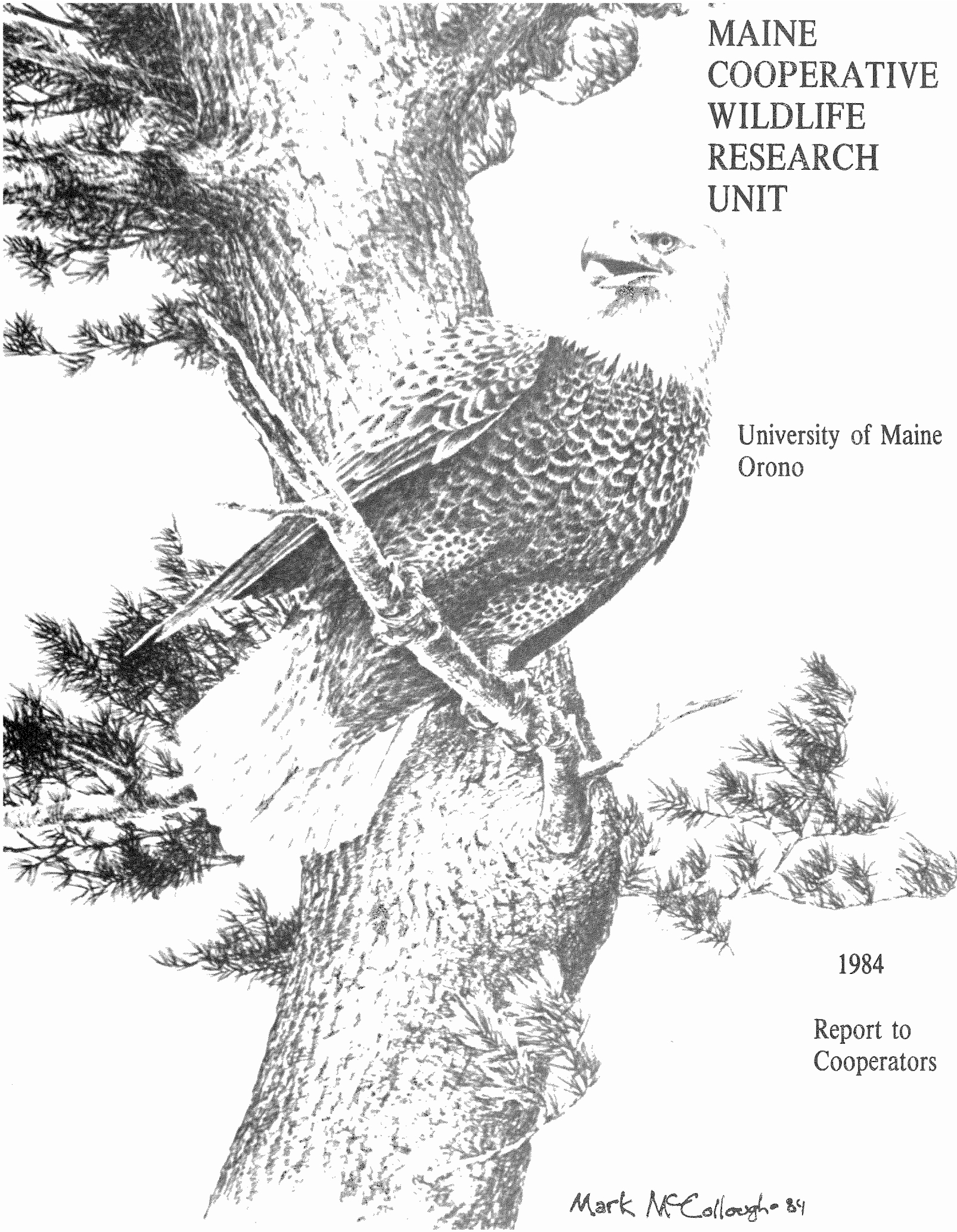

MAINE COOPERATIVE WILDLIFE RESEARCH UNIT

University of Maine
Orono

1984

Report to
Cooperators

MAINE COOPERATIVE WILDLIFE RESEARCH UNIT

240 Nutting Hall
University of Maine
Orono, Maine 04469

Cooperators

MAINE DEPARTMENT OF INLAND FISHERIES AND WILDLIFE

UNIVERSITY OF MAINE

FISH AND WILDLIFE SERVICE, U.S. DEPARTMENT OF THE INTERIOR

WILDLIFE MANAGEMENT INSTITUTE

October 1983 - September 1984

This report details the research objectives, procedures, and findings of numerous investigators. Since data contained may be preliminary and inconclusive, permission to reproduce or publish any of the contents of this report in any way is withheld pending specific authorization from the Unit Leader.

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PERSONNEL AND COOPERATORS (October 1984)

COORDINATING COMMITTEE

Maine Department of Inland Fisheries and Wildlife:
Glenn H. Manuel, Commissioner

University of Maine, Orono
Ray B. Owen, Jr., Chairman, Wildlife Department,
College of Forest Resources

U.S. Fish and Wildlife Service
Reid Goforth, Supervisor, Cooperative Wildlife Research Units

Wildlife Management Institute
Laurence R. Jahn, Vice President

WILDLIFE PERSONNEL

Unit Staff
John A. Bissonette, Acting Unit Leader,
Associate Professor of Wildlife
John A. Litvaitis, Associate Scientist
Joyce A. Harrison, Wildlife Technician
Matthew A. Miller, Wildlife Technician
Dennis Kingman, Wildlife Technician
Fred DiBello, Wildlife Technician
Robert C. Burke, Wildlife Technician
John W. Ault III, Wildlife Technician
Maxine L. Horne, Unit Secretary

University and Associated Staff
Ray B. Owen, Jr., Chairman, Wildlife Department
College of Forest Resources and Professor of Wildlife
James R. Gilbert, Associate Professor of Wildlife
Chester F. Banasiak, Associate Research Professor of Wildlife
Patrick W. Brown, Assistant Professor of Wildlife
Malcolm L. Hunter, Jr., Associate Professor of Wildlife
David M. Leslie, Assistant Professor of Wildlife
Jerry R. Longcore, Research Wildlife Biologist, USFWS
Hewlette S. Crawford, Jr., Research Wildlife Biologist, USFS
Charles S. Todd, Research Associate
Kathleen M. Wynne, Research Associate
Lisa DeBruyckere, Wildlife Technician
Dave Eggeman, Wildlife Technician
Jody J. Jones, Research Assistant
Janet McMahon, Research Associate
Jack Witham, Research Associate

Maine Department of Inland Fisheries and Wildlife
Glenn H. Manuel, Commissioner
Norman E. Trask, Deputy Commissioner
Frederick B. Hurley, Jr., Director, Bureau Resource Management
Robert W. Boettger, Director, Wildlife Division
George J. Matula, Jr., Research Supervisor, Wildlife Division

Personnel from many University departments as well as State, Federal, and private organizations are actively collaborating with the Unit. Individuals assisting with projects currently reported are listed in connection with the appropriate project summary.

GRADUATE STUDENTS

Name	Degree Candidacy	Support
Stephen M. Arthur	Ph.D.	MDIFW; MCWRU; ME Trappers Assoc. (NE Coastal Ch.)
Timothy D. Bowman	M.S.	AFCBP
MaryEllen Chilelli	Ph.D.	MDIFW; MDC; MCWRU
Diane R. Eggeman	M.S.	Delta Waterfowl & Wetland Research Station, UMO
Catherine A. Elliott	Ph.D.	IPC; MDIFW
Donald P. Englehardt	M.S.	MDIFW; MCWRU
William J. Galbraith	M.S.	MDIFW; USFWS-MBHRL
Daniel J. Harrison	Ph.D.	MDIFW; MCWRU
Jonathan A. Jenks	M.S.	McIntire-Stennis; MCWRU
W. N. Johnson	M.S.	McIntire-Stennis
Dennis G. Jorde	Ph.D.	MDIFW; USFWS-MBHRL; CFR; Hatch Act
David J. Leptich	M.S.	MDIFW; McIntire-Stennis
Daniel G. McAuley	M.S.	ECE Program; USFWS (PWRC, CNFRL)
Mark A. McCollough	Ph.D.	USFWS; NWF; NC
Mary F. Small	M.S.	Holt Woodland Research Foundation
Sally Stockwell	M.S.	MDIFW; Wheelabrator Frye Inc.
Paul I. V. Strong	Ph.D.	MDIFW; MAS
Michael E. Thompson	M.S.	MDIFW; MCWRU; McIntire-Stennis
Peter D. Vickery	M.S.	Nat.Conserv; ME.Aud.Soc.; ME Pest Control Bd; MA Aud. Soc.; Coastal Blueberry, Inc.
Pralad Yonzon	Ph.D.	UMO

Graduate Students: Theses completed during current period.

Thomas A. Allen	Ph.D.	
W. Alan Crossley	M.S.	Completed Fall 1984
Margaret A. Halpin	M.S.	
John A. Litvaitis	Ph.D.	
Paul W. Rego	M.S.	
Joyce Snyder	M.S.	Completed Fall 1984

COLLABORATING AGENCIES AND ORGANIZATIONS

Atlantic Flyway Cooperative Banding Program,
Atlantic Waterfowl Council - AFCBP

Big Bend National Park - BBNP

Canadian Federal Government (NSERC)

Canadian Wildlife Service (CWS)

Coastal Blueberry, Inc - CB

Eagle Valley Environmentalists - EVE

Holt Woodlands Research Foundation -HWRF

International Paper Company - IPC

L.L. Bean, Inc. - LLB

Libby Sporting Camps - LSP

Maine Audubon Society - MAS

Maine Cooperative Fishery Research Unit - MCFRU

Maine Department of Conservation - MDC

Maine Department of Inland Fisheries and Wildlife - MDIFW

Maine Pesticides Control Board - MPCB

Massachusetts Audubon Society - MAAS

National Marine Fisheries Service, Northeast Fisheries Center - NMFS

National Park Service - NPS

National Rifle Association - NRA

National Wildlife Federation - NWF

Nature Conservancy - NC

Maine Chapter - NC-MC

Newfoundland Wildlife Division (NWD)

North American Wildlife Foundation-
Delta Waterfowl & Wetland Research Station - DWRS

Society of Sigma Xi - SX

St. Regis Paper Co. - SR

University of Maine

- Graduate Student Board - GSB
- College of Forest Resources - CFR
  - Hatch Act Funds - HAF
  - McIntire-Stennis - MS

U.S. Environmental Protection Agency - EPA

U.S. Fish and Wildlife Service - FWS

- Migratory Bird and Habitat Research Lab - MBHRL
- Office of Migratory Bird Management - OMBM
- Patuxe Wildlife Research Center - PWRC
- Columbia National Fishery Research Laboratory - CNFRL

U.S. Forest Service- Northeast Forest Experiment Station - NEFES

U.S. National Park Service - NPS

U.S. State Department - USSD

Wildlife Management Institute - WMI

Wheelabrator-Frye, Inc (now part of Signal Fuels) - SF

Mr. Scott Skinner

Mr. Joseph Sewall

THE MAINE AMPHIBIAN AND REPTILE ATLAS PROJECT (MARAP)

Investigators: M. L. Hunter, Jr.
Jane Arbuckle
John Albright

Advisors: Barry Burgason
Shirley Davis
Arthur Ritter

Cooperators/ Project Support: The Nature Conservancy
The Maine Audubon Society
Maine Department of Inland Fisheries and Wildlife

Objectives:

(1) Determine the status and distribution of amphibians and reptiles in Maine, particularly rare species and those that reach their range limit here.
(2) Describe the general ecology (e.g., habitat selection and life history) of Maine's herpetiles.

Scope:

There are approximately 35 species of amphibians and reptiles occurring in Maine of which 20 probably reach the limit of their range here. One or more species have probably been extirpated from the state and there may well be species occurring here that have not been previously recorded. There is a dearth of basic knowledge about the status, distribution, and ecology of Maine's herps and this is the reason MARAP was initiated. Nearly 100 volunteers from around the state have been issued instruction manuals and record cards to report their observations of herps. These cards will be computer encoded and range maps generated.

Project Status:

In the project's first year some interesting results have already been obtained. Three species that have been unrecorded for many years were found, albeit in very limited numbers (Spotted turtle, Blandings turtle, and black racer). One species formerly thought to be very rare, the four-toed salamander, appears to be just very secretive. Major range extensions have been recorded for at least two species, mink frog and gray tree frog.

Future Plans:

It is anticipated that it will take several years to complete the project. After the first year's data are compiled we will identify some specific questions (e.g., are black racers limited to sandy outwash plains in York County?), and may hire field assistants to answer them.

A LONG-TERM FOREST ECOSYSTEM STUDY

Investigators: M. L. Hunter, Jr.
A. J. Kimball
J. W. Witham

Cooperators/
Project
Support: Holt Woodlands Research Foundation

Objectives:

(1) To describe the structure of the plant and animal communities in an oak-pine forest ecosystem.
(2) To investigate the effect of woodlot management on community structure.
(3) To document phenological, interannual, and long-term changes in community structure.

Scope:

Thousands of people own woodlots, and they control a resource that is not currently being adequately managed, despite a growing demand for forest products. To many landowners, perhaps most, economic return from timber extraction is secondary to considerations such as recreation, aesthetics, and wildlife. In the absence of management advice these people often choose not to manage their land at all. Thus there is a great need for information on how to manage small woodlots, particularly in ways that maintain or enhance wildlife and similar values.

We know surprisingly little about forest ecosystems. This is true because foresters' attentions have been focused almost entirely on the trees; botanists have largely ignored forests on the assumption that foresters were studying them; and other biologists such as entomologists and wildlifers have only undertaken autecological studies concerned with a single species or group of species. In short, broad scope studies of Maine's forest ecosystems have "fallen through the cracks." It is particularly important that ecosystem level studies be long-term because of the complexity and variability of forest ecosystems.

This study is being conducted for 20 years on a 300 acre, red oak-white pine woodlot in Arrowsic, Maine called the Holt Forest. We have selected a 40 ha tract and divided it into forty 1 ha blocks with 20 ha serving as a control area and 20 ha as an experimental area.

During the first three years our primary objective is to address our first goal "To describe the structure of the plant and animal community." We are undertaking (1) a 100% inventory of trees (>10 cm DBH) and intense inventories of tree regeneration, (2) a complete description of the vascular plant vegetation using the releve' technique, (3) an inventory of all breeding bird territories, (4) transect surveys of nonbreeding birds, (5) small mammal trapping, (6)

salamander transect counts, (7) phenological observations on life history events in 40 plant species, (8) estimates of litter and fruit production, (9) general surveys of canopy insect abundance, and (10) meteorological observations. These data, largely population estimates, are integrated by area units (usually 0.25 ha blocks) and analyzed to portray the forest's community structure. After three years we will begin managing the experimental area with three objectives: (1) increase wood production, (2) increase wildlife diversity and abundance and (3) maintain the forest's aesthetic value. By continuing to monitor populations and processes we can attain our second goal, "To investigate the effect of woodlot management on community structure." Over the course of 20 years we will begin to understand how the community changes seasonally and from year to year; this is part of our third goal, "To document phenological, interannual, and long-term changes in community structure."

Project Status:

1983-84 was our second year of field work and tasks 1, 3, 4, 5, 6, 7, 8, and 10 as outlined above were completed.

Future Plans:

In 1984-85 we will initiate tasks 2 and 9 and continue 3, 4, 5, 6, 7, 8, and 10.

BIOSPHERE RESERVE DATA BASE -- BIG BEND NATIONAL PARK, TEXAS

Investigator: J. W. Ault III

Supervisor: J. A. Bissonette

Cooperators/ Project Support: National Park Service: Big Bend National Park, TX; U. S. State Dept. MAB Project-8 Office, Washington, D. C.; NPS Regional Office, Santa Fe, NM

Objectives:

(1) Compile an annotated bibliography of the archaeology, aquatic systems, climate, geology/paleontology, history, soils, terrestrial fauna, use and effects, and vegetation references for Big Bend National Park, Texas and the northern Chihuahuan Desert.

(2) Summarize the kind of data available for BBNP, and describe the facilities available to researchers.

(3) Make recommendations that will enable the Park Service to attain MAB objectives at BBNP.

Scope:

Big Bend National Park (BBNP), Texas was designated a Biosphere Reserve in 1976. This designation made BBNP part of the Man and the Biosphere (MAB) Program, an international conservation effort established by UNESCO.

The purpose of our work was to assist the Park Service in its participation in the MAB Program and provide encouragement and suggestions for interdisciplinary research. Our specific objectives were to (1) prepare an annotated bibliography for BBNP and the Chihuahuan Desert, (2) summarize the data bases and research facilities available to researchers at BBNP, and (3) recommend actions that will help promote MAB objectives at BBNP.

Project Status:

The annotated bibliography has been printed and will be available on computer at BBNP and the Southwest Region Office of the Park Service. We have identified approximately 3600 citations; 868 concern research conducted at BBNP and have abstracts included with the citation. Citations only are provided for 2700 entries concerning the Chihuahuan Desert, 700 entries are in Spanish.

The second volume of the report provides summaries of the data bases included in the annotated bibliography. Eight of nine summaries are complete. Also completed for this section are (1) a discussion of facilities available to researchers, (2) a list of names and addresses of scientists interested in research in the Chihuahuan Desert, and (3) a "quick reference" table of the kinds of work completed at BBNP.

Recommendations for actions needed to achieve MAB objectives have been developed. Guidelines for the recommendations came from three sources: (1) National Science Foundation recommendations for long-term ecological research, (2) Man and the Biosphere Program, Project -8 objectives, and (3) suggestions from 3 questionnaires sent to 144 scientists who have worked either in BBNP or in other parts of the Chihuahuan Desert. Recommendations are grouped into three categories, RESEARCH FACILITIES AND DATA BASES, LONG-TERM ECOLOGICAL MONITORING, and POLICY/ADMINISTRATION. Within each category the recommendations were ranked according to their importance.

In October 1983 we conducted a meeting at BBNP to discuss progress of the project and to review the recommendations. Approximately 30 people attended. Representatives were present from the Washington office of the National Park Service (NPS), Southwest Region office NPS, BBNP, Bolson de Maipimi Biosphere Reserve in Mexico, and the university community.

Future Plans:

Final copies of the report will be printed before 31 December 1984, and the project will be complete.

BIRDS, HERPETOFAUNA, AND SMALL MAMMALS OF MAINE'S PEATLANDS

Investigator: S. S. Stockwell

Advisors: M. L. Hunter, Jr., Chair
R. Davis
W. Glanz
J. Longcore

Cooperators/ Project Support: Maine Department of Inland Fisheries and Wildlife
Signal Fuels, Inc.
Maine Chapter of The Nature Conservancy
Maine Land Use Regulation Commission
Maine Department of Environmental Protection

Objectives:

(1) To identify those species of birds, small mammals, and reptiles and amphibians that inhabit Maine's peatlands.
(2) To quantify the relative abundances of Maine peatland wildlife species in relation to peatland vegetation and hydrology.
(3) To determine whether large, commercially valuable peatlands differ in their "value" to wildlife from smaller non-commercially valuable peatlands.

Scope:

Peatlands are one of the last remaining undisturbed ecosystems in the northeast. Before this project was initiated no extensive or intensive survey of the wildlife in Maine peatlands had been conducted. As a result we know little about how important peatlands are to various wildlife species.

Recently several commercial mining companies have expressed an interest in developing Maine's peatlands for a new source of energy for the state. Before issuing any mining permits, it is critical that the state know what species depend on peatlands for their continued survival, if any, and whether certain species are restricted to particular types or sizes of peatlands.

Project Status:

During the summers of 1983 and 1984, birds were censused in eight peatlands representing five different peatland geomorphological types. Each peatland was censused 4 or 5 times during May and June using the variable-width transect method. One hundred fourteen species were identified during the censuses. The number of species found in each bog ranged from 30 to 69 in 1983. Bird densities in each peatland were calculated from the 1983 data using the computer program TRANSECT. Densities ranged from approximately 2 to 10 per hectare.

Herpetofauna traplines, consisting of aluminum flashing drift fences and tin can pit traps, were erected in seven different plant communities in 1983. Traplines were operated for 3 to 7 days once during each month of May, June, July and September of 1983. In 1984, 17 additional pitfall traplines were erected in 6 new peatlands, adding 204 traps to the 126 that were operated the year before. All traplines were operated for 5 to 7 days once during April, May, June, July and August of 1984. During 1983, 1621 amphibians and 278 small mammals were captured in 2312 trap nights. Eight species of amphibians and 11 species of small mammals were identified. The number of species captured per plant community ranged from 6 to 11, and the number of captures per community ranged from 37 to 142 per 100 trap nights.

Small mammal live-trapping was conducted in August of 1983 in seven habitats. Twenty-six traps were initially set 15 meters apart on transects and operated for 3-4 nights, then moved to assessment lines and operated for an additional two nights. In 1921 trap nights, 277 animals were captured, representing 216 different individuals. Eight species were identified, with the number of species captured per plant community ranging from 3 to 6. The number of individuals captured per community ranged from 10 to 48. Small mammals were not livetrapped again in 1984.

Future Plans:

No future field research is planned. Data from 1983 and 1984 will be analyzed and tested for significant differences among peatland types and plant communities. A thesis is being prepared for completion in early 1985.

SONGBIRD SPECIES DIVERSITY IN RELATION TO THE STRUCTURE AND SIZE OF FOREST STANDS AND EDGES

Investigator: C. A. Elliott

Advisors: J. R. Gilbert, Chairman
P. W. Brown
W. E. Glanz
G. L. Jacobson
T. Saviello

Cooperators/
Project Support: International Paper Company
Maine Department of Inland Fisheries and Wildlife

Objectives:

(1) To determine songbird species diversity (BSD) in habitat types varying in alpha (within stand) diversity.
(2) To determine the effect of stand size on BSD for each habitat type.
(3) To determine BSD in edge habitat varying in beta (between stand) diversity.
(4) To determine the effect of length of edge on BSD for each edge type.
(5) To determine the relationship between bird species composition of the edge zone and that of the adjoining habitats.
(6) To use the results of objectives 1-4 to quantify the relationship between alpha and beta diversity and gamma (landscape) diversity.
(7) To use the results of this study to predict the effect of forest management practices on habitat diversity (alpha, beta, and gamma) and BSD.

Scope:

Habitat diversity is an important concept in wildlife management, with each species having certain habitat requirements. Management for a diverse wildlife community means management for habitat diversity. Two major components of habitat diversity are vertical and horizontal structure. Combined, these can be considered landscape diversity.

Vertical structure, also termed "within-stand" or "alpha" diversity, is a function of the number of layers of vegetation present in a habitat and the variety and abundance of plant species present within and among layers. It is often measured as foliage height diversity (FHD).

Horizontal structure, also termed "between-stand" or "beta" diversity, is a function of the change in vertical structure between habitat types. The transition zone, or edge, has length, width, and vertical structure, may include characteristics of the adjoining

habitats, may have unique characteristics, and may be the result of environmental gradients or man's activities.

"Landscape" or "gamma" diversity combines alpha and beta diversity and is a function of the interspersion, patchiness, size, and shape of habitat types. Management for habitat diversity is primarily concerned with maximizing gamma diversity.

This study will examine the relationship between habitat diversity at the alpha and beta levels, and one group of species, songbirds.

As alpha diversity and stand size vary from low to high, the diversity of the songbird community will also vary. There is a point where, for a given alpha diversity (or FHD), any further increase in stand size will have little effect on bird species diversity (BSD). Similarly, for an edge of given beta diversity, as length of that edge increases there is, in theory, a point where any further increase in edge length will have little effect on BSD. Four stands and 4 edge types will be chosen to represent a range of alpha and beta values and censused for songbirds. By taking larger and larger portions of the area censused, species-area or species-length curves will be constructed for each value of alpha and beta. Each edge type will also be censused on transects across the edge to provide information on the composition of the bird community within the edge zone relative to the adjacent stands.

Dividing the vegetation into 9 layers (0-0.5, 0.5-1, 1-3, 3-5, 5-10, 10-15, 15-20, 20-25, 25+ meters), the composition and volume of foliage present in each layer will be determined in 10 by 10 m plots placed at 10-100m intervals in stand and edge plots. FHD values will be calculated from these data and used to assess the homogeneity of the study areas.

A quantitative expression of gamma diversity will be developed from the results obtained from alpha and beta diversity values. All 3 levels of diversity are important in determining the overall diversity of an area, and, together with information on stand composition and the spatial and temporal arrangement of different stand types, can be used to assess the effect of forest management practices on habitat diversity.

Project Status:

Five study areas were chosen for study during the 1984 field season. A mixed wood stand and 4 edge types (clearcut-hardwood, clearcut-mixedwood, clearcut-softwood, and partial cut-softwood) were located in central Maine. A 64-hectare plot was placed in the mixedwood stand, 250 m x 500 m plots were placed across each edge type, and 1000 m x 100 m plots were placed along each edge type. Songbirds were censused 3 June - 1 July. Vegetation data was collected 2 July - 31 August.

Future Plans:

Vegetation data from 1984 will be entered into the computer this fall. Songbird data will be entered in the spring and preliminary analyses begun. The 1985 field season will entail repeating the songbird census in the 4 edge plots. Also, a softwood stand will be located, censused, and vegetation data collected. Field work will be completed by the end of July, at which time analyses and thesis preparation will begin.

SONGBIRD AND SMALL MAMMAL POPULATIONS IN MAINE RIPARIAN AND EDGE OAK-PINE FORESTS

Investigator: M. F. Small

Advisors: M. L. Hunter, Jr., Chairman
P. W. Brown
W. E. Glanz

Cooperators/ Project Support: Holt Woodland Research Foundation

Objectives:

(1) To determine densities of bird and small mammal populations in riparian oak-pine forests and forests with a powerline edge.
(2) To determine productivity of birds and small mammals in these study areas.
(3) To compare the densities of various species in the riparian forest to their densities in the area with a powerline edge.
(4) To compare the changes in vegetation height and composition near the powerline edge with those of a riparian zone.
(5) To observe the effects of distance from edge upon species density.

Scope:

Research on animal populations in riparian ecosystems has focused on the arid Southwest. Animal populations seem to be greater in this habitat than in surrounding habitats, a phenomenon similar to the effect of an edge. In the Northeast, the demand for riverfront housing continues, and logging beside rivers and streams is common. State and local agencies need to know how shoreline development affects wildlife populations before they can regulate it. This project is designed to compare animal populations in riparian forests to those in forests with an edge, and to discover the effect of distance from the river upon population characteristics. The data gathered may be used to assess the characteristics of riparian populations, whether they differ from those of a population near an altered habitat, and how they could be affected by shoreline development.

Project Status:

The first field season was completed in 1984. Songbirds were censused on four study areas: two in Lincoln County near a powerline, and two beside rivers in Sagadahoc County. Seventeen nests situated on the four areas were monitored for evidence of predation or cowbird

parasitism. Small mammals were censused on one of the powerline areas and one of the riparian areas. Height and species of vegetation were recorded at sample points within 30 m. of the edge or river to create height profiles.

Future Plans:

Analysis of data will begin in Fall, 1984. Vegetation sampling will be completed in Summer, 1985, and censusing of songbirds and small mammals will continue. Monitoring songbird nests will continue, and artificial nests may be used as well to monitor predation.

AVIAN USE OF LAKESHORE BUFFER STRIPS IN EASTERN MAINE

Investigator: W. N. Johnson

Advisors: P. W. Brown
G. L. Jacobson
J. R. Gilbert

Cooperators/
Project
Support: McIntire-Stennis

Objectives:

(1) To compare avian community parameters (i.e. diversity, richness, and density) between lakeshore buffer strips and undisturbed lakeshore.
(2) To quantify the composition and structure, or other specific components of vegetation used by selected species for breeding and foraging.
(3) To use the results of this study to evaluate the effects of habitat perturbations on breeding birds of lakeshore areas.

Scope:

There are approximately 3,400 ponds and lakes, greater than one acre in size, within the unorganized townships of Maine. The Maine Legislature has enacted laws that regulate land use along the shoreline of these areas. Regulations have been designed to: (1) protect and enhance water quality, (2) protect shoreland areas from erosion, (3) protect and preserve vegetation and wildlife, and (4) conserve natural beauty.

Timber harvesting adjacent to lakes and ponds must conform to standards provided by the Land Use Regulation Commission. These standards require the retention of a buffer of well-distributed trees along the shoreline. Buffer strips may provide adequate food and cover for some species of wildlife.

This study will investigate avian use of lakeshore buffer strips. Data obtained through vegetation analysis will be used to examine the vegetation components utilized by breeding bird. The results of this study will be used in evaluating the effects of timber harvesting on breeding birds in lakeshore areas.

Project Status:

Two study sites, a lakeshore buffer strip and an undisturbed lakeshore, were selected for study in 1984. Transect lines were established on 10 ha plots at each site. Reference points were

flagged on 25 m intervals along each transect. Songbirds were censused during June using the spot-mapping method. Composite maps for each species have been compiled and will be used to delimit the territories of singing males.

Vegetation was sampled during July and August using 160 0.04 ha circular plots centered on each reference point. Additional vegetation plots were centered at singing perches of territorial males and at active nests of selected species.

Future Plans:

Preliminary analysis of the data will begin in the fall. Birds will be censused again at each site during the spring of 1985. Two additional plots, located within lakeshore buffer strips, will also be censused. Vegetation analysis of the additional plots will be conducted during July and August.

THE EFFECT OF BLUEBERRY MANAGEMENT ON THE NESTING ECOLOGY OF BLUEBERRY BARREN AVIFAUNA

Investigator: P. D. Vickery

Advisor: M. L. Hunter, Jr.

Cooperators/ Project Support:
The Nature Conservancy - Maine Chapter
The Nature Conservancy - Northeast Regional Office
Maine Audubon Society
Maine Pesticides Control Board
Massachusetts Audubon Society
Coastal Blueberry, Inc.

Objectives:

(1) To identify the species composition and relative abundance of birds found nesting on blueberry barrens in southern Maine.
(2) To identify the vegetational requirements of birds nesting on blueberry barrens.
(3) To determine the impact of blueberry management on the avian community nesting on these barrens.

Scope:

Though blueberry barrens comprise a relatively small part of Maine's total acreage, these areas form a special ecosystem with a distinctive breeding avifauna. Bird life has co-existed with blueberry management for many decades. Recent introduction of the herbicide hexazinone (Velpar) on blueberry barrens may alter the vegetation sufficiently to have a detrimental affect on birds nesting in this ecosystem.

The Kennebunk Blueberry Barrens support a small, but unique group of breeding birds. These include Upland Sandpiper (*Bartramia longicauda*), Horned Lark (*Eremophila alpestris*), Bobolink (*Dolichonyx orizivorus*), Eastern Meadowlark (*Sturnella magna*), Vesper Sparrow (*Pooecetes gramineus*), Savannah Sparrow (*Passerculus sandwichensis*), and Grasshopper Sparrow (*Ammodramus savannarum*). The latter species is considered a rare nesting bird throughout New England. In Maine, to date, it has only been found breeding on the Kennebunk Blueberry Barrens and on adjacent blueberry land in Wells.

Project Status:

This study will examine nesting densities and species diversity in relation to blueberry management. Eight study plots were established in April 1984 to monitor nesting diversity and density under different management practices. Barrens are harvested or burned in alternate years. Three plots were placed in production year fields while five plots were located in non-production (burn year) fields. Density appears to be greater on blueberry fields not treated with herbicide. Interestingly, species diversity did not appear to decline in herbicide treated areas in 1984.

Future Plans:

Future study at Kennebunk will monitor the shifts in territories as these grassland species respond to the vegetational changes inherent in blueberry management. Continued vegetation sampling will correlate avian habitat preferences with vegetation structure. Placement of artificial song perches into areas of low usage will examine whether the absence of song perches limits usage in non-production (burn year) plots.

AN ASSESSMENT OF POTENTIAL HACK SITES FOR PEREGRINE FALCONS IN MAINE

Investigators: E. J. Snyder
R. B. Owen, Jr.

Cooperators/ Project Support: Maine Department of Inland Fisheries and Wildlife
U.S. Fish and Wildlife Service
U. S. National Park Service

Objectives:

(1) To assess the suitability of former peregrine falcon nesting areas in Maine as potential reintroduction sites.
(2) To locate sites with no previous peregrine history that are suitable for hacking.
(3) To outline peregrine hacking methods in preparation for releases in Maine during 1984.

Scope:

Peregrine falcons once nested in Maine in limited numbers but were extirpated by the mid-1960's. In 1983, as part of the U.S. Fish and Wildlife Peregrine Falcon Recovery Plan, Maine was selected for release of captive reared falcons. This project was established to provide data on potential hack sites and facilitate the transition to an active release program.

Project Status:

The project was completed and a final report submitted to the Maine Department of Inland Fisheries and Wildlife. Eighteen formerly-used eyries were evaluated as potential hack locations. In addition, several other cliff and island sites were investigated as possible release areas. All locations were checked by air and the best sites visited on the ground. Ten high priority release sites were identified, ranked, and landowner contacts initiated. Several coordination meetings between University, State and Federal biologists were conducted to facilitate the program. Finally a summary of hacking methods, including equipment for sites and attendants, hack box construction, costs, owl surveys, and food requirements, was provided to the state program director.

POST-FLEDGING ECOLOGY OF BALD EAGLES IN MAINE

Investigator: M. A. McCollough

Advisors: R. B. Owen, Jr., Chairman
J. A. Bissonette
M. L. Hunter, Jr.
W. E. Glanz
J. R. Gilbert

Cooperators/ Project Support: Maine Department of Inland Fisheries and Wildlife
U.S. Fish and Wildlife Service
National Wildlife Federation
The Nature Conservancy
Eagle Valley Environmentalists

Objectives:

(1) Describe post-fledging behavior of bald eagles in Cobscook Bay with emphasis on movements in relation to parent breeding areas, habitat use, and associated adult/juvenile relationships.
(2) Obtain information on juvenile eagle dispersal and movements and location of wintering areas in Maine.
(3) Investigate winter activity and habitat use of adult and immature eagles in Cobscook Bay.
(4) Evaluate artificial feeding of bald eagles during the winter as a technique to: (a) improve survival of juvenile and adult eagles, (b) provide a contaminant-free supplement of eagle diet in the winter, and (c) enhance subsequent nesting attempts of adult eagles.

Scope:

The Cobscook Bay bald eagle population is considered a nucleus for the recovery of viable populations in Maine. Highest nesting density, nesting success, and brood size are achieved in this area. Over the last five years, the Cobscook Bay eagle population increased to 12 pairs and fledged 53 eaglets: equivalent to 22% of the total annual bald eagle production in the northeastern U.S. A proposed oil refinery, tidal power projects, loss of habitat to land development, and recreational activity are potentially serious threats to the Cobscook eagles and therefore jeopardize the recovery of the statewide population.

This study will investigate fledgling eagle movements and behavior, adult-juvenile relationships, and wintering ecology of bald eagles in Cobscook Bay. Immature eagles will be radio-tagged to identify seasonal components of critical eagle habitat and document daily movements and behavior. All eaglets in Maine will be color-banded to assist in investigation of movements, dispersal, and survivorship. Supplemental food will be provided at 4 major eagle

wintering areas in an effort to improve survival of immature and adult eagles, provide a contaminant-free food source, and enhance subsequent nesting attempts of adult eagles.

Project Status:

From 1982-1983 11 fledgling eagles were radio-tagged at 12 nest sites in Cobscook and Machias Bays. Over 2,000 relocations were made of radio-tagged eagles, their parents, and siblings. Data on perch tree characteristics, habitat use, and behavior were collected for each relocation. Radio-tagged eagles were monitored each year from July to October until they dispersed from natal areas. Nine of the radio-tagged eagles were resighted after dispersal in Maine, Connecticut, and New York.

The bald eagle winter feeding program was continued for the third winter in Cobscook, Frenchman, Penobscot, and Merrymeeting Bays. Approximately 71,000 pounds of food (mostly deer, livestock, poultry, and furbearer carcasses) were distributed to the feeding stations from October 1983 to March 1984. At least 250 different eagles were observed at the feeding stations. The greatest response was in Cobscook Bay where up to 66 different eagles, mostly immatures, used the feeding stations daily. Band numbers from 120 different eagles were obtained at the Cobscook Bay station while observing birds from a blind with an 80X telescope. One hundred ten eagles were from Maine, originally banded at 45 nest sites across the state. Of particular interest were 26 adult eagles banded from 1975-78, including an adult eagle originally brought to Maine as part of an egg transplant program in 1975. Also resighted was an immature eagle from Upper Peninsula, Michigan; an immature from Sault Ste. Marie, Ontario; 8 immatures from Cape Breton Island, Nova Scotia; and an immature from Prince Edward Island.

In 1984, 40 of 42 eaglets produced in Maine were banded with individually coded color bands and band tags to investigate movements, dispersal and survival. An additional 7 eaglets were banded in New Brunswick. During the winter of 1983-84, color-marked eagles were resighted in Maryland, Delaware, New York, Massachusetts, and Connecticut. To date over 40% of the eagles banded in Maine since 1975 have been resighted. These data are being used to construct population models of Maine's eagle population.

Future Plans:

During winter of 1984-85, the winter feeding program will be continued at 4 major wintering areas. Research emphasis at feeding stations will document use of stations by eagles and obtain resightings of banded birds.

AQUATIC AND TERRESTRIAL RESOURCE INVESTIGATIONS OF ACID PRECIPITATION AND ASSOCIATED METALS

Investigators: J. R. Longcore, Maine Field Station, PWRC
K. L. Stromborg, PWRC
D. G. McAuley, PWRC
G. L. Hensler, PWRC

Cooperators/
Project Support: ECE Program PWRC Laurel, MD
ECE Program CNFRL Columbia, MO

Objectives:

(1) To measure and catalog pH and alkalinity of ponds, marshes, and other wetland areas suitable for waterbird habitats.
(2) To map wetland vegetation and classify vulnerable and resistant wetlands according to the criteria of the National Wetlands Inventory.
(3) To document annual variability in waterbird abundance and productivity as acidification on wetlands increases or decreases and to intensify the measurement of ring-necked duck use and survival on wetlands of different susceptibility to acidification.

Scope:

Acidification of lakes, ponds and other wetlands has reduced or eliminated some fish and aquatic invertebrate populations in some areas of the northeast. Most studies to date have been conducted on fish populations in headwater lakes. Little is known of the effects that acidification might have on the avifauna that use "brown water" lakes and associated beaver flowage habitats. This study is designed to assess wetland avian productivity and habitat relationships within an area of high vulnerability (based on bedrock characteristics) to acidification.

Project Status:

With the completion of the 1984 field season the following work was accomplished. The 32 wetlands underlain by bedrock with low acid-neutralizing capacity in the Cherryfield and Beddington, ME study areas were visited again, at least 4 times, to determine bird and brood use. More effort was expended this field season to locate the 21 ring-necked duck nests that were found. Twelve hens were marked with nasal saddles. Twenty-two hens with broods were monitored to determine brood and duckling survival until fledging. Two hens that were marked the previous year returned to the Cherryfield study area.

Associated with brood survival, 18 ducklings of various age classes and representing different broods and wetlands were collected and contents of esophagi and ventriculi were examined. At each

collection site an invertebrate sample was obtained from the wetland surface and bottom ponds used by ring-necked ducks. Samples are awaiting detailed analyses. Duckling food contents and invertebrates in environmental samples remain to be sorted and identified. Several broods from renests (first nests were flooded) are still being monitored and additional ducklings will be sought to augment the food habits sample. Water samples will be obtained from all duckling collection sites in late September.

Future plans:

The 1984 field season completes the field aspects of this study. A considerable amount of laboratory work and data analyses will be completed in the next fiscal year along with the preparation of a Masters Thesis and several technical papers. Scheduled completion date of the project is December 31, 1985.

INTERACTIONS AMONG MACROPHYTES, INVERTEBRATES, FISH AND WATERFOWL IN FOUR ADJACENT MAINE LAKES OF DIFFERENT ACIDITY

Investigators: M. L. Hunter, Jr.
K. E. Gibbs
J. R. Moring
J. J. Jones

Cooperators/ Project Support: Maine Cooperative Fishery Unit
University of Maine Etomology Department
U.S. Fish and Wildlife Service--ELUE Team
U.S. Environmental Protection Agency

Objectives:

(1) To study the biotic structure of four ponds of differing acidities emphasizing the components most directly related to waterfowl.
(2) To assess the function of each pond by studying competitive interactions among fish, ducklings, invertebrates, and macrophytes.
(3) To test two alternative hypotheses:
   (a) Acidic precipitation is deleterious to waterfowl because their food, aquatic invertebrates and macrophytes, is reduced.
   (b) Acidic precipitation is beneficial waterfowl because it reduces fish populations that compete with waterfowl for food.

Scope:

Acidification has reduced or eliminated fish and aquatic invertebrates in some lakes and ponds in the Northeast. Although much is known about the qualitative effects of acidification on aquatic organisms (i.e., presence or absence of species), less is known about the abundance of organisms and their role in ecosystem structure and function. The observed effects of acidification may result from interactions among trophic levels, and especially the disappearance of fish from a pond. The goal of this study is to elucidate the effects of acidification on four major components of a pond system: macrophytes, invertebrates, fish and waterfowl.

Project Status:

During two summer field seasons, we hatched six broods of black duck ducklings and imprinted them. Four of these broods were successfully reared on either an acid pond (ph - 4.4) that was without fish or a circumneutral pond (pH - 6.2) with fish for 13-15 days. Ducklings fed on the study ponds from dawn-dusk, and their behavior was monitored throughout the day. We also monitored duckling weights and food habits, invertebrate abundance and biomass, macrophyte biomass and diversity, and diets of fish when present.

Ducklings on the acidic fishless ponds grew faster than those placed on the circumneutral ponds with fish. Also, ducklings on the acidic ponds spent less time searching and moving, and more time resting or feeding than ducklings on the circumneutral ponds. Furthermore, ducklings on the circumneutral ponds moved greater distances to meet their nutritional requirements than ducklings on acidic ponds and thus less energy would be available for growth. These analyses support the alternative hypothesis that acidic, fishless ponds provide better duckling habitat.

Results from our first field season show that although there was little difference in total invertebrate biomass between acidic and circumneutral ponds, key food items of ducklings were found in greater numbers in the sweep net samples from the acidic pond (e.g., Odonata, Trichoptera, Chironomidae and other Diptera). Therefore, we believe the differences in abundance of food items were responsible for increased growth of ducklings on the acidic pond. Either fish are reducing key food items of ducklings in the circumneutral pond, or the lower pH in the acidic pond is favorable to invertebrates that are important duckling food. Evidence from stomach samples of brook trout from the circumneutral pond strongly suggests that fish compete for food with ducklings.

Future Plans:

Finish data analysis and write report by March 1985.

COYOTE/RED FOX INTERACTIONS IN MAINE

Investigator: D. B. Engelhardt

Advisors: J. A. Bissonette, Chairman
J. R. Gilbert
W. E. Glanz

Cooperators/
Project Support: Maine Department of Inland Fisheries and Wildlife
Maine Cooperative Wildlife Research Unit

Objectives: (1) Examine the responses of coyotes and red foxes to the presence of scent marks within their home ranges.

Scope:

The establishment of coyotes in Maine has created concern for other predators with which they may compete, including red fox. Little is known about the interactions between sympatric coyote and fox populations and their partitioning of resources such as food and space. The main thrust of this investigation is an attempt to determine whether coyotes displace red foxes. Two study areas were chosen: the Pierce Pond area in western Maine (Wildlife Management Unit 3), and the Cherryfield area (WMU 6). Information was obtained by tracking the responses of free-ranging, radio-collared red foxes and coyotes to the placement of artificial coyote or fox scent marks within their home ranges and by snowtracking. Predator food habits and prey abundance data were also collected.

Project Status:

During October, 1983 the small mammal population was sampled by snap-trapping in 5 different cover types on the Pierce Pond study area. Trapping was conducted for 3 days on each of two 100 x 100 m grids per cover type.

Snowtracking was performed during January-March, 1984. A 20-mile circuit of trails was driven by snowmobile a few days after each snowfall, and the presence and activities of predators were recorded along the trail. Artificial scent marks of coyote and fox urine, as well as a control (water), were placed at intervals along the circuit. Responses of animals to these marks were recorded by interpreting tracks in snow after 2 and 4 days.

From February until April, deer carcasses were observed for scavenger activity. Four carcasses were placed at an observation site at irregular intervals, and observed at all times of day. Nocturnal observation was facilitated by use of a night scope, obtained on loan from Baird Corp. Over 200 hours were spent observing the carcasses.

Species seen feeding from them include bobcat, coyote, raven, bluejay, and red squirrel.

The movements of red foxes were monitored on an intensive basis from mid-May through August, in connection with the performance of 3 experimental scent mark trials. During these trials the animals' movements were tracked by relocating them every 15 minutes for 8 hours per day. Monitoring was scheduled to cover all time periods of day and night. The third trial was finished on August 23, and this marked completion of the field work for this project.

Future Plans:

Data collected from fall 1982 through summer 1984 will be compiled and analyzed. The first draft of a thesis paper expected by December 31, 1984.

ECOLOGY OF FISHERS IN SOUTH-CENTRAL MAINE

Investigator: S. M. Arthur

Advisors: J. R. Gilbert, Chairman
J. A. Bissonette
M. D. Ashley
D. M. Leslie
W. E. Glanz

Cooperators/ Project Support: Maine Department of Inland Fisheries and Wildlife
Maine Cooperative Wildlife Research Unit
Northern Coastal Chapter, Maine Trappers' Assn.

Objectives:

(1) To evaluate fisher home range and dynamics.
(2) To determine fisher habitat use and its relation to small mammal distribution in winter.
(3) To document fall and winter food habits of fishers.

Scope:

A high-priced pelt, recent record-setting harvest levels, and a past history of over-exploitation make the fisher one of the most important furbearers in Maine, yet little is known about the species' ecology. This study will examine the ways in which fisher behavior and habitat requirements affect their populations in an area of high fisher abundance. Information gained through telemetry and winter snow tracking will be used to determine home range dynamics, and the relationship between fisher movements, small mammal distribution, and habitat use. Attempts will be made to capture 20 fishers in a 500 km^2 area in northeastern Waldo County. The fishers will be equipped with radio transmitter collars and released at the capture sites.

Project Status:

Trapping was conducted from November 1983 through May 1984. A male fisher was captured in February and a female was captured in May. Both were equipped with transmitters that operated well for 4-5 weeks and then became weak and difficult to locate. The male fisher was recaptured while resting in a tree, after a tranquilizer was administered with a 10 m jabstick. This fisher evidently had chewed the transmitter's antenna, so a replacement collar with a different antenna configuration was attached. Monitoring of both fishers during the summer indicated that they moved most frequently during the first and last 2 hours of darkness, and spent most of the daylight hours resting 5-10m above the ground in coniferous trees. Both animals occupied home ranges of about 9 km^2, that were heavily wooded and contained few roads.

Future Plans:

An estimated 75-85 traps will be used during September, October, and December, and assistance from local trappers will be requested during the November trapping season in order to capture 8-10 fishers, and equip them with transmitters. Snow tracking, to determine fisher movements and small mammal distribution, will begin as soon as snow is present and continue through the winter. Field work is scheduled to continue through spring.

MARTEN USE OF CLEAR-CUTS AND RESIDUAL FOREST STANDS IN WESTERN NEWFOUNDLAND

Investigator: J. Snyder

Field Assistant: S. Perin

Advisors: J. A. Bissonette, Chairman
P. W. Brown
D. B. Field
W. E. Glanz

Cooperators/ Project Support: Maine Cooperative Wildlife Research Unit
Newfoundland Wildlife Division
Canadian Government, NSERC

Objectives: (1) To investigate marten use of clear-cuts and residual forest stands and to determine the factors that affect this use.

Scope:

Pine marten once ranged over most forested areas of Newfoundland, however their present distribution appears to be restricted to isolated areas of mature forest in the western part of the province. It is likely that marten were never abundant, but they are now considered to be one of the rarest mammals in Newfoundland. Despite complete protection since 1934, neither marten numbers or their distribution has increased markedly.

Several factors including limited prey base, low reproductive success, accidental trapping and snaring, and habitat destruction may be involved. Because large scale forest harvesting has been carried out on areas inhabited by marten, this study addressed marten habitat requirements with special emphasis on marten use of residual "islands" of uncut timber of varying sizes, and various ages of regenerating clear-cuts. This information will aid in the formulation of management plans for marten in Newfoundland.

Project Status:

From July to December 1983, 18 marten (10 males, 8 females) were live-trapped, tagged and released in a 140 km^2 study area in western Newfoundland. A total of 3,587 trap nights resulted in 57 captures.

Clear-cuts were divided into 3 classes, based on the number of years since harvest and the stage of vegetation regeneration. Only 6 captures were in clear-cuts, all less than 8 years old.

Residual stands were divided into 5 size classes from <5 ha to >35 ha. There were 51 captures in the residual stands, with significantly more captures in the larger stands (>15 ha).

Snow-tracking was conducted from January to March 1984. Residual stands in which marten had been trapped, adjacent clear-cuts and uncut forest were searched. Marten were tracked for 29.0 km. Seventy-four percent of tracks were located in residual stands and uncut forest; 26% were in clear-cuts, all less than 10 years old. Snow stations were set up to monitor snow depths and profiles. Average snow depths were 90.2 cm in residual stands and ranged from 92.6 to 108.0 cm in clear-cuts.

Future Plans:

Expected date of thesis completion is December 1984.

COYOTE SOCIAL ORGANIZATION, DISPERSAL, AND SPATIAL INTERACTIONS WITH RED FOXES IN EASTERN MAINE

Investigator: D. J. Harrison

Advisors: J. A. Bissonette, Chairman
J. A. Sherburne
J. R. Gilbert
W. E. Glanz
P. W. Brown

Cooperators/
Project Support: Maine Department of Inland Fisheries and Wildlife
Maine Cooperative Wildlife Research Unit

Objectives:

(1) Describe the social factors influencing coyote populations in eastern Maine, including territory size and composition, territorial stability, and the role of non-territorial individuals.
(2) Evaluate the timing of dispersal, sex specific dispersal patterns, and mortality of juvenile coyotes.
(3) Determine the effect of resident coyotes on the spatial distribution of red foxes.

Scope:

Recent studies indicate that social (Harrison 1983) and competitive interactions (Major 1983) may affect the predator community in Maine. This project was designed to assess coyote social behavior, juvenile coyote dispersal, and the effects of spatial relationships between coyotes and red foxes on canid populations.

Project Status:

During the past year 13 coyote and 1 red fox were captured and radio collared, bringing the total number of radioed canids in the study area to 62 (51 coyotes, 11 foxes). Over 5,100 relocations of these animals were coded and entered into computer storage. Mortality information has been obtained for 18 coyotes (7 trapped, 5 shot, 1 hit by automobile, 2 cannibalism, 2 undetermined natural causes, 1 unknown), and for 5 foxes (3 trapped, 1 shot, 1 unknown).

Dispersal movements of 34 juvenile coyotes were monitored during fall 1981-spring 1984. Ninety-one percent (31 of 34) dispersed during their first year of life. Dispersal generally terminated at distances of >80 km from natal ranges. One juvenile female dispersed >400 km (straight line distance) to Vermont in 65 days. Preliminary analyses show no obvious differences in frequency or distance of dispersal between males and females.

Eleven of 14 coyotes >2 years of age exhibited territorial behavior. Three adult coyotes were wanderers, but one of these animals (2.5 year-old male) established a territory in an area after a large male was trapped. Three yearling coyotes (1< age <2 year-old) did not exhibit directional dispersal, but traveled extensively throughout occupied family territories. Home ranges of 11 foxes did not overlap coyote family territories.

Field work was completed during March 1984, and data analyses are proceeding on schedule.

FUTURE PLANS:

Habitats within coyote and fox ranges are being compared using LANDSAT imagery to assess the roles of cover types and interspecific avoidance on the observed distributions of these 2 canids. Data analyses and report writing will be the major activities during the upcoming year. The projected date for project completion is June 1985.

HABITAT USE AND HOME RANGE CHARACTERISTICS OF MOOSE IN NORTHERN MAINE

Investigator: M. E. Thompson

Advisors: J. R. Gilbert, Chairman
J. A. Bissonette
M. D. Ashley

Cooperators/
Project Support: Maine Department of Inland Fisheries and Wildlife
McIntire-Stennis

Scope:

Young forest communities are important components of good moose range. In Maine, these habitats are largely the result of timber harvesting, but in other areas they may be created by fire or flooding. The currently high populations of moose found throughout much of northern Maine are a result of cutting operations during the past several decades. These operations varied greatly in the type of cut and the methods used, hence the characteristics of the resulting cut-overs were quite diverse.

This project was designed to assess which cut-overs, out of the diverse array available, were being used by moose. To accomplish this, adult moose were radio-collared and monitored throughout the year using aerial and ground radio-tracking and direct observation. Habitat information for sites used by moose was obtained from forest cover-type maps, aerial photographs, and LANDSAT satellite imagery. Logging history was determined from site characteristics and landowner records.

The results of this study will be used by the Department of Inland Fisheries and Wildlife and landowners to evaluate the quality of existing habitat for moose and to include the needs of moose in land management plans.

Project Status:

All field work for this project was completed on August 30, 1984. Moose movements were plotted by computer and home range sizes calculated. In the winter, bull home ranges ranged from 1.80 to 10.05 km^2 (x = 6.56) while cows ranged from 0.99 to 18.30 km^2 (x = 7.04). Moose moved more in the summer; bull home ranges equalled 3.48 to 23.99 km^2 (x = 13.43) while cows ranged from 14.18 to 50.75 km^2 (x = 19.71).

Twenty four-hour movements of moose were also quantified for the summer of 1983. Bull and cow movements were similar with 24-hour moves ranging from 0 to 13 km (x = 1.70 km; however, when moves were to or from a pond used for aquatic feeding, the 24-hour movement averaged 4.62 km.

Future Plans:

The analysis of the habitat data associated with moose relocation sites is in progress; following completion, the final thesis will be written. Project completion is anticipated on December 31, 1984.

SUMMER HOME RANGE, HABITAT SELECTION, AND DAILY PATTERNS OF HABITAT USE OF MOOSE IN NORTHERN MAINE

Investigator: D. J. Leptich

Advisors: J. R. Gilbert, Chairman
D. M. Leslie
M. L. McCormack

Cooperators/
Project Support: McIntire-Stennis
Maine Department of Inland Fisheries and Wildlife

Scope:

This project examines three aspects of moose summer habitat use. 1) Summer home range information will be evaluated to determine if there are differences in the home range size and space use patterns of bulls and cows. 2) Habitats selected by moose within a cover type will be compared to random sites within that same cover type. By measuring a number of vegetative and physiographic characteristics at random and then comparing these to moose-use sites, information about the habitat characteristics influencing moose selection will be provided. 3) Temporal differences in habitat selection by moose will be examined by partitioning radio relocations by time of day and comparing habitat use to both availability and use at other times of the day. This will help reveal patterns of habitat use that are masked by pooling locations from all times of the day.

Project Status:

Fieldwork was initiated in May 1984. Nine radio-collared moose, (4 males and 5 females) were monitored throughout the summer. Over 400 relocations were obtained. Vegetation measurements and physiographic information were taken at 190 relocations and at random locations. Preliminary analysis will be performed over the coming winter.

Future Plans:

A second field season is planned for the summer of 1985.

SYNERGISTIC RELATIONSHIPS AMONG IMPORTANT WINTER FORAGES OF WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*)

Investigator: J. A. Jenks

Advisors: D. M. Leslie, Jr.
J. A. Bissonette
M. R. Stokes

Cooperators/
Project
Support: McIntire-Stennis

Scope:

Browse species utilized by white-tailed deer in winter are generally low in dietary digestibility. However, winter forage combinations (diets) may exceed expected digestibilities due to synergisms that enhance particle size reduction, nutrient uptake and microbial growth. This study will evaluate the winter nutrition of white-tailed deer concentrating on winter forage combinations and their effect on dietary digestibility, rumen turnover rate, and rumen protozoa populations numbers.

Objectives:

(1) To determine if synergisms exist among important winter forages of white-tailed de digestion.
(2) To determine whether certain winter forage combinations can decrease rumen turnover time in captive white-tailed deer.
(3) To determine rumen protozoa numbers of captive white-tailed deer on known winter diets.

Project Status:

During June-July 1984, 11 white-tailed deer fawns (5 males, 6 females) were obtained with the cooperation of The Maine Department of Inland Fisheries and Wildlife. Fawns were fed milk replacer for 80-100 days and their diets were supplemented with a variety of browse species, hay, and fresh herbaceous vegetation to develop and maintain a diverse rumen fauna. A facility for housing the fawns was completed in July 1984. Fawn mortality (27%) was experienced in July and attributed to vitamin deficiency and/or design defects in the facility.

In vitro digestion equipment was obtained during April 1984 and laboratory digestions were begun in July 1984 using standards of known *in vivo* digestibility. Digestions using samples collected during March 1984 were initiated in August 1984.

Future Plans:

Refurbish existing pen system including the completion of a perimeter fence encircling the main research facility. Complete in vitro digestions of samples collected during March 1984. Collect samples for further in vitro digestion. Collect forages for rumen turnover experiments. Conduct rumen turnover experiments during January/February 1985. Collect and store rumen samples for future analysis of protozoa population numbers.

MODELING THE POPULATION DYNAMICS OF MAINE'S WHITE-TAILED DEER

Investigator: M. Chilelli

Advisors: J. A. Bissonette, Chairman
D. M. Leslie
G. J. Matula
M. L. McCormack
W. L. Soule

Cooperators/ Project Support: Maine Department of Inland Fisheries and Wildlife
Maine Cooperative Wildlife Research Unit
National Rifle Association of America

Objectives:

(1) To develop a model that describes the annual fluctuations of white-tailed deer in Maine.
(2) To predict sustained annual harvest rates for antlered and antlerless deer, in selected wildlife management units, during a 10 year simulation period.

Scope:

As demands placed on natural resources by different consumer groups increase, management decisions become more complex. Comprehensive management plans, utilizing all available data, are necessary to provide a sustained harvest of white-tailed deer (*Odocoileus virginianus borealis*) while ensuring a healthy population. Models, consisting of a set of hypotheses concerning hot the ecological system under study is thought to function, provide a method to relate hypotheses to each other, keep track of the system as management proceeds, and allow pre-management experimentation of different strategies. The overall goal of this project is to develop a predictive population dynamics model for white-tailed deer in Maine. The development of this model will not only integrate the large and varied data array provided by MDIFW, but will help to identify interactions among various parameters pertaining to white-tailed deer ecology, pinpoint weaknesses in the current data sets, and guide future management and research endeavors.

Project Status:

A study proposal has been written and accepted.

Future Plans:

To continue background research on modeling, literature review, and examining MDIFW deer data files. In January 1985, work will begin on formulating a descriptive population dynamics model.

HARBOR SEAL POPULATION AND MARINE MAMMAL-FISHERIES INTERACTIONS

Investigators: J. R. Gilbert
K. M. Wynne

Cooperators/
Project Support: Northeast Fisheries Center,
National Marine Fisheries Service

Scope:

Several marine mammal species interact with commercial fisheries through direct and indirect competition for fish, entanglement of the marine mammal in nets, and damage to fishing gear. In New England, the potential for such conflicts has increased with the concurrent intensification of inshore fishing pressure and increase in marine mammal numbers. Because the number of harbor seals (*Phoca vitulina cocolor*) has increased dramatically following federal protection, the status, distribution, and discreteness of their population have become a concern to several fisheries. In addition to their potential role as competitive predators, seals and other marine mammals such as the harbor porpoise (*Phocoena phocoena*), are caught accidentally in fishing gear. Although these entanglements may result in monetary loss to the fishermen and biological loss to the marine mammal populations involved, they may also provide a population sample from which valuable and often inaccessible life history data may be obtained.

Project Status:

Since 1981, 81 (56M:25F) harbor seal pups have been tagged in order to monitor seasonal movements of individuals in New England; 18 (11M:7F) were tagged in June 1984. In addition to telemetric relocations, 26 sightings of seals tagged in 1983 and 1984 have been reported. Among these reports are 5 mid-winter sightings on Cape Cod and Nantucket Island, sightings of a tagged yearling and pup in Nova Scotia, and numerous sightings of pups offshore in Maine waters. Results of these returns indicate that harbor seal pups 1) are capable of long distance (30-130 km) movements from their natal areas within 1 month of weaning, 2) contribute to the transient seal population that overwinters in southern New England, and 3) are involved in direct conflicts with both U.S. and Canadian fisheries.

A small-take exemption to the Marine Mammal Protection Act was drafted and obtained on behalf of the New England groundfish gillnetters to allow the incidental taking, reporting, and salvage of small numbers of marine mammal species in the course of fishing operations. Twenty-one carcasses (17 porpoise, 4 seals) collected under this permit have been necropsied to determine the age, sex, health, reproductive condition, and food habits of individual captures. Other data collected by project observers on active fishing vessels will be used to develop a profile of gear characteristics relative to marine mammal capture rate. The success of this

small-take exemption program has prompted the examination of other New England fisheries which incidentally capture small numbers of marine mammals and may qualify for a similar exemption to the Marine Mammal Protection Act.

Future Plans:

Seal tag returns and sightings will be monitored throughout the year; pups will be tagged again in June. Gillnetters will be advised of the small-take exemption and organized as participants. At-sea observations will continue through Fall and resume again in early Spring. Carcass samples will be analyzed during the mid-winter lull in fishing activity. Contact with purse seiners, stip seiners, weir fishermen, lobstermen, trawlers, and longliners will be made to determine the nature and extent of their interactions with marine mammals.

NUTRITIONAL AND THERMODYNAMIC ASPECTS OF THE ECOLOGY OF BLACK DUCKS WINTERING IN MAINE

Investigator: D. G. Jorde

Advisors: R. B. Owen, Jr.
J. R. Gilbert
J. R. Longcore
M. R. Stokes
M. A. Vietti

Cooperators/ Project Support: College of Forest Resources -- Hatch Act Funds
Maine Department of Inland Fisheries and Wildlife
U.S. Fish and Wildlife Service, Migratory Bird and Habitat Research Laboratory

Project Summary:

This study focuses on winter survival of Black Ducks by examining several aspects of existence metabolism: 1) the relationship between thermoregulation and the microclimates of roost sites, 2) true metabolizable energy and nutrient content of winter foods, and 3) specific dynamic effect (heat of digestion) and its contribution to the energy balance of wintering ducks.

Objectives:

(1) To determine if the microclimates of roost sites influence Black Duck use and energetics.
(2) To examine the nutrient content and true metabolizable energy of foods selected by wintering Black Ducks.
(3) To determine the relationship between specific dynamic effect and thermoregulation.
(4) To develop an energy budget and energetics model of wintering Black Ducks.

Project Status:

The third field season was conducted from December through March. For the second consecutive field season, unusually warm weather continued through the winter and black ducks did not establish regular shoreline roost sites. Instead, the birds usually formed rafts and drifted off shore until the tide was low enough for them to start foraging. The microclimates at 6 locations, representing sites used and not used as roost areas, were recorded during 127 data-logging days. Two microclimate stations were operated concurrently to allow at least 7 days of paired comparisons. Water temperatures and ice conditions at the Skillings River and Raccoon Cove study areas were recorded daily.

Five females and two males were fitted with transmitters and their movements recorded during high and low tides. One bird was killed by a raptor and 6 birds are believed to have dispersed from the study area as weather conditions became warmer. Time budget activity and habitat use of 112 individual birds (31 hours) were recorded during various tide and weather conditions. In cooperation with the Maine Department of Inland Fisheries and Wildlife, 466 black ducks were banded and external measurements and weights recorded. Subsequently, 624 ducks were recaptured to monitor changes in winter body condition.

Nine black ducks (5 males and 4 females) were collected for food habits and winter condition studies. Food was removed, external measurements recorded, and carcasses frozen for protein and lipid analysis. In the laboratory, food samples were sorted, identified, and dry weight determined. Common foods included amphipods, soft shell clams, blue mussels, snails, and crabs. Fifteen weeks of nutritional studies to determine the digestibility and true metabolizable energy of several winter foods have been completed. All monthly samples of *Gammarus sp.* and fecal samples have been processed and caloric content determined.

Future Plans:

Continue with microclimate, habitat use, and behavioral studies in the field and physiological and nutritional studies in the laboratory. Complete data analysis and include pertinent data in the winter energetics mode. Finish writing dissertation and submit final reports by mid-summer 1985.

BEHAVIOR AND HABITAT USE BY COMMON GOLDENEYES WINTERING IN MAINE

Investigator: D. R. Eggeman

Advisors: P. W. Brown, Chairman
J. R. Longcore
W. E. Glanz

Cooperators/
Project Support: Delta Waterfowl and Wetlands Research Station, Manitoba
The Graduate School, University of Maine

Objectives:

(1) Compare behavior of common goldeneyes among groups based on sex, age, paired status, and among habitats.
(2) Examine intraspecific differences in habitat use.

Scope:

Recent evidence indicates that population components of wintering waterfowl differ in aspects of their ecology (e.g. distribution, habitat use, behavior). Past research on common goldeneyes in winter suggests that adult males use habitats different from those used by females and immature males. In addition, paired goldeneyes may be found in habitats different from those of unpaired birds. This study was designed to describe the behavior of common goldeneyes and determine relationships between sex, paired status, and behavior and habitat use.

Project Status:

The first field season began in November, 1983 and ended in April, 1984. The study area included riverine, inland tidal, and coastal areas in central Maine. Ground censuses of 20 sites used by goldeneyes were conducted once every 9-12 days to determine sex/age ratios and pairing chronologies. The proportion of adult males in the study area increased from 50% in fall to 55% in late winter. In spring, adult males composed 59% of all common goldeneyes. The proportion of paired females was 26% in early winter, 33% in late winter, and 49% in spring.

Time-activity observations of individual goldeneyes were made to document behavior at 7 of the 20 census sites. Behavior observations were made by focal animal sampling. Individuals were observed for 15-minute periods, and their behavior recorded every 15 seconds. Behaviors were grouped into the following categories: feeding, locomotion, resting and comfort movements, and other (including courtship and agonistic interactions). Observations were made of birds of each sex and social status, throughout the diurnal and tidal cycles, at each site. The effects of season, site, time of day, tide

stage, sex, age, and paired status on behavior will be determined from these data.

Habitats of goldeneyes observed during censuses and behavior observations were described. Habitat characteristics that were recorded included weather conditions, water depth, substrate type, and protection from wind and waves. Habitat data will be analyzed with census and behavior data to determine the influence of habitat characteristics on sex and age ratios, pairing chronologies, and behavior.

Four aerial surveys of the study area were made to detect seasonal changes in the distribution of goldeneyes within the study area. The surveys also confirmed that sites used for ground censuses and behavioral observations were in regions of the study area most used by common goldeneyes.

Future Plans:

Analyses of the first season's data will continue through fall, 1984. Field work will resume in December, 1984. Work will be restricted to a portion of the Frenchman's Bay area. More frequent ground censuses will be conducted, and behavior observations and habitat sampling will be continued. Nocturnal behavior observations will be included. Group sizes, pairing chronologies, temporal and spatial aspects of habitat use for other waterfowl species wintering in the study area will also be investigated. Field work will be completed in April, 1985.

THE USE AND IMPORTANCE OF TRADITIONAL SITES FOR COMMON LOONS IN MAINE

Investigator: P. I. V. Strong

Advisors: J. A. Bissonette, Chairman
W. E. Glanz
P. W. Brown
J. B. Dimond
M. L. Hunter, Jr.
J. A. Sherburne

Cooperators/ Project Support: Maine Department of Inland Fisheries and Wildlife
Maine Cooperative Wildlife Research Unit
Maine Audubon Society
Libby Sporting Camps
Mr. Scott Skinner
Mr. Joseph Sewall

Objectives:

(1) To determine the use and importance of traditional nest sites for loons in undisturbed areas.
(2) To determine the use and characteristics of brood rearing areas.
(3) To determine the use of migration and wintering areas by common loons in Maine.

Scope:

Increased development and recreational use of Maine lakes and ponds may adversely affect breeding populations of common loons. At the same time behavioral modifications by loons seem to be lessening the effects. This study is designed to look at potential conflicts between development and recreation, and reproductive success of common loons. The traditional use of territories, nesting sites, brood rearing areas, and feeding areas are being closely examined. Additionally, preliminary data on the use of Maine's lakes, ponds, and coastline during migration and winter are being collected.

Project Status

Three summer field seasons were completed by September 1984. Three remote and relatively undisturbed lakes in northern Maine comprised the study area. Nests were located and monitored. Territory configuration, feeding areas, and brood rearing areas were identified by location mapping involving nearly 900 hours of observation and over 21,000 locations over the 3-year period.

The study area was divided into control and experimental areas for an experiment on use of traditional nest sites. Nests were left alone on the control area and were barricaded before nesting commenced on the experimental area. Loons showed strong fidelity to previously used nest sites on the control area. The probability of nesting at a

previously used nest site used the previous year was 0.87 based on 5 years of data. Renest locations were also reused frequently. Twenty pairs of loons whose nests were barricaded prior to nesting less frequently and often some distance from previously used sites, although 4 pairs initiated nests immediately next to barricaded sites. Analysis for relationships with nest success has not been completed.

Although analysis of location mapping data has not been completed, gross examination indicates territory stability and reuse of feeding and brood rearing areas.

Twenty-six reports of groups of loons numbering 20 or more have been received during 2 spring and fall migration periods. Pushaw Lake in Old Town, Great Pond in Belgrade, and Androscoggin Lake in Wayne have had large flocks during migration for 2 consecutive years. A second winter loon count was conducted in February 1984. Shoreline observers counted 284 loons from Kittery to Calais.

Future Plans:

Summer field work has concluded. Data analysis and preparation of manuscripts will begin. Reports of migrating flocks will be solicited and a winter loon census will be conducted one more time.

ECOLOGY OF MALE BLACK DUCKS MOLTING IN LABRADOR

Investigator: T. D. Bowman

Advisors: P. W. Brown, Chairman
R. B. Owen, Jr.
J. R. Longcore
C. A. Gibbs

Cooperators/
Project Support: Atlantic Flyway Cooperative Banding Program
Canadian Wildlife Service

Objectives:

(1) To investigate the ecological requirements of molting male black ducks by determining: body condition changes during the wing molt, chronology of wing molt, habitat use by molting black ducks, and food habits of molting black ducks.

(2) To obtain information, through banding, on the harvest, wintering, and breeding areas of male black ducks molting in Labrador.

Scope:

A major decline in the black duck population over the past 20-30 years has prompted increased studies to examine the possible causes of the decline and to gather information on the ecology of the black duck throughout its life cycle. Information on the wing molt of black ducks is lacking. Only recently has extensive banding of male black duck been conducted in the far northern areas where they molt.

The purpose of this study is to collect baseline information on the ecology of male black ducks during the postbreeding wing molt that will help clarify the strategies used during this stage of the life cycle, and provide banding data useful in harvest management.

Project Status:

During the summer and fall of 1983 and summer of 1984 477 black ducks were banded. In 1984, 140 flightless male black ducks were captured by hand and examined. Each duck was weighed, and a series of external measurements was taken to study body condition. Recaptures of 24 black ducks allowed for successive determinations of body condition over the molt period.

Invertebrates were collected from areas used by molting black ducks to determine the relative abundance of food sources. To monitor habitat use and movements of molting black ducks on the study area, two males were marked with radios in 1984. Unfortunately, these attempts were unsuccessful because ice conditions and lack of a suitable boat prevented tracking of birds. Twenty-five black ducks were fitted with orange, alphabetically coded nasal saddles to allow

observations of individual birds on the study area and for the possible future identification of individuals on their breeding grounds.

Future Plans:

Field work will continue, from late June to late August. Proposed changes for this year include: use of a retrieving dog for capturing molting black ducks, increasing the number of nasal saddles used, expansion of the telemetry study, and sampling of invertebrates to determine temporal changes in abundance on molting areas.

A COMPARISON OF HABITAT USE BY SYMPATRIC POPULATIONS OF SPRUCE AND RUFFED GROUSE IN MAINE

Investigator: T. A. Allan

Advisors: M. L. Hunter, Jr.
R. B. Owen, Jr.
W. E. Glanz
P. W. Brown

Cooperators/ Project Support: College of Forest Resources--McIntire-Stennis
St. Regis Paper Company

Objectives:
(1) To describe the characteristics of habitats utilized by spruce grouse.
(2) To measure ecological and spatial overlap in habitat use by spruce and ruffed grouse.

Project Status:

All requirements for the degree of Doctor of Philosophy (Forest Resources) were completed in March 1984. An abstract of the thesis follows:

Habitat use of spruce grouse (*Dendragapus canadensis*) was studied in eastern Maine from the spring of 1981 until autumn of 1983. Seasonal changes in habitat use and spatial relationships were determined from 774 observations of 89 different grouse. Thirty eight grouse were fitted with back-mounted radio transmitters and monitored for an average of 69 days.

During the winter months males and females used conifer stands that were denser than random plots. Males were found higher in the trees than females, and in taller trees than those used by females. In spring and summer female spruce grouse used less dense habitats that were less dense than males. Habitat used by females was characterized by a more open canopy and more ground vegetation. From May to August both sexes were observed on the ground more than in trees.

By mid-summer, males and nonbrood females showed a strong selection for larch trees. In autumn, males and all females used larch trees most of the time. Larch was an important food during the transition to a winter diet of conifer needles. After larch dropped their needles, spruce grouse returned to dense winter habitats and fed primarily on a diet of spruce needles.

Detailed observations were made on the habitat use of brood and nonbrood females. Females with broods occurred in habitats that had less trees/ha and a more open canopy than nonbrood females. Nonbrood females used habitats similar to male spruce grouse habitats. Nonbrood females were found in trees more frequently, and at a greater height in the tree, than brood females. For example, when found in trees, nonbrood females and males were at heights of 3.1 and 3.3 m

respectively, whereas brood females occurred at an average height of 1.1 m.

Insects and berries were the primary foods of spruce grouse chicks. The availability of these food resources was sampled in open and dense stands. Open forest habitat contained more ground insect biomass and more berries than dense forest stands. Females with broods used areas exclusive of other brood females. It appears that brood females establish a resource defense territory in open forest habitat to provide abundant food for the brood.

Habitat use by ruffed grouse (Bonasa umbellus), occurring sympatrically with spruce grouse in this area, was examined. They were found at sites averaging 66 percent conifer tree species while spruce grouse sites averaged 89 percent conifer trees. Spruce grouse are apparently habitat specialists requiring essentially pure conifer forests while ruffed grouse are habitat generalists which are adapted to deciduous habitats but can exist in low densities in conifer forests.

BOBCAT MOVEMENTS IN RELATION TO SNOWSHOE HARE DENSITY

Investigator: J. A. Litvaitis

Advisors: J. A. Bissonette, Co-chairman
J. A. Sherburne, Co-chairman
J. R. Gilbert
R. B. Owen, Jr.
G. L. Jacobson, Jr.

Cooperators/
Project Support: Maine Department Inland Fisheries and Wildlife
Maine Cooperative Wildlife Research Unit

Objectives:

(1) Examine bobcat movement patterns, including vegetation cover types used and territory size.
(2) Determine relative snowshoe hare density by cover type, season, and within bobcat territories.
(3) Examine bobcat habitat use in relation to snowshoe hare distribution and compare bobcat territory size to snowshoe hare density.

Project status:

All requirements for the degree of Doctor of Philosophy (in Wildlife Management) were completed in July 1984. An abstract of the dissertation follows:

Bobcat (*Felis rufus*) prey use, habitat use, and home range size were compared to the distribution and density of snowshoe hare (*Lepus americanus*) in 2 study areas in Maine.

In Cherryfield, hare preferred hardwood and avoided mixedwood and open understories ($p<0.05$). Hare use of understories increased as hardwood stem density increased ($r=.36$, $p<0.0001$). In Pierce Pond, hare used softwood more, and hardwood and open understories less than expected ($p<0.05$). Hare pellet density was strongly associated with softwood stem density in this area ($r=.52$, $p<0.0001$). Although differences in understory cover and composition existed between areas, snowshoe hare responded similarly to relative differences in understory cover within each area.

Snowshoe hare remains were observed in over 60% of the bobcat feces collected during all seasons in both study areas. Other prey included white-tailed deer (*Odocoileus virginianus*), moose (*Alces alces*), small mammals, muskrats (*Ondatra zibethicus*), porcupines (*Erethizon dorsatum*), and birds. Prey remains in 230 bobcat carcasses indicated that prey use varied with bobcat age, sex, and weight.

Thirty bobcats were captured, marked, and released. Twenty one individuals were monitored for >3 months. Resident adult males occupied ranges ($x=95.7$ km^2) approximately three times as large as

adult females ($x=29.8$ km^2) and yearling females ($x=35.5$ km^2). Male and female bobcats occupied the largest portion of their total home ranges (>50%) during gestation (16 Mar-15 May) and the smallest portion (<20%) during the nursing season (16 May-15 June).

Use-availability analysis revealed several bobcat habitat preferences. In Cherryfield, bobcats preferred hardwood understories, while in Pierce Pond, softwood understories were used more than expected ($p<0.05$). These patterns corresponded to the habitat preferences of snowshoe hare in both areas.

When data from all bobcats were combined into a single multiple regression model, bobcat weight explained 45% of the variation in home range size ($p<0.0002$). The combination of weight and the amount of edge within a home range accounted for over 60% of the variation of home range size. Therefore, hare density was a poor indicator of bobcat home range size in the 2 study areas.

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