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Using Scent-Marking Stations to Collect Hair Samples to Monitor Eurasian Lynx Populations

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Abstract

*Noninvasive sampling of mammalian hairs for surveying their populations and for providing density estimations is widely applicable in wildlife ecology and management. However, the efficiency of the method may differ depending on the species or local circumstances. We modified a method of hair trapping from free-ranging Eurasian lynx (*Lynx lynx*) to collect DNA samples to work in a low-density population. We constructed hair traps based on a device developed for Canada lynx and assessed their effectiveness in Białowieża Forest, Poland. We set 153 hair traps baited with beaver (*Castor canadensis*) castoreum and catnip oil at points previously used by lynx for scent-marking. We conducted the study in 2 consecutive winter and summer seasons during 2003–2004. Lynx rubbed 22–46% of the hair traps in 5 different trapping sessions. Lynx were more likely to rub hair traps set directly at scent-marking points on conspicuous marked objects than when they were set some distance (1–3 m) from the marked objects. Efficiency of hair-trapping sessions increased from 30.1 to 46.4% after selecting the most likely points. The percentage of traps visited and rubbed by lynx was higher in winter than summer in 2 consecutive years (30.1 vs. 22.2% and 46.4 vs. 23.3%, respectively), which may be related to mating behavior. This method proved efficient for monitoring low-density Eurasian lynx populations.*
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Key words

DNA samples, Eurasian lynx, hair trapping, lures, Lynx lynx*, monitoring, scent marking.*

Noninvasive sample collection from free-ranging wildlife has been successfully applied in a number of mammals for detecting the species and recently for genetic analyses (Raphael 1994, Foran et al. 1997). Nevertheless, there is no versatile device or method for hair trapping from different species or a group of species. The idea of enticing wild felids to rub scented pads was conceived by John Weaver (Turbak 1998) and later evaluated in the field by McDaniel et al. (2000) in Canada lynx (*Lynx canadensis*) and by Weaver et al. (2003) for ocelot (*Leopardus pardalis*) populations.

McDaniel et al. (2000) found scent pads to be highly efficient in lynx with detections recorded at 45% of transects. However, the test was conducted in an area with a high lynx density (most likely 8–20 individuals/100 km^2; Mowat et al. 2000; G. McDaniel, Rocky Mountain Research Station, Missoula, Mont., USA, personal communication). It was concluded that efficiency of this method in low-density areas remains to be studied. Eurasian lynx can reach a maximum density of 5 individuals/100 km^2 in Białowieża Forest, Poland (Jędrzejewski et al. 1996), which is remarkably low compared to Canada lynx, although much lower densities can be found in Scandinavia (0.3 individuals/100 km^2; Odden et al. 2001).

Based on McDaniel et al. (2000), we conducted a test of Eurasian lynx hair-trapping efficacy in Białowieża Primeval Forest, Poland. However, unlike that study, we attempted to collect lynx hairs at scent-marking sites. The purpose of this research was to evaluate applicability of this method for a low-density lynx population at different times of the year.

Study Area

Białowieża Primeval Forest (BPF; eastern Poland; 52°30′–53°N, 23°30′–24°15′E) is located on the border between Poland and Belarus. The BPF is a temperate mixed lowland forest characterized by a high percentage of natural stands. The Polish part of the forest covers 595 km^2 and has a dense network of dirt roads situated every 1–2 km. Climate was temperate with a transitional character between marine and continental, with clearly marked warm and cold periods. Average temperature ranged −5 to −1°C in January and 16–19° C in July. Average annual precipitation was 500–600 mm with snow cover persisting an average of 86 days. Lynx density ranged 3–5 individuals/100 km^2 (Jędrzejewski et al. 1996), and average home ranges were 250 km^2 for males and 130 km^2 for females (Schmidt et al. 1997).

Methods

The study consisted of 2 phases: we conducted a pilot phase in September 2002, whereas we performed the main phase from February 2003 to January 2005 in 3 winter (Dec–Apr) and 2 summer (Jun–Sep) periods. During the first phase, we followed McDaniel et al. (2000) by placing hair traps along 8 transects 2–6 km apart. Transects consisted of 10 traps spaced every 200 m and baited with beaver castoreum and catnip oil. To increase the probability of detection by lynx, we situated rubbing stations along dirt roads known to be frequently used by the predators for traveling and nailed them to the trunks of trees 2–5 m from dirt roads. However, in contrast to McDaniel et al. (2000), we chose not to use pie pans as visual attractants to avoid drawing the attention of humans. We detected no lynx during this 6-week test.

We subsequently modified the method by setting rubbing pads at lynx scent-marking sites. We located most sites by snow tracking while driving forest roads. We easily identified the scent-marking sites after the lynx track turned aside from the main route and approached a distinctive object. We recognized a few sites only visually (without snow tracking) by their conspicuous appearance (e.g., a large cut or broken tree trunk) and confirmed by detecting the smell of lynx urine. We distinguished 7 main categories of objects used by lynx as scent-marking sites, among

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Table 1. Categories of objects selected for lynx hair trapping in Białowieża Forest, Poland, 2003. Total number of marked objects (121) differs from number of marking sites (113) because 8 rubbing stations consisted of 2 traps.

Description of the object	Number of traps at sites of this category	Percentage of traps rubbed by lynx
Unmarked objects		
Vertical live tree standing next to (1–3 m) a marked object	34	8.8
Directly marked objects		
Bridge railing	10	60.0
Wooden fence or shed corner	15	53.3
Cut or broken vertical tree trunk	14	50.0
Cut or broken horizontal tree trunk	13	38.5
Trunk of a large, old tree with conspicuous traits (damaged bark or deformed, swollen trunk)	8	37.5
Roots of uprooted tree or large branches lying on the ground	21	28.6
Other (log pile, tree cluster, washed roots sticking out of a cliff, wooden post)	6	0

which the roots of uprooted trees and cut or broken tree trunks and corners of sheds and fences were most numerous (Table 1). We attempted to cover the entire Polish part of BPF with rubbing stations, while maintaining 1–2 km between sites (Fig. 1). However, final trap-site distribution depended on availability of scent-mark objects and their suitability for fixing traps.

We made rub pads according to McDaniel et al. (2000) with slight modifications. We used 8×8-cm squares of a thick (9 mm), dense carpet. We pushed 10 nails cut to 12 mm through the pad so nails protruded 1.5–2 mm from the pad. Cutting nails with pincers improved hair collection on the pads. We prepared a scent lure based on McDaniel et al. (2000) by mixing beaver castoreum and imitation catnip oil (both supplied by Sterling Fur Company, Sterling, Ohio) in the ratio 32:1. We combined the lure with propylene glycol and glycerine in a ratio of 6:1:1 to prevent freezing and drying. We baited each pad with about 10 ml of the mixture the first time and used about 5 ml for re-baiting.

Most rubbing stations consisted of a single trap. However, in rare cases, we set another trap a few meters away to increase the stimulus for lynx to rub. We used no other attractants. We believed the scent-marking sites themselves were attractive enough because they had been visited by lynx in nearly all cases. We attempted to set pads directly on marked objects or as close as possible to the parts of interest to the lynx (Fig. 2). Parts included the most protruding elements of objects such as tips of broken or cut branches or roots. When we could not attach the trap directly to the marked item, we nailed it to the nearest (1–3 m away) tree. We set pads at a minimum height of 60 cm to be convenient for lynx because felids prefer rubbing with head areas (Reiger 1979). However, when possible, we located pads even higher to decrease the chance of use by other mammals (foxes [*Vulpes vulpes*], wolves [*Canis lupus*], or wild boars [*Sus scrofa*]). Wolves and wild boars observed in captivity rub pads with their backs (K. Schmidt, Mammal Research Institute, Białowieza, Poland, personal observation), whereas lynx always use their cheeks and can stand on their hind legs when excited by the lure (Fig. 2).

We attempted to check and re-bait hair traps every 10–14 days, although the actual range was 1–23 days. Traps with hairs were replaced with new ones. We recognized lynx hairs by the presence of tracks, macroscopic characteristic of hairs, and in doubtful cases by microscopic structure (Debrot et al. 1982). The probability of misidentification of lynx hairs was low in our study area because the potential nontarget species included only wolf and fox. Its risk was partly eliminated by setting the pads beyond the reach of those predators.

We grouped the rubbing stations into 8 categories, selecting the objects that were not marked directly as one of them. We compared frequency of rubbing the pads attached directly to scent-marked objects with those that were not marked by the replicated goodness-of-fit test. We used the same test to evaluate differences in hair-trapping success between seasons and years.

Results

We found 153 marking sites and used them for hair trapping. Number of hair traps set in each season varied because we adjusted locations seasonally depending on success at given stations. We simultaneously set 113, 36, 96, 90, and 91 traps in consecutive winter and summer sessions lasting 46–94 days.

Among sites selected for hair trapping, lynx most frequently rubbed pads attached directly to marking points (replicated goodness-of-fit test: $G = 13.0$, df = 1, $P < 0.001$; Table 1). Lynx ignored traps set >1 m from the marked object. The most successful objects for eliciting rubbing and collecting lynx hairs (50–60% of the objects of a given category) included railings on bridges (either wooden or metal), corners of human-made constructions such as wooden fences or sheds, and broken or cut tree trunks with the remaining rooted parts protruding conspicuously from the substrate.

Lynx rubbed 50% of hair-trap sites monitored during the study period (Fig. 3). Most (72%) rubbed traps were visited more than once. We recorded 1–4 lynx visits at individual rubbing stations during single sessions. However, this does not include cases in which lynx approached and scent-marked the pad without leaving any hairs and possible multiple visits between consecutive controls.

We found lynx hairs in only 4.4% of the marking sites before setting the rub pads (Fig. 4). Percent of pads rubbed by lynx varied between sessions from 22.2% in the summer of 2003 to 46.4% in the winter of 2004. The success in lynx detections was greater during the winter session in 2004 than in the 2003 (46.4 and 30.1%, respectively; replicated goodness-of-fit test: $G = 5.92$, df = 1, $P < 0.005$; Fig. 4) after excluding pads fixed to unmarked objects. In contrast, summer sessions produced similar results in both years ($G = 0.02$, df = 1, $P > 0.5$). Rubbing frequency generally was higher during winter than summer (Fig. 4). However, the difference was significant only in 2004 (46.4 and 23.3%, respectively; $G = 11.06$, df = 1, $P < 0.001$).

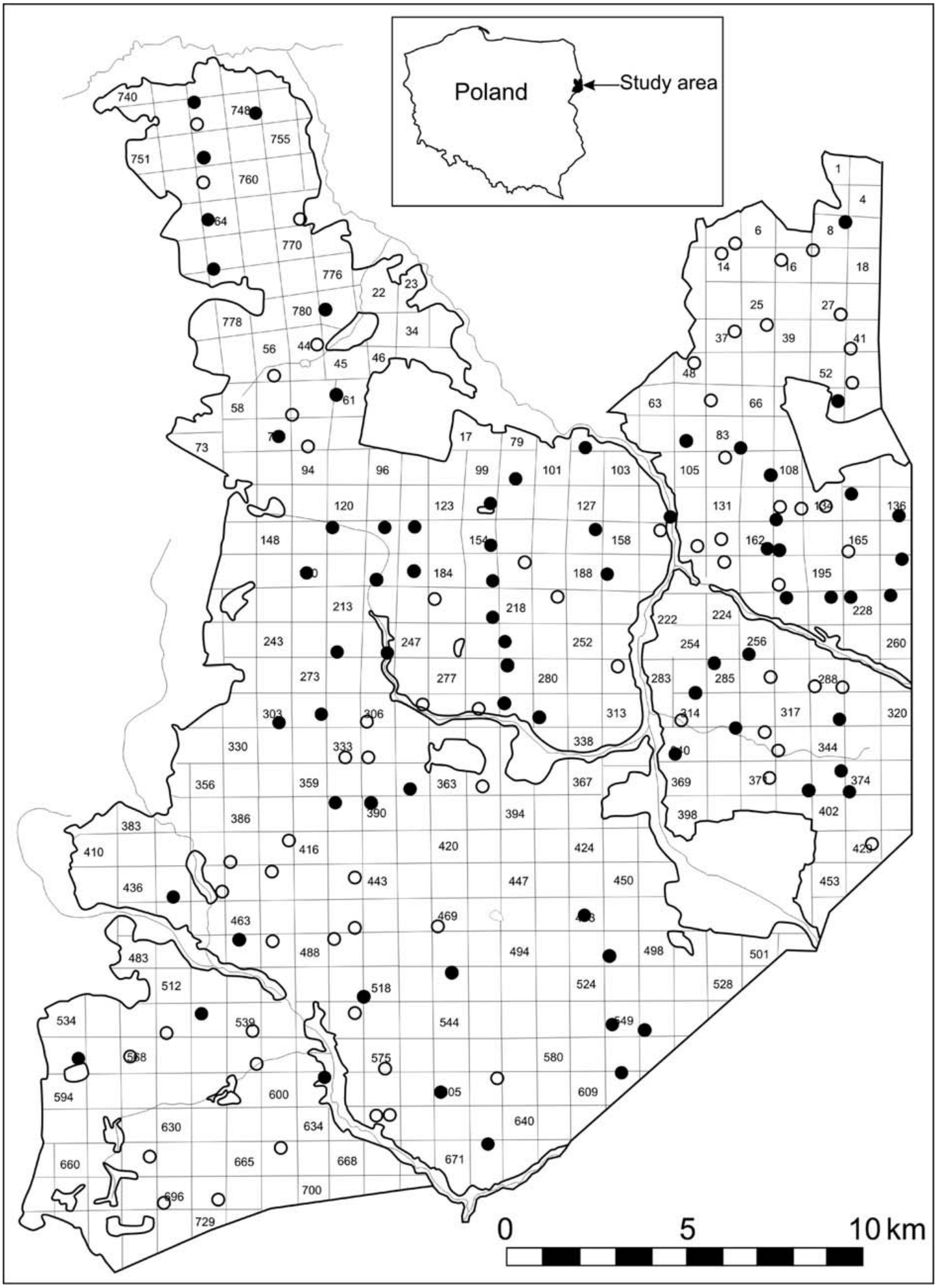

Figure 1. Study area location and distribution of the hair traps set at Eurasian lynx scent-marking sites. Black circles = traps where lynx hairs were collected, and open circles = traps where hairs were not collected, thick lines show borders of the Polish part of BPF. A grid of forest compartments (thin straight lines) and main rivers (thin wavy lines) also are shown.

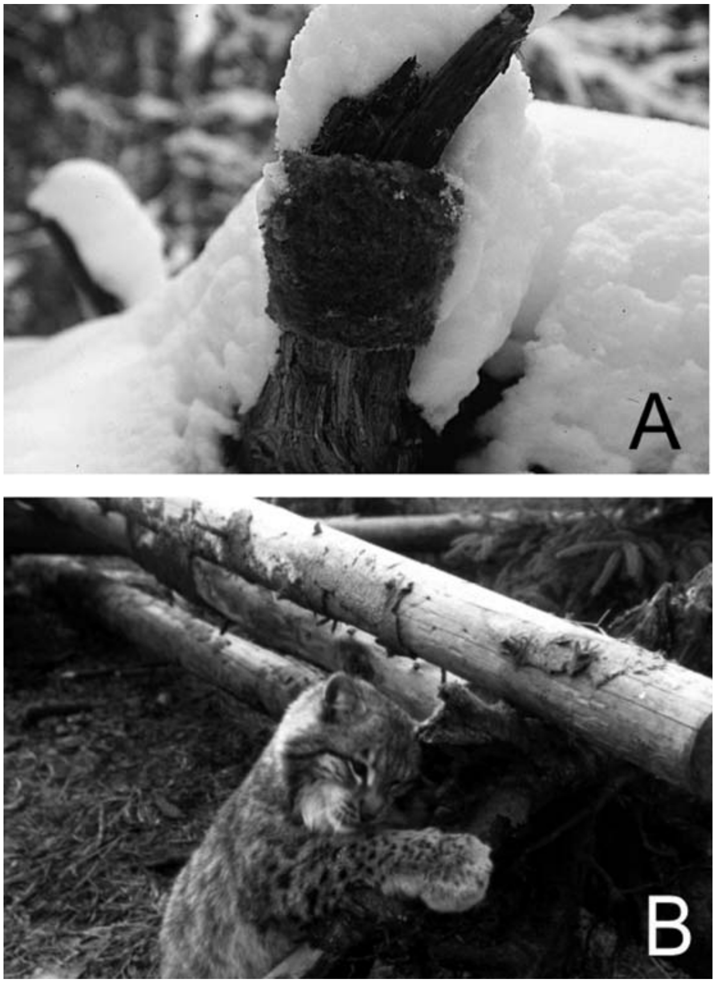

Figure 2. A rub pad fixed to the lynx scent-marking site (A) and a captive Eurasian lynx rubbing the pad scented with beaver castoreum and catnip oil (B).

During the entire study period, we collected 229 hair samples. Most (81.2%) contained numerous hairs with roots. Low-quality samples (single or few hairs) were more common in the summer (41.7%) as compared to the winter (14.5%).

Discussion and Management Implications

Rubbing behavior is a common phenomenon among cats and other predators and probably is an element of scent-marking (Reiger 1979, Mellen 1993). However, although we chose original lynx scent-marking points for hair collection, we found that lynx rubbed these objects with a very low intensity before we attracted them with the lure. Scenting rub pads with lure considerably increased the frequency of rubbing and its intensity because numbers of hairs found prior to fixing scent pads were always inconspicuous.

Our maximum rate of lynx detection is comparable to that obtained for Canada lynx by McDaniel et al. (2000). On the other hand, considering that our traps were set up in places known to be visited by lynx, the success rate was rather low. Other methods of hair trapping used for American martens (*Martes americana*) and grizzly bears (*Ursus arctos*) gave a higher rate of detection (up to 73%; see Mowat and Strobeck 2000, Mowat and Paetkau 2002). For Eurasian lynx, there is potential to increase detection rates by excluding marking sites not suitable for fixing the rub pad directly on the marked object. We suggest installation of the rub pad at precisely the point of lynx interest may greatly increase its motivation for rubbing. Further increase in detection of lynx is likely with a more advanced selection of marking sites.

Rubbing behavior may be related to communication about sexual activity in felids (Verbene and DeBoer 1976); therefore, seasonal differences in hair-collection success may be caused by the mating season. Most lynx mating probably occurs in Białowieża Forest during February and March, although males start to roam widely in search of females in December (Schmidt et al. 1997). Indeed,

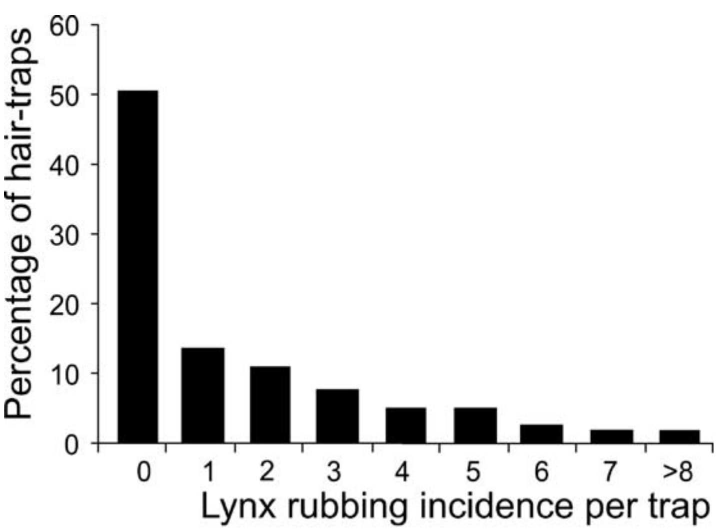

Figure 3. Number of lynx detections at rubbing stations set at marking sites (*n* = 153) in Białowieża Primeval Forest, Poland, 2003–2005.

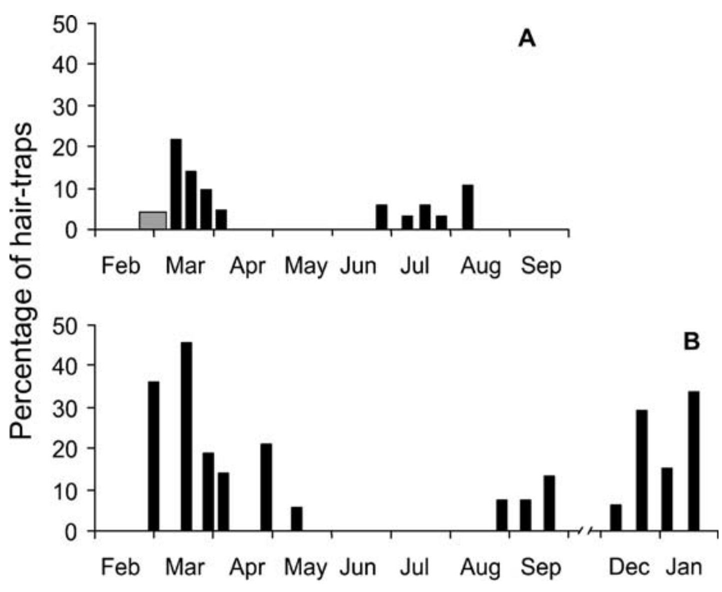

Figure 4. Variation in lynx hair-trapping success during the year in Białowieża Primeval Forest, Poland in 2003 (A) and 2004–2005 (B). Gray-shaded box shows percentage of marking sites where lynx hairs were recorded before setting the rub pads.

lynx rubbed our pads most frequently and intensely during February and March, and we also found a high proportion of traps with hairs in December–January 2004 and 2005. The lack of seasonal differences in 2003 may be due to a bias during the first winter session from including rubbing sites not fixed directly to marking objects.

Even during periods of high rubbing activity, lynx were not always willing to rub pads that were visited on other occasions. In a few cases, we snow-tracked lynx that visited neighboring rubbing stations and left fewer hairs on each consecutive hair trap. On other occasions, lynx ignored the trap at the first marking site they visited but rubbed on the next. This likely could occur if rubbing stations are too close together and may decrease the general rate of lynx detections. However, in some studies—such as those whose objective is to collect hair samples for molecular monitoring of particular individuals over time and space (e.g., to estimate home-range size)—it can be important to keep a surplus number of rubbing stations.

The modified hair-trapping method proved satisfactory for a low-density lynx population. However, because the distribution of rubbing stations is relative to the availability of scent-marking sites, this method can be used to monitor trends in population number under the condition that the location of rubbing stations does not change with time. We believe it may be suitable for other felids as well, but it seems most useful in areas with easy access to allow searching for scent-marking sites.

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