Partnership for Lynx Conservation in Maine
December 2001 – December 2002 Field Report
Maine Department of Inland Fisheries and Wildlife

Submitted by

Jennifer Vashon, Adam Vashon, and Shannon Crowley

Principal Investigators

Dr. John Organ, USFWS, Hadley, MA and Dr. George Matula, MDIFW, Bangor, ME

Source of Funds

United States Fish and Wildlife Service, Division of Federal Aid
United States Fish and Wildlife Service, Endangered Species Program
Maine Department of Inland Fisheries and Wildlife, Research Assessment Section
National Council for Air and Stream Improvement, Inc.
National Fish and Wildlife Foundation
Wildlife Conservation Society
Maine Outdoor Heritage Fund
Davis Conservation Foundation
Defenders Of Wildlife
Sweet Water Trust
Lynx System Developers

Cooperators

United States Forest Service
University of Maine
University of Massachusetts
The National Cancer Institute-LGD
Maine Cooperative Fish & Wildlife Research Unit
Maine Department of Conservation
Massachusetts Cooperative Fish & Wildlife Research Unit
Clayton Lake Woodlands
Great Northern Paper Co.
International Paper Co.
Irving Woodlands LLC
Seven Islands Land Co.
North Maine Woods Assoc.
Tufts University

STUDY SUMMARY

In 1999, we began an intensive radio-telemetry study of Canada lynx (*Lynx canadensis*) to document their movements, survival, habitat use, reproduction, and interspecific competition with other predators. This information will be used to generate recommendations for conservation of lynx, including land-use practices to maintain lynx habitat, and policies for recreational use of landscapes occupied by lynx in the northeastern United States. We have captured and radio-collared 30 different lynx (17 females, 13 males) in the study area. An adult female lynx that was captured by a recreational trapper outside the study area was also radio-collared. To date, 1 unmarked kitten (female) and 12 radio-collared lynx (3 males, 9 females) have died. Three lynx died from starvation (1 caused by an under-active thyroid gland), 4 from predation, 1 was illegally harvested, and 4 died of unknown causes. We have documented production of 17 litters: 1 litter in 1999, 3 litters in 2000, 4 litters in 2001, and 9 litters in 2002. Habitat data are currently being collected during each aerial telemetry location, at lynx den sites, and while backtracking lynx in the winter. Four stands where lynx den sites occurred were characterized as regenerating stands (some hardwood and some softwood dominated) with high visual obscurity and high volume of downed-woody vegetation. The remaining habitat data will be analyzed at a later date. Eleven of 83 coyotes, 1 bobcat, 7 of 11 fishers, and 4 of 6 foxes captured have been equipped with radio collars. Three radio-collared coyotes, 1 bobcat, 3 fishers, and all 4 radio-collared foxes have died. Necropsies have not been performed, but based on field observations 1 coyote and 1 fox were struck by vehicles, 2 foxes and 1 fisher died from starvation, 1 fox died of unknown causes, 1 coyote died from natural causes, 1 coyote was harvested, and 2 fisher were killed by a predator. Three winters of snow track surveys have been completed to estimate snowshoe hare and red squirrel abundance. During summer 2001, we initiated a fecal pellet survey to estimate the density of snowshoe hare on the study area. These pellet plots were surveyed in both the spring and fall of 2002.

INTRODUCTION

During the winter of 1999, the Maine Department of Inland Fisheries and Wildlife (MDIFW) began a field study to determine the status of Canada lynx populations in Maine and to develop techniques for monitoring Canada lynx populations in the northeastern United States. The study is expected to span 5 years, and is funded by the United States Fish and Wildlife Service, Division of Federal Aid, Maine Department of Inland Fisheries and Wildlife, National Fish and Wildlife Foundation, The Wildlife Conservation Society, Maine Outdoor Heritage Fund, National Council for Air and Stream Improvement, Defenders of Wildlife, Sweet Water Trust, Lynx System Developers, and Davis Conservation Foundation. Other partners include timber industry landowners (Clayton Lake Woodlands, Great Northern Paper Co., International Paper, Irving Woodlands LLC, North Maine Woods Association, and Seven Islands Land Company) who have allowed access to their land and/or have provided land management and covertype maps, the United States Forest Service, several Universities and other state and provincial governments that have provided equipment and discussion on study design. The National Cancer Institute Laboratory of Genomic Diversity will be conducting genetic analyses to determine the degree of interchange between Maine's lynx population and other populations in southeastern Canada. The Wildlife Veterinarian Clinic at Tufts University provided care and rehabilitation for an injured lynx, as well as, performed study animal necropsies.

The objectives of this study are to: 1) determine if there is a viable, self-supporting population of lynx in a four township area in northwestern Maine, or if northwestern Maine is simply hosting transients from populations in Canada; 2) document mortality factors affecting lynx in northwestern Maine; 3) identify habitats used by lynx in northwestern Maine and how they relate to snowshoe hare distribution and abundance; 4) investigate how lynx distribution in northwestern Maine is affected by sympatric populations of coyotes, red foxes, fishers and bobcats; and 5) test the efficacy of various survey methods used to determine the status of lynx.

STUDY AREA

In February 1999, we began work in a 4-township area in northwestern Maine, just east of St. Pamphile, Quebec (Figure 1), where lynx tracks had been encountered during previous MDIFW snow-track surveys. In mid-March 1999, we explored the Musquacook Lakes region, located 40 miles to the southeast, and encountered additional lynx sign at a greater frequency. Consequently, the remainder of effort has been devoted to the capture and detection of lynx in a 4-township area in the Musquacook Lakes region (Figure 1). Our effort has been focused in two of the four townships (T11 R12 WELS, T12 R12 WELS). In the summer of 2000, we expanded our capture efforts to include T11 R11 WELS and T12 R11 WELS.

Most of northwestern Maine is owned by large, industrial and non-industrial forest companies and is intensively managed for timber production. Recent land sales have occurred in the study area. In 1998, Great Northern Paper Company sold a large parcel of land to Irving Woodlands LLC, which included T12 R12 WELS and T12 R11 WELS. In 1999, International Paper sold their remaining northern land holdings to Clayton Lake Woodlands, which included T11 R11 WELS and T11 R12 WELS. Land management activities in these townships include timber harvest, herbicide applications to promote softwood regeneration, pre-commercial thinning (PCT), and road building. In the past, clearcutting was the primary harvest regime, the majority occurring during the spruce-budworm salvage era. Today, partial cutting is the predominate harvest method. Although this land is privately owned, public access is allowed, and is regulated through the North Maine Woods Association (NMW).

METHODS

Initial field efforts began in February 1999, and lasted until late April 1999. The first season's efforts concentrated on detecting lynx, primarily using snow track surveys, and on capturing lynx for subsequent radio telemetry study. In June 1999, we returned to the field on two occasions to document reproduction by one radio-collared female lynx. In August of 1999, an intensive year-round field effort began. Summer and fall field activities focus on capturing lynx, and winter field activities focus on identifying areas used by lynx, estimating relative abundance of prey and potential competing predators, testing snow-track survey techniques, and capturing lynx. Spring and early summer field activities focus on documenting reproduction. During all seasons, lynx movements, habitat use, mortality, and interactions with potential competing predators are documented.

Capture Efforts

Lynx are captured using foothold traps (Victor #3 softcatch traps), Aldrich foot snares (late winter 1999), cage traps (15"x 21"x 48" Safeguard), and pursuit by hounds. Foothold and cage traps are used during snow-free periods, and hounds and cage traps are used during snow cover months to capture lynx. Smaller cage traps (12”x12”x36” Tru-Catch) are also utilized to capture fishers. Lynx and incidentally captured coyotes, foxes, bobcats, and fisher are immobilized with a mix of ketamine hydrochloride and xylazine hydrochloride. Each animal is marked with uniquely numbered eartags in each ear, various genetic samples are collected (hair follicles, blood, and tissue samples), sex is determined, age is estimated (kitten/pup (0-1 year), subadult (1-2 years), and adult (>2 years)), and various morphological measurements are taken. Lynx weighing > 9 lbs (4.1kg) are fitted with a radio collar. Lynx kittens that weigh between 5 lbs (2.25 kg) and 9 lbs (4.1 kg) will be equipped with lighter radio collars (104 g). Only adult coyotes, foxes, bobcats, and fishers are equipped with radio collars. These animals should have established home ranges within the study area.

Movements and Habitat Use

Each radio-collared animal is located from a fixed-wing aircraft (Piper Super Cub) mounted with directional antennae nearly every day that weather conditions allow (on average, 3 days/week). The animal's location is plotted on an aerial photo and a global positioning system (GPS) unit provides UTM coordinates of the animal's location. Home range size and degree of home range overlap will be assessed using home range estimation software (Ranges V, and/or Animal Movement Analysis Arcview Extension). Stability of range areas for an individual animal will be estimated with multiple rate permutation procedures (MRPP) using the program BLOSSOM.

The pilot, a trained observer, assesses habitat associated with each telemetry location. Habitat is classified as forest (softwood, hardwood, mix), or non-forest (road, wetland, etc). Forested habitats are further classified as mature or regenerating, the dominant tree species is identified, the height of the stand (regenerating forest: 1-5', 6-15', 16-25'; mature forest: <25', 26-45', 46'+), and the canopy closure or stem density are estimated (scarce, moderate, dense), and the proximity of the stand to roads, water, and other habitats are noted. Landowner forest stand inventory data will be used to further characterize habitats within home ranges of radio-collared lynx. Additional habitat use methodologies will be addressed in the future.

Mortality

Radio-collared lynx and potential competing predators are monitored to detect mortality. Each radio collar is equipped with a motion sensitive mortality sensor. Observers are dispatched to investigate the site of any animal observed on mortality mode during a telemetry flight. If the animal has died, the site conditions are described and evidence is collected. If the carcass is available, it is collected and a necropsy is performed to determine cause of death. Survival rates will be estimated using the Kaplain-Meier staggered entry approach (Pollock et al. 1989,White and Garrot 1990) and/or the Heisey-Fuller method (Heisey and Fuller 1985).

Snow-tracking and visual observations (from the aircraft while radio-tracking) of radio-collared females with young are used to provide anecdotal data on kitten survival. Kittens that weigh > 5 lbs (2.25 kg) when captured are collared to document first year survival and cause of death.

Reproduction

During the month of May, repeated telemetry observations of a radio-collared female lynx in a specific location are used to indicate den establishment. We mark the den site by dropping foam-wrapped radio transmitters as near to the den site as possible from the airplane. This increases the possibility of locating the den if the adult female leaves when observers approach. When the den is located, kittens are captured by hand, various morphological measurements are taken, uniquely numbered eartags and PIT tags (2002) are administered, and hair samples (genetic analysis) are collected. The kittens are returned to the den, and the female's movements are monitored by aerial telemetry over several days to verify her return to the den. In winter months, when adult females and their kittens are traveling together, snow tracking is used to provide additional reproduction information for non-collared females and females radio-collared after the denning period.

Den Site Location and Evaluation

We quantify the composition of forest stands at the den sites of each reproductively active radio-collared female lynx. Den site habitat data are collected at 3 scales: micro-habitat, stand, and landscape. We collect standard, fixed-plot (1/40th ha) forest inventory data at den sites to calculate mean stand diameter, basal area, and density. Species composition will be described with several measures including relative dominance, relative density, relative frequency, and an importance value that combines the above three measurements. We measure visual obscurity, canopy closure, understory foliage density (Nudds 1977, Ferron and Ouellet 1992, Griffith and Youtie 1988, Haukos et al. 1998), and volume of downed woody material by species and log decomposition class (Brown et. al 1982, Gore and Patterson 1986, McComb and Lindenmayer 1997). Hardwood and softwood stem density is determined by counting all stems > 0.5m tall and < 7.5 cm dbh within two 15 x 0.5 m plots randomly selected within the fixed area plot (Litvaitis et al. 1985). To determine if the den site differs from the stand or is consistent with stand structure, these measurements are also taken at the stand level by systematically selecting 9 plots using the den site as the base (Brooks et al. 1998). We will use stand volume tables and forest inventory data provided by the landowners to further characterize the stand and to determine what proportion of the landscape contains the den stand components.

Prey and Predator Abundance Surveys

A concurrent study being conducted by the University of Maine will provide information on snowshoe hare abundance within regenerating pre-commercially thinned (PCT) stands. This research began during summer 2000 and is being conducted outside the study area on private land managed for timber and paper production. They have established transects in treatment stands (herbicide and PCT) and control stands (herbicide, but not PCT) to count snowshoe hare fecal pellets to estimate hare density. In 2001, they began a snowshoe hare mark/recapture study to test the validity of their fecal pellet data.

Formal Track Surveys

In the winter of 2000, a snow track survey was designed to assess the relative abundance and distribution of lynx, carnivores that may compete with lynx, and the species that lynx use as prey. For prey species, this survey was initiated to monitor trends in the hare population prior to the University's research. Because the University's study does not occur on our study area, we will continue to conduct this survey. The predator survey will document trends in carnivore abundance during the duration of this study and will augment telemetry data on interspecific competition between lynx and local populations of coyote, fox, fisher, and bobcat. Marten track intercepts will also be recorded to provide information on the abundance of this additional carnivore. Formal track surveys are conducted between 24 and 72 hours after a snowfall or wind event along permanent transects. We attempt to survey each transect at least twice each month (January-March).

Predator transects are 5 km long to increase the likelihood that tracks of predators will be encountered and are spaced a minimum of 5 km apart to maintain independence of transect data. Seven permanent transects have been established along roads to count the number of intercepting tracks of lynx, bobcat, coyote, fox, fisher, and marten. It is impossible to position predator transects within one habitat type due to habitat patchiness, therefore transects are located in more than one habitat type. At each lynx track intercept, UTM coordinates are obtained with a hand-held GPS unit (Garmin 12) for later habitat description.

Prey transects are 3/4 km long to increase the likelihood that tracks of prey will be encountered and are spaced a minimum of 1/2 km apart to maintain independence of transect data. In winter 2000, 42 permanent transects were established along roads to count the number of intercepting tracks of snowshoe hare and red squirrel. Each prey transect is positioned within only one habitat type. Habitat types are defined by forest management activity (period when stand was harvested (e.g. 1970's, 1980's, 1990's) and presence/absence of herbicide treatment) and dominant forest cover type (stand composition (S, H, SH, HS), stand height (<25', 26-45', 46'+), and stem density or canopy closure (scarce, moderate, dense)) using landowner forest inventory maps. Six habitat classes are identified.

After reviewing 2000 abundance data, variation of snowshoe hare track counts within habitat types was higher than expected. Road width varied considerably between some transects and may have been responsible for the high variation, therefore we eliminated transects that were >66 feet in width. As a result, 37 transects are now being monitored for prey abundance. Also, we observed higher than expected variation within transects. We suspect differences among observers may have been partially responsible for this variation. Therefore in 2001, we assigned one observer to a specific set of transects. Habitat classes were redefined by forest management activity only, after learning that inventory maps were not current.

Informal Track Surveys

Informal track surveys are not restricted by snow conditions and can be conducted anywhere. Informal track surveys are designed to identify areas occupied by lynx and to aid in capture activities. At each lynx track intercept, UTM coordinates are obtained with a hand-held

GPS unit, the number of individuals and their behavior is recorded (i.e. hunting, resting, traveling), and habitat is described. An observer describes the composition of the stand by reporting dominant species class (softwood, hardwood, mix), stem density/canopy closure (scarce, moderate, dense), and height class (regenerating forest: 1-5', 6-15', 16-25'; mature forest: <25', 26-45', 46'+).

Snowshoe Hare Pellet Count Surveys

In the summer of 2001, we established a second survey method to estimate snowshoe hare densities on the study area. This survey design follows the protocol of the University of Maine study mentioned previously in this document. We are sampling the 4 most prevalent habitat types within the study area. Habitat types are defined in the same way as snow track surveys: decade of cutting activity (70s, 80s, or 90s), and presence or absence of herbicide application. Eighteen sites were selected: 3 sites that were harvested in the 1970s and were sprayed with herbicide, 5 sites that were harvested in the 1980s and were sprayed with herbicide, 5 sites that were harvested in 1980s and were not sprayed with herbicide, and 5 sites that were harvested in the 1990s and were not sprayed with herbicide. It was difficult to find stands that were harvested in 1970s and not sprayed with herbicide and equally as difficult to find stands that were harvested in the 1990s and sprayed with herbicide. Most pellet count sites were established in stands adjacent to snow track transects so comparisons could be made between estimates. At each site, we established four, 400 m parallel transects spaced 75 m apart. At 20 meter intervals along each transect, a 500cm X 30cm plot was established in a random direction to count snowshoe hare fecal pellets. In the fall of 2001, all plots were cleared of hare fecal pellets. Pellet plots were surveyed in the spring and fall of 2002.

Interspecific Competition and Spatial Relationships

Simultaneous radio locations of lynx, coyote, fox, fisher, and bobcat will be examined to determine any relationship in the movements and spacing patterns of lynx and other predators, and if so, how this may affect lynx distribution in Maine. These observations will be evaluated by comparing movement patterns and home range overlap of radio-collared lynx, coyote, fox, fisher, and bobcat through GIS and other computer technology.

Testing the Efficacy of Snow Track Surveys

Another objective of this study is to develop an efficient snow track survey technique for detecting lynx presence. We accomplish this by testing trained observers ability to detect lynx tracks and by evaluating the distribution of lynx tracks within a township. This survey is conducted 24 hours after a snowfall. Trained observers on snowmobiles survey all roads within a township and record each lynx track observed. At the same time as the road survey, all radio-collared lynx within the township are located by aircraft. Once the road survey is completed, additional observers are provided with the coordinates of each radio-collared lynx location and they navigate to the telemetry location. The observer then follows the lynx track back to the point where the track becomes filled with snow. The observer records a track intercept each time the lynx track crosses a road. This information will be used to calculate a detection rate (# of radio-collared lynx tracks observed during road survey/actual number of radio-collared lynx track intercepts observed while backtracking radio-collared lynx). The number and distribution of lynx tracks observed along roads within a town and the detection rate will be used to develop a track survey technique to detect lynx presence in other areas of the state.

EARLY RESULTS

2001-2002 Winter Capture Activity

Lynx Capture by Use of Hounds

No attempts to capture lynx with hounds were made during this report period.

Cage Traps – Lynx (15”x 21”x 48” Safeguard)

Lynx cage traps were deployed sporadically from 14 January to 27 March; a total of 39 different nights. The number of traps set per night ranged from 1 to 12, for a total of 356 trap nights. Three male lynx and 2 female lynx were captured one or more times each, resulting in 8 total lynx captures (1 lynx/44.5 trap nights), and 1 male fisher was captured 1 time. Two snowshoe hares were incidentally captured (Table 1).

Cage Traps – Lynx (36”x 36”x 48” Custom Built)

A new, larger, custom-built trap was added as a capture technique during the winter of 2001-2002. We would like to acknowledge input from Dr. John Squires and his field staff on this trap design. Based on Montana’s success, we hoped capture efficiency would increase with a larger trap. These traps were deployed sporadically from 28 January to 27 March; a total of 30 different nights. The number of traps set per night ranged from 1 to 12, for a total of 307 trapnights. Four male lynx and 1 female lynx were captured one or more times each, resulting in 9 total lynx captures (1 lynx/34 trapnights), and 2 male fishers were captured 2 times. Two snowshoe hares were incidentally captured (Table 1).

Cage Traps – Fisher

Fisher cage traps were deployed sporadically from 12 January to 27 March for a total of 40 different nights. The number of traps set per night ranged from 4 to 11, for a total of 321 trapnights. Three male fishers were captured one time each (1 fisher/107 trapnights). This winter, we captured our first lynx in this trap. Three male lynx were captured one or more times each resulting in 4 captures (1 lynx/80 trapnights), as well as, 2 martens and 3 snowshoe hares (Table 3).

Cage Trapping Summary

Lynx were captured in all 3 types of cage traps set for lynx and fisher (see above). Ten lynx were captured one or more times each resulting in 31 captures over 984 trap nights (1 lynx/31 trapnights). Two lynx had not been previously captured and were equipped with radio collars. The remaining 8 lynx were already equipped with radio collars, however 1 lynx's (L2) radio collar battery was expected to expire and the radio collar was replaced. At the end of this trapping effort, 19 lynx were being monitored.

Fishers were also captured in all 3 cage traps (see above). Six different fishers were captured one time each over 984 trapnights (1 fisher/161 trapnights). Four of the 6 fishers had not been previously captured. Two fishers had been previously radio collared, however 1 fisher's (Fi6) radio collar battery had failed prematurely in November. We replaced his malfunctioning radio collar this winter. We were monitoring 6 fishers at the end of this trapping period.

2002 Summer/Fall Capture Activity

The focus of this trapping season was to replace collars on previously captured lynx whose collars were low on battery life. Trapping effort was focused within the home ranges of these known individuals. Trapping occurred in townships T11R12 WELS, T11R11 WELS and for the first time in township T10R13 WELS where one of our previously collared lynx had dispersed and established a home range.

Foothold Traps

Foothold traps (#3 softcatch) were set from 6 August to 27 September. An average of 57 traps (range 2 to 85) were set each night, for 2,956 trap nights. Seven different lynx (4 males, 2 females, 1 unknown) were captured one time each, averaging a lynx capture every 422 trapnights (1 lynx every 7.4 days). Four of seven captured lynx were previously captured and radio collared. Two of these lynx were captured to replace their radio collars, which were expected to run out of battery life. Three of 7 lynx had not been previously captured. Two were equipped with radio collars. The remaining lynx released itself unharmed before it could be immobilized.

Fifteen coyotes (6 male, 9 female) were captured one or more times resulting in17 captures, averaging one coyote per 174 trap nights (1 coyote every 3.1 days). Three coyotes (2 males, 1 female) were equipped with radio collars.

Cage Traps - Fisher

Fisher cage traps were set from 12 September to 27 September. The number of traps set each night ranged from 2 to 11, for a total of 151 trap nights. The goal for setting these traps was to recapture a previously collared individual whose collar was low on battery life. No fishers were caught during this trapping period. One snowshoe hare and one red squirrel were captured.

Mortality

Lynx

Three lynx mortalities were documented during this report period. The cause of death for all three mortalities was predation. One female (L9) was found decapitated and cached in a small rock crevice. We never recovered the head of this animal. Fisher tracks were observed visiting the cache site 2 days after we recovered the carcass. We could not determine the species of predator during the necropsy, but we suspect fisher. The second female (L36) was found cached in the base of a cedar snag and fisher tracks were observed at the site. This lynx was fully intact. Based on field observations and necropsy we concluded a fisher had killed this lynx. At the final lynx mortality (L38, adult female) site, we recovered the head and neck of the lynx, which had been cached in a root system. No tracks were detected at the mortality site. Based on the measurements of pre-mortem canine punctures observed on the hide during the necropsy, we concluded a fisher had killed this lynx. We have now documented fisher being responsible for 4 lynx mortalities and the presence of fisher at 3 additional lynx mortality sites. Two of the lynx mortalities where fisher had been present, we could not determine the cause of death as both carcasses had been completely consumed. However, we concluded that fisher had consumed each lynx based on scats and tracks observed at both mortality sites.

All 3 adult females that died during this report period had kittens. L9 had given birth to a late litter (1 kitten) last August (2001), we do not believe this late born kitten could have survived on its own. L36 was radio collared after raising her litter. However, during routine telemetry flights during the 2002 winter, L36 was observed with 3 smaller lynx, suggesting that she had 3 living offspring. We observed lynx tracks in the area of L36 mortality, however the status of these kittens is not known. L38 had produced a litter of 3 kittens this past spring (2002), at the time of her death we did not know the status of her kittens.

Coyote

One radio collared coyote and 9 ear-tagged coyotes died during this report period. The radio collar battery had expired before the coyote was harvested. Recreational trappers and ADC agents harvested 8 ear-tagged coyotes. Five coyotes were harvested in Canada: 4 in Quebec and 1 in New Brunswick. Four of the five coyotes were less than a year old. An additional ear-tagged subadult coyote died from an apparent mange infection.

Fisher

Two of 6 radio-collared fishers died during this report period. A subadult male (Fi9) was in poor condition when captured and died within 2 weeks. A necropsy has not been performed, but we speculate this fisher died of starvation. The second fisher (Fi7), an adult male, was recovered near a moose kill. Based on field observations and necropsy, we concluded that a coyote had killed this fisher.

Fox and Bobcat

No radio-collared foxes or bobcats remain in the study sample.

Den Site Habitat

Den site habitat data were collected in August and September at seven of the nine 2002 den sites. The natal den site was not found for one female who had moved her kitten a few days before we located her second den site. Logistically it was difficult to collect habitat data at the remaining den site that was over 60 miles from the study area. If time allows this summer, we will collect habitat at these 2 remaining sites.

Home Range and Movements

Since 31 March 1999, aerial telemetry efforts have continued. During each day that weather conditions allow telemetry flights, all collared animals are located. Thirty-one lynx, 11 coyotes, 4 foxes, 7 fishers, and 1 bobcat have been monitored by radio telemetry since the study began. Throughout the report period, 19 lynx, 8 coyotes, and 6 fishers were being monitored. During this report period 3 coyotes, 1 lynx, and 1 fisher's radio collars signals were lost (censored). One censored coyote was harvested this fall, and the fisher was recaptured this winter and his collar was replaced. Currently, 18 lynx, 6 coyotes and 4 fishers are being monitored. We are currently analyzing telemetry data and we will report on annual and seasonal home ranges in our final report.

Prey and Predator Abundance Surveys (Formal Track Surveys)

Thirty-six permanent prey transects have been previously established in 4 habitat types within our 4-township study area (T11 R12, T12 R12, T11 R12, and T11 R11). Each habitat type has 5 to13 prey transects. Habitats that were more common had more transects. Three additional prey transects occurred in less common habitats and were surveyed while in route to other transects. During winter 2001-2002, 2 prey transects were not surveyed on a regular basis due to active logging operations in the area. We were able to conduct 3 surveys in January and 2 in March. We did not conduct surveys in February, due to the infrequency of snow events and/or frequency of wind events. Snow track conditions were less than ideal (melting, drifting or heavy log truck traffic), but we were able to complete most surveys with the exception of a few transects during one survey. A total of 183 km were surveyed: 9,878 hare, 206 squirrel, and 66 grouse track intercepts were encountered.

Seven predator transects were initially established and surveyed in the winter of 2000. These transects were again surveyed during this report period, at the same frequency as the prey transects. However, forest harvest activity precluded one predator transect from being surveyed and weather conditions precluded a complete survey in March. A total of 140 km of predator transects were surveyed, and 141 coyotes, 84 marten, 37 lynx, 65 fishers, 0 fox, and 0 bobcat track intercepts were encountered. The data collected from these surveys will be analyzed at the end of the study after an additional winter of data have been collected.

Fecal Pellet Surveys

This spring and fall, pellet plots were counted at 18 sites in the study area from May 08 - 22 and September 20 – 29.

Informal Track Surveys

Informal track surveys were rarely conducted this winter, as we focused on other activities. Occasional surveys were conducted in adjacent areas to search for new areas of lynx occurrence.

Back-Tracking Lynx

During the winter of 2002, 5 radio-collared lynx were followed 6 times and unknown lynx (no telemetry data available) were followed 22 times. Habitat data were collected and will be analyzed at a later date.

These surveys also provided anecdotal information on kitten survival for previously radio-collared female lynx and kitten production for adult female lynx capture and radio collared after the den rearing period. This winter, 3 of 4 adult females who had produced litters (L1-1 kitten, L24-2 kittens, and L25-2 kittens) were still radio collared and being monitored. Throughout the winter, we confirmed that all 5 kittens were still alive. Our pilot independently confirmed these survival observations during routine telemetry flights this winter (visual observation of females and their young). In addition, our pilot observed several of our radio-collared females captured after the den rearing period. Three of the six females were observed with smaller lynx. Based on these observations, 2 females had 3 kittens and 1 female had 2 kittens still traveling with them this winter.

Lynx Detection Surveys

<u>Testing the Efficacy of Snow Track Surveys</u>

This winter, we were able to conduct 1 complete test of this survey technique. Weather conditions did not allow for additional surveys and this survey was conducted under less than ideal weather conditions (wind). Crews surveying roads by snowmobile observed 33 lynx intercepts. While backtracking radio-collared lynx in the survey area, 11 track intercepts on roads were observed. Operators on snowmobiles detected 7 of the 11 lynx track intercepts (crossing detection rate=64%) observed by backtrackers.

This spring, we analyzed 2001 data, which were collected during ideal snow tracking conditions to develop an efficient track survey technique to detect lynx presence in other areas of the state. The snow-track survey route covered 126.4 km within the 97 km^2 survey area, for a survey intensity of 131km/100km^2. During the first test, we detected 3 of 3 radio-collared lynx within the survey area (17 track crossings). During the second test, we detected 5 of 5 radio-collared lynx (23 track crossings). Observers recorded a crossing detection rate of 93%, as they detected 37 of 40 track crossings by radio-collared and non-collared lynx.

We simulated our ability to detect each radio-collared lynx under 4 levels of reduced survey intensity. The stepwise reductions in mapped survey routes translated to survey intensities of 1) 89km/100km^2, 2) 77km/100km^2, 3) 55km/100km^2, and 4) 33km/100km^2. The mapped lynx track crossings indicated that we would have detected all radio-collared lynx at survey intensities as low as 78 km/100km^2. At a survey intensity of 55km/100km2 lynx intercepts were detected, but not all radio collared lynx intercepts were observed.

Camera Surveys

A pilot study was conducted by MDIFW's Endangered and Threatened Species Group from February 8 to March 28 to test the efficacy of camera stations of detecting lynx presence. One township (100 km2) in the study area was selected to conduct the survey based on availability of radio collared lynx (n=7) and reduced field activities in the area, which would minimize cameras being triggered by other personnel. The township was divided into 9 grids (4 mi^2) and 2 cameras were set up in 5 of 9 grids, spaced at least 1 mile apart. No lures or visual attractants were used initially and cameras were checked once a week during a 7 week period. After February 21, visual attractants and lures were added to each camera station and cameras were checked once/week.

During the initial survey, no lynx were captured on film. During the second period (Feb 21-March 28), 4 lynx were captured on film one or more times for a total of 8 captures. During the first and second survey periods, 10 cameras were set for 102 and 300 camera nights, respectively. Success rate during the second survey period was 1 lynx/37.5 camera nights based on total lynx captures and 1 lynx/75 camera nights based on unique lynx captures.

Future Field Efforts

This winter's field crew is reduced due to current budget constraints and will ultimately affect our ability to meet past winter field season's accomplishments. We will focus this winter's field effort on replacing radio collars on 6 lynx that batteries are expected to expire this winter or spring. We will also continue snow-track surveys to track snowshoe hare abundance and continue testing our snow-track surveys for detecting lynx presence if resources are available. This spring, we will investigate dens of reproducing females to document reproductive effort. Field efforts are not expected to continue beyond this spring at our current level of funding.

Literature Cited

Brooks, R.T., H.R. Smith, and W.M. Healy. 1998. Small-mammal abundance at three elevations on a mountain in central Vermont, USA: A sixteen-year record. Forest Ecology and Management. 110:181-193.

Brown, J.K., R.D. Oberheu, and C.M. Johnston. 1982. Handbook for inventorying surface fuels and biomass in the interior west. USDA Forest Service, NFES 2125. 48pp.

Ferron, J., and J.P. Ouellet. 1992. Daily partitioning of summer habitat and use of space by the snowshoe hare in southern boreal forest. Canadian Journal of Zoology. 70:2178-2183.

Gore, J.A., and W.A. Patterson III. 1986. Mass of downed wood in northern hardwood forests in New Hampshire: potential effects of forest management. Canadian Journal of Forest Research. 16(2);335-339.

Griffith, B., and B.A. Youtie. 1988. Two devices for estimating foliage density and deer hiding cover. Wildlife Society Bulletin. 16(2):206-210.

Haukos, D.A., H.Z. Sun, D.B Webster, and L.M. Smith. 1998. Sample size, power, and analytical considerations for vertical structure data from profile boards in wetland vegetation. Wetlands. 18(2):203-215.

Heisey, D.M., and T.K. Fuller. 1985. Evaluation of survival and cause-specific mortality rates using telemetry data. Journal of Wildlife Management. 49:668-674.

Litvaitis, J.A., J.A. Sherburne, and J.A. Bissonette. 1985. Influence of understory characteristics on snowshoe hare habitat use and density. Journal of Wildlife Management. 49(4):866-873.

McComb, W., and D. Lindenmayer. 1997. Dying, dead, and downed trees. Pages 335-372 *in* M. Hunter, ed., Maintaining biodiversity in forest ecosystems. Cambridge University Press.

Nudds, T.D. 1977. Quantifying the vegetative structure of wildlife cover. Wildlife Society Bulletin. 5(3):113-117.

Pollock, K.H., S.R. Winterstein, C.M. Bunck, and P.D. Curtis. 1989. Survival analysis in telemetry studies: the staggered entry design. J. Wildl. Manage. 53(1):7-15.

White, G.C., and R.A. Garrott. 1990. Analysis of wildlife radio-tracking data. Academic Press, Inc. 383pp.

Table 1. Summary of lynx trapping effort and activity on Maine study areas December 2001-November 2002.

Study Area	Trapping Period	No. of Traps	Trapnights	Lynx Captures	Non-target Captures
Musquacook	1/14/02-3/27/02	12 Safeguard Lynx Cage	356	8	1 fisher 2 snowshoe hares
	1/28/02-3/27/02	12 Custom Lynx Cage	307	9	2 fisher 2 snowshoe hares
Musquacook	8/6/02- 9/27/02	Foothold traps (#3 softcatch)	2,956	7	15 coyotes 1 raccoon 1 otter 2 ravens 10 snowshoe hares 1 Northern flicker

Table 2. Summary of lynx captures in Maine from March 1999 to November 30, 2002.

ID	Capture Date	Sex	Ageclass	Radio Collared	Ear Tagged
L1	3/26/99	Female	Adult	Yes	Yes
[1]	6/18/99	Female	Kitten	No	No
[1]	6/18/99	Male	Kitten	No	No
L2	9/26/99	Male	Adult	Yes	Yes
L3	9/28/99	Female	Adult	Yes	Yes
L4[2]	10/05/99	Male	Kitten	No	Yes
L5[3]	10/18/99	Male	Subadult	Yes	Yes
L6	10/21/99	Female	Adult	Yes	Yes
L7	12/12/99	Female	Adult	Yes	Yes
L8	1/26/00	Female	Kitten	No	No
L9	6/12/00	Female	Adult	Yes	Yes
L10	6/13/00	Female	Subadult	Yes	Yes
L11	6/20/00	Male	Kitten	No	Yes
L12	6/20/00	Male	Kitten	No	Yes
L13	6/20/00	Male	Kitten	No	Yes
L14	6/21/00	Female	Kitten	No	Yes
L15	6/21/00	Male	Kitten	No	Yes
L16	6/24/00	Male	Kitten	No	Yes
L17	6/24/00	Female	Kitten	No	Yes
L18	8/08/00	Male	Subadult	Yes	Yes
L19	9/06/00	Female	Adult	Yes	Yes
L20	9/06/00	Male	Adult	Yes	Yes
L21	9/15/00	Male	Subadult	Yes	Yes
L22	9/15/00	Male	Adult	Yes	Yes
L23	9/23/00	Male	Adult	Yes	Yes
L24	9/25/00	Female	Adult	Yes	Yes
L25	10/15/00	Female	Adult	Yes	Yes
L26	10/17/00	Male	Adult	Yes	Yes
L27	10/20/00	Male	Subadult	Yes	Yes
L28[4]	10/26/00	Male	Adult	Yes	Yes
L29	3/29/01	Male	Subadult	Yes	Yes
L30	6/14/01	Female	Kitten	No	Yes
L31	6/14/01	Female	Kitten	No	Yes
L32	6/15/01	Male	Kitten	No	Yes
L33	6/18/01	Male	Kitten	No	Yes
L34	6/18/01	Male	Kitten	No	Yes
L35	7/25/01	Female	Adult	Yes	Yes
L36	8/13/01	Female	Adult	Yes	Yes

[1] no identification number was assigned because animal was not marked
[2] equipped with a radio collar during a recapture on 9/10/00
[3] caught by recreational trappers in T11 R15 WELS
[4] caught by recreational trappers in T11 R12 WELS, released in study area in January 2001 after rehabilitation

Table 2 (continued). Summary of lynx captures in Maine from March 1999 to November 31, 2002.

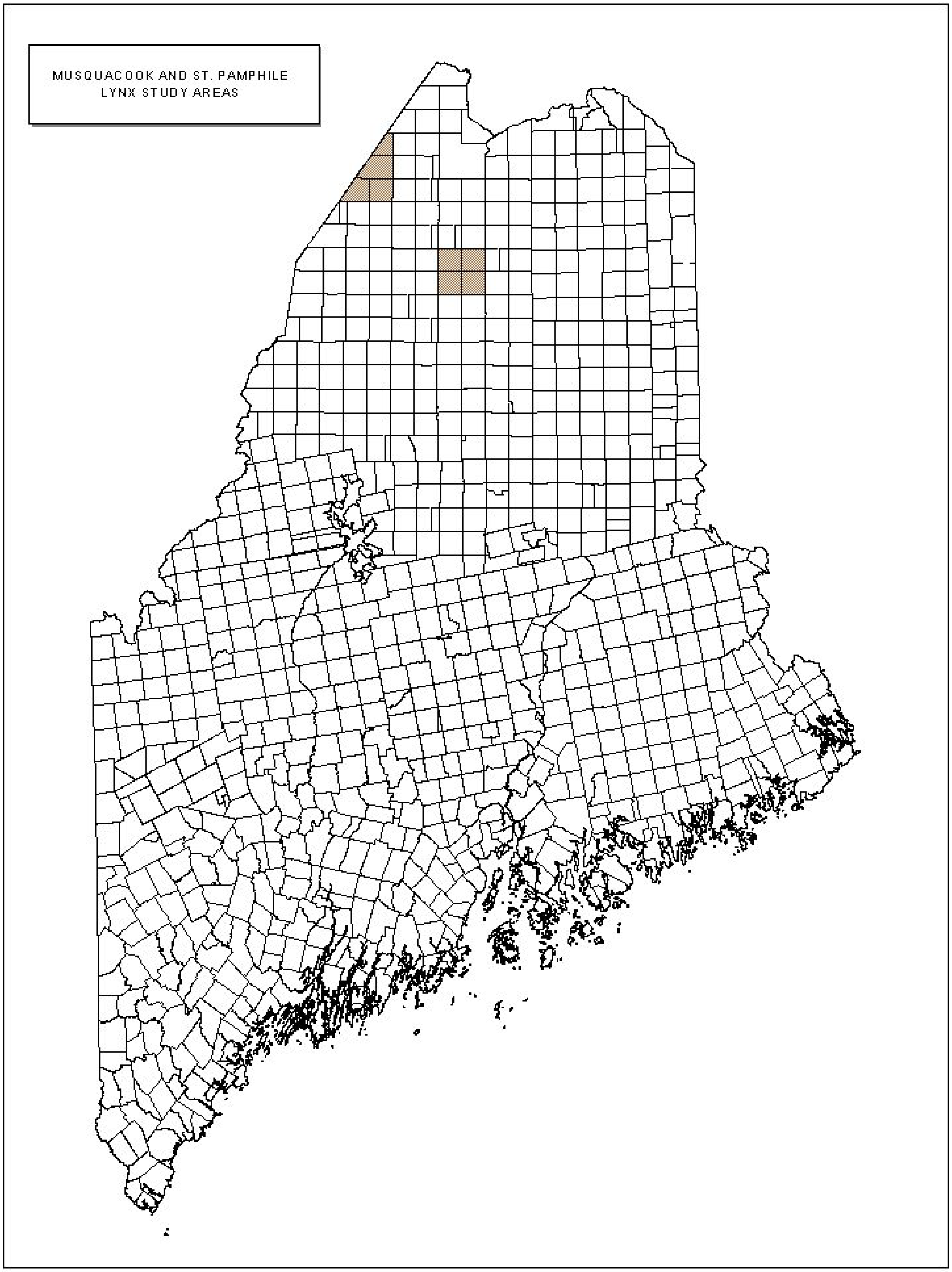
ID	Capture Date	Sex	Ageclass	Radio Collared	Ear Tagged
L37	8/25/01	Female	Adult	Yes	Yes
L38	8/27/01	Female	Adult	Yes	Yes
L39	9/15/01	Female	Kitten	No	Yes
L40	10/4/01	Female	Subadult	Yes	Yes
L41[5]	10/21/01	Female	Subadult	Yes	Yes
L42	1/17/02	Male	Subadult	Yes	Yes
L43	1/25/02	Female	Adult	Yes	Yes
L44	6/12/02	Female	Kitten	No	Yes
L45	6/12/02	Male	Kitten	No	Yes
L46	6/12/02	Male	Kitten	No	Yes
L47	6/12/02	Female	Kitten	No	Yes
L48	6/13/02	Female	Kitten	No	Yes
L49	6/13/02	Male	Kitten	No	Yes
L50	6/13/02	Male	Kitten	No	Yes
L51	6/15/02	Male	Kitten	No	Yes
L52	6/15/02	Male	Kitten	No	Yes
L53	6/15/02	Male	Kitten	No	Yes
L54	6/18/02	Male	Kitten	No	Yes
L55	6/18/02	Male	Kitten	No	Yes
L56	6/18/02	Female	Kitten	No	Yes
L57	6/18/02	Female	Kitten	No	Yes
L58	6/19/02	Female	Kitten	No	Yes
L59	6/19/02	Female	Kitten	No	Yes
L60	6/20/02	Female	Kitten	No	Yes
L61	6/20/02	Female	Kitten	No	Yes
L62	6/20/02	Female	Kitten	No	Yes
L63	6/20/02	Female	Kitten	No	Yes
L64	6/20/02	Male	Kitten	No	Yes
L65	6/20/02	Female	Kitten	No	Yes
L66	8/8/02	Female	Adult	Yes	Yes
L67	8/9/02	Female	Adult	Yes	Yes

[1] no identification number was assigned because animal was not marked
[2] equipped with a radio collar during a recapture on 9/10/00
[3] caught by recreational trappers in T11 R15 WELS
[4] caught by recreational trappers in T11 R12 WELS, released in study area in January 2001 after rehabilitation
[5] caught by a recreational trapper in T7 R4 WELS

Table 3. Summary of fisher trapping effort and activity on Maine study areas in 1999 - 2002.

Study Area	Trapping Period	No. of Traps	Trapnights	Fisher Captures	Non-target Captures
Musquacook	8/6/00-10/26/00	11 cage	588	3	5 snowshoe hares 1 black bear 2 martens
Musquacook	1/5/01-4/5/01	3-11 cage	379	8	8 martens 6 snowshoe hares 6 gray jays
Musquacook	1/5/02-3/27/02	4-11 cage	321	3	3 Lynx 1 marten 3 snowshoe hares
Musquacook	9/12/02- 9/27/02	3- 11 cage	151	0	1 snowshoe hare 1 red squirrel

Figure 1. The location of the St. Pamphile (upper left shaded area) and the Musquacook Lakes (lower right shaded area) study areas in Northern Maine.



ACKNOWLEDGMENTS FOR FIELD ASSISTANCE

The lynx study is a cooperative effort, with assistance by several agencies, universities and private organizations. Federal Aid Coordinator John Organ of the USFWS provided oversight as a principal investigator. Principal investigators from MDIFW include: George Matula, Craig McLaughlin, Walter Jakubas, and Charlie Todd. Biologists Jennifer and Adam Vashon coordinated and conducted field efforts and were assisted by Shannon Crowley, Anthony McCue, Shevenell Mullen, Michael Panasci, Kristin Parks, Deborah Perkins, Elliot Pickering, Saleen Richter, Shiloh Schulte, Holly Shepley, Jenny Sika, Jeffrey Sikich, Winthrop Staples, Mary Terra-Berns, and Eric York. Additional field assistance was provided by MDIFW biologists Mark Caron, Randy Cross, Wally Jakubas, Arlen Lovewell, George Matula, Craig McLaughlin, and Bill Noble; USFWS biologists John Organ, Kim Tripp, Jennifer Tietjen, and Ron Joseph; and houndsmen Nelson Cole, Don Helstrom, and Bob Parker. Pilots Jack and Joanne McPhee have been primarily responsible for locating radio-collared lynx and other predators. Pilot Frank Craig has provided additional radio telemetry flights. Game Wardens Dave Allen, Robert Decker, Jim Fahey, and Dave Milligan provided enforcement and field assistance. Allagash Wilderness Waterway Ranger Kim Allen provided logistical support. The University of Massachusetts, Massachusetts Cooperative Fish and Wildlife Research Unit, and University of Maine provided some of the traps used to capture lynx. Melody Roelke-Parker DVM, Warren Johnson, and Allison Wilkerson of the National Cancer Institute's Laboratory of Genomic Diversity, assisted with the development of genetic sample collection protocols and conducted analyses. William Healy, Robert Brooks, and Thomas Maier of the United States Forest Service and William Patterson from UMASS Department of Natural Resources Conservation provided technical assistance for developing habitat collection protocols. The Maine Forest Service (winter 1999) and Clayton Lake Woodlands (fall 1999 to present) provided lodging and communications assistance. North Maine Woods employees Esther and Camile Jandreau provided additional daily communication assistance during the winter of 1999. North Maine Woods Association, Clayton Lake Woodlands, International Paper Company, Irving Woodlands LLC, and Seven Islands Land Company provided access to the study sites. Robinson Lumber Company (winter 1999) and Clayton Lake Woodlands (present) helped with supplies and equipment maintenance. Valuable advice on field techniques and equipment needs was provided by biologists studying lynx in other jurisdictions, including: Clayton Apps (B.C. Ministry of Environment), Ted Bailey (USFWS-Kenai National Wildlife Refuge), Gary Koehler (Washington Department of Fish and Wildlife), Mike O'Brien (Nova Scotia Division of Wildlife), Brian Slough (Yukon Department of Renewable Resources), John Squires (USDA FS), and Mike Swartz (University of Montana). We would like to acknowledge the voluntary cooperation of John Snell, John Beaudoin, Toby Noyes, and Brad and Bob O'Connor who incidentally captured lynx while recreationally trapping for coyotes in or near the study area.