

# *National Fish and Wildlife Foundation's Support for Forest Management Research on Birds*

*An Evaluation of  
Outcomes and Impacts*

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## *Executive Summary*

# **National Fish and Wildlife Foundation's Support for Forest Management Research on Birds**

## **Evaluation of Outcomes and Impacts**

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### **Purpose**

To evaluate the impact of National Fish and Wildlife Foundation-sponsored research on advances in forest bird management and conservation, and on forest bird populations and their habitats.

### **Project Overview**

Nine objectives associated with the Foundation's forest bird research program were assessed for each of eleven North American research projects supported by the Foundation between 1991 and 1999. In 2003, site visits, telephone interviews, and other forms of data collection were used to document the outcomes of each project. Information was gathered from researchers, project collaborators, and prospective users of research results -- primarily forest products industry, nongovernmental organizations, and government agencies.

### **Key Findings**

- The Foundation incorporated a diverse set of stakeholder interests into the forest research program and engaged highly qualified research teams to investigate priority issues.
- Foundation funds were used effectively to leverage additional research funding, and to stimulate numerous research projects on forest management and conservation.
- Valuable and reliable information was derived from supported projects, most of which was directly applicable to forest management and conservation.

- Communication of results was generally good, and many peer-reviewed technical reports were published and communicated at professional meetings. Publications directly targeting forest managers often were lacking, which likely hindered field application of research results.
- Research results influenced forest management policy and planning in a general sense and several significant changes in forest management plans and policies were made.
- Several notable adjustments to local forest management actions resulted due to information originating from research projects, but results usually did not translate into management action.
- Research validated the significance of several existing forest management practices for forest birds. Anecdotal evidence suggests that changes made to forest management practices have benefited, or will benefit in the future, birds and their habitats, but lack of assessment and monitoring protocols by land managers prevented rigorous assessment of those possibilities.

### **Primary Recommendations**

The widespread and positive outcomes of these select research projects suggest that the National Fish and Wildlife Foundation should continue and enhance its support of forest management research on birds and, possibly, other wildlife. The Program must better emphasize timely and effective communication of results to prospective users of research information through, for example, publication of results in appropriate formats and development of regional workshops aimed at synthesizing and disseminating available scientific information.



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## INTRODUCTION

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*The main purpose of evaluation is to improve the quality of a program or project by identifying its strengths and weaknesses.*

Dr. Murari Suvedi, Professor,  
Michigan State University,  
2003



The Magnolia Warbler, a neotropical migrant, is one of more than 400 species upon which Partners in Flight focuses its conservation efforts. While most populations of Magnolia Warblers are secure, those occupying interior portions of North America have declined by more than 8% per year during the past 37 years.

Program evaluation is the process of systematically collecting information about a program to assess whether acceptable standards or expectations (such as processes, objectives or outcomes) have been met (Case et al. 1988, NSF 1998). Evaluation is an essential step in the evolution of a program, as it can offer an unbiased assessment of what works and what does not work under existing programmatic protocols, and can provide insight into potential changes necessary for processes or expectations. In essence, program evaluation is a form of organizational “accountability,” the outcome of which can be a more effective and publicly trusted organization (Independent Sector 2000).

### **The National Fish and Wildlife Foundation**

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The National Fish and Wildlife Foundation (hereafter, Foundation) is a private, non-profit, 501(c)(3) tax-exempt organization established by the United States Congress in 1984 for the express purpose of protecting and enhancing fish, wildlife, and plants, and the habitats upon which those species depend. The mission of the Foundation centers on promoting healthy populations of fish, wildlife, and plants by generating new and unique partnerships between the public and private sectors and strategically investing in conservation and sustainable use of natural resources.

The mission of the Foundation is pursued through three principal modes of action: (a) grants programs, (b) partnership development, and (c) leveraging of funds. Between 1984 and 2002, the Foundation supported over 5,000 grants and leveraged \$226 million in federal funds for more than \$700 million in on-the-ground conservation, education, and research. This has resulted in 27 million acres of restored and managed wildlife habitat, more than 14 thousand miles of restored rivers and streams, new models of private land stewardship, and stronger educational programs in schools and communities (NFWF 2002, 2003).

### **The Neotropical Migratory Bird Program**

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By the 1980s, mounting evidence was beginning to paint an alarming picture of the demise of neotropical migratory birds, species that migrate annually to the Caribbean Basin and Central and South America from North American breeding grounds. In response to widespread concern about bird populations in the United States, the Foundation, along with federal and state government agencies, nongovernmental organizations, and private industry, launched the Neotropical Migratory Bird Conservation Program in 1990. The goal of the initiative, largely carried out under an umbrella public-private partnership called *Partners in Flight*, was to support local, regional, national, and

international species and habitat conservation and management efforts to benefit neotropical migratory birds. Partners in Flight, through the guiding efforts of the Foundation, is now widely recognized as one of the largest and most successful public-private conservation enterprises ever established. Its conservation value has reached from the frozen taiga of Alaska, to the arid deserts of Sonora, to the wet pampas of Argentina (Finch and Stangel 1993, Martin and Finch 1995, Bonney et al. 2000). In addition, the initiative has stimulated the highest levels of national governments to recognize the need for more proactive conservation of migratory birds (e.g., Executive Order 13186, Federal Register 66:3853-3856, 2001).

### A Program for Forest Bird Research

Effective conservation and management of *forested habitats* in North America were identified as principal focal areas of Partners in Flight because many species of forest-dwelling birds had exhibited significant population declines during the preceding 30 years. The issue of forest management was seen as especially critical to the success of migratory bird conservation because more than 70% of forested lands in the United States were owned by private individuals and corporations, much of which was used to some extent for timber production and extraction (Wigley and Sweeney 1993), or was susceptible to development. Furthermore, the majority of acreage in the federal and state forest systems were open to timber or mineral extraction and other multiple use designations, thereby potentially creating habitat detrimental to the conservation of biological diversity, including forest birds (Williams and Rinne 1992).

Early in the development of the Neotropical Migratory Bird Conservation Program, the Foundation recognized that forestry-based research on non-hunted birds was scarce and that scientific information in this area would be paramount to successful bird conservation. In 1990, the Foundation established a forest bird research program (hereafter called the *Program*) geared towards establishing a better understanding of the habitat requirements of forest birds and the potential impacts of various land uses, including silvicultural practices, on those populations. The focus of each supported research project was intended to be related, either directly or indirectly, to developing ways in which conservation of forest-dwelling birds could be effectively integrated into existing forest management and land use, including silvicultural practices and landscape- and regional-level planning. During the 1990s, more than \$1.5 million was designated by the Foundation for forest management research on birds, which additionally leveraged more than \$4 million in partner contributions.



*Numerous independent activities and proposals have materialized..., but a complete, coordinated framework to ensure [neotropical] migrant protection was missing. [Partners in Flight] is designed to address this need by coordinating cooperative efforts among federal, state and local government agencies, professional alliances, philanthropic foundations, and private companies.*

Dr. Deborah Finch, Research Wildlife Biologist, USDA Forest Service, 1991

### Evaluating the Program

In 2003, the Foundation commissioned a broad-based evaluation of the effectiveness of the Program in generating high quality research information about forest birds, and in applying that information to forest management and conservation. The evaluation, while seeking to better understand the overall contributions of the Program, was not intended to be a comprehensive assessment of *all* projects. Rather, it was designed to use a select, but diverse, subset of supported projects to examine the outcomes and impacts of various approaches to forest bird research on conservation and management activities (see Design and Methods).

*Additional information relating avian communities to forest composition, distribution, fragmentation and various silvicultural practices is needed to ensure the future of sensitive neotropical migratory birds.*

Dr. James Dickson (Research Wildlife Biologist, USDA Forest Service) and others 1993

## PROGRAM OBJECTIVES

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A **performance measure** is a means of judging whether an objective has been fulfilled. It can be expressed in several ways but, in general, a performance measure is a statement that reflects a summation of activity or effort that can be expressed in a quantitative or qualitative manner. The activity or effort is deemed to be critical for achieving a particular objective.

A **core indicator**, on the other hand, represents a defined value, product, or characteristic that can be used to directly measure the result of the activity or effort identified through a performance measure. By summarizing information about core indicators, performance measures can be assessed.

The Foundation's Program director met with evaluators to discuss the overall purpose and objectives of the forest bird research initiative. From those discussions, evaluators developed language to reflect nine principal programmatic objectives. Several of the objectives had not been formally articulated by the Foundation prior to that exercise, although all were recognized to be integral to Program success.

Objectives statements provided the foundation upon which Program performance could be evaluated. Evaluators chose to evaluate objectives (and, hence, Program performance) using an approach similar to that used by the United States government (Government Performance and Results Act of 1993; GPRA) and the Sustainable Forestry Initiative (SFI) Program of the Sustainable Forestry Board. Both institutions have endorsed the concept of *performance measures* and *core indicators* (OMB 1995, Sustainable Forestry Board 2002) to assess the level of achievement of program objectives. [See sidebars on this page for definitions.]

For each of the nine objectives, one or more performance measures were identified and used to assess the extent to which an objective had been met. Core indicators were used as the metrics by which performance measures were directly evaluated. For objectives to be fulfilled, performance measures needed to be fully supported by core indicator metrics.

Objectives, performance measures, and core indicators form a hierarchical set of program benchmarks that indicate the level at which a program is performing. Outlined below is the structured set of benchmarks used for this Program evaluation.

### OBJECTIVE 1 Identify priority information needs pertaining to forest bird management and conservation, and incorporate those needs into Program

#### PERFORMANCE MEASURE 1.1

Foundation shall seek input from leaders and principal stakeholders in bird and forest management and conservation to identify priority information needs.

#### CORE INDICATORS

**1.1.1** Incorporation of state-of-the-art information, including refereed literature and organizational and agency management and policy documents, into identification of priority information needs.

**1.1.2** Participation of Foundation staff in formal meetings involving principal stakeholders in forest bird management and conservation.

**1.1.3** Obtain prior to Program implementation, and at regular intervals thereafter, external review of priority information needs.

**PERFORMANCE MEASURE 1.2**

Foundation shall incorporate high priority information needs from a diverse set of principal stakeholders into priority information needs.

**CORE INDICATORS**

- 1.2.1** Stated priority Program information needs reflect high priority information needs of a diverse set of principal stakeholders.

**PERFORMANCE MEASURE 1.3**

Foundation shall incorporate high priority information needs from a diverse set of principal stakeholders into Program funding decisions.

**CORE INDICATORS**

- 1.3.1** Funded research projects reflect high priority information needs of a diverse set of principal stakeholders.

**OBJECTIVE 2**

**Provide adequate financial and partnership support for research projects that are likely to successfully address priority Program information needs**

**PERFORMANCE MEASURE 2.1**

Foundation shall encourage application for funding and partnerships from internationally, nationally, and regionally recognized researchers in forest bird management and conservation.

**CORE INDICATORS**

- 2.1.1** Availability of funding and partnership opportunities are broadly and strategically disseminated via published, electronic, and verbal announcements.

- 2.1.2** Adequate numbers of internationally, nationally, and regionally recognized researchers in forest bird management and conservation apply for funding, or seek partnership support, from the Foundation.

**PERFORMANCE MEASURE 2.2**

Foundation shall ensure that adequate funding and partnership support is available to implement research projects addressing priority information needs.

**CORE INDICATORS**

- 2.2.1** Adequate Foundation funding is available to support high priority information needs.
- 2.2.2** Adequate partnership development is available to implement projects addressing high priority information needs.

**PERFORMANCE MEASURE 2.3**

Research proposals funded, or developed through partnerships, by the Foundation are highly likely to produce useful and reliable scientific information.

Objectives 1 and 2 pertain to the effectiveness of the Foundation in identifying important information needs and funding research projects that are capable of delivering high quality information about those issues. This type of evaluation is termed “process evaluation” (see page 14).



Foundation-sponsored research led by Richard Lancia of North Carolina State University found that the Downy Woodpecker (above) and Eastern Titmouse (left), both nonmigratory cavity-nesting species, were not affected by forest fragmentation that resulted from timber harvesting practices in the coastal plain of South Carolina.

Objectives 3-6 pertain to the short-term objectives of the Program, objectives that typically can be assessed through relatively straightforward activities and products. This type of evaluation is termed “outcome evaluation” (see page 15).

### OBJECTIVE 3 Stimulate additional avenues of research and areas of inquiry on forest bird management and conservation



#### PERFORMANCE MEASURE 3.1

Principal investigators, collaborators, or other researchers use information derived from supported projects to further investigate priority Program information and related needs.

#### CORE INDICATORS

**3.1.1** Projects with multiple years of Foundation support expand upon research and other objectives during latter years of support.

**3.1.2** Results from supported projects are incorporated into research needs assessments of agencies, organizations, and conservation partnerships.

**3.1.3** Results from supported projects stimulate other investigations.

**3.1.4** Results from supported projects are referenced in other research proposals.

### OBJECTIVE 4

Data and information derived from supported research projects are of high value to land managers, planners, and other decision-makers

#### PERFORMANCE MEASURE 4.1

Stated research goals and objectives of supported projects are achieved.

#### CORE INDICATORS

**4.1.1** Research hypotheses and questions posed in proposals are effectively addressed.

**4.1.2** Proposed project products are satisfactorily developed.

#### PERFORMANCE MEASURE 4.2

Definitive results are derived from supported projects.

#### CORE INDICATORS

**4.2.1** Results from supported projects are clear with respect to addressing stated research questions.

#### PERFORMANCE MEASURE 4.3

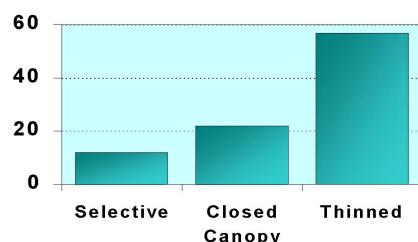
Project results have relatively direct application to forest management and conservation.

#### CORE INDICATORS

**4.3.1** Results from supported projects can be used immediately and directly by practitioners of forest management and conservation.

In a study supported by the Foundation, Thomas Martin of the University of Arkansas found that the Black-and-White Warbler (photo above), a neotropical migrant, suffered greater nest predation in stands that had been commercially thinned compared to that in closed canopy forests and mature stands where trees were selectively removed (Barber et al. 2001).

#### Predation Rates (%) on Nests of Black-and-White Warblers Under Different Silvicultural Treatments



**OBJECTIVE 5**

**Information from supported research is effectively communicated to prospective users**

**PERFORMANCE MEASURE 5.1**

Information derived from research projects is communicated by *principal investigators* to prospective users in a timely and effective manner.

**CORE INDICATORS**

**5.1.1** Project results are formally communicated at professional, technical meetings.

**5.1.2** Project results are formally communicated at meetings with professional practitioners of forest management and conservation.

**5.1.3** Project results are formally communicated at meetings with national or regional conservation or management groups.

**5.1.4** Project results are formally communicated at meetings with local conservation or management groups.

**5.1.5** Project results are published in refereed technical journals, symposium proceedings, or books.

**5.1.6** Project results are published in non-refereed publications, such as technical reports, brochures, magazines, newsletters, or the WWW.

**PERFORMANCE MEASURE 5.2**

Information derived from research projects is communicated by *project collaborators* to prospective users in a timely and effective manner.

**CORE INDICATORS**

**5.2.1** Project results are formally communicated at meetings with professional practitioners of forest management and conservation.

**5.2.2** Project results are formally communicated at meetings with national or regional conservation or management groups.

**5.2.3** Project results are formally communicated at meetings with local conservation or management groups.

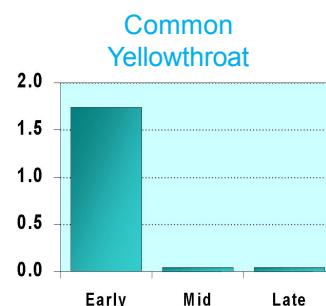
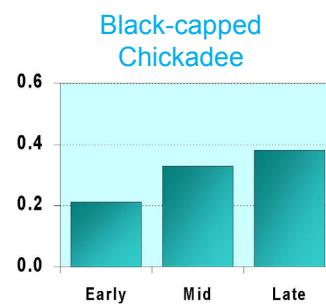
**5.2.4** Project results are published in non-refereed publications, such as technical reports, brochures, magazines, newsletters, or the WWW.

**PERFORMANCE MEASURE 5.3**

Information derived from supported research projects is communicated by the *Foundation* to prospective users in a timely and effective manner.

**CORE INDICATORS**

**5.3.1** Project results are formally communicated at meetings with national or regional conservation or management groups.



John Hagan and colleagues at the Manomet Center for Conservation Sciences documented habitat preferences (shown here as birds per survey plot) of forest-dwelling birds on industrial timber lands in Maine. Most species showed clear preferences for mid- to late-rotational stands (e.g., Black-throated Green Warbler; top graph and photo) or for early successional stands (Common Yellowthroat; bottom graph). Several species, however, showed little preference for a specific age class of forest (Black-capped Chickadee; middle graph, bottom photo). Data taken from Hagan et al. 1997.

Objectives 7-9 are associated with long-term outcomes of great consequence, such as positive changes in the behavior of people or in the population status of a target species. While often difficult to document, achievement of these types of outcomes ultimately define the success of a program. This type of evaluation is termed “impact evaluation” (see page 15).

The Ovenbird, a neotropical migrant considered to be sensitive to forest fragmentation and disturbance, was studied in four Foundation-sponsored projects across the United States. In those investigations, Ovenbirds exhibited a mixed response to silvicultural practices, suggesting that the level of impact on Ovenbirds depends upon the type of local forest disturbance and the landscape context within which those disturbances take place.



### OBJECTIVE 6

**Information from supported research projects provides management and conservation guidance to prospective users**

#### PERFORMANCE MEASURE 6.1

Information and recommendations from research projects are incorporated into organizational policies, procedures, and practices.

##### CORE INDICATORS

**6.1.1** Information from projects is included in *private and non-governmental organizations'* policies, procedures, and practices.

**6.1.2** Information from projects is included in *federal, state, or local government* policies, procedures, and practices.

**6.1.3** Information from projects is included in the policies, procedures, and practices of *professional societies*.

### PERFORMANCE MEASURE 6.2

Information and recommendations from research projects are incorporated into land use and species conservation and management plans.

##### CORE INDICATORS

**6.2.1** Information from projects is incorporated into *private and non-governmental* land use and species conservation and management plans.

**6.2.2** Information from projects is incorporated into *government* land use and species conservation and management plans.

### OBJECTIVE 7

**Recommendations derived from supported research projects are implemented by private, nongovernment, and government groups**

#### PERFORMANCE MEASURE 7.1

Management and conservation recommendations derived from projects are implemented by private and nongovernmental organizations, and government agencies.

##### CORE INDICATORS

**7.1.1** Private, nongovernmental, and government groups implement forestry and silvicultural practices that are based upon project results.

**7.1.2** Approaches to land use planning and land acquisition that are based upon project results are implemented by private, nongovernmental, and government groups.

**7.1.3** Private, nongovernmental, and government groups implement species management and conservation practices that are based upon project results.

## OBJECTIVE 8

### Habitat conditions are improved for forest-dwelling birds

#### PERFORMANCE MEASURE 8.1

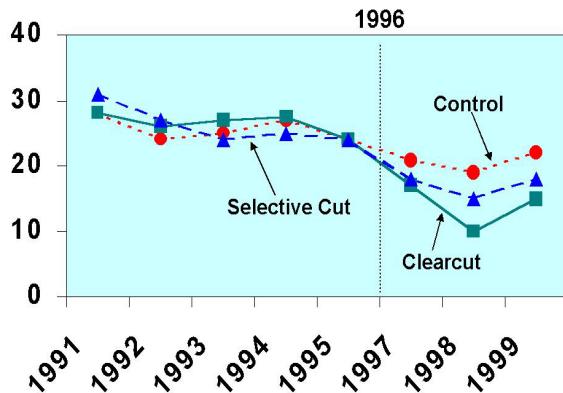
Implementation of management and conservation practices based upon project information directly improves habitat conditions for forest-dwelling birds.

#### CORE INDICATORS

**8.1.1** Higher quality forest lands are acquired or protected based upon project information.

**8.1.2** Forest acreage is directly improved through management or restoration practices that are implemented based on project information.

## Ovenbird Responses (Birds/100 ha) to Silvicultural Treatments in the Missouri Ozarks.



Research led by John Faaborg of the University of Missouri examined changes in abundance of Ovenbirds after selective cutting (single tree and small group) and clearcutting in 1996 (Gram et al. 2003). Ovenbirds declined significantly after both types of harvesting and, notably, Ovenbirds even declined in the adjacent control plots (uncut mature forest). Acadian Flycatchers (photo at left) exhibited similar patterns of decline. Faaborg and his colleagues suggested that birds might choose breeding habitats based upon environmental features well beyond the immediate nesting territory or forest stand.

## OBJECTIVE 9

### Population status of forest-dwelling birds is improved

#### PERFORMANCE MEASURE 9.1

Implementation of management and conservation practices based upon project information improves population status of forest-dwelling birds.

#### CORE INDICATORS

**9.1.1** Local populations of forest-dwelling birds exhibit more positive population trajectories after implementation of management and conservation practices derived from supported projects.

**9.1.2** Regional populations of forest-dwelling birds exhibit more positive population trajectories after implementation of management and conservation practices derived from supported projects.

**9.1.3** Increased reproductive success or survival, or other indicators of population status, of forest-dwelling birds occurs after implementation of management and conservation practices derived from supported projects.



Acadian Flycatchers require relatively undisturbed, closed-canopied forests during both the breeding season in the United States and during the overwintering period in Central America.

## DESIGN AND METHODS

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The principal goal of this evaluation was to examine the relative successes of various approaches to research on forest bird conservation and management activities, and to identify potential factors that may have limited those successes.

A solid underlying conceptual and practical design was paramount to extracting accurate and useful information about the Program (for general rationale, see Benson and Michael 1987, Suvedi 2003). The approach used was discussed and mutually agreed upon by the Foundation and Program evaluators prior to implementation. Those *a priori* discussions allowed both Program administrators and evaluators to define, understand, and agree upon the specific information that was necessary to evaluate the Program. Discussions also provided the opportunity to choose the most appropriate, realistic, and cost-effective means of collecting the necessary information.

### Goal of the Evaluation

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The principal goal of this evaluation was to examine the relative successes of various approaches to research on forest bird conservation and management activities, and to identify potential factors that may have limited those successes.

As such, the evaluation was built upon assessment of 11 research-based projects identified *a priori* by the Foundation. These projects did not represent a random subset of all research projects funded by the Foundation. Rather, the evaluation included some of the largest projects (based upon length and extent of funding) that the Program supported and represented a

diverse collection of research issues, geographic locations, organizational affiliations, and approaches to project implementation. Hence, the evaluation was not intended to assess the *overall* success of the Program. Instead, it used a select group of projects to (a) elucidate strategies that led to conservation successes, and (b) identify potential impediments to those successes.

By focusing on this non-random subset of projects, the evaluation was able to address a primary interest of the Program: developing effective means of generating and disseminating scientific information, and incorporating that information into on-the-ground management and conservation activities.

### Approach to Evaluation

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This project employed three basic types of evaluation to provide a comprehensive assessment of Program strengths and weaknesses: (a) process evaluation, (b) outcome evaluation, and (c) impact evaluation (McNamara 1998, NSF 1998).

*Process evaluation* assesses the extent to which a program is operating as intended, and examines such issues as engaging target audiences and effectiveness of decision-making. Because the process by which the Foundation made decisions and managed day-to-day operations of the Program was not

the primary focus of this evaluation, the results presented here offer only a cursory treatment of the effectiveness of Program management. Nevertheless, while offering less than a detailed, comprehensive examination of all management issues, inclusion of process evaluation still provided valuable insight into several major aspects of Foundation decision-making as it related to Program outcomes and impacts.

*Outcome evaluation* reviews the relationship between the intended, relatively short-term objectives of a program and the actual, documented outcomes. Such evaluations often focus on fundamental products or changes anticipated from program implementation.

*Impact evaluation* is a type of outcome evaluation that focuses on broad, longer-term programmatic impacts, such as changes in human behavior or long-term population trajectories of wildlife.

## Approach to Data Collection

In addition to integrating multiple approaches to program evaluation, Program evaluators also employed several means of information collection and analysis, including survey and naturalistic designs (Wilde and Sockey 1995).

A *survey design* uses a standardized set of questions that is used by all evaluators to collect either qualitative or quantitative data. Potential answers to questions often are limited by the evaluator and are categorized to assist in quantitative summarization of results.

A 44-page survey instrument was developed to help standardize presentation of questions and documentation of responses. All

questions were aimed at generating information that reflected the extent to which core indicators had been achieved.

Evaluators quickly realized, however, that the closed-ended survey questions that largely dominated the survey instrument would not be totally effective in extracting some relevant information from respondents. Closed-ended survey questions (Babbie 1995, Fink 1995) are characterized by a set of questions, the range of answers to which are predetermined by evaluators. Hence, little opportunity is given to respondents to express supplemental feelings and attitudes about focal issues. While closed-ended survey designs have many beneficial properties, the limited number of projects used and the lack of pre-existing information on the issues that were likely to be encountered by evaluators in this evaluation, required an additional, alternative approach to information collection.

A *naturalistic design* was also incorporated into interviews to generate more information per respondent. This approach used a more informal, *ad hoc* series of open-ended questions (Babbie 1995, Fink 1995) that built upon some of the closed-ended questions posed through the survey instrument. Naturalistic surveys and open-ended questions can be prone to evaluator bias and are often less quantitative and conducive to rigorous analysis compared to closed-ended survey instruments, but can be effective when relatively few subjects from which to collect information are involved and supplemental information about the survey population or focal issues are of value (Fink 1995).

Hence, evaluators used an adaptive approach to collection of survey data, initially favoring a closed-

A 44-page survey instrument was developed to help standardize presentation of questions and documentation of responses. The complete survey instrument is included as a separate attachment to this report.

ended series of standardized questions, but (after assessing the content of initial interviews) later incorporated a more naturalistic design that stressed open-ended questions and collection of supplemental information to clarify and expand upon answers to the more structured survey questions. With collective adjustment of behavior, evaluators were able to adapt to forest bird research and management issues that were not anticipated prior to implementation of the survey.

### Data Collection Methods

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Information about the Program and its supported projects was collected between January and November 2003 using a combination of site visits; face-to-face, telephone and e-mail interviews; and literature reviews. Interviews focused principally on four groups of individuals:

- Principal investigators of research projects
- Collaborating scientists and land managers
- Users of research information, including government and nongovernmental groups, and private landowners
- Foundation Program director

Both evaluators had responsibility for primary assessment of 5 or 6 research projects, although each individual reviewed proposals, reports, and other supporting materials from all projects. Selection of individuals to interview was based upon recommendations of principal investigators; availability of local, regional, and national leaders in forest conservation, management, and research; identification of prospective users of research

information; and the need for additional independent clarification of certain aspects related to the value of research projects. In total, approximately 100 individuals were interviewed.

Interviews typically were informal. The evaluator generated initial questions from the survey instrument, but allowed the individual being interviewed full and unimpeded expression of views about the research project under investigation. When relevant, evaluators often requested specific written materials from respondents pertaining to their involvement in, or use of information from, the research project.

Interviews required 20 minutes to 4 hours depending upon the role of each individual in the research, the individual's familiarity with the project, or the extent to which the individual made use of the research results. At the time of each interview, evaluators wrote answers to questions directly on the survey instrument or in a notebook. Respondents were not shown the information recorded by evaluators. Visits were made to about half of the field research sites to obtain a better understanding of research design, results, and conservation implications.

### Assessment of Program Objectives

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The extent to which each of the nine Program objectives were fulfilled was based upon careful scrutiny of information gathered in support of core indicators and performance measures. Both evaluators independently assessed the results of their respective surveys for each Program objective, then collectively discussed those independent evaluations to reach a final result. For virtually all nine Program objectives,

independent assessment of results were exceptionally similar, leading to little disagreement in the final assessment by the two evaluators. The similarity of these independent conclusions, while only representing the views of two individuals, lends support to the credibility of conclusions.

Results of this evaluation are presented both as quantitative and qualitative narratives of principal conclusions and highlights for each objective. However, because of the open-ended nature of many of the questions posed to respondents, quantitative evaluation of overall Program objectives was not feasible. Furthermore, because no “standards” exist for assessing the relative success of forest bird research, even collection of detailed, quantitative assessment data for Program objectives would still have required subjective assignment of overall scores of success for the nine objectives.

For this evaluation, assessment of each Program objective was summarized on a subjective, 4-point relative scale (see figure below):

**Poor:** Performance measures consistently unfulfilled (more than two-thirds of projects did *not* fulfill measures).

**Fair:** Inconsistent attainment of performance measures (between one-third and two-thirds of projects *did* fulfill measures).

**Good:** Performance measures consistently fulfilled (more than two-thirds of projects *did* fulfill measures).

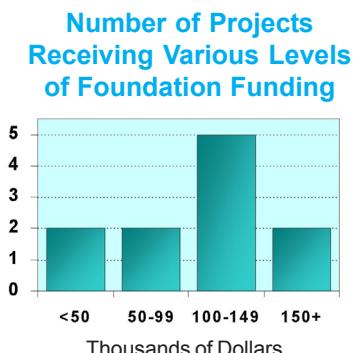
**Excellent:** Program or project performance consistently exceeded expectations (more than two-thirds of projects *did* fulfill measures and exceeded expectation of evaluators).



Summary scale used to depict overall attainment of each of the nine Program objectives. Each objective received one score based upon overall strength of associated performance measures.

## THE PROJECTS

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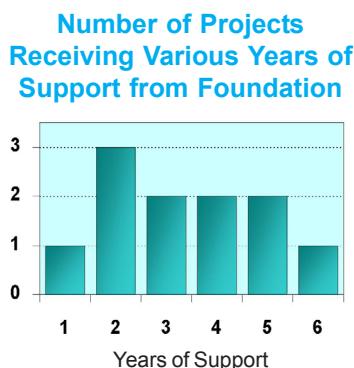


Eleven projects were chosen by the Foundation for inclusion in the Program evaluation. All projects were focused on applied research aimed at better understanding the habitat requirements of migratory birds breeding in North American forests, and had been completed at least 4 years prior to evaluation to ensure adequate time for analysis and dissemination of results.

Nongovernmental organizations comprised more than half (6) of the institutions to which research awards were made. Four university faculty received grants, as did one state agency biologist. Eight of the principal investigators or primary contacts had earned doctoral degrees. All projects represented collaborative efforts with at least two additional organizations.

All projects were supported for 1-6 years between 1991 and 1999. The average project received 3.4 years of financial support from the Foundation. Several projects were able to expend funds for longer periods than originally planned due to adaptation of project timetables to available funding.

A total of approximately \$1.5 million of federal funding was directed by the Foundation to the 11 projects, an average of about \$140,000 per project, which was relatively large compared to typical awards the Foundation makes for bird conservation work. Total funding ranged between approximately \$26,000 and \$450,000 for each project.



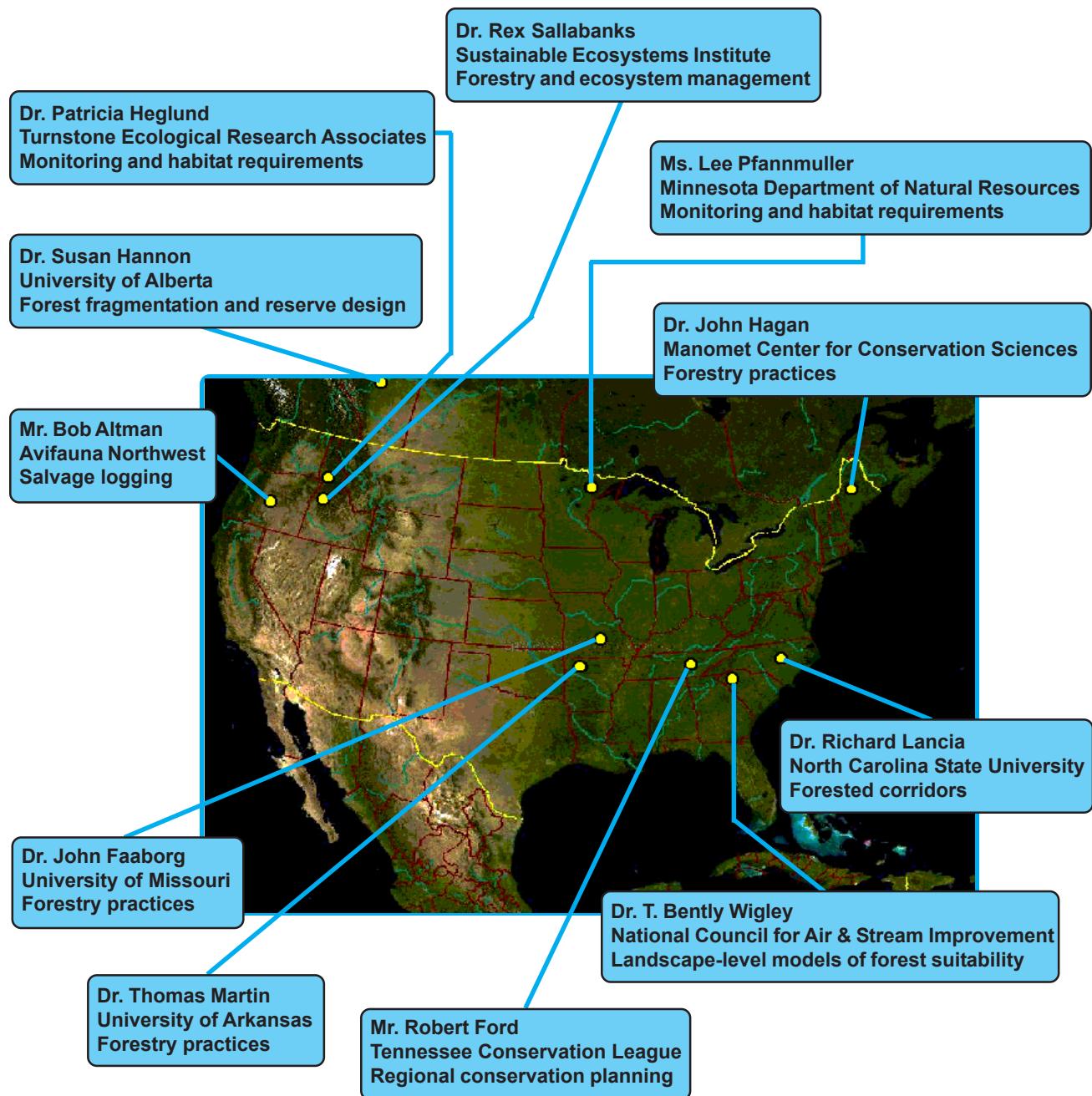
The \$1.5 million contributed by the Foundation leveraged at least \$4.1 million in matching (federal and non-federal) monies. This latter estimate, however, is likely to be conservative, as not all projects carefully tracked and reported funds originating in host organizations or from in-kind contributions donated by collaborators. Nevertheless, for every federal dollar the Foundation directed towards these research projects, at least \$3 in direct funding, materials, or services were secured.

Research projects were conducted in a diverse set of forest types and ecoregions of North America. In fact, the 11 projects have direct application to at least 18 ecoregions (Bailey 1995) of the United States and Canada.

The study design of seven of the projects were closely tied to active forest management, in particular timber harvesting practices. In addition, nearly all projects incorporated a landscape-level perspective into the implementation and interpretation of the investigation.

The objectives and focus of many of the projects evolved over time because of scientific knowledge gained during preceding years. The following pages provide a brief synopsis of the objectives of each project used in this evaluation. Project titles reflect the general thrust of each project and not necessarily actual project titles identified by principal investigators.

## LOCATIONS OF ELEVEN PROJECTS USED FOR PROGRAM EVALUATION\*



\* Key: Principal Investigator or Contact  
Organizational Affiliation  
Focus of Research Project



The pine-hardwoods forests of the Ouachita Mountains of central Arkansas served as an important study area for Foundation-supported research on neotropical migratory birds.

### ***Silvicultural Practices and the Health of Bird Populations***

*Thomas Martin*

University of Arkansas &  
University of Montana

- Assess effects of silvicultural practices on breeding productivity and abundance of birds in hardwood forests of Arkansas
- Identify habitat requirements

### ***Integrating Ecological and Economic Goals into Industrial Forest Management***

*John Hagan*

Manomet Center for Conservation Sciences

- Develop models that integrate both economics and ecology in forest management
- Develop GIS-based landscape management tools
- Identify habitat requirements
- Develop and facilitate stakeholder discussion groups on forest management in Maine

### ***Regional Forest Changes and Populations of Forest Birds***

*Lee Pfannmuller*

Minnesota Department of Natural Resources

- Develop long-term regional monitoring protocols for forest birds in Minnesota
- Develop GIS-based landscape management tools



Clearcut and corridor in Alberta's aspen forests



Birch-aspen forest in Minnesota

### ***Ecoregional Planning***

*Robert Ford & Daryl Durham*  
Tennessee Conservation League

- Develop GIS-based habitat and bird management tools
- Develop and implement ecoregional and inter-state bird conservation plans
- Enhance outreach and education efforts for bird conservation

### ***Effects of Forest Fragmentation Resulting from Timber Harvest***

*Susan Hannon*

University of Alberta

- Assess effects of silvicultural practices on breeding birds in aspen forests of Alberta
- Evaluate benefits of movement corridors linking forest fragments
- Develop recommendations for spatial and temporal design of timber harvesting operations

### ***Effects of Salvage Logging on Migratory Bird Populations***

*Bob Altman*  
Avifauna Northwest

- Evaluate effects of salvage logging practices on landbirds breeding in lodgepole pine forests of Oregon

### ***Timber Harvest, Forest Fragmentation and the Health of Bird Populations***

*Rex Sallabanks*  
Sustainable Ecosystems Institute & Conservation Research Foundation

- Assess effects of silvicultural practices and forest fragmentation on productivity of breeding birds in western forests
- Better understand the regional dynamics of bird populations

### ***Effects of Timber Management Practices on Bird Populations***

*John Faaborg*  
University of Missouri

- Assess habitat use, reproductive output, and abundance of birds breeding in Missouri oak-hickory forests managed under different silvicultural treatments



Uncut 50-70 year-old oak-hickory stands served as control plots in a study in the Missouri Ozarks.

### ***Development of Landscape-level Models for Sustainable Forest Management***

*T. Bently Wigley*  
National Council of the Paper Industry for Air and Stream Improvement

- Identify habitat requirements of birds, reptiles, and amphibians in coastal forests of South Carolina
- Develop mathematical models that incorporate economics and ecological factors in decision-making on industrial timberlands



The practice of clearcutting and its impact on bird populations was examined in most of the research projects

### ***Habitat and Corridor Use by Birds in Industrial Forests***

*Richard Lancia*  
North Carolina State University

- Identify habitat and landscape-level requirements of birds breeding in coastal plain forests
- Examine the effects of forested corridors on birds in industrial forests of South Carolina

### ***Assessing Bird Populations and Habitat Use on Industrial Timberlands***

*Patricia Heglund*  
Turnstone Ecological Research Associates

- Identify habitat requirements
- Develop predictive models of habitat use and effects of silvicultural treatments



Bottomland hardwood forest, such as that found in the Tennessee National Wildlife Refuge, was a focus of regional conservation planning in southeastern United States.

## OBJECTIVE 1

*Identify priority information needs pertaining to forest bird management and conservation, and incorporate those needs into Program*

The National Fish and Wildlife Foundation used five means of identifying research and information needs for management and conservation of forest-dwelling birds:

- Use of existing scientific information
- Creation of research and monitoring working groups comprised of diverse stakeholders and interests
- Guidance by federal agencies
- Guidance by paper products industry
- Guidance by conservation groups

## IDENTIFY INFORMATION NEEDS

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**R**ecognition of the critical needs of constituents or customers is an indispensable step in development of any effective program. In 1990, when the Foundation led development of the Neotropical Migratory Bird Conservation Program, “agencies and cooperators lack[ed] sufficient information on the population status and causes of population changes of neotropical migrants to effectively conserve their populations...” (Finch 1991:21). To address this gap in knowledge, the Foundation initiated a five-pronged approach for identifying priority information needs of land managers, conservationists, and other stakeholders.

### Use of Existing Information

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Prior to 1989, relatively few scientific studies had been conducted in the Western Hemisphere that addressed issues of forest bird management and conservation, especially those involving non-hunted species. That began to change, however, with a 1989 symposium and subsequent publication of proceedings entitled, *Ecology and Conservation of Neotropical Migrant Landbirds* (Hagan and Johnston 1992). That collection of research, along with several other notable works (e.g., Robbins et al. 1989, Terborgh 1989) provided the starting point for Foundation staff to identify information gaps pertaining to migratory bird conservation and to develop a strategy for overcoming those limitations.

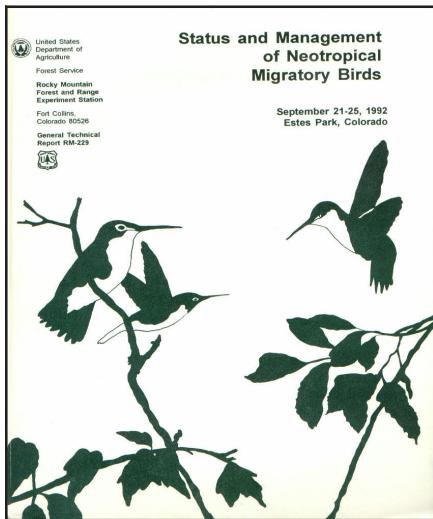
### Creation of Working Groups

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Through the Partners in Flight network, the Foundation and its partners established a formal Research Working Group charged with summarizing existing conservation-based knowledge of migratory bird populations and identifying additional research that was required for implementing productive management and conservation actions. The Research Working Group was comprised of a diverse set of biologists from federal and state agencies, nongovernmental organizations, and industry, especially those representing forest products. The Research Working Group continues as an active association today, some 13 years later.

Several valuable products were developed by the Research Working Group within several years of the formative meeting of Partners in Flight, and those efforts helped the Foundation establish a clear direction for its forest bird research program. In 1992, the group hosted a major workshop, “Status and Management of Neotropical Migratory Birds,” that attracted more than 700 participants to Estes Park, Colorado. The workshop brought together researchers and natural resources managers to discuss novel approaches to the conservation and management of migratory birds. One year later, a comprehensive review of neotropical migratory bird ecology and management was published that summarized the

presentations and outcomes of the Estes Park workshop (Finch and Stangel 1993), including recommendations for future research. A companion volume was published by Oxford University Press in 1995.



Several additional efforts under the Partners in Flight umbrella were also directed at identifying critical forest bird research needs. The Research Working Group implemented a detailed survey of research needs identified by land managers, researchers, and others involved in conservation of migratory birds. That process, initiated in 1995 but only recently published (Donovan et al. 2002) and distributed, has resulted in development of an interactive database on the WWW that provides detailed research needs for migratory landbirds in North America.

The Washington-Oregon chapter of Partners in Flight sponsored a more directed survey of research and information needs of public and private land managers in the Pacific Northwest (Arnett and Sallabanks 1998). That compilation of needs is helping guide forest research in western forests.

Finally, the efforts of the Foundation through Partners in Flight also stimulated identification of monitoring and assessment needs of forest birds in the United States (Butcher et al. 1992) and in Latin America and the Caribbean (Rivera-Milan et al. 1994).

In sum, creation of working groups within the Partners in Flight network resulted in several established processes and databases that has allowed the Foundation and others to identify significant information gaps for management of forest habitats. This has been a productive approach to identification of information needs, as it stresses integration of a broad and cross-cutting set of perspectives in a noncontentious environment.

### Guidance by Agencies

Approximately one quarter of the United States land base is managed by the federal government. Because much of those lands are forested and because of their legislative responsibilities relating to migratory birds, the Foundation made concerted initial efforts to seek guidance on critical information needs from several federal land management agencies, including the USDA Forest Service, Bureau of Land Management, and U.S. Fish and Wildlife Service.

Agencies typically interacted with Foundation staff through their respective national offices, although information passed to the Foundation was aggregated from regional and field offices as well. Those agencies contributed both formal and informal feedback on the direction of the Foundation's forest bird research program (Program). In addition, federal biologists served as reviewers of research proposals submitted to the Program.

### *Ecology and Management of Neotropical Migratory Birds*

*A Synthesis and Review of Critical Issues*

Edited by Thomas E. Martin  
Deborah M. Finch

The Foundation was instrumental in establishing several working groups charged with identifying research and information needs for more effective forest management. Several resulting publications, including books edited by Martin and Finch (1995; above) and Finch and Stangel (1993; above left) summarized state-of-the-art knowledge about migratory landbird ecology and conservation.

### Migratory bird conservation...

*...is only limited by our knowledge of the species.*

*GIS-based models are critical to an intelligent approach to bird habitat conservation.*

Dr. Steven Lewis  
Nongame Bird Coordinator  
U.S. Fish & Wildlife Service

A major contribution to identification of research needs was made by the Forest Service through a detailed synopsis of the ecology, habitat requirements, and conservation of neotropical migratory birds prepared in support of the Neotropical Migratory Bird Conservation Program (Finch 1991). Information gaps necessary for effective management and conservation were highlighted in that document which, in turn, were referenced regularly by Program staff in drafting funding recommendations.

Second, through those professional contacts, Program staff were instrumental in creation of an Industry Committee within the Partners in Flight network. The purpose of this working group was to contribute to the search for viable alternatives for the conservation of migratory birds. Today, 13 forest products corporations are active members of the Industry Committee, and have made significant contributions to identification of important gaps in research.

Finally, Program staff developed a collaborative relationship with the National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI), a partnership of the paper products industry charged (in part) with developing guidance for sound management of forests and forest resources. NCASI offered another independent assessment of the needs for forest research.

### Guidance by Industry

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Approximately one third of the United States is forested. Of those forested lands, 42% is managed by federal and state governments; the remainder (58%) is privately owned (Smith et al. 2001). The Foundation recognized that those private lands were critical for conservation of migratory birds and charted a course for inclusion of private landholders in the Partners in Flight initiative. In particular, the forest products industry, which currently owns 9% of all forested lands in the United States (Smith et al. 2001) and which actively manages the bulk of its forests, was invited to participate in identification of forest management information needs.

Three approaches were employed by Program staff to engage the forest products industry in Partners in Flight and identification of forest management information gaps. First, Program staff made direct contact with administrators within the industry. For example, a professional relationship was developed with the Director of Wildlife Resources at Champion International Corporation, which offered the Program an intimate understanding of the needs and perspectives of the forest products industry.

### Guidance by Conservation Groups

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Conservation-based organizations have always played a pivotal role in many aspects of Partners in Flight, and identification of research needs for forest birds was no exception. A Nongovernmental Committee was established within Partners in Flight and this group contributed to the overall direction of forest bird conservation and research.

Program staff also consulted directly with biologists from those nongovernmental groups. For example, a program manager and professional ornithologist from the National Audubon Society were regularly consulted during the early years of the Program. In latter years, the American Bird Conservancy contributed to Program direction.

## **Justification for Areas of Program Emphasis**

Research directed at the conservation of forest-dwelling migratory birds in North America could have taken numerous paths. The Program, as characterized by the 11 projects used in this evaluation, identified a subset of the important issues and disbursed the bulk of funding towards research projects that addressed those information needs. While not the only areas of research investigated, three principal avenues of research were stressed by the Program:

- Effects of silvicultural practices on bird abundance and fecundity
- Influence of landscape-level characteristics on bird abundance and distribution within landscapes dominated by timber harvest
- Development of predictive models of habitat use

Given the state of knowledge on these versus other better understood issues (e.g., population trends of migratory birds, forest fragmentation in agricultural landscapes) during the early 1990s, the Foundation was justified in pursuing research directed at birds inhabiting “working” forests. This thrust was consistent with existing priorities of industry (e.g., McMahon 1992), agencies (Kessler et al. 1992), and conservation organizations (e.g., IUCN et al. 1991). In addition, this evaluation confirmed the importance of the Program direction to principal stakeholders of forest sustainability and bird conservation.

***Manomet is doing what the research community should be doing.***

**Donald Mansius**  
**Director of Forest Policy and Management**  
**Maine Forest Service**

## **Evaluation of Objective 1**

### ***Identification of Important Information Needs***

Identification of information needs that would best facilitate the conservation and recovery of migratory bird populations was a critical first step in development of the Foundation’s Forest Bird Research Program. The Program’s performance in meeting this objective reflected a visionary process that stressed (a) incorporation of a diverse set of perspectives, (b) establishment of permanent working groups that could offer long-term guidance, and (c) focus on a restricted set of issues that, through examination in multiple geographic areas, could collectively contribute credible, broad-based recommendations for forest management.

**EXCELLENT**



## OBJECTIVE 2

*Provide adequate financial and partnership support for research projects that are likely to successfully address priority Program information needs*

## SUPPORT QUALITY PROJECTS

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**S**imply disbursing funds to projects is not a true measure of success for granting agencies or foundations. Rather, the challenge of grantmaking is to identify and support those projects that have a high probability of achieving stated goals and contributing to the mission of the granting organization (Orosz et al. 2003). The Foundation used three means of soliciting proposals from prospective research teams who could make meaningful contributions to its mission.

First, Program staff contacted and worked directly with nationally recognized scientists experienced in ecological research on forest birds to develop projects addressing high priority issues.

Second, the Foundation distributed requests for proposals for forest-based, ecological research. The mode of distribution included Partners in Flight newsletters, internet, web pages, and other printed notices. The Foundation was not selective in this distribution, with the intent of reaching a broad audience of prospective grantees.

Initial Program funding was directed at research projects conducted in eastern forests because of greater understanding of forest bird issues in those areas. That trend disappeared, however, by the Program's third year.

Finally, Program staff made presentations at meetings of Partners in Flight announcing funding availability and identifying priority research needs. With the exception of the first two years, requests for Program funding has always exceeded resources available to fulfill those requests. Fewer than half of all submissions typically are approved.

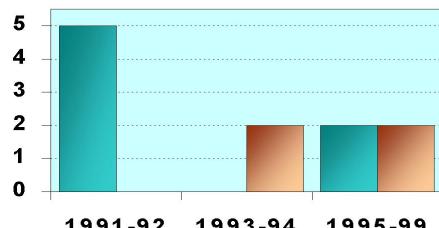
### Project Selection

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The Program strongly favored proposals that were (a) focused on priority forest management issues, (b) based upon collaborative partnerships with forest products industry, (c) led by respected scientists, and (d) underpinned by sound experimental design. While those are credible components of decision-making, the Foundation was under no legislative or other mandate to select projects for funding in a particular way. Thus, the Program developed its own means of identifying projects that could best meet its goals.

From its inception, the Program has relied upon both external peer review and internal staff evaluations to make funding recommendations. The significance of each of those review processes, however, evolved over time. Initially, research scientists with well established records and projects implemented in the eastern United States were favored because of the need to help ensure the success of this new program, and because of the greater availabil-

**Number of Eastern (Blue) and Western (Brown) Proposals Receiving Initial Year of Support**



ity of background information on eastern forest bird issues, respectively. That bias disappeared quickly, however, as more interest was generated from the West.

Program staff initially shouldered the bulk of proposal evaluation. But, by 1993, the level of external peer review was enhanced. For each proposal, Program staff attempted to obtain at least two independent assessments from government agencies, nongovernmental organizations, or industry biologists familiar with forest management issues and bird ecology. Using both internal and external reviews, a more inclusive Foundation staff met three times per year to discuss all Foundation proposals, including those on forest management.

Program evaluators examined each of the 37 proposals funded as part of the 11 projects for strong experimental design and methodologies, justifiable timetables, and realistic expectations for addressing priority information needs. For 35 of the 37 proposals, projects were well developed and justified and offered reasonable expectations for project objectives. The other two proposals had significant merit, but principal investigators overstated the extent of work that could be accomplished in the stated timeframe. Nevertheless, that the vast majority of the proposals funded by the Foundation were of extremely high quality reflects well upon the review process established by Program staff.

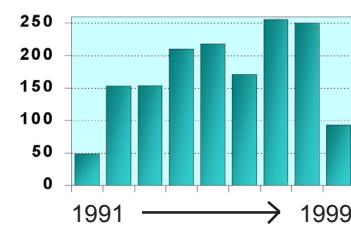
### **Availability of Funds**

Prior to 1990, few funds were available to biologists outside of natural resources agencies to initiate research on management of non-hunted forest birds, and even those resources were meager. With the advent of Partners in Flight,

scientists, managers, and conservationists sensed the possibility of a significant increase in available funding. While that did occur at many levels, the bulk of additional funds were directed at new positions and activities other than research.

Foundation funding for forest bird research was timely but, despite the gradual increase in Program contributions to research (reflected in these 11 projects), the extent of funding was never enough to hold the attention of many research biologists who originally attended Partners in Flight meetings. In time, the participation of research biologists in Partners in Flight waned.

**Total Annual Funding Provided by the Foundation for Eleven Focal Research Projects**



### **Evaluation of Objective 2**

#### ***Provide Support for Quality Projects***

**Given the level of funding, the Foundation made a reasonable effort to inform prospective scientists of the availability of funding for forest-based research on birds. Most of those efforts were directed at researchers who were active participants in Partners in Flight, reasoning that those individuals would be most cognizant of the issues deemed critical to success of the initiative. In most years, requests for funding far exceeded that available. In addition, the Program has been able to attract and support some of the premier researchers in forest bird ecology. Additional Foundation funds directed at bird research would re-establish the important role that research has in conservation initiatives, such as Partners in Flight.**

**Given the level of staffing, the Program performs exceptionally well in securing external peer and internal staff reviews for proposals submitted for funding. An independent assessment of the quality of the 37 research proposals funded in this evaluation found that nearly all aspects of all projects were of the highest quality and were deserving of support.**

**EXCELLENT**



## OBJECTIVE 3

*Stimulate additional avenues of research and areas of inquiry on forest bird management and conservation*

A **springboard effect** is exhibited when the results of a project lead to investigation of additional research questions and produce results that, when integrated, offer a more comprehensive understanding of larger ecological issues.

## STIMULATE ADDITIONAL RESEARCH

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A quality research project is characterized, in part, by its ability to stimulate additional lines of inquiry. The 11 projects supported by the Foundation were each examined for evidence of a “spring-board” effect (see sidebar to left) that would lend support to the presumption that these projects served in a synergistic capacity and influenced the advancement of science well beyond the systems in which the original work took place.

### Evolution of Research

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A common theme among the projects was the evolution in direction of research as answers to original questions became more transparent. For example, original work in Alberta’s aspen forests examined the response by bird populations to the effects of fragmentation. Once preliminary information on that issue was secured, emphasis was placed on understanding movement of birds through those fragmented landscapes and its implications for the spatial design of timber harvesting practices.

Research projects in Idaho reflected a shift in emphasis from stand-level studies in early years to more thorough examination of landscape- and regional-level dynamics in latter years. Research in the Arkansas Ozarks initially examined habitat use and reproductive performance of birds in undisturbed forests, but later used that study for comparison with different silvicultural treatments.

Two projects were especially noteworthy in this area. In Minnesota, collaboration between the Department of Natural Resources (DNR) and the Natural Resources Research Institute advanced from documentation of bird-habitat relationships and establishment of region-wide monitoring, to development of sophisticated mathematical models aimed at projecting long-term impacts of various land uses on bird populations.

Manomet’s work in Maine’s industrial timberlands progressed from assessment of bird-habitat relationships, to development of heuristic models that examined the tradeoff between economic and conservation benefits, to inclusion of multiple taxonomic groups of organisms in assessment of the overall health of forest ecosystems.

A program that supports continuity of both research teams and lines of research can be a cost-effective and efficient means of addressing complex ecological issues (e.g., NSF 2002), given that the original areas of inquiry were of importance (Objective 1) and that projects and investigators were of high quality (Objective 2). Projects sponsored by the Program were encouraged to evolve over time, changing research emphasis to accommodate knowledge gained in prior years. In turn, this allowed most projects to progressively investigate more complex issues, which were likely more reflective of the ultimate information needs of land managers.

In addition to the natural evolution of research questions, projects supported through the Program were notably effective in stimulating research not directly or originally intended to be funded by the Foundation. These efforts originated both within and outside of the core research teams.

### **Springboard Effect: Internal**

Internal efforts often were in the form of graduate and undergraduate student projects. The approach of the University of Missouri, in particular, highlights the significant contributions that these projects made to the advancement of science. In the first six years of work, approximately 180 undergraduate and 12 graduate students worked on the bird portion of the Missouri Ozarks Forest Ecosystem Project (MOFEP). All undergraduates were required to conduct independent research projects. Projects were diverse in nature, ranging from botanical aspects of silviculture practices to the effects of those practices on small mammal populations. Several of these projects led to more in-depth investigation through graduate theses.

Attempts to develop decision support tools for land managers in the Little Pee Dee region of South Carolina led researchers to create a spatially-explicit model (Habplan), that allows foresters to better schedule timber harvest in the context of environmental concerns, such as wildlife habitat and sedimentation of adjacent streams.

Aspen fragmentation studies in Alberta have led those scientists to further investigate types of predation pressure on bird nests and how characteristics of landbird populations vary with regional patterns of habitat quality.



Students working on Foundation-supported MOFEP research present results of their independent investigation at the 14th Annual Undergraduate Research Science Symposium at the University of Missouri. More than 200 students have developed research projects through MOFEP.

Original bird and habitat surveys in Minnesota that were funded through the Program led principal investigators there to expand into examination of edge effects, riparian forest management, and silvicultural practices.

Reproductive and habitat data from birds in Arkansas forests were used by the principal investigator in developing into far-reaching theoretical models of avian life history.

Manomet also exceeded expectations by building upon their experiences in northern hardwoods forests and developing an objective, quantitative approach for prioritizing species for conservation action.

**Manomet Center for Conservation Sciences developed a GIS-based process for identifying species at greatest risk in forested landscapes. This is an example of the springboard effect, whereby research teams pursue investigation of issues not considered in original research proposals.**

**MOSAIC Science Notes**

Science news brought to you by *The Shifting Mosaic Project*  
Manomet Center for Conservation Sciences

Mosaic Science Notes # 2001-1  
July 26, 2001

*A process for identifying species at risk in forested landscapes*

**Assessing Species Vulnerability**

One of the most difficult challenges forest managers face is maintaining biodiversity. The challenge can seem overwhelming because biodiversity is defined as "life in all its forms" and the number of species in a landscape is always changing, including all the processes that maintain these various levels.<sup>1</sup> How would a forest manager maintain life in all its forms? Is it possible to measure biodiversity? If so, is it accurate? The problem is that we have a daunting goal, and no obvious way to move progress toward achieving it. This is why foresters, who are responsible for conserving forest resources, can have trouble with the concept of managing biodiversity. It is a complex concept that is hard to measure, let alone prioritize. It is also hard to measure if it cannot be measured, it cannot be managed.

In this issue of MOSAIC, we introduce research designed to help make the biodiversity challenge more precise and measurable. Our approach focuses entirely on the species level of biodiversity, and attempts to distinguish between species that might be vulnerable to timber harvesting, and those that are not. If successful, the biodiversity challenge is reduced primarily to those species that are vulnerable. Managers can then create forest management plans that focus on reducing species vulnerability.

This article is part of the Shifting Mosaic Project, which has an explicit goal of maintaining biodiversity in commercially viable managed forests. The project is based on the premise that the closer we are to, or how far from, maintaining native species in a particular area, the more precisely they can be applied to conservation lands or ecological reserves just as needed.

**"We need a way to pare down the biodiversity challenge to something measurable..."**

Procedures that have been developed to rank species according to their potential to be lost from an area or extinction (loss from the planet) additive and categorical systems. These systems are useful for ranking a group of variables thought to be related to vulnerability (e.g., rarity, habitat availability). The scores for each variable are summed to produce a total score. Species with the highest scores are considered to be highest priority for conservation. By contrast, categorical systems rank species into risk categories (e.g., High or Low Risk) to distinguish relative risk among species within each category. The Shifting Mosaic Project is based on the *Priority in Flight* (PI), an international conservation program that assesses conservation priorities of birds. The best-known categorical system is the International Union for the Conservation of Nature (IUCN) and by The Nature Conservancy (TNC). Both of these categorize rare species into limited, and can misclassify species. Nevertheless, these structured approaches to assessing species risk can help set conservation priorities.

**A Matter of Scale**

Procedures that have been developed to rank species according to their potential to be lost from an area or extinction (loss from the planet) additive and categorical systems are useful for ranking a group of variables thought to be related to vulnerability (e.g., rarity, habitat availability). The scores for each variable are summed to produce a total score. Species with the highest scores are considered to be highest priority for conservation. By contrast, categorical systems rank species into risk categories (e.g., High or Low Risk) to distinguish relative risk among species within each category. The Shifting Mosaic Project is based on the *Priority in Flight* (PI), an international conservation program that assesses conservation priorities of birds. The best-known categorical system is the International Union for the Conservation of Nature (IUCN) and by The Nature Conservancy (TNC). Both of these categorize rare species into limited, and can misclassify species. Nevertheless, these structured approaches to assessing species risk can help set conservation priorities.

Governments make biodiversity policy decisions at the state and national level, but private landowners make biodiversity management decisions at the scale of their ownership.

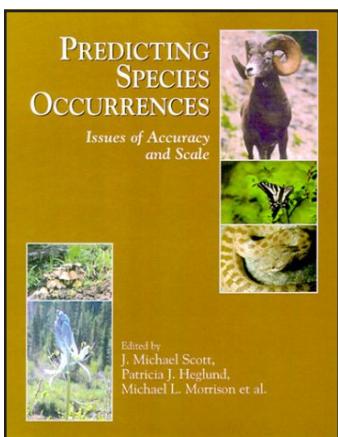
1. Matter of Scale

PI

IUCN

TNC

MOAIC SCIENCE NOTES 2001-1 ▲ Page 1



Researchers from Turnstone Ecological Research Associates and Sustainable Ecosystems Institute were instrumental in bringing together more than 100 scientists to evaluate current developments in landscape-level predictive modeling and to identify avenues for future research.

## Springboard Effect: External

The ability of projects to stimulate additional lines of research by scientists outside of Program-supported research teams was assessed directly and indirectly in this evaluation through three means: (1) direct evidence that Program-supported projects provided the impetus for additional research; (2) citation of supported projects in research needs assessments of agencies and organizations; and (3) citation of supported projects in published reports.

Though thorough investigation of this issue was not made by evaluators because of limited resources, information that was collected does provide an indication of the level of impact of Program-supported projects on the scientific community. The following represents examples of ways in which Foundation supported projects stimulated and guided research beyond that funded by the Foundation.

Landscape-level research by NCASI researchers in South Carolina provided the foundation for development of a broad study by North Carolina State University (Thompson et al. 2002) examining reproductive biology and habitat selection by Swainson's Warblers, a high priority species in southeastern United States.

Research conducted by Avifauna Northwest and Weyerhaeuser Company scientists on salvage logging in Oregon stimulated more in-depth research on sensitive species, such as the White-headed Woodpecker.

The direction of research for Canada's Sustainable Forest Management Network benefited from studies conducted by the University of Alberta and supported by the Program (Hannon and

McCallum 2003). Forest bird research led by the University of Arkansas helped shape research directions for Partners in Flight (Donovan et al. 2002).

Stimulated by their research in Idaho forests, principal investigators of both projects in that state collaborated in development of a landmark symposium and published proceedings, *Predicting Species Occurrences: Issues of Accuracy and Scale*. This effort brought together more than 100 research scientists to share information and chart direction for future research in this field of study.

Research conducted by Manomet Center for Conservation Sciences contributed significantly to the direction of forest research in Maine through its participation in the Cooperative Forestry Research Unit at the University of Maine. In addition, Manomet's research had substantial influence on forest research through the Forest Ecosystem Information Exchange that it established (e.g., Hagan et al. 2002), the purpose of which is "to be an interface between those that can generate information and those that need information about the region's forests."

The stated research needs of other agencies and organizations were influenced as well by research supported through the Program. Superior National Forest in Minnesota identified priority research needs based, in part, on the research delivered through the Minnesota DNR and Natural Resources Research Institute. Facilitation efforts by the Tennessee Conservation League, through the Southeastern Working Group of Partners in Flight, helped government agencies, nongovernmental groups, and private industry identify priority research information needs.

Numerous publications were generated from the Foundation-sponsored projects and, in turn, many of those works are regularly cited in other proposals and literature, ostensibly stimulating additional research. For example, publications resulting from forest research conducted at the University of Alberta have been cited 163 times to-date in the published literature (source: *Science Citation Index*).



In 1999, Manomet Center for Conservation Sciences created the Forest Ecosystem Information Exchange, a forum for public and private groups and citizens interested in sustainable management of Maine's forests. Its mission, through open discussion of forest research, is to identify and fill information gaps in conservation and management of forest resources. The Forest Ecosystem Information Exchange was one of the most effective means by which any of the eleven projects shared scientific information and stimulated additional research.

## Evaluation of Objective 3

### *Stimulate Additional Research*

**The 11 projects supported by the Foundation stimulated a significant amount of research -- often well beyond that outlined in original proposals. In addition, the supported projects helped chart the direction of other research efforts.**

**Supported principal investigators were encouraged by Program staff to adapt subsequent research proposals to scientific information collected during prior years. When appropriate, many research teams responded to that charge, which allowed several studies to progressively investigate more complex -- and likely relevant -- forestry issues.**

**The *springboard effect* was clearly evident throughout this collection of projects. Most studies stimulated valuable additional research, both within and outside of the funded research team. The cumulative result was development of novel approaches to scientific investigation that addressed many of the critical needs of forest managers. Clearly, maintaining the continuity of research teams over multiple years was instrumental to achieving these successes.**

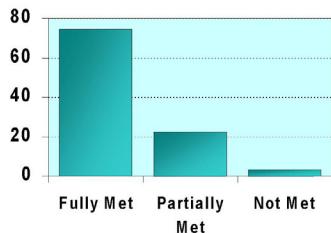
EXCELLENT



## OBJECTIVE 4

*Data and information derived from supported research projects are of high value to land managers, planners, and other decision-makers*

### Performance of Projects in Achieving Stated Objectives



Bars represent the average percentage of objectives for each of 11 projects that were fully met, partially met, or not met at all. Overall, 75% of objectives were fully achieved.

## GENERATE VALUABLE INFORMATION

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To maximize use for forest conservation and management, results from research projects needed to produce results and have outcomes reflective of three principal characteristics: (1) the stated objectives and goals of each project were met; (2) results were definitive with respect to research hypotheses and objectives being addressed; and (3) results and products had direct relevance and clear application to management and conservation of forest resources. Objective 4 was evaluated based upon assessment of these outcomes.

### Achieving the Objectives

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Original funding decisions by the Foundation were based, in part, on the likely contributions each project could make to conservation based upon the stated project objectives and goals. For each of the eleven projects, Program evaluators summarized all stated objectives over all years of funding, and combined any objectives that were similar. Evaluators then determined the extent to which each objective had been met (as of 2003), through examination of final project reports or other published or unpublished documents, and via discussions with principal investigators or other personnel familiar with the project. Performance for each objective was classified as either (1) fully fulfilled, (2) partially fulfilled, or (3) not fulfilled. Partially fulfilled objectives were those that lacked sufficient effort or data to truly meet the intent

of the stated objective. Objectives not fulfilled reflected those rare occasions on which the planned work failed to deliver viable information or the intended product.

The cumulative number of objectives for each project ranged between 2 and 14. Evaluators recognized 4 to 6 unique objectives for most (8) of the eleven projects.

An average of 75% of the stated objectives were fully fulfilled for each project (range = 50-100%). Approximately 22% of objectives within a project were partially fulfilled. Only two projects had an objective that was not fulfilled (see figure to left). While this measure of success is subjective, and therefore open to different interpretations, the results outlined here suggest that project investigators consistently delivered the information and products that were originally proposed to, and funded by, the Foundation.

No relationship was detected between the number of objectives pursued by a project and its success in meeting those objectives (Pearson's correlation,  $r = -0.15$ ). No obvious difference existed between this measure of success and the type of organization (public or private) to which Foundation funds were directed.

Objectives related to development of forest management recommendations often failed to be fully met. Seven of the 11 projects identified that type of objective, but only 4 of

those 7 (57%) projects fully fulfilled that obligation (compared to 75% successful completion for all objectives). Overall, only 4 of 11 (36%) projects directly generated specific, well documented land management recommendations.

Difficulties developing management recommendations may be the result of several factors. First, while most projects received several years of Foundation support, research scientists often are reluctant to propose management guidelines on complex issues that may not be completely elucidated within the limited timeframes and spatial contexts of their research projects (e.g., Richter and Redford 1999).

Second, academic scientists may not be especially familiar with many of the on-the-ground practices that define natural resources management (Meffe 1998) and, subsequently, may not feel comfortable interpreting scientific data in the context of management actions.

And finally, several research projects funded by the Foundation did not focus on specific issues of direct management concern. Hence, the breadth of the issue being investigated in some cases may not have allowed easy translation to management recommendations.

At least two actions could help remedy the limitations of most research projects (not only those in this evaluation) in developing relevant management recommendations. First, scientists and funding agencies should strive to develop *long-term* projects whenever possible to help reduce the uncertainty that is inherent to short-term environmental research investigations (Hilborn 1987). And second, identification of sound management recommendations could be accelerated through creation of teams of

scientists and practitioners of natural resources management that collaborate closely on both the research design and subsequent management recommendations. Several approaches used by investigators in this evaluation, including those in Maine and Tennessee, could serve as models for future Program projects.

## Definitive Results

All projects delivered high quality information related to objectives and research hypotheses. This significant Program accomplishment is reflected by the large number of works published in respected scientific journals (see below and assessment of Objective 5). The quality of information produced is an outgrowth of rigorous study designs (see Objective 2).

However, much of the information collected has yet to be published. To evaluate the ability of *those data not yet published* to deliver reliable information (*sensu* Romesburg 1981), Program evaluators examined characteristics of data sets included in final reports. Assessment was made regarding (1) concordance between the spatial scale of investigation identified in proposals and that represented by the data, and (2) minimum sample size necessary to effectively address the ecological issue of interest. The latter query was based upon attainment of a minimum sample size suggested for different types of analyses. Specifically, sample sizes necessary for multivariate analyses ( $n \geq 10$  times the number of predictor variables; Stevens 2001) and estimation of nesting success (nests per species  $\geq 20$  per treatment per year; Martin et al. 1997) were assessed. Both types of analyses were regularly used in projects.



Southeastern Working Group

Partnership facilitation efforts by the Tennessee Conservation League (TCL) were pivotal in development of the first truly effective regional working group of Partners in Flight. Lessons learned through these efforts, which stressed close communication and collaboration by *all* stakeholders in bird conservation, provides some of the groundwork for future large-scale conservation initiatives.



The Red-eyed Vireo is a good example of a species that is relatively easy to survey because it is vocal, but for which nest monitoring can be fairly difficult (because of nest crypticity). All projects collected sound survey information, but many studies were less successful in estimating nesting success.

Information included in annual reports demonstrated that data were collected at spatial scales compatible with specific ecological questions under investigation. For example, regional-level issues usually examined questions from study sites positioned over large areas -- millions of hectares. Likewise, data were collected over tens of thousands of hectares for landscape-based questions. These observations indicate that investigators closely adhered to study design protocols outlined in proposals.

Nearly all studies that examined habitat use had adequate sample sizes (numbers of point counts and detections of various species) to develop rigorous predictive models. Nest productivity data, on the other hand, were marginal for 4 of the 5 studies examined. This suggests that traditional survey approaches for studying avian responses to silvicultural practices were well executed in these studies, whereas nontraditional methods, such as nesting success, were much more difficult to effectively implement.

### **Direct Application**

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Program evaluators assessed, primarily through interviews with prospective users, whether information resulting from each project could be readily applied to issues of forest management. Virtually all respondents believed that the data had high potential to contribute to forest conservation and management. Because of the often-stated "disconnect" between research scientists and potential users of research information, this general viewpoint by practitioners of forest conservation and management represents a notable success of the Program.

However, several prospective users found that the information was not directly beneficial to land managers. Two reasons for this were cited. First, in some cases, the research information was not presented in a format that allowed ready assimilation by non-scientists. This issue -- effective communication -- is more aptly discussed under Objective 5.

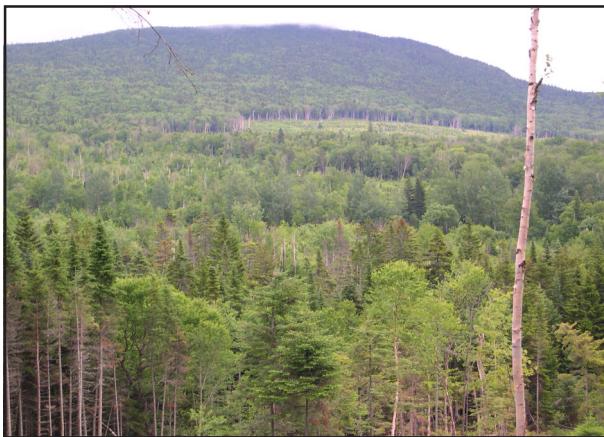
The other concern was that some results required additional synthesis, or steps, before data had direct relevance to management actions. In some cases, concurrent examination of numerous species made management implications nebulous because of varied responses by different species to silvicultural practices. In the absence of outreach materials that synthesized and "distilled" these complex patterns, immediate use by practitioners of forest management was not always achieved. In addition, the relevance of landscape-level phenomena was not always placed logically in the context of land management options.

### **Filling a Gap?**

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Traditionally, applied avian research directed at issues of high importance to land managers has not been aggressively pursued by the research community. To what extent did the Program fill this lingering need?

Overall, the Program was effective in generating information that was of great value to practitioners of forest management, planning, and policy. The majority of respondents recognized the value of the scientific information generated through the research projects, and this sentiment cut across the diverse group of public and private organizations that serve as stewards of North American forests.



*Information generated by Manomet Center for Conservation Sciences...has very rapid application to our forests.*

*Si Balch  
Technical & Planning Superintendent  
MeadWestvaco Corporation*

## Evaluation of Objective 4

### **Generate Valuable Information**

In general, the supported research projects delivered the information and products that were identified in the funding proposals. Deficiencies in that record, however, were evident for projects proposing to develop forest management recommendations; only 57% of those projects generated specific recommendations. In total, only about one-third of the 11 studies produced rigorous management recommendations.

All studies generated priority and defensible information. Research most often fell short, however, in studies involving the assessment of nesting success.

Most information was readily usable by forest managers, although several criticisms were leveled at the utility of data that had not been synthesized adequately for practical use.

Overall, forest managers, conservationists, and policy makers were exceptionally pleased with the rigor and breadth of scientific information produced through the Program. That information offered numerous public and private organizations guidance for more effective forest management and conservation.

Good



*Research conducted by the University of Arkansas...is profoundly useful.*

*Larry Hedrick  
Team Leader, Integrated Resources  
Ouachita National Forest*

**OBJECTIVE 5**

*Information from supported research is effectively communicated to prospective users*

## DISSEMINATE INFORMATION EFFECTIVELY

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A critical component of any research program is the assurance that information generated through projects is delivered in a timely fashion and in an appropriate format to target audiences. This evaluation focused on the extent to which principal investigators and other “spokesgroups” (collaborators, end users, and Program staff) communicated results of research projects through written and verbal means. Four principal outlets for this information were considered in this evaluation: (1) *technical publications* such as peer-reviewed scientific journal articles and book chapters; (2) *outreach documents* such as internal technical reports, information circulars, and popular publications; (3) *general presentations* at meetings of professional organizations and special interest groups; and (4) *targeted meetings* with prospective end users, including industry and conservation organization staff.

### Technical Publications

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At least 62 scientific publications were produced from the 11 projects, an average of nearly 6 publications per study. Exact numbers of publications were difficult to assess because (1) scientists often had several concurrent projects underway and some publications drew upon more than one of those studies, and (2) some publications may have originated, or been stimulated, through a Program-

sponsored project, but was funded through and credited to another source.

Many internationally recognized journals served as outlets, including the *Journal of Wildlife Management*, *Forest Science*, *Ecological Applications*, *Forest Ecology and Management*, and *Conservation Biology*. In addition, several symposium proceedings and agency technical reports were used disseminate research results. These publications were successful in bringing research results to the larger scientific community, the primary readers of those sorts of publications.

In general, principal investigators affiliated directly with state or federal government (through a university) were more effective in generating peer-reviewed publications than those associated with private institutions. Overall, government-led studies produced an average of 8 peer-reviewed publications, compared to only about 3 publications for each of the private organizations. This discrepancy is likely related to the incentives offered for publication by those different types of institutions. That is, academic promotion of university-based scientists is usually tied closely to the number and quality of peer-reviewed publications. In addition, university professors often generate publications through students working on graduate degrees through these projects.

Private organizations, on the other hand, usually do not have that same level of organizational incentive to publish in peer-reviewed outlets. Rather, the overriding requirement of those investigators is often a final report to an organization that provided funding. Furthermore, whereas academic scientists usually have officially recognized time for development of scientific works, their counterparts in private organizations may not have that level of "luxury."

## Outreach Documents

Outreach information in this evaluation includes documents that summarized the main results of a project, especially that information that could be used directly and readily for management or conservation purposes. The principal target audience was practitioners of forest management.

Fewer than one-third of the projects invested significant effort in developing outreach materials. In defense of the pool of projects, outreach materials were rarely stated as an objective in proposals. So, despite its value, few projects were expected by the Program to develop this type of communications vehicle.

The outreach efforts of three projects warrant mention. A principal focus of the work of the Tennessee Conservation League was to develop partnerships, the outcome of which was, in part, outreach materials that could help guide implementation of science-based conservation by those partners. Numerous outreach documents were produced through these efforts, including identification of priority habitat types, bird species, and management and conservation actions.

### The Effectiveness of Stand-Level and Landscape-Level Variables for Explaining Bird Occurrence in an Industrial Forest

John M. Hagan and Amy L. Meehan

**ABSTRACT.** We evaluated the effectiveness of habitat variables derived at two spatial scales for explaining the presence or absence of 20 bird species at 363 point count stations in an extensive industrial forest in Maine. Sixteen stand-level (microhabitat) and seven landscape-level (within 1 km radius, or 3.14 km<sup>2</sup>) variables were used in stepwise logistic regressions to determine which variables related best to bird species occurrence. Species were grouped into early successional ( $n = 6$ ) and late successional ( $n = 14$ ) species for analysis. Three regressions were run for each of the 20 species: (1) stand variable only, (2) landscape variable only, and (3) stand and landscape variables combined. Regression models that included only stand-level variables averaged significantly higher model concordance scores than regression models that included only landscape variables. For 17 of 20 species, models that included both stand and landscape-level variables were superior to models that included either stand or landscape-level variables. The presence of two species was better explained by landscape variables, and the presence of one species could not be explained by either stand- or landscape-level variables. Because many variables were positively associated with presence of some species and negatively associated with other species, management for particular stand- or landscape-level features must be preceded by a determination of which species are more important to conserve. *For. Sci.* 48(2):231–242.

**Key Words:** Avian, forestry, landscape, microhabitat, habitat loss, fragmentation, wildlife.

**I**NCREASINGLY, FOREST MANAGERS are seeking to integrate management for biodiversity into forest planning (Kohm and Franklin 1997, American Forest and Paper Association 2001). However, forest management, even for a single species, is a complex process. The presence or absence of a species at any given location may be dependent on factors at work at multiple spatial scales (e.g., Turner 1989, Wiens et al. 1993). An array of typically unknown microhabitat and

landscape factors can affect whether a species is found in any given forest stand. If forest managers are to manage successfully for biodiversity, or specific subsets of biodiversity (e.g., birds), it is important to understand the degree to which habitat factors at different spatial scales influence species occurrence.

Ecologists have long understood that microhabitat vegetation structure (in forestry terms, *within-stand structure*) in-

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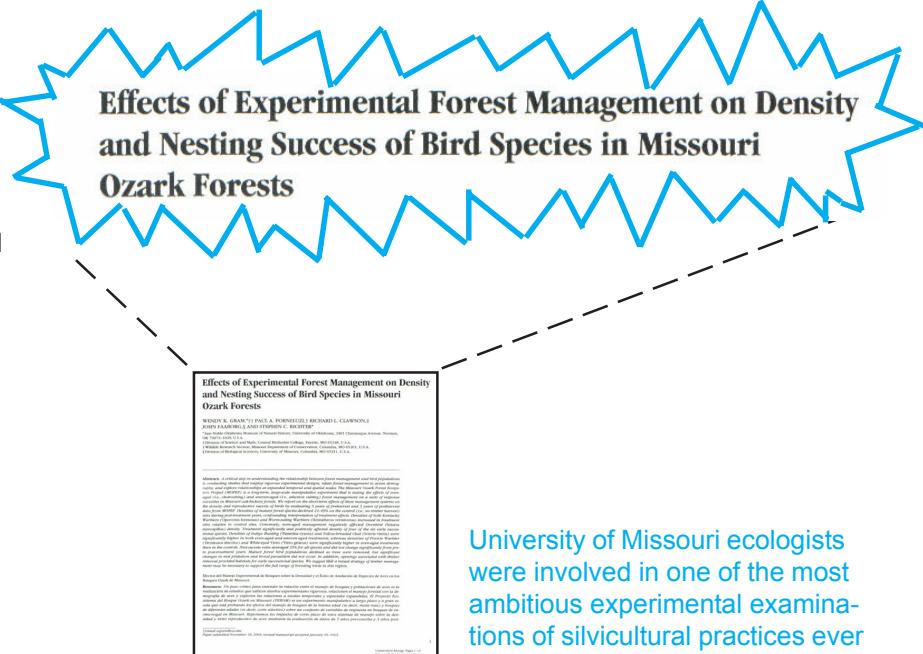
**Acknowledgments:** The authors thank S.D. Warren and Great Northern Paper Companies for access to their property. C. Haag (S.D. Warren) and M. McElroy (Great Northern) helped facilitate the project. J. Hatch (S.D. Warren) and D. Bass (Great Northern) both contributed essential GIS data. We also thank the staff of the U.S. Forest Service, Region 6, for assistance with fieldwork. Thanks to K. Johnson, C. Haag, D. Bass, R. Stadek, A. Suver, S. Woltman, P. Weinberg, and R. Williams. We are grateful to our financial supporters, including the Jessie B. Cox Charitable Trust, The John Merck Fund, the National Fish and Wildlife Foundation, the National Council of the Forest Products Industry for Air and Stream Improvement, and members and donors of Manomet Center for Conservation Sciences. We thank J.M. Reed, two anonymous reviewers, and the Associate Editor for greatly improving an earlier draft of this manuscript.

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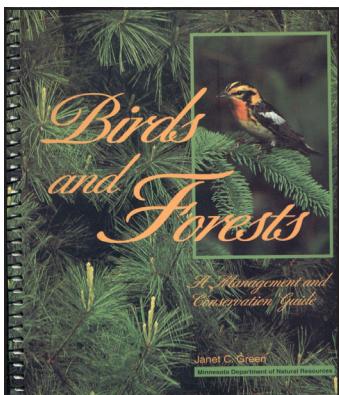
*Forest Science* 48(2) 2002 231

Scientists from Manomet Center for Conservation Sciences published the results of novel research aimed at better understanding the effects of silvicultural practices, and the landscape-level context of those activities, on abundance of forest-nesting birds in Maine. This work was published, in part, in the journal, *Forest Science*.

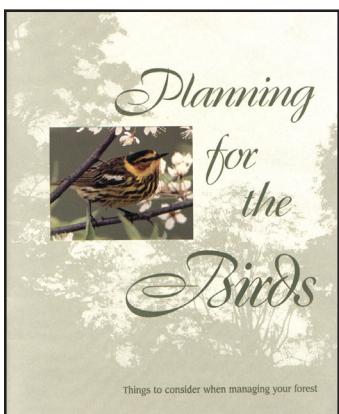


University of Missouri ecologists were involved in one of the most ambitious experimental examinations of silvicultural practices ever undertaken in the United States.

More than a dozen scholarly works on bird ecology have been published from this study, including this article in *Conservation Biology*.



Outreach booklets developed by the Minnesota Department of Natural Resources was an outgrowth of work funded by the Foundation. Booklets were intended to assist both large (top) and small (bottom) landholders in managing their forests in a sustainable and ecologically sound fashion.



The Program-supported work of Minnesota Department of Natural Resources ultimately led to creation of two widely acclaimed outreach publications (though not directly funded by the Foundation). The two booklets were aimed at land stewards concerned about maintaining the sustainability and ecological integrity of forest tracts.

Manomet Center for Conservation Sciences created an outreach newsletter, *Mosaic Science Notes*, that provides details to forest managers on the outcome of research conducted on industrial timberlands. Each issue of *Mosaic* focuses on a single forest issue and provides data summaries and graphics, and outlines the implications the results may have for forest management. Forest managers and conservationists in Maine praised this form of information dissemination.

sented information at meetings of the forest products industry. In total, at least 150 presentations (again, difficult to precisely measure) were made to national and regional scientific, conservation, and management societies.

### Targeted Meetings

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This type of information dissemination is intended to bring specific information directly to relatively small groups of people who can directly apply the information to forest management and conservation. Program evaluators assessed this form of communication by examining the extent to which research teams provided specific information to prospective users through one-on-one or small group meetings with forest products industry personnel, conservation groups, or other land stewards.

### General Presentations

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Scientific research supported by the Foundation was well represented in meetings of national and international scientific societies, including the Society for Conservation Biology, Ecological Society of America, Cooper Ornithological Society, and American Ornithologists Union. State-level meetings of The Wildlife Society also were used regularly as a forum for these projects.

Project results also were presented at several symposia on forestry, ecosystem-level management, and bird conservation. The efforts of the Tennessee Conservation League and several other research teams supported through the Program were showcased at national and regional meetings of Partners in Flight. Research scientists from the National Council for Air and Stream Improvement (NCASI) often pre-

All research teams disseminated information to some extent by this method, although efforts ranged widely from a single annual meeting with collaborators to more regular meetings to discuss research progress and results. NCASI scientists, for example, regularly met with individual groups to share information. The Manomet research team interacted regularly with the timber industry in Maine and has held informational field trips to study areas for state and regional conservation groups. Their Forest Ecosystem Information Exchange also offered an effective forum for discussion of research results.

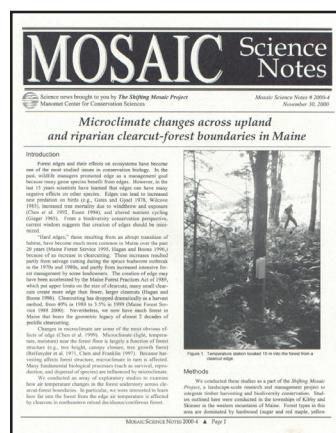
Tennessee Conservation League facilitated numerous meetings each year to share information. Others, such as scientists from the (Minnesota) Natural Resources Research Institute and University of Alberta, shared scientific information through standing committees

involved with state or provincial initiatives on forest management.

Small, targeted meetings between researchers and prospective users of scientific information probably was the weakest form of information dissemination examined in this evaluation. This was likely a result of the fact that this type of activity (technical assistance) is not seen as a priority to many institutions within which some of these scientists work.

## Other Contributions

As expected, publication in peer-reviewed journals was not a regularly used outlet for project collaborators, end users, or Program staff. However, several collaborators and end-users presented research results at meetings. For example, Ed Lindquist, Forest Wildlife Biologist at Superior National Forest presented results of the Minnesota research to prospective end users.



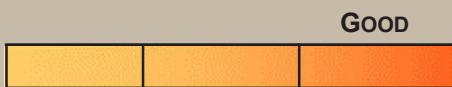
## Evaluation of Objective 5

### *Disseminate Information Effectively*

**Presentation at large, national and regional meetings was the most consistent means by which supported projects presented research results. Overall, publication of results in peer-reviewed outlets was significant across the pool of projects, but was inconsistently applied. In general, researchers directly affiliated with universities were more productive in publishing than scientists working for nongovernmental organizations. The combination of national-level presentations and publications were the principal mechanisms by which scientific information was disseminated to prospective users.**

**Unfortunately, those two approaches are likely the least effective in delivering scientific information to local practitioners of forest management and conservation. More effective are likely to be targeted outreach materials and small group meetings, both aimed at local and regional land managers. Unfortunately, these avenues of information dissemination were irregularly taken by supported research teams.**

**Thus, this Program evaluation has identified a notable gap in the effective dissemination of research results. While peer-reviewed publications and presentations before scientific societies are critical for judging the legitimacy of research results, those outlets probably are not highly effective in delivering information to practitioners of forest management in a form that are readily and immediately used.**



Mosaic Science Notes, developed by Manomet Center for Conservation Sciences, is intended to provide a summary of scientific research that can be directly applied to forest management and conservation. This information has been subsequently presented by collaborators at meetings of prospective end users of the information. For example, Si Balch of Mead Westvaco regularly made presentations to industry and other groups about Manomet's research results and its application to forest management.

## OBJECTIVE 6

*Information from supported research projects provides management and conservation guidance to prospective users*

# INCORPORATE RESULTS INTO PLANS

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This objective evaluates the most fundamental level of commitment by forest management and conservation organizations to incorporate research information into organizational policies and management plans. It does not consider actual implementation of forest management actions; that issue is covered under Objective 7. The level of this commitment was documented through examination of the policies and plans of three types of organizations: (1) forest products industry, (2) government agencies, and (3) conservation organizations.

### Forest Products Industry

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The movement towards better stewardship of plant communities, animal populations, and other “nontraditional” forest values that

Plum Creek Timber Company in Maine adopted the forest patch retention model developed through the research of Manomet Center for Conservation Science. The retention model stresses the need to retain small patches of overstory trees within landscapes dominated by even-aged harvesting practices, such as clearcutting. Research suggests that these small stands reduce the potentially negative impacts of clearcutting on bird populations inhabiting adjacent uncut forests.



began in the late 1980s (Morrissey et al. 1994, Sustainable Forestry Board 2002), about the same time as the inauguration of the Program, had a significant influence on ways in which industry approached forest management. Because of those concurrent efforts, the influence of Program-specific outputs on forest management policy was sometimes difficult to discern from actions influenced by the larger, more general movement.

Program-sponsored research did *not* have a broad impact on management plans of the forest products industry, although several significant outcomes did occur (see below). In many cases, scientific information generated from research projects did not reach the hands of private forest managers or, if it did, was not in a format that was considered to be readily usable.

The limited use of research information by industry did not appear to follow any prescribed pattern across the suite of research projects. The most notable example of industry use of information was documented in Maine, where the research team from the Manomet Center for Conservation Sciences worked on private lands, regularly discussed research needs with industry personnel, and made concerted attempts to understand the constraints under which industry operated. Those efforts resulted in significant impacts on the management philosophy, harvesting plans, and interest in biological issues, exhibited by several corporations.

Plum Creek Timber Company, for example, adjusted forestry plans in Maine based upon the forest patch retention models developed by Manomet (see sidebar to left). Other research-driven aspects of biological diversity included in management plans were nesting raptors and downed woody debris.

Mead Westvaco Corporation also used Manomet's research information extensively in development of management plans, including incorporation of biological diversity, ratios of different habitat types, and forest patch retention concepts. In addition, this large corporation created management guidelines for riparian zones in consultation with Manomet (see sidebar to right).

International Paper used information from several Foundation-funded research projects to help shape its silvicultural activities for the benefit of wildlife and plant communities.

NCASI held a unique position among Foundation-funded organizations because of its close affiliation with the forest products industry. While the evaluation identified no substantive changes to industry management plans that could be attributed directly to NCASI-led research, industry approaches to forest management almost certainly were influenced through regular interactions between NCASI scientists and industry colleagues.

Tennessee Conservation League engaged both small and large private landholders within the Interior Low Plateau ecoregion of Kentucky, Tennessee, and Alabama, including Champion International, Westvaco Corporation, and Willamette Industries Inc. Land management recommendations intended to maintain the viability of forest bird populations were collaboratively developed by a diverse



Mead Westvaco Corporation worked with Manomet Center for Conservation Sciences in Maine to develop guidelines for more effective protection of streamside management zones and the plants, animals, and other life that depends upon those unique habitats. Manomet research examined the affects of different buffer strip widths on physical and biological properties of the streamside zones.

assembly of forest managers, scientists, and land use planners. That information was considered in development of management plans for several large, private landholders.

Research in Arkansas, Oregon, South Carolina, Idaho, and Alberta included direct participation by industry biologists. Industry in those areas have used that research information to some extent in developing management plans.

Use of research information by timber-based industry was likely a function of the extent to which research teams directly and regularly engaged industry personnel. The influence of Manomet research results on the actions of the privately-owned land base in Maine, for example, clearly was a result of *a priori* discussions between scientists and land managers, active cooperation of those land managers in implementation of research, and creation of a targeted discussion forum that included an open invitation to interested stakeholders. While the evaluation did not document a broad influence on management plans and policies of industry

### Information for Statewide Forest Sustainability

Most state governments have responsibility to ensure the long-term sustainability of forest resources. This is not a simple task given the competing demands on forests. Don Mansius, Director of Forest Policy and Management for the Maine Forest Service offered his thoughts on what Foundation-sponsored research has meant to his agency and to sustainability of Maine's forests.

- Provided *state-of-the-art, cutting-edge information that is easily digestible and understandable* and is used by agency to establish regulations
- Manomet provided information *that is real, timely, and they get it into the hands of the people who are actually doing the work*
- Value of research information was reflected in the high marks industry received on annual certifications

and other private landholders by Program-sponsored research, several industry representatives indicated that the scientific information did help initiate and continue discussion of novel approaches to sustainable forestry.

### Government Agencies

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Research information generated through the Program did *not* have far-reaching impacts on public land management, but did affect numerous *local* policies and management plans of agencies charged with overseeing forest lands.

The USDA Forest Service was perhaps the greatest beneficiary of research information. Conclusions drawn about the effects of silvicultural practices on birds by the University of Arkansas were used in revision of the Ouachita National Forest Management Plan in Arkansas and Oklahoma. Several national forests in Oregon incorporated salvage logging recommendations from Avifauna Northwest into recommended management practices. Superior National Forest in Minnesota and Chequamegon and Nicolet national forests in Wisconsin used bird-habitat relationship information produced by the Minnesota Department of Natural Resources and Natural Resources Research Institute to craft more viable forest management plans.

Provincial government biologists accessed data from the University of Alberta's research on birds in industrial timberlands to develop policy for harvesting procedures in Canada. Both the U.S. Fish and Wildlife Service and Tennessee Valley Authority sought guidance from the Tennessee Conservation League and its partners for development of management plans on

federal lands in Tennessee. Missouri Department of Conservation intends to use results of the University of Missouri bird research to shape future policy on timber harvest.

Results of research conducted by Manomet Center for Conservation Sciences had substantial influence on revision of existing regulations within the state legislature. Scientists with Manomet conducted a mathematical simulation of the projected outcome of the Maine Forest Practices Act and determined that the existing policy would not deliver the projected benefits (Hagan and Boone 1996). In turn, the state legislature, based largely on that research, adopted new legislation that was considered to be more realistic with respect to forest sustainability. In addition, Manomet's research results have helped shape the approach to forest management and conservation developed by the Maine Forest Service (see sidebar to left).

### Conservation Organizations

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Nonprofit conservation groups have benefited from information generated through the Program, but probably less so than either government or industry groups.

The Tennessee Conservation League's partnership-building efforts, which were emphasized much more than research in their project, provided a forum through which conservation groups in southeastern United States could access state-of-the-art information on bird conservation.

Forest research in Arkansas and Missouri has benefited, or is projected to offer future benefits, to The Nature Conservancy and Audubon Missouri, respectively. The Arkansas Chapter of the Nature Conservancy,

for example, used the bird research to help justify its position on land acquisition in the region. The Northern Forest Alliance, Appalachian Mountain Club, and other groups believed that information generated by Manomet will help clarify the issues surrounding forest management in Maine (see sidebar to right).

### **Intangible Benefits**

Through interviews with prospective users of research information, three additional benefits to conservation were identified, all of which were difficult to precisely quantify given the nature of the original assessment design.

First, most prospective users, particularly those in the forest products industry, indicated that Foundation-sponsored (and other) research projects increased organizational awareness of the plight of migratory birds. Prior to 1990, few forest managers incorporated the needs of nongame migratory birds into forest management plans. Through Partners in Flight and its associated programs, knowledge of migratory birds has been pushed to the forefront of forest management. The result is that more management

activities are being conducted with the well-being of migratory birds in mind than ever before.

Second, both principal investigators and other scientists and forest managers who are exposed to Foundation-supported research results incorporate that information into their working knowledge of forest management. Subsequent professional opportunities to have input into forest management practices may therefore be influenced by exposure to those original research results. For example, one principal investigator of Foundation-supported research, Dr. T.B. Wigley, used research results to guide his requested technical review of a landmark regional forest assessment (see panel below).

And finally, research results from projects examined here helped validate, and in some cases refute, forest management principles and prescriptions that had been widely implemented in both public and private forest tracts throughout North America. So, while the research results may not have changed existing management plans, results did in some cases provide legitimacy to ongoing forest management actions.



### **An NGO Perspective**

While research information was used by all prospective user groups examined in this evaluation, nongovernmental organizations may have been the least engaged in use of research results. Jonathan Carter, Director of the Forest Ecology Network in Maine, identified what he believed to be the fundamental benefits provided thus far by researchers from Manomet Center for Conservation Sciences.

- Brought science to the forefront of decision-making
- Created a dialogue amongst groups with various viewpoints
- Generated sound scientific information for forest planning and management (though data can be subject to different interpretations)



## **Southern Forest Resource Assessment**

a multiagency effort led by the USDA Forest Service's Southern Research Station and Southern Region

Research results from the Program not only contributed directly to scientific publications, but also helped shape the professional opinions of scientists who subsequently offer their informed viewpoints on other conservation- and management-based documents, such as this landmark effort to evaluate the ecological state and management needs of southern forests.

## What Limits Incorporation of Research Information?

Scientific information produced through the Program clearly was used to develop organizational policies, practices, and procedures of government agencies, nongovernmental organizations, and the paper products industry. However, use of that information was not extensive and usually limited to properties on which research was conducted. Why was there not more

extensive use of research information? The general sense from this evaluation is that research results often are not delivered to prospective users in a form that can be readily applied to forest management and conservation. So, despite the high quality and relevance of research being conducted through the Program, most researchers put minimal effort into outreach materials directed specifically at practitioners of forest management and conservation (see Objective 5).

## Evaluation of Objective 6

### *Incorporate Results into Plans*

Organizational acceptance of scientific information is first reflected by its incorporation into official policies and management plans. Results from research projects supported by the Program were used in this way by numerous government agencies, private landholders, and conservation organizations. Hence, the research has potential to influence the actions necessary to maintain the viability of forest bird populations. However, two shortcomings in this outcome were identified.

First, while information from all projects was used to some extent by practitioners of forest management and conservation, only slightly more than half of the 11 projects were highly successful in having specific research-derived recommendations incorporated into forest management plans. Investigators who were most successful had developed a close professional relationship with prospective users of the information.

Second, use of research information often was limited to stewards of the property on which the research was conducted. Research information directed at land managers was not disseminated widely.

Incorporation of scientific research results into plans for forest management is encouraging. However, more concerted efforts to engage forest managers and conservation groups could substantially enhance the use of that information.

Good



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## OBJECTIVE 6: INCORPORATE RESULTS INTO PLANS

## OBJECTIVE 7

*Recommendations derived from supported research projects are implemented by private, nongovernment, and government groups*

*Total turnaround in bird management on Superior National Forest* were the words of Ed Lindquist, Supervisory Forest Wildlife Biologist, in describing the impact of Foundation-sponsored research for forest conservation in northern Minnesota. Research led by the Minnesota Department of Natural Resources and the Natural Resources Research Institute generated statistical models that predict the likely consequences of various forest management scenarios. Possibly most significant in those models was the capacity to predict the long-term impact of single timber sales on bird populations within and surrounding the affected stand. A prime consideration for evaluating the effects of harvest was the proportion of landscapes in various stages of forest succession, such as young forest pictured at right.

## IMPLEMENT MANAGEMENT ACTIONS

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**B**enefits of using research to inform management and conservation actions ultimately depend upon timely implementation of recommended actions. Objective 7 addresses this critical step in the overall process of generating reliable information for the benefit of natural resources conservation. Land management organizations were queried about the extent to which Program-sponsored research had been incorporated into management actions.

Though some attrition did occur, research-supported management actions identified in forest plans and policy (see Objective 6) were implemented by land management organizations. Those types of actions, however, were sporadic and inconsistent across the suite of 11 projects included in this evaluation.

### Success Stories

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Nevertheless, several notable accomplishments were documented. Recommended size of harvested forest patches in the

Ouachita National Forest of Arkansas and Oklahoma were changed to reflect edge and area effects identified by the University of Arkansas.

In Maine, both Plum Creek Timber Company and Mead Westvaco Corporation adjusted harvesting practices, including consideration of forest age-class distribution across the landscape, maintenance of streamside buffer zones, inclusion of retention patches within watersheds, and identification of critical habitat for sensitive species. As stated previously under Objective 6, research also provided validation of several existing forest management practices being implemented by the forest products industry.

Tennessee National Wildlife Refuge adjusted management actions to help promote Cerulean Warbler and other species habitat along the Tennessee River. Land management actions of numerous other landowners in Tennessee were also influenced by the management recommendations offered by the Tennessee Conservation League.



Significant management changes were instituted on Minnesota's Superior National Forest as a result of the Program-sponsored research (see sidebar to left). Snag retention practices implemented on national forest lands in Oregon were influenced by the results of research conducted by Avifauna Northwest.

### **Obstacles to Implementation**

Lack of widespread implementation of management actions based upon Foundation-sponsored research was a reflection of the cumulative shortcomings identified in the assessments of the first six objectives. Specifically, the lack of clearly stated management recommendations in several projects, along with ineffective dissemination of information to managers in other projects, created a bottleneck in the flow of useful information to institutions that have the potential to affect changes within forested landscapes.

Hindering implementation of management actions, too, is the inherent time lag between presentation of new scientific information and crafting of management plans that incorporate that information. In addition, several long-term projects were still underway in one form or another, even several years after the Foundation last supported the research. Those projects are likely to bear additional future benefits to the land management community.

Finally, incumbent upon managers is the responsibility to seek and assimilate information from a variety of sources, including the scientific literature. Larry Hedrick, Integrated Resources Team Leader, Ouachita National Forest, stated...

*I don't see how anyone can stay abreast of this job without staying abreast of the literature.*



Tennessee Conservation League and its partners developed lists of high priority species, such as the Prothonotary Warbler (left), that would allow both small and large landowners to manage their forests for the greatest benefit to wildlife.

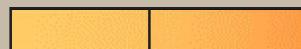
### **Evaluation of Objective 7**

#### ***Implement Management Actions***

**Several significant *local* changes in forest management have resulted from the research supported by the Foundation. On regional and national scales, however, that research has not yet had a widespread impact on the ways in which forest lands are managed.**

**The lack of consistency in local application of research results, and the minimal influence those results have had thus far on land stewards outside the immediate study areas may be a consequence of the interplay among several factors, including: poor dissemination of management-based recommendations; the time lag for collective research information (knowledge) to build to a "critical mass" often necessary to stimulate action; and the lack of incentive for many land managers to seek and assimilate the latest research information about wildlife conservation and management.**

**FAIR**



## OBJECTIVE 8

**Habitat conditions are improved for forest-dwelling birds**



**Loss of understory coniferous trees, such as spruce and fir, are a concern to forest managers in Minnesota not only because of the ramifications for long-term sustainability of forest resources, but also because numerous species of neotropical migratory birds depend upon those tree species for nesting habitat.**

## HABITAT GAINS

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**C**onservation actions typically are aimed at improving the *habitat* conditions for a species of interest and only indirectly at the species itself. This is especially true for migratory birds that annually range over thousands of square miles across several countries. Habitat enhancement usually represents the most direct means of ensuring the long-term viability of bird populations (Sherry and Holmes 1995).

The evaluation recognized this objective -- the improvement of forest habitat conditions for birds -- as the most direct and defensible measure of the extent to which the Program benefitted populations of wild birds. Evaluators conceded beforehand the difficulty in reliably quantifying habitat improvements.

The objective was directly assessed by examining the qualitative and quantitative evidence provided by land stewards that information derived from the Program stimulated beneficial changes in land management, planning, or acquisition and that those changes resulted in improved habitat conditions. Evidence for improved conditions would include, for example, reduced edge-to-interior ratios of forest patches or riparian buffer strips, increased coverage of forest types or age classes critical for high priority species, or enhancement of microhabitat conditions (e.g., forest understory vegetation) required by those species (e.g., Diamond 1975). Ideally, those improvements should be measured in terms of acreage.

### Documented Habitat Gains

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While management changes did result from new research information (Objective 7), land stewards could not definitively document that those management changes improved habitat conditions for forest birds. The shortcoming here was not that those beneficial habitat changes did not occur, but rather that land managers had not made an attempt to quantify the resultant changes in the land base or natural resources.

### Inferred Habitat Gains

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In light of the lack of documentation about habitat improvements for forest-dwelling birds, another approach was used to infer the habitat gains that may have resulted from Program-sponsored research. For this evaluation, changes that occurred in management action were extended to the land base on which those changes were implemented to project how habitats might have been improved. While subjective, these projections are based upon well documented patterns of habitat preference by various guilds of forest birds.

On the Superior National Forest, snags (standing dead trees) are now not cut unless a safety hazard. Snags are critical for both primary (e.g., woodpeckers) and secondary (e.g., chickadees, Great Crested Flycatcher) cavity nesters (Evans and Conner 1979). Retention of snags in Minnesota, Oregon, and

Maine likely improved millions of acres of habitat for numerous cavity-nesting species.

Changes in the sizes, shapes, and configuration of timber harvests probably resulted in reduced forest edge-to-interior ratios across forested landscapes in Alberta, Maine, and Arkansas, improving breeding habitat for species that are sensitive to edges or patch size.

For species that use landscape-level cues in selecting habitat, retention of small patches of over-story trees within clearcut stands may have improved the overall quality of forested landscapes.

Finally, several landholders have implemented significant shifts in their approach to land management, from consideration of only single species to incorporation of the habitat needs of multiple species. The likely result has been more effective conservation of *ecosystems* rather than simply on individual, high profile species. This philosophical change is likely to lead to greater success in meeting the long-term habitat needs of all species.

### Tracking Habitat Changes

A fair number of land management changes resulted from scientific information provided by Foundation-supported research projects. Unfortunately, quantitative documentation of on-the-ground gains in habitat quality has not taken place. The reason for this is understandable, given the staff time necessary to assess and monitoring the fine-scale metrics (e.g., edge-to-interior ratios) that might reflect changes in habitat quality for bird populations. However, use of monitoring to assess management actions is necessary to ensure the efficacy of those novel management actions.



Snag retention practices were implemented in several states after recommendations were generated through Foundation-sponsored research. Cavity-nesting species, such as this 3-month-old Great Crested Flycatcher, stand to benefit from this enhancement in land management.

## Evaluation of Objective 8

### *Habitat Gains*

Though previous objectives have documented significant changes in forest management and policy, no concerted effort was made by landholders to assess the extent to which those changes have potentially benefited forest birds through improved habitat conditions.

Simple inference based upon those implemented management changes, however, suggests that millions of acres of forest land in North America have benefited from scientific information generated by Foundation-sponsored research projects. Nevertheless, reliable assessment of this objective cannot be made given the lack of sound information about the extent of land use changes.

Long-term strategies designed to balance the multiple goals of forest management need to incorporate a fine-scaled assessment and monitoring protocol to track changes in presumed habitat quality for forest bird (and other wildlife) populations.

## OBJECTIVE 9

### *Population status of forest-dwelling birds is improved*

## BIRD POPULATION GAINS

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The ultimate goal of the Program is to benefit populations of forest-dwelling birds. Relating bird population changes directly to management actions, however, are extremely difficult to ascertain because of various environmental factors act simultaneously on bird populations, such as breeding habitat limitations, winter food shortages, mortality during migration, and stochastic events such as severe weather. Nevertheless, given its importance, assessment of population change was necessary to include in the evaluation.

This objective was evaluated directly through interviews with land management groups that had implemented actions based upon recommendations of research projects funded by the Foundation.

### **Documentation of Gains**

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Similar to that found in the assessment of habitat gains, land managers were uncertain of the extent to which habitat management changes had affected local bird populations. In fact, because of the confounding effects of the various environmental factors discussed earlier, land managers were even less speculative than they had been about potential habitat gains.

Few data exist to independently assess the extent of population changes. The Breeding Bird Survey of the U.S. Geological Survey is perhaps the most standardized and

consistent source of bird population data over regional spatial scales. However, the number of routes for those surveys were not numerous enough to generate legitimate comparisons of bird populations between areas that had management changes implemented and adjacent areas where those changes were not made.

### **The Need for Population Assessment**

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The evaluation did not reveal any long-term assessment and monitoring programs aimed at understanding the impacts of forest management changes on bird populations. While anecdotal information does exist in several areas for assessing the relationship between management and bird populations, those data are not substantial enough to draw definitive conclusions.

Population assessment and monitoring for animal and plant populations must become a standard part of forest management if that management is to evolve into a true multifaceted program.

## Evaluation of Objective 9

### *Bird Population Gains*

Not surprising in this evaluation was the lack of qualitative or quantitative information about the effects of implemented forest management practices on bird populations. While positive effects are likely to have occurred in some areas that implemented new forest management practices, *reliable assessment of this objective cannot be made given the lack of sound information about bird population changes.*

Long-term strategies designed to balance the multiple goals of forest management need to incorporate an assessment and monitoring protocol to track changes in bird populations inhabiting forested landscapes. Without those measures, forest managers may have little basis for implementing forest management practices under the banner of sound conservation.



Forest management practices developed with input from researchers supported by the Foundation probably had positive influences on populations of forest-nesting birds, such as Swainson's Thrush (top) which prefer older-growth coniferous forests, and Common Yellowthroat (bottom), an inhabitant of very early successional forests. However, land management agencies and industries have not instituted assessment and monitoring protocols to evaluate the long-term effects of those practices on bird populations.



*The National Fish and Wildlife Foundation should continue, and expand upon, its commitment to forest bird conservation through generation of quality scientific information.*

## CONCLUSIONS & RECOMMENDATIONS

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Overall, the forest bird research program of the Foundation produced significant and widespread benefits for bird conservation in North America. No other granting program in the United States duplicates the intent and approach of the Foundation. Because of that effectiveness and the unique niche that it claims, the National Fish and Wildlife Foundation should continue, and expand upon, its commitment to forest bird conservation through generation of quality scientific information. Relatively few other substantive sources of funding are available for applied research on forest birds and other wildlife. Indeed, few other Foundations or organizations that support research are so closely tied into the information needs of forest managers.

### A Significant Concern

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Of greatest concern was the lackluster communication of research results to land managers, and in a form that maximized its usefulness to those end users. Mediocre communication and dissemination of results was likely a prime reason that research information was not more widely integrated into management plans, and implemented through stand- and landscape-level forest prescriptions.

To overcome that major shortcomings, the Foundation should re-emphasize several existing facets of its Program, as well as add several new components, including:

- Strongly emphasize collaborative projects between researchers and land managers to ensure that research is focused on high priority information needs and is more likely to be used in development of management plans.
- Demand that research teams effectively communicate management recommendations and research implications to forest managers.
- In addition to peer-reviewed technical reports, stress development of research reports and outreach materials that target management-based end users of the information.
- The Foundation should draw upon its supported research projects and others to organize regular regional and national workshops on state-of-the-art forest management.
- The Foundation should develop a “dynamic” forest management manual that brings state-of-the-art scientific information to bear on forest management in support of bird (and wildlife) conservation.

### Other Recommendations

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The following table provides a summary of all conclusions and recommendations drawn from this evaluation.

**CONCLUSIONS****RECOMMENDATIONS*****IDENTIFY INFORMATION NEEDS***

- Visionary process that stressed participation of diverse stakeholders, development of stable process for identifying needs, and focus on restricted set of management issues.
- Maintain active participation in established working groups and other discussion forums.
- Develop, and solicit guidance from a panel of experts.

***SUPPORT QUALITY PROJECTS***

- Identified proposals that were focused on priority management issues; based upon partnerships with agencies and forest products industry; led by respected scientists; and underpinned by sound experimental design.
- Re-emphasize importance of research information to forest management through maintenance and expansion of funding opportunities.

***STIMULATE ADDITIONAL RESEARCH***

- Encouraged research teams to pursue complex, multifaceted, long-term research. Cumulative result was development of novel approaches to scientific investigation that addressed critical needs of forest managers.
- Continue to encourage research teams to pursue both basic and applied forms of research.
- Maintain multi-year approach to funding of research projects.

***GENERATE VALUABLE INFORMATION***

- Projects consistently generated high quality information that addressed priority needs of forest managers.
- Continue to stress to research teams the need to produce high quality scientific information.
- Several shortcomings in production of rigorous management recommendations.
- Demand, when appropriate, that research teams develop rigorous management recommendations.
- Aspects of studies involving assessment of reproductive success sometimes fell short.

**CONCLUSIONS****RECOMMENDATIONS****DISSEMINATE INFORMATION EFFECTIVELY**

- Presentation at national scientific meetings was the most consistent means by which project results were communicated.
- The extent and quality of peer-reviewed technical publications were impressive, but was inconsistent across the suite of research teams; researchers affiliated with universities generally were more productive than those working for nongovernmental organizations.
- Presentation of research results and management recommendations were rarely developed specifically for land managers. Outreach materials for both land managers and non-technical audiences (e.g., county planning commissions) were produced by only a handful of researchers.



Research on the effects of silvicultural practices on nesting migratory birds, such as the Worm-eating Warbler (right), has directly promoted bird conservation in the Missouri, Arkansas, and Oklahoma Ozarks region. In Missouri, information about the abundance and distribution of Cerulean Warblers, for example, was used by the Missouri Department of Conservation in conservation activities. Data from the University of Arkansas assisted the Arkansas Chapter of the Nature Conservancy in advocating land protection strategies in the mountainous region of eastern Oklahoma.

**INCORPORATE RESULTS INTO PLANS**

- Several significant outcomes were documented for incorporation of research results into policies and plans of agencies, private landholders, and conservation organizations.
  - Results from only half of the projects were directly used by land managers. Use of research information often was limited to stewards of the property on which the research was conducted.
- Recommendations offered under previous objectives could help better engage land managers and deliver information in a more useful format to this important group of end users.

**CONCLUSIONS****RECOMMENDATIONS****IMPLEMENT MANAGEMENT ACTIONS**

- Several significant *local* changes in forest management have resulted from research supported by the Foundation. That research, however, has not yet had a widespread regional or national impact on the way in which forest lands are managed.
- The lack of consistency in local application of research results, and the modest influence those results have had thus far on land stewards outside immediate study areas are consequences of passive dissemination of management recommendations; time lag for collective research information to build to a “critical mass” necessary to stimulate action; and lack of incentive for land managers to seek and assimilate the latest research information.

**HABITAT AND BIRD POPULATION GAINS**

- Landholders made no concerted effort to assess the extent to which changes in land management have potentially benefited forest birds.
- Simple inference based upon those implemented management changes, however, suggests that millions of acres of forest land in North America have benefited from scientific information generated by Foundation-sponsored research projects.
- No conclusions can be drawn with regard to the extent of changes in local or regional bird populations due to scientific information offered through Foundation-sponsored research.

- Recommendations offered under previous objectives could help better engage land managers and deliver information in a more useful format to this important group of end users.

The success of Manomet Center for Conservation Sciences in securing commitments for inclusion of research results into organizational policy and management plans was largely due to the group's effectiveness in communicating scientific information to stakeholder groups. In 2003, for example, Manomet scientists sponsored an all-day field trip

to industrial timberlands (above) for conservation groups from around New England to discuss forest research and conservation.

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