

**DEPARTMENT OF WILDLIFE ECOLOGY and
MAINE COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT**

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UNIVERSITY OF MAINE

MAINE DEPARTMENT OF INLAND FISHERIES AND WILDLIFE

BIOLOGICAL RESOURCES DIVISION, U.S. GEOLOGICAL SURVEY

WILDLIFE MANAGEMENT INSTITUTE

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Compiled and Edited by
William B. Krohn and Cynthia S. Loftin

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 Leader, Maine Cooperative Fish and Wildlife Research Unit, and Chair, Department of Wildlife Ecology.

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PERSONNEL AND COOPERATORS

COORDINATING COMMITTEE

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Wildlife Management Institute
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Unit Staff:

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Roland D. Martin, Commissioner

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GRADUATE STUDENTS

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Thomas J. Danielson	Ph.D.	UM, USGS, MDEP, EPA
Katie E. DeGoosh	M.S.	MOHF, MDIFW, UM, MCFWRU, PCCA
Sharon Fleming	M.S.	MASC, NMFS, MCFWRU
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Merry Gallagher	Ph.D.	MDMR, MDIFW, UM
Michael A. Hachey	M.S.	UM, SMS, ARC, MDIFW, MCFWRU
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Stephen Kneeland	M.S.	MDIFW, MOHF, USGS, MAFES, UM
Jennifer Kurth	M.S.	MDIFW, MOHF, USGS, MCFWRU, UM
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Steven C. Renner	M.S.	COA, UM, MAFES
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DISSERTATIONS AND THESES COMPLETED THIS PERIOD

Student	Degree Candidacy	Support
Rebecca J. Chalmers	M.S.	USGS-BRD, UM, NPS, DAPTF, ENR, MCFWRU
Carol R. Foss	Ph.D.	UM, USFWS, SEFP, MCS, USFS
Shane R. Heath	M.S.	UM, USFWS, FPL, MDIFW
Morgan W. Kelly	M.S.	MDIFW, MOHF, SPP, USFWS, UM, USGS
Marcy L. Nelson	M.S.	NMFS, UM, MDMR
Dustin W. Perkins	Ph.D.	UM, MCS, MCCS, CFRU, PCTC, IP, MP, NFWF, SILC
Carol A. Strojny	M.S.	USDA, USFS, UM

PERSONNEL NOTES

In May, **JOSEPH D. ZYDLEWSKI** became the Assistant Leader for Fisheries at the Maine Cooperative Fish and Wildlife Research Unit. Dr. Zydlewski is stationed in Nutting Hall along with the other members of the Maine Unit.

DUSTIN W. PERKINS received his Ph.D. degree in Wildlife Ecology and is employed by the Southern Plains Inventory and Monitoring Network in Texas. **SHANE R. HEATH** received his M.S. degree in Wildlife Ecology and is employed by the Institute for Wildlife Studies in California. **MORGAN W. KELLY** received her M. S. degree in Wildlife Ecology and is employed by the University of Texas at Austin. **CAROL R. FOSS** received her Ph.D. degree in Ecology and Environmental Science and is employed by Audubon Society of New Hampshire. **REBECCA J. CHALMERS** received her M. S. degree in Ecology and Environmental Science and is working for the MECFWRU preparing manuscripts from her thesis research while she explores employment options. **CAROL A. STROJNY** received her M. S. degree in Wildlife Ecology and is employed by Moosehorn Wildlife Refuge. **MARCY L. NELSON** received her M. S. degree in Wildlife Ecology and is employed by the Maine Department of Marine Resources in West Boothbay Harbor, Maine.

COLLABORATING AGENCIES AND ORGANIZATIONS

Abitibi Consolidated - AC
 Aquaculture Research Center - ARC
 Audubon Society of New Hampshire - ASNH
 Boise Cascade - BC
 Clayton Lake Woodlands - CLW
 College of the Atlantic – COA
 Allied Whale - AW
 Corner Brook Pulp & Paper - CPP
 Crown Vantage Inc. - CVI
 Declining Amphibian Population Task Force - DAPTF
 Duke University - DU
 Eastern National Park Research Fund - ENPRF
 Florida Power Light Energy - FPL
 Fulbright & State Organization of the Americas - FSOA
 Holt Woodlands Research Foundation - HWRF
 Houlton Band of Maliseet Indians - HBMI
 Huber Resources Corporation - HRC
 International Paper - IP
 Irving LLC - IL
 James River Corporation - JRC
 Maine Atlantic Salmon Commission - MASC
 Maine Audubon Society - MAS
 Maine Bureau of Public Lands - MBPL
 Maine Department of Environmental Protection - MDEP
 Maine Department of Inland Fisheries and Wildlife - MDIFW
 Maine Department of Marine Resources - MDMR
 Maine Department of Transportation - MDOT
 Maine Outdoor Heritage Fund - MOHF

Manomet Center for Conservation Sciences - MCCS
Mead Corporation - MC
Mead Paper - MP
National Council of the Paper Industry for Air and Stream Quality Improvement - NCASI
National Fish and Wildlife Foundation - NFWF
National Marine Fisheries Service - NMFS
National Science Foundation - NSF
 GK-12 Teaching Fellowship –GK-12TF
 Research Fellowship - RF
Natural Resources Canada - NRC
 Canadian Forest Service -CFS
New Hampshire Fish and Game Department - NHFG
New Hampshire Department of Resources and Economic Development -
 Division of Forests and Lands – NHDFL
Newfoundland Department of Forest Resources and Agrifoods
 Wildlife Division - NDFRA
Newfoundland Forest Service - NFS
Newfoundland Inland Fish and Wildlife Division – NIFWD
Norcross Wildlife Foundation - NWF
Plum Creek Timber Company - PCTC
Rachel Carson National Wildlife Refuge - RCNWR
Seven Islands Land Company - SILC
Switzer Environmental Fellowship Program - SEFP
The Nature Conservancy - TNC
United Nations Educational, Scientific & Cultural Organization - UNESCO
University of Maine - UM
 College of Natural Sciences, Forestry, and Agriculture – NSFA
 Sea Grant Program - SGP
 Cooperative Forestry Research Unit - CFRU
 Department of Biological Sciences - DBS
 Department of Civil and Environmental Engineering - CEE
 Department of Forest Ecosystem Science - FES
 Forest Ecosystem Research Program - FERP
 Department of Wildlife Ecology – DWE
 Graduate School - GS
 Graduate Research Assistantship - GRA
 McIntire-Stennis – MCS
 School of Marine Sciences - SMS
 Maine Agricultural and Forest Experiment Station - MAFES
University of Missouri – UMS
University of Georgia - UG
 Savannah River Ecological Laboratory - SREL
U.S. Department of Agriculture - USDA
 Forest Service – USFS
 National Research Initiative Competitive Grants Program - NRICGP
U.S. Department of Commerce - USDC

National Marine Fisheries Service - NMFS
U.S. Department of the Interior - USDI
U.S. Fish and Wildlife Service – FWS
Endangered Species Fund – ESF
Lake Umbagog National Wildlife Refuge - LUNWR
Neotropical Migratory Bird Program - NMBP
Moosehorn National Wildlife Refuge - MNWR
Okefenokee National Wildlife Refuge - ONWF
Partnerships for Wildlife Program - PWP
Penobscot Experimental Forest - PEF
USGS Biological Resources Division - BRD
Eastern Region State Partnership Program - ERSPP
Florida Integrated Science Center - FISC
Maine Cooperative Fish and Wildlife Research Unit – MCFWRU
Maine Water Research Institute – MWRI
National Park Service - NPS
Acadia National Park – ANP
Patuxent Wildlife Research Center - PWRC
State Partnerships Program - SPP
U. S. Department of State - USDS
U. S. Environmental Protection Agency - EPA
Wagner Forest Management, Ltd. - WFM
Western Newfoundland Model Forest – WNMF

ENDANGERED AND THREATENED SPECIES:

THE EFFECTS OF PREDATION ON NEST SUCCESS AND CHICK SURVIVAL OF BLACK TERNS IN MAINE

Investigator: S. R. Heath

Advisors: F. A. Servello, Chair
C. S. Loftin
W. E. Glanz
M. A. McCollough

*Cooperators/
Project
Support:* University of Maine
U. S. Fish and Wildlife Service
Florida Power Light Energy-Maine Hydro
Maine Department of Inland Fisheries and Wildlife

Objectives:

- 1) Determine the effects of microhabitat at nest sites, wetland-scale characteristics, and nest dispersion on predation of black tern nests.
- 2) Identify patterns of disturbance in black tern colonies during incubation, with an emphasis on the nocturnal period.
- 3) Determine if predation limits fledging rate.

SCOPE: Understanding the factors that limit nest and fledgling success is critical for designing conservation strategies for black terns in Maine. Previous research in Maine suggests that nest predation, water levels at colony sites, and nest location may be interrelated. We will use one year of nesting data that we collected in 2002 along with data previously collected in 1997-2001 in a multivariate analysis of the habitat and nest variables that may influence the probability of nest predation. Wetland and landscape-level variables have been measured using geographic information systems, aerial photography, and National Wetland Inventory maps.

Previous research on black tern colonies in Maine have indicated that food resources are not limiting the growth of black tern chicks, suggesting that predation may be a primary cause of chick loss. Predator enclosures and chick growth analyses will be used to determine chick survival and growth in the absence of predation. In addition patterns of disturbance and nest attentiveness will be measured at individual nests through use of temperature sensors placed in the nest cup.

PROJECT STATUS: All requirements for a M.S. degree in Wildlife Ecology were met in April 2004. The abstract follows:

Nest predation is a prominent cause of reproductive failure in wetland-nesting birds, including black terns. As a result, predator avoidance should play an important role in nest site selection. I examined intraspecific variation in nest success in order to identify factors affecting nest predation of black tern colonies in central Maine. I measured variables related to proximity of wetland features and nest aggregation for 231 successful and 124 depredated black tern nests during the period 1998-2002. I defined candidate models based on logistic regression and selected models with Akaike's Information Criterion adjusted for small sample sizes (AIC_c) to determine the best model for predicting nest outcome (success vs. depredated). Variables related to proximity to depredated nests, including the number of depredated nests within 30 meters and the number of depredated nests between 30-100 meters, were the most important factors influencing nest predation of black terns in Maine colonies during 1998-2002. Losses to predation were localized, suggesting nest predators in Maine wetlands exhibit area-restricted search behavior. Factors related to colonial nest defense, nest concealment, and proximity to wetland features were found to have little effect on the likelihood of nest predation.

Nocturnal nest absence in Laridae has been correlated with increased nest predation, prolonged incubation periods, and lowered chick survival. I monitored 45 nests in 2001-2002 with temperature monitors to determine the occurrence and duration of nocturnal nest absence in black terns and the effect of absence on nest temperature and incubation length in Maine colonies. Nocturnal absences occurred at 36 of 45 black tern nests, suggesting this behavior is common. In 2001, 36 absences lasting 60 minutes or longer were recorded, whereas only nine absences exceeded 60 minutes in 2002. Nocturnal absences among adjacent nests were rarely synchronous. The mean temperature decrease for absences greater than or equal to sixty minutes was 9.62 °C. Nest absence did not appear to influence nest predation rates or incubation length, but the indirect effects of absence on breeding productivity of black terns merits future research.

Chick survival is an important parameter of black tern population growth, but few studies have identified factors contributing to chick mortality. I utilized predator exclosures to determine whether predation and/or food resources were limiting chick survival of black terns in Maine colonies in 2001-2002. I assumed if predation were limiting, chick survival should be 100% in broods excluded from predation. Nests were also monitored in unenclosed clusters of nests to confirm that chick survival was as low as previous years. I also measured chick growth by hatch-order during the period from hatch to near-fledgling as an indicator of potential food limitation. Chick survival in the absence of predation was 88.2% in 2001 and 88.9% in 2002. Survival of chicks at unenclosed nests was 10.4% in 2001 and between 39.4-61.3% in 2002. I did not see evidence of differential chick growth with hatch-order, suggesting food limitations were not present in 2001-2002. My results suggest predation is the primary factor limiting chick survival in Maine colonies. Additionally, I describe the design of predator exclosures utilized in this study and report on their efficacy at excluding predators.

**CONSERVATION GENETICS OF THE YELLOW LAMPMUSSEL (*Lampsils cariosa*)
AND THE TIDEWATER MUCKET (*Leptodea ochracea*)**

Investigator: M. W. Kelly

Advisors: J. M. Rhymer, Chair
F. A. Servello
P. Rawson
A. Huryn
C. S. Loftin

*Cooperators/
Project Support:* Maine Department of Inland Fisheries and Wildlife
Maine Outdoor Heritage Fund
USGS State Partnerships Program
US Fish and Wildlife Service Endangered Species Funds
University of Maine -
Department of Wildlife Ecology
McIntire-Stennis
Graduate Research Assistantship

Objectives:

- 1) Analyze population genetic structure for tidewater mucket and yellow lampmussel within and among river drainages in Maine.
- 2) Assess species taxonomy on a range-wide basis.

SCOPE: Freshwater mussels make up the most endangered taxon in the U.S., with 70% of species listed as endangered, threatened, or of special concern. Declines in freshwater mussels are linked to habitat degradation from pollution and modifications to waterways, and to introductions of exotic species, such as the zebra mussel. In Maine, the Yellow Lampmussel (*Lampsils cariosa*) and tidewater mucket (*Leptodea ochracea*) are state-listed as threatened. Both species are also declining throughout their range.

This study is an assessment of genetic variation in the tidewater mucket and yellow lampmussel on two spatial scales. DNA analysis will be used to study phylogeographic variation across the geographic range of each

species as well as among and within river drainages in Maine.

Understanding patterns of genetic differentiation among populations of freshwater mussels in Maine will provide a rationale for determining whether their metapopulation should be managed as one or several distinct conservable units. On a national level, taxonomic clarification is critical to the conservation of both species.

PROJECT STATUS: All requirements for a M.S. degree in Wildlife Ecology were met in May 2004. The abstract follows:

The tidewater mucket (*Leptodea ochracea*) and yellow lampmussel (*Lampsilis cariosa*) are two freshwater mussel species in serious need of conservation, as they are declining throughout most of their Atlantic slope ranges. Both species are listed as Threatened in Maine, and as Endangered, Threatened, of Special Concern, or Species at Risk in most states and provinces throughout their ranges, which extend from Nova Scotia to Georgia. Because freshwater mussels rely on fish hosts for the movement of their larvae, barriers to the movement of fish hosts, such as habitat fragmentation by dams, may indirectly affect population genetic structure in mussels. An understanding of population genetic structure for *L. ochracea* and *L. cariosa* in Maine is important to delineate management units at the state level and may illuminate some of the landscape-level factors affecting population structure in both species. I used microsatellite loci originally developed for *Lampsilis abrupta* to assess population-level genetic variation for *L. cariosa* and *L. ochracea* within and among three river drainages in Maine. Seven of these loci were used to assess population structure of *L. cariosa*, but only three of the loci that amplified in *L. ochracea* were polymorphic. There was evidence for null alleles at some loci, but consistency in results across loci indicated that my overall findings were robust. Both species had significant genetic differences among populations. Significant differences were observed among populations within and among drainages for *L. cariosa*. By contrast, within, but not among, drainage differences were observed for *L. ochracea*. Although *L. cariosa* exhibited significant isolation by distance, there was no correlation between genetic distance and the number of intervening dams for either species after correcting for the effects of geographic distance. These results will be valuable in developing management plans at the state level, especially in light of impending dam removals, which are likely to require translocations of both species. Where translocations become necessary, I recommend that they occur among least divergent populations, if ecological conditions permit.

Basic taxonomic information has thus far been lacking for *L. cariosa* and *L. ochracea*, as morphological characters have proved unreliable in diagnosing monophyletic clades for freshwater mussels. Such information is critical to the development of conservation plans. To address this need, I evaluated range-wide taxonomy for specimens collected throughout the ranges of both species using DNA sequences of the mitochondrial ND1 gene. *L. ochracea* and *L. cariosa* each form well-supported monophyletic lineages. However, individuals from the Potomac River drainage identified as *L. cariosa* on the basis of morphology had the mtDNA of *L. cardium* or *L. ovata*, while individuals identified as *L. ovata* from the St. Lawrence river drainage had the mtDNA of *L. cariosa*. The discrepancy between morphology and DNA sequence data is evidence for hybridization of *L. cariosa* with *L. cardium* and/or *L. ovata* in the Potomac River drainage, and possibly in the St. Lawrence River drainage. This hybridization could have important implications for the Federal status of *L. cariosa*, and *L. ovata*, as well as for the state-level status of *L. ovata* in Vermont, and *L. cariosa* in Maryland and West Virginia.

POPULATION ECOLOGY OF BLACK TERNS IN MAINE

Investigator: F. A. Servello

*Cooperators/
Project
Support:* University of Maine -
Department of Wildlife Ecology
Maine Department of Inland Fisheries and Wildlife
U.S. Fish and Wildlife Service, Partnerships for Wildlife Program
Maine Outdoor Heritage Fund
Florida Power Light Energy

Objectives: 1) Determine the annual local survival of breeding adult black terns (*Chlidonias*

niger) in Maine, site fidelity to individual wetlands, and movement rates among wetlands.

- 2) Determine breeding success at black tern colonies and factors influencing rates of nest and chick losses.
- 3) Determine the relative effects of demographic parameters on population rates of change for black terns using demographic models, and use stochastic modeling to evaluate extinction risk and management strategies.

SCOPE: The black tern was formally state-listed as an endangered species in Maine in 1997, a legal status it also has in a number of states in the northern U.S. In Maine and the northeastern U.S., black tern populations are disjunct from the core breeding range in North America and are relatively small. The Maine population has approximately 80 breeding pairs distributed among 6-9 colony sites. With a few exceptions studies of black tern ecology in North America have focused on nest success, nesting habitat, and breeding behavior, apparently because the low and variable reproductive success may be a contributing factor in the slow recovery of this species and the low densities in peripheral regions such as the northeastern U.S. Information on recruitment, survival, and site fidelity needed to examine population dynamics issues is insufficient. Other than annual census data, little is known about the basic population characteristics or limiting factors of black terns in Maine.

PROJECT STATUS: Objective 2 of the project has been completed and the results are summarized below. Objectives 1 and 3 are in progress.

I marked a total of 90-136 nests in 6-7 colonies annually during 1997-2002 and measured clutch size, hatchability, nest success, and chick survival and documented causes of nest losses. Clutch size during the early-nesting period ($\bar{x} = 2.89$, <15 June) was high and greater than during the late-nesting period ($\bar{x} = 2.65$, ≥ 15 June). Hatchability was 100% for 95 eggs (34 nests) monitored during four years. Mean annual nest success (0.53) was near average for this species, varied little (0.45-0.60), and did not differ between early and late periods. Mean chick survival was low (0.29). Reproductive success estimates were dependent on unknown re-nesting rates, but annual means were likely between 0.44 and 0.64 fledglings per breeding pair. Nest success was relatively stable within large colonies for five of six years, suggesting that nest success was a function of site characteristics. Flooding caused substantial nest losses in three years, and nest predation caused similar losses in other years. Nest predation rate was relatively constant during the nesting season in non-flood years. Black Tern reproductive success in Maine was low, but minimum levels for maintenance of tern numbers are dependent on unknown survival rates for adults and juveniles as well as immigration and emigration rates.

FUTURE PLANS: Final analyses for Objectives 1 and 3 will be complete in 2004.

INFLUENCE OF FOREST PRACTICES ON STAND- AND SUB-STAND SCALE HABITAT SELECTION OF LYNX IN NORTHERN MAINE

Investigator: A. K. Fuller

Advisors: D. J. Harrison, Chair
W. E. Glanz
W. B. Halteman
W. B. Krohn
J. S. Wilson

*Cooperators/
Project
Support:* Maine Cooperative Forestry Research Unit
Maine Department of Inland Fisheries and Wildlife
Maine Agricultural and Forest Experiment Station
United States Fish and Wildlife Service
The Nature Conservancy

- Objectives:*
- 1) Evaluate stand-scale habitat selection by lynx using snow tracking.
 - 2) Develop a model to determine which habitat variables best predict sub-stand scale habitat selection by lynx across a range of forest types.
 - 3) Describe substand-scale features of rest sites used by lynx and lynx activities.
 - 4) Describe spatial-use and movement patterns of lynx.

SCOPE: This project utilizes radio collared lynx representing the only verified population in the eastern United States to evaluate the effects of forest practices on this federally threatened species. Lynx (*Lynx canadensis*) occur across much of the northern United States and Canada, but little is known about lynx-habitat relationships in eastern North America. Results of the few habitat studies conducted on lynx throughout their North American range have been extrapolated to areas with potentially unique ecologies, including differences in climate, prey abundance, predator-prey communities, and rates of forest succession. Lynx are considered specialists on snowshoe hare (*Lepus americanus*), and habitat use by lynx is closely associated with density of snowshoe hares. Partial harvesting may reduce habitat quality for lynx because partially harvested stands had the lowest densities of snowshoe hares during winter among all overstory types (including regenerating clearcut, coniferous, deciduous, and mixed wood stands) sampled in north central Maine. Partial harvesting is commonly practiced in Maine, but it is unknown how lynx respond to the forest structure and reduced density of hares in these stands. Thus, we are evaluating the effects of forest practices, including partial harvesting and clearcutting, on lynx in northern Maine. Silvicultural practices that create early successional stages may increase densities of snowshoe hares and associated foraging opportunities for lynx. However, habitat use by lynx may be associated with more than just access to snowshoe hares, but with overstory and understory features related to protection from predation. Determining sub-stand scale habitat selection by lynx will be useful for evaluating the effects of alternative silvicultural practices on lynx and their prey.

PROJECT STATUS: Three lynx (2F, 1M) were snow tracked for 31.8 km between 4 January and 28 March, 2002 and random straight-line transects were sampled within the home ranges of the 3 lynx for 55 km. Vegetation was sampled within 341 plots along the lynx trails and within 605 plots along random transects. Three lynx (1F, 2M) were snow tracked for 32.8 km between 4 January and 1 April 2003 and 45 km of random straight-line transects were sampled within their home ranges. Vegetation was sampled within 380 plots along the lynx trails and within 495 plots along random transects. Stand-scale habitat selection is currently being evaluated for early regeneration (<14' tree height), mid-regeneration (14-24' tree height), partially harvested stands (1-12 years old), and mature second-growth stands (deciduous, coniferous, and mixed wood stands) and will be completed by December 2004.

FUTURE PLANS: Data analysis will continue with objectives 2-4 to be completed in 2005. A final report is scheduled for completion by May 2005.

FACTORS AFFECTING HABITAT SELECTION AND POPULATION PERFORMANCE OF AMERICAN MARTEN (*Martes americana atrata*) IN NEWFOUNDLAND

Investigator: B. J. Hearn

Advisors: D. J. Harrison, Chair
M. L. Hunter, Jr.
W. B. Krohn
R. J. O'Connor
A. S. White

*Cooperators/
Project
Support:* University of Maine, Department of Wildlife Ecology
Natural Resources Canada - Canadian Forest Service
Newfoundland Department of Forest Resources and Agrifoods -
Wildlife Division

Western Newfoundland Model Forest
 Corner Brook Pulp and Paper
 Abitibi Consolidated

- Objectives:*
- 1) Document the population characteristics of Newfoundland marten on two study areas, one area open to trapping and snaring and the other closed, representing a range of forest management and natural habitat conditions.
 - 2) Determine scale-specific (i.e., seasonal and annual stand- and landscape-level) habitat selection of marten across the range of habitat conditions present within the two study areas.
 - 3) Examine home-range area and habitat composition in relation to the proposed explanations of why Newfoundland marten are restricted in distribution in the province to primarily old-growth forests.

SCOPE: The Newfoundland marten (*Martes americana atrata*) is one of only 14 terrestrial mammals endemic to the island of Newfoundland. Since the early 1900s, the Newfoundland marten has declined both in numbers and distribution; excessive trapping, in combination with habitat loss due to logging and fire, are suggested as the major factors contributing to the early decline. In 1934, commercial trapping for marten was closed on the island. However, despite this protection, marten populations continued to decline. Trapping for marten remains closed but some number of marten are taken each year in traps and snares set for other furbearers and snowshoe hares (*Lepus americanus*). In 1973, the Pine Marten Study Area (PMSA), was established in southwestern Newfoundland, and is generally considered to contain the last viable marten population on the Island. The area is closed to all land-based trapping and snaring. The PMSA was created as a refuge from which marten would disperse to reoccupy their historical range. In 1985, the Newfoundland marten was federally classified by the Committee On The Status of Endangered Wildlife In Canada (COSEWIC) as Threatened. In 1996, the status was uplisted to Endangered.

Earlier work on Newfoundland marten was conducted within the PMSA and focused on the effects of timber harvesting on “old growth” habitat and explaining the underlying association of Newfoundland marten with old growth forests, i.e., 81+ year-old balsam fir (*Abies balsamea*). In general, these studies concluded that loss of old growth habitat through clearcut logging was limiting the distribution and recovery of marten in Newfoundland. More recent work, looking at forest structure and prey densities in forest of various ages, suggested that marten in Newfoundland are restricted to mature and overmature balsam fir due to the depauperate prey base, i.e., lack of prey in younger stands. An alternative suggestion is that marten in Newfoundland are restricted in distribution due to issues of habitat security, that is, marten attempting to occupy second-growth stands are subjected to increased mortality due to incidental snaring and trapping.

In 1995, a 5-year cooperative project to determine the basic population characteristics of Newfoundland marten, particularly in relation to old-growth habitat within the PMSA, was initiated. Field work began in June 1995 and in May 1996, the project was expanded with the addition of a second study area. This second area, outside the PMSA, was centred near Red Indian Lake in south-central Newfoundland and had what was believed to be a newly established marten population. The underlying assumption was that, due to past forest harvesting (hence habitat conditions that appeared dissimilar to the PMSA), the RIL study area had a recently established, low-density marten population, and that the area represented a habitat sink for marten. The goal of the project is to evaluate these competing explanations for the historical decline and current restriction of the distribution of marten in Newfoundland. Further, following the analysis of factors influencing habitat selection and restriction, we hope to develop forest and wildlife management recommendations for the conservation and management of Newfoundland marten.

PROJECT STATUS: The analysis of stand-level habitat selection was completed in February 2004. To begin the analysis, forest and landcover composition (softwood, mixedwood, hardwood, bog, barren, etc.) and forest structural characteristics (stand height, crown closure, successional stage) hypothesized to be of overriding importance for Newfoundland marten were utilized to develop 10 broad habitat classes. Habitat types recognized included tall (> 12.6 m) closed canopy (>50%) softwood, tall open canopy softwood, medium height (6.6-12.5 m) open and closed canopy softwood, young regenerating softwood forests < 6.6 m, recent (< 5 years) cuts, unproductive scrub forest <

6.6 m, precommercially thinned softwood areas (15 – 20 years old), nonforested areas (bog and barren), and overmature insect-killed stands. Using residency and home-range criteria previously developed, locational data was sufficient to produce 92 year-specific home ranges from 97 individual adult resident marten. Results indicated that marten did not use habitat classes in proportion to their availability ($T = 75.6$, $n = 458$, $P < 0.0001$) and displayed selection for insect-killed stands and avoidance of areas with little or no canopy closure. However, in contrast with conclusions reached by previous researchers concerning the habitat requirements of Newfoundland marten, tall overmature coniferous forest did not dominate in the composition of marten home ranges. Newfoundland marten used of most younger immature and mature forest habitat classes in proportion to availability within their home ranges. These empirical results are inconsistent with the presumed stand-scale habitat requirements of marten in Newfoundland for old-growth forests. In March 2004, these stand-scale habitat selection results were presented to the national (COSEWIC-Committee on the Status of Endangered Wildlife In Canada) Newfoundland Marten Recovery Team, as well as provincial natural resource managers, and forest industry partners in a 1-day workshop focused around habitat issues for Newfoundland marten.

FUTURE PLANS: A report presenting the results of the stand-scale habitat selection analysis is in preparation and will be released in December 2004 at the upcoming meeting of the Newfoundland Marten Recovery Team. Work will continue in January 2005 and will focus on: 1) the preparation of a journal manuscript concerning the stand-level habitat selection results, and; 2) analysis of survival and cause-specific mortality and population demography data. The projected date of completion of the dissertation is December 2005.

**FISH HOSTS AND POPULATION STRUCTURE OF THE YELLOW LAMPMUSSEL (*Lampsilis cariosa*)
AND TIDEWATER MUCKET (*Leptodea ochracea*) IN MAINE**

Investigator: J. M. Rhymer
A. Huryn
M. Kelly (M.S. student)
P. Wick (M.S. student)
S. Kneeland (M.S. student)

Cooperators/ *Maine Department of Inland Fisheries and Wildlife*
Project Support: Maine Outdoor Heritage Fund
USGS-BRD Eastern Region State Partnership Program
USFWS Endangered Species Program
Maine Cooperative Fish & Wildlife Unit
University of Maine
Department of Wildlife Ecology
MAFES (Hatch)

Objectives:

- 1) Increase our understanding of the demography and genetic structure of populations of yellow lampmussel and tidewater mucket in Maine.
- 2) Identify host fish species for these mussel species and relate host fish and mussel distributions.
- 3) Spatially relate the genetic and demographic composition of existing populations of tidewater mucket and yellow lampmussel to landscape factors.

We are collaborating with Dr. Cynthia Loftin (MCFWRU) to identify landscape scale factors that indicate suitable mussel and host fish habitat (Landscape Control of the Distribution of Two Rare Atlantic Slope Freshwater Mussels in Maine).

SCOPE: Maine's rarest mussels, the tidewater mucket, *Lampsilis ochracea* and yellow lampmussel, *Lampsilis cariosa*, are listed as threatened in the state and as endangered, threatened or of special concern by states elsewhere in their northeastern range. They occur as fragmented populations in three watersheds in central Maine - the

Kennebec, Penobscot and St. George. By virtue of the high quality of its water resources and the absence of zebra mussels, Maine has some of the last significant populations of these mussels. These watersheds could well serve as important refugia for *Lampsilis ochracea* and *Lampsilis cariosa* if populations along the Atlantic slope are extirpated. Although the current distributions of the tidewater mucket and yellow lampmussel have been well documented in Maine, conservation efforts are hampered by lack of knowledge of: 1) fish host(s) and factors affecting their distribution, 2) population age (viability) and genetic structure (degree of isolation), and 3) effects of disconnected or deteriorating habitat quality on mussel distribution. Isolation of mussel populations could affect their age structure, reproductive potential and population viability, and also promote genetic divergence among populations. Understanding patterns of genetic differentiation among populations will provide a rationale for determining whether their metapopulation should be managed as one or several distinct conservable units, and may provide a more logical basis for understanding factors responsible for the present-day distribution of these mussels in Maine.

PROJECT STATUS: Laboratory experiments revealed that white perch (*Morone americana*) is a probable host for both yellow lampmussel and tidewater mucket and yellow perch (*Perca flavescens*) may also be a host for yellow lampmussel. Population age structure has been analyzed for several populations of each mussel species and genetic analyses are complete. An MS thesis of this work was defended by M. Kelly.

FUTURE PLANS: DNA analysis will be done to determine if fish species other than those identified in the lab are used in nature by tidewater mucket and yellow lampmussel.

LANDSCAPE CONTROL OF THE DISTRIBUTION OF TWO RARE ATLANTIC SLOPE FRESHWATER MUSSELS IN MAINE, THE YELLOW LAMPMUSSEL (*Lampsilis cariosa*) AND THE TIDEWATER MUCKET (*Leptodea ochracea*)

Investigators: C.S. Loftin

Cooperators: USGS-BRD Eastern Region State Partnership Program
Department of Wildlife Ecology, University of Maine
Maine Cooperative Fish and Wildlife Research Unit

Objectives: Identify landscape-scale factors indicating suitable habitat for yellow lampmussels and tidewater muckets in Maine.

(This study is part of larger study developed under the USGS State Partnership Program with Drs. Judith Rhymer and Alex Huryn at the University of Maine. The final project report will combine the results of Dr. Rhymer's and Dr. Huryn's study with the study discussed herein.)

SCOPE: The declining condition of the world's aquatic environments is resulting in a loss of aquatic biodiversity. Freshwater bivalves are experiencing drastic declines in distribution and number due to a variety of disturbances. North America contains the greatest diversity of freshwater bivalves in the world, yet more than half of the remaining species are threatened with extinction. Although in many cases mussel decline can be attributed to manipulations of the local environment, forces at a larger scale may contribute to the occurrence and structure of mussel communities. Cumulative effects of upstream and stream-side land uses and hydrological modifications may affect mussel occurrence in a watershed, potentially deteriorating quality of occupied sites or leading to population isolation due to unsuitable hydrological conditions between occupied sites. These modifications may lead not only to a change in mussel community composition, but also to a change in ecosystem structure and function resulting from modification of the density and composition of the bivalve community. However, mussel distributions may also be somewhat independent of habitat conditions and more tightly regulated by abundance and diversity of host fish. Efforts to conserve North America's remaining mussel populations must recognize the complexity of relationships among potential determinants of mussel community composition, distribution, and demography and the

multiple scales at which those relationships occur (Vaughn 1997).

Distributions of Maine's mussel species have been documented by Maine's Department of Inland Fisheries and Wildlife (MDIFW). The tidewater mucket (*Leptodea ochracea*) and the yellow lampmussel (*Lampsilis cariosa*) are state-listed as threatened species due to their scattered, declining populations. The relationships of these mussel distributions to watershed conditions such as stream connectivity, dam locations, riparian land use, and hydrological condition have not been examined. Identification of landscape- and local-scale conditions of stream reaches, river segments, and ponds and lakes occupied by these mussels is critical to conservation of these mussel species. Given that Maine contains some of the last, significant populations of the tidewater mucket and yellow lampmussel in eastern North America, and its watersheds are relatively undeveloped, conservation of these species may hinge on protection of the populations that remain in Maine.

PROJECT STATUS: Development of the spatial database of mussel population distribution and watershed characteristics is completed. Analysis of these data to summarize landscape features where the mussels occur is underway.

FACTORS AFFECTING LEAST TERN PRODUCTIVITY IN MAINE

<i>Investigator:</i>	J. C. Perkins
<i>Advisors:</i>	F. A. Servello, Chair J. M. Rhymer J. Kelley M. A. McCollough
<i>Cooperators/ Project Support:</i>	University of Maine Maine Outdoor Heritage Fund Maine Department of Inland Fisheries and Wildlife Rachel Carson National Wildlife Refuge Maine Audubon Society
<i>Objectives:</i>	<ol style="list-style-type: none"> 1) Determine rates for major reproductive parameters of the least tern population in Maine including clutch size, hatchability, nest success, chick survival, and fledgling success. 2) Evaluate management alternatives for increasing least tern productivity. 3) Determine rates of nest losses to predators, storm tides, and other factors, and identify predator species if possible. 4) Determine temporal patterns and intensity of predator and non-predator disturbances at the largest Maine colony (Crescent Surf Beach) during the incubation period, with an emphasis on predator activity. 5) Document spatial patterns of nest losses within colonies due to predation, storms, and other factors. 6) Examine temporal patterns in vegetation, shape, and other characteristics of beaches used by least terns for nesting, and determine relationships with colony occurrence.

SCOPE: The least tern is a state-listed endangered species in Maine. Historically, there may have been as many as 20 potential nesting sites within Maine. In the last 25 years, there have been only 12 sites on which least terns have produced successful nests, and only seven sites have produced successful nests in the last five years. The goals of this project are to understand the factors influencing population growth and occurrence in Maine and to provide information on nesting ecology, predation, and disturbance for making recommendations on future management.

PROJECT STATUS: Data collection was completed in August 2003. I monitored a total of 235 nests at four colonies in 2002 and over 300 nests at five colonies in 2003. I documented clutch size, hatchability, and nest success for all nests and determined causes of nest losses. I documented fledgling success and departure from colony sites for color-banded chicks at two colonies in 2002 and 2003, and used data loggers to monitor nocturnal nest attentiveness at three colonies in 2003. Data analysis is complete and thesis writing is in progress.

FUTURE PLANS: Completion of thesis in Fall 2004.

EFFECTS OF SNOWSHOE HARE DENSITY AND LANDSCAPE CHARACTERISTICS ON HABITAT USE BY CANADA LYNX IN MAINE

Investigator: L. L. Robinson

Advisors: D. J. Harrison, Co-chair
W. B. Krohn, Co-chair
J. S. Wilson
M. A. McCollough
W. J. Jakubus

*Cooperators/
Project
Support:* Maine Cooperative Fish and Wildlife Research Unit
Maine Department of Inland Fisheries and Wildlife
Cooperative Forestry Research Unit
U.S. Fish and Wildlife Service
University of Maine
 Department of Wildlife Ecology
 McIntire-Stennis
 Graduate Research Assistantship
The Nature Conservancy
Clayton Lake Woodlands
Huber Resources Corporation
Irving LLC
National Council on Air and Stream Improvement

Objectives:

- 1) Determine the variability of hare densities within regenerating conifer clearcut stands through time and evaluate how hare densities change as these stands approach maturity.
- 2) Document hare densities in shelterwood and selection harvest stands and evaluate changes in hare densities in these stands as understories develop.
- 3) Develop models for discriminating habitat characteristics (e.g., hare densities, stand-scale habitat characteristics, and landscape metrics) between simulated lynx home ranges where lynx were and were not detected during systematic winter track surveys.
- 4) Develop and test a predictive model of lynx occurrence at the landscape (i.e., home range) scale.

SCOPE: The Federally threatened Canada lynx (*Lynx canadensis*) is a wide-ranging field occupying most of Canada and some northern parts of the U.S.A., with Maine supporting the only verified population of lynx east of Minnesota. Lynx are considered specialist predators of snowshoe hares (*Lepus americanus*), and hare density acts as a regulating factor for lynx populations. Hare densities in the Northeast are strongly associated with dense, conifer understory, which provides hares with thermal cover in the winter and escape cover from predators. Dense, conifer understory is associated with early forest succession, can be produced artificially through forest management

practices, and is found in regenerating conifer clearcuts approximately 12 to 25 years after cutting and herbicide application. Relatively young regenerating stands as large as 5,000 hectares are common throughout Maine today resulting from past clearcutting in response to the widespread eastern spruce budworm (*Choristoneura fumiferana*) outbreak of the late 1970s and early 1980s. However, the Maine Forest Practices Act of 1989 placed large disincentives on clearcuts larger than 35 acres. This caused a shift in forest management in Maine away from clearcuts in favor of various partial harvest cuts, which now constitute 96% of the forest management in Maine. Some partial harvest stands maintain only about 5-10% of the hare density that can be supported by regenerating conifer clearcuts. Thus, the shift to partial harvesting in Maine could have potential implications for lynx conservation in the Northeast, although a wider range of partial harvests need to be studied.

This project will study hare densities in different forest cover types and will evaluate changes in hare densities as those forest stands mature. These data will then be combined with data from previous studies of hare density so that estimates of hare density will be known for each forest type in northern Maine. We will use data from ecoregional snow tracking surveys conducted by the Maine Department of Inland Fisheries and Wildlife and U.S. Fish and Wildlife Service to simulate lynx home ranges where lynx have and have not been detected. We will apply hare density estimates to these simulated home ranges to evaluate the influence of hare density on habitat use by lynx in northern Maine.

Because lynx are wide-ranging animals capable of dispersing greater than 900 km, other landscape characteristics such as edge, distance from core population, and snowfall may be important in the selection of habitat for home ranges by lynx in addition to hare densities. This study will compare these landscape characteristics for areas where lynx were and were not detected to determine which variables are important in habitat selection by lynx.

This study will supply important information on the relationship between lynx occurrence and the abundance of its primary prey in addition to other landscape characteristics that can then be used to more accurately evaluate the potential for lynx occurrence within the landscapes of northern, western, and eastern Maine.

PROJECT STATUS: Pellet plots to estimate hare density were established in 38 forest stands during the summer of 2004 and will be cleared of pellets by the middle of October 2004.

FUTURE PLANS: We will conduct pellet surveys for the next two years and will begin model development in the winter of 2004.

ROAD MORTALITY RISK FOR SPOTTED AND BLANDING'S TURTLE POPULATIONS

Investigator: F. Beaudry

Advisors: M. L. Hunter, Co-chair
P. G. deMaynadier, Co-chair
J. M. Rhymer
D. J. Harrison
D. Hiebeler

*Cooperators/
Project
Support:* Maine Department of Transportation
University of Maine
Department of Wildlife Ecology
Maine Department of Inland Fisheries and Wildlife
Maine Outdoor Heritage Fund
United States Environmental Protection Agency
The Nature Conservancy
Norcross Wildlife Foundation

- Objectives:*
- 1) Evaluate habitat selection and seasonal movement patterns of spotted and Blanding's turtles in Maine.
 - 2) Develop a GIS-based model to identify turtle-road hotspots, which will allow targeting current mitigation needs and modeling avoidance planning during future projects.
 - 3) Develop a predictive model of spotted and Blanding's turtle persistence and road mortality rates linked to a spatially-explicit population viability analysis.
 - 4) Complete a comprehensive review of road conservation mitigation options suitable for endangered turtles in southern Maine.

SCOPE: Recent population analyses of several freshwater turtle species indicate that as little as 2-3% additive annual mortality of adults is unsustainable, leading ultimately to local population extinction. As such, road-kill may prove to be the single most important factor threatening the extinction of the Blanding's turtle in Maine. There is increasing emphasis on the part of federal and state transportation authorities to minimize and mitigate impacts to wildlife populations from road construction and improvement projects. To this end, the project objectives outlined above are designed to help identify the extent and significance of road impacts to endangered turtles in Maine as a precursor towards a) designing strategic mitigation measures for problem road sections, and b) identifying remaining roadless remnants of the landscape where long term turtle population viability remains highest.

PROJECT STATUS: In February 2004, a project proposal was presented to the Wildlife Ecology Department. The final proposal was given to the graduate committee in April. During the first field season, started in April 2004, 15 Blanding's turtles and 16 spotted turtles were tracked using radio-telemetry.

FUTURE PLANS: Field data will be compiled and preliminary analyses will be completed during the 2004-2005 winter, followed by a second field season in spring and summer 2005.

GENETIC IDENTIFICATION OF FISH HOSTS FOR THE YELLOW LAMPMUSSEL (*Lampsilis cariosa*) AND TIDEWATER MUCKET (*Leptodea ochracea*)

Investigator: S. C. Kneeland

Advisors: J. M. Rhymer, Chair
C. S. Loftin
M. Kinnison

*Cooperators/
Project
Support:* Maine Department of Inland Fisheries and Wildlife
Maine Outdoor Heritage Fund
USGS State Partnerships Program
Maine Agricultural & Forestry Experiment Station - Hatch
University of Maine
Department of Wildlife Ecology

- Objectives:*
- 1) Develop a genetic identification key for *Lampsilis cariosa* and *Leptodea ochracea* and other freshwater mussel species in Maine with overlapping distributions.
 - 2) Compare known distributions of *Lampsilis cariosa* and *Leptodea ochracea* and life history characteristics of these species with fish in Maine to predict likely hosts in the wild.
 - 3) Sample naturally parasitized fish in localities where *Lampsilis cariosa* and *Leptodea ochracea* occur to confirm and/or designate fish as suitable hosts.

SCOPE: North America has nearly 300 species of freshwater mussels, yet nearly 72% are of special concern,

threatened, endangered, or possibly extirpated. Reasons for decline are largely anthropogenic, as mussels have been subjected to habitat loss or alteration due to channelization, siltation, eutrophication, and river impoundment. In Maine, the yellow lampmussel (*Lampsilis cariosa*) and tidewater mucket (*Leptodea ochracea*) are found in only three watersheds and are state listed as threatened.

Yellow perch (*Perca flavescens*) and white perch (*Morone americana*) are probable hosts for the yellow lampmussel, and white perch is a probable host for the tidewater mucket. However, it is possible that other host species not yet tested exist for both mussel species. This study will involve creating a genetic identification key that will be used to identify glochidia attached to naturally parasitized fish in the wild. The genetic identification key will be developed by collecting tissue samples from known adult mussel species. Glochidia will be removed from naturally parasitized fish and identified with the key to confirm or designate fish as suitable hosts for the yellow lampmussel and tidewater mucket.

The conservation of some freshwater mussels is limited by inadequate knowledge of host species. The spread of exotic species, illegal stocking, and dam removal has caused some fish communities to change in many areas. Therefore, knowledge of host species in changing or stable fish communities is essential for mussel conservation.

PROJECT STATUS: A total of 256 tissue samples have been obtained representing eight species that coexist with the yellow lampmussel and the tidewater mucket. Samples were obtained from multiple populations throughout the Kennebec, St. George, and Penobscot River drainages. Laboratory work is underway to develop a genetic identification key.

A pilot study to evaluate methods of catching fish, rates of parasitism, and species parasitized was performed. Several specimens with glochidia attached were kept for future identification of glochidia.

FUTURE PLANS: Complete laboratory work on the genetic identification key, and use it to identify glochidia from the pilot study. Use distributional data, life history characteristics, and results from the pilot study in preparation for sampling naturally parasitized fish in the second field season.

**HABITAT SELECTION, RELOCATIONS, AND FISH HOSTS OF THE YELLOW LAMPMUSSEL
(*Lampsilis cariosa*) AND TIDEWATER MUCKET
(*Leptodea ochracea*) IN MAINE**

Investigator: J. M. Rhymer
C. S. Loftin
J. Kurth (M.S. student)
S. Kneeland (M.S. student)

Cooperators/
Project Support: Maine Outdoor Heritage Fund
USGS – State Partnerships Program
Maine Cooperative Fish & Wildlife Unit
University of Maine
Department of Wildlife Ecology
MAFES (Hatch)

Maine Department of Inland Fisheries and Wildlife

Objectives:

- 1) Analyze habitat selection of yellow lampmussel and tidewater mucket in Maine to determine potential suitable locations for these species in the Kennebec drainage and elsewhere in Maine.
- 2) Measure survival, growth and movements of resident and translocated populations of these species to determine efficacy of experimental relocations in the Sebasticook River drainage.
- 3) Sample fish in areas where tidewater muckets and yellow lampmussels occur to determine potential host species by using DNA analysis to identify species of

larval mussels found on fish gills.

SCOPE: Potential removal of the Fort Halifax dam on the Sebec River is currently under review. Its removal would strand populations of yellow lampmussel and tidewater mucket during dewatering, and as such, would present a unique situation in North America, in that dam removals have not affected listed mussel species in other cases. Even if the Fort Halifax dam is not removed, petitions to remove dams in Maine are expected in the future. Our data will provide insight into the current and potential distribution of these species and their fish hosts, as well as provide information on the potential success of using mussel relocation as a tool to minimize effects of dam removals. This information will assist agencies in conservation planning for and recovery of protected mussel species.

PROJECT STATUS: A qualitative mussel survey of the Sebec impoundment and experimental translocations have been initiated within the impoundment and to two other localities within the same drainage. Fish have been sampled from the Sebec River impoundment as well as other localities in Maine where these mussels occur. All species of mussels that co-occur with yellow lampmussel and tidewater mucket have been sampled to devise a species-specific DNA key and DNA analysis is underway.

FUTURE PLANS: Quantitative sampling of mussels will be done in the Sebec River impoundment prior to dam removal and translocation experiments will continue for another two years. Extensive fish sampling for host identification will continue.

LANDSCAPE THRESHOLDS AND RESPONSE TO FRAGMENTATION BY ENDANGERED NEWFOUNDLAND MARTEN

Investigator: A. K. Fuller

Advisors: D. J. Harrison, Chair
W. E. Glanz
W. B. Halteman
W. B. Krohn
J. S. Wilson

*Cooperators/
Project
Support:* Canadian Forest Service
Newfoundland Inland Fish & Wildlife Division
Corner Brook Pulp & Paper
Abitibi Consolidated
Newfoundland Forest Service
Western Newfoundland Model Forest
Maine Agricultural and Forest Experiment Station

- Objectives:*
- 1) Evaluate and define landscape-scale currencies (defined below) that are associated with habitat occupancy by marten in Newfoundland, and to determine how patterns of occupancy change with amount of suitable habitat and degree of fragmentation in home range-sized landscapes. Evaluate how patterns of habitat occupancy by marten are affected by the amount of suitable habitat, landscape pattern, and fragmentation.
 - 2) Develop a series of landscape thresholds for predicting landscape-scale occupancy of habitat by marten and to compare to thresholds currently being developed in Maine. Use the thresholds to develop a tool for use in predicting population responses of marten to proposed forest-harvesting scenarios.

- 3) Evaluate whether marten are responding to habitat loss or habitat fragmentation. Determine whether spatial-use strategies and responses to fragmentation exhibited by marten in Newfoundland differ from processes exhibited by American marten at less extensive (e.g. Maine) spatial scales.

SCOPE: Newfoundland marten (*Martes americana atrata*) are an endangered subspecies of mustelid that are endemic to the island of Newfoundland. Marten have large area requirements per unit body weight, are sensitive to fragmentation, and have been documented to respond to landscape pattern at scales larger than individual home ranges. However, because marten are intrasexually territorial, they may not be able to expand their ranges into new areas following landscape fragmentation. These characteristics make marten a good coarse filter species to use in evaluating the effects of fragmentation and how species respond to pattern and process on the landscape. Lack of data on responses of Newfoundland marten to landscape-scale habitat change hinder efforts to predict population responses to forest harvesting, and limit the ability of managers to recommend alternative harvesting plans that might retain target population levels of marten.

The effects of the amount of habitat and the spatial arrangement of habitat on populations are often confounded. It is unknown whether marten will respond more to loss or to fragmentation, especially given the naturally occurring highly fragmented landscape in Newfoundland. A biologically relevant categorization of habitat availability that most directly influences the spatial decisions by an animal at a particular scale (habitat currencies) will be determined. Habitat currencies (e.g., % mature forest in home range, landscape metrics) important to Newfoundland marten will be defined, to evaluate how changes in the currency affect probability of occupancy of landscapes by marten, and to provide a tool for evaluating the influences of proposed forest harvesting scenarios on landscape-level habitat occupancy by marten. These currencies will be used to evaluate threshold responses of marten to human-induced landscape change and to build and test predictive models of marten occurrence based on landscape characteristics. These models will enhance the ability of managers to prioritize areas of likely presence for conducting population surveys, to identify areas of potentially suitable habitat that require forest planning, and to reliably predict population responses of marten to alternative forest management scenarios.

PROJECT STATUS: Landscape-scale currency associated with habitat occupancy has been defined. Simulated home ranges are currently being produced using a Fretwell-Lucas model of home-range placement on the landscape, which will be used to compare landscape metrics between actual and simulated home ranges.

FUTURE PLANS: Data analysis will continue with final project completion scheduled for December 2005.

FISHERIES RESOURCES:

INVENTORY OF INTERTIDAL AND ESTUARINE FISHES OF ACADIA NATIONAL PARK

Investigators:
P. Bryer

A. Jordaan

Supervisor: L. J. Kling

*Cooperators/
Project Support:* National Park Service - Acadia National Park
University of Maine - School of Marine Sciences

Maine Cooperative Fish and Wildlife Research Unit

- Objectives:* 1)
 Inventory fish species found in tidepools at locations adjacent to Park
 lands on Mount Desert Island and Schoodic Peninsula, and
 2) Conduct detailed assessments of estuarine fishes at Northeast
 Creek, Frazer Creek, Bass Harbor Marsh,
 Mosquito Cove, and Somes Sound over different seasons and estuarine locations.

SCOPE: Acadia National Park (ANP) is part of the National Park Service's Northeast Temperate Network, and inventory and monitoring activities are becoming increasingly important to the long-term management goals of ANP. Summaries of past studies of freshwater fish resources of ANP have been issued (Bowes et al. 1999) and more detailed inventories (with relative abundance assessments) have been published (Moring et al. 2001). However, detailed inventories of fishes of estuaries and intertidal areas adjacent to Park lands are limited.

Fishes inhabiting these mixing areas between the land and ocean are extremely important components of ecosystems (Edwards et al. 1982). Estuaries are typically the most productive regions of coastal waters, and tidepools serve important nursery and refuge functions for many commercially-important species of marine fishes in Maine waters, such as juvenile pollock (*Pollachius virens*), Atlantic herring (*Clupea harengus*), winter flounder (*Pleuronectes americanus*), and lumpfish (*Cyclopterus lumpus*). As a consequence, future Park management may rely heavily on baseline inventories of species presence and their relative abundance.

In this project fishes were inventoried during three field seasons: 2001, 2002 and 2003. The objective was to sample as many diverse habitats as possible in the intertidal and estuarine zones to maximize the resultant species lists rather than to focus on quantitative sampling procedures that would have allowed for repetitive comparisons in future years.

PROJECT STATUS: Major Findings: There are essentially two primary findings, the first involves the tidepool study and the second involves the estuarine study. The tidepool study strongly suggests a pattern of fish species dividing along a wave energy gradient. That is, tidepools in quiet areas, where mudflats and salt marshes dominate, contained one group of species, whereas along highly exposed coastline another group of species dominated. The estuarine study demonstrated that the primary determinant of the distribution of species in the freshwater-marine setting was the presence/absence and placement of bridges and causeways that change the flow regime within the estuary. The final report will discuss these findings, in conjunction with the consequences of climate and land-use changes and the potential damage caused from oil spills along the coast of Mount Desert Island. The fieldwork component of the project has been completed. The entering of data into Microsoft Access and Excel for the data inventory and analysis required has been completed and is now undergoing a quality check. A draft of the tidepool section of the report has been completed and the estuarine section is being drafted.

FUTURE PLANS: We plan to have a draft report done in November 2004, with the final report issued in 2005.

INVESTIGATIONS INTO THE CULTURE OF RAINBOW SMELTS

Investigator: M. A. Hachey

Supervisor: L. J. Kling, Chair
 M. Gallagher
 M. Kinnison

*Cooperators/
 Project Support:* University of Maine - School of Marine Sciences
 Aquaculture Research Center
 Maine Department of Inland Fisheries and Wildlife
 Maine Cooperative Fish and Wildlife Research Unit
 Maine Outdoor Heritage Fund

Objectives: To demonstrate a cost-effective and environmentally friendly method for rearing rainbow smelts in intensive re-circulating aquaculture systems that will allow individuals to hatch and grow disease free smelts as an additional source for the retail baitfish market.

SCOPE: Rainbow smelt (*Osmerus mordax*) is an anadromous species with a historic distribution encompassing the Atlantic coastal drainage from New Jersey to Labrador with a few native landlocked populations occurring within this range (Scott and Crossman 1973). In Maine, native and transplanted, landlocked rainbow smelt populations support important commercial bait and recreational fisheries as well as a forage base for the state's salmonid fisheries. Commercial smelters provide smelt for sportfish anglers to use as live bait, while recreational anglers catch them for food as well.

Most smelt are captured with dipnets during the spawning runs at night as they ascend natal streams in the Spring of the year. This practice has contributed to dramatic population fluctuations and closures of certain inland waters. In this project we demonstrated intensive culture production techniques to produce Rainbow.

PROJECT STATUS: During the project period we developed methods for spawning in captivity, egg incubation and disinfection and fungicidal treatment of eggs. Larval fish were reared in greenwater using enriched rotifers and then enriched Artemia. Survival through metamorphosis was 7-10%. Fish were weaned successfully onto a commercial salmon starter diet. Growth and survival during the weaning trials are in the process of being statistically evaluated. A temperature rearing trial is being conducted on the juveniles to predict temperature unit growth rates and to develop optimal feeding procedures.

FUTURE PLANS: A final report will be produced by March 2005. We hope to obtain additional funding to continue our investigations with Rainbow smelt culture to improve the effectiveness of the procedures.

MOVEMENTS OF AMERICAN EELS IN FRESHWATER LAKES

Investigator: M. Gallagher

Advisors: W. E. Glanz, co-chair
J. G. Trial, co-chair
A. D. Huryn
J. D. McCleave
F. W. Kircheis

*Cooperators/
Project
Support:* Maine Cooperative Fish and Wildlife Research Unit
Maine Department of Marine Resources
Maine Department of Inland Fisheries and Wildlife
University of Maine

Objectives: To document seasonal and daily movement patterns of American eels and relate these movements to habitat and environmental conditions.

SCOPE: Little is known about the commercially important American eels in their freshwater residence, especially their habitat selection and patterns of movement. This project captured eels and tracked their movements using surgically implanted radio transmitters. In Year 1, all fieldwork was conducted in Hermon Pond. In Year 2, the studies were expanded to include several other ponds, along with habitat mapping of ponds.

PROJECT STATUS: All fieldwork has been completed. Data analysis is nearly completed and writing of the dissertation has started.

FUTURE PLANS: A Ph.D. dissertation will be completed in May 2005.

ALTERNATIVE METHODS FOR ENUMERATING JUVENILE ATLANTIC
SALMON (*Salmo salar*) AND STUDYING THEIR DISTRIBUTION
IN MAINE RIVERS

Investigator: S. L. Fleming

Advisors: K. E. Webster, Co-chair
J. R. Trial, Co-chair
J. F. Kocik

*Cooperators/
Project
Support:* Maine Atlantic Salmon Commission
National Marine Fisheries Service
Maine Cooperative Fish and Wildlife Research Unit

Objectives:

- 1) Test three alternative techniques for estimating juvenile Atlantic salmon populations in Maine rivers as possible replacements for electrofishing.
- 2) Develop density distributions of juvenile Atlantic salmon as related to physical parameters of sites.

SCOPE: Atlantic salmon populations in eight Maine rivers have been placed on the Endangered Species List. The common method of assessing stream populations of juvenile salmon is backpack electrofishing – a potentially harmful technique. This project observes juvenile Atlantic salmon in various river conditions using the less invasive techniques of snorkeling, streamside viewing, and overhead observation. In addition, while conducting the snorkeling technique, locations of fishes were flagged and density distributions for the site were analyzed.

PROJECT STATUS: All fieldwork has been completed and data are being analyzed.

FUTURE PLANS: A manual detailing methods for conducting juvenile Atlantic salmon surveys using the snorkeling technique will be prepared for the Maine Atlantic Salmon Commission. A Master of Science thesis is expected to be completed in December 2005.

HABITAT RESOURCES:

RIPARIAN BUFFER WIDTHS AND AMPHIBIAN COMMUNITIES IN WESTERN MAINE:
EXPERIMENTAL AND RETROSPECTIVE APPROACHES

Investigator: D. W. Perkins

Advisors: M. L. Hunter, Chair
P. G. deMaynadier
W. B. Haltemen
J. M. Hagan
C. S. Loftin
R. J. Seymour

Cooperators/ University of Maine

Project McIntire-Stennis
Support: Manomet Center for Conservation Science
 Cooperative Forestry Research Unit, University of Maine
 National Fish and Wildlife Foundation
 Plum Creek Timber Company
 International Paper
 Mead Paper
 Seven Islands Company

- Objectives:*
- 1) Determine if amphibian densities and species richness in and adjacent to headwater streams change 1-2 years after harvesting.
 - 2) Determine if changes in amphibian densities and species richness vary with buffer strip width.
 - 3) Determine if there is an effect on amphibian densities and species richness in these headwater stream areas 5-10 years post-harvest.

SCOPE: Forests are the dominant ecosystem in the northeastern United States and therefore harbor much of the region's biodiversity. However, timber production is economically important in this region. Due to biodiversity and economic reasons, ecologists and foresters seek timber management practices that do not degrade ecosystems and maintain biodiversity while still maintaining profit margins. Riparian areas provide habitat for a broad array of species, are critical to maintaining stream water quality, and have been identified by the forest industry in Maine as a key area of concern. To protect these riparian areas many forestry companies leave buffer strips. It is unclear whether current regulations are adequate for water quality and biodiversity. We will use amphibians to study the effects of different buffer widths on riparian biota along first order streams in western Maine using experimental and retrospective approaches.

PROJECT STATUS: All requirements for a Ph.D. degree in Wildlife Ecology were met in April 2004. The abstract follows:

Riparian areas are one of the most complex, diverse, and dynamic environments in forested ecosystems. Amphibians are excellent candidates to study in riparian areas because they are sensitive to forest management, have high diversity in riparian areas, and are one of the most abundant vertebrates in temperate forests. I conducted a field experiment in which 15 headwater streams in western Maine were randomly assigned to five treatments, and I examined them for 1 year prior to harvest and for 2 years after harvests. I also undertook a retrospective study on 12 headwater streams representing three treatments where harvests had occurred 4-10 years earlier. I used pitfall traps and cover-controlled active-searches to sample terrestrial and stream amphibians to determine: a) if amphibians can define the riparian zone based on species occurrence and abundance; b) if and how different types of timber management affect amphibian communities; and, c) if sticks placed in pitfall traps will reduce the incidental capture and subsequent mortality of small mammals.

In Chapter 1, I found total and average species richness was highest in the trap location located closest to the stream, and 3 species were caught almost exclusively on the banks adjacent to the stream. I conclude that the riparian zone as defined by amphibians along headwater streams is relatively narrow (8-9 m), yet distinguishable due to high diversity and unique species occurrence. In Chapter 2, I found wood frogs (*Rana sylvatica*), redback salamanders (*Plethodon cinereus*), and spotted salamanders (*Ambystoma maculatum*) all showed sensitivity to riparian forest management. American toads (*Bufo americanus*) were either unaffected or increased in abundance after harvests took place. Buffers ranging in width from 11 to 35 m appeared to partially mitigate for the timber harvests, as abundances were generally higher within the buffer than in the adjacent clearcut for some species. Partial harvests had the least effect on the amphibian community and should be considered for harvests in riparian area. In Chapter 3, I found that the placement of sticks in pitfall traps is an effective method that reduces small mammal mortality without affecting amphibian capture rates, is efficient, and is inexpensive.

A LONG-TERM FOREST ECOSYSTEM STUDY

Investigators: M. L. Hunter, Jr.
 A. J. Kimball
 A. S. White

J. W. Witham
S. P. Elias

*Cooperators/
Project
Support:* Holt Woodlands Research Foundation
McIntire-Stennis

Objectives:

- 1) Describe the structure of the plant and animal communities in an oak-pine forest ecosystem.
- 2) Investigate the effect of woodlot management on community structure.
- 3) 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.

This study is being conducted for 20 years on a 120 ha, 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.

Our primary objective is to describe the structure of the plant and animal community. We are undertaking (1) a 100% inventory of trees (>10 cm DBH) and intensive inventories of tree regeneration, (all trees are being individually numbered and on 12 tracts, mapped); (2) a complete description of the vascular plant vegetation using the relevé technique; (3) an inventory of all breeding bird territories; (4) small mammal trapping; (5) salamander cover object counts; (6) estimates of seed and fruit production; (7) general surveys of canopy insect abundance; (8) meteorological observations. These data, largely population estimates, are integrated by area units (usually 0.25 ha blocks) and analyzed to portray the forests' community structure. After five years of gathering baseline data, in 1987 we began 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 the second objective. Over the course of 20 years, we have begun to understand how the community changes seasonally and from year to year; this is the essence of the third objective.

PROJECT STATUS: In 2004, tasks 3, 4, 5, 6, 7, 8, and portions of task 1 as outlined above were completed; 100% tree inventory was postponed.

FUTURE PLANS: The 2005 field season will primarily focus on timber inventory with additional work on plants and trees.

SIMULATING WETLAND-LANDSCAPE FIRE DISTURBANCE AND SUCCESSION TO DEMONSTRATE POTENTIAL FOR CHANGES IN AMPHIBIAN PRESENCE/ABSENCE

Investigator: J. McCloskey

Advisors: C. S. Loftin, Chair
L. Smith
S. A. Sader
W. B. Halteman
J. Wilson

Cooperators/ USGS-BRD Florida Intergrated Science Center
Project U. S. Fish and Wildlife Service
Support: Okefenokee National Wildlife Refuge
 Maine Cooperative Fish and Wildlife Research Unit
 University of Maine – Department of Wildlife Ecology

- Objectives:*
- 1) Use satellite data to create a land cover map showing dominant vegetation associations within the Okefenokee Swamp.
 - 2) Develop vegetation change detection maps by comparing current and past vegetation maps.
 - 3) Develop model to simulate spatial and temporal effects of water levels and fire on vegetation composition and structure.
 - 4) Develop models to show habitat association of specific amphibians species within the swamp vegetation types.

SCOPE: The Okefenokee National Wildlife Refuge (ONWR) is a mosaic of several wetland communities covering approximately 1700 km². Many amphibian species found within ONWR are obligatorily linked to water. Human activity (particularly fire suppression, logging, dredging, peat mining, and water impoundment) within ONWR may cause changes in the swamps natural hydrologic and fire regime. Such changes may be permanently altering the vegetation composition and structure of the swamp, thereby adversely affecting amphibian populations. This study will determine how changing fire and water levels effect the vegetation spatial distributions, composition and structure within ONWR. Subsequently, we will determine associations between existing vegetation and presence/absence of amphibians.

PROJECT STATUS: Amphibian data collected by the Florida Integrated Science Center were used to develop statistical models that show habitat associations of certain amphibian species. Programming of the spatial landscape model was completed and we are in the process of sensitivity analysis, calibration, and validation of the model. A time series model is being developed to forecast severe wildfire years using the Southern Oscillation Index (SOI) and historical wildfire, water level, and rainfall data as parameters.

FUTURE PLANS: Experimentation of the model will be done to determine the effects of various fire management policies on vegetation composition and structure (measured using patch, isolation, and compositional metrics) within ONWR. For example, we took 48 years of output from Loftin's (1992) hydrology model that predicted continuous water level depths in every 500 m cell over the entire ONWR. This output was re-classified into thematic maps showing four water depth categories for each of two seasons. The maps were further categorized into hydroperiod coverage (i.e., the number of times in a season that a cell spent in a particular water depth category). We then use the hydroperiod coverage as a time series to develop rules for fire ignition and spread as well as for vegetation succession. We assume that the empirical water level, precipitation, and SOI data captures the frequency and autocorrelation of wet and dry years. Thus, we can constrain the model by choosing to start the time series at different years (i.e., wet or dry) or allowing it to choose randomly. Contrasting these two approaches may show the effect of autocorrelation of wet and dry years on the fire regime and the vegetation. We will then evaluate how such scenarios might affect amphibians within the ONWR. We will visit the ONWR to discuss the application of the model with ONWR personnel and recommend management strategies that take into account the social, cultural, economic, and ecological issues and their impact on local communities and the ONWR ecosystem.

VEGETATION RESPONSE TO IMPOUNDMENT MANAGEMENT AT MOOSEHORN NATIONAL WILDLIFE REFUGE

Investigators: C. S. Loftin
J. R. Longcore

Assistants: L. Hierl (MPP/MEM student, Duke University)
C. Currier

H. Alcock
D. McAuley

Cooperators/

University of Maine, Department of Wildlife

Ecology – Graduate School

*Project
Support:*

U. S. Geological Survey, Biological Resources Division – Cooperative Unit Program
Maine Cooperative Fish and Wildlife Research Unit
U. S. Fish and Wildlife Service, Moosehorn National Wildlife Refuge
Duke University

Objectives:

- 1) Develop impoundment vegetation maps using ground surveys and ArcGIS software to compare to previously documented vegetation distributions.
- 2) Assess past and present hydrological data to characterize impoundment hydrology and relate to vegetation history.

SCOPE: Moosehorn National Wildlife Refuge staff created 53 wetlands between 1950-1970 in an attempt to provide suitable waterfowl habitat. Since construction these wetlands have been managed by water level manipulation. Surveys were conducted in the mid-1980s to create wetland vegetation maps to document dominant vegetation types, to document bird use of the impoundments, and to collect invertebrate specimens in floating-leaved and emergent vegetation. The purpose of the current study is to determine changes in vegetation distributions and composition since these earlier surveys were conducted, and relate these changes to hydrological management of the refuge impoundments.

PROJECT STATUS: The study was completed and Ms. Hierl completed MPP/MEM degree requirements at Duke University. The final report abstract follows:

Wetlands are vital to waterbirds because they provide food resources and habitat for cover, nesting, brood rearing, and other basic needs. Wetlands, however, continue to be destroyed and degraded by human activities. Protecting wetlands from loss is important, but we also must ensure that protected and managed wetlands continue to provide the expected ecological services on the landscape. The Moosehorn National Wildlife Refuge (hereafter MNWR) contains ~ 900 hectares of wetlands; much of the wetland area was created or modified in the 1950s when beaver created impoundments on many refuge streams. Since then, changes in the value of these impoundments as waterbird habitat have not been systematically assessed, although water levels have been manipulated to enhance habitat for waterfowl. The objectives of this study were (1) to assess changes in vegetative structure in 49 impoundments at MNWR during the interval 1984-85 to 2002; (2) to provide management recommendations to improve wetland habitat quality for waterfowl and other waterbirds; and (3) to provide a multivariate, adaptive framework for long-term monitoring and assessment of the wetlands at MNWR, which may be applied to other wildlife refuges. By applying a Mahalanobis distance multivariate analysis, we classified 17 of the refuge's wetlands as poor habitat based on the percent emergent vegetation cover, percent shrub, percent open water, relative richness (i.e., richness of vegetative types), and interspersion juxtaposition index (i.e., a measure of distances among different vegetation type patches). The Mahalanobis analysis quantifies a distance for each wetland from a reference condition that we defined based on habitat conditions suitable to support a diverse waterbird community. Based on this analysis, we identified specific wetland characteristics to manage to improve habitat conditions. The Mahalanobis distance analysis is ideal for instituting an adaptive wetland management approach because (1) metrics can be added or removed easily; (2) ranges of target habitat conditions can be changed; and (3) the analysis can be used to set management priorities for single or multiple management objectives.

THE ROLE OF DISPERSAL IN TERRESTRIAL VERTEBRATE DISTRIBUTIONS

Investigator: V. Bahn

Advisors: W. B. Krohn, Co-chair

R. J. O'Connor, Co-chair
 M. K. Beard-Tisdale
 W. B. Halteman
 G. L. Jacobson

*Cooperators/
 Project
 Support* Biological Resources Division, USGS
 Maine Cooperative Fish and Wildlife Research Unit
 University of Maine
 Department of Wildlife Ecology

Objectives:

- 1) Review current concepts and techniques for modeling terrestrial vertebrate occurrences and identify most critical field for improvement.
- 2) Compare traditional and spatially-explicit distribution models with advanced model selection techniques to determine their relative effectiveness.
- 3) Investigate causes of spatial autocorrelation in species' distribution patterns.

SCOPE: This project aims at supplying a review of the current modeling concepts and techniques for terrestrial vertebrate occurrences with the goal of improving current approaches. Specifically, the influence of dispersal on distribution patterns and its consequences to distribution modeling was identified as the problem with the highest negative impact and the best chances for improvement. Within this topic, the first part was to improve spatial modeling techniques and model selection. The second part will investigate the causal link between dispersal and spatial autocorrelation in distribution patterns.

PROJECT STATUS: The review of current concepts and techniques for modeling terrestrial vertebrate occurrence and the identification of the most critical steps that need improvement have been completed. The spatial modeling was completed. I used data from the Breeding Bird Survey (BBS) and conditional autoregressive models to model 110 species with traditional models and with spatial regression models. In all cases, the spatial model outperformed the traditional model by, on average, 10% in explained variance (R^2). In addition, an advanced model selection criterion (Akaike's Information Criterion; AIC) lent exclusive support to the spatial models. The link between dispersal and spatial patterns was investigated by comparing relative dispersal strength among the 110 bird species to the strength of autocorrelation in their distributional patterns. I used metapopulation theory, Taylor's power law and density dependence theory to characterize relative dispersal strength. The preliminary results point in the expected direction - more dispersal leads to higher autocorrelation - but are not unambiguous and need further review.

FUTURE PLANS: I will investigate several other ecological theories for dispersal predictions to strengthen my results. In addition, I will build an individual-based, spatially-explicit simulation model, to investigate whether dispersal can theoretically lead to the observed autocorrelation patterns in bird distributions and how sensitive the patterns are to variation in distribution and landscape parameters.

ENVIRONMENTAL FACTORS ASSOCIATED WITH UNIQUE LAKE COMMUNITIES IN MAINE

Investigators: E. Schilling (Ph. D. student)
 K. DeGoosh (M. S. student)
 D. Anderson (Research Associate)

Advisors: For Emily Schilling (Ph. D. student):
 C. S. Loftin, Chair
 A. Huryn
 K. Webster

P. Vaux
J. Trial

For Katie DeGoosh (M. S. student):

C. S. Loftin, Co-Chair
K. Webster, Co-Chair
D. Anderson
A. Dieffenbacher-Krall
M. Kinnison

*Cooperators:
Project
Support*

Maine Outdoor Heritage Program
Maine Department of Inland Fisheries and Wildlife
University of Maine -
Department of Wildlife Ecology
Department of Biological Sciences
National Science Foundation Research Fellowship
Maine Cooperative Fish and Wildlife Research Unit

Objectives:

- 1) Determine the effects of the introduction of fish on macroinvertebrate communities of fishless lakes in Maine.
- 2) Identify attributes of macroinvertebrate communities that indicate fishlessness.
- 3) Identify geomorphic and geographical factors controlling the distribution and abundance of fishless lakes in Maine.
- 4) Build GIS-based models predicting the probability that a given lake is fishless.
- 5) Assess the accuracy of the models using macroinvertebrate indicator species

SCOPE: Throughout much of the 20th century, the introduction of game fish to inland waters of the United States and Canada was conducted at a furious pace. The goal of these introductions was generally to enhance game-fishing opportunities. In some cases lakes and streams with native fish species, such as members of the Cyprinidae, were stocked with other species considered more desirable as game fish. In other cases, lakes and streams that were truly “fishless” were stocked. Until recently, fishless lakes were viewed as having little or no value to society, as indicated by the term “barren” that was widely used to describe them. Over the past several decades, however, there has grown a considerable body of knowledge supporting views of such “barren” water bodies as habitats for uniquely structured animal communities, as excellent trophic habitats for waterfowl, and as landscape-level source habitats for amphibians and other biota.

Over the past several decades, financial support for the documentation and management of the biodiversity and ecological integrity of public lands has increased. This has resulted in considerable effort toward the enumeration, conservation, and restoration of fishless lakes. However, accurate estimates of the number and distribution of these habitats, prior to the widespread stocking efforts of the mid- to late 20th century, are few. Estimates for six of Canada’s western mountain parks indicate that over 20% of their lakes have been altered through introductions of non-native fish. The situation in the United States is more extreme. Fewer than 45% of the 16,000 high lakes in the western mountains remain unstocked, although 95% were naturally fishless. The rehabilitation of stocked lakes is now a priority for national park management in North America.

Maine Department of Inland Fisheries and Wildlife (MDIFW) has documented at least 30 fishless ponds in Maine; many ponds currently with fish are known to have been fishless prior to stocking. Documented fishless ponds and stocked but previously fishless ponds (and perhaps previously fishless ponds that were stocked and are now populated with naturalized stock) occur throughout the state, many in watershed headwaters. This wide distribution suggests that other fishless ponds likely exist. The ability to predict the likelihood that a particular pond is currently or historically fishless based on its landscape setting and geomorphic features would assist the MDIFW in balancing recreational management objectives with the responsibility to protect unique wildlife habitats. We will sample invertebrates in ponds in selected regions of Maine that are currently “fishfull” and compare those with ponds that have various degrees of fishlessness (naturally and those with a history of stocking). These data will be combined with geomorphic and geographic information to develop GIS-based models predicting locations of ponds

that are most likely, naturally fishless. Macrovertebrate indicator species will be used to assess the accuracy of model predictions during subsequent field sampling. We will also develop and apply methodologies to document the historic presence or absence of fish in lakes predicted to be fishless but found to contain fish, to confirm model predictions.

PROJECT STATUS:

Invertebrate and fish surveys of fishless-fishfull lake pairs:

During the summers of 2002 and 2003, thirty-seven ponds (18 currently fishless, 6 historically fishless, 12 fishfull) were sampled around the state using various techniques to quantify differences in invertebrate communities between fishless and fishfull lakes. The study lakes represent two types of fishless lakes. In central and western Maine the lakes are at high elevations and are located high in the watershed, some on the watershed boundary. Lakes located high in the watershed likely have steep outlet streams, which create barriers to fish migration. This is the probable cause for fishlessness of this set of lakes. In Downeast Maine, we sampled a set of kettle lakes that have no outlet or inlet and have a low pH (less than 5.0). The pH of these lakes makes them inhabitable by fish unless they are limed (a practice that has been conducted by MDIFW to make acidic waters habitable by stocked fish). GIS analyses were conducted to describe landscape characteristics for study lakes. The data were used to build a model to predict the probability of a given lake being fishless. During the summer of 2004 we surveyed 20 new ponds (10 of each type) that were predicted to be fishless for fish and invertebrates. The fish survey data combined with data gathered from sediment cores (described below) will provide an indication of the accuracy of our predictive model. Invertebrate samples from all study lakes are currently being sorted and identified, with the aim of finding species that can be used as indicators of the fishless condition.

Paleolimnological study of fishless-fishfull lake pairs:

Published research has shown the presence of certain species of the aquatic larvae of *Chaoborus* (Diptera), indicates fishless conditions in lakes. This paleolimnological indicator, *Chaoborus americanus*, may be identified in sediments by their mandibles, which can remain in sediments of hundreds of years. During the summer of 2004, sediment cores were collected at 40 ponds (n=18 fishless ponds, 22 fishfull ponds) using a Huang-ve gravity corer. The top sediments in these cores will be examined for the presence of *Chaoborus americanus*, to determine if *Chaoborus* remains in the sediment do indeed indicate fishless ponds in Maine. Further, the cores from those ponds predicted to be fishless by the model described above will be analyzed to determine historical fish presence in the pond.

FUTURE PLANS:

Invertebrate and fish surveys of fishless-fishfull lake pairs:

Invertebrate samples collected during the 2001-2003 field seasons will be sorted and identified to species where possible. Data analysis will begin.

Paleolimnological study of fishless-fishfull lake pairs:

In the Fall 2004 /Spring of 2005, collected sediment cores will be processed in the lab. Further work to pick out the *Chaoborus* mandibles and microscopically identify them will take place during the summer of 2005. The presence or absence of the pre-determined indicator species will determine if in fact a given lake is currently (or was at some point in the past) fishless as predicted by the model.

USING ALGAE TO EVALUATE THE CONDITION OF MAINE'S STREAMS AND RIVERS

Investigators: T. J. Danielson (Ph.D. student)

Advisors: C. S. Loftin, Chair
D. Courtemanch
S. Brawley
F. Drummond

J. Stevenson

Cooperators/

University of Maine, Department of Wildlife

Ecology*Project Support*

U.S. Geological Survey, Biological Resources Division
 Maine Cooperative Fish and Wildlife Research Unit
 Maine Department of Environmental Protection
 U. S. Environmental Protection Agency
 Houlton Band of Maliseet Indians
 Manomet Center for Conservation Sciences

Objectives:

- 1) Develop analytical tools to evaluate the condition of stream algal communities across a gradient of conditions ranging from minimally disturbed streams to those that have been highly degraded.

.....2)
 Build a model to predict stream classification attainment based on algal community attributes.

SCOPE: The state of Maine Department of Environmental Protection currently evaluates the conditions of Maine's streams and rivers by sampling communities of aquatic macroinvertebrates at specific locations. This information is used with supporting chemical, physical, and landscape data to determine if streams and rivers are achieving aquatic life goals assigned to them under the State's Water Classification System (e.g., Class A, Class B, Class C). In this project, we will develop bioassessment methods that examine stream algal communities and their relationships with water quality conditions. We will also develop a model to predict if streams attain assigned classes (e.g., Class A) based on characteristics of their algal communities.

PROJECT STATUS: Stream algae and water chemistry were sampled during summer 2004 at 54 locations in Maine. These locations are in drainages affected by land uses such as urban, agriculture, and forestry activities. Sample analysis, including algal species identification, is currently underway.

FUTURE PLANS: The project is entering the data analysis phase.

THE PRESETTLEMENT FOREST OF NORTHERN MAINE

Investigator: L. J. Mitchener

Advisors: W. B. Krohn, Co-Chair
 A. S. White, Co-Chair
 C. V. Cogbill
 R. S. Seymour
 J. S. Wilson

*Cooperators/
 Project Support:* The Nature Conservancy
 University of Maine, Department of Forest Ecosystem Science
 Maine Cooperative Fish and Wildlife Research Unit
 University of Maine, Department of Wildlife Ecology

Objectives:

- 1) Determine the frequency, distribution and composition of the presettlement vegetation along survey lines in northern Maine.
- 2) Develop and test new methods for predicting estimated relative abundance of dominant species from abiotic factors.

- 3) Document the type, frequency, and severity of disturbance events along the township lines, prior to significant European settlement.
- 4) Test the likelihood of specific disturbances across the landscape.
- 5) Develop and test a new method for detecting sample bias in the MLO records.

SCOPE: Understanding the pattern and process of presettlement vegetation is important to scientists and land managers alike. This understanding is especially important in regions, such as northern Maine, where extensive logging, or other anthropogenic disturbance, has removed much of the original forest cover leaving little basis for relating the mature post-settlement vegetation to the original presettlement vegetation. Given the lack of original forest cover, the influence of disturbance on the presettlement forest is not easily discernible. The General Land Office (GLO) surveys conducted prior to and during early settlement serve as a means to reconstruct the forest composition associated disturbance regimes. The GLO surveys in Maine cover much of northern Maine at township-level resolution. These surveys, once entered into a Geographic Information System (GIS) can be combined with present-day environmental data from the Maine Office of GIS (Maine OGIS) to analyze the presettlement species-environment relationship. Statistical modeling of the species-environment relationship will result in a landscape scale model of presettlement forest conditions. Spatially explicit knowledge of the vegetation composition and the disturbance agents of the presettlement forest can, therefore, serve as a baseline for both ecological and silvicultural programs.

PROJECT STATUS: We completed the transcription of the land survey field notes of townships in northern Maine into the GIS database. The transcription of the witness trees and line segment data resulted in a dataset rich with information, curiosities, and potential. Three types of data were spatially recorded: witness trees, one-mile segments of vegetation segments, and natural break segments of species dominance. Additional information of surveyors, years of surveys, and the local landscape were also recorded. General township descriptions are currently being transcribed. The description data however, have been indexed in terms of content, and mapped.

An historical, introductory paper has been drafted. This paper describes the function of the Office of the Maine Land Agent, giving special attention to the early surveyors and the instructions they received; the land survey methods used in northern Maine, especially the content and resolution of the information collected by each method; documents where and when individual surveyors worked, and the types of land surveys done; and identifies and discuss potential applications of these different types of land survey records relative to ecology studies.

The second paper, currently being written, will document the composition of the presettlement forest. Specifically, this will describe the presettlement forest composition of Northern Maine using the three data types; determine whether any differences in the species composition are due to differing methods, or if real geographic variation exists in the presettlement forest composition of northern Maine; and will classify the natural break segment data into cover types in the presettlement forest.

A third paper will focus on modeling the line segment data to create a prediction model. We opted to use classification and Regression Tree Analysis (CART). The modeling is underway and the proposed objectives are 1) to predict and map the estimated relative dominance of the major tree species using CART; 2) to predict and map major forest cover types by following a decision tree to classify the tree species model results and using an a priori classification system; 3) to cross-validate the model using a split between trainings and validation data sets and calculate the misclassification error rate; and 4) to determine the usefulness of a qualitative model validation using land survey general township descriptions.

FUTURE PLANS: A paper on the disturbance of the presettlement forest will round out the project, which has an expected completion in the spring of 2005.

BIRD-HABITAT RELATIONSHIPS: A MULTI-SCALE ANALYSIS OF FOREST BIRDS IN THE EASTERN UNITED STATES

Investigator: D. M. Queheillalt

Advisors: R. J. O'Connor, Chair
M. K. Beard-Tisdale

D. Hiebeler
C. S. Loftin
A. S. White

*Cooperators/
Project
Support:* National Council on Air and Stream Improvement
USDA Forest Service
University of Maine - Department of Wildlife Ecology

Objectives:

- 1) Create predictive models of bird-forest relationships for the eastern U.S. (37 states east of the 100th meridian) using Forest Inventory Analysis (FIA) and Breeding Bird Survey (BBS) data.
- 2) Examine how predictive models of bird-forest relationships change when using FIA data at multiple resolutions.
- 3) Develop methods that quantify the effects of nested variables in regression tree analyses (RTA) of bird-forest relationships.
- 4) Examine the role of forest-type versus FIA importance values as predictors of bird-forest relationships.
- 5) Examine the relative importance of climate, land-cover, and elevation in bird-forest relationships.

SCOPE: The USDA Forest Service conducts Forest Inventory and Analysis (FIA) surveys periodically to determine the extent, composition, and health of public and private forests in the U.S. Using FIA and Breeding Bird Survey (BBS) data, Matthews et al. (2004) modeled the occurrence of 150 bird species at a county-level resolution for the eastern U.S. This project will expand upon these models by examining changes in bird-habitat models of forest-birds in the eastern U.S. brought about by the use of multi-resolution (county-level and 20 x 20 km²) FIA data. These multi-scale models will be used by the USDA Forest Service to predict how bird distributions are affected by land cover (e.g., FIA), climatic, and environmental variables at multiple scales. This project will also address the role of individual predictors in bird-habitat models, at different spatial resolutions; to determine which bird species are most sensitive to change in cover of particular forest-types and in cover of particular tree species.

PROJECT STATUS: The fall and spring of 2003 were spent conducting a thorough literature review, gathering and preparing data for analysis, and automating regression tree analyses using Splus statistical software. Development of predictive models of bird-forest relationships using multi-resolution FIA data began in the summer of 2004 and will continue until the fall of 2005.

WILDLIFE RESOURCES - MIGRATORY BIRDS:

DEVELOPMENT AND APPLICATION OF OBSERVATION-BASED TECHNIQUES FOR ASSESSING FOREST SONGBIRD NESTING SUCCESS

Investigator: C. R. Foss

Advisors: M. L. Hunter, Jr., Chair
W. A. Halteman
W. B. Krohn
R. J. O'Connor
R. S. Seymour

*Cooperators/
Project
Support:* University of Maine
Switzer Environmental Fellowship Program
McIntire-Stennis

U.S. Fish and Wildlife Service -
 Lake Umbagog National Wildlife Refuge
 Neotropical Migratory Bird Program
 USDA Forest Service
 N.H. Fish and Game Department
 Maine Department of Inland Fisheries and Wildlife
 N.H. Department of Resources and Economic Development
 Division of Forests and Lands
 Boise Cascade
 Mead Corporation
 James River Corporation
 Crown Vantage, Inc.
 Maine Bureau of Public Lands
 Seven Islands Land Company
 Wagner Forest Management, Ltd.
 Audubon Society of New Hampshire

- Objectives:*
- 1) Assess the effectiveness of reproductive index ranking of territories and fledgling surveys as indices of nesting success in forests.
 - 2) Identify any behavioral biases that may skew reproductive index ranks for particular species.
 - 3) Determine the relative effectiveness of sampling points and transects in fledgling surveys.
 - 4) Determine effective sampling radii for fledglings.
 - 5) Determine appropriate seasonal and diurnal periods for fledgling surveys.
 - 6) Assess effects of partial cutting in spruce-fir forests on species composition, abundance, and nesting success of breeding bird communities using behavior mapping and reproductive index ranking.

SCOPE: Recent concerns about the relationships between forest fragmentation, harvesting practices, and biological diversity have increased the need for data on avian distribution, abundance, and productivity in forested landscapes. Recent population declines of some songbird species, notably some neotropical migrants, have underscored the need to understand patterns of reproductive success for forest songbirds. Selection management has been championed by some conservation groups as an alternative to clearcutting, which provides for both timber and wildlife habitat needs while minimizing ecosystem disturbance. Research has yet to address many important questions about impacts of selection harvests on native wildlife.

This study explores the potential for observation-based survey techniques to provide relatively cost-effective indices to avian nesting success in forested habitats, and uses a combination of established and newly developed field survey techniques to study relationships between cutting intensity in spruce-fir stands and species composition, abundance, and nesting success of forest birds.

PROJECT STATUS: All requirements for a Ph. D. degree in Wildlife Ecology were met in August 2004. The abstract follows:

This study investigates approaches to habitat evaluation for forest songbirds using fledgling observations to document successful nesting. The initial work involved morning and afternoon point and transect surveys to test feasibility of fledgling detection and identification in 4 replicates of 3 forest types in northern New Hampshire. Mean fledgling detection rates were significantly higher for transect than point surveys.

A transect-based behavior-mapping protocol was adapted from traditional spot-mapping, based on the initial work, and compared to nest-searching and monitoring on 3 sites and to constant-effort mist-netting on one site in western Maine. Compared with nest searching, behavior mapping detected more resident species (98% vs. 57%), successful species (93% vs. 39%), home ranges (97% vs. 42%), and successful pairs (95% vs. 29%). Compared with mist-netting, behavior mapping detected more resident species (98% vs. 56%), successful species (100% vs. 38%), home ranges (98% vs. 37%), and successful pairs (100% vs. 28%).

Data for species composition, home range abundance, pairing success, and nesting success on 55 15-30 ha sites, ranging from urban neighborhoods to primary forests, provided a basis for developing and testing candidate metrics to assess forest biological integrity. The nine selected metrics include 3 representing species richness and composition, 4 representing nest guild structure, and 2 representing abundance and condition.

Breeding data from a managed Acadian spruce-fir ecosystem were used to explore relationships among bird home range density, pair density, and nesting success. Relationships among the three metrics were not consistent among species.

Behavior-mapping and vegetation data from 11 20-ha sites (28 site-years) in northern New Hampshire and adjacent Maine provided a basis for evaluating effects of partial cutting on breeding birds in Acadian spruce-fir forest. Mean values differed significantly between partially cut (residual basal area 14.3 to 22.4 m²/ha) and control sites (residual basal area 28.5 to 36.2 m²/ha) for 13 of 48 vegetation variables considered. Eighteen of 24 bird species analyzed showed no significant differences in abundance between partially cut and control sites. Harvested sites supported significantly more home ranges for 5 species and significantly higher nesting success for 2 species.

THE LONG-TERM EFFECTS OF A SELECTIVE TIMBER HARVEST ON THE BIRD COMMUNITY OF AN OAK-PINE FOREST IN MAINE

Investigator: S. P. Campbell

Advisors: M. L. Hunter, Chair
R. J. O'Connor
J. M. Rhymer
A. S. White
W. B. Halteman

Cooperators/ Holt Woodland Foundation
Project University of Maine, Department of Wildlife Ecology
Support: NSF GK-12 Teaching Fellowship

Objectives:

- 1) Examine changes in bird abundance in response to harvest-created gaps.
- 2) Examine shifts in habitat use in response to harvest-created gaps.
- 3) Compare local trends in bird abundance to regional trends.
- 4) Investigate temporal and spatial stochasticity of habitat use.

SCOPE: Population declines in many species of Neotropical migrant birds have largely been attributed to the destruction and degradation of forest on their tropical wintering grounds as well as on their temperate breeding grounds. These findings have in turn drawn considerable attention to current forest management practices in both tropical and temperate regions. Much of this attention has been given to the effects of clear-cutting and fragmentation; however, few studies have examined the effects of small harvest-created openings or gaps in a forest.

One such study that is examining the effects of small harvest-created gaps on the forest bird community is being conducted at the Holt Research Forest in Arrowsic, Maine. The Holt Research Forest is the location of a long-term (22 years to date) oak-pine forest ecosystem study that was established with the broad goals of monitoring long-term changes in the forest's plant and animal community and documenting the effects of forest management practices on these communities. It was established in 1983 and after five years of baseline data collection on the entire 40-ha study area, one half of the area was harvested such that 10 1-ha blocks were partially cut with a group-selection timber harvest. The other half of the forest was left as an unharvested control. Since the timber harvest in 1987-1988, data collection has continued. This effort has resulted in long-term databases reflecting the effects of harvest-created gaps on the forest and its associated communities. In particular, the resident scientist (J. Witham) has compiled an extensive database on the bird community by territory mapping all species encountered in 16 visits to the study area during each breeding season.

Using the first 20 years of this long-term data set, I plan to examine various aspects of the effects of

harvest-created gaps on the bird community. Specifically, I will be examining changes in abundance and habitat use in response to the creation of the gaps. In addition, I will compare the long-term population trends of birds at the Holt Forest to those trends occurring on a regional scale. Finally, I plan to investigate the degree of temporal and spatial stochasticity of habitat use, i.e., I will analyze the long-term data on habitat use to see if the same areas of the forest are repeatedly preferred or if territory placement is random.

PROJECT STATUS: Preliminary analysis of the data show that there are 31 species of breeding birds abundant enough for analysis; of these, only seven showed a notable response to the timber harvest. Ovenbirds and Black-throated Green Warblers avoided harvested areas, while White-throated Sparrows, Common Yellowthroats, and Eastern Wood-Pewees moved into these areas. Winter Wrens were previously absent from the forest and appeared in harvested areas immediately following the harvest, apparently in response to remnant slash piles. Black-and-white Warblers moved into harvested areas 5 years after the harvest. All of these species except the Black-and-white Warbler returned to near pre-harvest distributions 15 years after the harvest occurred. I am currently looking at the data in greater detail to more fully explore the effects of the group-selection harvest on the bird community (Objectives 1 and 2). These results will be incorporated into the analyses of the long-term trends in population size (Objective 3) and habitat use (Objective 4).

WILDLIFE RESOURCES - OTHER THAN MIGRATORY BIRDS:

EFFECTS OF HARVESTED CANOPY GAPS AND NATURAL CANOPY GAPS ON AMPHIBIANS WITHIN A NORTHEASTERN FOREST

Investigator: C. A. Strojny

Advisor: M. L. Hunter, Jr., Chair
F. A. Servello
R. Wagner

*Cooperators/
Project Support:* USDA National Research Initiative Competitive Grants Program
USFS, Penobscot Experimental Forest
University of Maine
..... Department of Forest Ecosystem Science
..... Forest Ecosystem Research Program
..... Department of Wildlife Ecology

Objectives:

- 1) To compare relative abundance of forest amphibians *among* harvested and natural canopy gaps and contiguous, closed-canopy forest.
- 2) To compare relative abundance of forest amphibians *within* harvested and natural canopy gaps to determine if gap aspect influences distribution.
- 3) To determine how redback salamander (*Plethodon cinereus*) distribution and body size are affected by down woody material size under both open and closed canopy conditions.

SCOPE: Amphibians that utilize upland forests are in constant contact with the forest floor, relying on cool moist conditions for respiration. Harvesting can have a negative effect on amphibian populations by altering forest floor microhabitats. Creating small-scale canopy gaps modeled after natural disturbance patterns may retain adequate habitat structure for amphibians, facilitating the maintenance of amphibian abundance in managed forests. In the Penobscot Experimental Forest of central Maine, canopy gaps have been created as part of a long-term research

project to better understand the ecological effects of canopy removal. One aspect of the project will be to evaluate effects of partial canopy removal on forest amphibian abundance. Another aspect of the project is to explore relationships between down woody material and redback salamanders in harvest-created gaps and closed-canopy forest.

PROJECT STATUS: All requirements for a M.S. degree in Wildlife Ecology were met in September 2004. The abstract follows:

Amphibians that inhabit upland forests are in constant contact with the forest floor, relying on moist conditions for respiration. Timber harvesting can have a negative effect on amphibian populations by altering forest floor microhabitats. We tested the hypothesis that creating small-scale canopy gaps modeled after natural disturbance patterns may retain adequate habitat structure for amphibians, thus facilitating the maintenance of amphibian diversity and abundance in managed forests. From spring – fall of 2002 and 2003, we used pitfalls with drift fences to sample 2,930 and 9,060 amphibians, respectively, in 22 large harvest gaps, 22 small harvest gaps, 19 natural canopy gaps, and 36 closed-canopy forest plots located in the Penobscot Experimental Forest of central Maine. Location within large harvest gaps (north vs. south aspect, gap center vs. edge) did not influence capture rates for *Ambystoma maculatum*, *Notophthalmus viridescens*, *Plethodon cinereus*, *Rana catesbeiana*, or *Rana sylvatica*, but higher capture rates at gap edges than gap centers were detected for *Rana clamitans*. Responses among gap types (large harvest, small harvest, and natural) varied by amphibian species and age-class. Metamorphs (young of the year) had relatively lower capture rates in large harvest gaps for *A. maculatum*, *R. catesbeiana*, *R. clamitans*, and *R. sylvatica*. In some cases (*R. clamitans* juveniles, *R. sylvatica* juvenile-adults and metamorphs), capture rates in small harvest gaps were similar to natural gaps. We did not detect statistically significant ($p < 0.1$) differences among gap types for *N. viridescens*, *Rana palustris*, juvenile-adult *A. maculatum* or *P. cinereus*, although for juvenile-adult *A. maculatum*, we caught relatively fewer individuals in all gap types than in closed-canopy areas. We also explored relationships between the size of down woody material and its use by *P. cinereus*, a terrestrial salamander, in harvest-created gaps and closed-canopy forest. Log searches ($N = 231$) for *P. cinereus* indicated that the probability of detecting a salamander is least for small logs in harvest-created gaps, whereas in closed-canopy forest, the probability was both higher and constant among log sizes. These results suggest that harvest gaps, especially small gaps, provided habitat analogous to natural gaps for some amphibian species.

INTERACTIONS BETWEEN HARBOR SEALS AND FINFISH AQUACULTURE IN MAINE

Investigator: M. L. Nelson

Advisors: J. R. Gilbert, Chair
F. A. Servello
K. J. Boyle

*Cooperators/
Project Support:* National Marine Fisheries Service
University of Maine
Department of Wildlife Ecology
Sea Grant Program
Maine Department of Marine Resources

Objectives:

- 1) To document the frequency and pattern of harbor seal predation at Maine fish farms in Maine.
- 2) To determine if this frequency and pattern is related to the number of harbor seals at nearby haul-outs.
- 3) To determine if repeat attacks at a site are the result of the same seals or different seals.

SCOPE: The methods I intend to employ to satisfy each of the above objectives include: conducting personal interviews with site managers, reviewing available logs of predations events (i.e., from insurance companies) and personal observations; conducting aerial surveys of harbor seal locations and abundance within a 20 km ‘swimming distance’ of marine fish-farms; capturing harbor seals at finfish aquaculture facilities and haul-outs within 20 km distance and fitting said individuals with radio tags for the purpose of monitoring movements and documenting presence at finfish sites.

PROJECT STATUS: All requirements for a M.S. degree in Wildlife Ecology were met in September 2004. The abstract follows:

Harbor seal (*Phoca vitulina concolor*) predation has been cited as a major cause of mortality, injury, and escapement at Atlantic salmon (*Salmo salar*) marine aquaculture sites in the State of Maine. Escapements of farm-raised Atlantic salmon are also of concern due to the potential for breeding and competition with the endangered wild Atlantic salmon. I document the nature and frequency of seal predation at finfish aquaculture facilities and whether this frequency and pattern is influenced by proximity to harbor seal haul-outs. Operational finfish aquaculture facilities in Maine were surveyed during 2001, 2002, and 2003 and asked specifically about farm characteristics, management practices, predator deterrence methods employed, and predation. Aerial surveys documenting harbor seal haul-outs along the Maine coast were conducted concurrently. Empirical estimates from negative binomial regression models suggest the importance of maximizing the distance between farms and neighboring harbor seal haul-outs and minimizing the number of surrounding harbor seal haul-outs when attempting to deter seal predation at marine salmon farms in Maine. This study further highlighted the ineffectiveness of Acoustic Harassment Devices (AHDs) and the need for further investigation into the effectiveness of different pen types at deterring seal predation.

BAT AND SMALL MAMMAL HABITAT RELATIONSHIPS IN THE INDUSTRIAL FORESTS OF NORTHERN MAINE

Investigator: S. C. Billig

Advisors: F. A. Servello, Chair
D. J. Harrison
W. E. Glanz
J. M. Hagan

*Cooperators/
Project
Support:* Manomet Center for Conservation Sciences
College of Natural Sciences, Forestry, and Agriculture
Department of Wildlife Ecology
Plum Creek Timber Company

Objectives:

- 1) Determine relationship between coarse woody debris and small mammal abundance.
- 2) Determine if upland buffer straps between clearcuts retain pre-harvest species assemblages of small mammals.
- 3) Determine effects of forest and upland buffer edges on bat activity.

SCOPE: A difficulty in designing forested landscapes that maintain existing biological diversity in northern Maine is our poor understanding of how many species relate to managed forest habitats. The goal of this project is to better understand the relationships of small mammals, including bats, to habitat features in industrial forests of northern Maine. It has been hypothesized that small mammal abundance is related to coarse woody debris, but this hypothesis is relatively untested in the northeast. There is also little research on the value of buffer straps for retaining small mammal species in clearcut landscapes. I will examine microhabitat factors in relation to small mammal abundance and occurrence, with special emphasis on the importance of coarse woody debris and determining if separation

zones, clearcuts, and continuous forest habitats maintain different species assemblages of small mammal. Overall, little is known about bats in northern New England except from research in New Hampshire, which indicates that bats need mature forests and linear edges, such as roads, for travel pathways. I will examine bat activity in relation to forest edge habitat in a heavily harvested area.

This project is being conducted in conjunction with the Shifting Mosaic Project, a forest research and management project of the Manomet Center for Conservation Sciences.

PROJECT STATUS: Both years of fieldwork have been completed. Small mammals were trapped on 45 sites for the study of coarse woody debris. Trapping grids were centered on permanent forest structure sampling plots established by Manomet Center for Conservation Sciences. Data on microhabitat and forest structure were related to small mammal occurrence and abundance. Small mammals were trapped in harvested buffers (n = 25), unharvested buffers (n = 5), clearcuts (n = 25), and continuous forest (n = 25), to evaluate species assemblages and habitat structure measurements were made on each site. Bat activity was surveyed using broadband ultrasonic bat detectors. Bat activity data were collected from clearcut-forest edges (n = 10), clearcut-buffer edges (n = 10), and clearcut center points (n = 10). Thesis is undergoing final revisions.

FUTURE PLANS: Completion of final thesis is planned in 2005.

HARBOR SEAL AND GRAY SEAL BEHAVIOR ON A SHARED HAUL-OUT SITE (MOUNT DESERT ROCK) IN THE GULF OF MAINE

Investigator: S. C. Renner

Advisors: J. R. Gilbert, Chair
W. E. Glanz
F. A. Servello
S. K. Todd

*Cooperators/
Project
Support:* University of Maine Agricultural and Forest Experiment Station
College of the Atlantic
Allied Whale
University of Maine
Department of Wildlife Ecology

Objectives:

- 1) Compare behavior patterns of harbor seals and gray seals on Mount Desert Rock, including aggressive encounters, resting, and non-resting behaviors as a function of tide cycle, species composition on the haul-out ledge, and animal density.
- 2) Determine environmental factors (tide, time of day, sea-state, or cloud cover) that influence haul-out patterns for both species of seals.
- 3) Evaluate differences in haul-out site characteristics between ledges used primarily by gray seals and those used by harbor seals.

SCOPE: The number of gray seals (*Halichoerus grypus*) in the Gulf of Maine has been increasing for more than 20 years. Substantial data exist that quantify overlap of food resources for gray seals and harbor seals (*Phoca vitulina*), but few researchers have observed both species on common haul-out sites. Hauling-out serves several important functions for most phocids including rest between foraging forays (thus fat storage), predator avoidance, and molting. This project will address inter- and intra-specific interactions that may affect haul-out duration, location, and function.

PROJECT STATUS: Fieldwork was completed in August 2001. Data analysis is nearly complete. Partial result was

presented in poster format at the Society for Marine Mammalogy Biennial conference in December 2003.

FUTURE PLANS: Project completion is scheduled for December 2004.

DOI AMPHIBIAN RESEARCH AND MONITORING INITIATIVE (ARMI):
EFFECTS OF LANDSCAPE HETEROGENEITY AND ENVIRONMENTAL
STRESSORS ON PALUSTRINE AND LOTIC AMPHIBIAN POPULATIONS
IN ACADIA NATIONAL PARK

- Investigators:* C.S. Loftin
R. Chalmers (M. S. student)
M. Bank (Ph. D. student)
- Advisors:* For R. Chalmers (M. S. student):
C. S. Loftin, Chair
W. B. Halteman
J. Longcore
R. E. Jung
- For M. Bank (Ph.D. student):
C. S. Loftin, Co-chair
J. Jellison, Co-Chair
T. A. Haines
W. Glanz
R. E. Jung
- Cooperators/
Project Support:* U. S. Geological Survey – Biological Resources Division
Patuxent Wildlife Research Center
University of Maine
Department of Wildlife Ecology
Department of Biological Sciences
National Park Service
Acadia National Park
Maine Cooperative Fish and Wildlife Research Unit
Eastern National Park Research Fund
Declining Amphibian Task Force
- Objectives:*
- 1) Develop species-habitat models of selected amphibian species in Acadia National Park at various spatial scales.
 - 2) Identify environmental correlates related to selected amphibian species occurrence and population status in ANP palustrine and riparian wetlands.
 - 3) Determine the relationship between counts of stream-dwelling salamanders and estimates of population sizes.
 - 4) Evaluate the relationship between mercury contamination and population performance in two-lined salamanders (*Eurycea bislineata*) along a spatial and temporal gradient.

SCOPE: Worldwide amphibian declines and increased reports of amphibian malformations have prompted the United States Department of Interior (DOI) to initiate an Amphibian Research and Monitoring Initiative (ARMI). Regional ARMI programs are planned throughout the United States. Acadia National Park (ANP) is serving as a long-term intensive amphibian monitoring index site. This proposed research includes defining relationships of

stream-dwelling salamanders and cross-scale habitat composition (within-stream to watershed-scale), with the intent of using salamander population counts and trends as indicators of park stream conditions. Although mercury contamination in lotic ecosystems in the Park is well-documented and is a result of non-point atmospheric deposition, levels in streamside salamanders are unknown. This study will provide insights into mercury bioaccumulation levels in stream-side salamanders, how they contribute to mercury cycling and transfer in both lotic and terrestrial food webs, and the potential for a decline of stream-dwelling biota with increasing mercury contamination. Another aspect of this research includes a survey of four-toed salamanders, a species of concern in Maine, Massachusetts, and Vermont. The distribution of four-toed salamander has decreased throughout its range due to wetland loss associated with land clearing and development. This species may require mature hardwood or conifer forests and fishless wetland breeding sites, making it vulnerable to habitat disturbance. Our objective is to document the distribution and habitat associations of this species within ANP, and develop predictive models of their potential occurrence in the Park based on the documented local- and landscape-scale habitat associations.

PROJECT STATUS:

Wetland and nest scale habitat use by the four-toed salamander (*hemidactylum scutatum*) in maine, and a comparison of survey methods

The M.S. thesis was completed and defended. The thesis abstract follows:

Conserving amphibian populations requires knowledge of a species and its habitat relationships. The four-toed salamander (*Hemidactylum scutatum*) is listed as Endangered in Indiana, Threatened in Illinois, and Rare or of Special Concern in Maine, Massachusetts, Vermont, Ohio, Wisconsin, Missouri, and Minnesota. Little is known of *H. scutatum* ecology despite the species' extensive range. Infrequent sightings of *H. scutatum* throughout its range may indicate either low numbers or that the species' behavior make detection difficult. Records for *H. scutatum* in Maine existed from only 32 sites before my study, and the total number of occurrences of this species in Maine is unknown (P. deMaynadier, Maine Department of Inland Fisheries and Wildlife, personal communication). I found 238 four-toed salamander nests in 36 wetlands, which were new sites. The survey protocol, natural history descriptions, and definitions of wetland and shoreline habitat presented will increase detections of this species and thus improve the monitoring and management of *H. scutatum* and the wetland habitat that this species occupies. In the first chapter, I compare monitoring techniques for the species, document new points in which I found the species, and present natural history information. I conducted surveys of adults on roads during rainy spring nights, surveys of nests, and surveys of larvae with dipnetting in wetlands, and I present incidental visual encounters and pitfall captures for comparison. Greatest numbers of salamanders were found with the nest surveys, which were conducted in palustrine wetlands by walking in the water and parting the shoreline vegetation to search for eggs and attendant females. I found *H. scutatum* nests in 35 of 92 wetlands searched. In the second chapter, I investigate species-habitat relationships that predict *H. scutatum* presence at two scales: the wetland (and surrounding landscape) and the available shoreline points in which nests could occur. I collected data at wetlands with and without nests, and I collected data along the shoreline at points with and without nests. With these data, I created models that predicted wetlands with nests, and I created and evaluated models that predicted nest point selection within a wetland and available point characteristics between wetlands with and without nests. Wetlands with nests were best predicted by higher pH and were negatively associated with shrub scrub and unconsolidated bottom NWI classes. Wetlands with nests were also predicted by the availability of shoreline points that provided *Sphagnum* spp. for egg attachment, wood substrate, water flow, the presence of blue-joint reed grass (*Calamagrostis canadensis*), meadowsweet (*Spiraea alba*), steeplebush (*Spiraea tomentosa*), and sensitive fern (*Onoclea sensibilis*), and the absence of sheep laurel (*Kalmia angustifolia*) and deciduous forest NWI class. Within wetlands with nests, shoreline points with nests were best distinguished from shoreline points without nests by steeper shores, greater near-shore and basin water depth, deeper nesting vegetation, presence of moss and winterberry (*Ilex verticillata*), and a negative association with *Spiraea alba*, leatherleaf (*Chamaedaphne calyculata*), and *Kalmia angustifolia* within 1m of the shoreline point.

Effects of trophic and watershed complexity on mercury contamination in two-lined salamanders:

Stream salamander removal sampling was completed on 4 streams in ANP during July 2003. Stream salamander abundance counts (# of salamanders categorized by age class/per 100 rocks) and habitat surveys were also completed on 23 streams during July 2003. All mercury analyses and fieldwork have been completed. Data

analyses will be completed during late 2004. A literature review on mercury contamination in biota from Acadia has been accepted for publication to a special Acadia National Park issue of *Environmental Monitoring and Assessment*, and results of the salamander mercury analysis will be included in a special issue of *Ecotoxicology: Mercury in Northeastern North America*, to be published in early 2005.

FUTURE PLANS: The dissertation will be completed by February 2005.

EFFECTS OF LOCAL AND LANDSCAPE HETEROGENEITY ON MERCURY LOADINGS IN PALUSTRINE AMPHIBIANS FROM ACADIA NATIONAL PARK, MAINE

Investigators: C. S. Loftin
A. Amirbahman
M. Bank (Ph. D. student)

Cooperators: Declining Amphibian Population Task Force
FY2003 USGS Maine Water Research Institute
University of Maine -
Department of Wildlife Ecology
Department of Civil and Environmental Engineering
Department of Biological Sciences
Eastern National Park Research

- Objectives:*
- 1) **Quantify concentrations of total and methyl Hg levels in water, sediments, larval green frog (*Rana clamitans*), and larval bullfrogs (*Rana catesbeiana*), from 5 amphibian die-off sites and compare them with total and methyl Hg concentrations of the same species from 5 sites with no known amphibian die-offs.**
 - 2) Compare concentrations of total and methyl Hg levels in larval two-lined salamanders (*Eurycea bislineata*) analyzed from streams within the affected (i.e., die-off) watersheds with streams located in watersheds with no known amphibian die-off sites (using existing total Hg salamander data from 2001 and 2002).
 - 3) Analyze relationships among stream, wetland, and selected watershed-scale environmental variables and total and methyl Hg concentrations recorded in sampled biota, including existing chemistry and Hg data from soils, sediments, stream water, fish, and salamanders from Acadia.
 - 4) Relate findings from this investigation with disease analysis results from the same frog species from the same sites in ANP (USGS Wildlife Disease Center (Madison, WI)).

SCOPE: We are comparing levels of mercury (Hg) contamination previously documented in samples of soils, sediments, stream water, fish, and salamanders collected in Acadia National Park (ANP) to those of newly-collected samples of selected frog species inhabiting Park wetlands, including those where amphibian die-offs have recently been reported. The Hg loadings in amphibians at these sites are unknown and have never been quantified or compared to sites where amphibian die-offs have not occurred. We predict that Hg concentrations in the larvae of the selected frog species from ANP wetlands may be high in comparison to Hg levels in local fish and lotic salamander larvae due to: 1) life history characteristics (i.e., length of larval period), 2) diet, 3) micro-habitat selection patterns, and 4) the strong potential for high rates of methyl Hg production in palustrine environments.

Our approach examines Hg contamination in both the physical environment and biota and across the

landscape from headwaters to the receiving surface waters. Hg levels in frog species inhabiting lentic environments in watersheds with different biotic communities, local geomorphology, fire disturbance histories, and land cover types will be analyzed at multiple spatial scales to determine important predictor variables of Hg levels in the selected frog species. Since an extensive spatial database for Hg concentrations in two-lined salamander larvae in ANP has been developed, we have a unique opportunity to evaluate, in a cost effective manner, the relationship between the observed salamander larvae Hg levels from a given stream and the Hg levels in frogs inhabiting the receiving surface waters at lower positions in the watershed.

PROJECT STATUS: The study was completed. The final report abstract follows:

Mercury (Hg) contamination in the northeastern United States, including Acadia National Park (ANP), is well documented and continues to be a public health issue of great concern. Hg contamination of wild amphibians has received little attention despite mounting evidence and reports of worldwide population declines. Here we report total Hg and methyl Hg concentrations for water, sediment, and green frog and bullfrog tadpoles (~ 1 year of age) from ANP, Maine, USA. Average total Hg concentrations in green frog and bullfrog tadpoles were 25.1 ± 1.5 and 19.1 ± 0.8 Hg ng/g wet wt, respectively. Average total Hg was highest for green frog tadpoles sampled from the Schooner Head site, a small semi-permanent pond where Ranavirus was detected during the summer 2003 sampling period. Methyl Hg comprised 7.6-40% of the total Hg in tadpole tissue (wet wt. basis), and average total Hg levels in tadpoles were significantly different ($P < 0.05$) among pond sites ($n = 9$). Total Hg in pond water was a significant predictor of tadpole total Hg levels ($P < 0.05$). Dissolved organic carbon was a significant predictor of both total Hg ($P < 0.05$) and Methyl Hg ($P < 0.05$) in water, and total Hg in water was also strongly correlated with Methyl Hg in water ($P < 0.05$). The methylation efficiency (ME) rates defined as total Hg:Methyl Hg ratio in pond waters sampled at ANP were higher than the reported ME for national parks located in the western region of the United States. Of the 9 ponds we sampled at ANP, 44% had ME greater than 10% suggesting that wetland food webs in the park are likely susceptible to high levels of total Hg bioaccumulation. These findings may be important to National Park Service resource managers especially considering the Class I airshed status of ANP and the strong potential for negative effects to aquatic ecosystem structure and function from Hg pollution.

BEHAVIOR AND LIFE HISTORY CHARACTERISTICS OF NEONATE HARBOR SEALS IN MAINE

Investigator: J. P. Skinner

Advisors: J. R. Gilbert, Chair
D. J. Harrison
W. E. Glanz

*Cooperators/
Project
Support:* National Marine Fisheries Service
Maine Forest and Agriculture Experiment Station
University of Maine
Department of Wildlife Ecology

Objectives:

- 1) Document morphological and life history characteristics of neonate harbor seals along the coast of Maine.
- 2) Examine changes in diving behavior, home range size and site fidelity as harbor seal pups are weaned from their mothers and become independent foragers.
- 3) Compare the frequency of pup hauling out behavior with pup age, location, weather conditions, time of day and tide cycle.

SCOPE: Maine lies at the southern end of the breeding range of the Western Atlantic harbor seal (*Phoca vitulina concolor*), which is found from the arctic waters of Canada east to the shores of Greenland to as far south as the coast of Virginia in the United States. This subspecies has been largely studied in Canada but to a lesser extent in

the United States. In North America, harbor seals were heavily hunted in the early 20th century. After the establishment of the Marine Mammals Protection Act (1972) the U.S. population has grown markedly, however, the Canadian population has continued to decline in recent years. Differences in habitat and the population status at the northern and southern ends of the harbor seal range offer us an opportunity to study behavioral and phenotypic plasticity of this species. This study will document early life history characteristics and morphometrics of neonate harbor seals in Maine. Additionally, we will examine changes in movement and haul-out behavior of harbor seal pups from nursing to independent foraging. These characteristics will allow us to make comparisons with the results from studies conducted in other parts of the Western Atlantic harbor seal range.

PROJECT STATUS: The first field season was completed early July of 2004. Our study area was located between eastern Penobscot Bay (Stonington) and eastern Blue Hill Bay (Swan Island) which contains many ledges that provide suitable pupping sites for adult female harbor seals. We captured 66 individual pups and 2 adult females and recaptured 21 pups one to three times. Morphometric data were collected on harbor seal pups and some individuals were fitted with radio transmitters that allowed us to monitor their movements throughout the season. Analyses are currently being carried out on the 2004 data.

FUTURE PLANS: One additional field season is anticipated for summer of 2005. Project is scheduled for completion by December of 2005. The results will be presented or displayed as a poster at the 16th biennial conference of The Society for Marine Mammalogy in December of 2005 and published in suitable refereed Journals.

THE RESPONSE OF MAULINO FOREST AMPHIBIANS TO EXOTIC PINE PLANTATIONS

Investigator: P. A. Palacios

Advisors: M. L. Hunter Jr., Chair
J. Simonetti, Co-chair
A. J. K. Calhoun
F. A. Servello
R. Holberton
I. Fernandez

*Cooperators/
Project
Support:* Fulbright grant- U. S. Department of State

- Objectives:*
- 1) Determine if there is a difference in amphibian species richness and abundance among continuous forest, forest fragments, and pine plantations.
 - 2) Determine if there is a difference in body condition and survival rate among continuous forest, forest fragments, and pine plantations.
 - 3) Determine if there are changes in species richness and abundance near and away from streams.
 - 4) Identify if amphibian dispersal occurs between continuous forest, forest fragments, and pine plantations.

SCOPE: Deforestation and forest fragmentation have increased worldwide, becoming a significant threat to biodiversity. Maulino forest is a scarce type of Chilean temperate forest which has been reduced to small fragments as a result of deforestation. The main cause of the decrease of maulino forest has been cutting to use the land for agriculture and its replacement by plantations of exotic species, such as *Pinus radiata*.

Amphibian populations are declining globally. In maulino forest, 7 species of amphibians are potentially

present, all of them endemic to Chile and threatened on a national level. The overall goal of this research is to study the effect of maulino forest fragmentation and its replacement by exotic pine plantations on the endemic amphibian community. This will be undertaken by systematic sampling of amphibians with pitfall traps in a landscape with forest fragments, pine plantations, and a 145 ha national reserve considered as a continuous forest. Amphibians will be individually marked to determine if there is movement between the continuous forest and forest remnants across the pine plantation matrix.

PROJECT STATUS: Exploratory survey done in May 2004. Development of a full proposal in progress.

FUTURE PLANS: Fieldwork will start in September 2005.

THE EFFECTS OF HABITAT ALTERATION ON AMPHIBIAN FITNESS, HABITAT SELECTION, AND MOVEMENT

Investigator: S. M. Blomquist

Advisors: M. L. Hunter, Jr., Chair
A. J. K. Calhoun
D. J. Harrison
C. S. Loftin
A. S. White

*Cooperators/
Project
Support:* National Science Foundation
McIntire-Stennis
University of Missouri
University of Georgia, Savannah River Ecological Laboratory

Objectives:

- 1) Determine the effects of terrestrial habitat alteration on the fitness of amphibians.
- 2) Determine whether or not adult amphibians change their movement patterns and habitat selection in response to alteration of the terrestrial habitat.

SCOPE: This project is part of the Land-use Effects on Amphibian Populations (LEAP) project currently underway at the University of Maine, Orono. Land-use practices, such as forest harvesting, that reduce the quality of terrestrial habitat surrounding a pond may threaten the persistence of a local amphibian population and may disrupt dispersal between local populations within the metapopulation. LEAP involves 4 replicates of 4 forest harvesting treatments (clearcut with coarse woody debris [CWD] removed, and clearcut with CWD retained, 50% canopy cover partial cut, and uncut forest) centered on amphibian breeding ponds. In pond-breeding amphibian metapopulations, most individuals in a local population are philopatric to their natal breeding site and use the terrestrial habitat surrounding the breeding pond for foraging and overwintering. The treatments extend 164 m from the pond's center to capture 95% of amphibians in that local population.

I will use a linear series of experiments on the eggs, larvae, metamorphs, juveniles, and adults of wood frogs and conduct breeding experiments with adult wood frogs to calculate 3 components of fitness: survival, growth, and reproduction. Wood frog larvae reared in 7 cattle tanks in each treatment will be transferred to pens in the same treatment and allowed to mature. Because wood frogs live only 3-5 years, I will be able to assess lifetime fitness for frogs reared in tanks in years 1 and 2 (2004 and 2005). At each transfer, frogs will be released and compared with wild frogs.

Habitat selection will be assessed for 60 frogs each year at the subpatch (4th order), patch (3rd order), and home range (2nd order) based on locations of radio-tracked, wild wood frogs and fluorescent powder tracking. The habitat choices of wild wood frogs within the LEAP array will indicate which treatment is preferred by individuals. These choices will be directly related to body condition and survival of the tracked frogs. Based on habitat choice at

the home range scale, the condition and survival of that individual can be compared to the survival and condition of animals penned in that treatment. The strength of this design is that it allows assessment of fitness and habitat choice in amphibians. This link has not been made previously for amphibians.

PROJECT STATUS: In 2004, I completed reared wood frogs from egg through metamorphosis in 7 cattle tanks in each treatment. The growth and survival of these animals was assessed in response to canopy, light, and temperature at the tank. The animals from this experiment were marked according to treatment and released to the LEAP arrays to follow survival and dispersal.

I am currently in the process of constructing the pens to house juvenile and adult amphibians at each LEAP array. A pilot telemetry and habitat selection study will be conducted during late September through mid October.

FUTURE PLANS: In 2005-2007, I plan to continue rearing wood frogs from egg through metamorphosis in 7 cattle tanks in each treatment. The growth and survival of these animals was assessed in response to canopy, light, and temperature at the tank. The animals from these experiments will be marked and released to the pens at each LEAP array to follow survival and growth for the remainder of these individuals' lives. I will also perform a habitat selection and fine-scale movement study of wood frogs. In 2007, I will also perform breeding experiments with wood frogs reared in cattle tanks and pens to determine the breeding success of individuals from each treatment.

THE LOSS OF MATURE NEOTROPICAL MONTANE FORESTS AND IT'S EFFECT ON CAVITY-NESTING AVIFAUNA

Investigator: N. Politi

Advisors: M. L. Hunter, Chair
F. A. Servello
W. B. Krohn
R. Holberton
A. S. White

*Cooperators/
Project
Support:* Fulbright & State Organization of the Americas
United Nations Educational, Scientific and Cultural Organization

Objectives:

- 1) Determine the density and characteristics of trees and stands with cavities and assess which features are important in nest site selection (tree level and stand level).
- 2) Determine the effects of forestry practices on: a) structure of the cavity-nesting guild, b) cavity density and selection, and c) interactions among cavity-nesters.

SCOPE: Only a small percentage of the total forested land can be set aside as reserves to conserve its biodiversity and management of forests outside reserves will determine the fate of much biodiversity. A balance must therefore be reached between biological diversity and forest uses. In order to meet this challenge there is a need for sound scientific knowledge specifying the characteristics necessary to maintain functioning forest ecosystems and how to manage for them. The overall goal is to study the composition and function of the avian cavity-nesting community and the dynamics of cavity formation as a basis for developing a forest management system that will sustain biodiversity in national parks and surrounding areas in the Yungas montane forests of Argentina.

PROJECT STATUS: The project is underway. We have carried out two field surveys: one in December 2003 and another from June to August 2004. These surveys have helped us determine the sites where we will work and adjust methodologies. These surveys have also made us realize that in order to maintain mature forests management guidelines should be urgently implemented since forests are being lost at an alarming rate. Furthermore, most forests

are managed through regulations by the Argentine governments that address the timber resource but with no consideration for wildlife.

We have been able to identify trees species and characteristics that seem to favor cavity formation. Primary cavity excavators (mainly woodpeckers) seem to not be a keystone species in this forested ecosystem. We are currently conducting data analysis.

FUTURE PLANS: We will carry out a survey in October 2004 to determine if cavities marked in the previous two surveys are used by birds to nest. We are planning a year long field survey for 2005-2006 when we will add additional study sites.

THE EFFECTS OF HABITAT ALTERATION ON JUVENILE AMPHIBIAN DISPERSAL

Investigator: D. A. Patrick

Advisors: M. L. Hunter, Jr., Chair
A. J. K. Calhoun,
R. J. O'Connor,
W. B. Krohn
J. Gibbs

*Cooperators/
Project
Support:* National Science Foundation
University of Missouri
University of Georgia, Savannah River Ecological Laboratory

Objective: Determine the effects of terrestrial habitat alteration on dispersal of juvenile amphibians.

SCOPE: This project is part of the Land-use Effects on Amphibian Populations (LEAP) project currently underway at the University of Maine, Orono. Land-use practices, such as forest harvesting, that reduce the quality of terrestrial habitat surrounding a pond may threaten the persistence of a local amphibian population and may disrupt dispersal between local populations within the metapopulation. LEAP involves 4 replicates of 4 forest harvesting treatments (clearcut with coarse woody debris [CWD] removed, and clearcut with CWD retained, 50% canopy cover partial cut, and uncut forest) centered on amphibian breeding ponds. The treatments extend 164 m from the pond's center to capture 95% of amphibians in that local population.

I am using terrestrial drift fences to capture individually marked juvenile animals of two species, wood frog, *Rana sylvatica*, and spotted salamander *Ambystoma maculatum*, at 50, 100, and 150 m from the ponds edge. This information will be compared with detailed biotic and abiotic surveys in the different forestry treatments, in order to parameterize a predictive model of population redistribution. Separate choice experiments at two spatial scales (fine scale at a 1 m range, and mesocosm within 10 m diameter enclosures) will also be used in the parameterization process. This model will then be used to make predictions as to how land-use changes are likely to affect dispersal and long term viability of amphibian populations and metapopulations.

PROJECT STATUS: In 2004, I individually marked a combined total of 2700 wood frogs and spotted salamander juveniles. I also captured approximately 6000 unmarked amphibians at the terrestrial drift-fences. A mesocosm-level experiment assessing orientation mechanisms of emerging amphibians was conducted in ten replicated enclosures in the Penobscot Experimental Forest, and a similar experiment assessing the effects of coarse woody debris on movement. A pilot study of the planned fine scale movement study was also conducted. A total of 288 biotic and abiotic samples were also taken, including data on spatial aggregation of variables.

FUTURE PLANS:

In the winter of 2004 I intend to begin developing the monte-carlo simulation that will form the basis of my

predictive model. In 2005 I intend to continue marking and monitoring the movement of animals. The fine-scale choice experiments will also begin. Several mesocosm-level experiments are also planned, including an assessment of the effects of juvenile density on rates of movement.

**PUBLICATIONS, THESES AND DISSERTATIONS
PROFESSIONAL AND PUBLIC TALKS GIVEN, AND AWARDS**

SCIENTIFIC PUBLICATIONS

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- O'CONNOR, R. J. and T. L. WAGNER. A test of a regression Tree Model of Species Distribution. *The Auk*. 121:604-609.
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- PAYER, D. C., D. J. HARRISON. 2004. Relationships between forest structure and habitat use by American martens in Maine, USA. *In* D. J. Harrison, A. K. Fuller, and G. Proulx (editors). *Martens and fishers (Martes) in human altered environments: an international perspective*. Springer, New York, NY. 279 pp.

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- FRANKLIN, J., R. GARDNER, A. MILLS, W. MICHENER, K. HOLSINGER, K. NADELHOFFER, R. J. O'CONNOR, J. GOLDMAN, J. MACMAHON, and H. SWAIN (Eds.) 2004. A plan for Developing and governing the National Ecological Observatory Network (NEON). Report from the NEON Coordination and Implementation Conference, National Museum of Natural History, Washington, DC, September 4-6, 2003
- FULLER, A. K. and D. J. HARRISON. 2003. Occurrence, distribution, and survey methods for native terrestrial mammals in Acadia National Park, Mount Desert Island, ME. *Maine Agricultural and Forest Experiment Station Miscellaneous Publication 752*, Orono, ME, 28 pp.
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- FULLER, A. K. and D. J. HARRISON. 2004. Ecology of red foxes and niche relationships with coyotes on Mount Desert Island, Maine. Final contract report to U. S. National Park Service, Boston, MA. 42 pp.
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- HARRISON, D. J., A. K. FULLER, J. A. HOMYACK, and W. B. KROHN. 2003. How do clearcutting, pre-commercial thinning, and partial harvesting influence wildlife habitat? Page 10 *in* Managing for Fiber Production, Wildlife Habitat, and Biodiversity: Latest Results from CFRU Research, CFRU PR 03-01, University of Maine, Orono, ME.
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- HOMYACK, J., D. J. HARRISON, and W. B. KROHN. 2003. Final results from studies on the effects of precommercial thinning on snowshoe hares and small mammals in northern Maine. Pages 47-52 *In* 2003 Annual Report of the Maine Cooperative Forestry Research Unit, Maine Agricultural and Forest Experiment Station Miscellaneous Report 2684, University of Maine, Orono, ME.
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- FOSS, C. R. 2004. Nesting success as an indicator of habitat quality for forest songbirds. Ph. D. Dissertation, University of Maine, Orono, ME. 217 pages.
- HEATH, S. R. 2004. Nest success and chick survival of black terns in Maine: effects of predation on breeding productivity. M. S. Thesis, University of Maine, Orono, ME. 130 pages.

KELLY, M. W. 2004. Conservation genetics of the yellow lampmussel (*Lampsils cariosa*) and the tidewater mucket (*Leptodea ochracea*) M. S. Thesis, University of Maine, Orono, ME. 90 pages.

NELSON, M. L. 2004. Interactions between harbor seals and finfish aquaculture in Maine. M. S. Thesis, University of Maine, Orono, ME. 86 pages.

PERKINS, D. W. 2004. Riparian buffer widths and amphibian communities in western Maine: experimental and retrospective approaches. Ph. D. Dissertation, University of Maine, Orono, ME. 118 pages.

STROJNY, C. A. 2004. Effects of harvest gaps and natural canopy gaps on amphibians within a northeastern forest. M.S. Thesis, University of Maine, Orono, ME. 81 pages.

PROFESSIONAL TALKS PRESENTED

BAHN, V., R. J. O'CONNOR, and W. B. KROHN. "The role of dispersal in shaping bird distributions." Presented at the American Ornithologists' Union/Society of Canadian Ornithologists 2004 Meeting, Université Laval, Québec City, Québec, Canada, August 16-21, 2004.

BANK, M. S., C. S. LOFTIN, T. A. HAINES, and R. E. JUNG. Effects of watershed heterogeneity on mercury bioaccumulation in two-lined salamanders. Invited Lecture for the "Mercury Biogeochemistry" graduate course taught by Dr. Aria Amirbahman (CIE 598), November 4, 2003, University of Maine, Orono, Maine.

BANK, M. S., C. S. LOFTIN, T. A. HAINES, and R. E. JUNG. Effects of watershed heterogeneity on mercury bioavailability in lotic ecosystems. Presentation to the 24th Annual Society of Environmental Toxicology and Chemistry Annual Meeting. Science Without Borders: Developing Solutions for Global Environmental Challenges. Austin, TX. November 9-13, 2003.

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BANK, M.S., C.S. LOFTIN, T.A. HAINES, A. AMIRBAHMAN, and R.E. JUNG. Mercury bioaccumulation in biota from lotic and lentic ecosystems. Presentation to the Gulf of Maine Research Institute Ecology Seminar, Portland, Maine. January 12, 2004.

BANK, M.S., C.S. LOFTIN, T.A. HAINES, and R.E. JUNG. Effects of watershed heterogeneity on mercury bioaccumulation in two-lined salamanders, Invited lecture for Mercury Biogeochemistry, Fall semester, University of Maine, Orono, Maine. 2003.

BANK, M. S., C.S. LOFTIN, T.A. HAINES, A. AMIRBAHMAN, and R.E. JUNG. Mercury bioaccumulation in biota for lotic and lentic ecosystems. Invited presentation to the USGS noontime seminar series, Menlo Park, CA, 2004.

BANK, M. S., C.S. LOFTIN, A. AMIRBAHMAN, J. PECKENHAM, T.A. HAINES, and R.E. JUNG. Mercury bioaccumulation in lotic and lentic amphibians: regional conservation implications for aquatic ecosystems in the northeastern United States. Abstract for Presentation at the Maine Water Conference, Augusta, Maine, April 21, 2004.

BANK, M. S., C.S. LOFTIN, A. AMIRBAHMAN, J. PECKENHAM, T.A. HAINES, and R.E. JUNG. Mercury bioaccumulation in lotic and lentic amphibians: regional conservation implications for aquatic ecosystems in the northeastern United States. Abstract for presentation at the 2004 Joint Meeting of the Society of Ichthyologists and Herpetologists, ARMI Symposium, Norman, Oklahoma, May 26-31, 2004.

BEAUDRY, F. "Factors influencing extinction risk of the San Clemente sage sparrow." Presented at the Wildlife Ecology Seminar Series, University of Maine, Orono, ME, January 26, 2004.

BEAUDRY, F., and M. L. HUNTER, JR. "Road mortality risk for spotted and Blanding's turtles in southern Maine." Presented at the Blanding's Turtle Northeast Regional Meeting, Concord NH, February 13, 2004.

BLOMQUIST, S. M., M. J. SREDL, and D. A. COX. "Conservation strategies for Chiricahua leopard frogs in the Buckskin Hills." Presented at the Northeast Biological Graduate Student Conference, Orono, ME, February 29, 2004.

BYNUM, N., E. STERLING, M. L. HUNTER, JR., J. GIBBS, and I. HARRISON. "Inquiry-Based-Learning Modules for Conservation Biology Education." Course Curriculum and Laboratory Improvement Conference, National Science Foundation, Crystal City, VA, April 16-18, 2004.

CAMPBELL, S. P. "A long-term study on the effects of a selective timber harvest on a forest bird community in Maine." Presented at the Northeast Biological Graduate Student Conference, Orono, ME, February 29, 2004.

CAMPBELL, S. P. Moderated a habitat ecology session (oral presentation) at the 2004 Northeast Biological Graduate Student Conference, University of Maine, Orono, ME, February 27-29, 2004.

CHALMERS, R. Moderated a dispersal and movement session (oral presentation) at the 2004 Northeast Biological Graduate Student Conference, University of Maine, Orono, ME, February 27-29, 2004.

CHALMERS, R., and C.S. LOFTIN. Four-toed salamander (*Hemidactylium scutatum*) survey methods and nesting habitat. Abstract for presentation at the 2004 Joint Meeting of the Society of Ichthyologists and Herpetologists, ARMI Symposium, Norman, Oklahoma, May 26-31, 2004.

CHALMERS, R., and C. S. LOFTIN. Modeling four-toed salamander (*Hemidactylium scutatum*) nesting habitat. Abstract and Presentation at the 2004 Annual Meeting of the Society of Conservation Biologists, July 30-August 2, New York, New York.

CAMPBELL, S. P., J. W. WITHAM, and M. L. HUNTER, JR. "A twenty-year study of spatial responses of birds to a group selection timber harvest in an oak-pine forest in Maine." Presented at the 122nd Stated meeting of the American Ornithologists' Union, Universite Laval, Quebec, Canada, August 16-21, 2004.

DEGOOSH, K., C. S. LOFTIN, and K. WEBSTER. "Is *Chaoborus americanus* an indicator of fishless ponds in Maine?" Presented at the 2004 UMaine Graduate Student Expo, Augusta, ME, April 13, 2004.

DEGOOSH, K., C. S. LOFTIN, and K. WEBSTER. "Using sub-fossil mandibles of *Chaoborus americanus* as a paleolimnological indicator of fishless ponds in Maine." Poster presented at the Northeast Biological Graduate Student Conference, University of Maine, Orono, ME. February 27-29, 2004.

DEGOOSH, K., C. S. LOFTIN, and K. WEBSTER. "Is *Chaoborus americanus* an indicator of fishless ponds in Maine?" Presented at the 2004 Maine Water Conference, Augusta, ME, April 21, 2004.

DEGOOSH, K., SCHILLING, E. G., C. S. LOFTIN, and K. WEBSTER. "Does *Enaborus americanus* indicate the presence of fishless ponds in Maine?" Atlantic International Chapter of the American Fisheries Society, Fairlee, VT. September 20, 2004.

FULLER, A. K., and D. J. HARRISON. "Preliminary overview of sub-stand scale habitat selection by lynx." Presented at "A land based conservation strategy for Canada lynx in the region surrounding the White Mountain National Forest, North Conway, NH, January 6-7, 2004.

FULLER, A. K., and D. J. HARRISON. Preliminary results of studies of sub-stand scale habitat selection by lynx in northern Maine. Invited presentation at Wildlife Management Institute's Eastern Lynx Workshop, North Conway, NH, January 6, 2004.

FULLER, A. K., and D. J. HARRISON. "Sub-stand scale effects of forest practices on Canada lynx." Presented at the Maine Cooperative Forestry Research Unit at the University of Maine, Orono, ME, January 21, 2004.

FULLER, A. K., and D. J. HARRISON. "Preliminary results of studies of substand-scale habitat selection by lynx in northern Maine." Presentation to Maine Cooperative Forestry Research Unit, Orono, ME, January 21, 2004.

GILBERT, J. R. "Why marine mammals are wildlife." Presented at the University of Maine Student Chapter of the Wildlife Society meeting, Orono, ME, April 15, 2004.

GRYGO, A., S. KAHL, K. WEBSTER, C. LOFTIN, K. TONNESSEN, and S.J. NELSON. Development of the SPARC Database for Watershed Research, Poster Presentation at the 2004 University of Maine Graduate Student Research Expo, Orono, Maine, April 12-13, 2004.

GRYGO, A., S. KAHL, K. WEBSTER, C. LOFTIN, K. TONNESSEN, and S.J. NELSON. Development of the SPARC Database for Watershed Research, Abstract for Poster Presentation at the 2004 Maine Water Conference, Augusta, Maine, April 21, 2004.

HARRISON, D. J. "Deer and Coyotes in Maine: A case for or against predator control in Maine." Presented at the University of Maine Student Chapter of the Wildlife Society meeting, Orono, ME, November 6, 2003.

HARRISON, D. J., A. K. FULLER, J. A. HOMOYACK, and W. B. KROHN. How do clearcutting, pre-commercial thinning, and partial harvesting influence wildlife habitat? Invited presentation at workshop on Managing for Fiber Production, Wildlife Habitat, and Biodiversity: Latest Results from CFRU Research. Plum Creek Timber Company, Fairfield, ME, December 16, 2003.

HARRISON, D. J. Landscape planning for wildlife. Invited presentation at workshop on Managing for Fiber Production, Wildlife Habitat, and Biodiversity: Latest Results from CFRU Research. Plum Creek Timber Company, Fairfield, ME, December 16, 2003.

HARRISON, D. J., D. C. PAYER, and A. K. FULLER. Maintaining structural requirements of wildlife within forest stands. Invited presentation at workshop on Managing for Fiber Production, Wildlife Habitat, and Biodiversity: Latest Results from CFRU Research. Plum Creek Timber Company, Fairfield, ME, December 16, 2003.

HARRISON, D. J., J. A. HOMOYACK, J. A. LITVAITIS, and W. B. KROHN. Quantifying densities of snowshoe hare in Maine using pellet plots. Invited presentation at Wildlife Management Institute's Eastern Lynx Workshop, North Conway, NH, January 6, 2004.

HARRISON, D. J., J. A. HOMOYACK, A. K. FULLER, and W. B. KROHN. Effects of precommercial thinning and partial harvesting on snowshoe hares in Maine. Invited presentation at Wildlife Management Institute's Eastern Lynx Workshop, North Conway, NH, January 6, 2004.

HARRISON, D. J., C. L. HOVING, and W. B. KROHN. "Distribution and extent of lynx habitat in eastern North America and Maine from GIS modeling." Presentation at Wildlife Management Institute's Eastern Lynx Workshop, North Conway, NH, January 7, 2004.

HARRISON, D. J. "Status of lynx litigation, critical habitat designation, and recovery planning in the U. S." Presentation to Maine Cooperative Forestry Research Unit, Orono, ME, January 21, 2004.

HUNTER, M. L. "The Holt Research Forest: A case study of integrated forest research and management." Presented at the Jones Ecological Research Center, Newton Georgia, February 16, 2004.

- KELLY, M., and J. M. RHYMER. "Conservation genetics of two rare freshwater mussel species in Maine: the Tidewater Mucket (*Leptodea ochracea*) and the Yellow Lampmussel (*Lampsilis cariosa*)." Presented at the Northeast Graduate Students Wildlife Conference, University of Maine, Orono, ME, March 2004.
- KELLY, M., and J. M. RHYMER. "Conservation genetics of two rare freshwater mussel species in Maine: the Tidewater Mucket (*Leptodea ochracea*) and the Yellow Lampmussel (*Lampsilis cariosa*)." Presented at the Graduate Research Exposition, University of Maine, Orono, ME, April 12, 2004.
- KELLY, M. and J. M. RHYMER. "Conservation Genetics of Two Rare Freshwater Mussel Species in Maine: the Tidewater Mucket (*Leptodea ochracea*) and the Yellow Lampmussel (*Lampsilis cariosa*). Presented at the Workshop on Conservation Genetics of Freshwater Mussels, USGWS National Conservation Training Center, Shepherdstown, WV, June 2004.
- KELLY, M. and J. M. RHYMER. "Conservation Genetics of Two Rare Freshwater Mussel Species in Maine: the Tidewater Mucket (*Leptodea ochracea*) and the Yellow Lampmussel (*Lampsilis cariosa*). Presented at the Society for Conservation Biology annual meeting. Columbia University, New York, NY, July 30, 2004.
- KROHN, W. B. "Using historic wildlife information: promises and pitfalls." Presented at the Wildlife Ecology Seminar Series, University of Maine, Orono, ME, December 8, 2003.
- KROHN, W. B., D. J. HARRISON, and M.A. MCCOLLOUGH. "Predicting responses of snowshoe hares and lynx to alternative forest harvesting scenarios across multiple spatial scales." Invited presentation at Wildlife Management Institute's Eastern Lynx Workshop, North Conway, NH, January 6, 2004.
- LOFTIN, C.S. "Changes in the Savannah River tidal marsh vegetation following removal of a tidal flap gate." Presented at the Wildlife Ecology Seminar Series, University of Maine, Orono, ME, March 29, 2004.
- LONGCORE, J. "Ten top lessons every professional scientist must learn." Presented at the Wildlife Ecology Seminar Series, University of Maine, Orono, ME, April 5, 2004.
- MAGEEAN, D. M., R. J. O'CONNOR, S. CASHMAN RAIN, and N. SCOTT URQUHART. "Quantifying the spatial issues in human dimensions research." Proceedings of the Open Meeting of the Global Environmental Change Research Community, Montreal, Canada, October 16-18, 2003.
- NELSON, M., J. R. GILBERT, J. LEWIS, and K. BOYLE. "Interaction between harbor seals (*Phoca vitulina*) and finfish aquaculture in Maine." Abstract presented at the 15th Biennial Conference on the Biology of Marine mammals, Greensboro, NC, December 14-19, 2003.
- O'CONNOR, R. J. Central Science Laboratory (UK Department of the Environment, Food, and Agriculture): Population approaches and issues in pesticide effects assessment. Workshop on Assessment of Long-term Effects of Pesticides on Birds and Mammals, York, England, January 2004.
- PALACIOS, P. A. "Litterfall dynamics in Maulino forest fragments, Chile." Presented at the Wildlife Ecology Seminar Series, University of Maine, Orono, ME, January 26, 2004.
- PALACIOS, P. A., and M. L. HUNTER, JR. "Land-use practices and the effect of microhabitats on juvenile amphibian movements. Poster presented at the Northeast Biological Graduate Student Conference, Orono, ME, February 28, 2004.
- PATRICK, D. "Conservation of Roseate Tern on Rockabill Island, Ireland." Presented at the Wildlife Ecology Seminar Series, University of Maine, Orono, ME, September 20, 2004.
- PERKINS, J. C., R. CHALMERS, S. P. CAMPBELL, E. SMALL, J. LONG, and C. STROJNY. Steering Committee Members for 2004 Northeast Biological Graduate Student Conference, University of Maine, Orono, ME, February 27-29, 2004.

QUEHEILLALT, D. M., and M. L. MORRISON. "Monitoring riparian restoration sites for vertebrate use: a case study along the central coast of California." Presentation at the 15th Annual International Conference of the Society for Ecological Restoration, Austin, TX, November 20, 2003.

RENNER, S., and J. GILBERT. "Factors affecting harbor seal (*Phoca vitulina*) activity budgets on haul-out ledges shared by grey seals (*Halichoerus grypus*) on Mount Desert Rock in the Gulf of Maine." Abstract presented at the 15th Biennial Conference on the Biology of Marine mammals, Greensboro, NC, December 14-19, 2003.

RIVERA, L. O., N. POLITI, L. ABENDANO, and G. PETER. "Population status and conservation of Alder amazon (*Amazona tucumana*) in Argentina. Presented at the IV Reunion Regional de Selvas de Montana (IV Regional conference of montane cloud forest), Tarija, Boliva, August 2003.

RHYMER, J. M. "Conservation Genetics: turtles, voles, shrews, ducks, and mussels. Invited Seminar, Department of biological Sciences, Clemson University, Clemson, SC, February 28, 2004.

RHYMER, J. M., M. J. WILLIAMS and R. T. KINGSFORD. 2004. Implications of phylogeography and population genetics for subspecies taxonomy of Grey (Pacific Black) Duck (*Anas superciliosa*) and its conservation in New Zealand. Presented at the American Ornithologists' Union annual conference, Laval University, Quebec, Canada, August 18, 2004.

ROBINSON, L. "The effect of snowshoe hare density on Canada lynx occurrence in Maine." Presented at the Northeast Biological Graduate Student Conference, Orono, ME, February 28, 2004.

SCHILLING, E.G., C.S. LOFTIN, and A.D. HURYN. Landscape attributes of fishless lakes in Maine, Poster presentation at the 2004 Annual Meeting of the Society of Conservation Biologists, New York, New York, July 30 - August 2, 2004.

SERVELLO, F. A. "Black Tern ecology in Maine." Presented at the Wildlife Ecology Seminar Series, University of Maine, Orono, ME, December 1, 2003.

SEWARD, L. C. N. "Wildlife Radiotelemetry Workshop" Presented at Craig Brook National Fish Hatchery for "Biology Day" at John Bapst Memorial High School, Bangor, ME, May 25, 2004.

STROJNY, C. A. Moderated Forest Ecology session (oral presentation) at the 2004 Northeast Biological Graduate Student Conference, University of Maine, Orono, ME, February 27-29, 2004.

STROJNY, C. A. and M. L. HUNTER, JR. "A comparison of amphibian abundance in harvest-created and natural canopy gaps in a northeastern forest." Presented at the 2004 Joint Meeting of Ichthyologists and Herpetologists, Norman, OK. May 27-31, 2004.

WOODS, S., V. ROUGH, J. GILBERT, G. WARING, and S. BRAULT. "The current status of gray seals (*Halichoerus grypus*) in the United States." Abstract presented at the 15th Biennial Conference on the Biology of Marine mammals, Greensboro, NC, December 14-19, 2003.

ZYDLEWSKI, J., S. CLEMENTS, M. KARNOWSKI, C. SHRECK, and G. ZYDLEWSKI. "Movements and migrations of coastal cutthroat trout." Presented at the Atlantic International Chapter of the American Fisheries Society, Fairlee, VT, September 20, 2004.

PUBLIC TALKS PRESENTED

GILBERT, J. R. "Maine's Wildlife: The Good, Bad, and the Ugly." Presented at the Winterport Women's Club, Winterport, ME, January 14, 2004.

GILBERT, J. R. "Harbor Seals in Maine." Presented at Project SHARE education series, Machias, ME, February 12, 2004.

HARRISON, D. J. "Effects of coyotes on Maine's deer herd: is there a need for a snaring program." Talk presented to Student Chapter of The Wildlife Society, University of Maine, Orono, ME, December 6, 2003.

HUNTER, M. L. "Of salmon and salamanders: Conserving shore lands in a forested landscape." Presented at the Downeast Lakes Land Trust, February 4, 2004.

SERVELLO, F. A. "Wildlife Ecology program and black tern research at UM." Maine School of Science and Mathematics, Limestone, ME, December 12, 2003.

TELEVISION, RADIO, AND NEWSPAPER INTERVIEWS

BEAUDRY, F. Following a telephone interview with Misty Edgecomb, reporter for the *Bangor Daily News*, a front-page article entitled, "Volunteers help protect Maine's turtles", was published on June 24, 2004. Story included information about Beaudry's graduate work in the Department of Wildlife Ecology.

BEAUDRY, F. Following a field visit and interview, a story entitled "Tracking rare turtles in southern Maine" aired on Maine Public Radio, during the program "Maine Things Considered", on June 11, 2004. Jeannie Baron was the reporter for Maine Public Radio.

AWARDS, HONORS, AND APPOINTMENTS

DEGOOSH, K. Received 2nd place award for a poster presentation in the Bio Sciences Category at the 2004 University of Maine Graduate Student Research Expo, Augusta, ME, April 13, 2004.

DEGOOSH, K. Received 1st place Best Graduate Student presentation for a poster presentation entitled "Is *Chaoborus americanus* an indicator of fishless ponds in Maine?" at the 2004 Maine Water Conference, Augusta, ME, April 21, 2004.

STROJNY, C. A., and M. L. HUNTER, JR. Presentation entitled, "A comparison of amphibian abundance in harvest-created and natural canopy gaps in a northeastern forest" received honorable mention in the conservation category of the Siebert Awards, of the Society for the Study of Amphibians and Reptiles. This presentation was given at the 2004 Joint Meeting of Ichthyologists and Herpetologists in Norman, OK, May 27-31, 2004.