SHERWIN SKI AREA DEER and WILDLIFE STUDY

FINAL REPORT

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INTRODUCTION

The proposal to develop the Sherwin Ski Area in Mammoth Lakes, Mono County, California (Figs. 1 and 2), initiated concern over potential adverse impacts of such a development on local wildlife. Much of the land on which the ski area is to be located is managed by the U.S. Forest Service (USFS), which is legally mandated by the National Forest Management Act of 1976 to conserve diversity of plant and animal communities and monitor wildlife population trends when planning land management activities. Wildlife surveys have been conducted in the area (USDA, 1981a); however, more intensive and extensive information is required to determine:

1.) the timing, pattern and intensity of mule deer (Odocoileus hemionus) use in the area,

2.) the existence of critical deer areas (e.g., fawning and migration) within the proposed ski area,

3.) the presence, relative abundance, and habitats of those wildlife species defined by the USFS as Sensitive, Management Indicator, Special Interest, or Harvest species which are expected to occur in the proposed ski area (USDA, 1981a), and

4.) potential mitigating activities to be incorporated into the development plan, if the ski area is developed.

ACKNOWLEDGMENTS

This investigation was conducted under a contract from the O'Connor Design Group, Mammoth Lakes, California, with the cooperation of and a Special Use Permit from the USFS, Mammoth Ranger District, Inyo National Forest, and with the cooperation of the California Department of Fish and Game (DFG). The Principal Investigator took over the contract on 1 May 1984 from the original consultant and merged the present study into a larger investigation of Eastern Sierra deer supported by the Bishop Resource Area of the Bureau of Land Management (BLM), DFG, Inyo and Mono Counties, the University of California, Berkeley, and several private funding organizations. The design of the wildlife study is based on consultations with USFS biologists Clint McCarthy and Pat Stygar. Much of this investigation, both fieldwork and graphics, was done by Timothy Taylor.

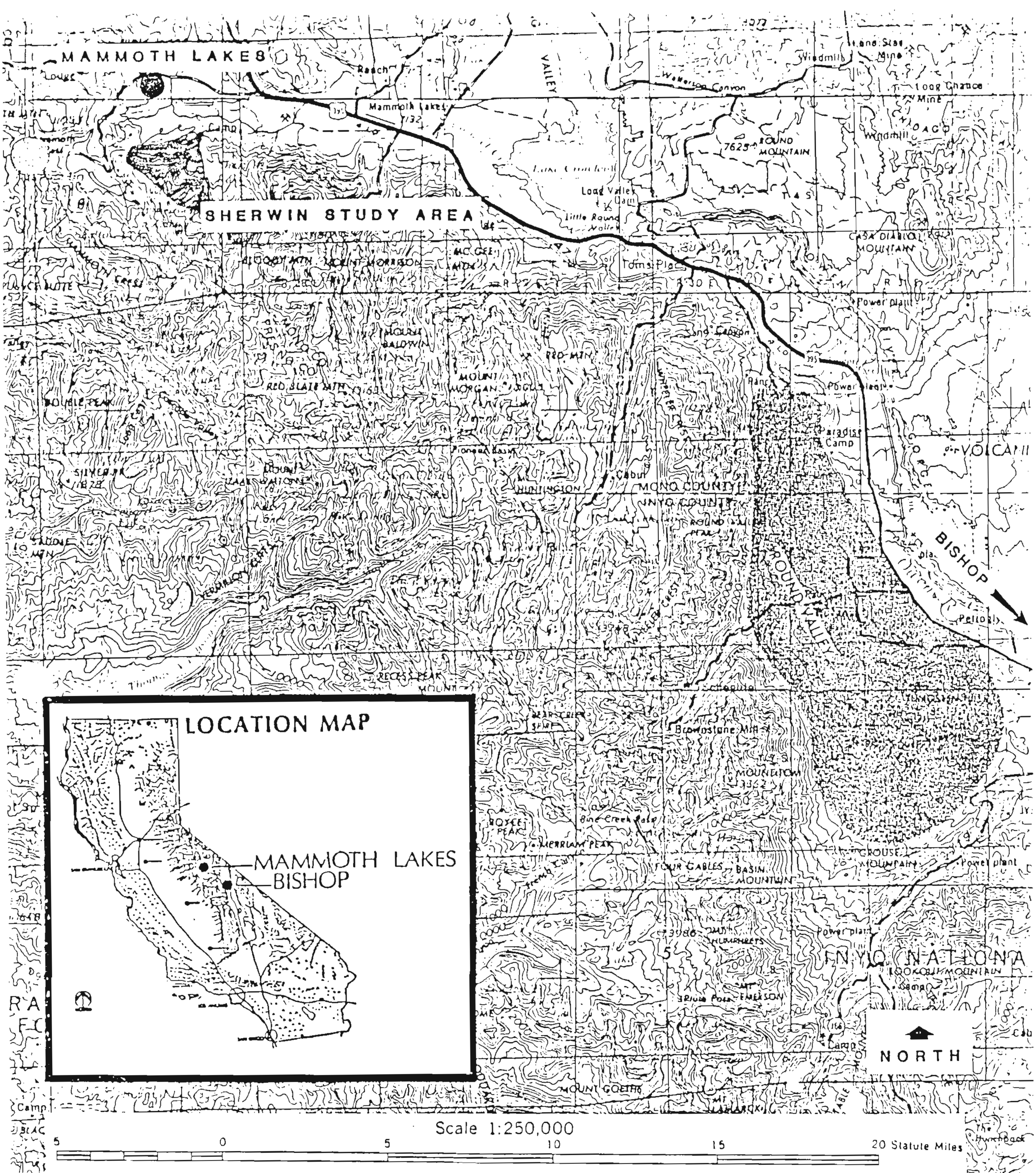


Figure 1. Location of the proposed Sherwin Ski Area in California.

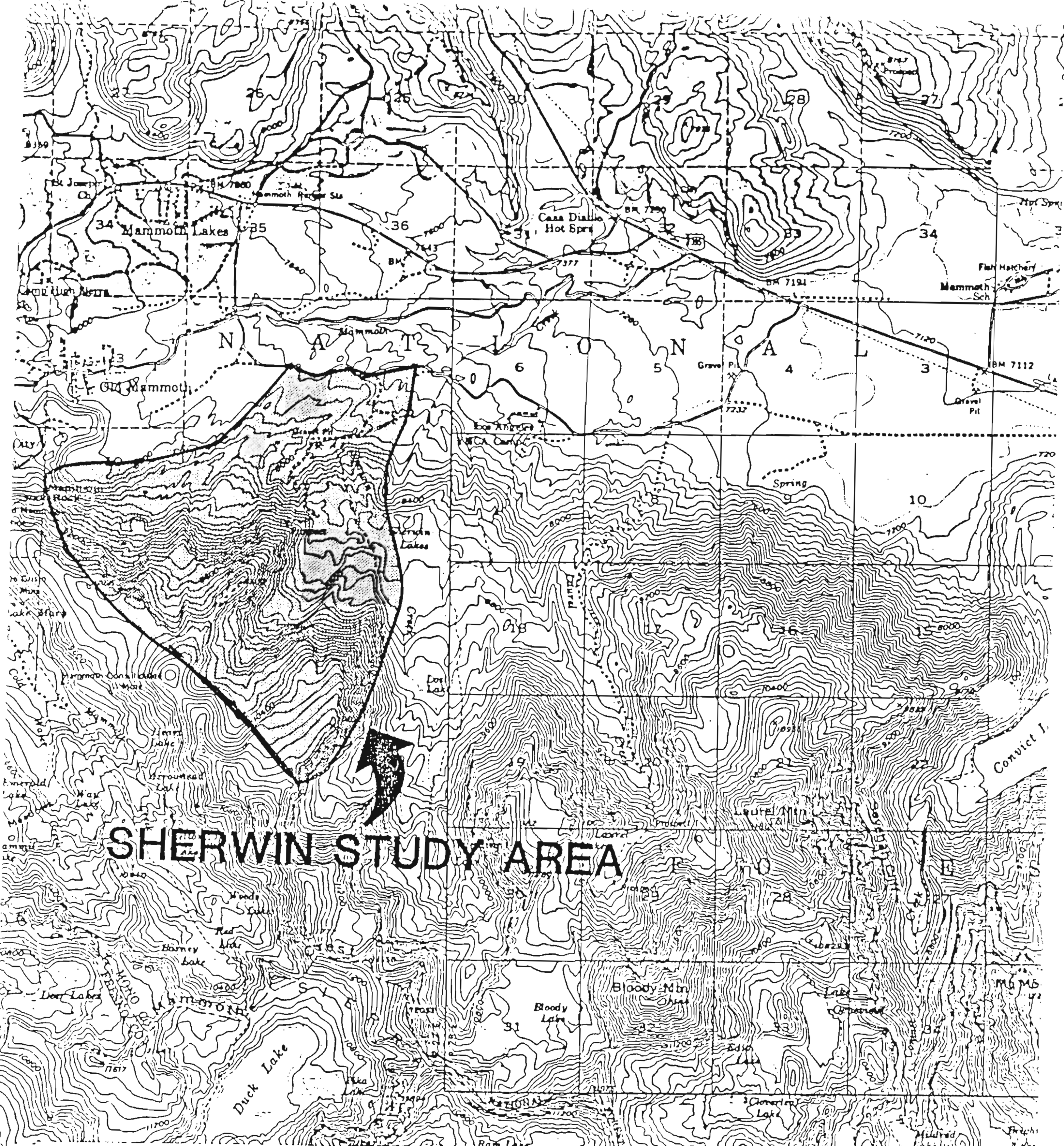


Figure 2. Location of the present Study Area near the town of Mammoth Lakes, California.

STUDY AREA

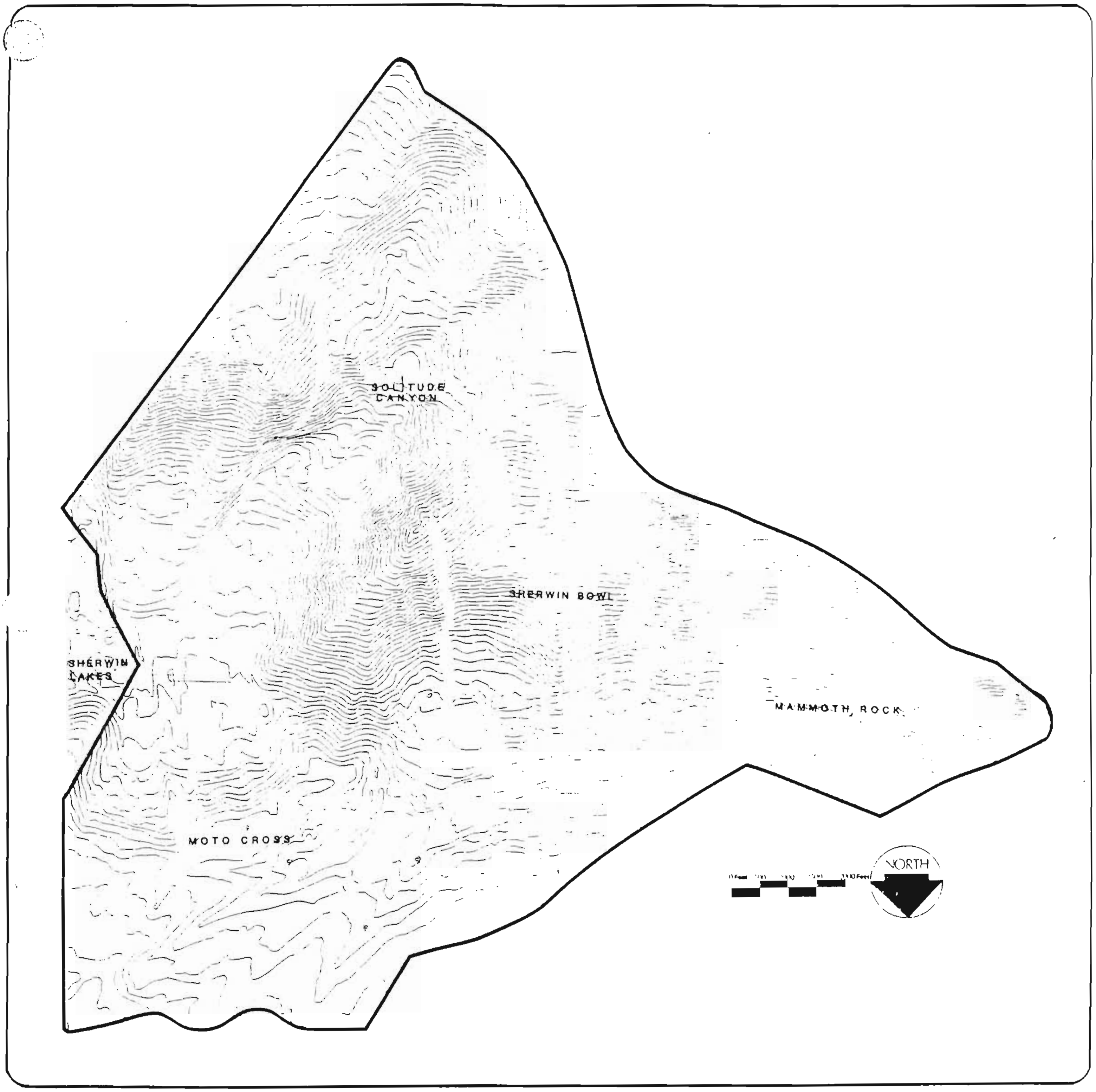
The proposed Sherwin Ski Area, hereafter designated the Study Area, is located in Sections 10-15, 23, and 24 of T.4S, R.27E, in the Mammoth Ranger District, Inyo National Forest (Fig. 3). The area comprises approximately 2,000 acres of steep, generally north-facing, mountainous terrain, varying in elevation from 8,000 to 11,600 feet, and lies between the Sherwin Creek drainage on the east and the Mammoth Lakes basin on the west. There is no commercial logging in the area. Limited grazing (70 AUM's) by horses and mules occurs in a meadow area in the northwest part of the Study Area (USDA, 1981a).

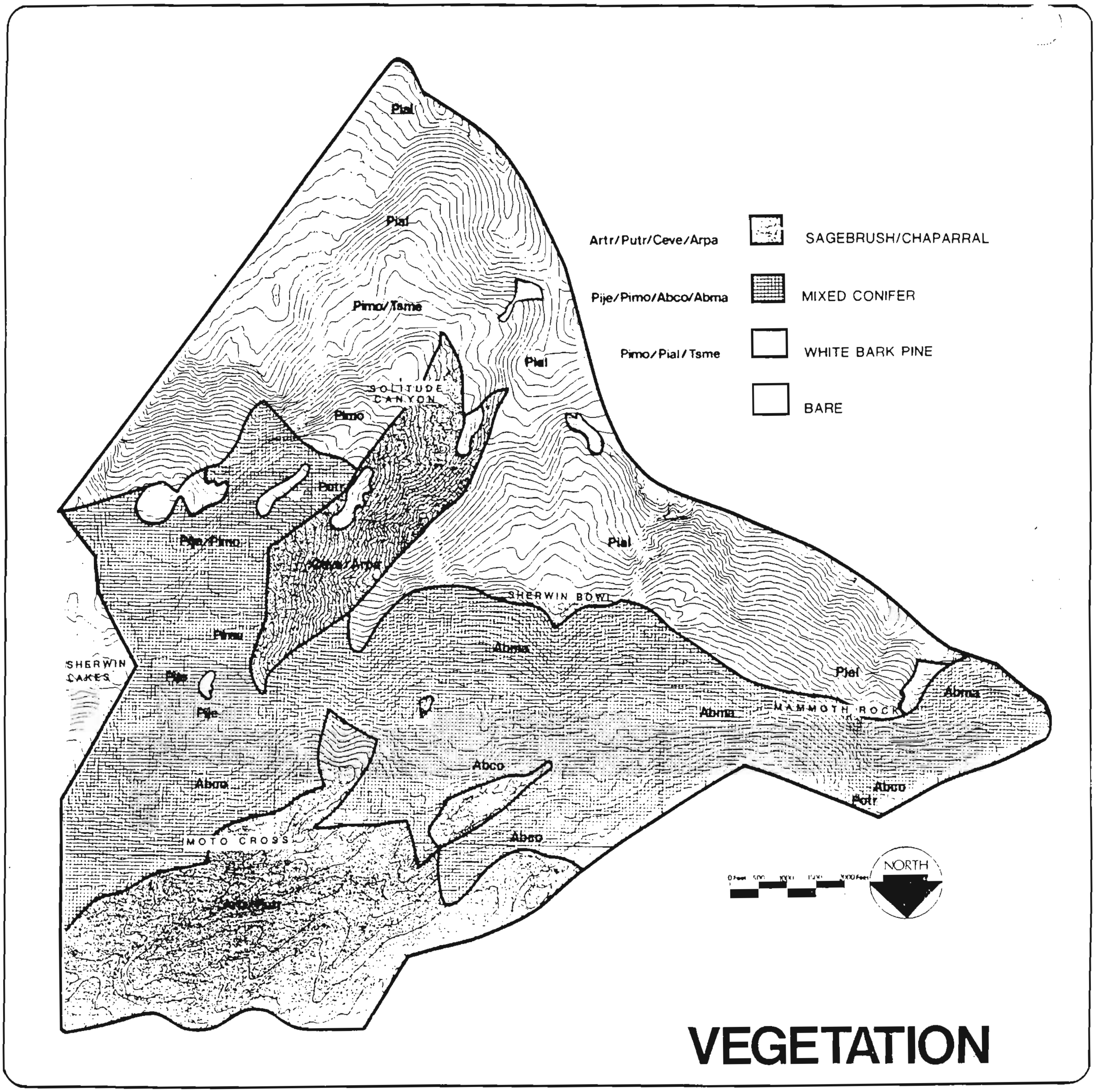
Present road access is limited to a four-wheel drive dirt road, approximately one mile in length, which enters the area from the east, climbs the steep slopes on the northwest flank of Solitude Canyon, and terminates at an abandoned mining prospect. Access is restricted by a locked gate at the start of this road (USDA, 1981a). An off-road motorcycle recreation area, the Moto Cross, also is present at the base of the eastern side of the Study Area.

Two main vegetation types were identified within the area by the USFS (USDA, 1981a) using the CALVEG (USDA, 1981b) classification system (Fig. 4). The first type of vegetation is Mixed Conifer (Jeffrey pine (Pinus jeffreyi), white fir (Abies concolor) and red fir (A. magnifica)). The second is Whitebark Pine (P. albicaulis). A third vegetation type, composed of a mixture of Chaparral (manzanita (Arctostaphylos patula) and tobaccobrush (Ceanothus velutinus)) and Sagebrush Scrub (bitterbrush (Purshia tridentata), and sagebrush (Artemesia tridentata)) is found on the rolling hills at the base of the mountains.

Figure 3. (Opposite) The Sherwin Study Area, showing major landmarks. Contour intervals are 50 ft.

Figure 4. (Overleaf) Vegetation types within the Sherwin Study Area. Abbreviations are as follows: Artr = Artemesia tridentata, Putr = Purshia tridentata, Ceve = Ceanothus velutinus, Arpa = Arctostaphylos patula, Pije = Pinus jeffreyi, Pimo = P. monticola, Abco = Abies concolor, Abma = A. magnifica, Pial = P. albicaulis, Tsme = Tsuga mertensiana.


SOLITUDE CANYON
SHERWIN BOWL
SHERWIN LAKES
MAMMOTH ROCK
MOTO CROSS
NORTH


Artr/Putr/Ceve/Arpa
SAGEBRUSH/CHAPARRAL
Pije/Pimo/Abco/Abma
MIXED CONIFER
Pimo/Pial/Tsme
WHITE BARK PINE
BARE
Pial
Pimo/Tsme
SOLITUDE CANYON
Pimo
Putr
Pije/Pimo
Ceve/Arpa
SHERWIN BOWL
Abma
SHERWIN LAKES
Pije
MAMMOTH ROCK
Abco
Potr
MOTO CROSS
NORTH

VEGETATION

METHODS

A. Deer

1.) Capture and Marking

In May 1984, 6 adult female mule deer were captured in and near the Study Area by use of tranquilizer darts; 3 more were captured in April and May 1985 (Fig. 5). These animals were fitted with radio-transmitter collars, provided by DFG, and released. In addition, during January - March 1984 and 1985, 212 deer were captured in Round Valley, approximately 15 miles northwest of Bishop, California, and 30 miles southeast of the Sherwin Study Area, in conjunction with a larger ecological study of Eastern Sierra deer (Kucera, unpublished) (Fig. 1). Thirty-two of these deer (13 males and 19 females) were fitted with radio collars; all received numbered ear tags, and 81 adult does which did not receive a radio collar received individually numbered "marking collars".

2.) Telemetry

Following capture, the locations of radioed deer were determined throughout the year, both from the ground and from a fixed-wing plane provided by DFG. A total of 37 telemetry flights were made between 16 April 1984 and 14 November 1985. Flights were taken throughout the year, but were concentrated during spring (April-June) and fall (September-October) migration periods. Numerous day hikes and backcountry trips were taken throughout the summer and fall to locate radioed animals on their summer range and during migration.

Within the Study Area, the original plan to monitor deer locations by triangulation was modified due to the large error in signal location induced by the very steep and rocky terrain. Only locations based on visual sightings of radioed animals are reliable in such terrain, and only these are included in this report. Due to safety considerations, night monitoring of radioed deer was not attempted.

Observations of marked but un-radioed deer in or near the Study Area were made throughout the course of daily field work, and locations of these were plotted on aerial photos. Because only one marked deer summered in the Study Area in 1984, the attempt to estimate deer population size in summer by use of the Lincoln Index (Connolly, 1981) was abandoned.

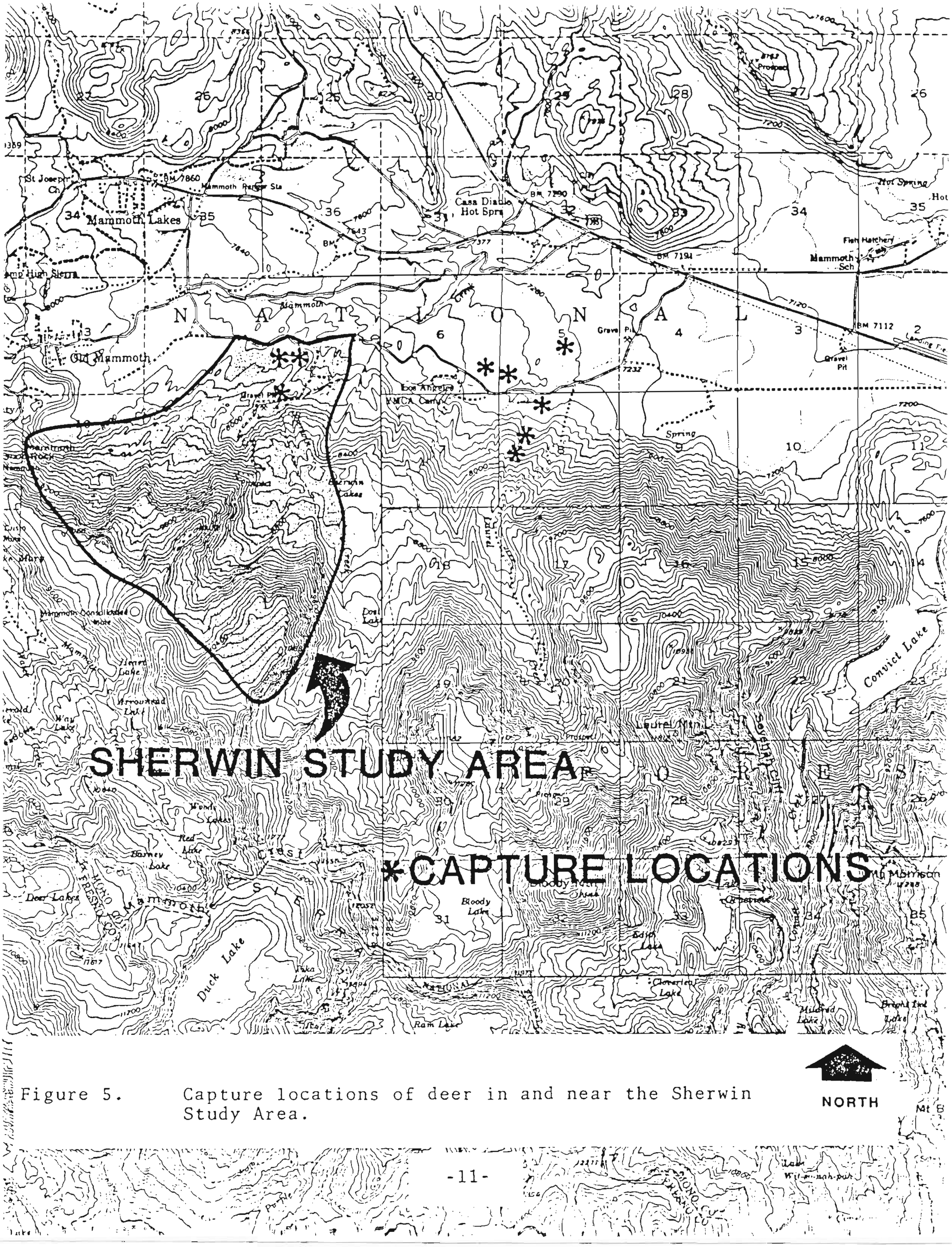


Figure 5. Capture locations of deer in and near the Sherwin Study Area.

3.) Pellet Transects

In order to determine the amount and timing of summer deer use, 30 randomly located, permanently marked pellet group transects (Neff, 1968) were established in the Study Area, which was divided into three strata according to vegetation type (Fig. 6). The location of each of the 10 transects per stratum was selected by choosing two random numbers corresponding to a grid system overlaid on an aerial photo of the area. The compass orientation of each transect was the same, and was determined randomly. Each transect consisted of 10, 1/400 acre circular plots spaced 50 feet apart; the plots were marked by a 3/8 inch rebar stake, 3 feet high and painted for visibility, at the center.

Transects were read monthly during snow-free periods by counting the number of pellet groups found in each plot, after which all pellets were removed. The average number of pellet groups/transect, multiplied by 40, gives number of groups/acre/month. Dividing this by 13, the average number of pellet groups deposited by deer per day, yields number of deer days/acre/month. The vegetative characteristics of each transect were also described.

4.) Road Surveys and Migration

During late summer and fall (20 August - 29 October) of 1984, and throughout the snow-free period of 1985 (15 April-28 October), a weekly dawn road survey was conducted from a vehicle in and near the Study Area to determine the timing and pattern of migration (Fig. 7). Beginning at 1/2 hour before official sunrise, a fixed route was driven, mainly along Sherwin Creek Road between Old Mammoth and Highway 395, including the Moto-cross area. All deer observed were counted and classified by age and sex. The beginning and end of the transect were alternated on consecutive surveys. Surveys were less frequent in summer 1985 (24 June-23 Aug), after the spring migration had passed, and were performed weekly again beginning 10 September 1985. During the fall migration the frequency of road surveys was increased when storms occurred.

Immediately after significant snowfall, as well as throughout the spring migration peiod, the Study Area was inspected on foot. Deer observed were classified, and migration trails evident in the fresh snow or on the soil were plotted on an

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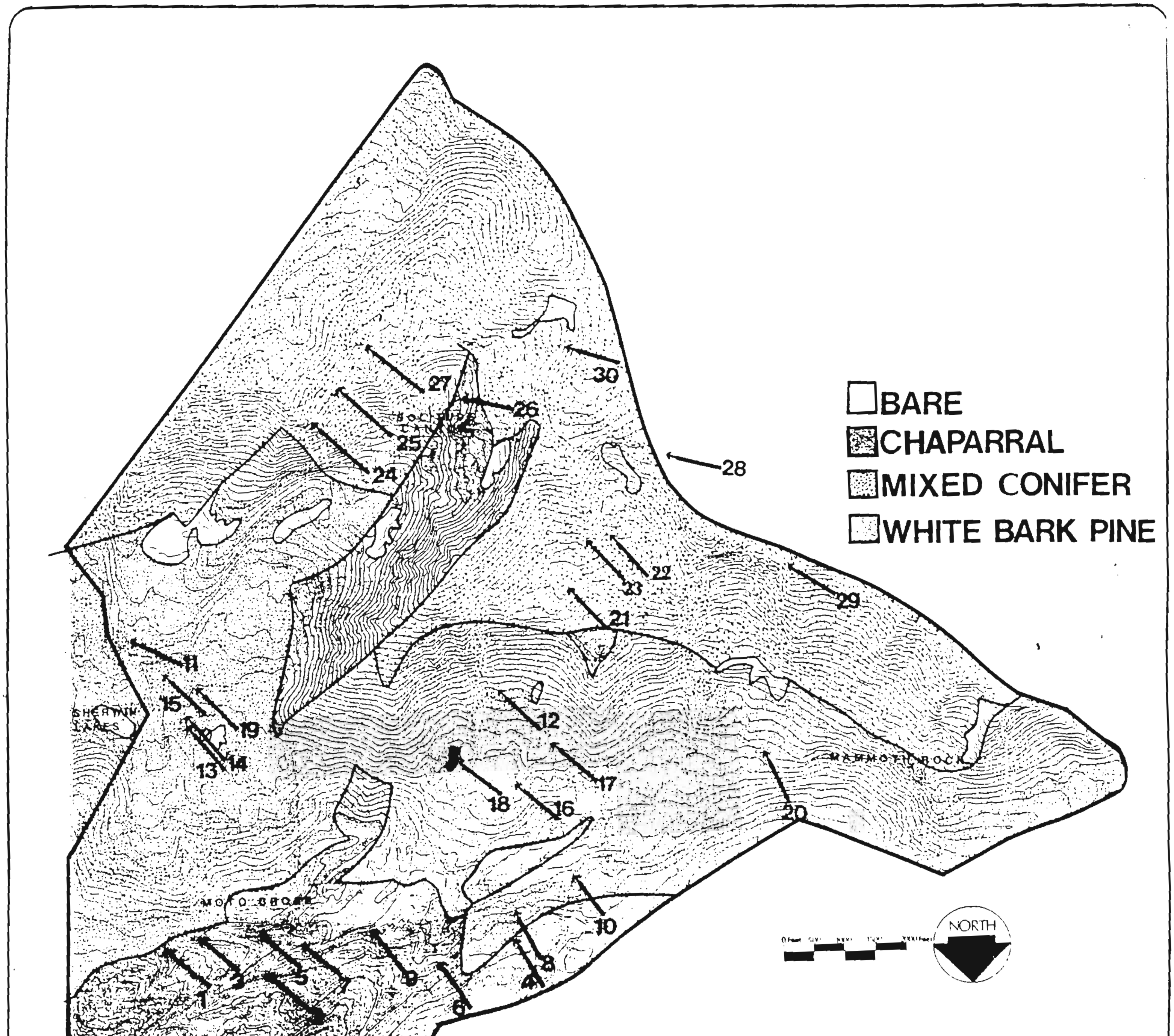
Figure 6. (Overleaf) Locations of the deer pellet transects in the Sherwin Study area.



DEER PELLET GROUP TRANSECT LOCATIONS

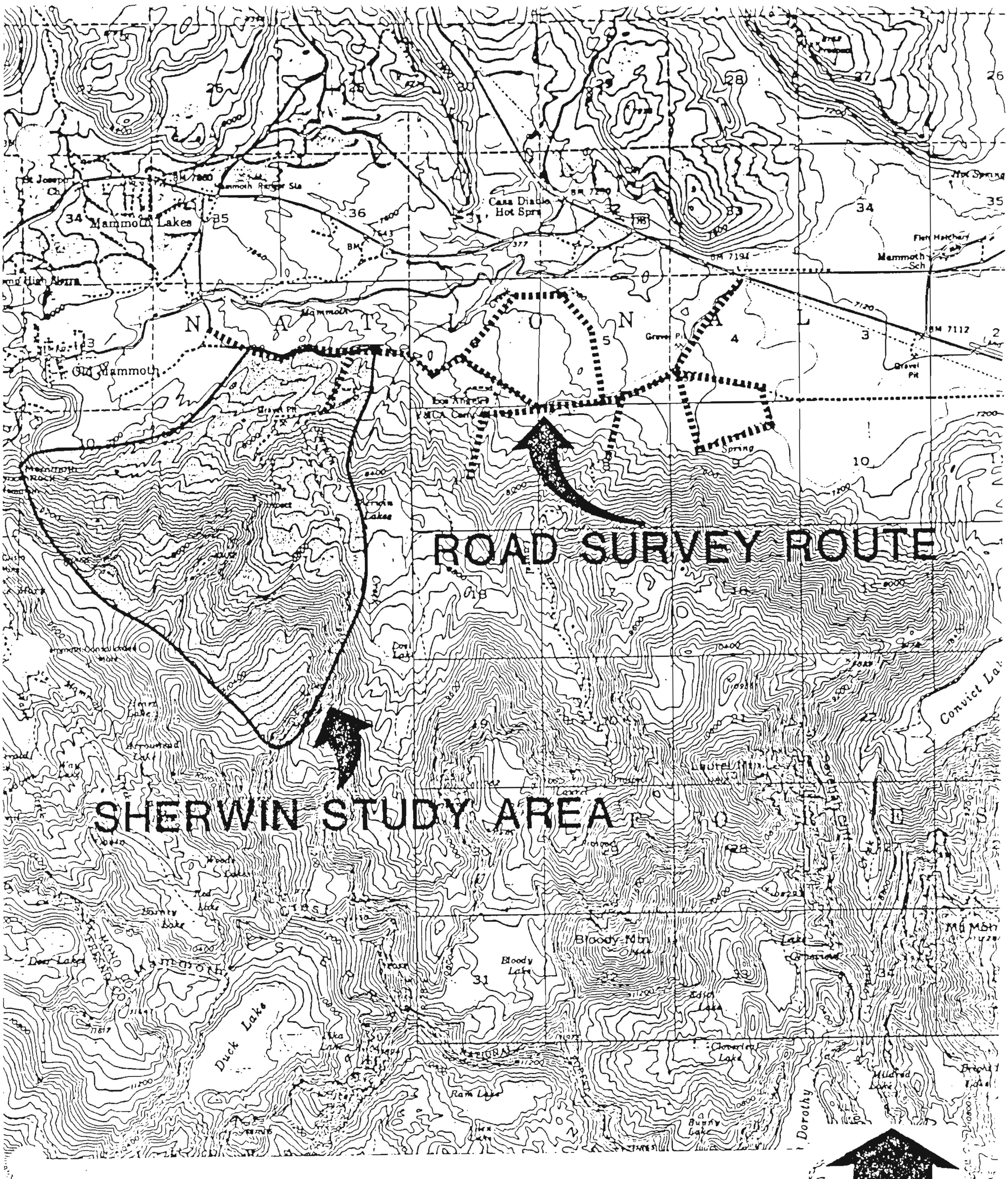


Figure 7. Location of the dawn road survey in and near the Sherwin Study Area.

aerial photo. Because of the large number of animals using the same narrow trails, using a track count method to estimate numbers was unworkable.

In order to quantify the number of deer moving through part of the Study Area, a battery-operated infra-red trail traffic counter (Scientific Dimensions, Inc., Albuquerque, NM) was placed a few hundred yards south of the top of Solitude Canyon in 1985. Previous work had shown this to be an important migration route. The infra-red beam was positioned to cross a narrow deer trail at about 30 inches above the ground. Deer walking the trail broke the beam, and were recorded on an automatic counter. There is essentially no human use of this trail.

B. Other Wildlife

1.) Introduction

This part of the study was designed to provide information on the presence, relative abundance, and habitats of those wildlife species defined by the USFS as Sensitive, Management Indicator, Special Interest, or Harvest species which are expected to occur in the Sherwin Study Area (USDA, 1981a; 1984). No federally listed threatened or endangered species are thought to be present (USDA, 1981a; 1984).

2.) Diurnal Raptors

The presence of goshawks (*Accipiter gentilis*), a Sensitive species, was investigated during the course of 4 field days spent in late June and early July, examining on foot those areas of potential goshawk habitat mapped by the Forest Service (USDA, 1981a). These potential habitats were examined as thoroughly as possible for adult goshawks or sign, e.g., plucking posts, nest trees, etc. In addition, during the course of other fieldwork in the Study Area, all observations of goshawks or sign were recorded. When adults were sighted attempts were made to locate nest sites.

The presence of prairie falcons (*Falco mexicanus*), another Sensitive species, was determined during 3 days of fieldwork in early June. Potential nesting cliffs were examined for the presence of breeding adults or for sign of breeding attempts, e.g., whitewash on cliffs, eggshell fragments, dead chicks, etc. Additionally, any prairie falcons observed during the course of other fieldwork in the Study Area were recorded.

Other raptors, e.g., golden eagles (*Aquila chrysaetos*), red-tailed hawks (*Buteo jamaicensis*), etc., were noted during the course of other fieldwork in the Study Area.

3.) Owls

The presence of spotted owls (Strix occidentalis), great gray owls (S. nebulosa), both Sensitive species, and flammulated owls (Otus flammeolus), a Special Interest species, was determined by the use of recorded calls played at night in areas of potential owl habitat as mapped by the Forest Service (USDA, 1981a). One night per week during May and June, beginning one-half hour after official sunset, these areas were visited. Recorded owl calls were played at approximately 100m intervals along the transect route, and any responses noted.

4.) Blue Grouse (Dendragopus obscurus)

Blue grouse, a Harvest species, did not require any surveys specifically directed toward them, but during the course of fieldwork in the Study Area, all sightings of blue grouse or sign, e.g., droppings, booming, etc., were noted and plotted on an aerial photo.

5.) Management Indicator Avian Species

Those Management Indicator species to be expected in the Study Area (USDA, 1981a), specifically yellow-bellied sapsuckers (Sphyrapicus varius), Williamson's sapsuckers (S. throideus), hairy woodpeckers (Picoides villosus), pygmy nuthatches (Sitta pygmea) and brown crepers (Certhia familiaris), were surveyed by using a variation of the plot technique outlined by Dedon and Barrett (1982) and Raphael (1983). During late May and June, when breeding birds are most conspicuous, an observer visited a plot as soon after dawn as possible, sat quietly, and tallied the number of each of the above species detected (visually and aurally) during 5 successive 10-minute intervals. Other bird and mammal species were noted as time allowed. Two plots per day were visited. When adults of the above species were observed, attempts were made to find nest locations. Plot locations were based on the vegetation types described and the deer pellet plots already established in the Study Area. Five plots each were selected randomly in the Whitebark Pine and Chaparral/Sagebrush Scrub vegetation types, and 10 randomly placed plots were used in the Mixed Conifer type. In addition, 1 extra plot was placed in Whitebark Pine, 2 extra in Mixed Conifer, and 3 extra in Chaparral in areas likely to be disturbed by the ski area, for a total of 26 plots in the Study Area.

6.) Carnivores

The presence of Sierra Nevada red fox (Vulpes vulpes necator), pine marten (Martes americana), and fisher (M. pennanti), all

Sensitive species, was investigated both in the summer and winter. In summer, the presence of these carnivore species was detected by their tracks left on the surface of a 1 x 1m alluminum sheet blackened with a kerosene flame, with a can of fish, its top punctured with small holes, in the middle (Barrett, 1983). During June and July 1985, a track station was placed on a plot, and read every other day for 6 days; 15 randomly placed plots, 5 per vegetation type, were sampled. In addition, 5 more plots were placed in the Mixed Conifer type in areas likely to be disturbed by a ski development. Thus, a total of 20 plots was used.

Eleven winter surveys were conducted on skis from February through April 1985. Different routes through the Study Area were travelled, and tracks or other sign of these species noted and plotted. The presence of other notable wildlife, e.g., blue grouse, coyote (*Canis latrans*), mountain lion (*Felis concolor*), etc., also was recorded when appropriate.

The habitat on each plot was described according to standard Forest Service procedures used in timber compartment exams, in coordination with Forest Service biologists.

RESULTS

A. Deer

1. Spring/Summer

Figure 8 shows the results of the road survey from 15 April to 23 August 1985. Many deer already were in the vicinity of the Study Area by mid-April, when some of the Sherwin Creek Road survey route was not yet passable due to snow. The first deer were seen in the Study Area on foot on 17 April 1985, when the road was still blocked by snow; the first deer were seen on the road survey within the Study Area proper on 29 April. The number of deer counted on the road survey varied between 300 and 600 through May, and then steadily declined as the animals migrated to their summer ranges. The number of deer counted on the road survey within the Study Area itself followed a generally similar trend, but was much lower, due in part to the poor road access. It should be remembered that this survey route was mainly in chaparral vegetation at lower elevations. Most of the deer had left this "staging area" (Fig. 9) by early June. The first deer sign in Solitude Canyon was observed on 16 May 1985, when deer began moving over Solitude Pass to the summer range.

Of the 32 deer radioed in Round Valley in both winters, 23 were known to migrate to the north. Seventeen (74%) of these (12 females) were observed in or near the Study Area during the

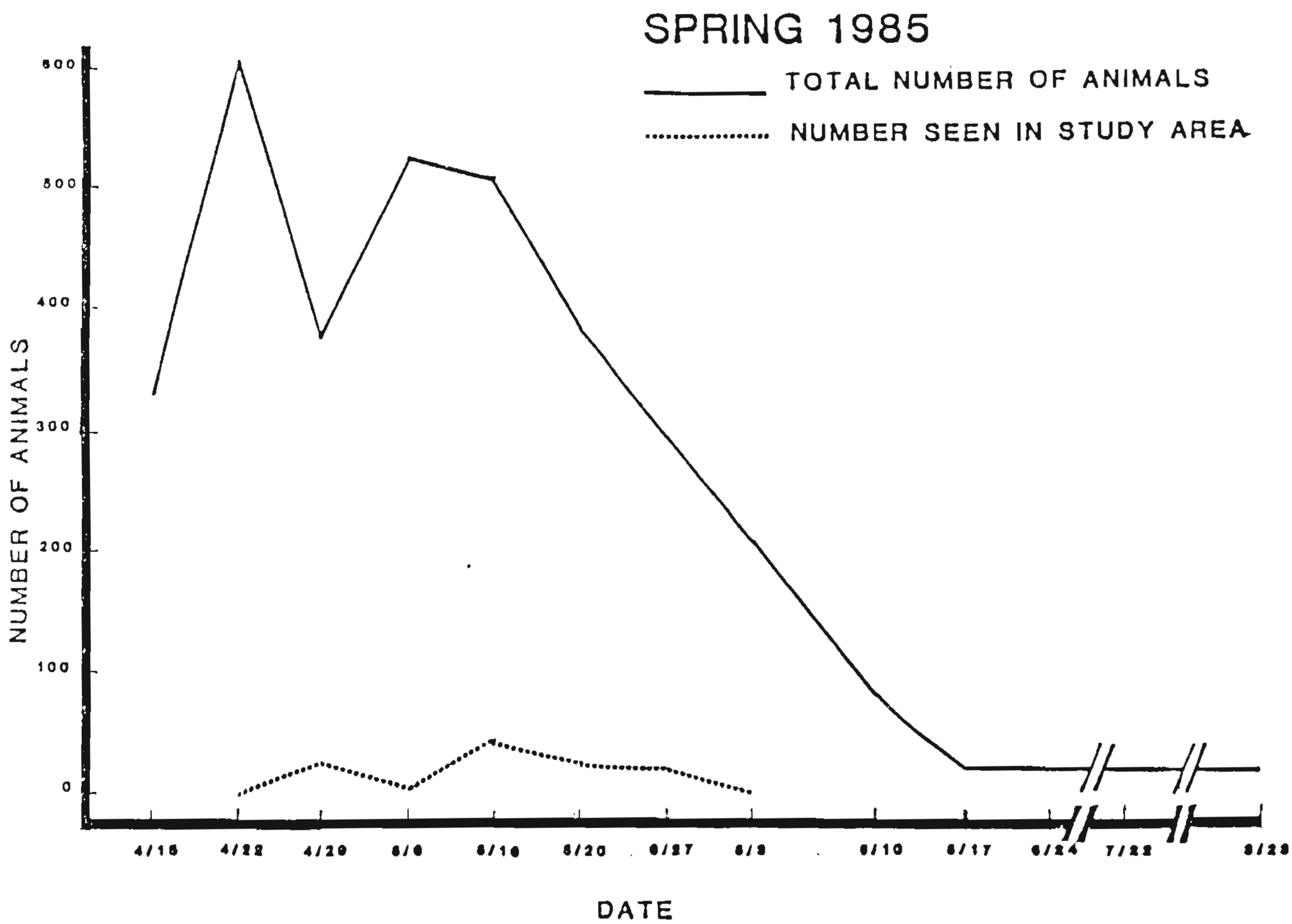


Figure 8. Deer counted on the dawn road survey, Spring 1985.

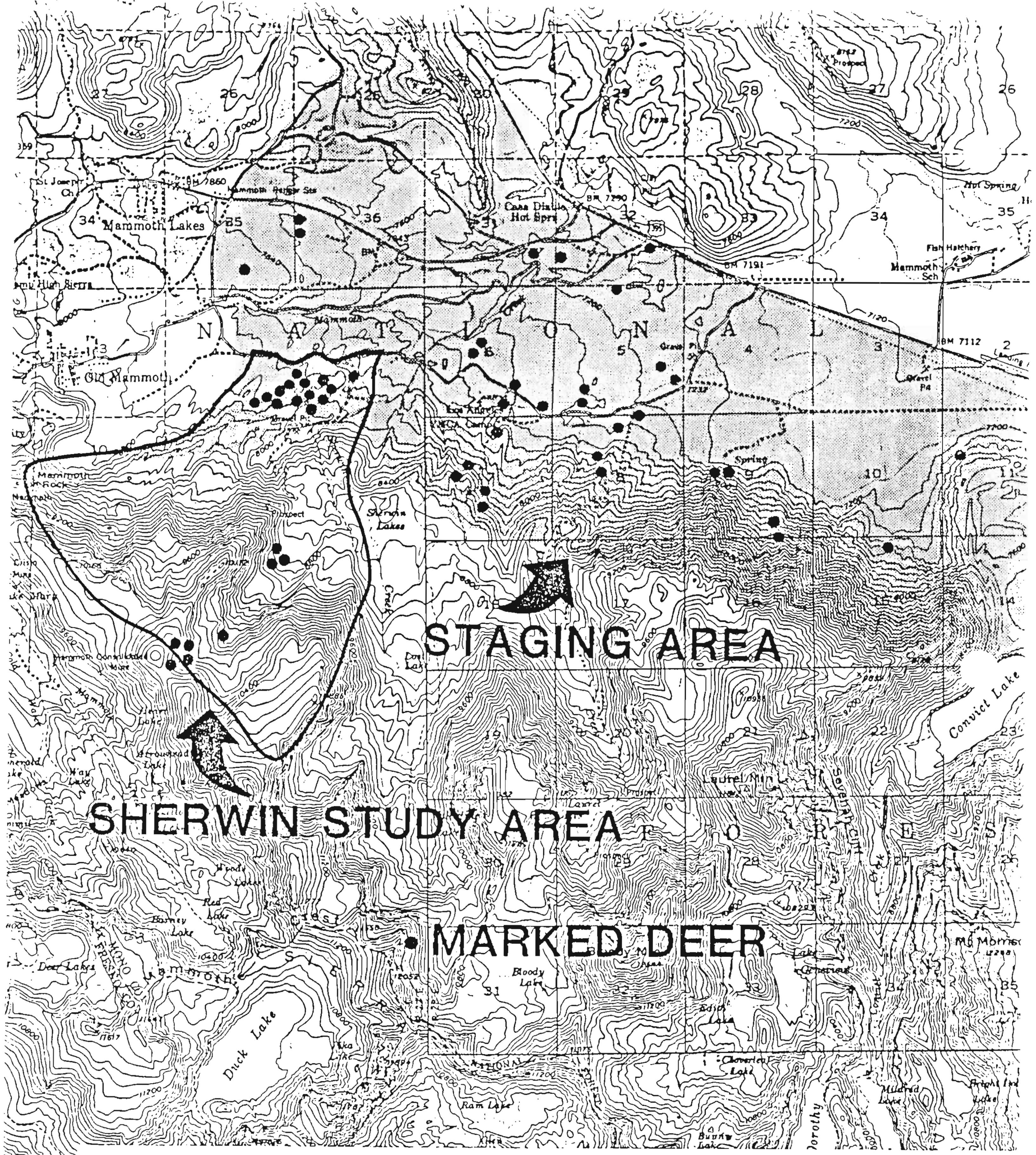


Figure 9. Location of the Staging Area, and locations of deer radioed or marked near Bishop, observed in or near the Sherwin Study Area.

spring (Fig. 9). An additional 36 marked, un-radioed deer (14 males, 19 females, 3 fawns) from Round Valley also were observed in the same area (Fig. 9).

Of the 9 does radioed during spring migration in or near the Study Area, the summer locations of 8 were determined precisely, as were the summer locations of the 17 radioed deer and 4 of the marked but unradioed deer (2 males, 2 females) from Round Valley seen in or near the Study Area (Fig. 10). These animals summered from near Agnew Pass on the north to Florence Lake on the south, which represents an airline distance of some 33 miles, and comprises several hundred square miles of the Sierra Nevada.

Of the does radioed in or near the Study Area, 8 of 9 summered outside it: three went to the Fish Creek drainage, one went to the North Fork of Mono Creek, and another went as far as Florence Lake. One doe summered on Mammoth Pass, and one was located only generally in the summer, southwest of Lake Thomas A. Edison. One radioed doe remained in the Study Area during the summer of 1984 and was located and sighted frequently (Fig. 11). She remained in the Mixed Conifer/Chaparral/Sagebrush Shrub, and produced one fawn. In 1985, she shifted her summer range about 2 miles northeast, near Mammoth Creek. The final doe summered about 2 miles east of the Study Area.

During 141 days of summer fieldwork in the Study Area between 6 June and 15 October 1984 and 6 June and 7 September 1985, 32 un-marked deer (20 does, 6 bucks, 3 fawns and 3 unidentified) were seen. The locations of these sightings are shown in Fig. 11. None of the bucks was seen more than once, and although does are difficult to recognize individually, it is unlikely that many of these were seen repeatedly. The paucity of deer sign observed in the Study Area makes it unlikely that many of the deer remained throughout the summer.

The results of the pellet transects are presented in Table 1 (Pg. 23). Assuming a defecation rate of 13 pellet groups/day (Neff, 1968), summer deer use in the Study Area ranged from 0 deer days/acre/month in Mixed Conifer in June and Chaparral in July, to 7.1 deer days/acre/month in Chaparral in May and June. While probably not a precise measure of the amount of deer use of the various vegetation types, these data do provide an index of relative use of different vegetation types by month.

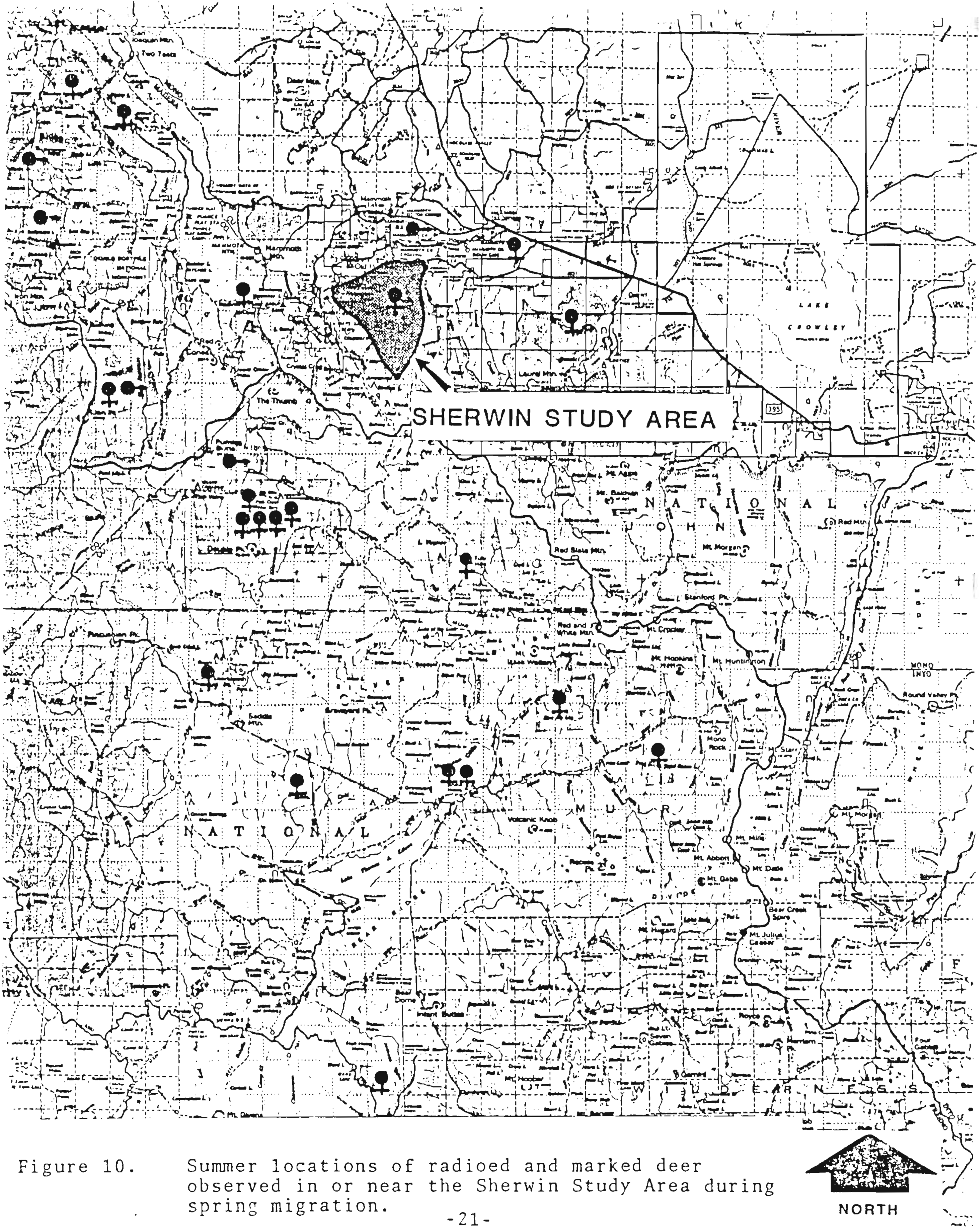
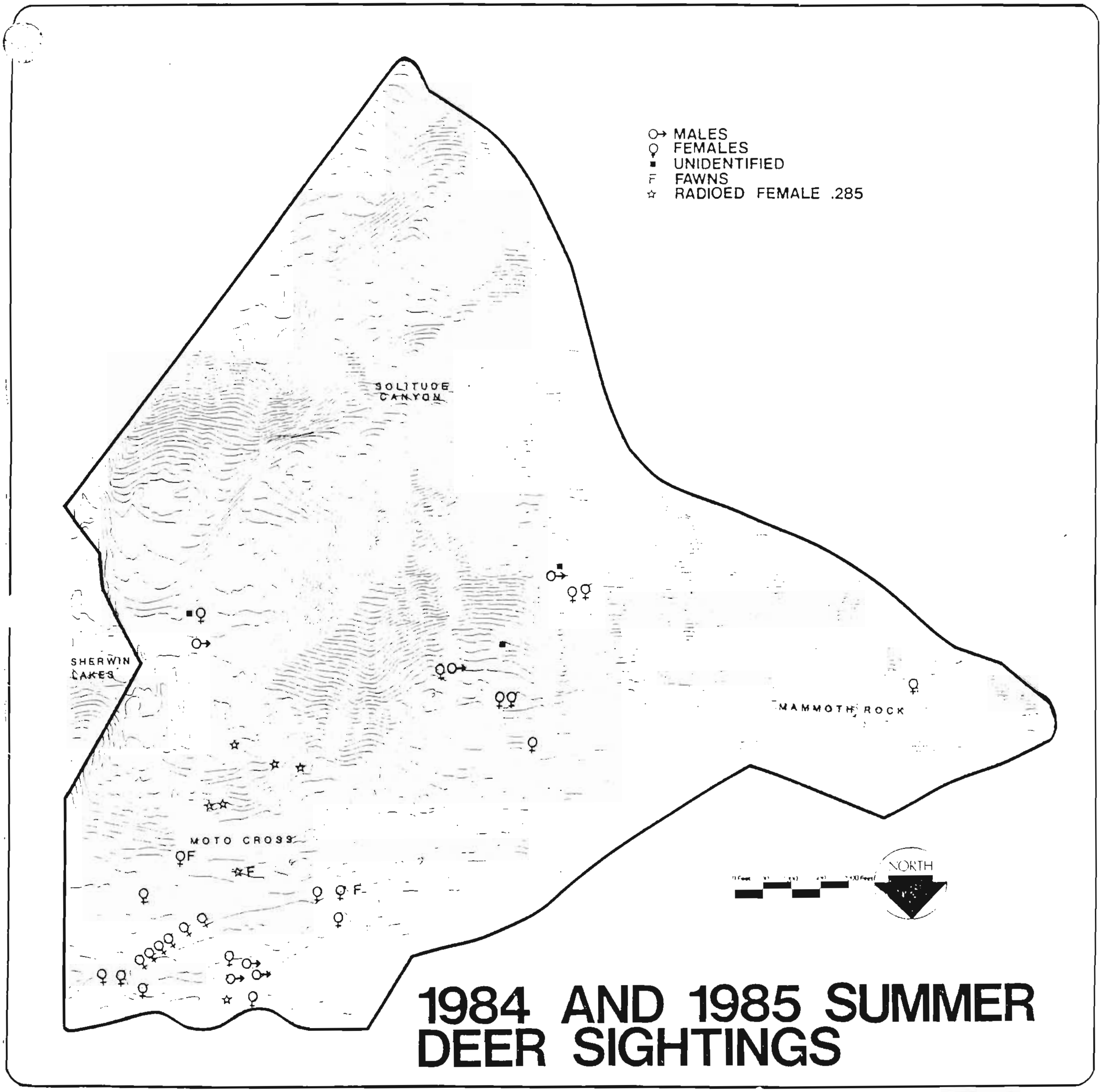


Figure 10. Summer locations of radioed and marked deer observed in or near the Sherwin Study Area during spring migration.



1984 AND 1985 SUMMER DEER SIGHTINGS

TABLE 1. Results of the deer pellet transects in the Study Area, 1984 and 1985 combined.

Month	MAY	JUNE	JULY	AUG.*	SEPT.*	OCT.
			CHAPARRAL			
# Pellet groups	23	23	0	6	12	7
Avg./transect	2.3	2.3	0	0.6	1.2	0.7
Avg./acre	92	92	0	24	48	28
Deer days/acre	7.1	7.1	0	0.9	1.9	2.1
			MIXED CONIFER			
# Pellet groups	1	0	1	3	3	0
Avg./transect	0.1	0	0.1	0.3	0.3	0
Avg./acre	4	0	4	12	12	0
Deer days/acre	0.3	0	0.3	0.4	0.4	0
			WHITEBARK PINE			
# Pellet groups	**	1	1	1	2	**
Avg./transect		0.1	0.1	0.1	0.2	
Avg./acre		4	4	4	8	
Deer days/acre		0.3	0.3	0.2	0.3	

* 1984 and 1985 combined
** Transects not read this month because of snow.

Figure 11. (Page 22) Summer locations of the one radioed doe and unmarked deer observed in the Sherwin Study Area.

2. Fall/Winter

Figure 12 shows the results of the dawn road survey from late August through October in both 1984 and 1985. A different pattern of migration is evident in the two years.

In 1984, with the first significant snow of the year on 16-17 October, a large wave of deer moved through the Study Area (Fig. 12a). More than 100 deer were counted on the October 18 dawn road survey. During surveys three days before and four days after this, 2 and 4 deer were counted, respectively. No deer were seen on 29 October 1984, after which the roads were closed by snow and the surveys discontinued.

No large peak of deer movement was evident on the Fall 1985 survey (Fig. 12b). The largest number counted, 38 on 12 September, followed an unusually early snowfall of about one foot at the base of the Study Area, and up to three feet at Solitude Pass. Subsequent storms, with the exception of one on 7 October, show little temporal relation to deer counted on the road surveys.

In order to get another picture of the temporal pattern of fall migration, the cumulative percent of radioed deer crossing the Sierra Crest and moving through or near the Study Area was plotted by date for 1984 and 1985 (Fig. 13). The 1984 data (Fig. 13a) mirror the pattern of the 1984 fall migration shown by the road survey data (Fig. 12a), with 73% (8 of 11) of the radioed deer crossing the crest in response to a storm on 16-17 October. In 1985 (Fig. 13b), it can be seen that a few (3 of 18, or 17%) crossed immediately subsequent to the storm on 11 September. Fully half (9 of 18) of the radioed deer crossed the crest on 8 and 9 October, following a storm on 7-8 October. The rest appeared gradually through 13 November, when the last radioed animal migrated through, in response to a major winter storm. No deer were known to pass through after mid-November, 1985.

For 1985, Fig. 13 probably presents a better picture of the timing and pattern of Fall migration than does the road survey (Fig. 12b), which did not detect major movement on 7-9 October. This may largely be due to the fact that deer hunting season was

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Figure 12. (Page 25) Deer counted during dawn road surveys, and daily precipitation; a. Fall 1984; b. Fall 1985.

Figure 13. (Page 26) Cumulative percent of radioed deer crossing the Crest and moving through or near the Study Area by date; a. Fall 1984; b. Fall 1985.

FIG. 12

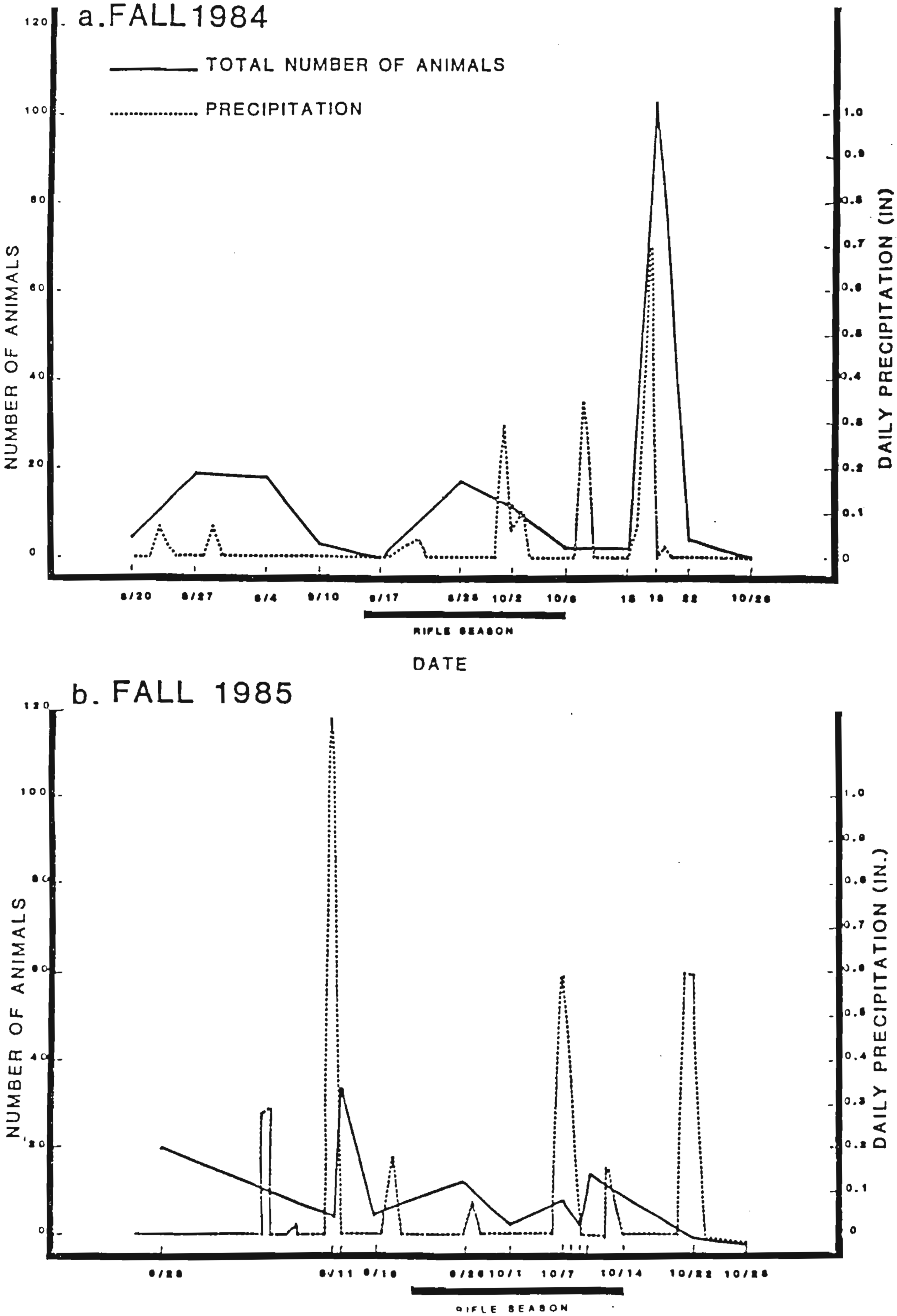
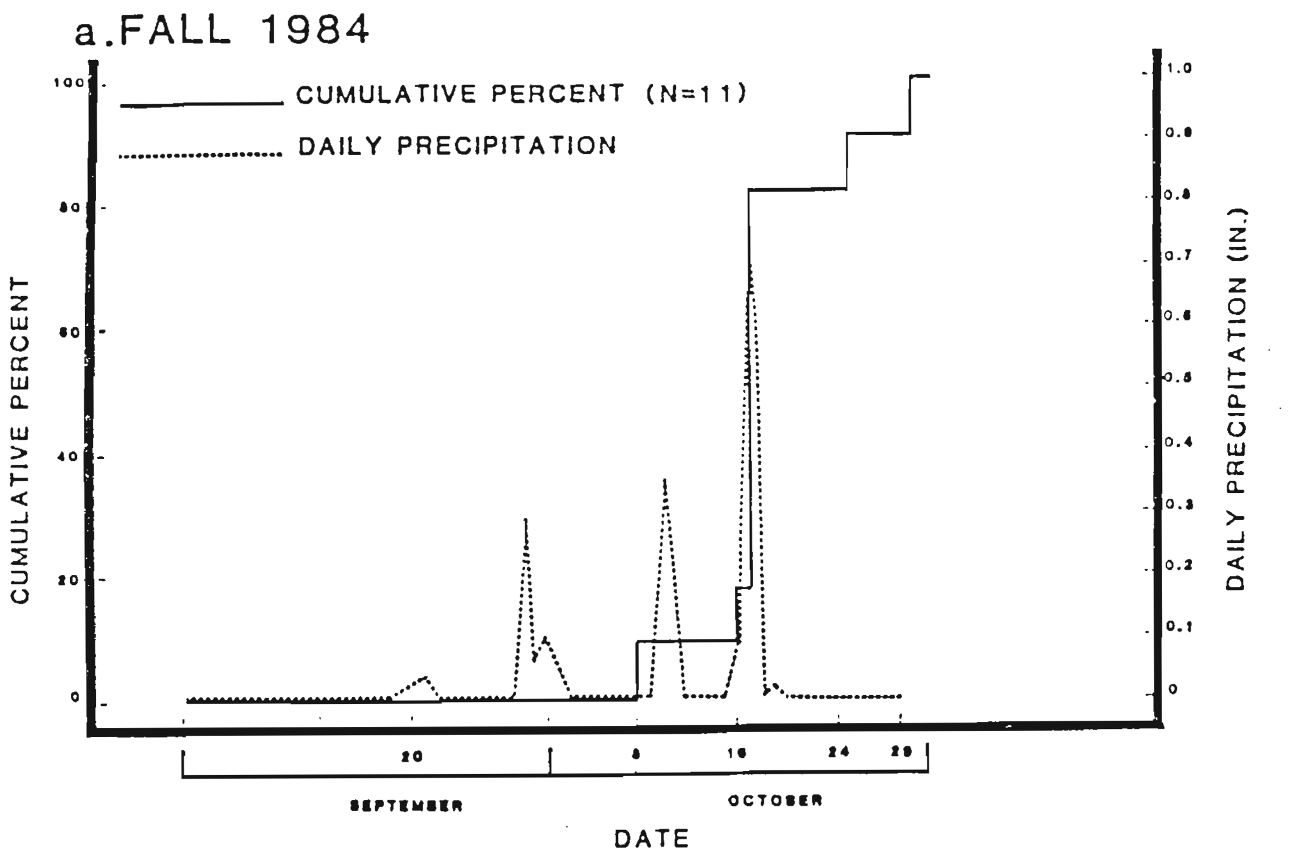
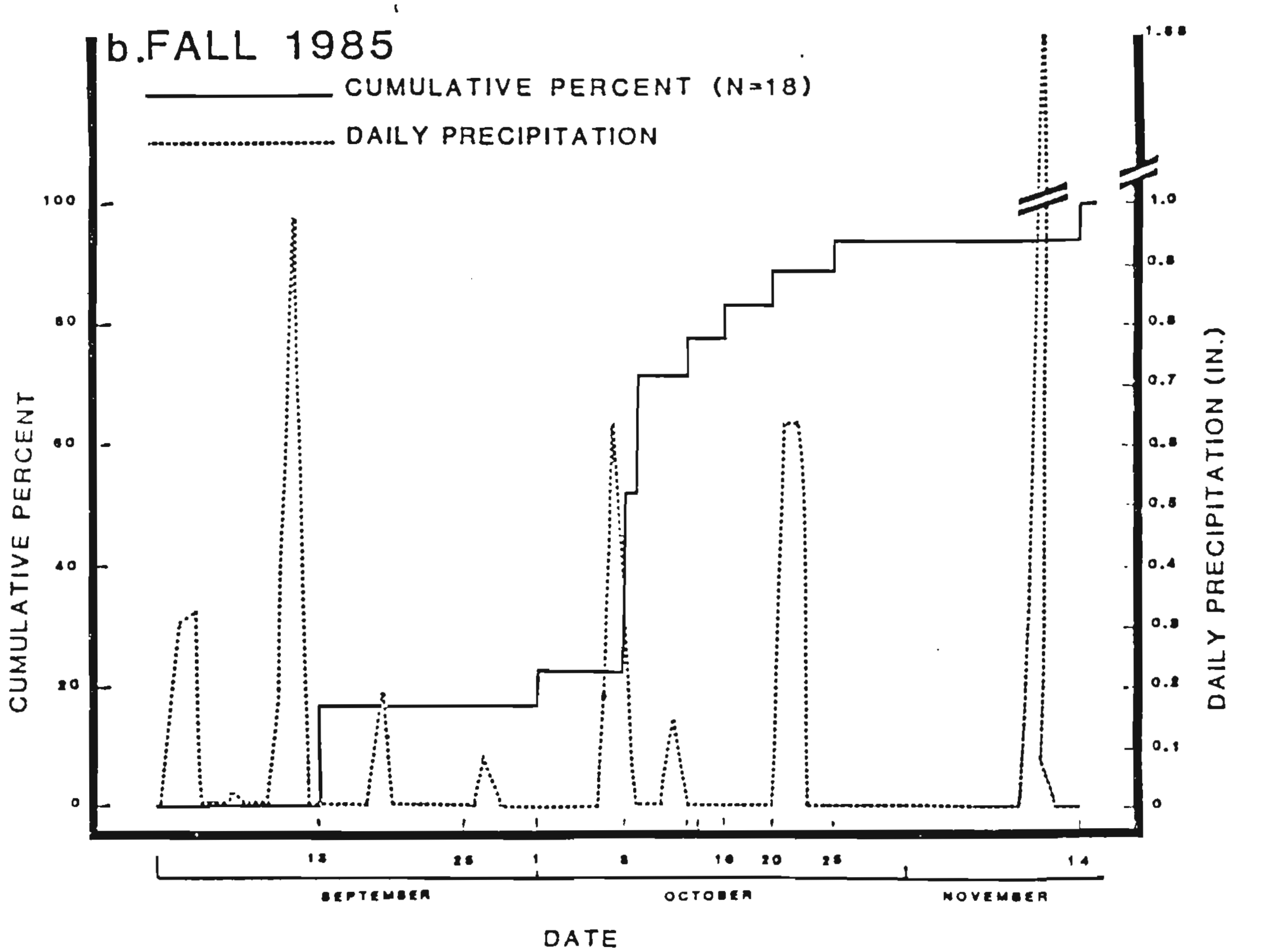

a.FALL1984
TOTAL NUMBER OF ANIMALS
PRECIPITATION
NUMBER OF ANIMALS
DAILY PRECIPITATION (IN)
RIFLE SEASON
DATE
b. FALL 1985
NUMBER OF ANIMALS
DAILY PRECIPITATION (IN.)
RIFLE SEASON

FIG. 13



a.FALL 1984
CUMULATIVE PERCENT (N=11)
DAILY PRECIPITATION
CUMULATIVE PERCENT
DAILY PRECIPITATION (IN.)
SEPTEMBER
OCTOBER
DATE



b.FALL 1985
CUMULATIVE PERCENT (N=18)
DAILY PRECIPITATION
CUMULATIVE PERCENT
DAILY PRECIPITATION (IN.)
SEPTEMBER
OCTOBER
NOVEMBER
DATE

still on, and many hunters, knowing that the storm would trigger migration, were in the field. This human disturbance may have kept deer at higher elevations than the survey route, and may have kept them in heavier cover. Hunting season had ended by the time the Fall 1984 migration occurred.

3. Staging Areas and Migration Routes

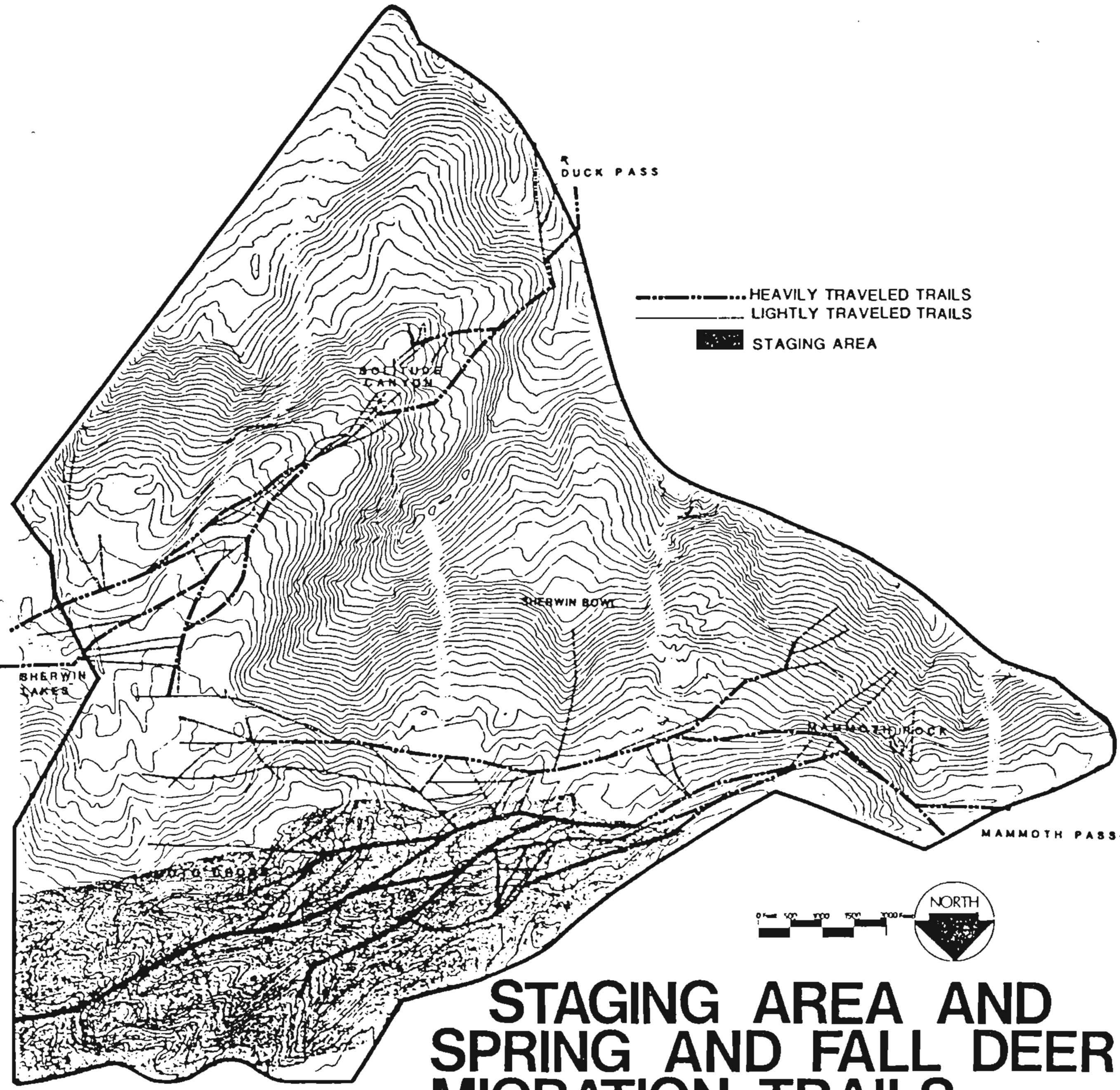
Figure 14 shows the major spring staging areas and migration trails in the Study Area. The staging area includes much of the lower and eastern parts of the Study Area, and consists primarily of Chaparral/Sagebrush Scrub vegetation with scattered white firs and Jeffery pines. This area is essentially a continuation of a staging area that goes east and south for several miles along the base of Laurel Mountain toward Convict Creek, and out in the flat to Highway 395 (Fig. 9).

The migration trails mapped on the ground in spring or in the fresh snow in fall also are shown in Fig. 14. Two general migration routes are evident: one comes east from Mammoth Pass, passes near Mammoth Rock, and traverses the base of the Study Area, splitting into several trails. The second comes from Duck Pass, enters the Study Area at the top of Solitude Canyon, descends the Canyon and, joining segments of the Mammoth Pass trail, turns east to go through Sherwin Lakes. The same trails were used in both years of the study, fall and spring. Additional less heavily used and more dispersed trails were seen above and to the east of the top of Solitude Canyon, and in the Sherwin Bowl area.

4. Total Numbers

There are several ways to estimate the total number of deer migrating through the Study Area. The first is from the infra-red counter on the deer trail near the top of Solitude Canyon. Between 16 May and 30 June 1985, the counter recorded 1282 hits. In order to assess the accuracy of the counter, direct observations of deer going over Solitude Pass were made on 7-8 June 1985. Forty-seven deer were observed apparently going through the counter and beam; 38 hits were recorded on the counter. During the same period, 49 deer were seen going over the pass but not by the counter. These observations both of migrating deer not going by the counter, and of the counter not recording animals apparently going through the beam, indicate that the counter likely underestimates the number of deer moving through Solitude Canyon. If deer which avoid the counter do so on the basis of visual cues, it would be expected that such avoidance would be less by animals moving at night rather than in the day.

Figure 14. (Opposite) Deer migration trails in the Sherwin Study Area.



STAGING AREA AND SPRING AND FALL DEER MIGRATION TRAILS

Nevertheless, both the under-counting of deer moving past the counter and the movement of deer around the counter produce an error in the same direction, that of underestimating the actual number of deer migrating through Solitude Canyon. The real number is probably substantially greater than 1282. This number of course does not include any deer moving west through the lower part of the Study Area toward Mammoth Pass.

A second way to estimate the number of deer moving through the Study Area involves the proportion of animals radioed in Round Valley which passed through or near the Study Area in 1985. Thirteen out of 25 (52%) deer radioed on the winter range near Bishop came through the Study Area in 1985. This excludes animals captured during spring migration near the Study Area. Approximately 6,000 deer were counted in a DFG survey of Round Valley deer in January 1985 (DFG files, Bishop). Assuming that different age and sex classes of deer were radioed in proportion to their occurrence in the population, one could estimate that 3120 (6000 x 0.52) deer came through the Study Area. The assumption of proportional representation in the radioed sample is weak, however; no fawns or yearlings were radioed, and adult males were radioed in greater proportion than their existence in the population. These two sources of error, however, are in opposite directions, and should tend to balance each other. In fact, according to DFG age and sex composition counts of the Buttermilk and Sherwin Grade herds, adult males constituted only about 6% of the population in 1984-85 (DFG files, Bishop). There are many more fawns and yearlings, of both sexes, yet none were in the radioed sample, and thus do not enter the calculation. An estimate of some 3000 deer in Spring 1985, then, is not unreasonable and may be conservative. The fall migration should involve more animals, due to the presence of the summer's fawns.

Evidence consistent with an estimate of several thousand deer comes from the spring road surveys (Figure 8). Between mid-April and late May, from 250 to 600 deer were counted on every survey. These totals represent only those animals seen from the road; many animals present are not visible. Also, these totals surely involve a turnover of individuals as they move from the winter range, though the "staging area" in and near the Study Area, to the summer range, and are consistent with an estimate in the thousands. The fact that the known summer range of radioed deer passing through the Study Area encompasses hundreds of square miles is further evidence consistent with an estimate that several thousand deer pass through the Study Area on migration.

Further, it is suspected that animals from the Casa Diablo herd, some 20-30 miles east of the Study Area, also migrate through it to Western Sierra summer ranges. No animals have been marked or radioed from that herd, however, so no estimates of the number of those deer migrating through the Study Area can be made.

B. Other Wildlife

1.) Diurnal Raptors

Areas of potential goshawk habitat (USDA, 1981a), primarily old-growth Mixed Conifer, were examined on foot on 26-28 and 30 June 1985. No birds or sign were seen. One goshawk was seen in the Study Area in the course of other fieldwork on 31 May 1985. This was in aspens at the base of the slope in the northwestern part of the Study Area, below Mammoth Rock. This area was searched extensively and visited several more times over the summer, but no other birds or evidence of goshawk activity were found.

Potential praire falcon nesting areas were examined on 5-7 June 1985. Cliffs by "Rock Chute", just west of Sherwin Bowl, as well as Mammoth Rock and Solitude Canyon were examined for the presence of adults or evidence of breeding. No prairie falcons or sign were observed. In the course of other fieldwork, prairie falcons were seen on 6 June 1985 along the crest above Mammoth Rock, and on 30 June and 12 and 20 September 1985 at the top of Solitude Pass.

2.) Owls

Beginning on 22 May, and continuing once per week through 15 July, 8 owl surveys were conducted. The survey route, mainly through old-growth Mixed Conifer, is shown in Fig. 15. No responses were elicited from recorded calls of flammulated, spotted, or great gray owls. In the course of other fieldwork, the only owl observed was a great-horned owl (*Bubo virginianus*), seen on 23 July and 15 August about 1/4 mile west of the Moto Cross.

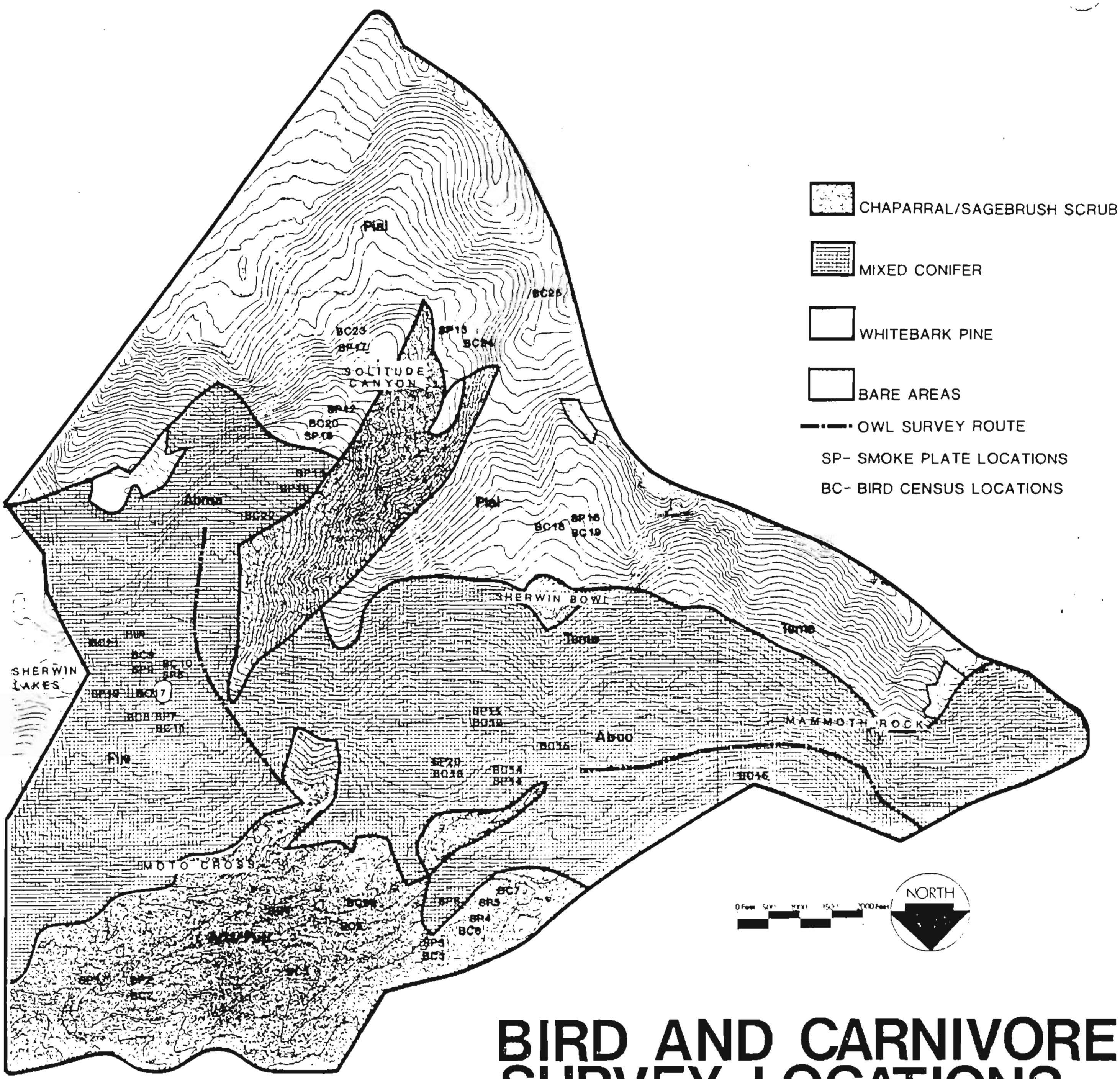
3.) Blue Grouse

Blue grouse and sign were seen and heard commonly throughout the Study Area, in all three major vegetation types and at all elevations. Hens with chicks were seen on 18 June 1985 in an aspen grove in Solitude Canyon, on 26 June below Sherwin Bowl in a patch of Chaparral, and on 12 July in the meadow area in the northwest part of the Study Area.

4.) Management Indicator Avian Species

The locations of the bird survey plots are shown in Fig. 15. Beginning on 28 May and continuing through 20 June 1985, the avian Management Indicator species were surveyed. None were detected in either the Chaparral or Whitebark Pine type. One

Figure 15. (Opposite) Locations of the owl survey route and bird and carnivore plots.



BIRD AND CARNIVORE SURVEY LOCATIONS

yellow-bellied sapsucker was observed on plot BC-15. Williamson's sapsuckers were found at Bird Census Plots BC-8 (3 individuals), BC-10 (2 individuals), BC-11 (1 individual), BC-17 (2 individuals), and BC-21 (2 individuals). These plots are all old-growth Mixed Conifer around a sand flat, and areas of large (30-40" DBH) Jeffery pines.

Hairy woodpeckers were found only on plot BC-10 (2 individuals). No pygmy nuthatches were found during the survey. Brown creepers were found on plots BC-8, BC-11, BC-12, BC-13, BC-15 (all 1 individual in each), and BC-21 (2 individuals).

5.) Carnivores

Between 25 June and 13 August 1985, smoke plates were placed on the plots shown in Fig. 15. Marten tracks were found on plots SP-7 near the sand flat, and SP-14 below Sherwin Bowl, in Mixed Conifer, and on plot SP-13 in Whitebark Pine in Solitude Canyon. The tracks of possibly a Sierra Nevada red fox were found on plot SP-16 in Whitebark Pine above Sherwin Bowl, but this is only tentative, because the tracks were somewhat smeared by rain. No fisher tracks were seen. Many plots had coyote tracks, and all had rodent tracks, especially Spermophilus and Eutamias.

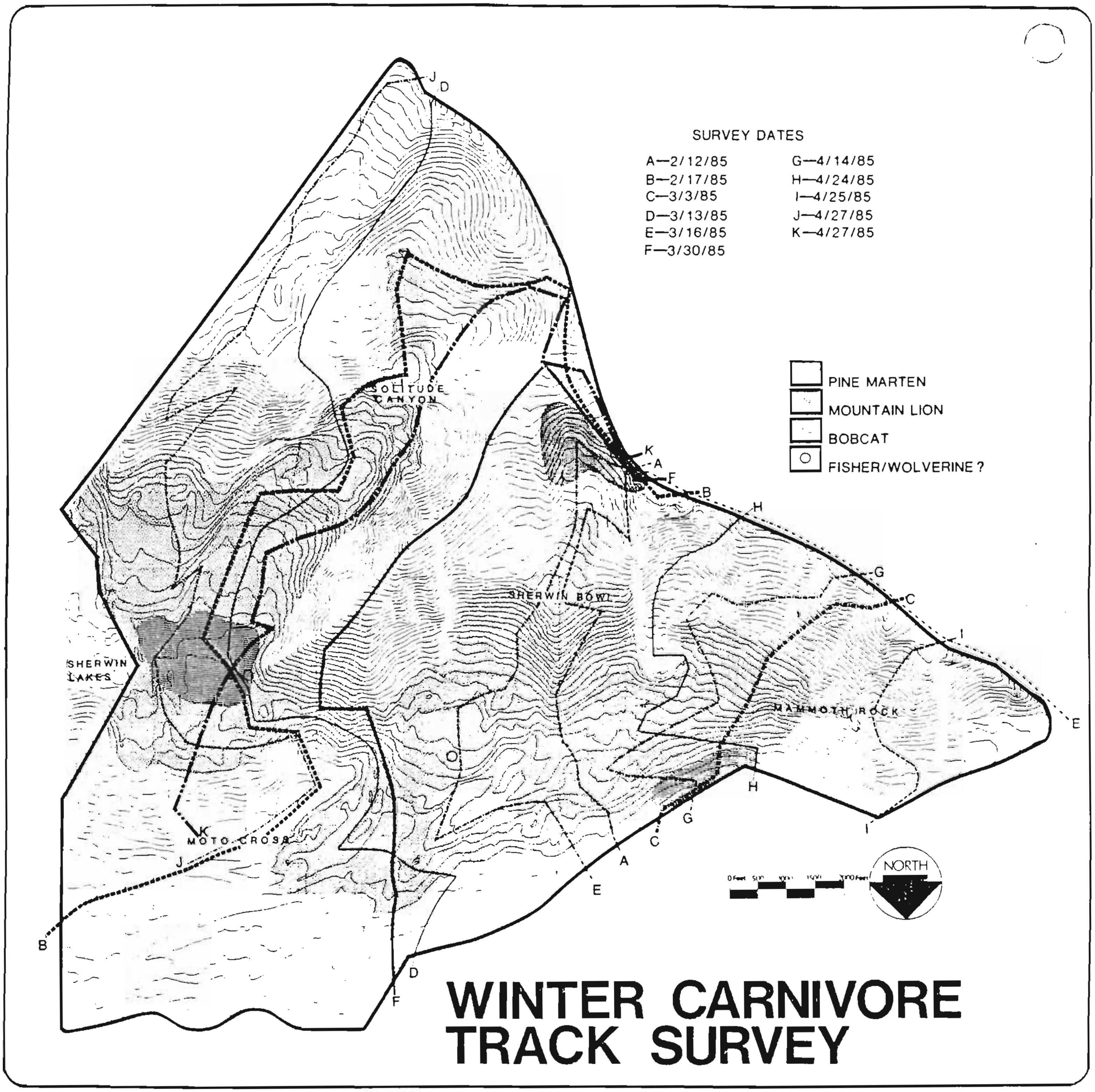
Tracks and sign from racoon (Procyon lotor) and black bear (Ursus americanus) were seen in the Moto Cross, mountain lion sign (tracks, scat, and one apparently lion-killed radio-collared deer) was observed in Solitude Canyon, and badger (Taxidea taxus) diggings were seen in the Chaparral.

The winter carnivore survey found marten tracks throughout a wide portion of the Study Area, particularly the Mixed Conifer (Fig. 16). Larger tracks, possibly of fisher or wolverine (Gulo gulo), were seen on two occasions, once at he base of Solitude Canyon, and once west of the Motocross, below Sherwin Bowl. Mountain lion tracks were found above Sherwin Bowl, and bobcat (Felis rufus) tracks were observed at the base of Solitude Canyon. Coyote tracks were found along the top of the ridge. No red fox tracks were observed.

DISCUSSION

Deer begin leaving the winter range, near Bishop, in early April. There is a gradual upward drift to the Study Area and environs, where deer congregate for periods as long as six weeks. These "staging areas" are typical of migratory mule deer (Leopold et al., 1951; Russell, 1932). In 1984, the first deer were observed in the staging area on 20 April; in 1985, the first deer were observed in the Study Area proper on 17 April.

Figure 16. (Opposite) Winter track survey route and carnivore track locations.



WINTER CARNIVORE TRACK SURVEY

Deer remain in these holding areas, primarily in the Chaparral/Sagebrush Scrub and lower conifer areas, for 3 - 6 weeks until ready to move to their western Sierra summer ranges.

During May and June, deer move through the Study Area on two main routes. One is through the Sherwin Lakes area and up Solitude Canyon to Solitude Pass, then through the upper Mammoth Lakes Basin and over Duck Pass into the Fish Creek drainage. Some of these deer ultimately move as far as Lake Thomas A. Edison and beyond. Deer sign was first noticed in Solitude Canyon on 16 May 1985; there is typically snow on the passes when the deer cross.

The other major migration route is along the base of the Study Area, below Mammoth Rock, and toward Mammoth Pass, giving access to the Middle Fork of the San Joaquin. Additionally, some deer passing through the Study Area move north and cross the Crest along San Joaquin Ridge north of Mammoth Mountain, summering in the Minarets and Agnew Pass area. Approximately 3000 deer participate in the migration from the Buttermilk and Sherwin Grade herds, which winter in Round Valley near Bishop. An unknown number of deer from the Casa Diablo herd also may be involved in this migration. These same routes are used during the fall migration.

The summer locations of individually marked or radioed deer known to pass through or near the Study Area (Fig. 10) demonstrate that this area serves as part of the migratory route of deer which summer over a large part of the Southern Sierra Nevada. The radioed deer which travelled farthest to the south summered just below Florence Lake, on the South Fork of the San Joaquin. The radioed deer summering farthest north was near Agnew Pass. Hundreds of square miles are included in the summer range of these deer. Given this large summering area, the large number of deer passing through the Study Area may not be surprising.

Only one radioed deer summered in the Study Area, and she stayed in the Mixed Conifer/Chaparral/Sagebrush Scrub vegetation at the base of the mountain in 1984 (Fig. 11). In 1985, she summered about 2 miles to the northeast. Other summer observations of deer in the Study Area (Fig. 11) indicated that summer use is relatively light, probably due to the absence of water and poor forage in much of the area. Most of the observations of deer were made in the Chaparral/Sagebrush Scrub vegetation, where browse conditions are more favorable. Even here, however, deer in summer are much more rare than in other nearby areas, such as above the spring at the northern face of Laurel Mountain, about 2 miles southeast of the Study Area. Heavy human presence in the area may be at least partly responsible for this difference in deer density.

Results from the pellet transects (Table 1) confirm the light summer deer presence. The greatest deer use was in the Chaparral in spring and fall, during migration. Thus, little fawning can be expected in the Study Area; its overwhelming importance to deer is as a migration corridor.

No nesting goshawks or prarire falcons were found in the Study Area, although on a few occasions individuals of each species were seen foraging. No spotted, great gray or flammulated owls were found on any of the surveys. Blue grouse were found throughout the Study Area, in all vegetation types.

With respect to the avian Management Indicator species, none were found in either Whitebark Pine or Chaparral vegetation types. One yellow-bellied sapsucker was found at one Mixed Conifer plot (BC-8). Williamson's sapsuckers were more common, and were found at plots BC-8, 10, 11, 17 and 21; all except BC-11 had more than 1 individual. These areas are all old-growth Mixed Conifer at the base of Solitude Canyon. Only one plot, BC-10, had hairy woodpeckers, and brown creepers were found at 6 plots (BC-8,11,12,13,15 and 21). No pygmy nuthatches were found.

The most common carnivore of particular management interest was the marten. Its tracks were found in the summer on plots SP-7 and 14 in Mixed Conifer and SP-13 in Whitebark Pine in Solitude Canyon (Fig. 15). In the winter, marten tracks were found commonly throughout the Mixed Conifer, and less so in the other vegetation types (Fig. 16). Evidence for the presence of fisher, wolverine, and Sierra Nevada red fox must remain tenuous. Possible tracks of the first two were seen in two locations in the winter (Fig. 16), but the soft and melting snow made positive identification impossible. Possible Sierra Nevada red fox tracks were found on one smoke plate, SP-16 (Fig. 15), but rain made the tracks somewhat blurry, again precluding positive indentification. If any of these 3 species do exist in the Study Area, they are quite rare, and possibly only temporary inhabitants or transients.

At least one mountain lion occurrs in what appears to be excellent lion habitat in Solitude Canyon, and bobcat tracks were observed at the base of Solitude Canyon (Fig. 16). Coyote tracks were found commonly at the top of the ridge, and black bear, racoon and badger sign occurred in the lower areas.

From these findings, it is obvious that the wildlife concern of overwhelming importance with respect to a ski development is the migratory deer. Wildlife mitigation is to be discussed in detail in another report, but some general comments are in order here. Summer resident deer are few, and indeed any habitat alteration resulting in earlier successional vegetation would likely favor summering deer. There are no threatened or endangered species present, and only one sensitive species, pine marten, is present in any appreciable numbers. Sierra Nevada red fox, fisher, spotted and great gray owls, and goshawks and prairie falcons are absent or occur only rarely.

Thus, the approximately 3,000 deer which use the area for staging and migration are of greatest concern. Unfortunately, wildlife science is still at a stage where accurate and reliable

predictions of impacts of projects upon wildlife are often difficult or impossible. This is particularly true regarding long-lived, vagile, intelligent species. The difficulty in the present case arises from the temporary, but absolutely critical, use that migratory deer make of the Study Area. Converting a certain number of acres of summer or winter habitat from one type of vegetation to another and predicting impacts on deer is relatively easy. Predicting the consequences of a major development in an important migration corridor is much more difficult. The area seems to work just fine now; the question is, how much worse will it be made by a ski development?

The timing and nature of deer use, and the timing of use by skiers, present both opportunities and constraints. The constraints are conceptually very simple: the less human disturbance, the less deleterious impact on migrating deer. The opportunities arise from the fact that most deer use occurs when there is little skiing to be done, i.e., spring and fall. Spring is the time with most potential for conflict; in years of heavy snowfall, deer could be present in the staging area, or attempting to move over Solitude Pass or by Mammoth Rock, while ski conditions were still favorable. In the fall, most deer will pass through the Study Area before the ski season is underway; pre-season activities (maintenance, preparation of facilities, etc.), however, could nevertheless pose some problems.

Deer use is concentrated through Solitude Canyon, and along the base of the Study Area, both major migration routes. In general terms, minimizing impacts to deer must involve planning to minimize human presence in Solitude Canyon and along the base of the ridge when deer are present, placing permanent stuctures as far as possible from migration routes, and screening those structures with vegetation or natural topographic features. The first can be achieved through a monitoring system to determine the presence of deer in the spring and a contingency plan to cease operations when migration occurs. The latter two can be achieved only through careful and thoughtful design. The ultimate success of such features, however, can only be determined empirically.

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APPENDIX 1

Terrestrial vertebrates potentially occurring in the Study Area.

1 = Sighted, or sign observed, in Study Area during this study.
2 = Reported in Study Area by U.S. Forest Service.
3 = Sensitive, special interest, or harvest species, as defined by U.S. Forest Service.

A. Birds

Northern goshawk	Accipiter gentilis 1,2,3
Sharp-shinned hawk	A. striatus
Cooper's hawk	A. cooperi 1
Red-tailed hawk	Buteo jamaicencis 1,2
Golden eagle	Aquila chrysaetos 1
Prairie falcon	Falco mexicanus 1,3
American kestrel	F. sparvarius 1
Blue grouse	Dendragopus obscurus 1,2,3
White-tailed ptarmigan	Lagopus leucurus 1
Sage grouse	Centrocercus urophasianus 2,3
Mountain quail	Oreortyx pictus 1,2,3
Band-tailed pigeon	Columba fasciata 2,3
Mourning dove	Zenaida macroura 1,3
Flammulated owl	Otus flammeolus 3
Great horned owl	Bubo virginianus 1,2
Northern pygmy owl	Glaucidium gnoma 3
Burrowing owl	Athene cunicularia 2
Spotted owl	Strix occidentalis 3
Great gray owl	S. nebulosa 3
Northern saw-whet owl	Aegolius acadicus
Common poor-will	Phalaenoptilus nuttallii 1
Vaux's swift	Chaetura vauxi
White-throated swift	Aeronautes saxatalis 1
Broad-tailed hummingbird	Selasphorus platycercus
Rufous hummingbird	S. rufus 2, 1
Calliope hummingbird	Stellula calliope
Yellow-bellied sapsucker	Sphyrapicus varius 1,2
Williamson's sapsucker	S. thyroideus 1
Hairy woodpecker	Picoides villosus 1,2
Downy woodpecker	P. pubescens
White-headed woodpecker	P. albolarvatus 1,2
Black-backed woodpecker	P. arcticus
Northern flicker	Colaptes auratus 1,2

Say's phoebe	Sayornis saya 1
Western kingbird	Tyrannis verticalis 1
Willow flycatcher	Empidonax trailii 1
Hammond flycatcher	E. hammondii 1,2
Dusky flycatcher	E. oberholseri 1,2
Western wood peewee	Contopus sordidulus 2,1
Olive-sided flycatcher	Nuttalornis borealis 1
Horned lark	Eremophila alpestris 2
Violet-green swallow	Tachycineta thalassina 1,2
Steller's jay	Cyanocitta stelleri 1,2
Clark's nutcracker	Nucifraga columbiana 1,2
Common raven	Corvus corax 1
Mountain chickadee	Parus gambeli 1,2
White-breasted nuthatch	Sitta carolinensis 1,2
Red-breasted nuthatch	S. canadensis 1,2
Pygmy nuthatch	S. pygmea
Brown creeper	Certhia americana 1,2
Rock wren	Salpinctes obsoletus
Canyon wren	Catharus guttatus 2
House wren	Troglodytes aedon 1,2
Sage thrasher	Oreoscoptes montanus
Hermit thrush	Catharus guttatus 2
American robin	Turdus migratorius 1,2
Mountain bluebird	Sialia currucoides 1,2
Townsend's solitaire	Myadestes townsendi 2
Golden-crowned kinglet	Regulus satrapa
Ruby-crowned kinglet	R. calendula 1
Northern shrike	Lanius excubitor
Loggerhead shrike	L. indovicianus 1
Starling	Sternus vulgaris 1,2
Warbling vireo	Vireo gilvus
Yellow warbler	Dendroica petechia 1
Yellow-rumped warbler	D. coronata 1
MacGillivray's warbler	Oporornis tolmiei
Wilson's warbler	Wilsonia pusilla 1
Western meadowlark	Sturnella neglecta 1
Brewer's blackbird	Euphagus cyanocephalus 1,2
Brown-headed cowbird	Molothrus ater 1
Western tanager	Piranga ludoviciana 1,2
Lazuli bunting	Passerina amoena
Evening grosbeak	Hesperiphona vespertina
Cassin's finch	Carpodacus cassinii 1,2
House finch	Carpodacus mexicanus 1
Pine grosbeak	Pinicola enucleator
Rosy finch	Leucosticte arctoa
Pine siskin	Carduelis pinus 1,2
Lesser goldfinch	C. psaltria

Red crossbill	*Loxia curvirostra* 1
Green-tailed towhee	*Pipilo chlorurus* 1
Vesper sparrow	*Pooecetes gramineus*
Dark-eyed junco	*Junco hyemalis* 1
Chipping sparrow	*Spizella passerina*
Brewer's sparrow	*S. breweri* 1
White-crowned sparrow	*Zonotrichia leucophrys* 1
Fox sparrow	*Passerella iliaca* 1
Song sparrow	*Melospiza melodia* 1

B. Mammals

Vagrant shrew	*Sorex vagrans*
Little brown myotis	*Myotis lucifugus*
Long-eared myotis	*M. evotis*
Long-legged myotis	*M. volans*
California myotis	*M. californicus*
Pika	*Ochotona princeps* 1,2
White-tailed jackrabbit	*Lepus townsendii* 1,2,3
Black-tailed jackrabbit	*L. californicus* 1,2,3
Mountain beaver	*Aplodontia rufa*
Eutamias spp.	1,2
Yellow-bellied marmot	Marmota flaviventris 2
Belding's ground squirrel	*Spermophilus beldingi* 1
Calif. ground squirrel	*S. beecheyi* 1
Golden-mantled ground squirrel	*S. lateralis* 1
Douglas' squirrel	*Tamiasciurus douglassii* 1,2
Northern flying squirrel	*Glaucomys sabrina*
Northern pocket gopher	*Thomomys talpoides* 1
Deer mouse	*Peromyscus maniculatus*
Bushy-tailed wood rat	*Neotoma cinerea*
Western jumping mouse	*Zapus princeps*
Microtus spp.	
Porcupine	*Erethizon dorsatum* 1
Raccoon	*Procyon lotor* 1
coyote	*Canis latrans* 1,2,3
Red fox	*Vulpes vulpes* 1 (?)
Black bear	*Ursus americana* 1,3
Marten	*Martes americana* 1
Fisher	*M. pennanti* 1 (?)
Ermine	*Mustela erminea*
Long-tailed weasel	*M. frenata* 1

Wolverine	*Gulo gulo* 1 (?)
Badger	*Taxidea taxa* 1
Striped Skunk	*Mephitis mephitis*
Mountain lion	*Felis concolor* 1
Bobcat	*Felis rufus* 1,3
Mule deer	*Odocoileus hemionus* 1,3

C. Amphibians

Western toad	*Bufo boreas*
Yosemite toad	*B. canorus*
Pacific treefrog	*Hyla regilla*
Mountain yellow-legged frog	*Rana mucosa*

D. Reptiles

Western fence lizard	*Sceloporus occidentalis*
Sagebrush lizard	*S. graciosus* 1
Northern alligator lizard	*Gerrhonotus coeruleus*
Rubber boa	*Charina bottae*
Gopher snake	*Pituophis melanoleucus*
Common kingsnake	*Lampropeltis getulus*
Western terrestrial gartersnake	*Thamnophis elegans*