US FOREST SERVICE NORTHERN RESEARCH STATION

Research *Review*

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Conserving Birds in the Americas: Computer Modeling Tools for Conservation Planning

Birds are special to many of us, from backyard feeder-watchers to active birders and duck hunters, all the way to professional ornithologists and wildlife biologists. They are also inspiring and fascinating for their beauty and song, their ability to live in hostile environments, their long-distance migrations, and for some, their strangeness of appearance or behavior. From a broader perspective, birds provide valuable ecosystem services such as eating insect pests and carrion and pollinating flowers. They also are important indicators of ecosystem health, for the extirpation or extinction of a bird species that is particular about its habitat tells us that its habitat is compromised or gone.

Laws regulating hunting, protecting migratory birds from market hunting and feather harvesting, and prohibiting the use of DDT and other toxic chemicals, as well as habitat conservation, have allowed many bird species (bald eagles, peregrine falcons, waterfowl) to rebound from earlier population declines. However, most current problems are caused by the destruction and degradation of habitats. The "U.S. State of Birds Report" released this spring (2009) reported not only that Hawaiian and ocean birds are at great risk of extinction, but also that many mainland species have declined recently and are of conservation concern. In recent decades, about 60 percent of aridland-, 55 percent of grassland-, and 33 percent of forest-bird species have declined in abundance. Many of these species are long-distance (neotropical) migrants, breeding in the United States but wintering in the tropics, making them susceptible to events on two continents and the oceans between. There is also growing concern about the effects of climate change—an increase in the numbers and intensity of storms and hurricanes could negatively affect survivorship and changes in the timing of plant growth and insect hatchings could result in a situation where bird migration and nesting are out of synch with important food resources.

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U.S. Forest Service research scientists have contributed greatly to bird conservation through applied research, development of standardized monitoring protocols, and direct participation in various regional and national working groups. Frank Thompson and colleagues shaped bird conservation approaches for midwestern and southeastern forested landscapes, especially in regard to concepts associated with population viability and source-sink dynamics.

Jane Fitzgerald, American Bird Conservancy

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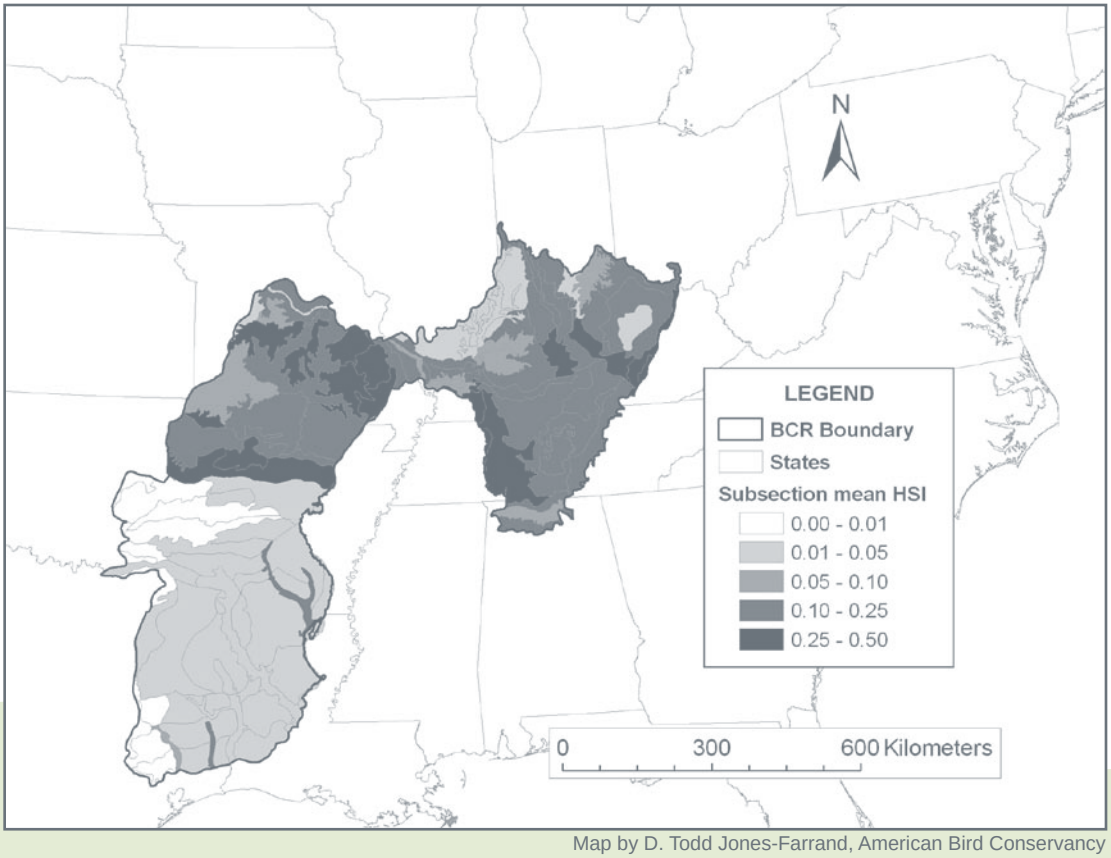
CURRENT BIRD CONSERVATION EFFORTS

The North American Bird Conservation Initiative (NABCI), begun in 1999, provides improved bird conservation through regionally based, biologically driven, landscape-oriented partnerships. It facilitates integration and cooperation among more narrowly focused bird conservation initiatives addressing landbirds (Partners in Flight), waterfowl, shorebirds, and waterbirds. NABCI provided a formal link between Canada, the United States, and Mexico and a geographic framework, known as bird conservation regions (BCRs), to integrate regional conservation plans. (These BCRs delineate ecologically distinct regions with similar bird communities, habitats, and resource management issues that range from 52,000 to 2.9 million km^2.) Federal and state land management agencies and private conservation organizations have formed partnerships called joint ventures (JVs) to coordinate conservation actions and produce cumulative, positive and ecologically relevant impacts at the scale of BCRs. Each of these regional conservation partnerships is encouraged to "step down" national and international population goals for all bird species of conservation concern to the BCR scale and to develop spatially explicit habitat objectives needed to reach identified goals. This generally entails what Partners in Flight refers to as "the five elements of conservation design": (1) landscape characterization and assessment; (2) bird population response modeling; (3) conservation opportunities assessment; (4) optimal landscape design; and (5) monitoring and evaluation.

NORTHERN RESEARCH STATION IS AN IMPORTANT COOPERATOR

U.S. Forest Service scientists in the Northern Research Station (NRS) and their cooperators have been key players in these efforts by providing the scientific knowledge and tools needed for effective and strategic bird conservation. These capabilities allow conservation planners to evaluate the capacity of landscapes and ecoregions to support priority species at desired levels and to predict the effects of conservation actions or landscape change resulting from development and climate change.



Map by D. Todd Jones-Farrand, American Bird Conservancy

Map of the Central Hardwoods and West Gulf Coastal Plain Bird Conservation Regions (BCRs) with predicted habitat suitability values for the cerulean warbler in ecological subsections within each BCR. These maps identify areas of high habitat suitability (darker shades) that may be essential to sustaining populations and areas of low suitability (lighter shades) where habitat may be able to be improved.

HABITAT SUITABILITY MODELS BASED ON GIS

Habitat suitability index (HSI) models have been used to evaluate wildlife habitat and the effects of management activities and development since the early 1980s. HSI models estimate habitat suitability on a scale of 0 (not suitable) to 1 (highly suitable) based on an assessment of resource attributes considered important to a species' abundance, survival, or reproduction. Traditionally HSI models were applied to a local area with measurements collected in the field. NRS scientists and cooperators, however, developed HSI models that can be applied to large landscapes through the utilization of a geographic information system (GIS). These models rely on data layers or maps derived from remote sensing and other existing spatial databases or from large-scale inventories such as the Forest Service's Forest Inventory and Analysis (FIA) Program. Because of the focus on large geographic areas and their use of GIS technology, these "next generation" HSI models can better address ecological and landscape effects on wildlife such as area sensitivity, edge effects, interspersion, landscape composition, and juxtaposition of resources.

PLANNING IN BIRD CONSERVATION REGIONS

A team of consisting of NRS scientist Frank Thompson; USGS scientist Dan Twedt; University of Missouri post-docs Todd Jones-Farrand and John Tirpak; and Joint Venture coordinators Jane Fitzgerald and Bill Uihlein developed HSI models for 40 bird species of conservation concern and are applying them to bird conservation planning in the Central Hardwoods and West Gulf Coastal Plain BCRs. Their approach maps available habitat in each region, produces habitat-based estimates of bird abundance, and will be used to develop and evaluate management approaches for meeting population goals. A major challenge to applying models at this scale is supplying the data needed. Any variables used in the models have to be mapped at a relevant resolution across the entire region of interest. Landcover and landform features are generally available in GIS coverages spanning states, countries, or continents, but features such as vegetation structure may only be mapped as part of inventories on some managed lands such as state or national forests. Working with Mark Nelson, an analyst with the NRS FIA Program, the team solved this problem by spatially modeling vegetation structure from FIA inventory data. FIA measures vegetation features on plots distributed across forest land in the United States at a density of 1 plot per 6,000 acres. The resulting maps of habitat suitability are now being used by partners to develop conservation implementation plans of the ecological subsections in the bird conservation regions.

Five management options affect population levels of the birds of concern on the Hoosier National Forest in southern Indiana. The options vary in the amount of timber management and prescribed fire.

LINKING LANDSCAPE CHANGE MODELS WITH WILDLIFE MODELS

Landscapes change over time due to succession, natural disturbances (windthrow, ice damage, fire, insects), land management, and land-use change (development), and these changes in turn affect bird populations. These landscape processes can be modeled in a dynamic landscape model that can forecast future landscapes. These predictions, in turn, can be linked to the previously mentioned HSI models to predict how wildlife habitat will change.

Another team consisting of NRS scientists Steve Shifely, Frank Thompson, and Bill Dijak, along with University of Missouri faculty members Josh Millspaugh and Hong He and doctoral student Chad Rittenhouse, used this approach to determine differences in vegetation and wildlife habitat conditions among five management alternatives as part of the Hoosier National Forest's planning process. The alternatives differed in terms of the type, extent, magnitude, frequency, and location of management activities. They modeled disturbances such as tree harvest, prescribed fire, wildfire, and windthrow, and succession using LANDIS, a landscape decision-support model. They then used the resulting maps of future landscapes as inputs for Landscape HSI models, software for running HSI models developed by some of the team. In this way, they linked wildlife habitat suitability models to spatially explicit vegetation change models that include ecological processes affecting vegetation composition, structure, and configuration. These tools are valuable for land management or conservation planning because they (1) are based on explicitly stated assumptions and relationships; (2) provide a way to consider

cumulative effects of multiple forest attributes at multiple spatial and temporal scales; (3) produce graphics and maps that help convey information to multiple constituencies about the effects of the alternatives.

Some of the members of this team are now applying this approach to looking at larger scale issues such as the effects of climate change and wildfire on wildlife across the Ozark Region of Missouri. Because it is positioned at the border of eastern forests with the grasslands of the Great Plains, this is an area predicted to be under great ecological stress resulting from climate change. Using this approach helps planners to know the effects of the various land management decisions for the various ecosystems in an area and what those decisions would mean to birds of concern.

BIRDS OF CONCERN IN THE CENTRAL HARDWOODS REGION

The Central Hardwoods Bird Conservation Region (CHBCR) straddles the Mississippi River between Illinois and Missouri. The western part of the region is also known as the Ozarks or Interior Highlands and eastern part as the Interior Low Plateaus. The CHBCR occupies a transition zone between what were historically tallgrass prairie and oak savanna and woodlands to its north and west, pine forests and woodlands to the south, and oak and mixed mesophytic forests to the east. The CHBCR's priority birds can be divided into four groups of species based on general habitats that they inhabit: forest-woodland, grass-shrublands, grasslands, and wetlands.

Of 310 forest-breeding birds nationwide, 22 percent are species of conservation concern, including 11 federally listed as endangered or threatened. In forest and woodlands in the CHBCR, there are16 species of regional concern, with 10 of these being of national concern as well. Here are three birds of high concern in the central hardwoods region:

U.S. Forest Service

The **cerulean warbler** is a neotropical migrant that inhabits mature forests, especially in riparian areas and bottomlands in the eastern and central United States. It has declined seriously (66 percent since 1967) across most of its range and has been petitioned for listing as an endangered species. This particular bird (top right) has just been banded after being caught in a mist net. These warblers are beautiful little birds in shades of soft blue-gray, and black. More information can be found at:

http://my.nature.org/birds/about/cerulean.htm

http://bna.birds.cornell.edu/bna/species/511/articles/introduction

or at the cerulean warbler's Facebook page:

www.facebook.com/group.php?gid=19504105543

Deanna K. Dawson,
Patuxent Bird Identification InfoCenter
Photo used with permission

The **prairie warbler** is a neotropical migrant that returns to nest in early successional habitats (old fields, savannas, and young forests, but not prairies!) throughout the eastern United States. Like many early successional species, this warbler's populations have declined greatly since 1967. This little beauty (middle right) has a bright yellow-gold belly with black streaks and an olive green back. More information can be found at:

http://bna.birds.cornell.edu/bna/species/455/articles/introduction

The **worm-eating warbler** is a neotropical migrant that breeds on lower slopes in the interiors of eastern deciduous forests. It is modestly colored in grays and tan but has striking stripes of black and buff on its head (bottom right). Despite its name, it eats caterpillars, not earthworms. More information can be found at:

http://bna.birds.cornell.edu/bna/species/367/articles/introduction

Charles H. Warren, images.nbii.gov

THE TOOL TEAM MEMBERS

Bill Dijak is a GIS specialist, **Steve Shifley** a research forester, and **Frank R. Thompson III** a research wildlife biologist and project leader with the USFS Northern Research Station, Columbia, MO.

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Hong He is an associate professor with the Forestry Department, **Josh Millspaugh** is an associate professor in the Department of Fisheries and Wildlife Sciences, and **Chad Rittenhouse** was a Ph.D. student in the Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, MO.

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USFS Northern Research Station, RWU NRS-11: www.nrs.fs.fed.us/units/ch/

Landscape-Level Habitat Suitability Models software: www.nrs.fs.fed.us/pubs/1865

LANDIS Landscape Disturbance and Succession model: www.nrs.fs.fed.us/tools/landis/

USFS Partners in Flight: www.fs.fed.us/biology/wildlife/partnersinflight.html

US Geological Survey, Breeding Bird Survey: www.pwrc.usgs.gov/bbs/

North American Bird Conservation Initiative: www.nabci-us.org/

Partners In Flight: www.partnersinflight.org/

Central Hardwoods Joint Venture: www.chjv.org

Lower Mississippi Valley Joint Venture: www.lmvjv.org/

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