

Canada Lynx (*Lynx canadensis*) in the Northern Appalachians:

Current Knowledge, Research Priorities, and
a Call for Regional Cooperation and Action



Susan Morse

Report of a Meeting held in Portland Maine, April 2002

by

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PREFACE

Recently declared “threatened” by the U.S. Fish and Wildlife Service under the Endangered Species Act, and either listed or scheduled to be listed as a Species at Risk in several eastern Canadian provinces, there are numerous knowledge gaps with regard to the conservation status of the Canada lynx (*Lynx canadensis*) and their critical prey species, snowshoe hare (*Lepus americanus*) in eastern North America. Conservation of northern species at the southern end of their ranges presents particular challenges. With populations confined to the southern extensions of boreal-like forest habitat that exist primarily in large upland plateaus and at higher elevations, lynx habitat quality is naturally lower in the southern periphery. This situation may become compounded further by the pressures on habitat brought about by resource extraction and human settlement. Connections between the Northern Appalachian region and contiguous boreal forest north of the St. Lawrence Seaway are tenuous at best, and there is little idea at present whether genetic interchange across this relatively hostile area is sufficient to prevent isolation of Northern Appalachian lynx. Not only is research increasingly demonstrating that the ecology of southern populations differs from that of the north, but few generalizations about western lynx populations (which have been the focus of most research to date) can be readily applied to the East.

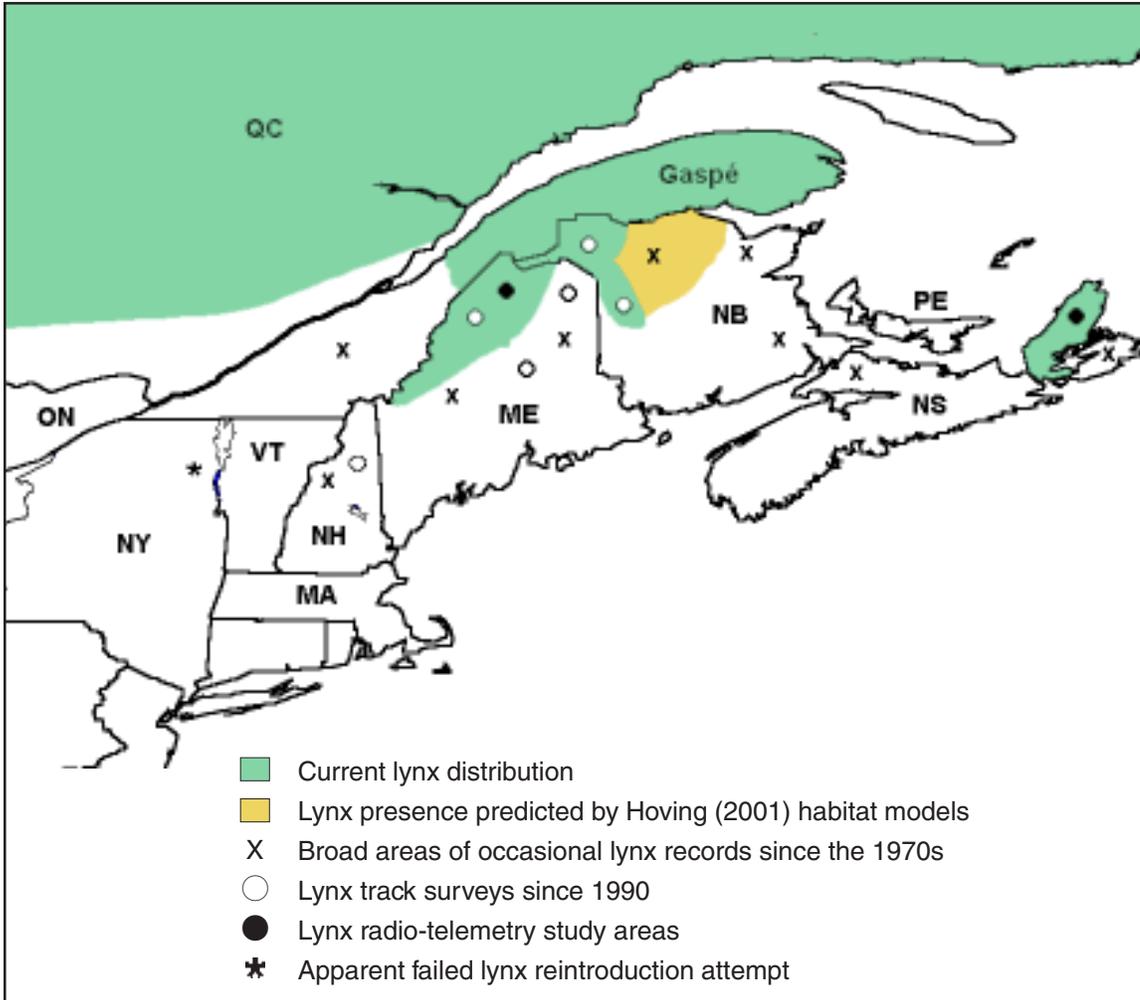
Canada lynx is an important flagship species and furbearer for the Northern Appalachian region straddling the border of the United States and Canada. The Northern Appalachian region is a natural conservation planning unit, and coordination of research and conservation activities in the region is critical for the large-scale ecosystem and landscape approach required for the successful conservation of wide-ranging species such as the lynx. Such coordination faces many obstacles, however, including monetary and personnel constraints of small jurisdictions and a lack of common regulations among states/provinces and between the USA and Canada.

This report seeks to distill discussions that take place during a recent workshop convened among regional biologists and managers, that was aimed at summarizing and discussing the state of region-specific knowledge and priorities for action concerning lynx in the Northern Appalachians. This report is not meant to review the biology of the lynx, nor serve as detailed minutes of the meeting, but is rather a summary of the latest available information as presented on that occasion, and the results of day-long discussions among lynx experts. This is the first stage of what we hope will be a dynamic and ongoing process, and should be read in that context. We sincerely hope that the exchange started at this meeting will continue in the same spirit and provide a blueprint for a continuing quality of dialogue and investigation without which Northern Appalachian Canada lynx would be at increasing risk.

We would like to thank the participants, who collectively brought decades of experience from the field to the table, along with their intimate knowledge of the particular region-specific biology of this animal. Most workshop participants (listed in Appendix 1) provided helpful comments and/or re-wrote sections of various drafts of this report. Special thanks to Susan Morse for generously providing the photograph that adorns this cover. The convening of the Northern Appalachians Lynx Science Workshop was an initiative of the Wildlife Conservation Society, and was co-sponsored by U.S. Fish and Wildlife Service, and International Association of Fish and Wildlife Agencies.

MAP OF LYNX DISTRIBUTION IN THE NORTHERN APPALACHIANS

(modified from Hoving [2001] with input from workshop participants)



EXECUTIVE SUMMARY: WORKSHOP OUTCOMES

In April, 2002, a Northern Appalachian Lynx Science Workshop was convened with the goal of making the first steps towards adopting a regional approach to lynx research and conservation in the trans-boundary region of northern New England, Québec, New Brunswick, and Nova Scotia. Such a gathering was timely due to the recent listing of lynx as a Species at Risk in Nova Scotia and under the U.S. Endangered Species Act, as well as the initiation of several research efforts directed at the species over the past few years. Scientists and managers concerned with lynx in the region attended the workshop to address issues central to achieving conservation of this species. Discussions centered around identifying critical monitoring, research, management, and conservation needs; the development of a regional and cross-border management strategy; and the potential for working closely with the forest industry sector towards lynx conservation in the private land matrix.

The general conclusion was that a group facilitating eco-regional communication, well-coordinated collaborative science, and the development of regional conservation planning for lynx and hare would be far better able to drive the research agenda, secure the necessary resources, and facilitate implementation of necessary conservation measures than single-species initiatives driven by individual jurisdictions. Participants agreed that there was a need to collectively carve out the best strategies and prioritize individual actions that would lead to coordinated activities towards the conservation of Northern Appalachian lynx.

In the event that the northeastern lynx might appropriately be regarded as a Distinct Population Segment in the context of the U.S. Endangered Species Act, a creative opportunity may present itself for pulling together representatives from federal, provincial, and state management agencies, universities and the private sector (including non-governmental organizations and forest industry leaders) to proceed with the work that needs to be done to achieve conservation of this species. The Northern Appalachian Lynx Science Workshop and formation of a lynx science group could serve as a springboard for such action. Even without a D.P.S. designation, such a group operating over the transboundary region could serve well in a technical advisory role to official provincial, federal recovery teams, and to help ensure cross-border cooperation.

Much discussion focused on the nature of the guidance that the group would want to provide to ensure lynx conservation at the landscape scale. As it is so important to work from a common information base, a critical activity would be to determine what data are already available, and what meta-analyses exploring the most important questions could be performed using existing data. Participants reached the conclusion that lynx conservation needs should not be looked at in isolation of snowshoe hare –its principal prey –the distribution and abundance of which drives lynx abundance in any given area. With respect to monitoring and research, there are strong arguments to be made that hares should in fact be the priority focus, particularly in light of the fact that in this region they serve as the anchor in an otherwise depauperate prey community. The ramifications for lynx and members of the diverse predator community with which it undoubtedly competes, are not yet fully understood.

Whereas some understanding of lynx habitat associations has been attained in north-eastern North America, population dynamics remain poorly understood. The extent to which hare populations actually cycle throughout the Northern Appalachians, for example –so well known in northern regions –is still very much in question. We cannot be sure at this time what is the “currency,” or the specific environmental factors that lynx (and snowshoe hare) respond to, and what actually drives habitat selection at the stand and landscape scales. Moreover, we are only beginning to develop an understanding of the impacts of forest management on hare (and lynx) habitat. For example, biologists are investigating the impact of the shift that is occurring in Maine from clearcutting to partial harvesting and the implications for the entire landscape. Finally, a more comprehensive understanding of the suite of mortality factors that impact lynx in the region –ranging from roadkill, to interspecific competition, to disease and incidental mortality from trapping –is needed.

It is clear that the Québec portion of the Northern Appalachians contains the most robust lynx populations, although the extent of movement into Maine and New Brunswick, and across the St. Lawrence Seaway is unknown. There is hopeful evidence of periodic movements of lynx between Nova Scotia and New Brunswick, indicating that the possibility for successful dispersal out of Cape Breton remains open. Genetic analyses are underway to help address such critical questions as the degree of isolation of lynx sub-populations, and hence the prospects for maintaining habitat connectivity. It is important to note that hare in the Gaspé Peninsula are currently at peak levels, and that a window of opportunity exists within the next year or two to study dispersal of lynx when hare populations begin to crash.

Hare and lynx monitoring programs and protocols are poorly developed in most jurisdictions of Northeastern North America. Much discussion focused on the need to undertake a coordinated effort to monitor hare populations across jurisdictions over the long term. An immediate priority is to develop monitoring programs that are standardized across boundaries. The same is certainly true in the case of lynx; however, there was recognition that doing the job right will take tremendous resources that are currently unavailable. This will likely necessitate some creative thinking with regard to the involvement of private citizens and landowners.

The underlying context of all discussions at the workshop was the profound challenge that we face with regard to the maintenance of robust lynx populations in the East, given the rarity of true boreal habitats and abundant snowshoe hare populations. The influence of global climate change on lynx habitats and their more southern competitors (particularly coyotes [*Canis latrans*], bobcat [*Lynx rufus*], and fisher [*Martes pennanti*]) adds another layer of complexity to an already uncertain situation. Fortunately, there is tremendous potential for persistence of lynx in managed forests in the region, many of which are remote from human population pressures. This potential offers opportunities to work together with forest industry leaders in order to incorporate increasing understanding of lynx (and hare) habitat needs into management planning. The dispersal needs of wide-ranging species like the lynx will be useful to inform the conservation community of priorities for landscape connectivity. Several of the priority research action items identified in the workshop (see below) would benefit from immediate action, but success will require a collective research effort.

A summary of research priority action items resulting from the workshop are as follows:

- ◆ Develop mechanisms for tracking hare populations in New Brunswick, a key link in the geographic picture.
- ◆ Complete genetic analyses and determine what metapopulation and source/sink dynamics exist.
- ◆ Compile existing hare population and habitat data into a landscape model to understand what if any synchrony exists across the region.
- ◆ Use the opportunity of lynx/hare population peak in Québec to better understand dispersal and metapopulation dynamics.
- ◆ Develop standardized hare survey methodology that can be incorporated across jurisdictions.
- ◆ Develop standardized lynx detection and survey protocols appropriate for administration in all appropriate habitats throughout the Northern Appalachians region.
- ◆ Work towards a greater understanding of lynx population dynamics (demographics) and causal factors (e.g., habitat, prey, competition).
- ◆ Attain better understanding of lynx mortality factors.
- ◆ Develop harvest-independent lynx population and demographic indices.
- ◆ Synthesize existing data into meta-databases to allow for synthesis and pattern analysis.
- ◆ Pool resources among jurisdictions and interest groups to avoid duplication and successfully accomplish actions.
- ◆ Formalize structure of Northeastern lynx science group and steering committee.
- ◆ Maintain communication between biologists, managers, forest industry leaders, conservation groups, etc. concerned with Northern Appalachian lynx conservation.

INFORMATION NEEDS AND RESEARCH AND ACTION PRIORITIES

Genomic Diversity. At this time, DNA samples from lynx in Cape Breton, New Brunswick, Newfoundland, Québec (both sides of the St. Lawrence), and Maine are being analyzed by Warren Johnson's lab (National Cancer Institute) as part of the MDIFW/USFWS Maine lynx study (see Appendices 2 & 3). This should begin to yield necessary information on the extent of genetic flow between regions (New Brunswick-Québec-Maine, Cape Breton-New Brunswick, north and south of the St. Lawrence River). The extent to which these results will be able to answer fundamental questions related to dispersal and metapopulation, and/or get population markers, or the detail that we need in a timely manner, is as yet unclear. Preliminary results should be forthcoming by late November.

Lynx and hare need to be treated together. We have a complex predator community, and a simple prey community, the anchor of which is snowshoe hare. The myriad issues facing lynx conservation demand a focus on both species together.

Hare monitoring. One of the first priorities will be to look most closely at population dynamics of snowshoe hare over the region. There needs to be a coordinated effort to monitor hare populations across jurisdictions over the long term, as well as a consistency in monitoring efforts across boundaries, and the development of standards. For example, a program to track hare populations in New Brunswick, a key piece of the puzzle, is needed. Currently there is no feeling that there is synchrony with hares within the province, and that this may be driven by differences in snow depth.

Lynx monitoring. Apart from the annual analysis of harvest statistics and trends elucidated from trappers' logbooks (as included in Québec's lynx management plan [MEF 1995]) and the furbearer track surveys in Maine, there are no comprehensive lynx monitoring programs in the Northern Appalachians region. There are significant areas where even surveys for detection (presence/absence) have not been conducted. Examples include sites where Christopher Hoving's model predicts lynx should have been (i.e., Christmas Mountains in north-central New Brunswick), and where there were no confirmed occurrences, or northern Vermont, where credible reports of lynx occurrence over the years need to be followed up. The U.S. Forest Service rubbing post protocol (McDaniel et al. 2000) is being applied on a limited basis, but questions remain as to its efficacy in the Northeast. The recent experience of northern Maine is a case in point. Until a concerted effort to look for lynx was initiated in 1994/5, evidence that a resident population existed in the state was limited to anecdotal reports (breeding was then confirmed when animals were radio-collared beginning in 1999).

Other means of monitoring lynx besides the traditional reliance on trapping are needed, since no legal trapping seasons exist for lynx in Northern Appalachian jurisdictions other than Québec. During the first year of lynx crash, pregnancy and litter numbers are poor measures of recruitment and population decline; therefore we need to put more emphasis on lynx/hare dynamics. In the south, the key could be adult lynx mortality, and the intensive population research in Maine (MDIFW; see Appendices 2 and 3) should be continued in order to learn more about demographic parameters that influence population viability.

Lynx conservation efforts will depend on the ability to mount and maintain effective monitoring programs. At present, this will likely require help from the private sector, including large landowners, local trappers, or non-profit and local citizens groups where harvest data do not exist. For example, trained volunteers could assist agency personnel and university biologists in conducting such surveys (e.g., Keeping Track®).

Hare population dynamics. What is the evidence for hare cycling in the south? Is true cycling occurring or merely population fluctuations? The best case for cycling would be on the more boreal settings of the Gaspé Peninsula and Cape Breton, but is it occurring elsewhere? These questions have implications for habitat suitability, because individual lynx will disperse at the onset of hare population crashes. Population peaks and valleys are synchronous between Québec and some parts of New Brunswick, but the amplitudes are unknown. Peaks in Québec and Newfoundland appear to be getting lower over time. Hare population changes with habitat succession are also important, given that hare habitat is ephemeral and under constant change, especially in this region where extensive permanent shrublands are rare to non-existent (in contrast to true boreal forest).

Lynx population dynamics and dispersal. Research areas need to focus on lynx dispersal issues, which would be best evaluated with telemetry. At the scale of the ecoregion, is there a source/sink phenomenon going on? Now is the time to take advantage of peaks that we are observing in Québec to see where lynx are dispersing. Are corridors between northern and southern populations open at all? In Maine, kitten dispersal is not well documented, but limited observations suggest that they may be returning to their natal areas, which could indicate limited habitat and dispersal opportunity and saturation of the study area. We need to acquire a deeper understanding of lynx at the population level (demographics) to understand the currency to which lynx are responding. For example, if we look at impacts of habitat fragmentation on lynx occurrence too soon before we understand the background matrix that drives the metrics, we will not get the complete picture. The Gaspé Peninsula of Québec appears to be a key area for source population(s). At least one participant, however, pointed out that although forest cover on the Gaspé Peninsula reaches 95%, only a relatively small number of large contiguous blocks of public forest remain unfragmented, as there is a high density of roads (paved and unpaved but accessible) in areas key to maintaining connectivity with New Brunswick and Maine (Global Forest Watch 2002).

Lynx mortality factors. Impacts of roads, interspecific competition (coyotes, bobcat, fisher), disease (i.e., canine distemper), and incidental trapping, need to be better studied. For example, a surprising result of the MDIFW radio-telemetry study has been the recording of several incidences of suspected fisher predation on lynx, underscoring the need for better understanding about the relative importance of various mortality factors in the region, and how these relate to habitat change.

Developing a better understanding of hare habitat. We have an inadequate understanding of the temporal relationships between hare and habitat, especially in relationship to forest management. Judging from Angela Fuller's (1999) research, the broader implications of the rapid shift toward partial harvesting that has been occurring in Maine, for example, appear to be quite negative for snowshoe hare populations. It will be necessary to develop an understanding of how much hare habitat is needed to support lynx at the landscape scale, e.g., age class, successional stage, etc. One goal would be to develop

predictive landscape models of hare density at stand and sub-stand scales, and thereby assess lynx habitat currency as it relates to hare. The first steps toward building a hare model would be to compile existing hare habitat information (mostly stand-level) into a landscape model.

Lynx habitat supply assessment. Given that hare habitat and movement and activity of lynx are the two main topics upon which research needs to be focused, steps should be taken to pull together 1) a predictive model of hare density relative to forest structure at stand and sub-stand levels, 2) a model of lynx density/occupancy at various scales to define currency for habitat quality, and 3) an integration of the two to evaluate habitat supply across the landscape and produce a template for actions. Priorities for action include: analysis of lynx genetic data and follow-up, compiling existing hare data, and making the best of the current peaks in Québec and (possibly) Maine to gain a better understanding of dispersal issues.

Synthesis of existing data. There is a need for assembling different, relevant data-sets and bringing together existing data to analyze existing patterns. We need to build on Christopher Hoving's (2001) modeling work and historical analyses, which accomplished a lot of this synthesis.

Making the most of limited resources. Resources available within each jurisdiction are limited; therefore we have to be careful that we don't set the bar so high that we won't be able to clear it. Focusing on a few collective endeavors, rather than engaging in diffuse individual efforts, may translate into a more efficient harnessing of limited available resources.

Working with forest industry. Forest industry leaders should be involved in regional lynx conservation efforts. Trust must first be built; the focus should be on building relationships upon existing partnerships, exploring collaboration opportunities, and acquiring support at all levels of a given organization. Two-way information sharing is a big issue. Aside from gaining access to private lands to conduct field studies, biologists are interested in obtaining data layers pertinent to habitat analyses (including historical information). Forest companies must be kept abreast of the results of research occurring on their properties, and actively share in discussing new tools to help them manage for lynx and hare. Forest certification has put the onus on forest landowners to develop more detailed monitoring programs. Although these organizations have the ability to carry out the necessary field programs, most lack the technical expertise to develop proper monitoring protocols. This gap may provide a good opportunity for collaboration and result in enhanced industry participation.

In the case of the MDIFW lynx research in northern Maine, although the land has changed hands since 1999, there has been good cooperation with forestry companies. Den sites translate into bragging rights. While forest companies did express some concern about the potential legal ramifications of the listing of lynx, MDIFW and USFWS assured them that the objective of the research was to get good science incorporated into the process. The industry has been involved at a funding level as well, i.e. through a consortium of landowners, and companies have generously provided appropriate data layers for habitat analyses and have been tremendously cooperative in facilitating research efforts taking place on their land.

Practical issues concerning remote data layers. Remote data should be gathered as a regional exercise whenever possible instead of attempting to thread data together piece by piece. Forest inventory data for study area will provide consistent habitat classification on timely basis, although some industry leaders are understandably reluctant to share information on a large scale. The Nature Conservancy has been conducting broad-scale geographic analyses of the Northern Appalachian region for the identification of priority conservation sites in its ecoregional planning process –a substantial effort that could serve as a springboard for other broad-scale analyses.

Regional coordination. What role should a coordinated Northern Appalachians Lynx Science group play? Should it concern itself exclusively with the science of lynx conservation and provide information to inform management decisions, or should it be an informal recovery team for the transboundary region? A research group would be charged with managing science and conservation, coordination of research planning and implementation, addressing information needs over a broad area, and helping to secure necessary resources. A “recovery team” would take this a step further, by formulating a regional Action Plan, and/or serve as a technical advisory committee to any of the formal federal, provincial, or state Recovery Teams. A coordinated group would have much greater potential and chance for success than jurisdictional single-species initiatives.

A group concerned with Northern Appalachian lynx conservation should hold regular meetings, and maintain contact and communication in the interim. A regular meeting would provide the glue to the bigger group, while a smaller sub-set (5-6 person Steering Committee) would need to convene on a more regular basis and take the responsibility to guide the process. The group would also have to be able to communicate its identity to others. It stands to tremendously increase the collective power to seek financial assistance and raise the priority of action related to lynx within individual jurisdictions. Translation mechanisms are key: Any and all important documents generated must be translated into French.

An important role for the lynx science group will be to serve as a vehicle for communication of scientific information particular to lynx and hare in the Northern Appalachians to conservation groups, forest industry leaders, and wildlife managers working in the region. For example, Northeast Wildlife Administrators should be enlisted to ensure they are aware, have buy-in, and a mandate is there for any appropriate action they have the power to pursue. This in turn could come back through the Northeast Furbearer Resource Technical Committee. If, for example, the lynx science group recommended standardized monitoring of lynx and/or hare to jurisdictions, and this information was fed back through the proper channels, it might actually happen.

APPENDIX 1:

LYNX SCIENCE WORKSHOP STRUCTURE

Organization and Goals of the Meeting

The session began with presentations by agency representatives giving jurisdictional status reports, and descriptions of current and recent agency-led monitoring and research efforts. This was followed by presentations of current research initiatives led by University of Maine research team (led by Daniel Harrison and William Krohn), proposed dynamic regional carnivore modeling exercises (Carlos Carroll for The Wildlands Project), a report of pending court decisions under the U.S. Endangered Species Act (given by Michael Amaral of the U.S. Fish & Wildlife Service), and a slide show detailing research on lynx foot morphology as it relates to track identification (presented by Susan Morse of Keeping Track®). At the end of the first day, participants launched into a discussion of needs and priorities for lynx conservation in the region. This extended into the next day with break-out groups focusing on the individual topics of: 1) information needs as they relate to lynx (and snowshoe hare) habitat; 2) information needs as they relate to lynx (and snowshoe hare) population dynamics, 3) working with forest industry, and 4) how to achieve regional cooperation. The final 90 minutes of the workshop were spent wrapping up discussions while concentrating on appropriate next steps.

Specific goals of coming together –as expressed by the participants themselves –included:

- ◆ Develop a better understanding of lynx ecology in the Northern Appalachians;
- ◆ Prioritize research necessary to enable effective conservation of lynx in eastern North America;
- ◆ Discuss ways in which to achieve better research coordination and efficiencies across the region;
- ◆ Plan for analyses of large contiguous forest areas across biophysical gradients;
- ◆ Make preliminary steps towards resolving cross-boundary issues and individual jurisdictional concerns regarding managing lynx and sharing of information;
- ◆ Begin the process of developing a blueprint for an Action plan for the conservation of Northern Appalachian lynx with clear objectives, endpoints, and deadlines;
- ◆ Discuss ways in which to communicate with forest industry and non-governmental conservation leaders.

Workshop Participants

Michael Amaral	New England Field Office, U.S. Fish and Wildlife Service
Mark Anderson	The Nature Conservancy
Carlos Carroll	Klamath Center for Conservation Research
Graham Forbes	New Brunswick Cooperative Fish & Wildlife Research Unit, University of New Brunswick
Clément Fortin	Société de la faune et des parc du Québec, Direction du développement de la faune
Angela Fuller	Department of Wildlife Ecology, University of Maine
Louise Gratton	La Société canadienne pour la conservation de la nature - Région du Québec
Dan Harrison	Department of Wildlife Ecology, University of Maine
Christopher Hoving	Wildlife/GIS consultant (formerly Department of Wildlife Ecology, and Maine Cooperative Fish and Wildlife Research Unit, University of Maine)
Cade Libby	Fish & Wildlife Branch, New Brunswick Department of Natural Resources & Energy
John Litvaitis	Department of Natural Resources, University of New Hampshire
Bevan Lock	Stora Enso Port Hawkesbury Limited Woodlands Unit
Robert Long	Cooperative Fish & Wildlife Research Unit, University of Vermont
George Matula	Maine Department Inland Fisheries & Wildlife, Wildlife Resource Assessment Section
Craig McLaughlin	Utah Division of Wildlife Resources (formerly MDIFW)
Susan Morse	Keeping Track, Inc. (Vermont)
Mike O'Brien	Furbearers & Upland Game Section, Nova Scotia Department of Natural Resources
Eric Orff	New Hampshire Fish and Game Department
John Organ	Federal Aid Division, U.S. Fish & Wildlife Service
Gerry Parker	Canadian Wildlife Service
Justina Ray	Wildlife Conservation Society-Canada
Jennifer Tietjen	Lake Umbagog National Wildlife Reserve
Adam Vashon	USDA Wildlife Services (formerly MDIFW)
Jennifer Vashon	Maine Dept. Inland Fisheries & Wildlife

APPENDIX 2:

RESEARCH AND CONSERVATION REPORTS

The following is a brief summary highlighting recently completed and ongoing research on Canada lynx and snowshoe hare in the Northern Appalachians as presented in this workshop. The details can be found in corresponding theses and publications, or by directly contacting researchers.

Lynx habitat relationships in eastern North America (University of Maine)

What do we need to know about lynx habitat relationships in eastern North America?

- ◆ Lynx distributions at the temporal scale;
- ◆ Geographic scale habitat associations (regional and within states/provinces);
- ◆ Sub-stand scale selection: how do lynx (and hare) respond to finer scales, i.e. pre-commercial thinning;
- ◆ Lynx responses to snowshoe hare density: If hare select based on cover, is the best hare cover the best lynx cover?

Some of these are being addressed with current and past research efforts, much of it conducted by graduate students and faculty at the University of Maine, led by Dan Harrison and William Krohn.

Some Highlights:

Hoving (2001):

In examining temporal stability in lynx distribution, there was no evidence the situation has changed drastically within Maine. Elsewhere in the Northeast, lynx were gradually extirpated from Pennsylvania, New York, Vermont, New Hampshire, Massachusetts, and Prince Edward Island.

Extensive areas of regenerating forest are associated with lynx occurrences in Maine. There are no convincing data to support assertions that lynx are or were associated with old-growth forest conditions in eastern North America.

A regional model was constructed comparing 1,150 lynx observations collected since 1985 against random points. Deciduous forest cover and snowfall were included in a model at regional scale (100 km² circle to approximate lynx home range), with a predictive power equal to 94%. Bottom line: You're not going to have lynx without enough snow or with too much deciduous forest cover. (This, incidentally, is not necessarily the same potential habitat as for wolves). Lynx presence was associated with landscapes having more than 2.6 m mean annual snowfall and less than 27% deciduous forest cover.

When the sensitivity of potential lynx habitat to changes in snowfall depth (in the face of climate change, for example) was modeled, serious negative impacts on future distribution were projected. This is, however, purely a "what if" scenario and not a prediction, as a warming climate does not necessarily mean snowfall (or hare) will decrease.

At a smaller scale where snowfall and deciduous forest are more uniform (such as within Maine), models predicted that the extent of the landscape in regenerating habitat is an important factor determining lynx presence. The proportions of the landscape in partial harvest, recent clearcuts, and forested wetlands were also important.

Fuller (1999) and Homyack (in prep):

Hare densities respond to habitat change in a logarithmic rather than a linear fashion: 12-15 year old regenerating clear-cuts had 280 times higher hare densities than early regenerating partially harvested stands (1.6/ha vs. 0.01/ha); mature mixed forest stands had about seven times higher snowshoe hare densities than those that were partially harvested. Control stands (regenerating stands that had been clearcut and herbicided previously) had seven times more snowshoe hare than those that were pre-commercially thinned, but not as striking a difference as between partial and clear-cuts.

Fuller (in prep):

Angela Fuller is conducting her current Ph.D. research on lynx sub-stand scale habitat selection by undertaking within-home range backtracking of lynx in snow (home ranges are based on telemetry data provided by MDIFW). The study involves GPS and continuous line sampling, tracking of prey and edge crossings, and stopping for intensive silviculture measurements. She will be evaluating different foraging path shapes (tortuosity), assessing habitat availability on paths, and comparing the results to random transects within the appropriate home range.

Canada lynx den characteristics in northern Maine (MDIFW and USFWS)

Editors' Note: the overall MDIFW research project (see Appendix 3) was not presented in detail at this workshop (for more information, see MDIFW 1998-2001).

Organ et al. (in prep):

The dens of 11 females were examined to describe den site selection in a heavily managed forest and to look at productivity (17 litters to date). Preliminary analyses of habitat at the den sites showed volumes of downed woody debris equivalent to what has been found on 100-yr old stands, even though stands are only 15 years old. Likewise, horizontal cover was thick and dense and stem density was high. This unusual structure might be an artifact of a spruce budworm outbreak that occurred in the late 1970s and early 80s, or it could be similar to the situation on Cape Breton island where understory density and debris is not simply a function of stand age.

Population viability modeling for lynx in the Northeast trans-boundary Region (The Wildlands Project)

Carroll (in prep):

This project is part of the overarching goal of The Wildlands Project (TWP) to promote coordinated wildlands planning to preserve and restore connectivity in the U.S./Canada transborder region. It is founded on the premise that focal species can help identify location and size of reserves due to their large area and connectivity needs as well as their sensitivity to ecosystem processes.

The primary goal is to develop a comprehensive carnivore conservation strategy in the Northeastern U.S., through dynamic modeling of the potential viability and distribution of lynx (along with other species) based on habitat, human impacts, and potential future restoration or degradation of the landscape. Specific tasks will be to refine existing habitat suitability models and develop new ones with GIS technology using satellite imagery, human impact (census), and other data, and incorporate these static habitat models into a dynamic individual-based model (PATCH) that provides information on extinction risk and viability. This would provide the foundation for assessing the potential ability of specific conservation networks for the maintenance of viable populations of carnivores and the contribution of northeastern U.S. carnivore populations to viability of carnivores in the region. Another goal will be for these analyses to identify potential corridors within and between core refugia for lynx, including potential dispersal routes between Canada and Northeastern United States.

U.S. Federal Endangered Species Legislation

In March 2000, USFWS published the final rule, listing lynx as threatened in 14 of the lower 48 states. The 14 northern tier states were designated as one Distinct Population Segment (DPS). Since the majority of lynx habitat occurred in western National Forests, the primary threat was deemed to be inadequacy of existing federal forest management plans to provide guidance for lynx conservation. Designation of critical habitat was deferred due to higher priority designations.

Defenders of Wildlife et al. sued the U.S. Department of Interior in December 2000 under the citizen suit provision of the E.S.A. The lynx suit complaint challenged the lynx listing on the following main points:

- ◆ Failure to list as endangered, rather than threatened;
- ◆ Failure to designate critical habitat;
- ◆ Failure to recognize many of the “serious, ongoing threats to lynx;”
- ◆ Failure to designate multiple DPS’s.

USFWS provided a response 60 days after the suit was filed, as well as a copy of the administrative record, about 8,000 pp. long. The expectation is that the rule from Judge Gladys Kessler will be based on the administrative record (no jury trial or expert witness testimony) and that it will come this fall. It is quite possible that the verdict will be in favor of designating critical habitat, and/or perhaps multiple DPS’s.

Designating critical habitat, however, may be difficult to do with this wide-ranging mammal. Up to April 2002, much FWS staff time was devoted to responding to the lawsuit, taking biologists out of the field and keeping them from working on a recovery plan. If the ruling does go the direction of designating “critical habitat”(CH), FWS could use Christopher Hoving’s habitat model (1999) as a starting point to define CH in the Northeast. CH only affects activities on federal land or federal activities on other land, so it would not apply to many or perhaps any activities on the private forest land that dominates the land base in the Northeast. Another important consideration is also that the “habitat” may be suitable for lynx for only a limited time period, representing a stage in plant succession.

Canadian Endangered Species Legislation

Editors' Note: There was no presentation specifically devoted to this topic at the workshop.

The House of Commons passed a federal Endangered Species Act (Species at Risk Act, SARA) –the third attempt at passing legislation –in June 2002, and referred the bill into the Senate. Previous versions of the bill never made it past the House; this time there is broad consensus that this bill is at least acceptable. Within the Northern Appalachian provinces, Nova Scotia, New Brunswick, and Québec all have provincial endangered species acts. Canada lynx is listed as a Species at Risk in Nova Scotia and New Brunswick, and is on the list of those “likely to be listed” in Québec.

Canada lynx status in Canada is just up for review by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and a status report was recently published by the Canadian Wildlife Service (Poole 2001). Although populations in southern Canada (particularly in the east) were mentioned several times throughout with regard to “localized reductions in numbers and range of lynx,” the overall future of the species in Canada was deemed secure due to the “generally extensive and continuous state of lynx habitat in boreal Canada.” The status in 1989 –“not at risk” –was recommended again (Poole 2001).

APPENDIX 3:

JURISDICTIONAL SUMMARIES

Nova Scotia

Management: Process is underway to list lynx under the Nova Scotia Endangered Species Act (*Editors' note: Canada lynx were listed as Endangered on September 26, 2002*). Although the level of protection will not change much since lynx are already protected from harvest, the designation bestows additional powers, i.e., the mandate to come up with a recovery plan, ability to designate critical habitat, or other measures. Simply the heightened profile may also raise awareness amongst those who harvest wildlife as well as the general public. A Status Report was authored by Gerry Parker (2001) evaluating the past, present, and projected status of lynx in Nova Scotia. It is important to note that any decision that is made for lynx in Nova Scotia has to be sure not to impact the American marten (*Martes americana*) population (also largely restricted to Cape Breton Island), which is very low (probably fewer than 100 individuals) and was classified as endangered in 2001.

Current status and distribution: Lynx have been absent from the mainland since the 1950s and, other than the occasional straggler or disperser, are currently confined to Cape Breton Island. Current population is estimated at 100-200 animals, with 400-600 at peak. At the end of snowshoe hare peaks, and into drops in the 1980s and again in the late 1990s, there were significant dispersals of lynx right to the extreme western end of the province. There is some good potential habitat on mainland Nova Scotia. At least one recent dispersion was into an agricultural area (one female in November 2000), which may have remained because few if any coyotes and no bobcats use high density agricultural land in the floor of Annapolis Valley. A narrow isthmus connects the mainland of Nova Scotia with New Brunswick. Even so, six to eight individuals could have made it to Moncton, N.B. or beyond, given that several made it to central/western Nova Scotia. With respect to the current status of lynx habitat on Cape Breton Island, moose have kept regeneration down and there is a high road density. Most areas on the island experienced deforestation over a short period of time following spruce budworm infestation and salvage logging in the 1970s. Sixty percent of the highland plateau of Cape Breton is a managed industrial forest, which speaks to the socio-political importance of the forest industry in that area.

Historical notes: Harvesting of lynx was stopped in 1975. The population has been relatively stable since then, although not in good shape. The season was reopened in 1978, but then closed after two years during the subsequent hare population crash.

Monitoring: Present day monitoring and data collection includes 1) mandatory submission of all incidental harvests, 2) collection of presence/absence information in conjunction with baited track monitoring and stations operated to obtain information on lynx and American marten, 3) annual collection of abundance rankings from licensed fur harvesters and hunters, and 4) public reports of specific track or animal sightings.

Research and Surveys: Radio-telemetry and snow tracking research was conducted by Gerry Parker and colleagues in the late 1970s on Cape Breton Island (Parker et al. 1983).

New Brunswick

Management: Listed as an endangered species in New Brunswick since 1976, but also classified as a furbearing mammal. The Species at Risk program concerns itself with issues surrounding lynx status, while it is the responsibility of the Furbearer Program to manage data and address management issues and monitoring. The New Brunswick Endangered Species Act holds prohibitions against possession, harming or attempts to harm, which can incur significant fines, but there is no legal definition of critical habitat.

Current status and distribution: There is a small resident population concentrated in the west central part of the province, particularly the northwest corner. Records in the province are spotty. In 2000, two kitten roadkills were found in the northwest part of New Brunswick, and in 2001 one kitten was shot in the northeast. Furthest sighting in the south was a single track found during a winter transect survey in Charlotte County.

Harvesting: There was a bounty on wild cats that started in 1898, which was removed in 1961. Many lynx were exported from New Brunswick in the early 20th century (e.g., 580 in 1919), but by 1930, there were no exports reported.

Monitoring: With the exception of lynx track transect surveys conducted by University of New Brunswick in 1998 and 1999 to determine lynx occurrence/abundance (see below), there have been no official surveys or studies. Present-day monitoring and data collection consists of mandatory collection of carcasses for all lynx found dead, track transect surveys for furbearers and associated prey species (not province-wide), and sighting reports from public and DNR staff (some of which are investigated as to their credibility).

Research and Surveys: In 1998/9 Wildlife Trust Fund New Brunswick (generated from hunting and fishing licenses) funded a survey in the northwestern corner of the province. A rough estimate came up with 20-25 lynx in a 2,000 km² area, or 1/100 km². Lynx sign was never located in areas where snowshoe hare were not abundant and bobcats were abundant. In the northwest by the border with Maine, lynx were fairly abundant. Other parts of the province were not surveyed. Information on lynx movements is unknown, but in this part of New Brunswick, the population probably relies on the Gaspé Peninsula in terms of persistence, fed by dispersing animals (see Forbes et al. 1999, 2000).

Québec

Management: On the list of species "likely to be listed as threatened or vulnerable" since 1992. Until 1980, harvest was regulated through the duration of trapping season only. High fur prices, high trapping pressure in the 1980-1990 period, research, and population monitoring resulted in the implementation of a management plan in 1995. A status report is in progress (Fortin & Tardif in prep). Lynx classification is up for review in 2002; it is expected that this report will recommend removal of Canada lynx from the list of species at risk.

A new management strategy was implemented in 1995 (MEF 1995), followed by the creation of Fur Management Units (FMU) and FMU-specific trapping licenses in 1999. Bag limits vary from 2 to 4 lynx in most FMU's with no bag limit in the 5 FMU's on the

tip of the Gaspé Peninsula. Management is based on the lynx/hare cycle (i.e., four years of successive low hare abundance triggers the crash of lynx populations).

Current status and distribution: Present in all forested regions north of the St-Lawrence River and on lower St. Lawrence and Gaspé regions. Absent in the Eastern Townships, most of the Lower St. Lawrence Valley, and on Anticosti Island. The lynx population estimated at 10 lynx/100 km² at the peak of the cycle, 2/100 km² at the trough, and 4-6 lynx/100 km² on average. The last and current peak began in early 2000. Gaspé Peninsula populations (Regions 1 and 11) have been measured at the same level of abundance as the rest of the province. For a number of years preceding (1993-2000), they were somewhat lower than the provincial average, although they have been “exceptionally high” during these last years.

Harvesting: The total lynx harvest in Québec between 1992-2001 was 11,407 animals, with peaks in 1992-1994 (1176, 928, 965), and 1998-2001 (1105, 1471, 1884, 3012), and closed season in most of the province 1995-1997. In 1998-1999, snowshoe hare populations south of the St. Lawrence did not rise at the same time as they did in the north. In 2001/2002, over 600 lynx were harvested on the Gaspé Peninsula.

Monitoring: Present-day monitoring and data collection involves hare and lynx population trends calculated from harvest reports. Trappers’ logbooks have been used since 1989 (on a voluntary basis) to obtain trapline-specific data on effort as well as captures, from which population trends and abundance for lynx and hare are estimated. Total harvest for lynx is taken from the fur trade system, while hare harvest is obtained through small game harvest statistics. Hare population trends are also monitoring using scat sampling stations (Godbout 1999; Godbout & Poirier 1999).

Research and Surveys: Research priorities as far as lynx are concerned in Québec include: 1) using population modeling to track hare and lynx cycles, 2) estimating harvest potential in each FMU, and 3) genetic analyses of populations north and south of the St. Lawrence to evaluate genetic interchange.

Maine

Management: Lynx have been listed as a species of Special Concern since 1996. Participants in a meeting held in western Maine in 1997, including state, provincial, federal, private, university, and industry stakeholders, concluded that lynx and marten deserved additional attention. The consensus was that lynx status in the Northern Appalachians needed to be determined and Maine was the appropriate starting point.

Status and distribution: There is a breeding population resident in the northern part of the state. There had been next to no information concerning population status until the late 1990s. Early population estimates of ~200 lynx were based on very limited information; we still do not have strong population estimates.

Harvesting: In 1967, the bounty on lynx was repealed and the species was protected completely from hunting and trapping.

Research and Surveys: The Maine Department of Inland Fisheries and Wildlife (MDIFW) has conducted track surveys each winter since 1995 throughout the state targeting lynx and other furbearers. In 1998, because of imminent listing and direction from the 1997 meeting, MDIFW and U.S. Fish and Wildlife Service (USFWS) launched a radio-telemetry study. The goals of this research were to address issues of viability, interchange with larger populations to the north, documentation of population parameters, home range, habitat selection at the stand and landscape levels, interspecific relationships with other predators, and testing the accuracy of various survey techniques including: remote trigger cameras, hair snare work (U.S. Forest Service national detection protocol), and snow tracking.

As of summer, 2002, 31 adults and 37 kittens have been captured for a total of 68 individuals. MDIFW is also cooperating with the University of Maine on work related to snowshoe hare and predator/prey relationships, and sub-stand scale habitat selection (see Appendix 2).

New Hampshire

Management: Lynx were classified as Endangered in 1980.

Current status and distribution: Viable population unlikely to be present. From the 1930s through the 60s, almost all lynx harvested were from the White Mountains in the north. There have been only two known mortalities in nearly 50 years, one in 1966 in the town of Lee, and one in 1992, when an apparently emaciated adult male (21 lbs) was killed by a car on Interstate Route 89 in Grantham. Retired lynx trapper Ray Evans (active in the early 1960s) claimed that lynx sign persisted in the high elevation areas of the White Mountains into the 1980s. There have been sporadic, unverified reports of lynx tracks and sightings in the 1970s, 80s, and 90s, primarily in the White Mountain National Forest region.

Harvesting: From 1928-1964, 139 lynx were harvested in the state, with decline beginning in the 1930s. Lynx were removed from bounty and totally protected in 1971.

Research and Surveys: In 1986, there was a track census in White Mountain National Forest (100 km) led by John Litvaitis (Litvaitis et al., 1991); no lynx tracks were found.

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