

**COOPERATIVE FORESTRY RESEARCH UNIT**  
**Research Proposal**

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**Date of Proposal:**

April 15, 2009

**Project Title:**

*Relative Densities, Patch Occupancy, and Population Performance of Spruce Grouse in  
Managed and Unmanaged Forests in Northern Maine*

**Abstract**

Spruce grouse are a protected, conifer dependent species in Maine, and are of special conservation status in New York, Vermont, and New Hampshire. In the southeastern portion of their range (centered on Maine), spruce grouse populations have recently been classified as fragmented and vulnerable to extinction; these concerns are receiving national and cross-border attention. Populations in the southeastern portions of the geographic range have also been characterized as sensitive to habitat alteration and the reduction of conifer forests. A recent time series of satellite imagery suggests a >50% reduction in classic conifer and lowland conifer habitat in northern Maine since 1970, suggesting that research is needed to address the status of spruce grouse habitats and the future viability of populations in Maine. We hypothesize that the structural requirements of spruce grouse may be met in a wider variety of silvicultural conditions than are typically considered viable habitat for the species. This project will thus compare and evaluate spruce grouse populations and patch occupancy among advanced regenerating conifer-dominated clearcuts, precommercially thinned conifer stands (10-20 years post-thinning), and “classic” mature conifer dominated and lowland conifer stands. Additionally, we will model vegetation and landscape attributes associated with patterns of occurrence and density to evaluate attributes that might be retained in harvested areas to maintain habitat suitability for spruce grouse. Value-added aspects of the project include the maintenance of long-term silvicultural re-measurements in regenerating conifer clearcuts (post-herbicide), re-measurement of PCT stands 10-20 years post-thinning, and funding to re-measure stands critical to the ongoing hare-lynx studies funded by CFRU. Finally, the study will have logistical and analytical benefits of working on established study sites with a known history of management and baseline information on habitat characteristics and structural conditions.

**Principle Investigator(s)**

<u>Name</u>	<u>Organization</u>	<u>Phone</u>	<u>Email</u>
Dr. Daniel J. Harrison	CFRU/UMaine	581-2867	<a href="mailto:harrison@umenfa.maine.edu">harrison@umenfa.maine.edu</a>
Dr. Angela K. Fuller	UMaine	581-2869	<a href="mailto:angela_fuller@umit.maine.edu">angela_fuller@umit.maine.edu</a>

**Principal Research Establishment**

The University of Maine, Orono, Maine

## Potential Cooperating CFRU Members or Other Research Organizations

<u>Name</u>	<u>Organization</u>
Kelsey Sullivan	Maine Department of Inland Fisheries and Wildlife
Dr. T. Bently Wigley	National Council for Air and Stream Improvement National Fish and Wildlife Foundation
MDIFW	Maine Outdoor Heritage Program
Scott Williamson	Regional Conservation Needs Grants Program

## Start and Termination Dates of Study

October 1, 2009 – May 31, 2013

## Background

Spruce grouse (*Falci pennis canadensis*) are a conifer-dependent species (Boag and Schroeder 1992, Storch 2000) with uncertain conservation and population status in Maine and protective management (i.e., no open hunting season). Although reduction in the extent of mature conifer forest in western, northern, and eastern Maine could be hypothesized to adversely affect spruce grouse, this species often occupies stands of black spruce, white cedar, and tamarack (Bouta and Chambers 1990, Boag and Schroeder 1992, Whitcomb et al. 1996b) on areas of marginal site quality. Previous work in Maine has documented that size and distribution of conifer patches are important determinants of spruce grouse occupancy and that dispersal through unfavorable habitat is important to maintain occupancy of small patches over time (Whitcomb et al. 1996a).

The management status of spruce grouse is highly variable in jurisdictions adjacent to Maine. The species is state listed as endangered in New York and Vermont, and is listed as a species of conservation concern in New Hampshire. However, sizeable populations occur in Quebec and New Brunswick where the species is legally harvested. Maine's Acadian forest occurs along the transition zone between the conifer dominated forests to the north, where the spruce grouse is abundant, and the more fragmented, hardwood dominated forests to the south where the species is absent. Populations have been documented to be particularly sensitive to habitat alteration and reduction in extent of conifer stands along their southern range boundary. In fact, the recent Spruce Grouse Continental Conservation Plan (Williamson et al. 2008) suggests that spruce grouse populations in the southeastern portion of the Atlantic Northern Forest are fragmented and vulnerable to extirpation. Fragmentation of suitable habitat for spruce grouse is particularly detrimental because of their relatively short dispersal distances (Fritz 1979, Herzog and Keppie 1980) and large (25 ha) home range size (Turcotte et al. 2000). Spruce grouse conservation in the southeastern portion of their range is receiving national and international attention, and it would be strategic for Maine's forest landowners to understand the species' habitat selection and the contribution of habitats created or enhanced through past forest management activities to counteract the recent declines in amount of habitat assumed to be important to spruce grouse.

Spruce grouse have been traditionally assumed to be associated with large patches of mid-late successional conifer forest and with coniferous forested wetlands. Within a 4.5 million acre study area in northwestern Maine, Legaard and Sader (*in preparation*) estimated from a time series of satellite imagery that mid-late successional coniferous forests were being harvested at a

rate of 9,000-28,000 acres annually from 1976-2007, and that coniferous forested wetlands were being harvested at an accelerating rate (1,000-2,000 acres annually from 1976-1988, and 3,000-5,000 acres annually from 1989-2007). Large clearcuts have been implicated in local extirpation of spruce grouse populations (Boag and Schroeder 1992) and spruce grouse in Quebec moved out of recent clearcuts and into uncut buffer strips (Potvin and Courtois 2006) where they had reduced survival and reproductive success (Turcotte et al. 2000). However, the New York State Comprehensive Wildlife Conservation Strategy attributes the decline of spruce grouse in New York to maturation of the forest and prohibitions on forest management in the Adirondack Forest Preserve, suggesting that some form of forest management may be necessary to maintain populations. Additionally, spruce grouse have also been documented to occur in plantations and precommercially thinned stands (PCT); therefore, forestry may sometimes promote the well developed middle stories and tree heights of 7-14 m that represent the structural characteristics of the lowland conifer stands that spruce grouse typically occupy (Boag and Schroeder 1992, Potvin and Courtois 2006). Substantial use of precommercially thinned stands by spruce grouse was documented during a CFRU sponsored study of the effects of PCT on snowshoe hares, small mammals, and forest structure (Homyack 2003). During 2001, 19 adult spruce grouse (8 females, 11 males) were observed in 17 stands treated with PCT (mean = 1.12 birds/stand), and 7 adults (3 females, 4 males) were observed in 13 unthinned stands that had been clearcut previously (mean = 0.54 birds/stand). Seven of 8 females observed in the PCT-treated stands were accompanied by broods, which indicated local occupancy and reproduction within these human-created habitats. Further, no broods were observed in the unthinned stands, suggesting that PCT could be beneficial for breeding female nest-site selection and success.

Intensive forestry is often hypothesized to result in reduced diversity and abundance of wildlife, particularly those species typically associated with mid-late successional conifer forest. However, wildlife typically respond to structural characteristics of forests rather than to species and age composition *per se*. Homyack (2003) speculated that PCT could positively affect forest structure for spruce grouse and concluded that further exploration of these relationships would be beneficial to forest landowners. An evaluation of the density, patch occupancy, and population performance of spruce grouse among regenerating clearcuts (without subsequent precommercial thinning), precommercially thinned stands, and “classic” mid- to late-successional, lowland conifer stands is needed to evaluate whether human-created habitats can support, enhance, or promote viable spruce grouse populations. We propose to capitalize on the previous data collected (e.g., site location, site quality, and forest structural characteristics) within the 30 stands (17 thinned, 13 unthinned) utilized by CFRU scientists during the precommercial thinning study and 15 unthinned stands (7 shared with PCT study) that have been repeatedly measured as part of the ongoing lynx-hare research project funded by the CFRU. These sites will be paired with nearby patches of classic habitat to form a basis for evaluating the relative habitat quality of spruce grouse among the 3 site classes.

## **Project Objectives**

**Objective 1:** Survey and compare mating season densities of spruce grouse among 1) regenerating clearcuts (25-30 years post-cutting); 2) stands that have been clearcut (25-35 years previous), herbicided, and precommercially thinned; and 3) “classic” stands of mid- and late-successional lowland forest (black spruce and tamarack).

**Objective 2:** Evaluate and compare patterns of patch occupancy of spruce grouse among clearcut, PCT, and classic habitats. Calculate average patch sizes, interpatch distance, and amount of each stand type in circles centered on nests and survey stations that approximate two ecological spatial scales 1) the scale of nest location, and 2) the scale of the home range of grouse and their broods during summer.

**Objective 3:** Model vegetation, stand, and landscape attributes associated with patterns of occurrence and density of spruce grouse to evaluate characteristics that might be retained in harvested areas to maintain use by spruce grouse after harvesting.

**Objective 4:** Evaluate and compare survival, nest success, and recruitment of spruce grouse among the clearcut, PCT, and classic habitat patches to evaluate relative population performance (this objective will require funding additional to that proposed herein).

## **Experimental Design**

We will census spruce grouse in unthinned clearcuts, precommercially thinned stands, mid-late successional conifer forest stands, and in coniferous forested wetlands. We will conduct standardized transect surveys and will attract birds by broadcasting a recording of the female cantus (aggressive call) and will subsequently capture birds with a noose pole (Schroeder and Boag 1989, Keppie 1992). We will individually mark adult birds with colored leg bands and young chicks with wing tags. Surveys will be conducted in early spring and summer using a combination of fecal pellet transects, audio calls, and trained pointing dogs. Censuses will coincide with the nesting period, which typically occurs 17 days after the ground is 50% free of snow (Keppie and Towers 1990). Additionally, we have a history of 15 precommercially thinned stands and 15 unthinned stands where we have long-term vegetation data. We will repeat vegetation measurements to evaluate structural development in PCT stands and to compare with classic “paradigm” habitats. Vegetation measurements include height and dbh of understory and overstory stems, density of understory and overstory stems, density of regenerating stems, percent ground cover, number and volume of logs, canopy density, and horizontal vegetation distance.

## **Value-Added Aspects of the Project**

Our experimental design will benefit from long-term monitoring by the CFRU within 15 regenerating conifer clearcut stands that have been successively measured to evaluate structural characteristics and successional development in 2001, 2005, and in 2008. Those stands will be re-measured in 2011 to accomplish shared objectives across silvicultural studies, the ongoing hare project, and the proposed spruce grouse study. Additionally, we plan to utilize precommercially thinned conifer stands that were previously studied and measured (2001) by CFRU scientists. This will provide 5 stands 10 years-post thinning, 5 stands 15 years post-thinning, and 3 stands 20 years post-thinning with known histories that will be utilized as study sites for the spruce grouse aspect of the work, and which will be re-measured in 2011. Those re-measurements will also provide valuable silvicultural data on stand development, growth, and structural maturation following thinning. There is no funding within currently approved projects to fund the re-measurements of those stands; therefore, approval of the spruce grouse project would meet multiple objectives of the CFRU and would maintain CFRU previous investments in

long-term studies. Further, habitat inferences from the spruce grouse study would be substantially enhanced by available baseline information on stand development and structure within those proposed study sites.

## **Analytical Approach**

We will compare the density of breeding males and observations of females with broods between habitats. First, we will test for annual variation in density by testing the significance of interaction terms. If annual variation was not detected, we will pool data from the different years. We will evaluate the effects of landscape composition at two spatial scales using log ratios (Aebischer et al. 1993). Metrics defining patch occupancy will be calculated with program FRAGSTATS. Finally, we will use a regression modeling approach to model within and between-stand characteristics associated with spruce grouse occurrence and abundance to evaluate attributes that may be retained in harvested or thinned stands to maintain habitat use by spruce grouse.

## **Anticipated Benefits to the CFRU**

This project would provide the first baseline information on the relative densities of spruce grouse among managed, intensively managed, and classic habitats in the eastern United States. Additionally, the project will provide insight into the utility of human-managed habitats to support this conifer-forest associated species. We anticipate that spruce grouse will continue to receive increased attention in the Acadian forests of the northeastern U.S. and that Maine will evolve as the central focus for spruce grouse conservation in the eastern U.S. Information on habitat use will provide a basis for informed decisions that might avoid overly simplistic assumptions that declines in mature conifer forest and conifer forested wetland habitats equate to spruce grouse endangerment.

## **Schedule of Deliverables**

<u>Deliverable</u>	<u>Date</u>
CFRU Report	Annually
CFRU Field Tour	Fall, 2011
Oral Presentation	Fall, 2012
CFRU Research Note	December 2012
Powerpoint Presentation to CFRU	January 2013
Graduate Thesis	May 2013
Peer-reviewed Publications	December 2013

## **Communications Plan**

- CFRU annual reports (by November 1, yearly)
- Oral progress reports at CFRU advisory committee meetings
- CFRU Results article
- Graduate Thesis
- CFRU Technical Report or Note
- Potential Publications:

- 1) Habitat composition and fragmentation effects on spruce grouse occupancy of landscapes in Maine.
- 2) Effects of clearcutting and precommercial thinning on spruce grouse in Maine.

## LITERATURE CITED

- Boag, D. A., and M. A. Schroeder. 1992. Spruce grouse. Pages 1-28 *In* A. Poole, P. Stettenheim, and F. Gill, editors. The Birds of North America, No. 5. The Academy of Natural Sciences, Philadelphia, PA and The American Ornithology Union, Washington, DC.
- Bouta, R. P., and R. E. Chambers. 1990. Status of threatened spruce grouse populations in New York: a historical perspective. Pages 82-91 *In* Ecosystem management: rare species and significant habitats. New York State Museum Bulletin 471.
- Fritz, R. S. 1979. Consequences of insular population structure: Distribution and extinction of spruce grouse populations. *Oecologia* 42:57-65.
- Herzog, P. W., and D. M. Keppie. 1980. Migration in a local population of spruce grouse. *Condor* 82:366-372.
- Homyack, J.A. 2003. Effects of precommercial thinning on snowshoe hares, small mammals, and forest structure in northern Maine. M.S. Thesis. University of Maine, Orono, Maine. 196 pp.
- Keppie, D. M. 1992. An audio index for male spruce grouse. *Canadian Journal of Zoology* 70:307-313.
- Potvin, F., and R. Courtois. 2006. Incidence of spruce grouse in residual forest strips within large clear-cut boreal forest landscapes. *Northeastern Naturalist* 13:507-520.
- Schroeder, M. A., and D. A. Boag. 1989. Evaluation of a density index for territorial male spruce grouse. *Journal of Wildlife Management* 53:475-478.
- Storch, I. 2000. Grouse. Status and Conservation Action Plan 2000-2004. IUCN, Cambridge, UK. 112 pp.
- Turcotte, F., R. Courtois, R. Couture, and J. Ferron. 2000. Impact à court terme de l'exploitation forestière sur le tétras du Canada (*Falci pennis canadensis*). *Canadian Journal of Forest Research* 30:202-210.
- Whitcomb, S. D., F. A. Servello, and A. F. O'Connell. 1996a. Patch occupancy and dispersal of spruce grouse on the edge of its range in Maine. *Canadian Journal of Zoology* 74:1951-1955.
- Whitcomb, S. D., F. A. Servello, and A. F. O'Connell. 1996b. Productivity of the spruce grouse at the southeastern limit of its range. *Journal of Field Ornithology* 67:422-427.
- Williamson, S. J., D. Keppie, R. Davison, D. Budeau, S. Carriere, D. Rabe, and M. Schroeder. 2008. Spruce Grouse Continental Conservation Plan. Association of Fish and Wildlife Agencies. Washington, DC. 60pp.

## RESUMES OF PRINCIPAL AND CO-PRINCIPAL INVESTIGATORS:

### *DANIEL J. HARRISON*

#### PROFESSIONAL POSITIONS

**7/2002-present: *Professor of Wildlife Ecology***, Dept. of Wildlife Ecology, University of Maine; ***Cooperating Scientist***, Maine Cooperative Forestry Research Unit (1999-present), ***Cooperating Professor***, Department of Forest Ecosystem Science (1997-2005); ***Cooperating Professor***, Center for Research on Sustainable Forests (2006 – present), and ***Faculty Associate***, Maine Cooperative Fish and Wildlife Research Unit, Univ. of Maine. Tenured, academic year appointment with shared research (50%) and teaching (50%) responsibilities; appointment changed to 75% research, 25% teaching, effective 9/1/2005. Course instruction: Wildlife-Habitat Relationships (WLE 450, Cr. 4), Introduction to Wildlife Resources (WLE 100, Cr. 1), Graduate Course in Habitat Ecology (WLM 650, Cr. 4; team-taught), Graduate Course in Carnivore Ecology and Management (WLE 565, Cr. 3). Serve as academic advisor to undergraduate students (10-24/yr) and as thesis advisor for graduate students. Responsible for: base-funded research program in wildlife-forestry relationships supported through the Maine Agricultural and Forest Experiment Station; extramurally funded research program in habitat relationships of forest wildlife and ecology of meso-carnivores and their prey; public service; technology transfer. Provide research advisement and technology transfer to large private forest landowners, state and federal resource management agencies, and NGO's.

**7/2001-6/2002: *Interim Chair***, Department of Wildlife Ecology, Univ. of Maine

**9/2000-6/2001: *Professor of Wildlife Ecology***, Dept. of Wildlife Ecology, Univ. of Maine

**9/93-8/00: *Associate Professor of Wildlife Ecology***, Dept. of Wildlife Ecology, Univ. of Maine

**1/88-8/93: *Assistant Professor of Wildlife***, Dept. of Wildlife Ecology, Univ. of Maine

**2/86-12/87: *Wildlife Research Supervisor*** (Staff Associate-Wildlife), CT DEP, Wildlife Bureau

**6/85-2/86: *Furbearer Program Leader*** (Wildlife Biologist II), CT DEP, Wildlife Bureau

#### EDUCATION

1982-1985: University of Maine, ***Ph. D. in Wildlife***, August 1986.

1980-1982: University of Maine, ***M.S. in Wildlife Management***, May 1983

1976-1980: University of Wyoming, ***B.S. in Wildlife Management***, May 1980.

#### RESEARCH OVERVIEW

Dr. Harrison's research program is focused on mammalian predator-prey systems and social organization, and inter-specific interactions and habitat relationships of forest carnivores. Recent research has addressed landscape-scale habitat requirements of wide-ranging mammals, use of umbrella species in wildlife habitat planning, effects of forest practices on wildlife, lynx and marten conservation, social organization and dispersal of eastern coyotes, competition among mammalian predators (coyote-bobcat and coyote-fox niche relations), and the effects of un hunted populations of deer and hares on post-fire forest succession. His current research includes studies of the effects of trapping and timber harvesting on American martens, history and habitat association of lynx, effects of forest management on snowshoe hares, and habitat extent and distribution for wolves in eastern North America. Another ongoing effort of his research team includes GIS-based assessments of habitat selection by several species of mammalian predators at multiple spatial scales. His projects have generated > \$3 million in external grant support from a variety of state and federal agencies, landowner cooperatives, foundations, and NGO's.

#### PUBLICATIONS

1 co-edited book, 12 chapters in edited books, 31 refereed journal articles, and 50 technical publications.

## **RESEARCH PRESENTATIONS (including as co-author)**

157 scientific presentations (authored or co-authored)

## **GRADUATE MENTORING**

Served as major advisor for 14 M.S. and 6 Ph.D. students; 16 theses completed to date.

Served on > 35 graduate committees where I did not serve as major advisor.

Mentored 3 post-doctoral research scientists and managed forest-wildlife research lab.

## **CLASSROOM TEACHING**

Taught 27 sections of 6 undergraduate semester courses (median instructor rating 1.42; 1=excellent, 5=poor ); managed and taught the required 3-week, summer field session for wildlife students annually for 10 years (median instructor rating 1.50); advised 8-32 undergraduate wildlife students annually, taught 9 semesters of graduate courses in Predator Ecology and Habitat Analysis (median instructor rating 1.50), and instructed graduate thesis (36 semesters).

## **HONORS AND AWARDS**

**2009:** Distinguished Wildlife Alumnus Award, Dept. Wildlife Ecology, Univ. Maine

**2008-2009:** University Research Sabbatical, University of Maine (competitive award)

**2008:** Award of Professional Excellence, Department of Wildlife Ecology, The University of Maine (awarded to alumni)

**2007:** Award of Meritorious Service, Maine Chapter of The Wildlife Society

**2006:** G. Peirce and Florence Pitts-Webber Award to the Outstanding Researcher in Forest Resources, University of Maine

**2000:** G. Peirce and Florence Pitts-Webber Award to the Outstanding Researcher in Forest Resources, University of Maine

**1992:** Distinguished College of Forest Resources Professor of the Year, Univ. Maine

**1985:** Dow-Griffie Award to an Outstanding Graduate Student in Agriculture, Forestry and Wildlife at the University of Maine

**1984:** New England Outdoor Writer's Scholarship to Outstanding Wildlife Student in New England (selected from regional competition among state-level awardees).

***ANGELA K. FULLER***

## **PROFESSIONAL POSITIONS**

### **Post-Doctoral Scientist and Associate Graduate Faculty, University of Maine**

Orono, Maine: August 2007 – Present

Lead a landscape planning initiative for The Nature Conservancy in northern Maine using American marten and Canada lynx as focal species. Model current and retrospective habitat conditions using predictive models, use spatial optimization models to identify tradeoffs among lynx and marten habitat and forest management objectives, quantify net conservation benefit for lynx and marten using alternative harvest and management scenarios, and quantify anticipated habitat conditions for lynx and marten to 2019. Collaborate with US Fish & Wildlife Service, forest industry, Maine Department of Inland Fisheries and Wildlife, and NGO's. Co-advise a Master's student researching the population dynamics of snowshoe hares and spatial ecology of Canada lynx.

**Post-Doctoral Scientist, University of Maine**

Orono, Maine: June 2006 – August 2007

Generated, tested, and applied landscape-scale models to predict probability of occupancy and density of endangered Newfoundland martens. Developed a novel approach to estimate density for wide-ranging territorial quadrupeds. Served as a consultant to the Newfoundland endangered species recovery team.

**Graduate Research Assistant (Ph.D.), University of Maine**

Orono, Maine: January 2001 – May 2006

Dissertation research included concepts of scale, spatial use of landscape features, fragmentation, habitat amount thresholds, movement patterns, and habitat selection at multiple spatial scales. I examined the effects of scale on ecological processes and patterns to identify spatial scales relevant to Canada lynx and American martens. Research included applied and theoretical ecology, analytical approaches, and predictive modeling. Field-work on lynx was conducted during winter at a remote field station. Hired, trained, and supervised 6 field technicians during 2 winters. Collaborated with state and agency personnel in Maine and Federal and Provincial personnel in Newfoundland. Co-authored grants and presented grant proposals for research in Maine and Newfoundland. Presented research at National and local conferences.

**Instructor, Wildlife Habitat Evaluation (WLE 455), University of Maine, Orono, Maine: Spring 2004**

**Research Associate, University of Maine**

Orono, Maine: January – December 2000

Research involved statistical and GIS analysis and writing contract reports for three studies: 1) General Ecology of Red Foxes and Competition with Coyotes on Mount Desert Island, Maine. 2) Occurrence, Distribution, and Survey Methods for Mammals in Acadia National Park, Mount Desert Island, Maine. 3) Habitat Selection of White-tailed Deer on Mount Desert Island, Maine.

**Teaching Assistant, Wildlife Field Survey (WLE 250), University of Maine, Orono, Maine: May 1997**

**Teaching Assistant, Management of Wildlife Populations (WLE 410), University of Maine, Orono, Maine: Spring 1997**

**Graduate Research Assistant (M.S.), University of Maine**

Orono, Maine: November 1996 – December 1999

Designed master's thesis research project on the influence of partial timber harvesting on American marten habitat selection and responses by their primary prey. Field-work included marten live-trapping, ground-based and aerial radiotelemetry, small mammal trapping, and microhabitat sampling. Analysis involved GIS applications using ARC/INFO. Hired, trained, and supervised 10 field technicians during summer and winter conditions. Presented research at National, International, and local conferences.

**Resource Management Intern, Acadia National Park, Bar Harbor, Maine: Fall 1996**

**EDUCATION**

Ph.D. University of Maine, Wildlife Ecology, 2001- 2006

M.S. University of Maine, Wildlife Ecology, 1996-1999

B.S. University of Maine at Machias, 1992-1996

## **AWARDS & HONORS**

The Wildlife Society Leadership Institute, 2008

Outstanding Wildlife Ecology Graduate Student Award for academic and research excellence and professionalism, University of Maine, Orono, Maine. April, 2006.

Dow and Griffee Graduate Student Research Award, University of Maine, Orono, Maine. December, 1999.

Outstanding Graduate Student Award, Department of Wildlife Ecology, University of Maine, Orono, Maine. April, 1999.

## **PUBLICATIONS**

Fuller, A. K., D. J. Harrison, and J. H. Vashon. 2007. Winter habitat selection by Canada lynx in Maine: prey abundance or accessibility? *Journal of Wildlife Management* 71:1980-1986.

Fuller, A. K., and D. J. Harrison. 2005. Influence of partial timber harvesting on American marten in Maine. *Journal of Wildlife Management* 69:710-722.

Campbell, S. C., A. K. Fuller, and D. Patrick. 2005. A review of doctoral education: looking beyond research. *Frontiers in Ecology and the Environment* 3:153-160.

Fuller, A. K., D. J. Harrison, and H. J. Lachowski. 2004. Stand-scale effects of partial harvesting and clearcutting on small mammals and forest structure. *Forest Ecology and Management* 191:373-386.

Fuller, A. K. 2004. Canada lynx predation on white-tailed deer. *Northeastern Naturalist* 11:395-399.

Harrison, D. J., A. K. Fuller, and G. Proulx. 2004. *Martens and Fishers (Martes) in Human Altered Environments: An International Perspective*. Springer, New York. (Peer-reviewed book)

19 Miscellaneous Publications and Technical reports

## **PRESENTATIONS**

27 Presentations at National and International Conferences (First Author on 14, Co-author on 13)

43 Scientific Presentations (First Author on 26, Co-author on 17)

15 Invited Lectures

4 Public Service Talks