

Testing Remote Cameras for Surveying Canada Lynx



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Few carnivore species are currently of greater concern in North America than the Canada lynx (*Lynx canadensis*). The lynx was listed as a

federally threatened species in 2000. Prior to listing the lynx, relatively little was known about their status and distribution in the Northeast, where it was historically known to occur from Maine to Pennsylvania. As previously reported in the April 2006 issue of *Wild Cat News*, a major study of lynx ecology was undertaken by the U.S. Fish and Wildlife Service, Maine Department of Inland Fisheries and Wildlife (MDIFW), and University of Maine in 1999. This study was designed to be the premier study of lynx ecology in the Northeast and would provide management recommendations to benefit the

species throughout its range.

A primary goal of the Maine lynx study was to develop effective lynx survey techniques to document status and distribution. However, because lynx are secretive and occur at low densities in remote, wilderness areas, survey development has proven difficult. After lynx were federally listed, a hair snare technique was developed. Although hair snares have worked well in the Rockies, they have not been successful in the Great Lakes States and the Northeast. Researchers in Maine developed a lynx snow tracking protocol in 2003. Although this technique was successful as

discussed in the April 2006 issue of *Wild Cat News*, winter logistics in remote areas of northern Maine were very difficult and the technique could only be used from January to March under ideal snow conditions. Hence, there is considerable interest in devising an alternative, effective technique for surveying lynx that does not face the challenges of previously-used methods.

Remote cameras are a relatively new technology that is increasingly being used by wildlife researchers around the world to detect the presence of carnivores; indeed, several past issues of *Wild Cat News* have included remote camera studies. Remote cameras are especially attractive for species such as lynx that are secretive and occur in landscapes difficult to access by humans. However, assessments of the potential utility of remote cameras for assessing lynx populations are limited. Our goal in this study was to assess the utility of remote cameras for monitoring lynx presence and relative abundance given a known (i.e., radiomarked) population.

Camera Trapping Methods

We surveyed lynx in one township near Clayton Lake in Aroostook County of northwestern Maine; this township contained a minimum known number of lynx from the ongoing MDIFW study as described previously in the April 2006 issue of *Wild Cat News*.

From July 24 to October 18, 2005, 36 passive infrared-triggered remote cameras (Moultrie Feeders GameSpy 100 2.1 Megapixel Digital Camera) were placed and maintained on logging roads throughout the township at a stocking density of one camera per section. Cameras were placed on the sides of logging roads perpendicular to the road with the goal of detecting lynx traveling along roads. Each camera was attached to a sturdy tree about two feet off the ground. About 15 feet in front of the camera near the center of the road, a mixture of beaver castoreum, vaseline, and catnip was used as an olfactory attractant. A CD was hung at the bait site (but out of camera view) as a shiny visual attractant. When an animal triggered the camera,

one picture was taken every minute the infrared beam was interrupted. Cameras were checked monthly (i.e., three times during the study) to download images onto a laptop computer, replenish lures, and change camera batteries.

Data Analysis

Upon evaluation of images and data sheets, we conducted several analyses. First, we calculated the total active camera-days of effort and per-species detection rates. Second, we determined the number of sections where lynx were detected versus not detected by cameras. Third, we assessed lynx detections via camera relative to known individuals. Nine known radiomarked lynx were alive on the township during our study; these animals wore color-coded radio collars that permitted recognition of individual lynx in certain instances. An average of 18 locations/lynx was collected for the study period during diurnal aerial radio telemetry flights. We used these locations to calculate 100% minimum convex polygon use-areas for each lynx to provide an assessment of where lynx were present relative to our cameras. From this information, we determined whether (1) more cameras within a home range resulted in more cameras recording lynx detections, and (2) the number of lynx detections were dependent on the number of lynx use-areas overlapping the camera location.

Results

From July 24 to October 18, 2005, we recorded 2,512 camera-days out of 3,024 maximum possible; thus, the cameras worked properly or were otherwise functioning 83% of the time. A total of 1,680 animal images were taken (Table 1); total animal detection rate was 0.67 animals per camera-day. The vast majority of images (69%) were of moose (*Alces*

Species	Images	Proportion of all Images	Images per Camera-day*
Moose	1,117	0.69	0.69
White-tailed deer	112	0.07	0.07
Black bear	87	0.05	0.05
Coyote	68	0.04	0.04
Snowshoe hare	49	0.03	0.03
Lynx	45	0.03	0.03
Other	142	0.09	0.09
Total	1,680	1.00	1.00

Table 1: Images of animals from remote camera survey for lynx in northern Maine from July 24 to October 18, 2005. Results are based on 36 infrared-triggered cameras placed afield for 2,512 total working camera-days.

*Images / total working camera-days

alces). Forty-five lynx images were taken (0.02 lynx per camera-day; Table 1).

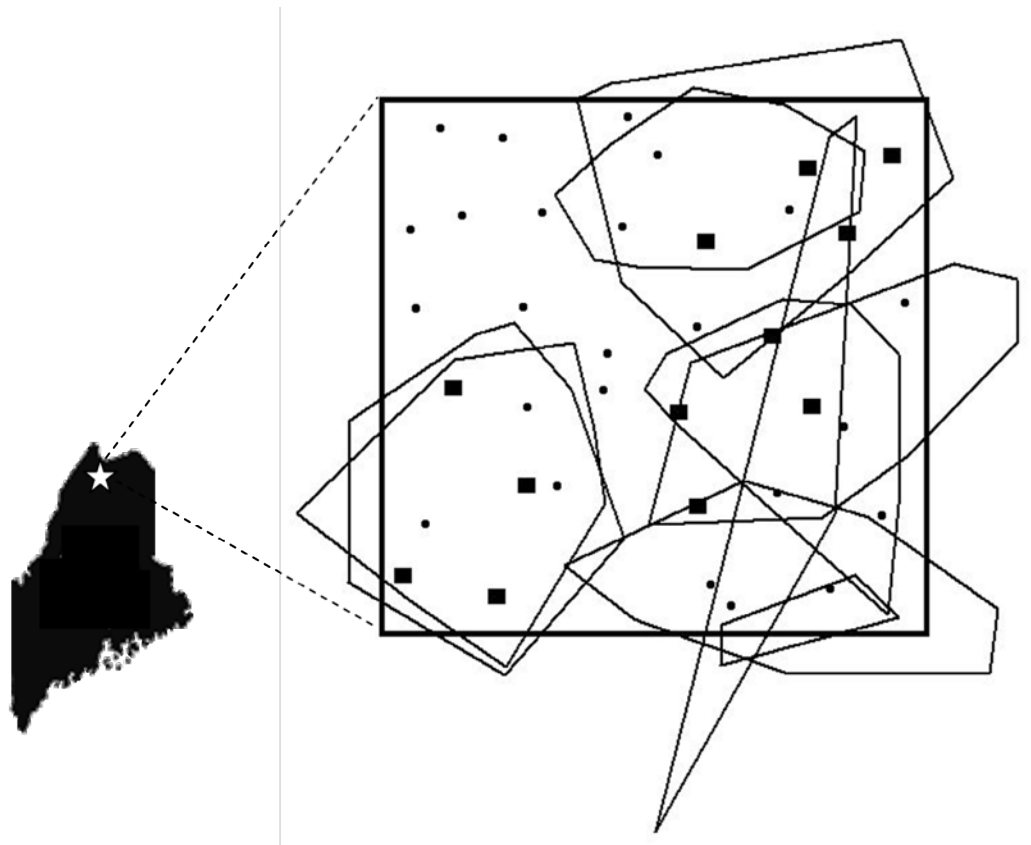
Lynx were detected in 17 of 36 sections (47%) on the study area; all detections occurred in sections where lynx use-areas were known to overlap camera locations (Figure 1). Twelve cameras (33%) took no images of lynx where lynx use-areas overlapped. The remaining seven cameras (20%) had no lynx detections where lynx presence was unknown. More cameras within a lynx use-area resulted in more cameras recording lynx detections ($R^2 = 0.48$, $P = 0.024$). However, the number of lynx detections per camera was not dependent on the number of lynx use-areas overlapping the camera location ($R^2 = 0.19$, $P = 0.271$).

Utility of Remote Cameras for Surveying Lynx

Our work represents a novel research effort that should provide wildlife biologists with useful information regarding the potential for remote cameras to survey lynx populations. Results imply that passive-infrared remote cameras are very inexpensive and useful for surveying lynx presence, but not relative abundance. Furthermore, the ability to potentially determine individual lynx based on pelage characteristics or color-coded radio collars as used by MDIFW enhances the possibility of using camera capture-recapture or mark-recapture analyses to estimate lynx abundance and density. However, more expensive active-infrared cameras would be recommended for these analyses.

We assert that remote camera surveys at the township level are generally useful for determining lynx presence, but using one or more cameras per section would be preferable. We first documented lynx

Figure 1: Locations of remote cameras and individual lynx use-areas in northern Maine from July 24 to October 18, 2005. The study township is shown as the darker square; individual lynx home ranges are the irregular polygons. Small squares within the township ($n = 12$) represent cameras where home ranges overlapped, but no lynx detections occurred. Small circles within the township indicate placement of additional cameras ($n = 24$).



presence at Day Three of the survey, given the known presence of nine lynx on the study area. We believe our >2,500 camera-days represents a minimum effort for remote camera surveys of carnivores, and we strongly urge wildlife biologists to consider maximizing camera stocking rate within budget constraints, especially in regions where lynx density may be lower than that in northern Maine. Simply put, a wildlife biologist can not expect to get adequate survey data by only using a few remote cameras deployed for a short survey period, especially when cameras occasionally fail or produce images containing non-target animals (in our case, moose) or no animals whatsoever.

We performed separate analyses to determine whether remote cameras were useful for assessing relative abundance of lynx, and they were not, as 33% of cameras missed known individuals with use-areas

overlapping camera locations. The number of lynx detections per camera was not dependent on the number of lynx use-areas overlapping camera locations. We would have expected a significant relationship if lynx detections were sensitive to the number of lynx present. Although we do not recommend remote cameras for assessing relative abundance of lynx, correlating survey methods to true relative abundance or absolute abundance is difficult for carnivores, regardless of survey method used. We suggest that remote cameras can be used within an occupancy modeling framework to provide a better alternative to presence/absence or relative abundance surveys.

Our cameras were of a passive-infrared design, which measures objects interrupting the infrared sensor in a relatively wide area in front of the camera. Active infrared cameras are more expensive per

unit, but an animal has to break a very narrow infrared beam emitted between the camera and a receiving unit. Thus, images taken by active infrared cameras are generally close-up, broadside images of animals. For lynx, this would be useful for identifying individual animals by pelage markings or color-coded radio collars, as we were able to do with 15% to 20% of the lynx images obtained with passive-infrared cameras. These data could then be analyzed using capture-recapture or mark-recapture methods to estimate lynx abundance and density, rather than just presence or relative abundance. We suggest wildlife biologists consider using active-infrared cameras to assess lynx abundance and density using capture-recapture methods, but to be aware of increased per-unit costs associated with purchase of active-infrared cameras.

Lynx Detection Using Remote Cameras

Remote camera studies for lynx are rare in the wildlife literature, and to our knowledge, no such results are yet published in peer-reviewed scientific journals. However, two unpublished reports have provided limited analyses of lynx detection rates using <550 camera-days/study. An earlier remote camera study on our northern Maine study area produced three lynx detections in 300 camera-days. Remote cameras detected only 33% of radio-collared lynx known to be on the study area. A Minnesota

study reported no lynx detections in 512 camera-days, even though five radio-collared lynx were present in the study area and were occasionally close to cameras. However, it was noted that a lynx hair snare survey in the same region did not produce any lynx hair in this area, either.

Detection of carnivore species varies considerably due to differences in remote camera survey design and species ecology, but generally ranges from zero images per 100 camera-days for mountain lions (*Puma concolor*) to 16 per 100 camera-days for jaguars (*Panthera onca*). Remote camera detection rates for bobcats (*Lynx rufus*), which are occasionally sympatric with lynx in northern Maine, have been reported at four per 100 camera-days and seven per 100 camera-days. Our detection rate of two lynx per 100 camera-days was somewhat lower than the average detection rate for carnivores, but nonetheless represents the first estimate of detection rate for lynx using remote cameras for >2,500 camera-days.

Remote Cameras Versus Other Lynx Survey Techniques

Several other survey methods exist for lynx, including snow-track surveys and hair snares. Others have extracted DNA from hair and scat samples collected from lynx by following tracks made in snow. These techniques have proven useful for monitoring lynx populations and identifying individual animals, but are generally costly in terms of labor

and equipment. Intuitively, snow-track surveys should be very useful for surveying lynx, as tracks in snow can be identified easily, and there is no reliance on animals having to be at specific locations to record their presence, as is necessary for hair snares and remote cameras. Clearly, snow-track surveys have proven successful for lynx in northern Maine.

We suggest that remote cameras should not replace snow-track surveys, as this is an obviously efficient, accurate, and widely-used survey technique. However, when adequate snowfall is problematic, or wildlife biologists are limited in number or ability to respond immediately to field conditions, remote cameras may provide a useful alternative for surveying lynx, and when using active-infrared cameras, provide actual abundance or density estimates.

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Individual lynx photos at proper angles for showing pelage markings and color-marked radio collars that may be useful for camera capture-recapture or mark-recapture analysis.