

Winter Mammal and Habitat Survey of the Greater Goose Pond Forest.

Keene, New Hampshire

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ABSTRACT

In the Greater Goose Pond Forest, a mammal and habitat survey was conducted within a 380-acre study area surrounding Goose Pond, during the 1994 winter.

The purpose of the study was to confirm the presence of medium to large-sized mammals and to determine their habitat preference during the winter.

Forest cover types were determined using aerial photographs and field checked on a grid system basis. Mammals signs were recorded along a 3410m survey route comprised of existing trails and transects set up across the property. The survey route was run five times during the study period.

Nine timber stands comprised of five forest cover types were delineated. Signs of twelve species of medium to large-sized mammals were observed during the study period: red squirrel, gray squirrel, eastern chipmunk, porcupine, snowshoe hare, short-tailed weasel, mink, fisher, fox, coyote, white-tailed deer and moose. Our results indicated that some mammal species may have a preference for a particular forest cover type during the winter, although more data is required to confirm these findings.

The Greater Goose Pond Forest represents a valuable wildlife habitat due to its large size and diversity of forest and wetland communities. Maintaining the diversity and richness of wildlife on the property will require thoughtful management decisions based on this and other wildlife studies.

INTRODUCTION

Overview & Purpose of the Study

The Greater Goose Pond Forest consists of 1,000 acres of woodland and wetlands, including the 42-acre Goose Pond. Goose Pond was created from a smaller pond and bog in the late 1860's and became the first piped water supply for Keene in 1868. During the 1900's, the pond became a backup water supply and remained so until 1984. Throughout this period, the pond and much of the surrounding acreage was protected as a drinking water reservoir and watershed. In 1984, on account of the relative cost of surface water treatment protocols, the city decided to remove Goose Pond from the water supply system. The use of the pond and the surrounding land was now no longer dictated by water supply regulations, so in 1985 a committee was appointed to decide the future use of the property. A plan was produced which envisioned a North Central Park stretching from Drummer Hill to the Gunn Road. The park was named the **Greater Goose Pond Forest** and was to remain a forested area for hiking, cross-country skiing, fishing and nature studies.

Since 1985, important connecting parcels have been purchased and a parking lot on the East Surry Road and trail to the pond have been constructed. In 1992, a review of the 1985 Master Plan was carried out by an appointed group of Keene citizens. The revised plan called for a more comprehensive mapping and inventory of the forest, the identification of unique or sensitive wildlife areas and the planning of future trails and signs. The possibility of logging areas of the forest was also included in the plan. The Monadnock Sierra Club has issued a resolution opposing logging in the Greater Goose Pond Forest.

The 1992 Greater Goose Pond Forest Plan states that the long term goal for this area is to maintain its natural beauty while encouraging public use. This large woodland area should be accessible only on foot, ski, pedal bike or snowshoe, along trails that lead to ponds, nature walks and scenic vistas. To achieve this goal it is essential that a thorough knowledge of the natural resources of the site be known.

Whereas a cursory bird survey around Goose Pond and a forest inventory of specific lots have been undertaken, no formal study of the mammals and their habitat within the Greater Goose Pond Forest has been done. The winter season with its snow provides the best opportunity for a field study of medium to large-sized mammals. Such a study would indicate which mammalian species inhabit the forest and could provide information that identifies areas that are particularly important for certain species of mammals. This knowledge would be helpful in planning future trails, for educational programming and for assessing the potential impacts on the area's wildlife resources from any logging operations.

The objective of this study was to determine the diversity of medium to large-sized mammal species and to survey the forest cover within a 380-acre portion of the Greater Goose Pond Forest. This project was designed to confirm the presence and location of as many of these mammalian species as possible within the study area and to indicate their habitat preferences during the winter months.

We hypothesized that: i) the Greater Goose Pond Forest supports a wide diversity of medium to large-sized mammals; ii) some of these mammals have a preference for particular habitats during the winter; iii) the collection of data will provide the city with a more informed perspective on potential logging operations in the Greater Goose Pond Forest.

Description of Study Area

The Greater Goose Pond Forest lies north of Keene (NH) and covers approximately 1000 acres. The city owns land stretching from the Drummer Lot off Elm Street to the former Paquette parcel that approaches the Gilsum Town line. Portions of the forest reach the East Surry Road, while the eastern boundary runs along the Old Gilsum Road and to the edge of the Ministers' Lot.

The area is characterized by moderately steep to very steep slopes, with isolated pockets of flatter terrain. Goose Pond is located in a basin surrounded by hills reaching elevations up to 350m along the east, 300m to the northwest, and decreasing to 210m to the south and southwest.

The soils in the Greater Goose Pond Forest are those generally associated with steep topographical features (ranging in slope from 15% - 50%) and are shallow, stony glacial tills. These soils are found throughout the Greater Goose Pond area. Adjacent to Goose Pond, and along several drainageways, there exist wetland soils of fine sandy loam or mucky peat. Drainage and groundwater recharge are dependent upon maintenance of the forested areas, wetlands and natural drainage channels.

The Greater Goose Pond Forest contains a wide variety of vegetation, ranging from wetland plants to forested uplands. The forest is composed of areas dominated by softwoods, hardwoods and mixed woodlands. Two of the parcels added to the Greater Goose Pond Forest were logged prior to their purchase - the Burroughs parcel was cut in the 1970's and the Leigh parcel, on the hillside east of the pond, was logged in the mid-1980's.

METHODS & MATERIALS

Forest Cover Types

Forest cover types and their boundaries within the study area were determined using aerial photographs. Forest cover types were classified according to the following:

- 1) Hardwoods = < 10% softwoods
- 2) Softwoods = < 10% hardwoods
- 3) Mixed Woods = > 40% of each type
- 4) Mixed, Hdwds Dominant = 60% - 90% Hdwds in canopy
- 5) Mixed, Sftwds Dominant = 60% - 90% Sftwds in canopy

The forest cover types were field checked on a grid system basis. Grid intervals were 150m by 150m, resulting in 59 sampling points throughout the study area. At each grid intersection trees were sampled with a 10 basal area factor prism. The species and DBH of each tree sampled was recorded.

Mammal Survey

Straight-line transect lines were set up through the study area using a compass (see location maps in appendix). Each transect was marked at measured intervals (15-30m) by wrapping flagging tape around the trunk of a tree. These lines were designed to intercept as many forest cover types present, and cover as much of the property as possible given there was

a limited amount of time available to survey the study site.

The survey route included the trail from the Surry Road parking lot to northern end of Goose Pond, and the trail from the metal gate on Surry Road to the dam at the south-east corner of Goose Pond. The total distance of this circular route was 3410m. The survey route intercepted all forest cover types within the study area except an area of softwoods along the northern edge.

The survey route was walked five times between 19 February and 7 March 1994. Each recording session occurred at least one day after a snowstorm (see field log in appendix). When walking the transect, we recorded the following information: date, start and end time, weather conditions (temperature & cloud cover), ground condition and location of all mammal signs along the transects. The majority of mammal signs observed were tracks, but also included scat piles and sightings. The location of each track and direction of travel across the transect or trail was recorded.

The forest covers types and descriptions of timber stands within the study area are summarized in Table 1. The percentage dominance of each tree species within each forest cover type was calculated by dividing the total basal area for a particular tree species within a forest cover type by the total basal area of all the trees within the forest cover type.

The frequency of sign occurrence for each mammal species per forest cover type was calculated by dividing the total length of transect within a forest cover type by the number of signs per species within the forest cover type (Table 2).

The relative activity for each mammal species versus another was calculated by dividing the total number of sign per species by the total number of sign for all species (Table 2).

RESULTS

Signs of 12 species of medium to large-sized mammals were recorded within the study area: red squirrel, gray squirrel, eastern chipmunk, porcupine, snowshoe hare, short-tailed weasel, mink, fisher, fox, coyote, white-tailed deer and moose. All the signs of each species recorded on each survey walk are summarized on location maps in the appendix.

Red Squirrel

(Tamiasciurus hudsonicus)

The red squirrel is relatively common throughout New England. In winter, red squirrels feed on nuts, and conifer seeds, which are stored in large underground caches. Red squirrels find winter shelter in underground burrows or tree cavities.

Red squirrel tracks were observed in all forest cover types along the survey route. The highest frequency of tracks were found in mixed-softwood dominant woods (Table 2).

Gray Squirrel

(Sciurus carolinensis)

The gray squirrel is common throughout New England. During the autumn, gray squirrels are known to shift their home ranges in response to food availability. In winter, gray squirrels feed on a variety of seeds and nuts, which are stored in tree cavities and buried individually underground. Gray squirrels require oaks or other tall trees to build dens or leaf nests.

Only three tracks of gray squirrels were observed in mixed woodland.

Eastern Chipmunk

(Tamias striatus)

The eastern chipmunk is common throughout New England. Chipmunks feed on a variety of seeds, nuts, insects, meat and eggs. In winter, chipmunks undergo periodic bouts of torpor, alternating with foraging bouts on sunny winter days. Dens are located in underground tunnel systems.

Two chipmunks were observed in mixed woodland, during a brief warm period in mid-March.

Porcupine

(Erethizon dorsatum)

Porcupines are relatively common throughout New England. In winter, porcupines feed primarily on the bark, twigs, and buds of hemlock. Porcupines require den sites in rock caves, hollow trees, or abandoned buildings.

One porcupine track was observed in mixed-softwood dominant woods.

Snowshoe Hare

(Lepus americanus)

The snowshoe hare is common throughout New England and is associated with a variety of forest types, particularly open wooded areas with a dense brushy understory for feeding and cover. In winter, snowshoe hares feed on twigs, buds and bark of small trees and seedlings.

Snowshoe hare tracks were observed in mixed-softwood dominant woods, mixed woods

and hardwoods. The highest frequency of tracks were found in mixed woods (Table 2).

Short-tailed Weasel

(Mustela erminea)

The short-tailed weasel is relatively common throughout New England. Weasels are found in a variety of habitats including open or forested country, often near waterways. In winter, weasels hunt a variety of small mammals including voles, mice and shrews. The den site is usually below ground under a fallen tree or stump.

Short-tailed weasel tracks were observed in mixed-softwood dominant woods, mixed woods, and hardwoods. The highest frequency of tracks were found in mixed-softwood dominant woods (Table 2).

Mink

(Mustela vison)

Mink are relatively common in New England and are found in association with aquatic habitats including streams, lake shores, ponds, marshes, and forested wetlands. Mink are opportunistic carnivores, feeding on a variety of small mammals, muskrat, rabbits, fish, frogs, crayfish, and other vertebrate and invertebrate species associated with wetlands. Den sites include hollow logs, natural cavities under tree roots, or in burrows along stream, marsh, or lake edges.

Observations of mink included tracks and slides. Tracks were observed along the shores of Goose Pond or close to streams, in all forest cover types along the survey route. The highest frequency of mink tracks were found in mixed-hardwood dominant woods (Table 2), in an area

where a stream entered Goose Pond. On 3 March, two sets of tracks were observed travelling along the western shore of Goose Pond. Since mink breed between February and March these tracks may have been a mated pair.

Fisher

(Martes pennanti)

Fishers are relatively common throughout New England. Fishers require extensive forests and are found less frequently in more open stands or burned areas. In winter, fishers hunt a variety of mammals including squirrels, hare, mice, and porcupine. Fisher movements are often predictable, regularly retracing hunting routes every two or three days. Den sites are in hollow trees, logs, ground holes under large boulders, or vacant porcupine dens.

Fisher tracks were observed in all forest cover types along the survey route. The highest frequency of tracks were found in mixed-softwood dominant woods (Table 2).

Fox: Red and Gray

(Vulpes fulva and Urocyon cinereoargenteus)

It was difficult for us to distinguish between the tracks of these two species, so all fox tracks observed are considered together. Both red and gray fox are relatively common in New England. Gray foxes are more closely associated with densely forested areas than red fox, although both species utilize a mix of forest, open fields and brushy areas. Preferred winter food sources include mice, shrews, voles and occasionally hares. Both species use den sites such as hollow logs and tree and rock cavities.

Fox tracks were observed in all forest cover types along the survey route. The highest frequency of tracks were found in mixed-hardwood dominant woods.

Coyote

(Canis latrans)

Coyotes are relatively common in New England. Coyotes are opportunistic feeders. In winter their food is mainly snowshoe hare and deer carrion. The den is usually an excavated burrow that is well hidden by vegetation, a rock or stump.

Coyote tracks were observed in mixed-softwood dominant woods, mixed woods and hardwoods. The highest frequency of tracks were found in hardwoods. The distribution of coyote tracks coincided with those of white-tailed deer and snowshoe hare. The remains of a deer was found with coyote tracks leading to and from the site.

White-tailed Deer

(Odocoileus virginianus)

According to reports by the New Hampshire Fish and Game Department, white-tailed deer populations have increased in south-west New Hampshire in recent years. Deer will utilize a variety of habitats throughout the course of the year depending on food availability and snow conditions. In winter, deer rely on shrub and hardwood browse, acorns and conifers. When the snow depth exceeds 16-18 inches, deer tend to move to areas of dense coniferous cover called "deer yards". In southern New Hampshire this conifer cover is typically hemlock stands.

Deer tracks were observed in all forest cover types along the survey route. The highest

frequency of tracks was found in hardwoods, which may indicate the importance of an abundant supply of acorns for deer (which they dig out from beneath the snow) during winter.

Moose

(Alces alces)

Moose are relatively common throughout New England. Moose utilize a wide variety of habitats depending on the time of year, food availability and snow conditions. In winter moose often move to higher elevation areas with dense coniferous cover, where they browse on red and striped maple and conifers (especially balsam fir).

Moose signs were not observed along the survey route. Moose scats and tracks were found in the mixed-softwood dominant woods in the southern portion of the study area.

DISCUSSION

Although we observed signs of 12 species of medium to large-sized mammals within the Greater Goose Pond Forest study area, this tally may not represent the full complement of mammalian species which frequent this site. Hibernating mammals and infrequent visitors were unlikely to be observed during the study period. Also, large areas of the study site were not intercepted by the survey route. We recommend that further studies should be conducted in the areas that were not covered by this project, in particular, the northern and southern portions of the study site. Further studies, during the winter and at other times of the year, may reveal signs

of other mammalian species. Considering the number of wetlands within the study area, we suspect that raccoons, otters and beavers may inhabit or at least visit the Greater Goose Pond Forest.

A large portion of our transect lines were located close to the edges of Goose Pond. Our results relating to habitat preference and frequency of signs of mammal species may be biased towards those species which frequent areas close to the pond.

The number of tracks intercepted by our transects does not translate directly into the number of individuals of a particular species within the study area because the same individual may have crossed the line more than once during a single day or night. We assumed that the frequency of tracks within a forest cover type may indicate habitat preference. Thus, our results indicated that some mammals may have a preference for particular forest cover types during the winter, although this study should be repeated to provide more data to confirm these findings. For example, our results indicated that deer were perhaps using the southern area of the property as a deer yard. However, the presence of tracks may give little indication whether an animal is simply passing through an area or is searching the area for food, water, shelter, or den sites. Many other factors influence the pattern of habitat use by a given species, including fluctuations in weather patterns and food availability, and the unique natural history of that species (e.g. home range, diet and foraging strategies). Some of the species studied have home ranges larger than the Greater Goose Pond Forest Study Area, although many could potentially meet all of their food, cover, and breeding needs within the Greater Goose Pond Forest.

The determination of the habitat use and preferences of each mammalian species can help land managers assess how each species may be affected by different management activities, such

as logging. If the long-term goal is to manage the area without adversely affect species already present then some management activities may have to be modified or cut. For example, fisher require extensive forests and may be impacted by clearings created through the removal of timber.

REFERENCES

Unpublished Documents:

Greater Goose Pond Forest Management Plan (1985), revised 1992. City of Keene, Department of Parks and Recreation.

Forest Inventory and Management Plans have been completed for the Ministers' Lot (1985), the Drummer Hill Lot (1986) and the Wright, Sylvester and Thompson-Reed Lots (1991).

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APPENDIX

- a. Forest Cover Types map
- b. Table 1
- c. Table 2
- d. Mammal species location maps:
 - Red squirrel
 - Gray squirrel
 - Chipmunk
 - Porcupine
 - Snowshoe Hare
 - Short-tailed Weasel
 - Mink
 - Fisher
 - Fox
 - Coyote
 - White-tailed Deer
 - Moose
- e. Field Log

Table 1. Timber Stand Descriptions of the Greater Goose Pond Forest Study Area.
 Figures represent % Dominance of each tree species within each Timber Stand.

TIMBER STAND	TREE SPECIES														Forest Cover Type		
	Softwoods				Hardwoods												
	EH	WP	BF	RO	RM	AB	WA	YB	GB	WB	BB	SM	BC	AE			
1	69	11		18	2												Mixed, Softwoods Dom.
2	38			38	15			7			2						Mixed, Hardwoods Dom.
3	18	75		5	2												Softwoods
4	7			61	10	3		13	3								Hardwoods
5	52			26	8	9	2	2		2							Mixed Woods
6				92	2	1	3			2							Hardwoods
7	23	12		39	15	7			1		4						Mixed, Hardwoods Dom.
8	41	41	1	10	2		1	2									Mixed, Softwoods Dom.
9	10	49		16	7	6	1	2	6	1	2	1	1				Mixed Woods

LEGEND

Tree species:

- EH Eastern Hemlock
- WP White Pine
- BF Balsam Fir
- RO Red Oak
- RM Red Maple
- AB American Beech
- WA White Ash
- YB Yellow Birch
- GB Gray Birch
- WB White Birch
- BB Black Birch
- SM Sugar Maple
- BC Black Cherry
- AE American Elm

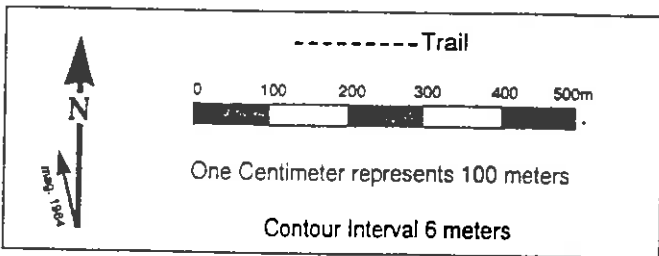
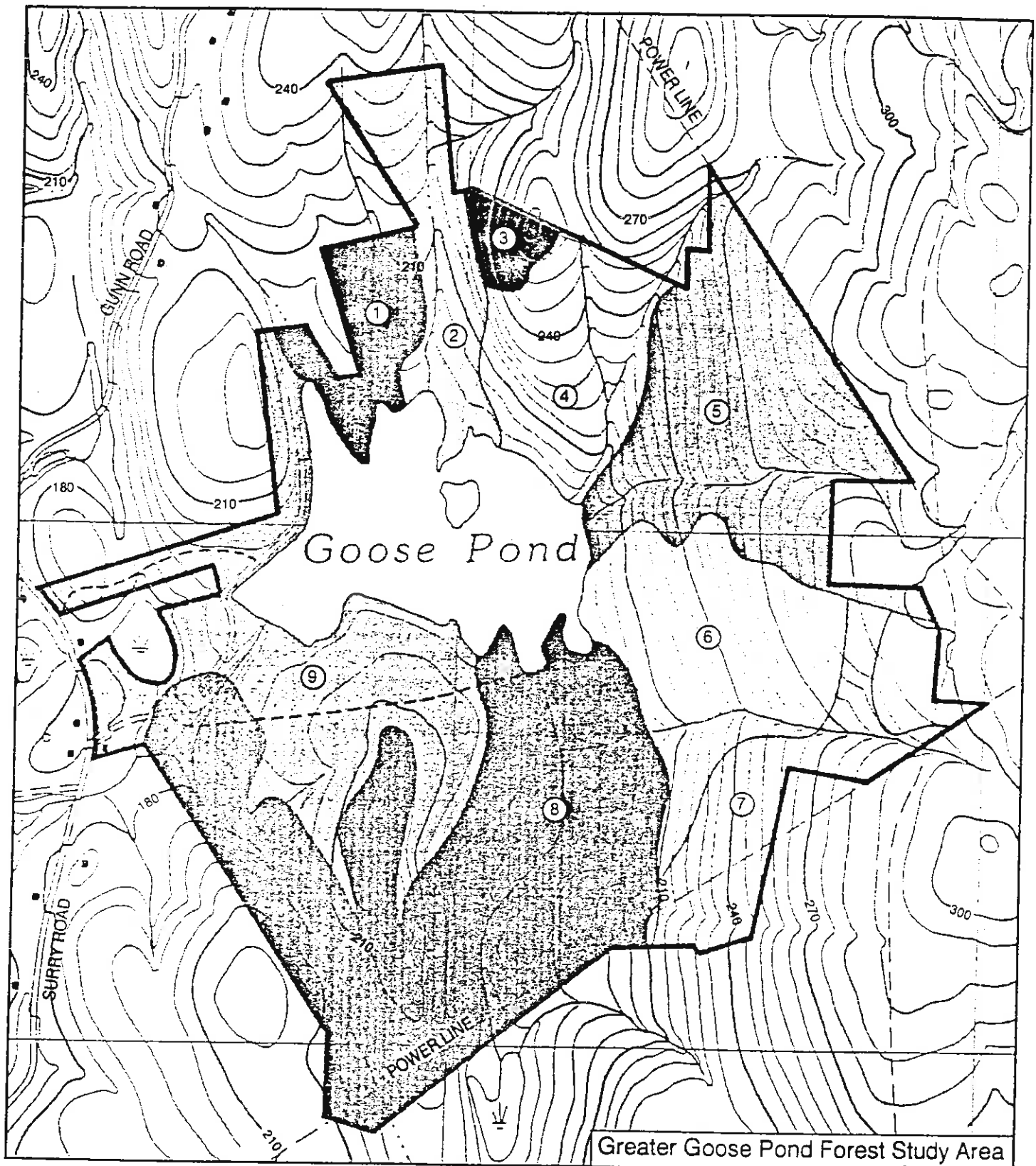
Forest Cover Types:

- Hardwoods = < 10% softwoods
- Softwoods = < 10% hardwoods
- Mixed Woods = > 40% of each type
- Mixed, Hardwoods Dom. = 60% - 90% hwdws
- Mixed, Softwoods Dom. = 60% - 90% sftwds

Table 2. Frequency of mammal tracks per forest cover type and relative activity of each mammal species within the Greater Goose Pond Forest Study Area.

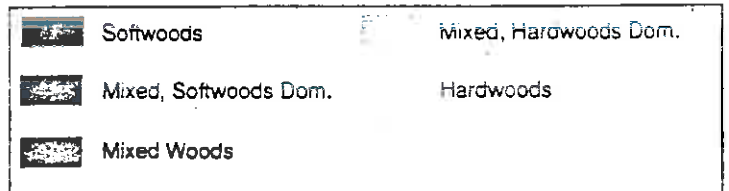
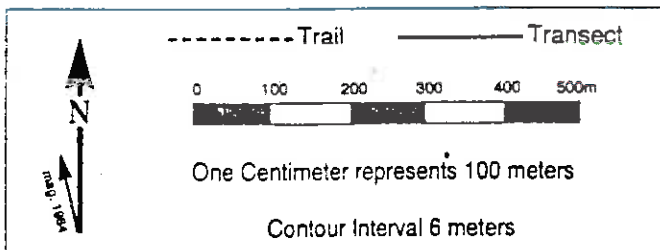
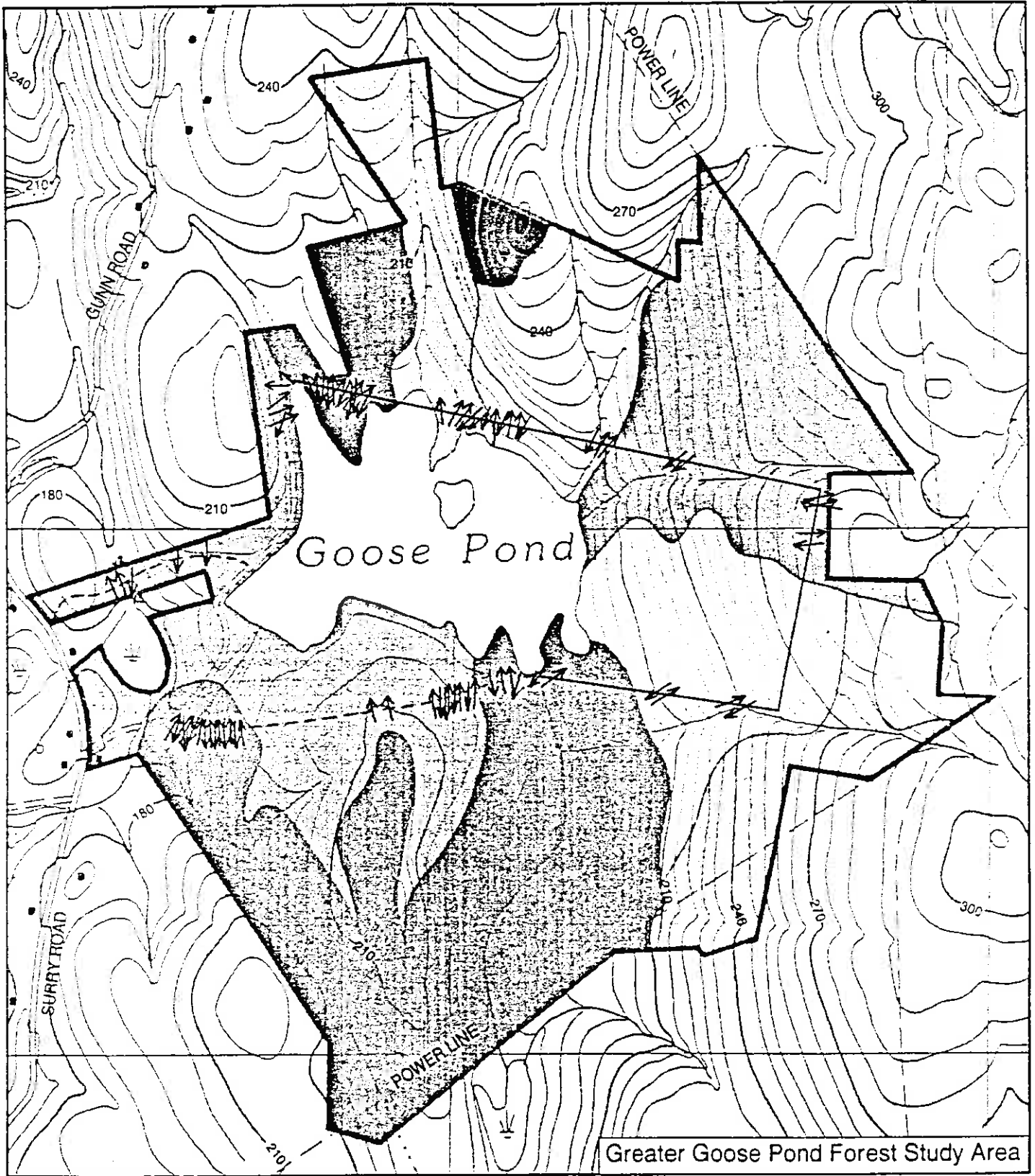
Frequency figures indicate average distance between tracks within each forest cover type, and along all transects. % relative activity gives a relative estimate of activity of one mammal species versus another.

MAMMAL SPECIES	FOREST COVER TYPE				Frequency along all transects	Relative activity %
	Mixed - sft. dom.	Mixed Woods	Mixed - hrd. dom	Hardwoods		
Red Squirrel	20m	56m	28m	60m	41m	26.9
Gray Squirrel		620m			1137m	0.9
Porcupine	660m				3410m	0.3
Snowshoe Hare	330m	109m		360m	162m	6.7
Short-tailed Weasel	165m	930m		360m	426m	2.6
Mink	220m	124m	24m	720m	131m	8.3
Fisher	73m	1860m	170m	90m	180m	6.0
Fox	41m	93m	17m	240m	70m	15.7
Coyote	600m	207m		180m	244m	4.4
White-tailed Deer	55m	89m	85m	14m	39m	27.8

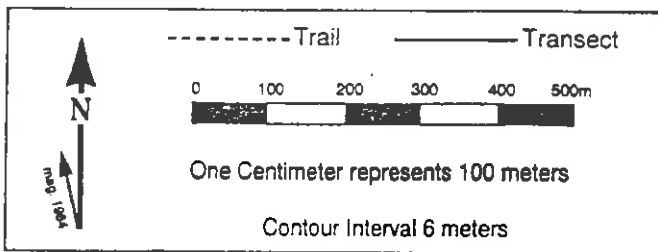
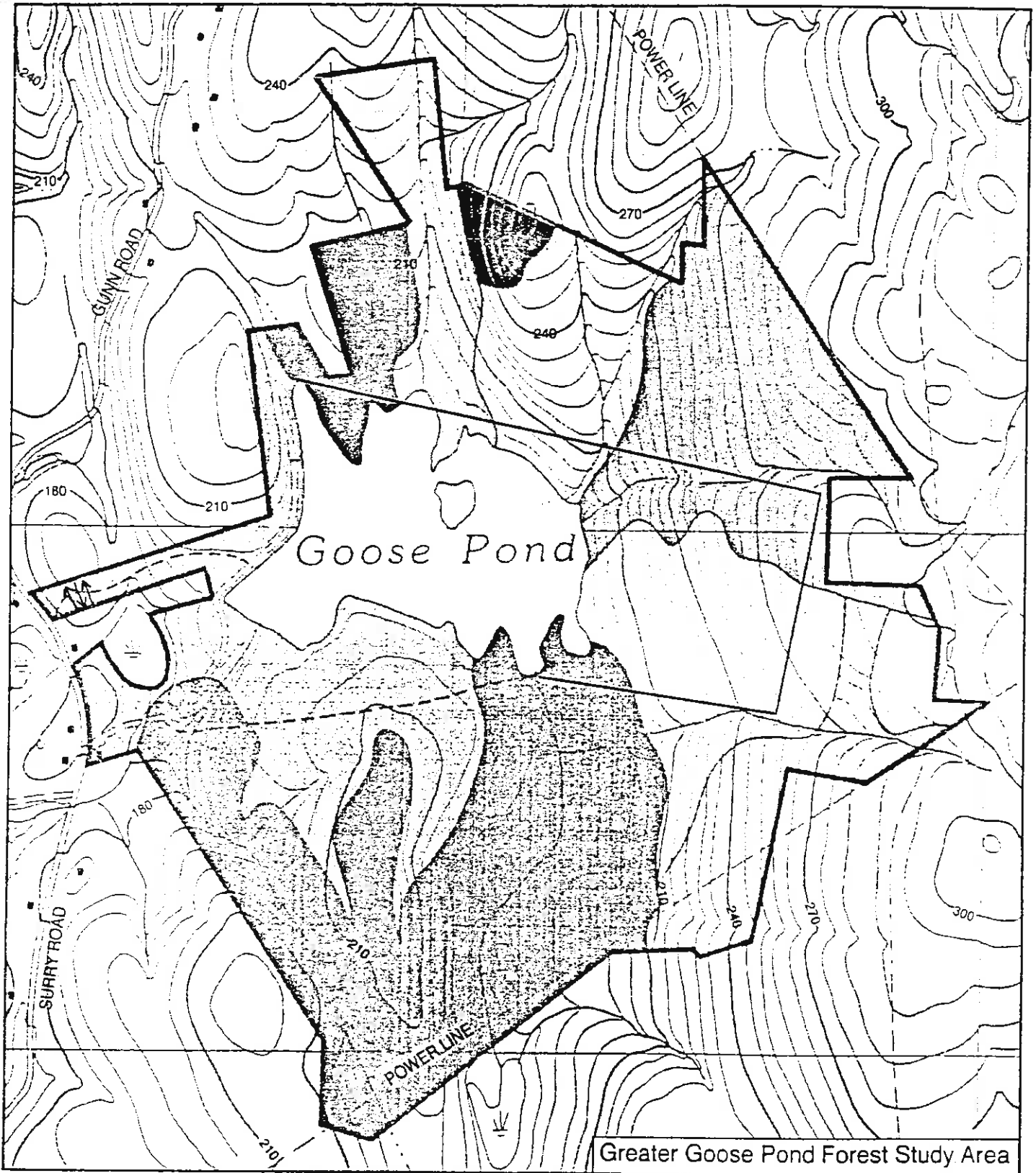


	Softwoods		Mixed, Hardwoods Dom.
	Mixed, Softwoods Dom.		Hardwoods
	Mixed Woods		① Timber Stand - See descriptions on next page.

FOREST COVER TYPES MAP

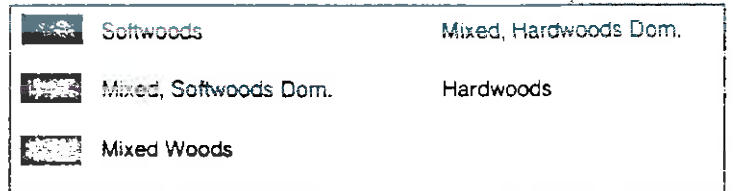
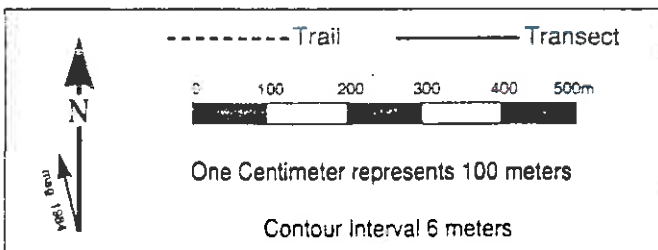
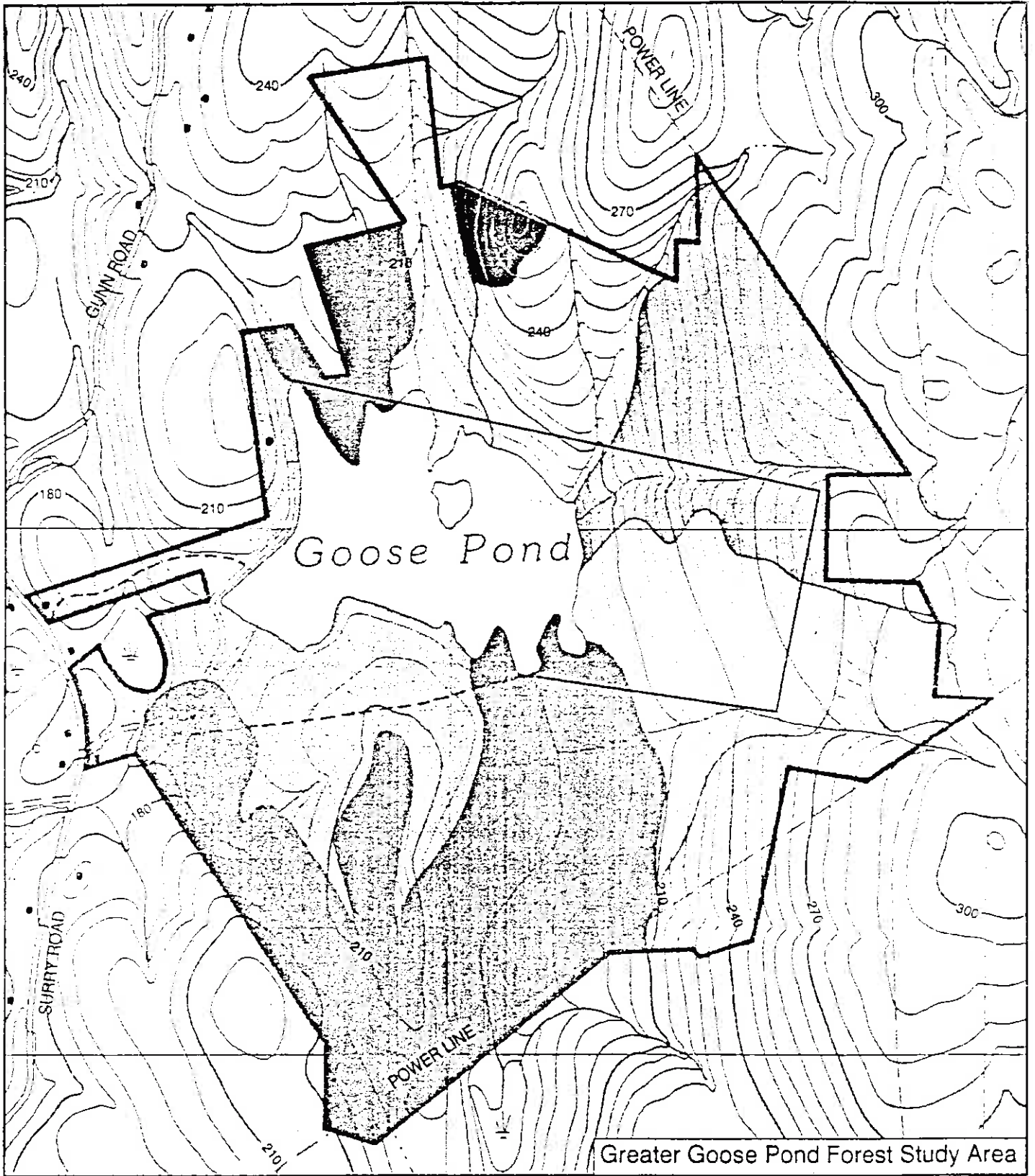


RED SQUIRREL LOCATION MAP
 DIRECTION OF TRAVEL →



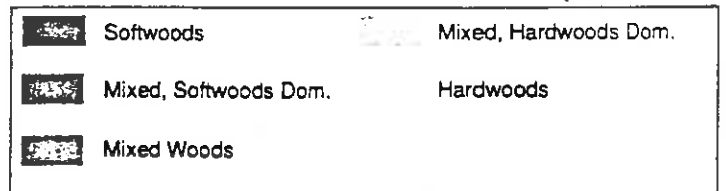
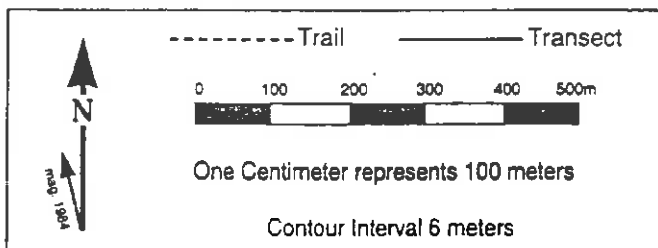
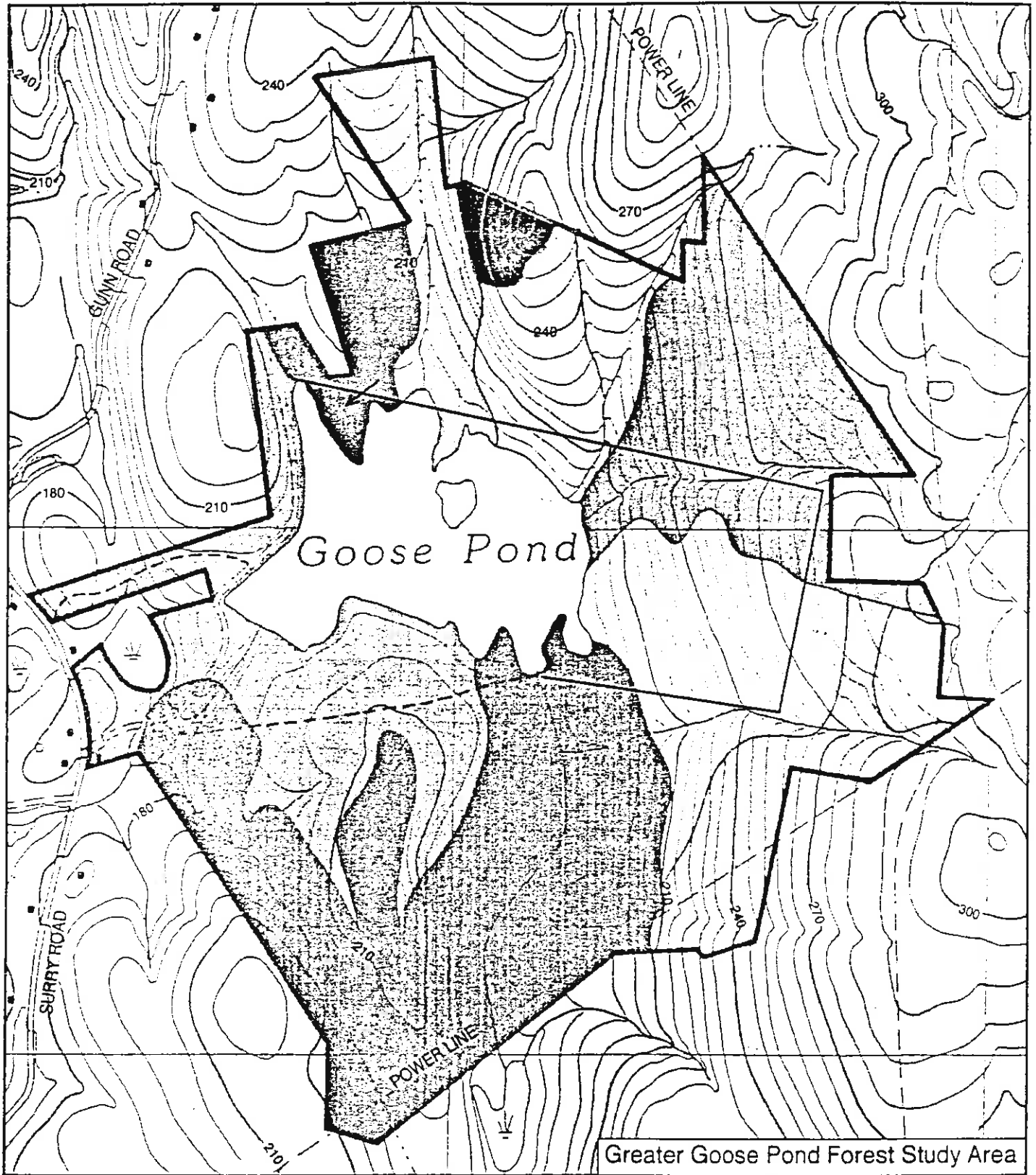
	Softwoods	Mixed, Hardwoods Dom.
	Mixed, Softwoods Dom.	Hardwoods
	Mixed Woods	

GRAY SQUIRREL LOCATION MAP
 DIRECTION OF TRAVEL →

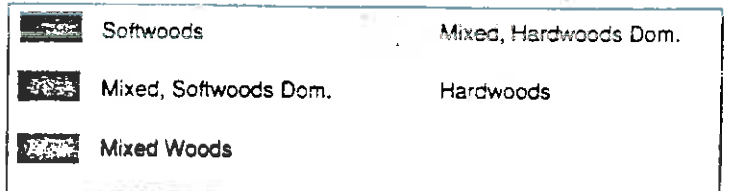
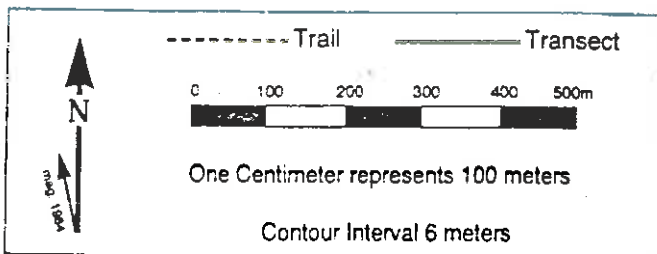
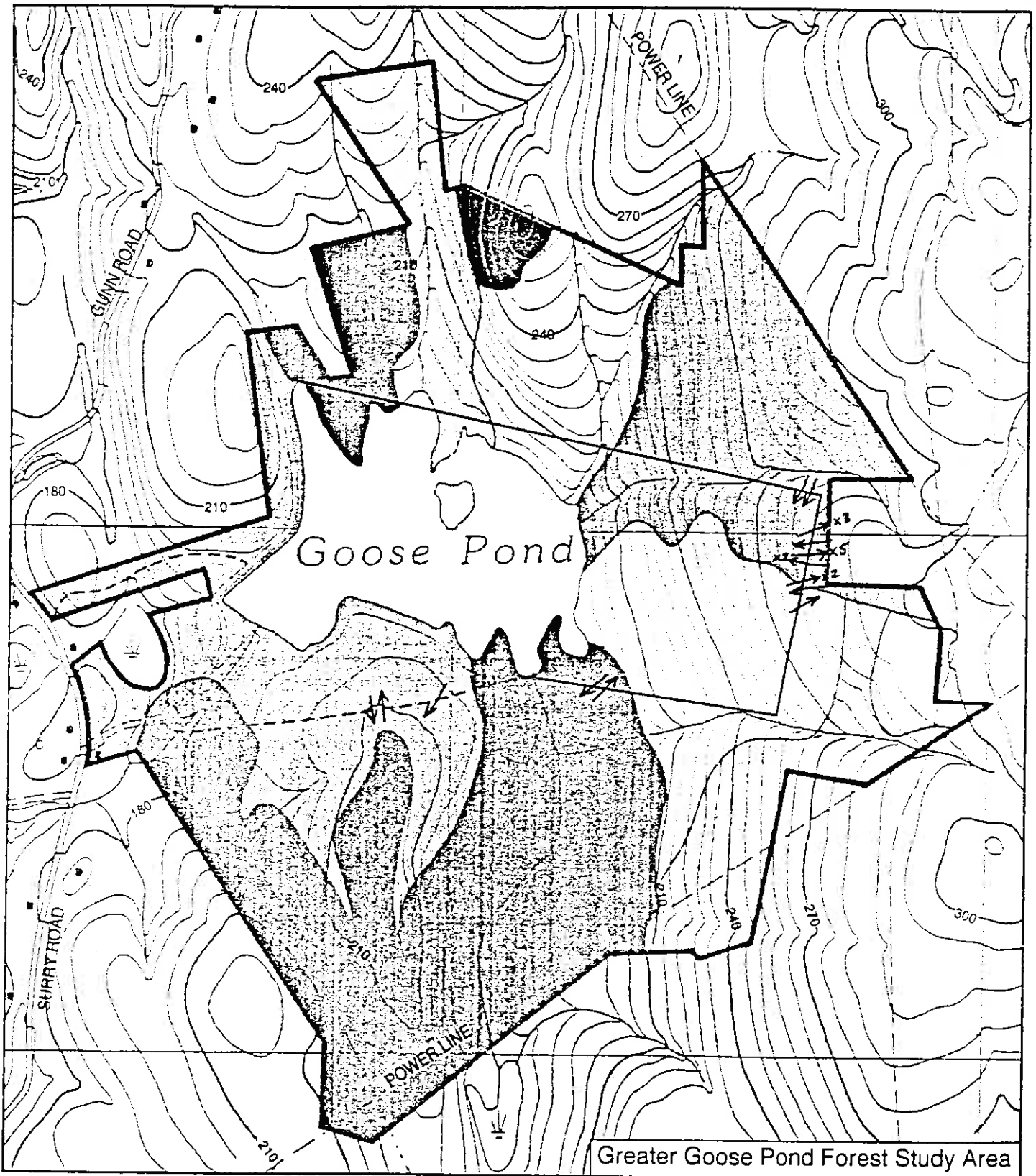


CHIPMUNK LOCATION MAP

SIGHTING ●

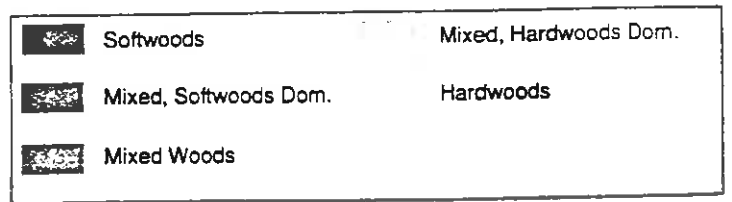
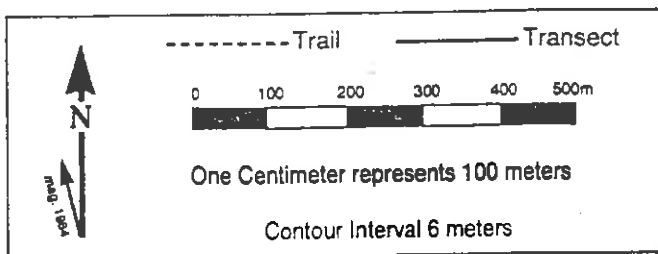
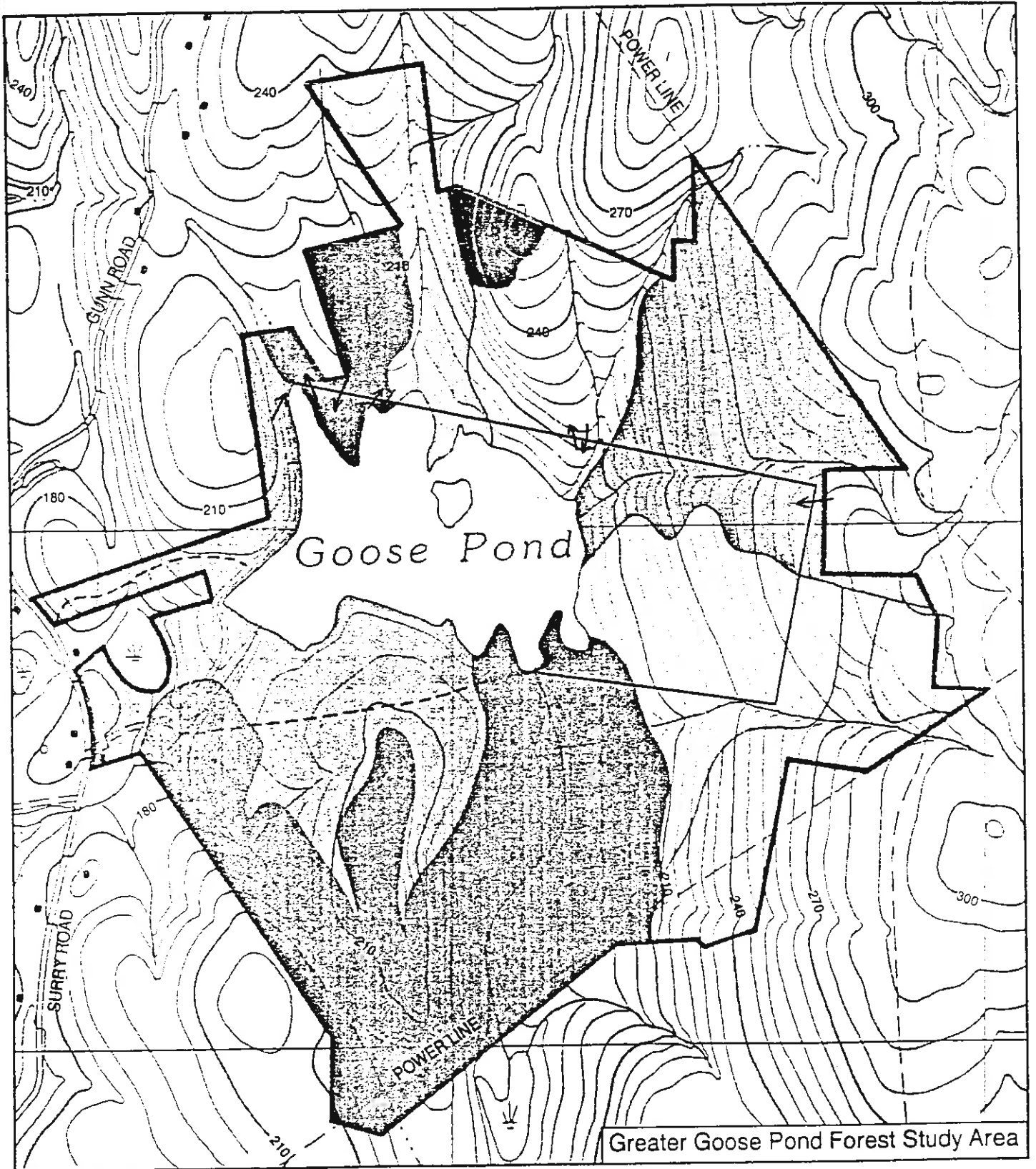


PORCUPINE LOCATION MAP
 DIRECTION OF TRAVEL →



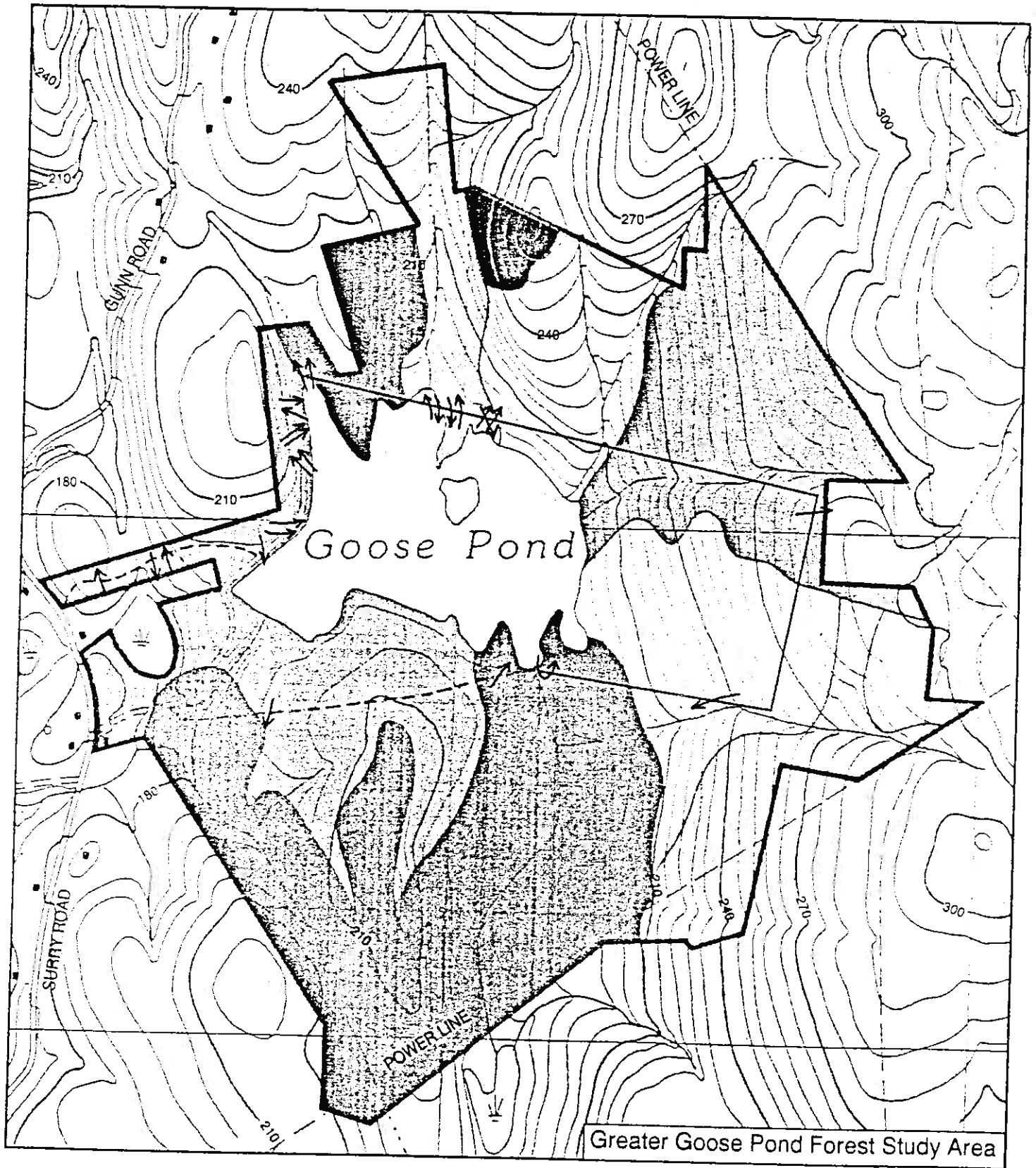
SNOWSHOE HARE LOCATION MAP

DIRECTION OF TRAVEL →

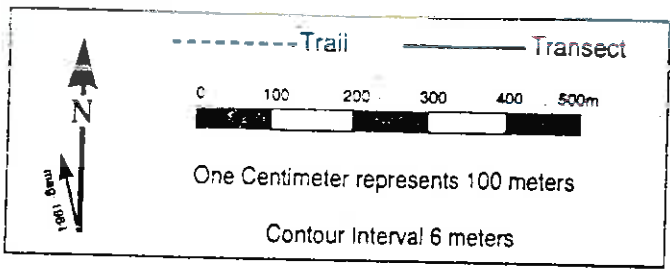


SHORT-TAILED WEASEL LOCATION MAP

DIRECTION OF TRAVEL →

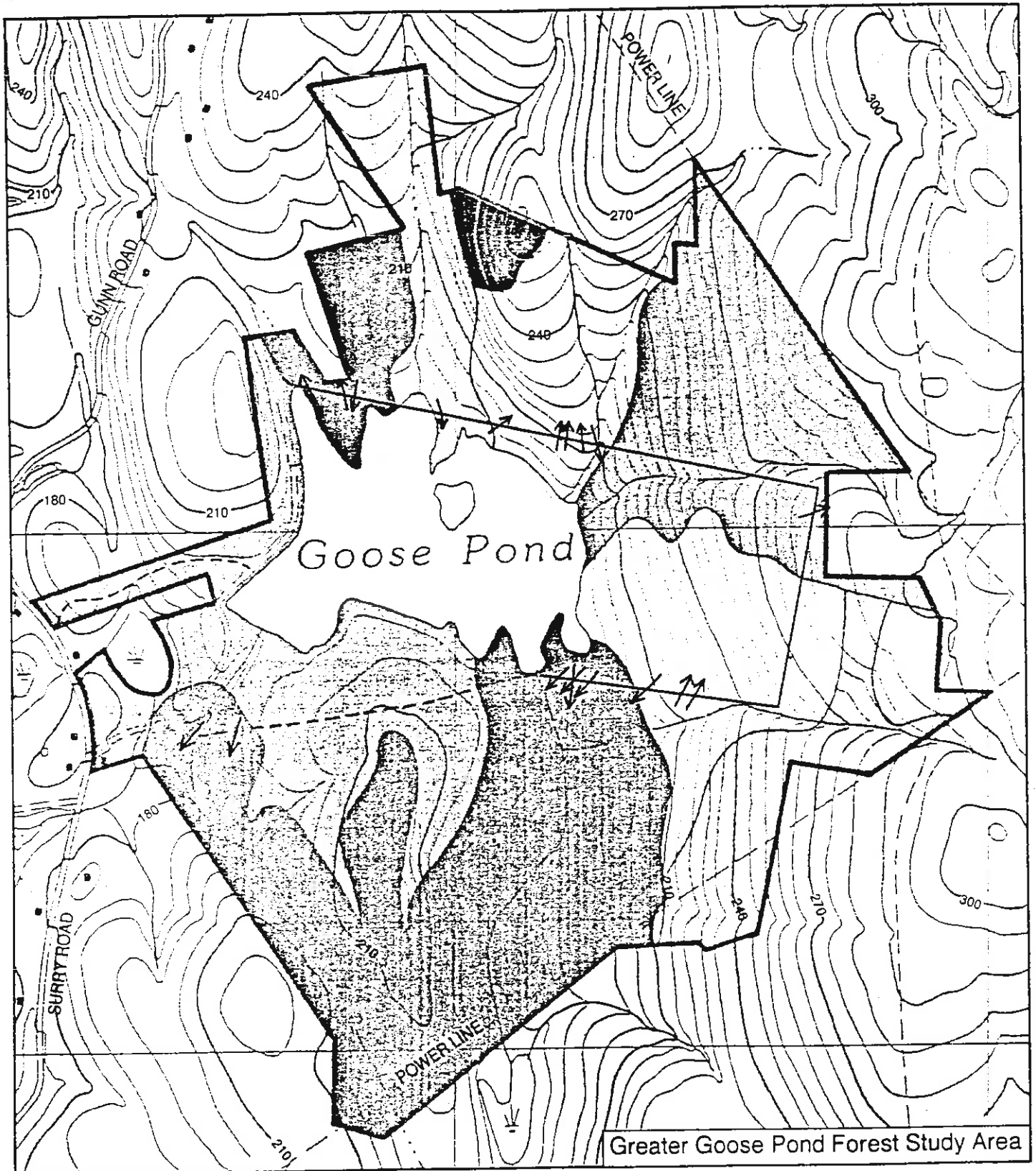


Greater Goose Pond Forest Study Area

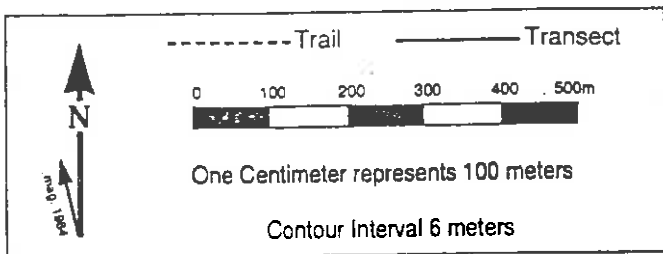


	Softwoods	Mixed, Hardwoods Dom.
	Mixed, Softwoods Dom.	Hardwoods
	Mixed Woods	

MINK LOCATION MAP
 DIRECTION OF TRAVEL →

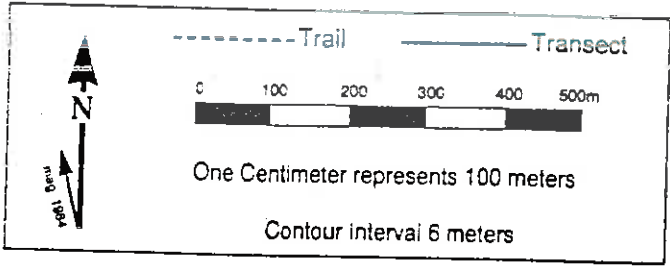
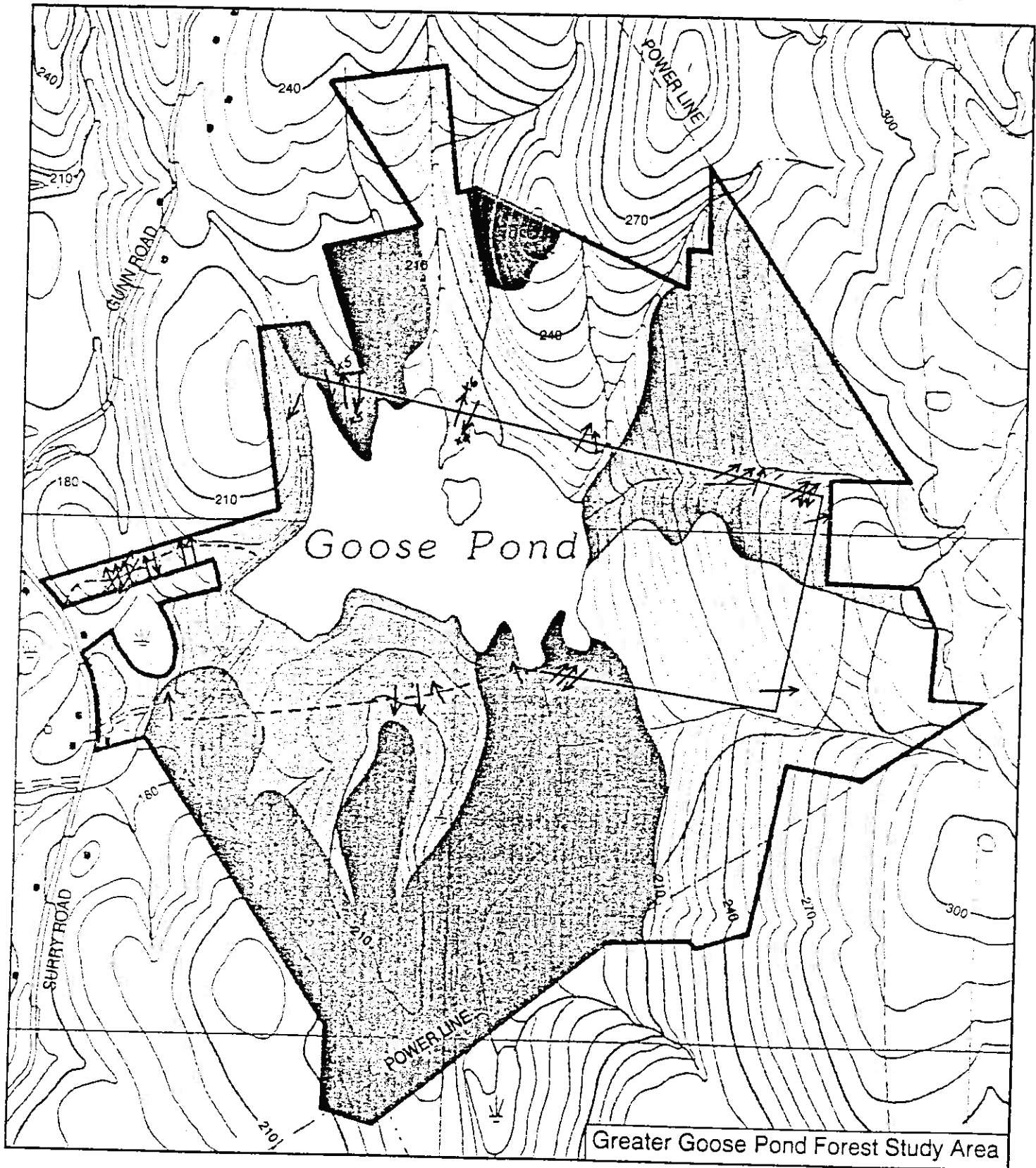


Greater Goose Pond Forest Study Area



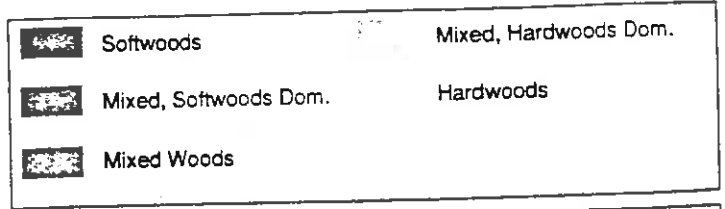
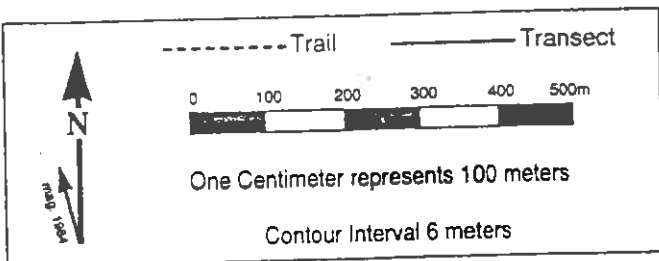
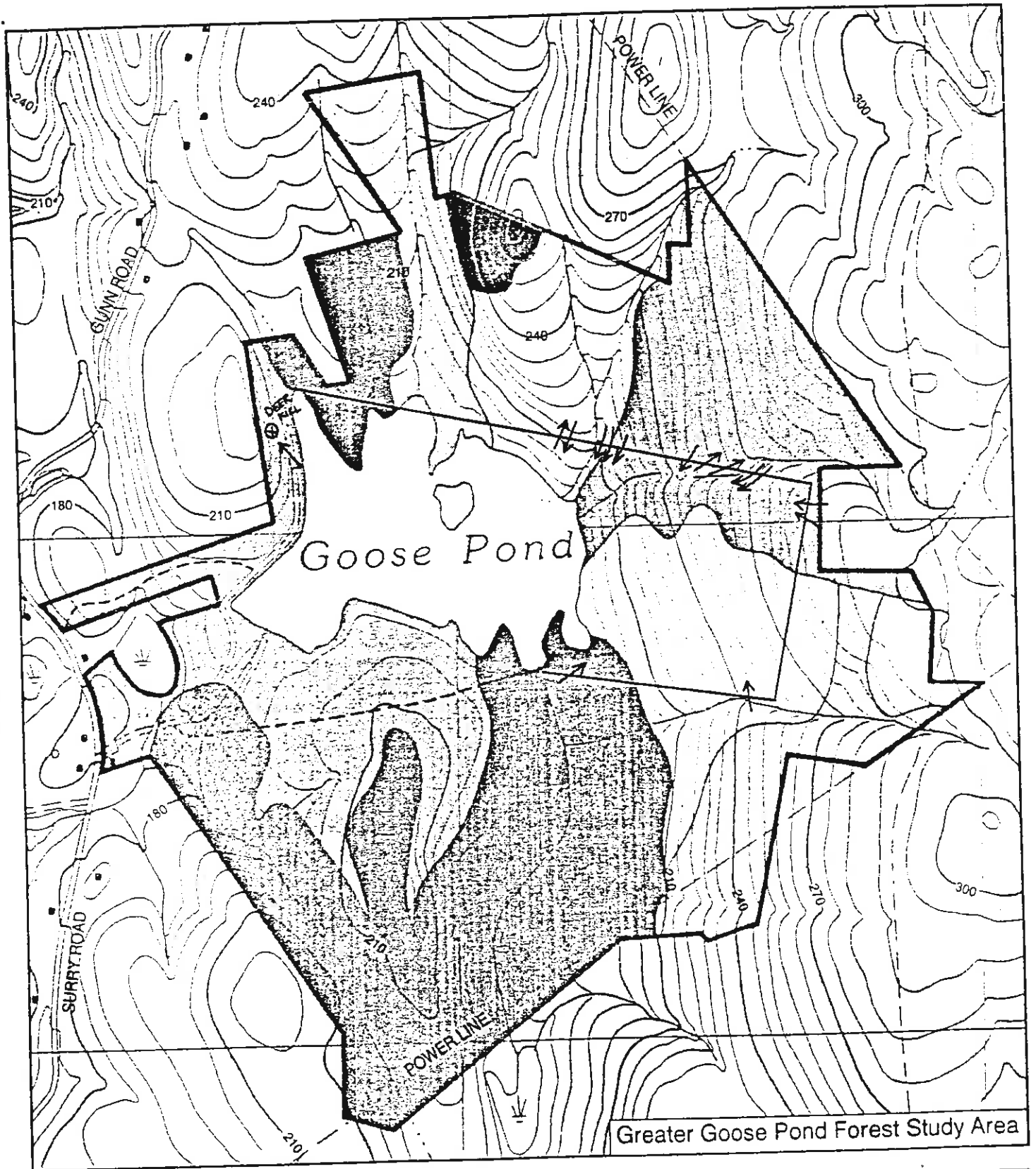
	Softwoods	Mixed, Hardwoods Dom.
	Mixed, Softwoods Dom.	Hardwoods
	Mixed Woods	

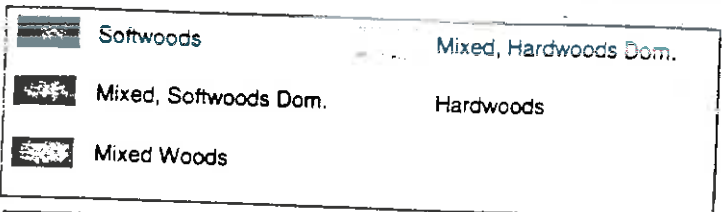
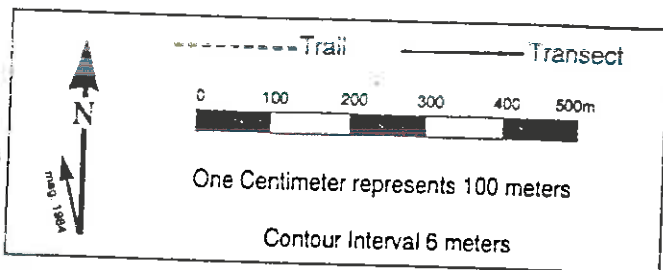
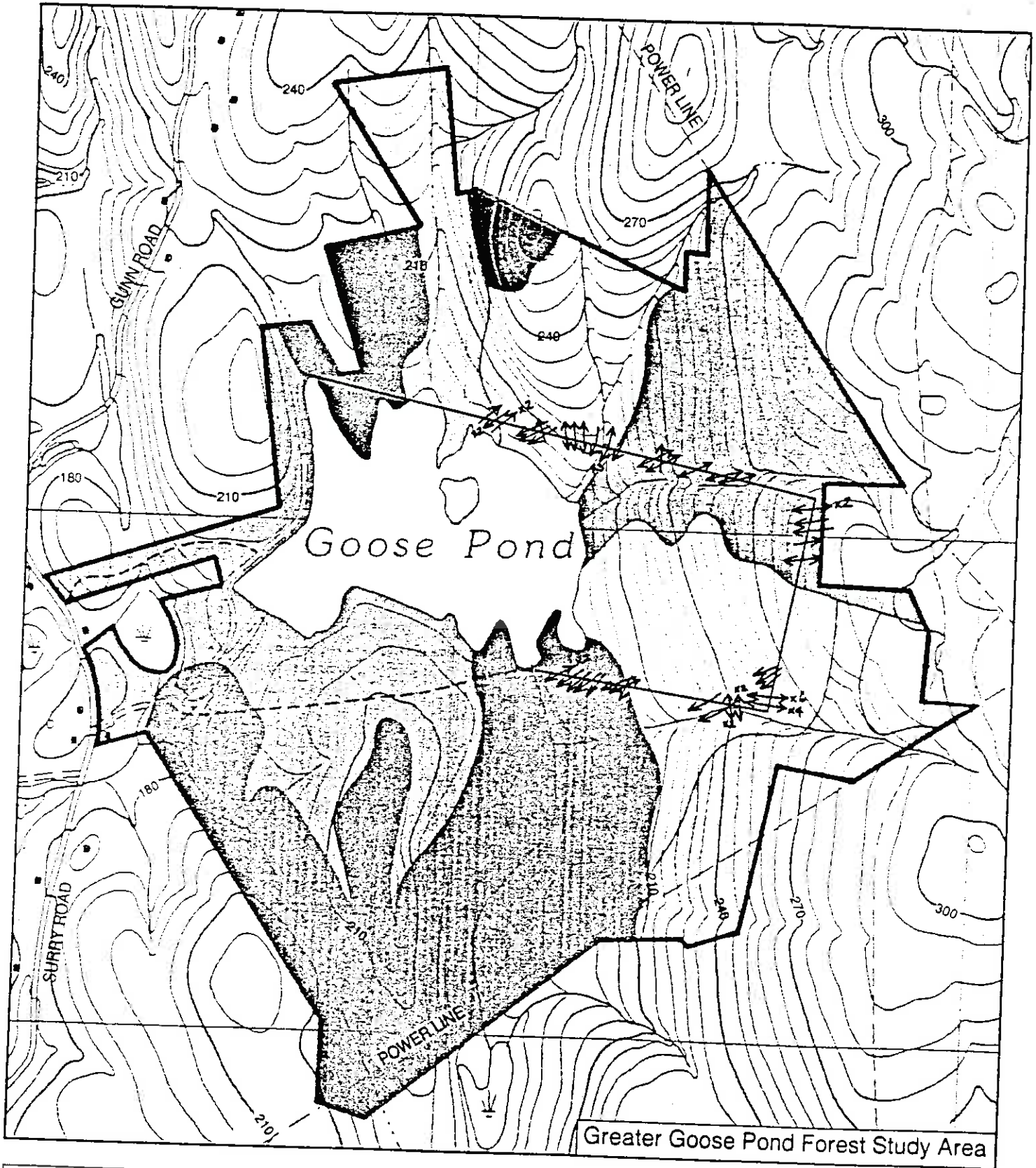
FISHER LOCATION MAP
 DIRECTION OF TRAVEL →



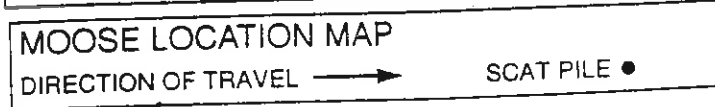
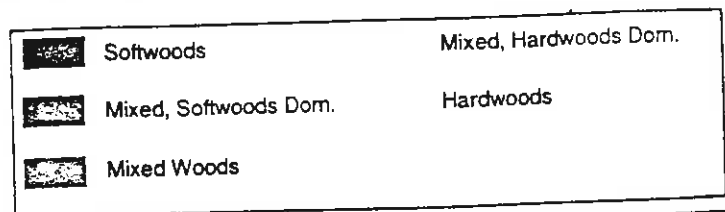
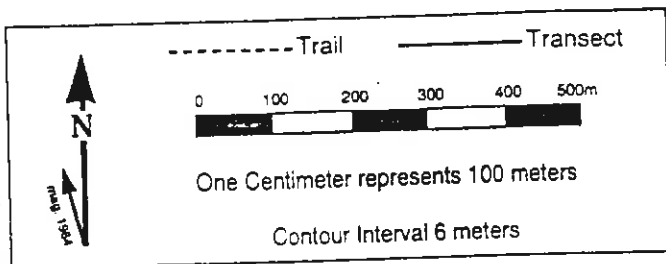
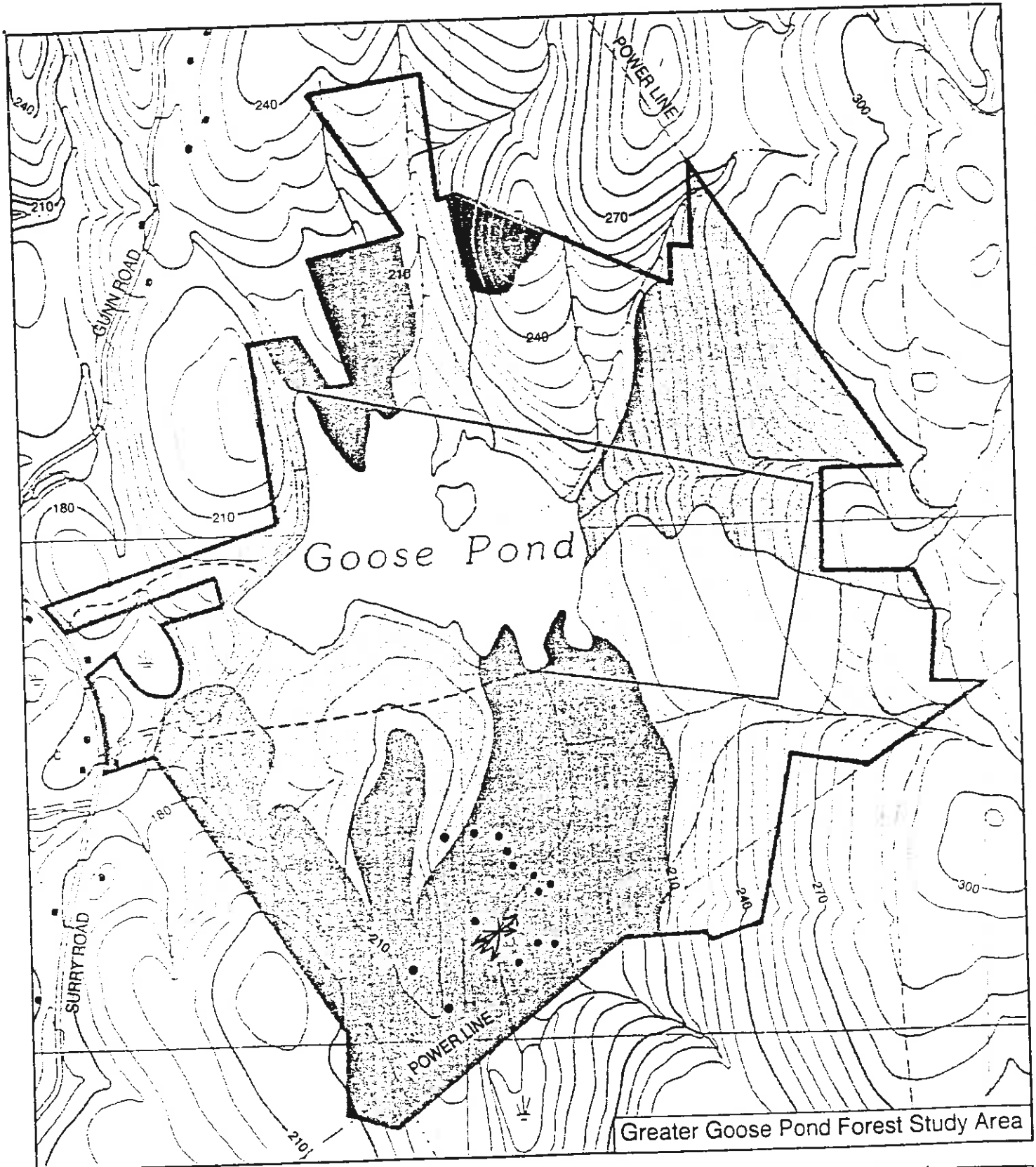
	Softwoods	Mixed, Hardwoods Dom.
	Mixed, Softwoods Dom.	Hardwoods
	Mixed Woods	

FOX LOCATION MAP
DIRECTION OF TRAVEL →





WHITE-TAILED DEER LOCATION MAP
 DIRECTION OF TRAVEL →



FIELD LOG

TRANSECT SURVEY: #1

TRACKER: A. Jennings, E. Dehler-Seter

DATE: 2/19/94

TIME: 0715 - 1130

LAST SNOWFALL: 2/15/94

WEATHER: Clear, 28°F

SNOW CONDITIONS: Deep powder with thin ice crust.

SPECIES RECORDED: Fox, Fisher, Porcupine, Mink, White-tailed Deer, Coyote, Snowshoe Hare, Gray Squirrel.

TRANSECT SURVEY: #2

TRACKER: A. Jennings, E. Dehler-Seter

DATE: 2/28/94

TIME: 1410 - 1740

LAST SNOWFALL: 2/26/94

WEATHER: Clear, 27°F

SNOW CONDITIONS: 1-2" of fresh powder over deep packed snow.

SPECIES RECORDED: Gray Squirrel, Red Squirrel, Short-tailed Weasel, Fox, Coyote, White-tailed Deer, Snowshoe Hare, Fisher.

TRANSECT SURVEY: #3

TRACKER: A. Jennings

DATE: 3/2/94

TIME: 0940 - 1415

LAST SNOWFALL: 2/26/94

WEATHER: Clear, 18°F

SNOW CONDITIONS: Deep, packed snow with thin covering of powder

SPECIES RECORDED: Fox, Short-tailed Weasel, Mink, White-tailed Deer, Fisher, Coyote, Snowshoe Hare.

TRANSECT SURVEY: #4

TRACKER: A. Jennings, E. Dehler-Seter

DATE: 3/5/94

TIME: 0920 - 1220

LAST SNOWFALL: 3/3/94

WEATHER: Cloudy, 35° F

SNOW CONDITIONS: 6" of fresh snow over deep, packed snowbase.

SPECIES RECORDED: Mink, Short-tailed Weasel, Red Squirrel, Fisher, White-tailed Deer.

TRANSECT SURVEY: #5

TRACKER: A. Jennings

DATE: 3/7/94

TIME: 0920 - 1345

LAST SNOWFALL: 3/3/94

WEATHER: Cloudy, 35° F

SNOW CONDITIONS: Deep, firm snow.

**SPECIES RECORDED: Mink, Red Squirrel, Short-tailed Weasel, Coyote, White-tailed Deer,
Fisher, Chipmunk.**

