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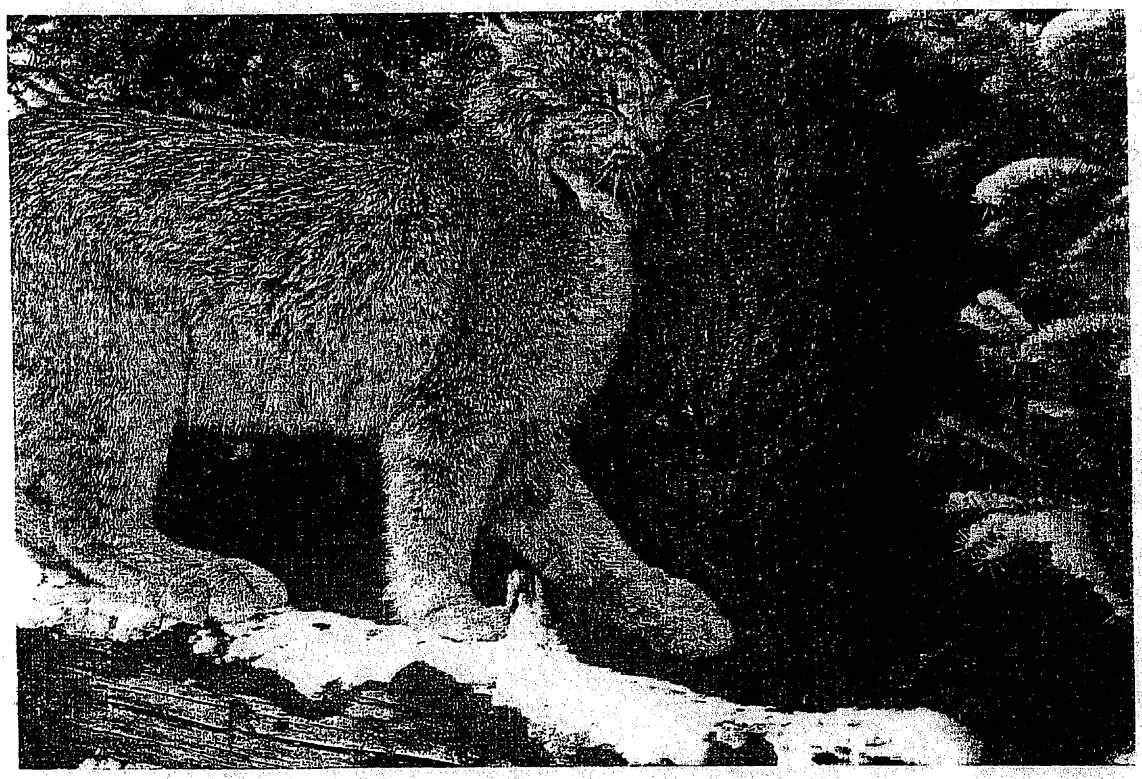
LYNX SURVEY IN THE ADIRONDACK PARK



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Principal Investigator

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185th Street and Southern Boulevard
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1999

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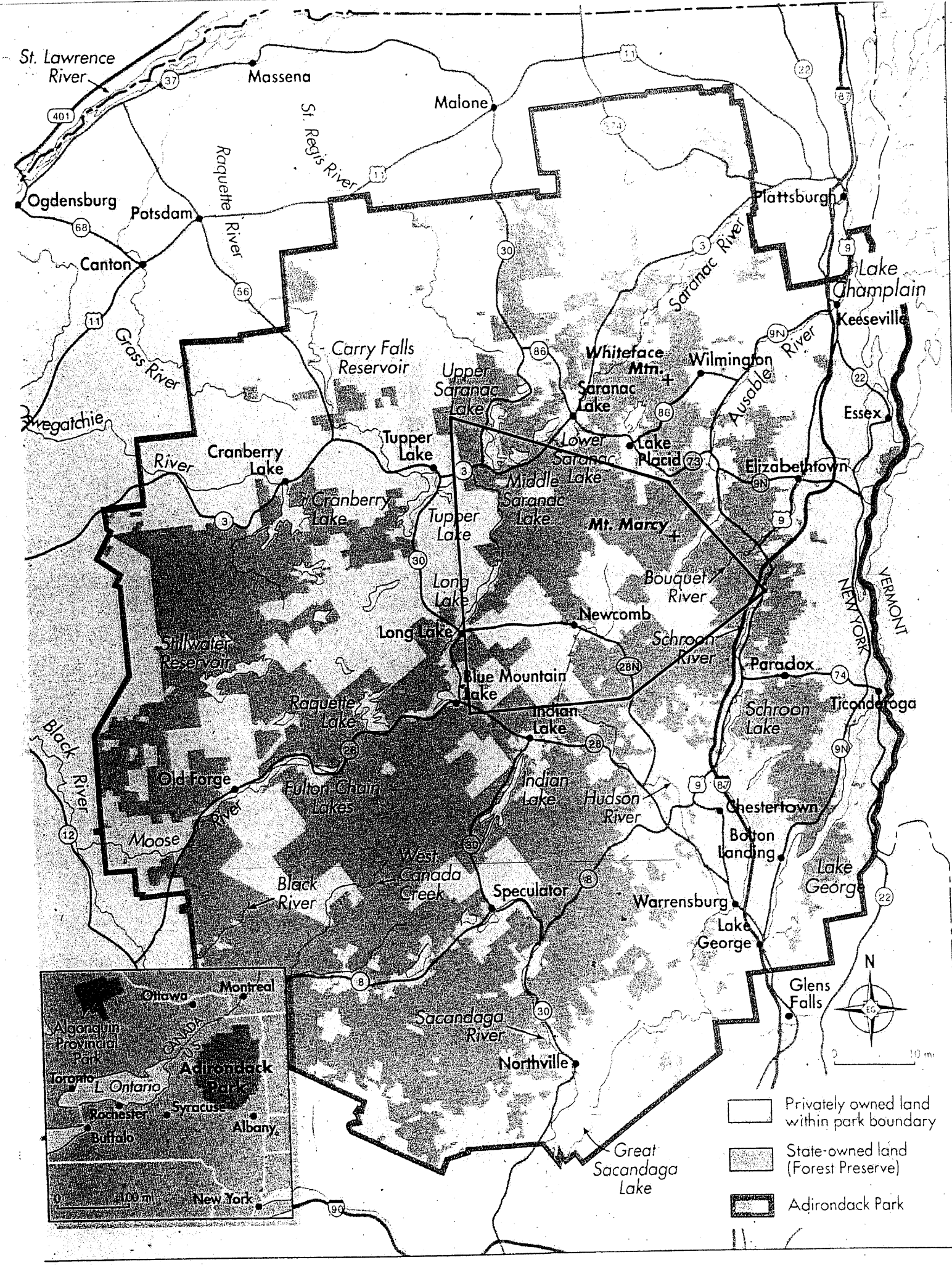
INTRODUCTION

Conservation of the Canada lynx (*Lynx canadensis*) has emerged as a major issue in recent years. The U.S. Fish and Wildlife Service has proposed listing lynx in the lower 48 states as a threatened species under the Endangered Species Act.

Lynx originally inhabited the Adirondack region of New York but were extirpated by the late 1800s (Brocke 1982). During the three winters of 1988-1990, biologists from the State University of New York (SUNY) translocated 83 lynx (48 female/35 male) from the Yukon Territory to the High Peaks region of the Adirondacks (Fig. 1) (Brocke et al. 1990, 1991). The released lynx ranged over extraordinarily large areas (averaging 421 km^2 for females/1760 km^2 for males); one lynx was shot in New Brunswick, Canada, some 720 km from its release site (Brocke et al. 1991). At least 37 (45%) of the lynx (19 female/18 male) died from various causes, principally road-kills (18) (Brocke and Gustafson 1992, R. Brocke pers. commun.). Close monitoring of the released animals, however, did not continue beyond spring 1993, and the ultimate outcome of the restoration effort has remained unclear.

Over the past several years, carnivore biologist John Weaver and geneticist George Amato of the Wildlife Conservation Society have developed a new, non-invasive technique for surveying lynx (Weaver and Amato In Prep.). The technique capitalizes on the natural cheek-rubbing

Figure 1. Location of the lynx survey area (black line) in Adirondack Park, New York .

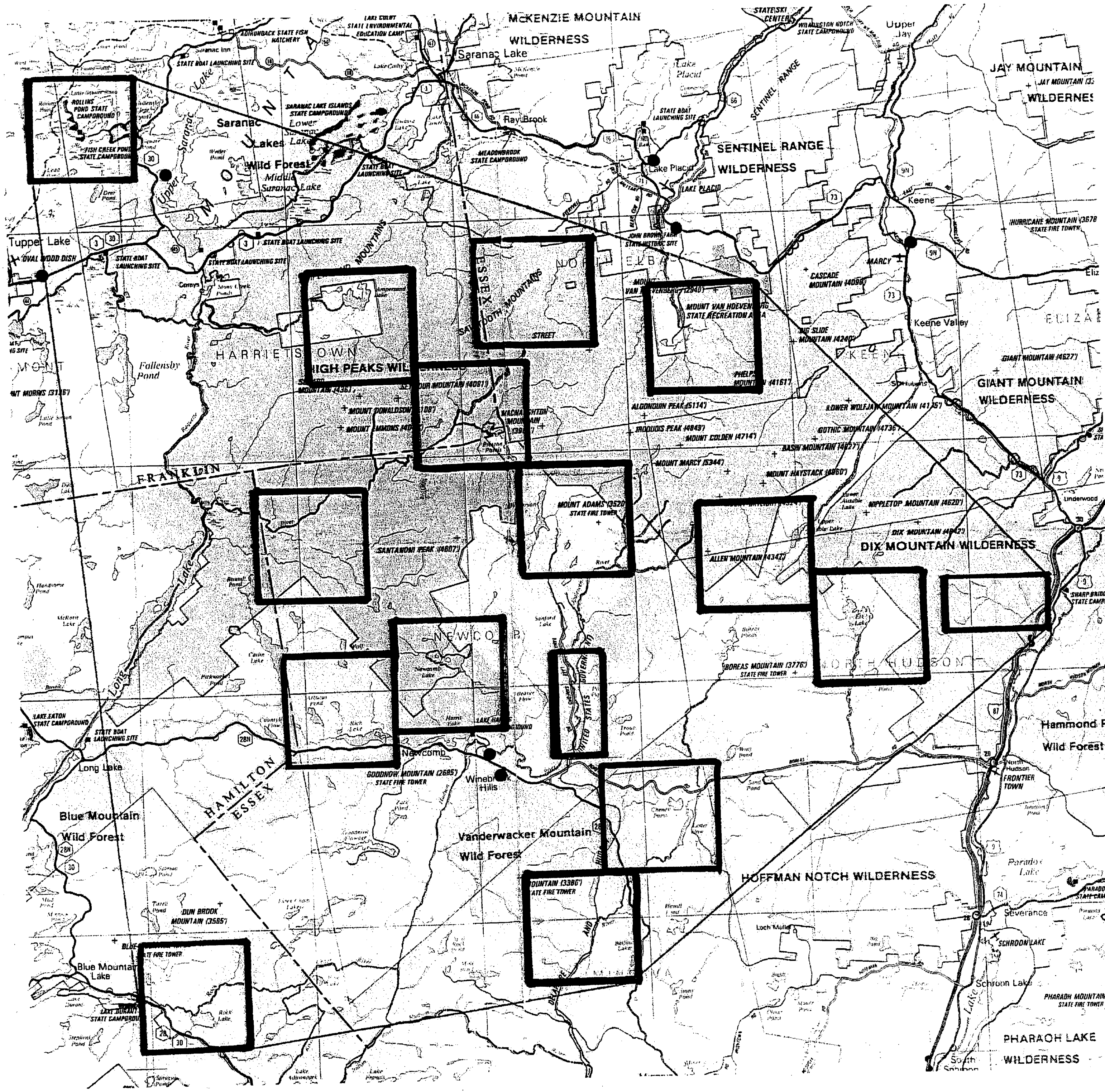

St. Lawrence River
Massena
Malone
St. Regis River
Raquette River
Ogdensburg
Potsdam
Canton
Plattsburgh
Saranac River
Lake Champlain
Keeseville
Grass River
Carry Falls Reservoir
Upper Saranac Lake
Whiteface Mt.
Wilmington
Saranac Lake
Ausable River
Essex
Tupper Lake
Lower Saranac Lake
Lake Placid
Elizabethtown
Cranberry Lake
Middle Saranac Lake
Mt. Marcy
Long Lake
Bouquet River
Newcomb
Stillwater Reservoir
Schroon River
Paradox
Blue Mountain Lake
Raquette Lake
Indian Lake
Schroon Lake
Ticonderoga
Black River
Old Forge
Fulton Chain Lakes
Hudson River
Chestertown
Moose River
Boiton Landing
West Canada Creek
Speculator
Warrensburg
Lake George
Glens Falls
Sacandaga River
Northville
Great Sacandaga Lake
VERMONT
NEW YORK
Ottawa
Montreal
Algonquin Provincial Park
CANADA
U.S.
Adirondack Park
Toronto
L. Ontario
Rochester
Syracuse
Albany
Buffalo
New York
0
100 mi
N
0
10 mi
Privately owned land within park boundary
State-owned land (Forest Preserve)
Adirondack Park

behavior of cats to collect hair for DNA analysis. This new technique can yield reliable and useful information on (1) distribution, abundance, and genetic structure of lynx populations, and (2) habitat and landscape features used by lynx. Using this technique, we have detected rare lynx in the western United States (Weaver et al. In Prep.) as well as endangered ocelots in south Texas (Weaver and Wood In Prep.). Here, I report on a survey of lynx during August-October 1998 in the High Peaks region of the Adirondacks where lynx had been released previously.

SURVEY AREA

I selected a survey area in close consultation with Kent Gustafson who was in charge of field operations for the original release and monitoring of lynx in the Adirondacks. Kent generously shared most of the telemetry locations of the released lynx and provided keen insight into their use of habitats. After careful consideration of the distribution of initial locations and habitats, I selected an area of approximately 1792 km^2 (700 mi^2) around the High Peaks region to survey for lynx (Fig. 2). The actual sample units (see text below) covered approximately 600 km^2 (240 mi^2), or 34% of the survey area (Fig. 2); 113 (41%) of the telemetry locations provided to me occurred in these sample units. Thus, the 1998 survey focused strategically on the areas deemed most likely to have lynx. (Note: some likely areas in corporate ownership were not surveyed because the timber company would not provide permission as requested.)

Figure 2. Location of the lynx survey units within the High Peaks region of Adirondack Park, New York.


McKENZIE MOUNTAIN
WILDERNESS
Saranac Lake
Ray Brook
Lake Placid
SENTINEL RANGE
WILDERNESS
JAY MOUNTAIN
WILDERNESS
Upper Jay
Keene
Keene Valley
Saranac Lakes
Wild Forest
Lower Saranac Lake
Middle Saranac Lake
Upper Saranac Lake
Tupper Lake
OVAL WOOD DISH
ROLLINS POND STATE CAMPGROUND
FISH CREEK POND STATE CAMPGROUND
SARANAC LAKE ISLANDS STATE CAMPGROUND
MEADOWBROOK STATE CAMPGROUND
STATE BOAT LAUNCHING SITE
JOHN BROWN FARM STATE HISTORIC SITE
MOUNT VAN HOEVENBERG STATE RECREATION AREA
HARRIETSTOWN
HIGH PEAKS WILDERNESS
Follensby Pond
SEWARD MOUNTAIN
SEYMOUR MOUNTAIN (4091')
MOUNT DONALDSON
MOUNT EMMONS
ALGONQUIN PEAK (5114')
IROQUOIS PEAK (4849')
MOUNT COLDEN (4714')
MOUNT MARCY (5344')
MOUNT HAYSTACK (4960')
BASIN MOUNTAIN
GOTHIC MOUNTAIN
LOWER WOLFJAW MOUNTAIN
GIANT MOUNTAIN (4627')
GIANT MOUNTAIN
WILDERNESS
CASCADE MOUNTAIN (4098')
BIG SLIDE MOUNTAIN (4240')
PHELPS MOUNTAIN (4161')
FRANKLIN
ESSEX
SAWTOOTH MOUNTAINS
NORTH ELBA
KEENE
SANTANONI PEAK (4607')
MOUNT ADAMS (3520') STATE FIRE TOWER
ALLEN MOUNTAIN (4342')
NIPPLETOP MOUNTAIN (4620')
DIX MOUNTAIN (4857')
DIX MOUNTAIN WILDERNESS
HURRICANE MOUNTAIN (3678') STATE FIRE TOWER
NEWCOMB
Newcomb Lake
Newcomb
Winebrook Hills
GOODNOW MOUNTAIN (2685') STATE FIRE TOWER
NORTH HUDSON
BOREAS MOUNTAIN (3776') STATE FIRE TOWER
Hammond Pond
Wild Forest
North Hudson
FRONTIER TOWN
UNITED STATES GOVERNMENT
Long Lake
Long Lake
LAKE EATON STATE CAMPGROUND
HAMILTON
ESSEX
Blue Mountain
Wild Forest
Vanderwacker Mountain
Wild Forest
HOFFMAN NOTCH WILDERNESS
OWLS HEAD MOUNTAIN
Blue Mountain Lake
LAKE DURANT STATE CAMPGROUND
Rock Lake
Schroon Lake
PHARAOH LAKE
WILDERNESS
PHARAOH MOUNTAIN STATE FIRE TOWER
Severance
Paradox Lake
Loch Muller
Underwood
SHARP BRIDGE STATE CAMPGROUND
Elizabethtown
Fallensby Pond
Handsome Pond
Rich Lake
Harris Lake
Cheney Pond

METHODS

Field Surveys

The new Weaver field technique capitalizes on the natural cheek-rubbing behavior of cats to collect hair for DNA analysis. A sample*station* consists of a visual attractant and a studded, 10-cm (4 in) square pad of carpet nailed to a tree. A special scent (proprietary: Weaver's Lynx Lure) on the pad stimulates lynx to rub their cheeks. In trials with 45 captive lynx at different facilities, 90% of the cats responded to Weaver's Lynx Lure with no differences between sex or age classes.

Design of the survey followed the basic protocol recommended for forest carnivores (Zielinski and Kucera 1995), with some modification. Pilot surveys of lynx in Montana indicated that a mixture of systematic and clustered layouts on 40-km^2 sample units was most efficient for this species in terms of detection, precision, and cost (J. Weaver unpubl. data). Accordingly, lynx surveys were conducted on 40-km^2 sample *units* with four 10-km^2 sample *cells*. There were 8 hair-rubbing *stations* per sample unit; at least 1 station was placed in each cell (systematic) while the other 4 stations were clustered in likely locations within the unit. Stations were spaced at least 0.8 km (0.5 mi) apart. After the first session of 15 nights, stations were checked for hair. Four of the stations (including any with hair) were shifted to new locations within the sample unit for the second session of 15 nights to expand geographic and

ecological coverage (see Fig. 3). The elevation and habitats of the survey sites were very similar to those of the telemetry locations of the released lynx. Surveys were carried out during August-October for the following considerations: (1) ease and safety of access, (2) amount of obtainable lynx hair, and (3) lynx movements and relative demographic closure.

DNA Protocols

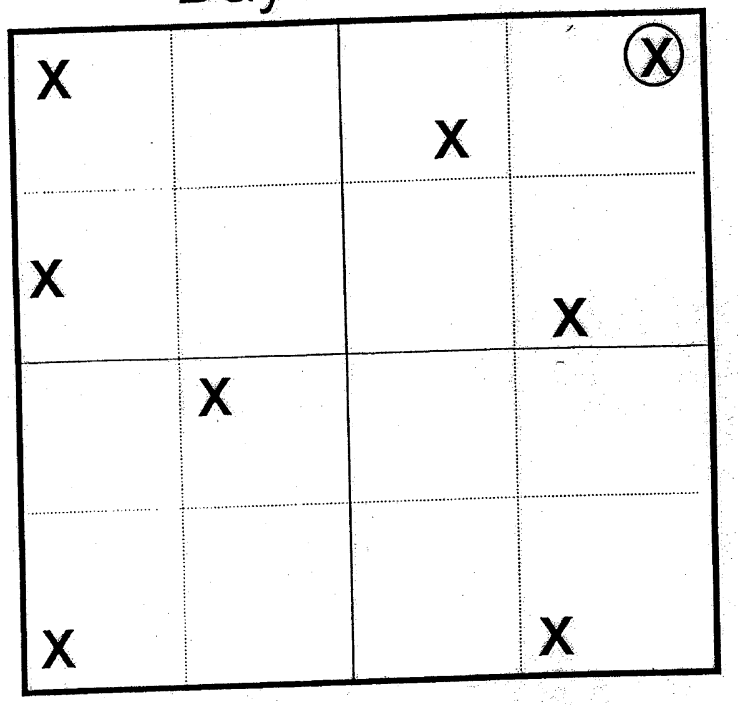
To develop a method for unambiguous identification of hair as lynx, we first obtained voucher samples of hair from 25 known lynx and 25 known bobcats (*L. rufus*) at captive colonies (Weaver and Amato In Prep.). DNA from these hairs was isolated by a standard phenol/chloroform procedure. A fragment of the 16S mitochondrial ribosomal gene (mt rDNA) was amplified using polymerase chain reaction (PCR) for direct DNA sequencing (White et al. 1989). The 16S mt rDNA fragment has proven useful for identification of species in a wide variety of vertebrate taxa (Amato and Gatesy 1994, Amato et al. 1999). This fairly conservative region was chosen to minimize the problem of intraspecific variation in species identification.

Amplifications were performed in a Perkin Elmer 9600 (cycling conditions: 38 cycles of 94° C denaturation for 45 sec, 47° C annealing for 45 sec, 72° C extension for 45 sec) with the following reagent concentrations: 67mM Tris, 3mM MgCl2 , 16.6mM NH4(SO4)2, 0.8mM premixed dNTPs, 0.2uM of each primer and 1U of Taq DNA polymerase (Perkin Elmer, Norwalk, Connecticut). A fragment of the 16S mt rDNA gene was PCR-

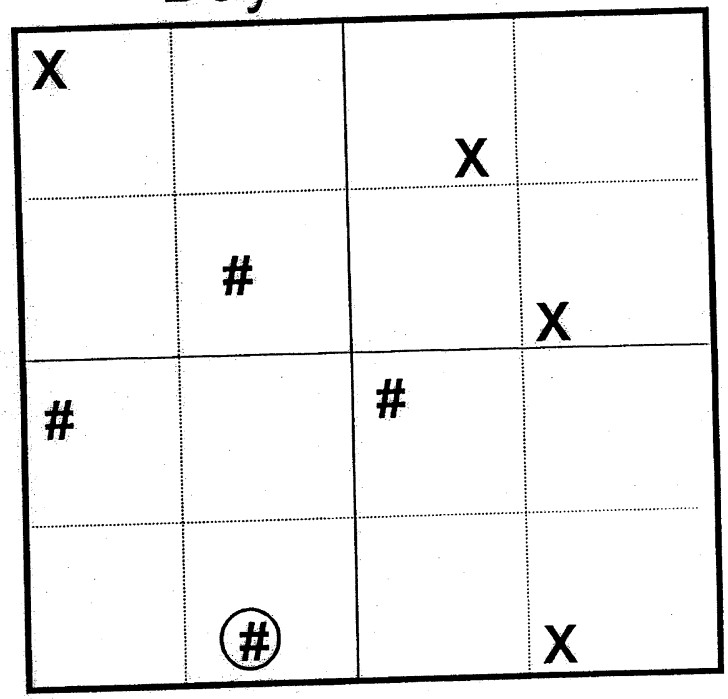
Figure 3. Example of a layout of lynx rubbing stations within a survey unit.

Lynx Survey Units

Session I
Days 1 - 15



Session II
Days 16 - 30



4 mi x 4 mi = 16 mi^2

X = sample station
\# = new station
◯ = station with hair

amplified with universal vertebrate primers: 16Sa 5'caaaccccgcctgtttaccaaaaacat3' and 16Sb 5'ccggtctgaactcagatcacgt3' (Kocher et al. 1989). Purified PCR products were cycle-sequenced using flourescently labeled dideoxy terminators and run on Applied Biosystems 373A and 377 automated sequencers. Sequences were obtained from both strands of DNA and compared analytically. Individual bases were assessed by 'Population Aggregation Analysis' for utility in species identification (Davis and Nixon 1992).

An invariant sequence was obtained for all sampled lynx, and it matched a lynx rDNA fragment previously published in GenBank. A different, invariant sequence was obtained for all bobcats sampled. Sequences in the 16S mt rDNA fragment were different between lynx and bobcats in two diagnostic respects: (1) substitutions of one nucleotide for another at specific points in the sequence, and (2) insertions or deletions (Weaver and Amato In Prep.).

For identification of hair samples collected in the field surveys, DNA was extracted overnight at 56°C in Lifton's buffer (0.1M Tris, 0.2 M Sucrose, 0.05 M EDTA, 1% SDS, pH 8.5) to which 1.4 mg/ml of Proteinase K was added. DNA was precipitated using standard Phenol, Chloroform, Ethanol precipitation procedures (Sambrook et al. 1989). 16S fragments were amplified using PCR and directly sequenced following the protocols specified above.

RESULTS

Our team surveyed fourteen full sample units and two half units (to fit within public ownership) encompassing 600 km² (240 mi²). Rubbing stations at 180 different sites were exposed for a total of 3600 nights. Only three pads with possible lynx hair were collected and sent to the lab; none were lynx . (Due to other priorities, the lab has not yet determined the species identity of these hair).

DISCUSSION

The 1998 survey yielded no evidence of lynx in the High Peaks region of the Adirondacks. At least two explanations are possible: (1) some lynx occur there, but the survey did not detect them because the technique does not work as efficiently under conditions in the Northeast, or (2) lynx do not occur in the study area .

This survey technique works best under dry conditions; frequent, heavy rainfall may degrade the stimulus of the scent attractant to an unknown extent. The Adirondacks received near-record high amounts of rainfall during the summer and fall of 1998 (R. Masters pers. commun.). It is possible that this unusual amount may have reduced the efficacy of the technique. I would note, however, that in our primary study area in NW Montana (which is reknown for its dense vegetation and high rainfall), lynx continue to respond to scented pads during periods of rainy weather.

In 1998, we also conducted surveys for lynx in the Cascade Range of Oregon and Washington where lynx have been considered extirpated for several decades. With similar intensity of effort as in the Adirondack survey, we detected the presence of lynx in that region of both states where lynx apparently are quite rare . The effects of weather notwithstanding, I believe that our survey would have detected lynx unless they were extremely rare.

The other possibility is that none of the lynx translocated to the High Peaks region of the Adirondacks survived and settled in the core release area. Nearly 50% of the released lynx are known to have died from vehicle collisions and shooting; several of these occurred at considerable distances north of the release area in Canada. A few (<10) sightings of animals presumed to be lynx have been reported since the releases (R. Masters pers. commun., M. Kautz pers. commun.). These have come from areas of New York state north and west of the survey area.

Based upon our limited field experience in the High Peaks region, we were surprised at the dearth of snowshoe hare abundance in much of the study area. The hare sign that we did observe was confined to those spruce stands with brushy understory ... such patches of suitable habitat were small in size, few in number, and widely scattered. For a 64-ha study site of mixed conifers and hardwoods in the central Adirondacks, Brocke (1975) estimated a density of 0.29 hares/ha. This represents a very low

density, comparable to that found in northern Canada and Alaska when hare numbers are at the low point of the '10-year'cycle (Keith 1963). During those conditions, lynx become nomadic over large areas, production and survivorship of lynx kittens declines to nearly zero, and lynx density plummets dramatically (Brand et al. 1976, Brand and Keith 1979,Ward and Krebs 1985).

In conclusion, it appears that very few -- if any – of the lynx translocated to the High Peaks region of the Adirondacks survived and settled in the core release area. A few sightings of purported lynx have been recorded further north and west in New York, and these may warrant some future survey effort.

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ACKNOWLEDGMENTS

I thank the Geraldine R. Dodge Foundation and the Camp Fire Conservation Foundation for their generous support of this important survey. Rainer Brocke and especially Kent Gustafson were quite helpful in providing background for the survey and orientation to the study area. Dick Sage arranged for accomodations at the Adirondack Ecological Center, and Ray Masters shared many insights about the local ecological conditions and history. Marie Kautz of the New York Department of Environmental Conservation endorsed and participated in the survey. Tom Helms at Helms Aero Service provided competent aerial support. Steven Christensen, Richard Dixon, Percy Fleming, Avery and Monica Rockefeller, and Dick Sage kindly provided access to private lands to carry out lynx surveys. Justina Ray, Noah Weber, and especially Peggy Wood carried out the field survey with their customary competence and good cheer. To each of you, my thanks for your help.