumps of trees cut during timber harvesting. Stump sprouts are the most competitive source of oak reproduction and, hence, individually contribute the most to oak regeneration potential. However, we can't rely solely on stump sprouts to maintain, or increase current oak stocking levels because not all stumps produce sprouts, and not all sprouts produced are competitive.

For the major oak species in southern Indiana, the capacity to produce sprouts the year after cutting decreases with increasing diameter from about 4 cm dbh. Sprouting capacity varies by species and decreases in order from chestnut oak, to scarlet and northern red, to black to white oak. Trees less than 4 cm in diameter are good and fairly reliable sprouters, especially if they are young in age. Sprouting capacity in oaks decreases as tree age increases from 50 to 110 years, regardless of species.

Over time, the competitive success of oak stump sprouts varies by species and depends on tree diameter and age, and site quality. Weigel and Peng 2002 considered oak stump sprouts to be competitively successful if they equaled or exceeded 80 percent of the mean height of the dominant competitor within 1 m of each oak stump 10 years after clearcutting in southern Indiana. Their models showed that the competitive success of oak stump sprouts declined with advancing tree age and increasing stem diameter for all species; and decreased with increasing site index with white and chestnut oak. Scarlet oak was the most competitive stump sprouter across the range of diameters (4 to 70 cm) and ages (50 to 110 years) followed by chestnut, black and lastly white oak. Competitive differences among species were greatest for young, small diameter trees.

Based on a Missouri study of oak stump sprouts in stands harvested by the clearcut or single-tree selection method, overstory density does not appear to affect first year stump sprouting in oaks, but heavy shade does retard height growth over time. Oaks are intolerant to intermediate in their tolerance of shade. They do well in 30 to 50 percent of full sunlight, but it requires significant reductions in overstory stocking and removal of midstory canopies to achieve these levels of light in the understory of a partial cut stand.

Other factors that influence the development of oak stump sprouts include season of cutting, wildlife herbivory and Armillaria spp. root disease.

Models of oak stump sprout regeneration for southern Indiana can be used with some knowledge of tree diameter, age, and site index to estimate the potential contribution of stump sprouts to future oak stocking. This knowledge can be useful to foresters concerned with regenerating oak and sustaining oak stocking in Indiana. Foresters can influence the magnitude of oak regeneration potential through management based on sound forest inventory information and scientific knowledge.

Weigel, D.R.; Peng, C-Y, J. 2002. Predicting stump sprouting and competitive success of five oak species in southern Indiana. *Canadian Journal Forest Research* 32: 703-712.

Wildlife Effects on Oak Regeneration

Robert K. Swihart and Nathan Lichti
Department of Forestry and Natural Resources, Purdue University

Dozens of wildlife species rely on oaks for food, nurseries, and shelter. By their foraging or other activities, wildlife can have measurable effects on regeneration of oaks, and these impacts can occur throughout the life cycle of oaks. To assess the scope and magnitude of wildlife effects, we conducted a global review of the literature pertaining to changes in acorn production induced by insects, levels of acorn predation attributed to extant and extinct birds, mammals, and insects, the role of scatter-hoarding and larder-hoarding birds and mammals in dispersal and germination of acorns, and the changes in growth, form, and survivorship caused by herbivores feeding on seedling or saplings. Many studies are qualitative, anecdotal, or not designed to measure specific effects of wildlife on oak regeneration. For those that are, complex ecological interactions often influence the degree to which a particular species affects regeneration. Nonetheless, effects of wildlife on oak regeneration can potentially be substantial. We summarize patterns and quantitative findings related to herbivory and acorn production, consumption, and dispersal. We also suggest additional studies designed specifically to address wildlife-oak interactions.

Invasive Plant Impacts on Forests

Ron Rathfon
Extension Forester, Purdue University

Many plant species considered today to be exotic and invasive were originally introduced as botanic garden specimens and later promoted and widely planted for conservation plantings. Invasives such as Amur honeysuckle *(Lonicera maackii)* have a well-documented history in this country. The history of establishment and spread of other exotic, invasive plants is more speculative. The local impacts of some of these species on forests are readily observable. Only recently has the scientific literature begun reporting on the ecology, impacts, and control of many invasive plants. This presentation will review the literature for five invasive plant species impacting Indiana forests.

Do Invasive Plants Impact Wildlife?

Victoria Nuzzo, John Maerz, and Bernd Blossey
Department of Natural Resources, Cornell University, Ithaca, NY

Impacts of invasive plants on wildlife have long been suspected but difficult to document. Here we report how invasive plants directly and indirectly alter habitat structure and food webs, using amphibians as focal species to assess impacts on native wildlife. Using a combination of field studies and experimental venues we tested for effects of japanese knotweed *(Fallopia japonica)* on Green frog *(Rana clamitans)*, purple loosestrife *(Lythrum salicaria)* on American toad *(Bufo americanus)* and garlic mustard *(Alliaria petiolata)*, japanese barberry *(Berberis thunbergii)*, and japanese stilt grass *(Microstegium vimineum)* on red backed salamander *(Plethodon cinereus)*. Japanese knotweed had a negative effect on the foraging success of Green frogs during their migrations from ponds to terrestrial overwintering habitats, and purple loosestrife had a negative effect on the development and survival of American toad tadpoles. Garlic mustard, japanese barberry and japanese stiltgrass had no discernable direct impacts on red-backed salamander abundance; however all three species were associated with changes in native vegetation, and with increased abundance and impacts of nonnative earthworms on forest floors. Nonnative earthworms reduced leaf litter levels, reducing habitat and thus abundances of many invertebrate species that are important salamander prey. Because red-backed salamanders feed on many insect herbivores that attack native tree seedlings, a reduction in salamander abundance results in increased mortality of oak seedlings.

Achieving a Balance – Session Summary

Moderated by John Shuey
The Nature Conservancy

For all ecological management there is an equal and potentially opposite reaction. Actions which benefit one species (or habitat for that matter) cannot succeed without disadvantaging another. This session will explore these tradeoffs – where positives might have unforeseen negative consequences. We will discuss both short-term and long-term positive and negative impacts of management strategies. The panel will discuss how resource management decisions could be based on holistic visions of forest and wildlife health in Indiana.

Overview of Trends from Thursday and Friday Sessions

Dr. Vicky Meretsky
IU-School of Public and Environmental Affairs

Chip Morrison

Declines in Early Forest Successional Species

Brian J. MacGowan
Purdue University, Department of Forestry and Natural Resources

Early successional forests are areas dominated by shrubs, young trees, and to varying degrees grasses and forbs. In Indiana, seedling-sapling forests have declined more than 570,000 acre from 1986-1998. The reduction of clear-cutting as a silvicultural technique in the region, and to a lesser degree, suppression of other forms of disturbance, has resulted in the loss of early successional forests in Indiana and throughout the region. Average annual net growth exceeded harvest (2.5 to 1) during the most recent Indiana forest inventory (1986-1997). Suppression of disturbance has impacted wildlife species reliant upon early successional forests. Population indices for American woodcock *(Scolopax minor)* in Indiana have averaged a 7.0 percent decline annually ($P < 0.05$). Drumming indices for ruffed grouse *(Bonasa umbellus)* have declined since the cyclic peak of 1979 and were 9 percent of levels during peak years (1979-1981) in 2002. Population declines for both species have been attributed to the loss of young forests via succession. Management for early successional forests, and the wildlife species dependent upon them, requires relatively frequent and sizable disturbances. In the absence of disturbance, young dense forests stands will revert to second growth forests. While private individuals own 76 percent of timberland in Indiana, 72 percent of those ownership units are <100 ac. Given these size constraints and other ownership demographics for privately-owned forests in Indiana (i.e., percent units managed, silvicultural techniques used), successful management of early successional habitats for the long-term are likely limited to state and federal forestlands.

Understanding Scale with Respect to Wildlife Habitat

Gary Langell
IDNR, Division of Fish and Wildlife

Habitat diversity is key to sustaining the entire suite of forest dependent wildlife species. There are many factors that influence the extent to which habitat diversity exists and is maintained on privately owned forest landscapes. Discussion will focus on how ownership and habitat fragmentation negatively influence our ability to manage forest dependent wildlife species at the landscape level.

Invasive Plants and Their Harmful Effects

Ellen M. Jacquart
The Nature Conservancy

Invasive plants are causing significant harm to the forests of Indiana. Landowners need to be aware that good forest management also includes controlling these invaders. Invasive plant species can displace native plants, eliminate food and cover for wildlife, and threaten rare plant and animal species. If you manage your forest for timber production, invasive plants can also impact your bottom line. Species like garlic mustard, a biennial herb, can densely cover the ground and has the ability to decrease seed germination of many other species. Glossy buckthorn, an invasive shrub, has been shown to decrease tree recruitment in canopy gaps. Tree-of-heaven, an Asian tree species able to grow three feet per year, is now invading forests in Indiana and quickly overtopping native hardwood trees. The top ten plant invaders of forests in Indiana and the damage they cause will be discussed. Control methods will also be discussed and resources for more information provided.

Making Money from Trees and Wildlife

John Seifert
Purdue University, Department of Forestry and Natural Resources

Many woodland owners do not realize the opportunities to capitalize on their woodland investment. Most woodland in Indiana has been beating the rate of inflation and then some for many years. The woodland investment and the opportunity to make money from the trees come from three sources. The first gain is from what is referred to as the appreciation of the asset in real dollars. The same unit of hardwood (board foot) be it oak, or maple or poplar has been gaining about 1.2 percent above the rate of inflation which has averaged about 3.1 percent over the last 40+ years. A second positive growth potential is volume. Trees grow and the average for woodlands in Indiana, that growth rate is typically between 0 – 8 percent, with the average annual volume growth of 4.0 percent. The final piece of the investment puzzle is what we call grade or quality increase. As small trees become larger, they begin to shed their lower branches. As these branches are shed, the branch wounds heal over and the tree begins to put on clear wood. This clear wood is what is valued by the industry and as trees go from 12, to 16 to 20 inches and larger they make grade changes, which result in increased value per tree or board foot. This grade change can be from 0 – 6 percent.

So when you factor in inflation and real price appreciation, volume increase and grade increase, we are see woodlands that are returning double digit returns of 10 – 15percent. To see returns in the double digit bracket takes a sound forest management plan and assistance from professional foresters.

An emerging opportunity in Indiana for woodland owners is to lease your woodlands for hunting and recreation. This has been a common practice in much of the southern US, but only now is beginning to become a part of the woodland investment opportunity. Some of the very early entrepreneurs in Indiana saw the opportunity to lease land ten years ago. Many were close to major metropolitan areas. Now, opportunities to lease land are no longer limited to those close to urban centers. And, many of those potential clients are coming from out of state to have the opportunity to hunt. Deer hunting leases go from annual to multi-year contacts. Rental rates range from $5-20 per acre and most leases are on a per farm basis. Leases usually include crop, open field and woodland acres.

Forest Wildlife Population Trends

Dr. John S. Castrale
Indiana Division of Fish and Wildlife

Forests support a wider variety of wildlife than any other major habitat type in Indiana and the Midwest. The distribution and overall trends in populations of forest-dependent animals throughout time are tied closely to forest acreage. Other factors that influence forest animal abundance are tract size, fragmentation and isolation of woodlands, plant species composition, internal diversity, vegetation structure, topography, ages of forest, availability of tree cavities, and surrounding landscapes. Since its low point of 1.5 million acres of forestland in the 1930s, timberland in Indiana has increased to about 4.5 million acres presently and many woodland animals continue to show positive population trends. However, many woodland species are dependent on disturbance, and the lack of fire and active forest management is causing declines in early successional species and those that favor habitat edges and a well-developed understory. On the other hand, some animals are sensitive to edges and require large areas of contiguous forest. Fragmentation from roads, human development, and agriculture negatively impact these edge sensitive species in landscapes with low or moderate amounts of forest.

Managing Woodlots for Wildlife

Bill Hunyadi
Regional Biologist, Ruffed Grouse Society

Private woodlots are an extremely valuable resource to landowners in Indiana. Woodlot owners have the opportunity to realize multiple benefits from their woodlands: timber production, recreation, wildlife habitat, watershed management, fuelwood or just plain scenery. Depending entirely on personal goals and values, the landowner's management decisions permit a focus on one or a mix of all these uses, and can result in an economic return as well.

In addition, Indiana woodlot owners are in a position to greatly improve the overall quality of forest and wildlife habitat in the state. As timber sales have declined drastically over the last two decades, the young forest component (seedling-saplings) have also been reduced, by at least 56 percent. This loss extends to those wildlife species that need this type of young, or early successional, forest habitat.

Ruffed grouse, for example, have declined by 80-90 percent in the state since the early 1980's. Woodland managers, one woodlot at a time, can help stem this loss by initiating timber /wildlife management practices that can provide revenue, create habitat for species that need young forests, and increase the overall forest health.

Although not all Indiana woodlots will be within the range of ruffed grouse, the same habitat needs exist with regard to other young forest dependent species like woodcock, yellow-breasted chats, the endangered golden-winged warbler, and woodlot edge associated species like cottontails and quail.

Management for early successional forest wildlife species does not mean a landowner would have to give up habitat for, and numbers, of deer and turkey. Well-managed woodlots should be as balanced as possible, given the constraints of property size. Balance is easier to achieve in the big picture when the neighboring landscape is brought into consideration.

For those landowners that would like to maximize the wildlife potential of their property, information can be critical. Considerations of planning, harvesting, planting, marketing, timber stand improvement, and costs and benefits can be daunting. There is help available ranging from state service foresters, to consulting foresters, to a wealth of written materials on timber and wildlife opportunities and methods.

The woodlots of Indiana are an exceptional resource. They provide a staggering amount of habitat and foods for many species of wildlife. Proper, easily attainable management technique can retain important habitat components of Indiana's forestlands, making them more productive for wildlife and timber.

Getting Assistance: Advice and Financial

Dan McGuckin
Division of Fish and Wildlife, Department of Natural Resources

Many state, federal and non-Governmental agencies provide technical and financial assistance to landowners to develop and manage the wildlife and forest resources on their property. Landowners seeking such assistance can contact Indiana Department of Natural Resources District Biologists and District Foresters, Natural Resources Conservation Service District Conservationists, U.S. Fish and Wildlife Service Private Lands Biologists, Private Consulting Foresters and The Nature Conservancy. Common practices developed include wetland establishment/restoration, native grass establishment/restoration, tree and shrub planting, timber stand improvement, food plot establishment, prescribed fire planning and invasive species eradication. Landowners must consider their management goals, their current landscape assets and limitations, finances, time available, and a timeline for development. After developing a management plan with the appropriate agency cooperators, application can be made into many programs providing annual and one time incentive payments, development cost sharing, voluntary conservation easements, and/or reduction of property tax payments. Many landowners are able to enroll in multiple conservation programs, maximizing their conservation benefits and minimizing their financial expenditure. With the exception of private consultants, technical assistance is normally free. We discuss available programs, participation requirements and eligible practices.

Hunting Leases and Landowner Liability

Steve Meng
President, Base Camp Leasing, Fishers, IN

Hunting clubs have been a long tradition in the southeast where landowners found they could derive annual income and improve security on their property. The demand for quality hunting experiences has expanded to the Midwest for several reasons. The opportunities to persue trophy deer and escape overcrowded public hunting are two of the main reasons leasing hunting rights is a rapidly progressing enterprise.

Safety is very important to those hunters who are looking to lease private land, and to the landowners who are leasing their land. When a landowner accepts compensation for hunting rights, liability exposure increases. Base Camp Leasing's program includes a professionally written lease to limit exposure; as well as an indemnity clause, releasing the landowner of liability. In addition, a 1 million dollar liability insurance policy is provided. Each property is leased to one group that is used to hunting together, with a maximum number in the group assigned to each property.

Hunting continues to be a very safe activity. The National Safety Council reports that hunting had only seven injuries per 100,000 participants in 1995, compared to bicycling with 937 injuries per 100,000. Our insurance company provides liability coverage on over 30 million acres of hunting lease land. Claims arise from accidental shootings, tree stand incidents, ATV accidents, unattended fires, and unmarked gates.

Base Camp Leasing takes care of the entire process of leasing landowner's property out to hunters. Many factors go into placing a value on a hunting lease. An agent of Base Camp Leasing will inspect the property, recommend the annual lease price, assign a maximum number of hunters, and make any other relevant recommendations. All of the paperwork and money collection is done through our headquarters in Fishers, Indiana. Our Web site at www.basecampleasing.com is our largest asset and has gained national attention in the hunting industry.

Developing Your Management Plan

Janet Eger
District Forester

A management plan is an essential tool for landowners who are serious about the health and productivity of their property. It is a written guide that can be referred to periodically as a reminder of the activities that should take place on the property to keep the forest producing the benefits desired by the landowner. The plan should encompass all aspects of the land, addressing the goals of the landowners, the current conditions, recommendations of actions that need to be accomplished, and a timetable for those actions to occur. The management plan is a fluid document, being amended and up-dated periodically as needed. A professional forester and the landowner should work together to develop the plan, but always with the desires of the landowner in mind. The forester can make recommendations that help achieve the goals of the landowner whether those goals be timber production, wildlife management, recreation, watershed protection, or a combination of these and other things. The management plan should be viewed as a "living" document, and brought out at least once a year for review. Regular reviews will also serve as a reminder to the landowner that certain things must be done. Trying to manage woodlands without a plan leads to lost time and productivity, the resources may suffer, and the landowner often fails to feel a true satisfaction with their land.

Fire as a Management Tool

Charlie Keller
State Fire Coordinator, Indiana Division Forestry

The target audience for this presentation will be landowners interested in using fire as a management tool for wildlife and forest management.

Topics covered by this presentation will include:

- A brief history of the use of fire in natural resource management
- How fire is currently used in Indiana for wildlife and forest management
- The future use of fire for management
- State and local laws and ordinances pertaining to the use of fire
- Relationships with local fire departments
- Fire behavior
- Firing equipment and methods
- Prescribed fire planning
- Potential costs associated with use of prescribed fire
- Training

Notes


Chip Morrison

PURDUE EXTENSION

New 2/05

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