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SUSITNA HYDROELECTRIC PROJECT 1983 ANNUAL REPORT



BIG GAME STUDIES VOLUME IV CARIBOU

Kenneth W. Pitcher

ALASKA DEPARTMENT OF FISH AND GAME
Submitted to the Alaska Power Authority

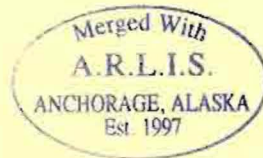
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Anchorage, Alaska

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NOTICE

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SUSITNA PROJECT OFFICE**

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PREFACE

In early 1980, the Alaska Department of Fish and Game contracted with the Alaska Power Authority to collect information useful in assessing the impacts of the proposed Susitna Hydroelectric Project on moose, caribou, wolf, wolverine, black bear, brown bear and Dall sheep.

The studies were broken into phases which conformed to the anticipated licensing schedule. Phase I studies, January 1, 1980 to June 30, 1982, were intended to provide information needed to support a FERC license application. This included general studies of wildlife populations to determine how each species used the area and identify potential impact mechanisms. Phase II studies began in order to provide additional information during the anticipated 2 to 3 year period between application and final FERC approval of the license. Belukha whales were added to the species being studied. In these annual or final reports, we are narrowing the focus of our studies to evaluate specific impact mechanisms, quantify impacts and evaluate mitigation measures.

This is the second annual report of ongoing Phase II studies. In some cases, objectives of Phase I were continued to provide a more complete data base. Therefore, this report is not intended as a complete assessment of the impacts of the Susitna Hydroelectric Project on the selected wildlife species.

The information and conclusions contained in these reports are incomplete and preliminary in nature and subject to change with further study. Therefore, information contained in these reports is not to be quoted or used in any publication without the written permission of the authors.

The reports are organized into the following 9 volumes:

Volume I.	Big Game Summary Report
Volume II.	Moose - Downstream
Volume III.	Moose - Upstream
Volume IV.	Caribou
Volume V.	Wolf
Volume VI.	Black Bear and Brown Bear
Volume VII.	Wolverine
Volume VIII.	Dall Sheep
Volume IX.	Belukha Whale

SUMMARY

Plans to construct a large hydroelectric project on the Susitna River within the western portion of the Nelchina caribou range have raised concerns about the welfare of this important caribou herd. Impact studies, which began in early 1980, continue with the basic objectives of monitoring herd status, determining range use and migratory routes and delineating subherds. The results of these studies are being used to evaluate potential impacts of project construction, to make recommendations to minimize adverse impacts and to evaluate mitigation measures. Primary methodology for the study is the repetitive relocation of radio-collared caribou. Population estimates are being made with a modified version of the aerial photo-direct count-extrapolation census procedure and by direct count.

During the winters of 1980-81 and 1981-82 the main Nelchina herd wintered primarily on the northeastern Lake Louise Flat eastward through the middle portion of the Gakona and Chistochina River drainages to Slana. During the winter of 1982-83 Nelchina caribou wintered from the Lake Louise Flat north and east from the Tok-Tetlin-Northway area to the western slopes of Mount Sanford in the Wrangell Mountains. Movements of Nelchina caribou northeast of the Mentasta Mountains have only occurred during about three of the past 30 years. Rapid, directed movement of caribou to the calving grounds commenced during the last week in April when the female segment of the herd was massed between Lake Louise and Crosswind Lake. Most females entered the Talkeetna Mountain foothills in the area of the lower Oshetna River. There was less use of the Watana impoundment area by caribou during the 1983 spring migration than during the previous three years.

Calving took place from Sanona Creek and the Little Oshetna River westward to the hills east of Stephan and Fog Lakes. Most calving activity occurred between the Black and Little Oshetna Rivers.

Summer range for the female-calf segment of the herd was the northeastern Talkeetna Mountains between Horn Mountains and the hills west of Tsis Creek. Males were found in the highlands throughout the Nelchina Basin.

Most caribou remained on summer range until late in the autumn period (late September) when they rapidly moved to the east. By early October most were located between Hogan Hill and Boulder Creek on the lower slopes of Mount Sanford.

The Nelchina herd was estimated to contain 18,713 caribou in October 1980, 20,730 in 1981, 21,162 in 1982 and 24,825 in 1983. Herd composition in October 1983 was estimated at 53% female ≥ 1 year, 32% males ≥ 1 year and 14% calves.

In 1982-83 calf survival from birth to 10.5 months of age was estimated at 0.54. Average annual survival for radio-collared caribou throughout the study period was estimated at 0.87 for females and 0.85 for males. Reported hunter kill of Nelchina caribou for the 1982-83 regulatory year was 861 animals.

The population estimate for the upper Susitna-Nenana subherd was reduced from 2,500 to 1,500 because it was determined that animals from the main Nelchina herd were present during the subherd census. The subherd census should be repeated when the two groups are well separated. Calving by females of this subherd was not restricted to a limited geographic area but was dispersed over a wide region. It appears that about 50% of the

subherd crosses the proposed Denali access route twice yearly during migration to and from summer range in the Chulitna Mountains.

Both the Watana impoundment and Denali access road appear to be potential barriers to the free movement of Nelchina caribou. Should the main Nelchina herd resume use of the summer and winter range north of the proposed impoundments the potential for adverse impacts will greatly increase. Increased direct mortalities may occur during hazardous impoundment crossings and from collisions with vehicles along the access road. Loss of habitat does not appear to be a serious consideration as only a small proportion of the total range is involved and it appears to mostly be of poor quality. Increased human access to the calving grounds and summer range in the Talkeetna Mountains facilitated by project construction could increase development and disturbance in this now remote area. Reduced condition resulting from extended and more difficult migratory routes could impact herd productivity, particularly during spring migration when pregnant females are in relatively poor condition.

The Susitna hydroelectric project should be viewed as one of a number of probable developments which will occur on the Nelchina caribou range. While no one action may have catastrophic results the cumulative impact will likely be a reduced ability for the Nelchina range to support large numbers of caribou.

It is recommended that range use and migratory routes be monitored by periodic relocations of radio-collared caribou. Population status should be monitored with annual censuses and sex and age composition sampling.

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INTRODUCTION

The Nelchina caribou herd, found primarily in the large basin formed by the upper drainages of the Susitna and Copper Rivers, and surrounded by four mountain ranges, the Wrangell Mountains, the Talkeetna Mountains, the Alaska Range and the Chugach Mountains, has been an important wildlife resource because of its size and proximity to the majority of the states human population. Between 1954 and 1983 in excess of 100,000 caribou were harvested from this herd. In 1983, 9,715 people applied for 1,750 permits to hunt for Nelchina caribou.

Plans to construct a large hydroelectric project on the Susitna River within the western reaches of the Nelchina caribou range have raised concerns about impacts of the development on this important caribou herd. Impact studies were started in early 1980 and a comprehensive report on the results published in March 1982 (Pitcher 1982). Considerable background material was also presented in that report; primarily historical range use, movement patterns and population levels. In April 1983 a progress report was distributed updating research results (Pitcher 1983). Following is a summary of background material, methodology, results, possible impacts and recommendations from that report.

Plans to construct a large hydroelectric project on the Susitna River within the western portion of the Nelchina caribou range have raised concerns about the welfare of this important caribou herd. Impact studies, which began in early 1980, continue with the basic objectives of monitoring herd status, determining range use and migratory routes and delineating subherds. The results of these studies are being used to evaluate potential impacts of project construction, to make recommendations to minimize adverse impacts and to evaluate mitigation measures. Extensive use of historical records of the Nelchina herd has been made in the analyses because of the changeable nature of caribou movement patterns.

During the winters of 1980-81 and 1981-82 the main Nelchina herd wintered primarily on the north-eastern Lake Louise Flat eastward through the middle portion of the Gakona and Chistochina River drainages to Slana.

During spring migration females moved across the Lake Louise Flat onto the calving grounds in the eastern Talkeetna Mountains on a broad front from Lone Butte to Kosina Creek. Significant numbers of female caribou (probably over 50% in 1982) passed through the upper Watana impoundment area enroute to the calving grounds. Most males remained on winter range during this period.

Calving occurred primarily in drainages of Kosina Creek although some occurred along Goose Creek and the lower reaches of the Black and Oshetna Rivers. Nelchina bulls were found scattered throughout the Nelchina range during this time mostly in transit to summer range.

Summer range for Nelchina females was the northern and eastern slopes of the Talkeetna Mountains. Bulls were scattered in "bull pastures" throughout the high country of the Nelchina range.

During autumn considerable dispersal occurred from the Talkeetna Mountains across the Lake Louise Flat. In 1982, perhaps 10% of the female segment crossed the Susitna River and moved onto the Jay Creek-Coal Creek plateau.

During the rut the herd appeared to be well mixed and moved eastward across the Lake Louise Flat. In mid-October 1982 about 10% of the herd crossed the Susitna River in the area of Watana Creek, migrated across the Jay Creek-Coal Creek plateau and moved eastward to winter range.

Historically, Nelchina caribou have used the same calving grounds however considerable variation in summer and winter range use has been noted. Migratory routes, although somewhat traditional, have varied depending on the geographic relationship of the calving grounds to summer and winter ranges.

The Nelchina herd was estimated to contain 18,713 caribou in October 1980, 20,730 in 1981 and 21,162 in 1982. Herd composition in October 1982 was estimated at 47.7% females ≥ 1 year, 26.5% males ≥ 1 year and 25.8% calves.

Calf survival from birth to 10.5 months of age was estimated at 0.58. Average annual survival for caribou ≥ 1 year was estimated at 0.88 for females and 0.92 for males (0.89 sexes combined). Reported hunter kill of Nelchina caribou for the 1981-82 regulatory year was 863 animals.

Observations of radio-collared (and non-collared) caribou indicated the existence of a discrete subherd resident in the upper drainages of the Susitna, Nenana and Chulitna Rivers (upper Susitna-Nenana subherd). Although overlap with animals from the main Nelchina herd occurred during winter, summer and fall, females were separated during calving. An initial census (direct count) of this subherd was attempted in October 1982 and 2,077 caribou were counted. Complications in evaluating the count resulting from delays from weather and movement of mainherd animals through the area make it desirable to repeat the census.

It is apparent, even though the massive crossings of the Susitna River in the area of Watana Creek have not occurred in recent years, that significant numbers of Nelchina caribou migrate through the upper portion of the proposed Watana impoundment. This occurs during both spring and fall. While it is not possible to predict the impacts of the Watana impoundment on migrating caribou it does appear that the greatest potential for deleterious impacts occurs during spring migration to the calving grounds. Pregnant females are often in the poorest condition of the year at this time and might be particularly vulnerable to an extended migration or a hazardous reservoir crossing. The proposed Denali access road passes through the range of the upper Susitna-Nenana subherd and historical summer and winter range of the main Nelchina herd. Potential impacts include increased mortality from vehicle collisions, impeded east-west movements, increased hunter access and possibly increased predation.

The Susitna hydroelectric project should be viewed as one of a number of probable developments which will occur on the Nelchina caribou range. While no one action may have catastrophic results the cumulative impact will likely be a reduced ability for the Nelchina range to support large numbers of caribou.

It is recommended that range use and migratory routes be monitored by periodic relocations of radio-collared caribou. Population status should be monitored with annual censuses and sex and age composition sampling. Increased emphasis should be placed on studying the upper Susitna-Nenana subherd.

The remainder of this report deals, mainly, with findings obtained since preparation of the last progress report (November 1982 - October 1983) and a discussion of the significance of these findings to project construction.

METHODS

Data on timing and routes of migration, range use and subherd status were collected by the periodic relocations of radio-collared animals. It was assumed that in general the behavior of radio-collared caribou was representative of the herd. Details of capture and radio-tracking techniques were previously described (Pitcher 1982).

Estimates of herd size were made using a modified version of the aerial photo-direct count-extrapolation caribou census procedure (Hemming and Glenn 1969, Davis *et al.* 1979, Doerr 1979, Pitcher 1982).

A helicopter (Bell 206B) was used to sample the post-calving aggregations, the herd during the breeding season and the herd in April to estimate proportions of females ≥ 1 year, males ≥ 1 year and calves. Groups of caribou were approached from the rear until the sex of each animal older than a calf could be determined from the external genitalia (presence or absence of the vulva).

Methodology for data storage, retrieval and analysis was included in the 1981 report for data management:biometrics (Miller and Anctil 1981).

The study area consisted of the entire range of the Nelchina caribou herd (Fig. 1). However, monitoring frequency of radio-collared animals was much more frequent when they were in the vicinity of the proposed impoundments.

Estimates of mean annual adult survival rates were made from radio-collared animals using a formula provided by Trent and Rongstad (1974) which is based on the number of mortalities detected and the period of time the radio-collared animals were monitored.

Estimates of calf survival to 11 months of age were made by multiplying the calf to female ≥ 1 year ratio obtained in April by the estimate for annual survival of females ≥ 1 year then dividing by the ratio of calves to females ≥ 1 year at birth (Fuller and Keith 1981).

RESULTS AND DISCUSSION

DISTRIBUTION AND MOVEMENTS: MAIN NELCHINA HERD

Winter: during early October 1982 the Nelchina herd was moving from west to east with animals spread from the northern Talkeetna Mountain foothills across the Lake Louise Flat to Fish Lake and Hogan Hill with the majority of the animals to the east (Pitcher 1983). The eastward movement continued and by 26 November at least 20 of 31 radio-collared caribou were either in or were northeast of the Mentasta Mountains (Fig. 2). By late December a number of animals had moved back to the west with the largest grouping near the Sanford River in the foothills of the Wrangell Mountains (Fig. 3). At least five radio-collared animals remained northeast of the Mentasta Mountains. By mid-February up to half of the herd had moved back to the Lake Louise Flat. Smaller numbers remained in the Wrangell Mountain foothills and northeast of the Mentasta Mountains (Fig. 4). The same pattern persisted into March with an apparent slow movement towards the

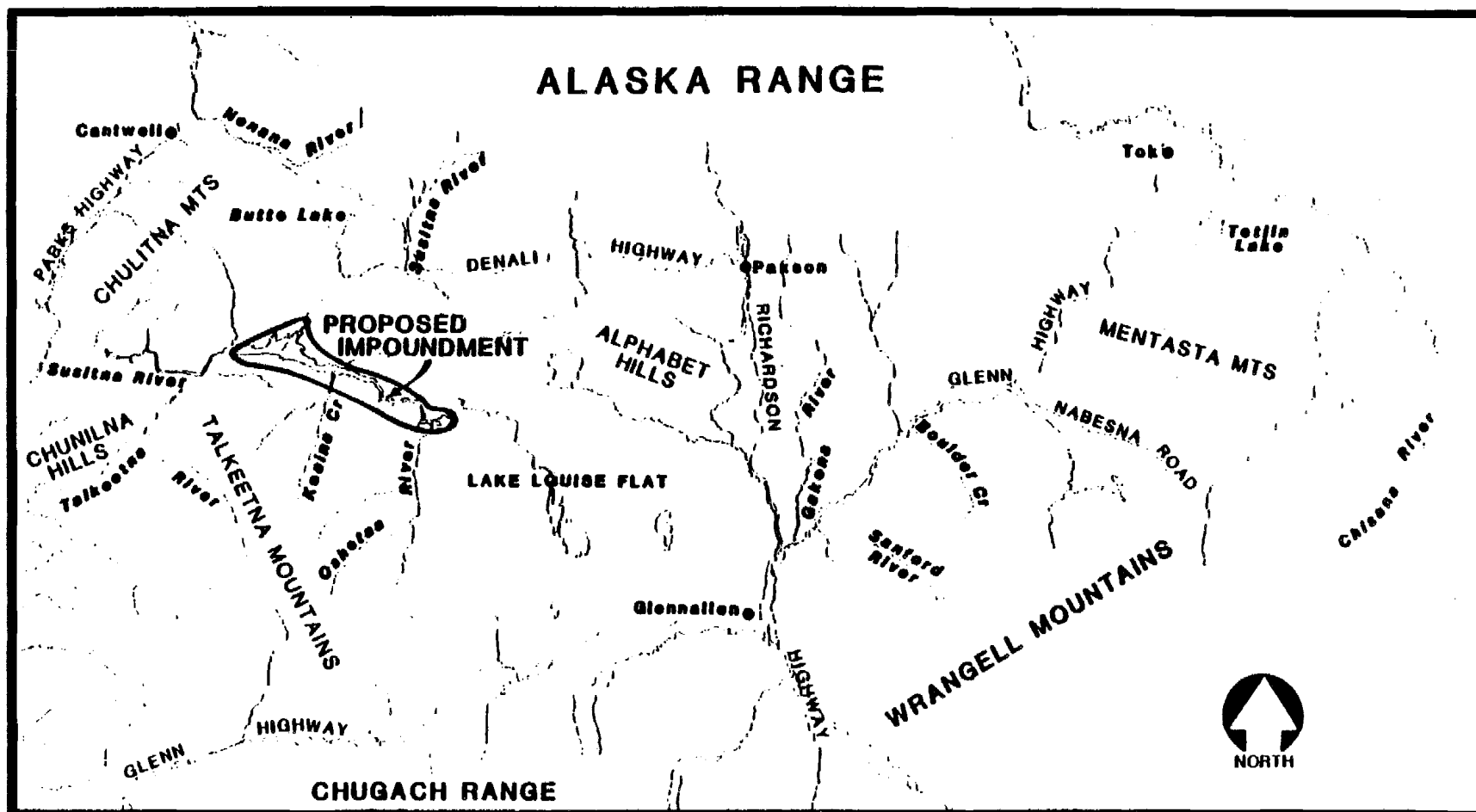


Figure 1. Nelchina caribou range with basic geographic features.

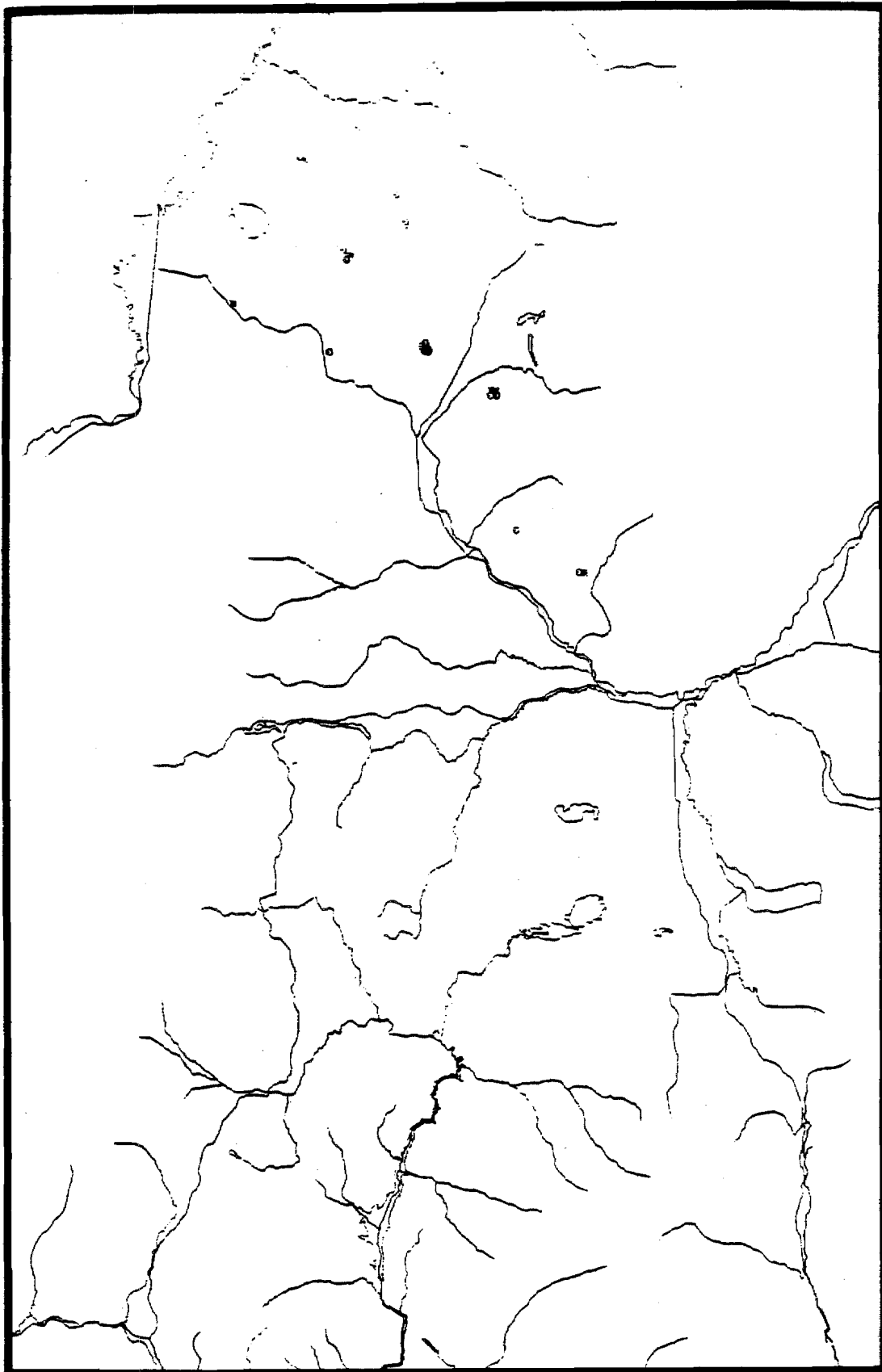


Figure 2. Distribution of Nelchina radio-collared caribou in late November 1982. ○ = female, * = male.

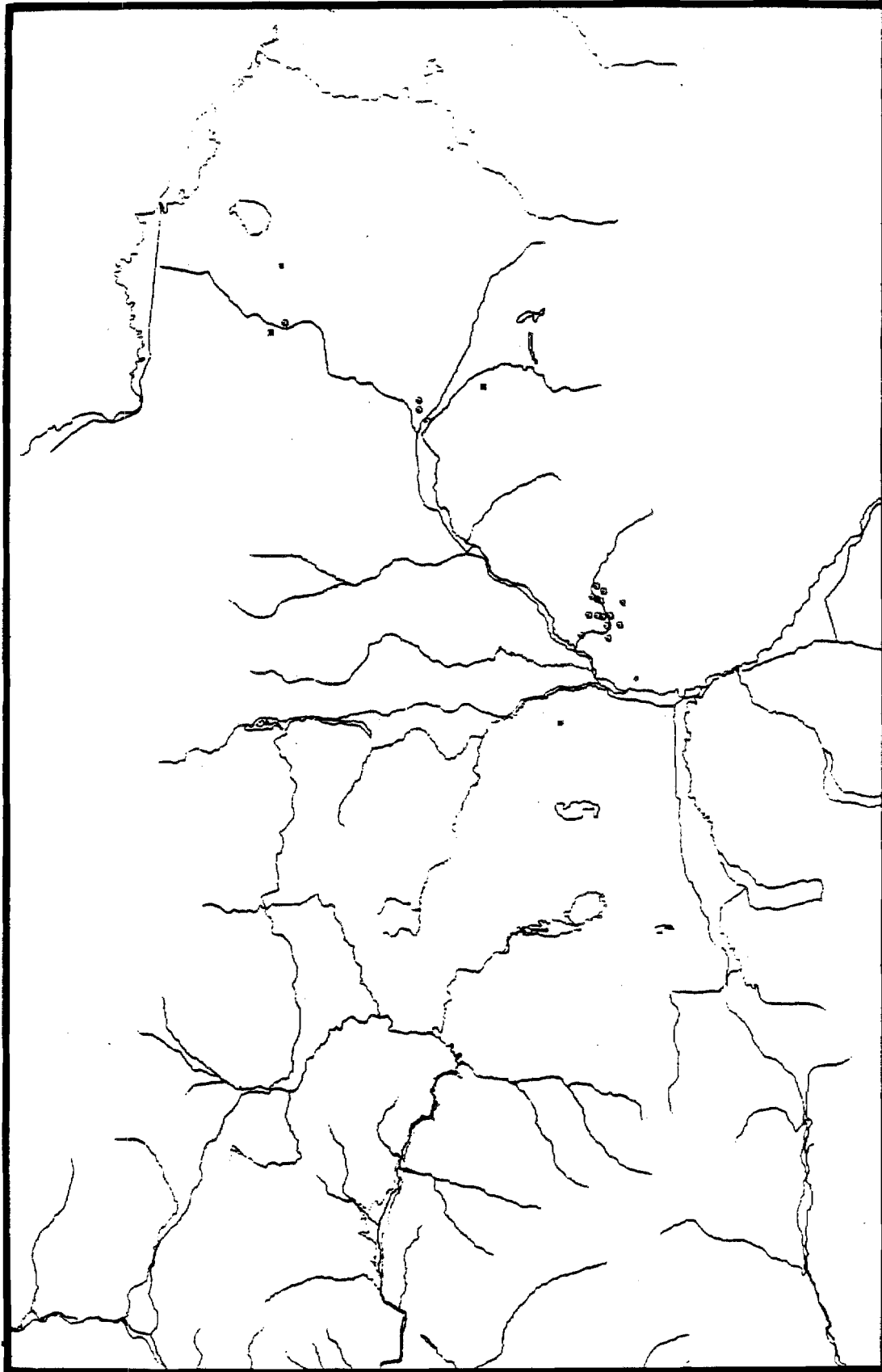


Figure 3. Distribution of Nelchina radio-collared caribou in late December 1982. ○ = female, * = male.

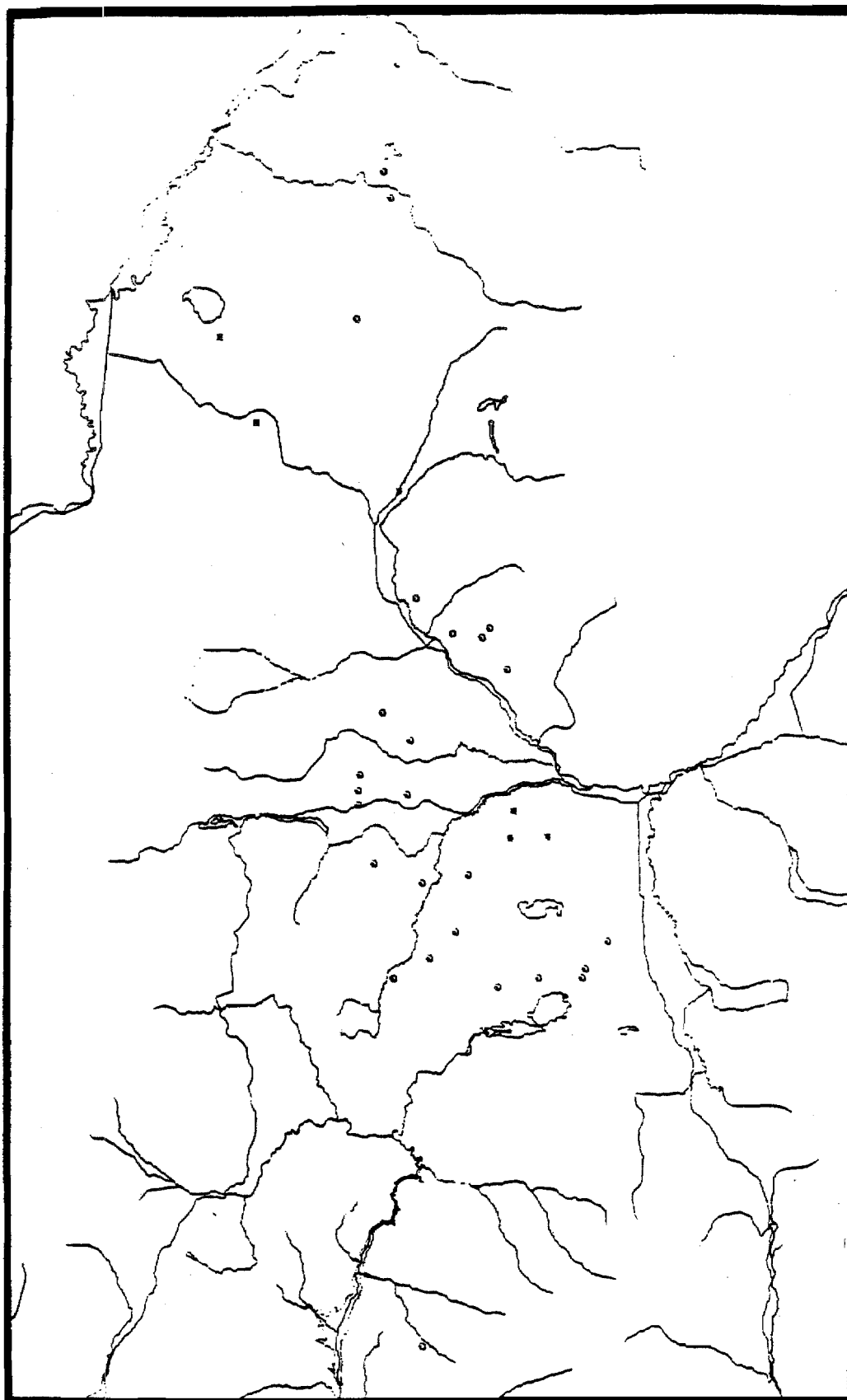


Figure 4. Distribution of Netchina radio-collared caribou in mid-February 1983. ○ = female, ■ = male.

Lake Louise Flat although some animals remained east of the Copper River near Boulder Creek and northeast of the Mentasta Mountains (Fig 5). By early April all radio-collared animals had moved southwest of the Mentasta Mountains and were centered on the Lake Louise Flat and east of the Copper River near Boulder Creek (Fig. 6).

During the previous two years Nelchina caribou wintered on the Lake Louise Flat and Gakona and Chistochina River drainages (Pitcher 1983). Movements of animals to the Tetlin area northeast of the Mentasta Mountains such as occurred during 1982-83 (Fig. 7) have only rarely taken place. During the winter of 1965-66 a similar movement occurred and it was speculated that emigration of Nelchina caribou may have occurred (Glenn 1967). A similar movement may also have taken place during 1978-79 as caribou trails were seen going to the northeast through the Mentasta Mountains and caribou sightings were reported from the Tok-Tetlin area (R. Tobey, S. Eide; pers. commun.). Speculation that such movements outside of "normal range" are related to either behavioral or food related pressures resulting from high population levels (Skoog 1968) do not appear appropriate as two of these movements occurred at moderate to low population levels. Only the 1965-66 movement took place during a population high.

Spring Migration: by 25 April most females were massed between Lake Louise and Crosswind Lake. A few stragglers were as far east as the Chistochina-Slana area. By 3 May all but one radio-collared female were west of Lake Louise and the Tyone River. A few females had reached the Talkeetna Mountain foothills near Goose Creek and Clarence Lake. Radio-collared males were still on winter range to the east although they appeared to be slowly drifting west. It appeared that the directed, rapid movement of the female segment towards the calving grounds began in late April, similar to 1982 (Pitcher 1983). The main migratory route (Fig. 8) appeared to be south of the upper end of the proposed Watana impoundment between the big bend of the Susitna and Lone

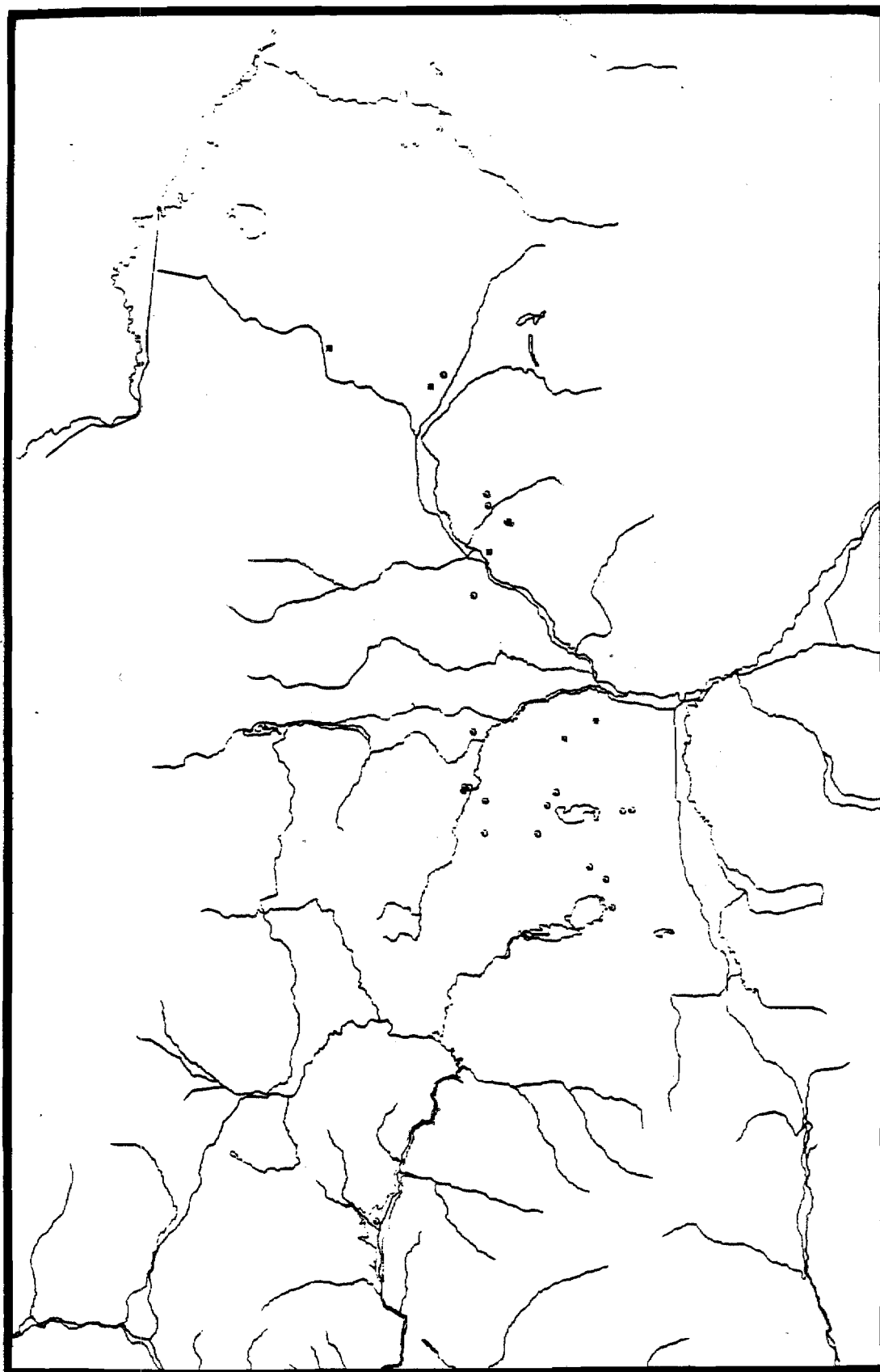


Figure 5. Distribution of Nelchlna radio-collared caribou in March 1983. \circ = female, $*$ = male.

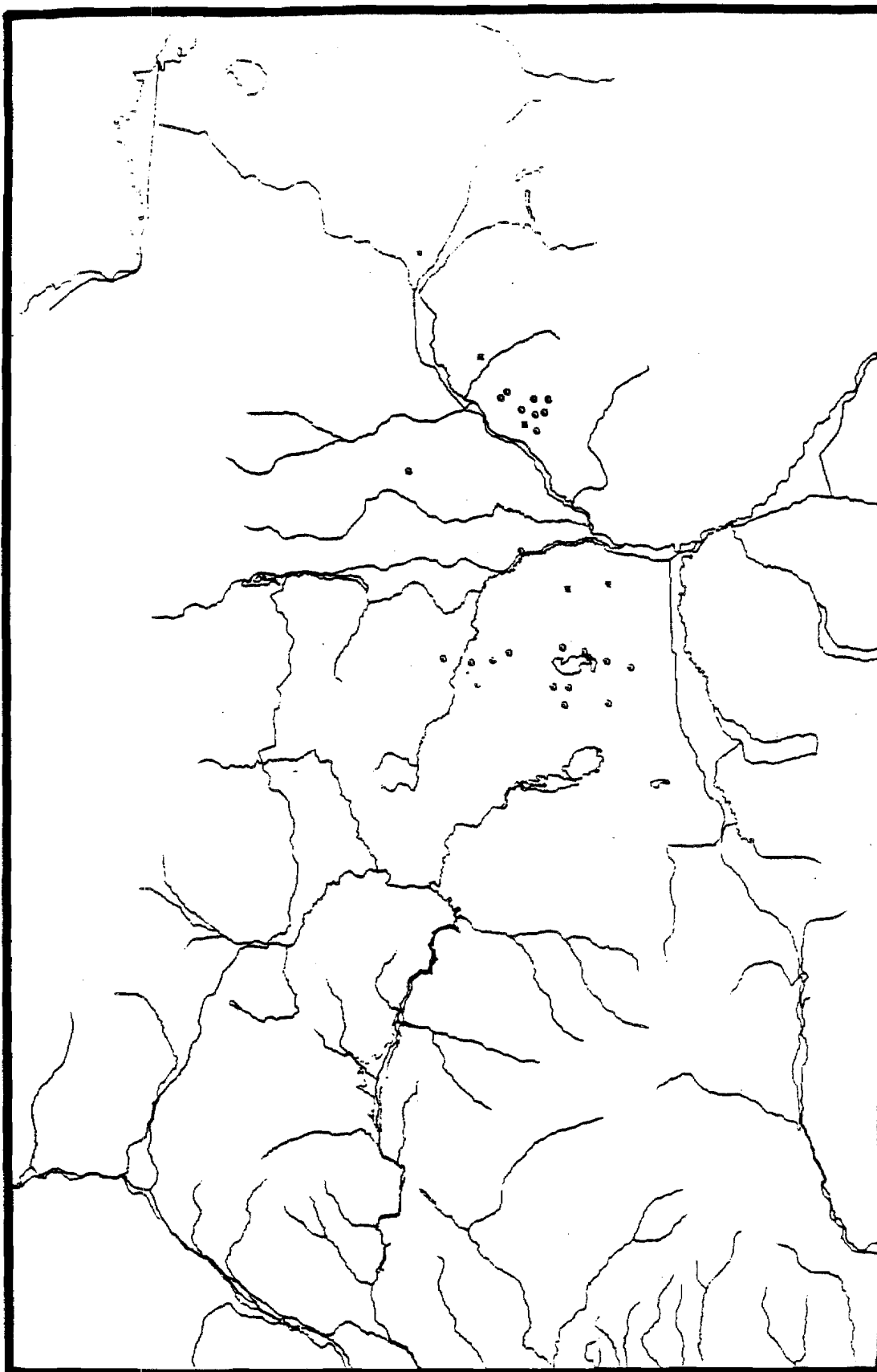


Figure 6. Distribution of Nelchina radio-collared caribou in early April 1983. \bigcirc = female, $*$ = male.

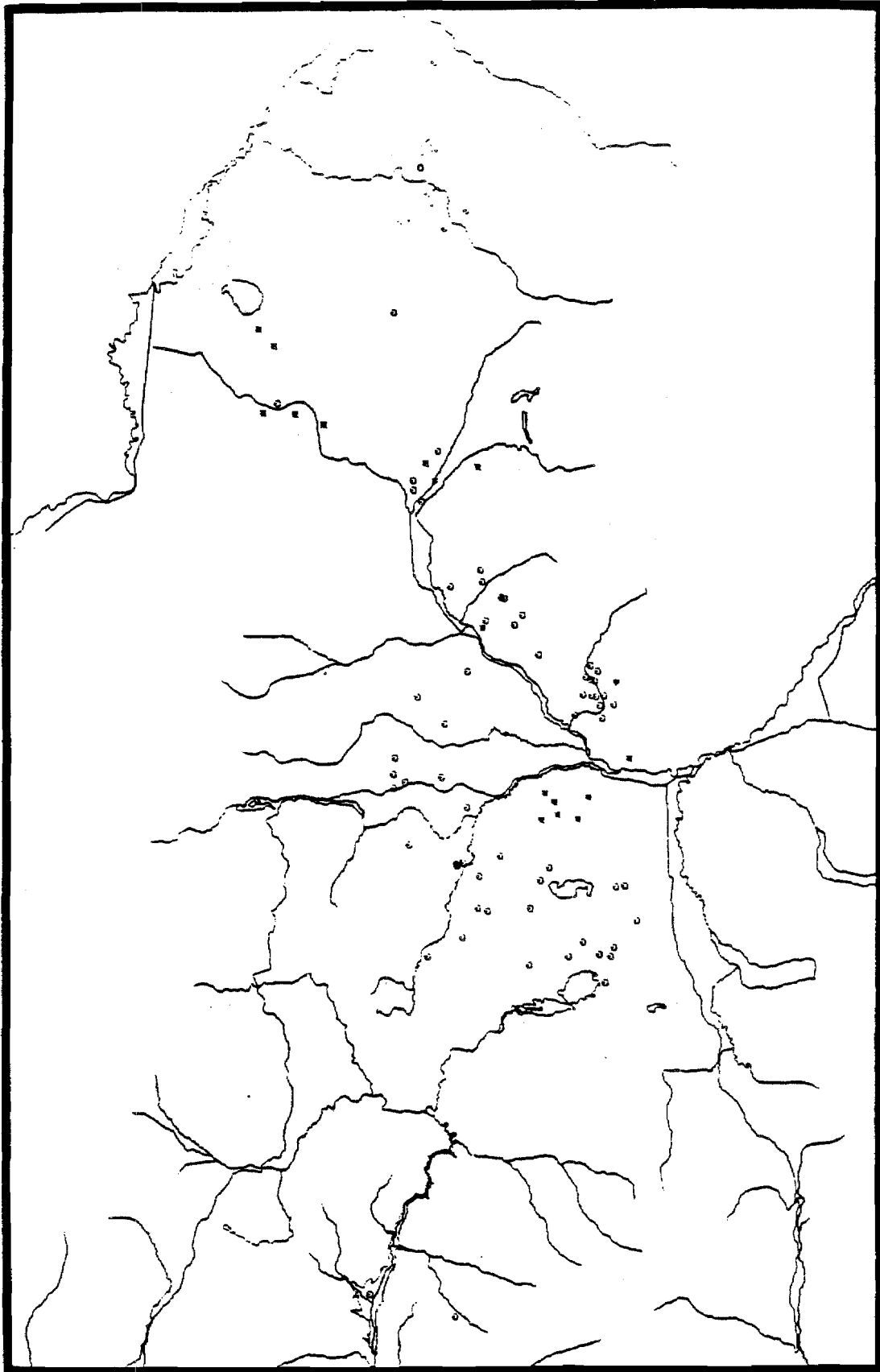


Figure 7. Distribution of Nelchina radio-collared caribou during winter, December 1982-March 1983. \circ = female, * = male.

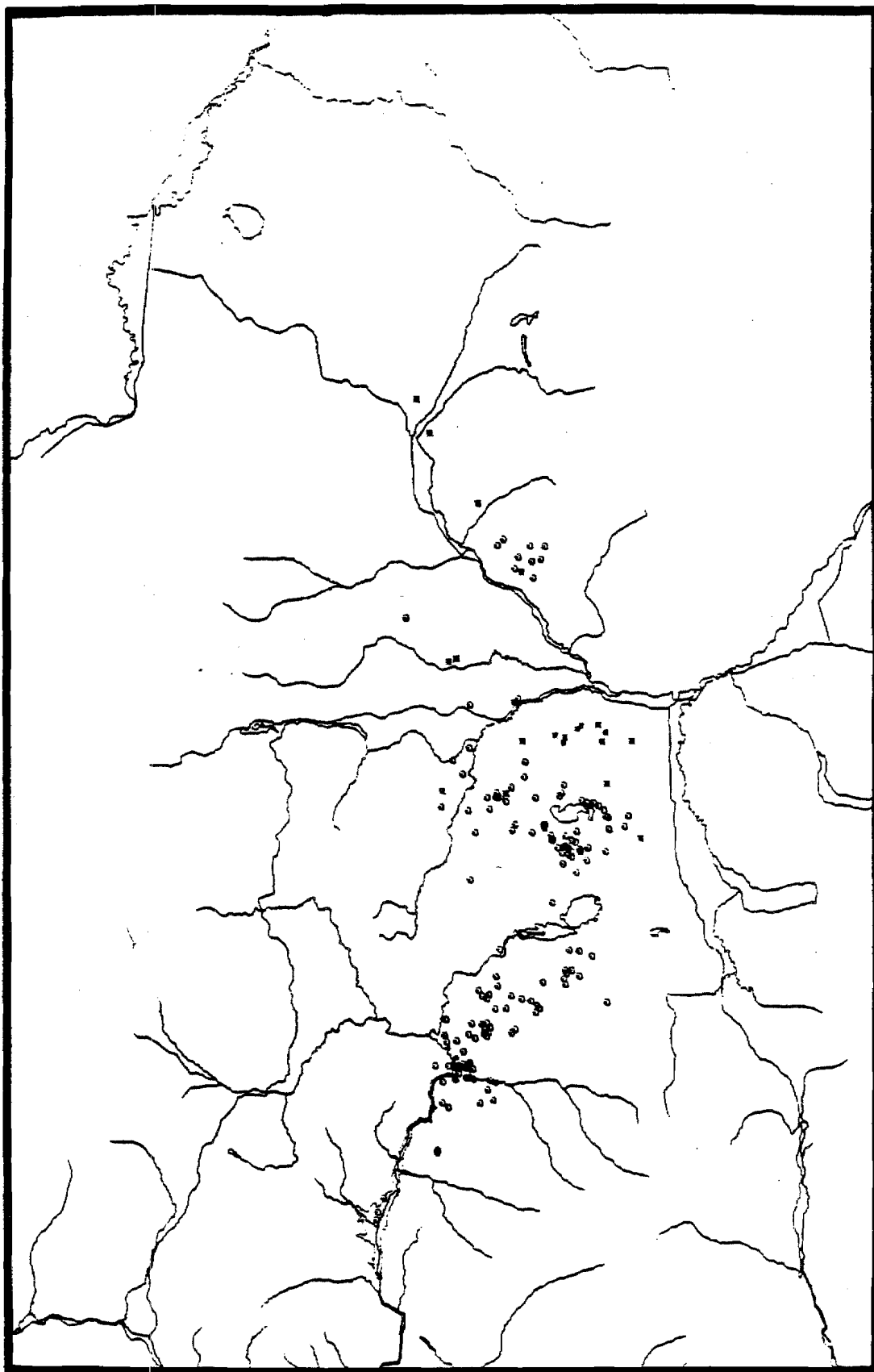


Figure 8. Distribution of Nelchina radio-collared caribou during spring migration, 1 April-14 May, 1983. \circ = female, * = male.

Butte. A few radio-collared females moved through the upper impoundment area, one at least crossing the river twice. Overall it appeared there was less use of the impoundment area than during any of the three previous years (Pitcher 1982, 1983). Most females moved into the Talkeetna Mountain foothills in the vicinity of the Oshetna River and Goose Creek. One radio-collared female which wintered on the north side of the Susitna near Watana Creek crossed the impoundment area in that area enroute to the calving grounds. Historically many caribou made this crossing of the Susitna enroute to the calving grounds after wintering in upper Susitna-Nenana drainages (Skoog 1968).

Calving Period: observations of radio-collared females along with sightings of non-collared caribou during the calving period (15 May - 10 June) indicated that calving took place from the alpine foothills east of Fog and Stephan Lakes east to the Little Oshetna River and Sanona Creek (Fig. 9). Most calving appeared to be centered between the Little Oshetna and Black Rivers. These observations are consistent with those made of calving locations since 1949, the first year for which records are available. While the local areas utilized have varied, calving has taken place between Fog Lakes and the Little Nelchina River. The only deviations have been during years with extremely heavy snow accumulations when some calving took place during migration to the calving grounds (Lentfer 1965, Skoog 1968, Bos 1973).

Summer: the female-calf segment of the Nelchina herd spent the summer period (11 June - 31 July) in the northern and eastern Talkeetna Mountains from Horn Mountains to the hills west of Tsis Creek. Radio-collared bull caribou were found in widespread locations throughout higher elevations of the Nelchina Basin. Summer distribution has been similar throughout the four years of the study (Fig. 10).

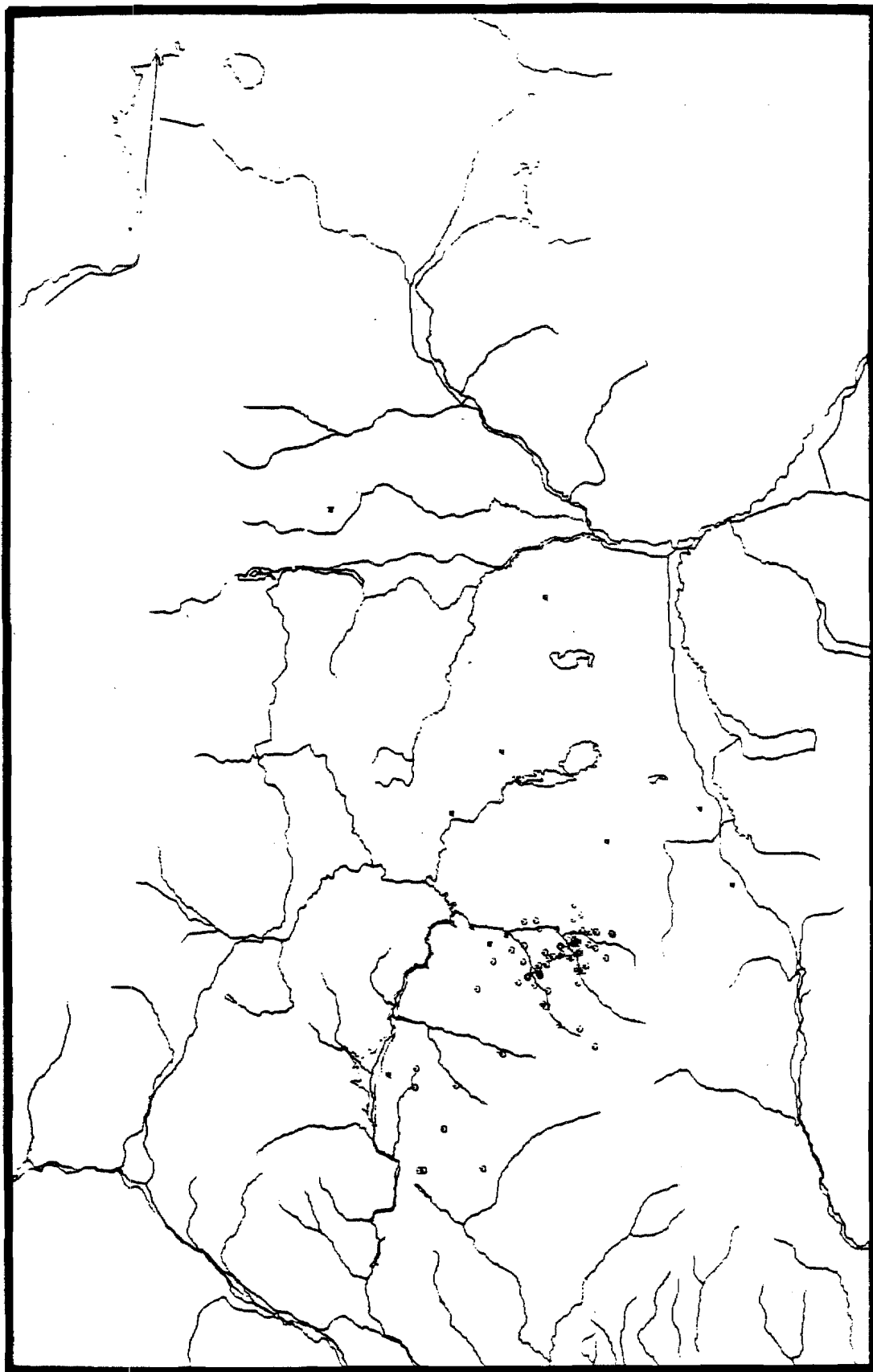


Figure 9. Distribution of Nelchina radio-collared caribou during calving. 15 May-10 June, 1983. ○ = female, * = male.

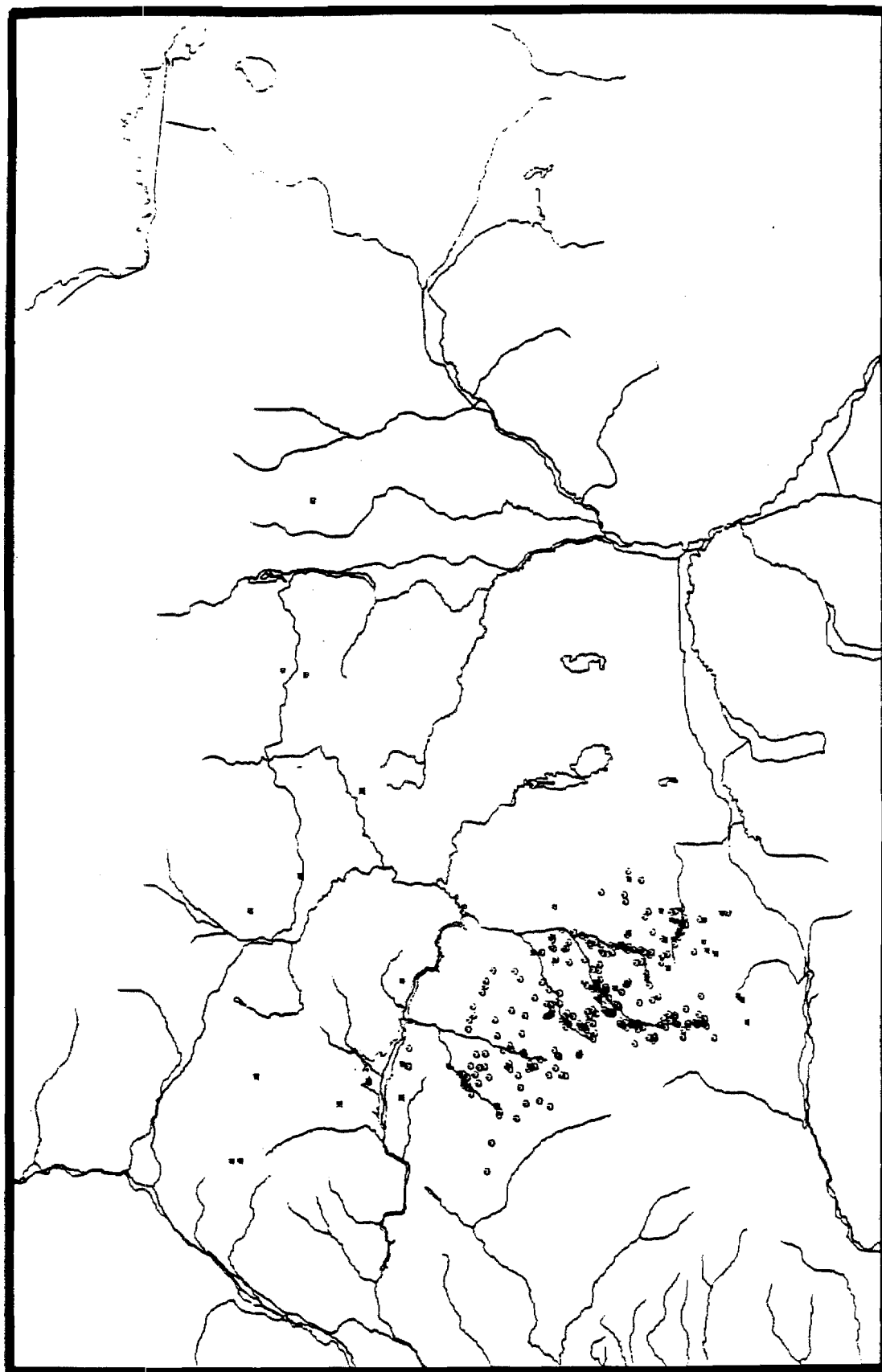


Figure 10. Distribution of Nelchina radio-collared caribou during summer, 11 June-31 July, 1980-1983. \circ = female, \ast = male.

Autumn: dispersal of both sexes from summer range during this period was apparent (1 August - 30 September) from examination of relocation records of radio-collared caribou (Fig. 11). Most movements were from summer range in the Talkeetna Mountains onto the Lake Louise Flat. Several animals crossed the Susitna River in the Watana impoundment area moving north onto the Jay Creek - Coal Creek plateau or into the Brushkana Creek area. While a small portion of the herd crossed the impoundment area during this time most moved onto the Lake Louise Flat to the east.

Rut: during a 3 October 1983 radio-tracking survey nearly all radio-collared animals were relocated between Hogan Hill and Boulder Creek on the lower slopes of Mount Sanford (Fig. 12). The largest concentration of caribou was between Sinona Creek and Indian Creek. This was the farthest east the herd has been during this period since the study began in 1980. During the entire study period rutting caribou have been found from the Talkeetna Mountains east to Boulder Creek (Fig. 13). Historically Nelchina caribou have rutted in a wide variety of locations with the eastern Talkeetna Mountains and Lake Louise Flat being most extensively used. The Deadman - Butte Lakes area was also extensively used during the years when major segments of the herd summered or wintered in the area.

Current distribution: year around use of the Nelchina range by radio-collared caribou from the main herd during the entire study period is shown in Figure 14 and encompassed an area of about 14, 150 mi². The northeastern Talkeetna Mountains, calving and summer range; and the Lake Louise Flat, winter range were the most intensively used regions. The northwestern portion of the range including drainages of the upper Chulitna, Nenana and Susitna Rivers received minimal use during the study period while historically it was important summer and winter range. The 1982-83 winter movement of caribou northeast of the Mentasta Mountains has only rarely occurred. In 1982-83 Nelchina caribou also wintered in the Nabesna Road area and along the western

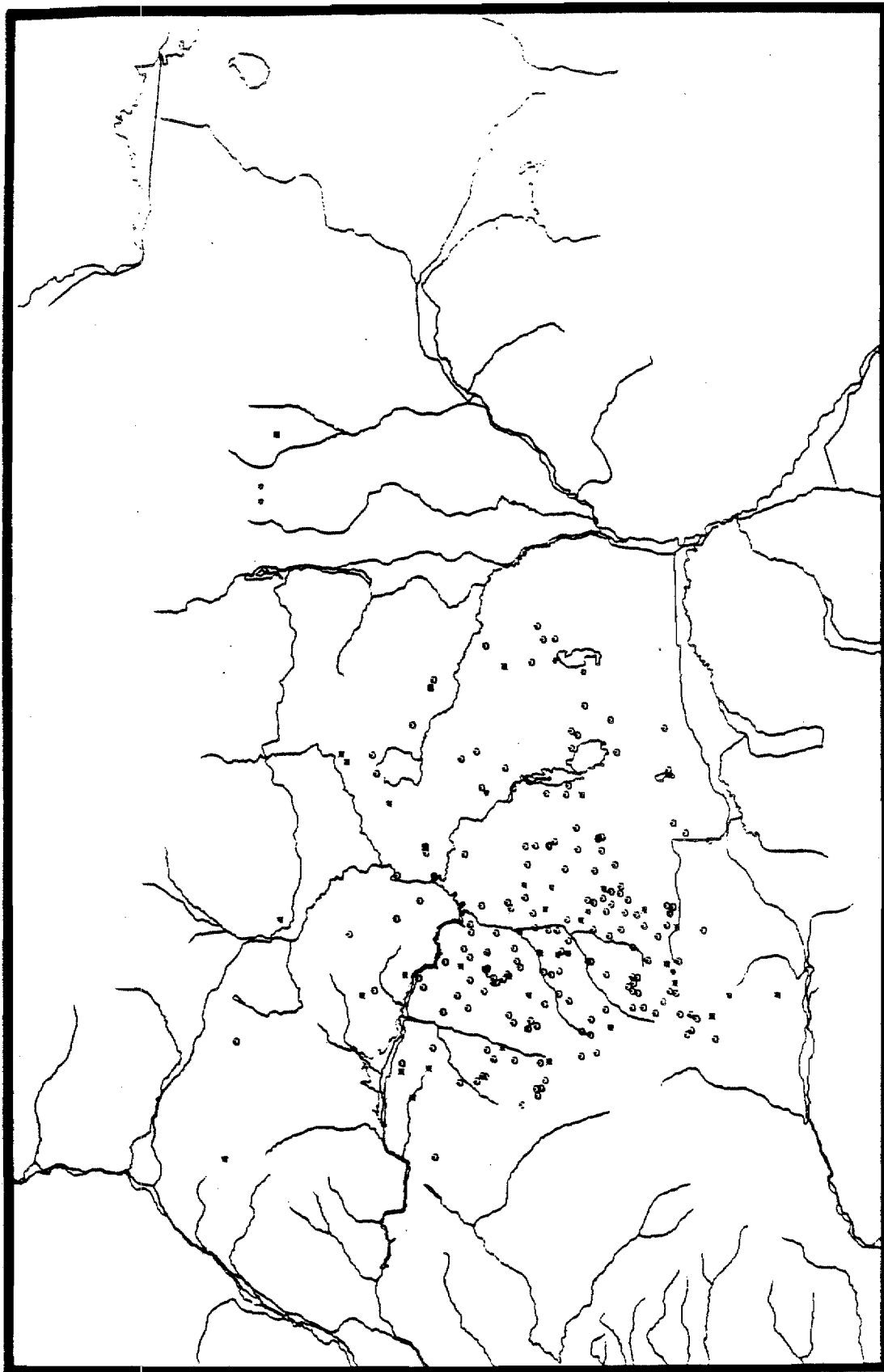


Figure 11. Distribution of Nelchina radio-collared caribou during autumn, 1 August-30 September, 1980-1983. O = female, * = male.

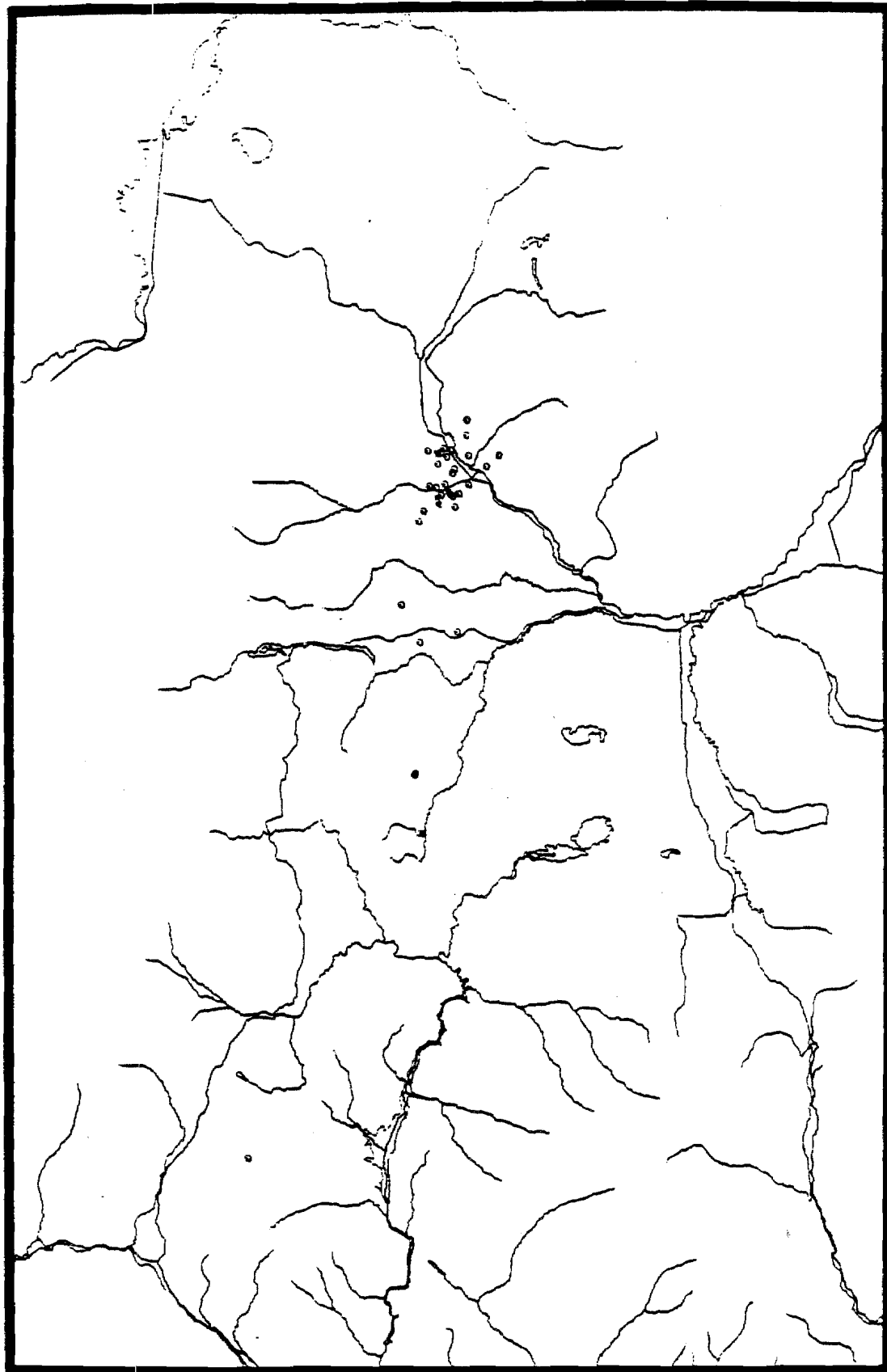


Figure 12. Distribution of Nelchina radio-collared caribou during the rut, 3 October, 1983. ○ = female, * = male.

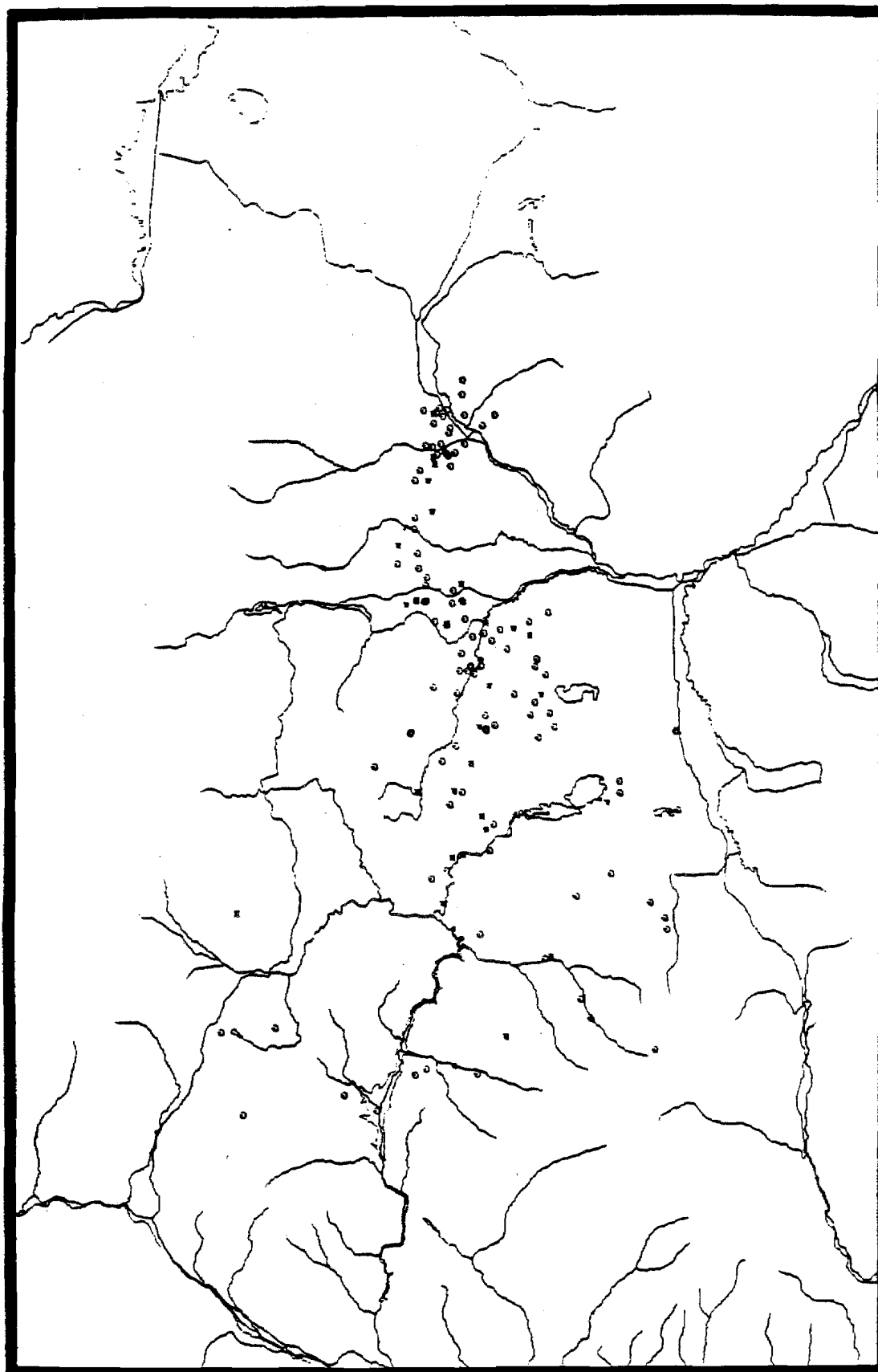


Figure 13. Distribution of Netchina radio-collared caribou during the rut, October 1980-1983. O = female, * = male.

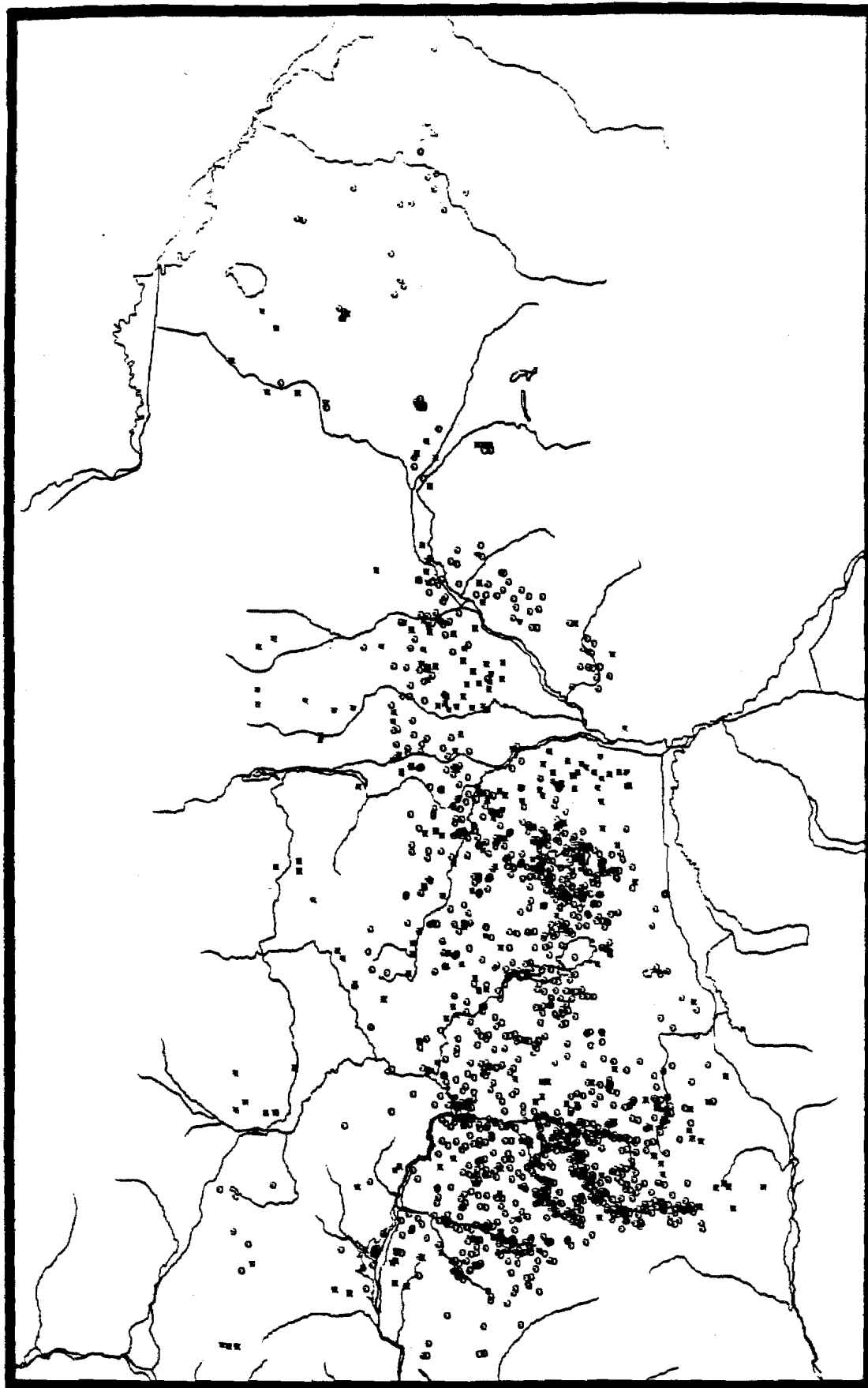


Figure 14. Distribution of main Nelchina radio-collared caribou during entire study period, 14 April, 1980-5 October, 1983.
 ○ = female, * = male.

slopes of Mount Sanford a common occurrence between 1960 and 1980.

POPULATION SIZE AND COMPOSITION: MAIN NELCHINA HERD

A reconnaissance flight on 25 June 83 indicated that the female-calf segment was aggregated sufficiently for counting. All 36 radio-collared females from the main Nelchina herd were located (Fig. 15) between Caribou Creek and Tsisik Creek. A total of 22,536 caribou were counted. Composition sampling from four count areas (Area 1 = Caribou Creek; Area 2 = Oshetna and Black Rivers; Area 3 = Kosina Creek; Area 4 = Tsisik Creek) indicated significant differences ($\chi^2 = 463.9$, $P < 0.001$) in the proportions of females, males and calves. Therefore composition data were weighted as sampling was not strictly proportional to the numbers in each subarea (Table 1).

Table 1. Sex and age composition of the post-calving aggregation of the Nelchina caribou herd; 27, 28 June 1983.

Area	Bulls per 100 cows ≥1 year	Calves per 100 cows ≥1 year	Calves		Cows ≥1 Year		Bulls ≥1 Year	
			N	%	N	%	N	%
1	127.9	33.8	46	12.9	136	38.2	174	48.9
2	8.8	48.1	452	30.6	940	63.7	83	5.6
3	19.1	40.7	164	25.5	403	62.6	77	12.0
4	26.5	30.8	298	19.6	969	63.6	257	16.9
weighted	26.8	38.6		23.3		60.4		16.2

Fall composition sampling, thought to be representative of herd composition, was conducted on 4 October between Hogan Hill and the Copper River northeast of Chistochina (Table 2). The ratio of males ≥1 year per 100 females ≥1 year (61) has not varied

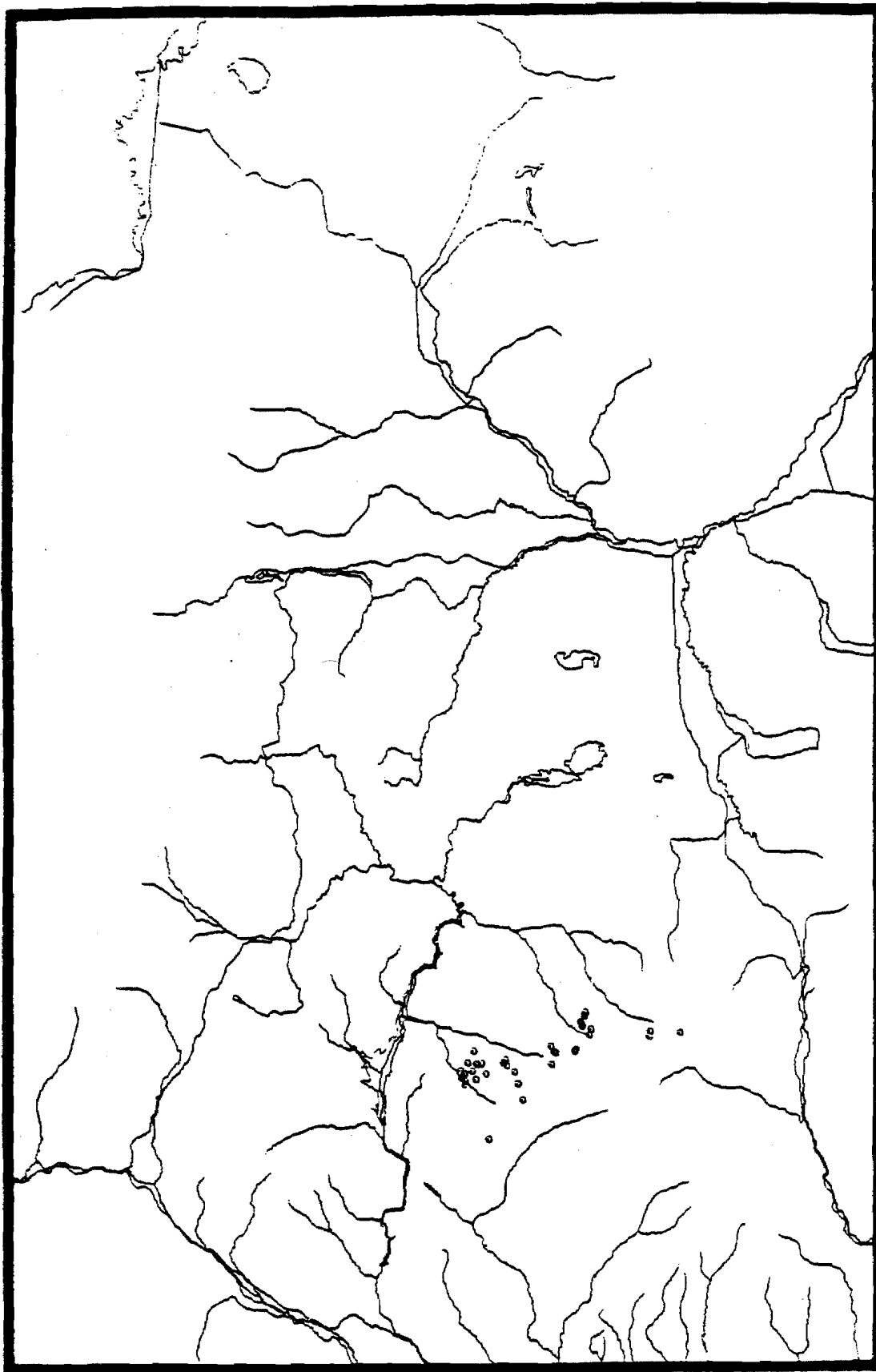


Figure 15. Distribution of Nelchina female radio-collared caribou during the census, 26 June, 1983.

significantly over the past four years ($x = 60$, range 55-62; $x^2 = 1.18$, $P 0.50$). The ratio of calves per 100 females ≥ 1 year (27) has varied considerably over the past four years ($x^2 = 37.8$, $P 0.001$) ranging from 27 to 54; $x = 42$. The calf ratios for the past two years approach the highest and lowest values ever recorded for this herd. The low 1983 calf ratio can, in part, be explained by the large number of non-reproductive yearling cows in the herd resulting from the very large 1982 calf crop.

Table 2. Fall sex and age composition data Nelchina caribou herd; 4 October 1983.

MM per 100 FF /1 year	Calves per 100 FF /1 year	Calves		Cows ≥ 1 Year		Bulls ≥ 1 Year	
		N	%	N	%	N	%
60.9	27.1	191	14.4	705	53.2	429	32.4

The 1983 fall herd estimate was 24,825 calculated as follows: $(22,536 \times 0.604) - 400 \times (1 + 0.879)$ where 22,536 = the number of caribou counted in the post-calving aggregation, 0.604 = the proportion of females in the post-calving aggregation, 400 = a preliminary estimate of hunter harvest of females and a 1% estimate for natural mortality of females between the time of the census and fall composition sampling and 0.879 = ratio of bulls and calves to cows in the fall composition counts.

During the past three decades the Nelchina herd has experienced a growth phase, 1950-60; a peak 1961-1965; a decline 1966-1973; and then another growth phase, 1974-1983 (Table 3). The census technique currently used to estimate herd size has not always produced precise estimates. Errors in enumerating animals and in estimating herd composition can result in either overestimates or underestimates. Examination of consecutive annual herd estimates (1976-77, 1977-78 and 1982-83) indicate rates of herd growth unlikely to occur without immigration (Table 3). However general

population trends and magnitude of herd size are apparent when a series of estimates are available. The observed exponential rate of increase (r) for the Nelchina herd between 1977 and 1983 was 0.08(9%). During this period an additional 3-4% of the herd was harvested annually.

Table 3. Nelchina caribou herd population estimates, in fall unless otherwise noted.

Year	Total Estimate	Female Estimate	Male Estimate	Calf Estimate
1955	40,000 ^{1/}	-	-	-
1962	71,000 ^{2/}	-	-	-
1967	61,000 ^{3/}	-	-	-
1972	7,842	4,800	1,622	1,420
1973	7,693	4,646	1,268	1,779
1976	8,081	4,979	1,663	1,439
1977	13,936	7,509	2,868	3,559
1978	18,981	9,866	4,429	4,686
1980	18,713	9,164	5,673	3,876
1981	20,694	10,154	6,184	4,356
1982	21,356	10,199	5,650	5,507
1983	24,825 ^{4/}	13,207	8,043	3,575

^{1/} Watson and Scott (1956), February census.

^{2/} Siniff and Skoog (1974), February census, perhaps should be adjusted downward by as many as 5,000 caribou due to presence of Mentasta herd.

^{3/} Felt by some to be an unreasonably high estimate.

^{4/} Preliminary estimate, awaiting final female harvest data.

MORTALITY

Natural mortality: eight radio-collared caribou, six females and two males, died of apparent natural causes between 1 October 1982 and 30 September 1983. Although collars were not monitored frequently enough to precisely determine cause of death it appeared that probably at least seven were killed by predators and of these at least four by wolves.

Estimates of x annual survival rates for the entire study period (1 July 1980 - 30 September 1983) were 0.87 (0.91 - 0.81, 80% conf. inter.) for females, 0.85 (0.95 - 0.71, 80% conf. inter.) for males, and 0.87 (0.91 - 0.81, 80% conf. inter.) sexes combined. These estimates were based on the number of observed natural mortalities of radio-collared caribou and number of animal months monitored (Trent and Rongstad 1974).

Calf survival from birth to about 10.5 months of age (20 May 1982 to 11 April 1983) was estimated from a theoretical birth rate of 0.66 calves per cow ≥ 1 year, an observed ratio of 0.41 calves per cow ≥ 1 year in April and estimated survival of females of 0.87 between 20 May and 6 April (Fuller and Keith 1981). Estimated calf survival was $(0.41 \times 0.87) = 0.54$.

0.66

Hunting mortality: the reported sport and subsistence hunter kill of caribou from the Nelchina herd in regulatory year 1982-83 was 861 animals; 702 males, 111 females and 48 for which the sex was not specified. The figures do not include illegal or non-reported kills nor are they adjusted for crippling loss. Preliminary returns for the 1982-83 season indicate a similar harvest probably about 900 caribou.

The estimate of annual adult survivorship appears to be low considering calf survival, hunting mortality and observed herd growth. These population parameters describe a herd which is growing at a rate of about 2% annually rather than the observed rate of 9% ($r = 0.08$) during recent years. Consideration must be given to the possibility that radio-collared animals are more susceptible to natural mortality than the population at large thereby inflating mortality estimates made from monitoring radio-collared animals.

UPPER SUSITNA-NENANA SUBHERD

In the 1982 Annual Report I estimated the size of this local group of caribou at about 2,500 animals based on an actual count of 2,077 made during the rut. During the time the count was being made two radio collars were placed on adult female caribou within the count area. One of these subsequently joined the main Nelchina herd and migrated to the Talkeetna Mountains calving grounds in the spring. In the fall of 1983 she again migrated through the range of the upper Susitna-Nenana subherd. Thus it appears that she was actually a main herd animal which migrated through the range of the upper Susitna-Nenana subherd at least during two years. It is likely that other main herd animals also follow this pattern (another animal collared in 1980 showed a similar pattern until killed by wolves) therefore my estimate of 2,500 caribou was probably high. Adequate data are not available to estimate herd size however it probably ranges between 1,000 and 2,000 animals and in lieu of a better estimate 1,500 caribou will be used.

Calving by females of this subherd has been dispersed over a wide area (Fig. 16); primarily in the headwaters of the Susitna River, the Butte Lake area, Brushkana and Deadman Creek drainages and the Chulitna Mountains. This was in contrast to the main Nelchina herd where females formed a relatively cohesive group and gave birth to their calves in a restricted geographic area (Fig. 9). Summer range was similar to calving range (Fig. 17) although animals were often found at higher elevations. The primary wintering areas were the Butte Lake - Brushkana Creek area, Monahan Flat and along the Susitna River north of the Denali Highway (Fig. 18). Several hundred caribou wintered in the Chulitna Mountains, particularly the northern slopes. Five of 10 radio-collared caribou from the upper Susitna-Nenana subherd migrated between summer range in the Chulitna Mountains and winter range to the east (thereby crossing the proposed Denali access route). Therefore probably about 750 upper Susitna-Nenana

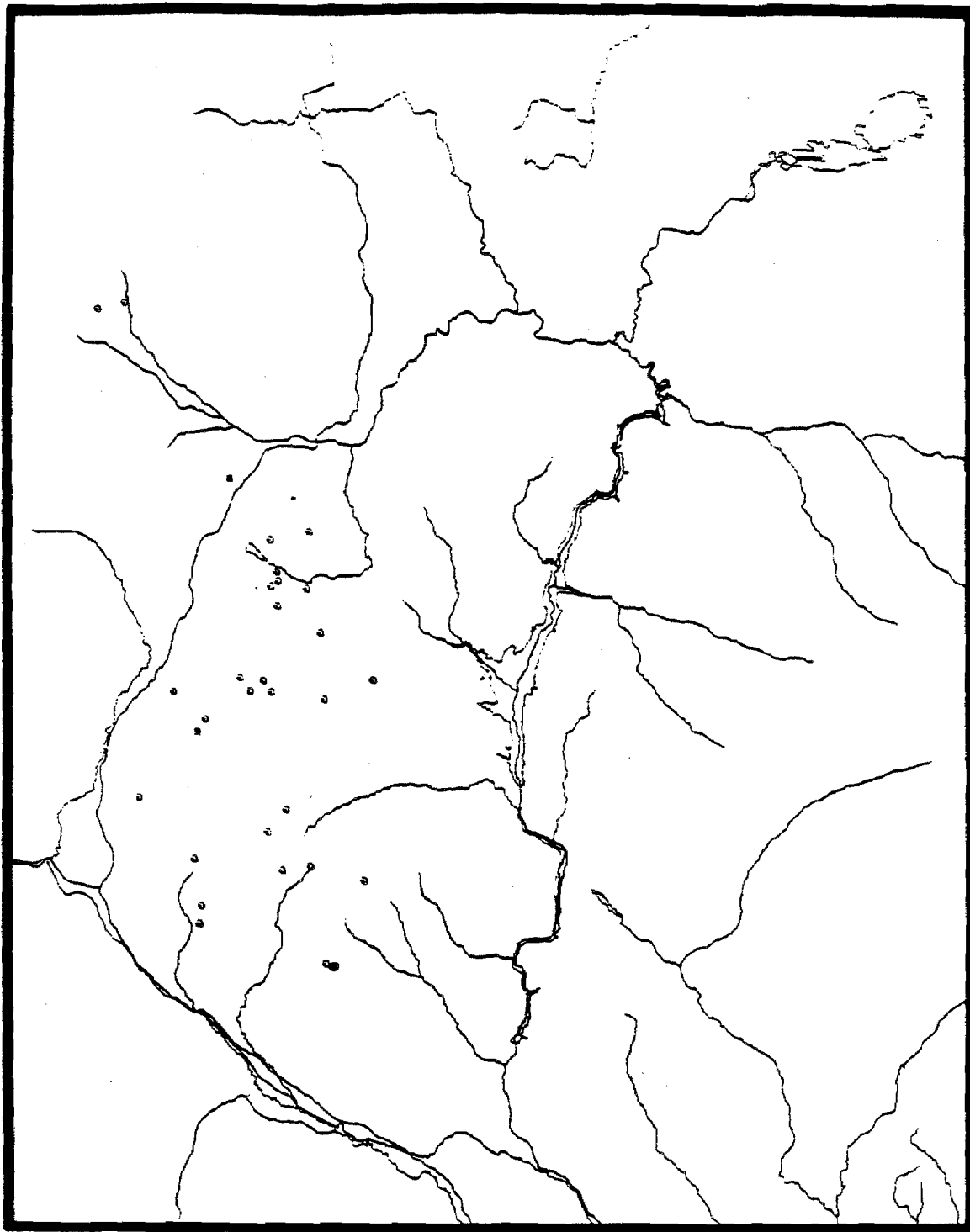


Figure 16. Distribution of Upper Susitna-Nenana radio-collared caribou during calving, 15 May-10 June, 1980-1983. ○ = female, * = male.

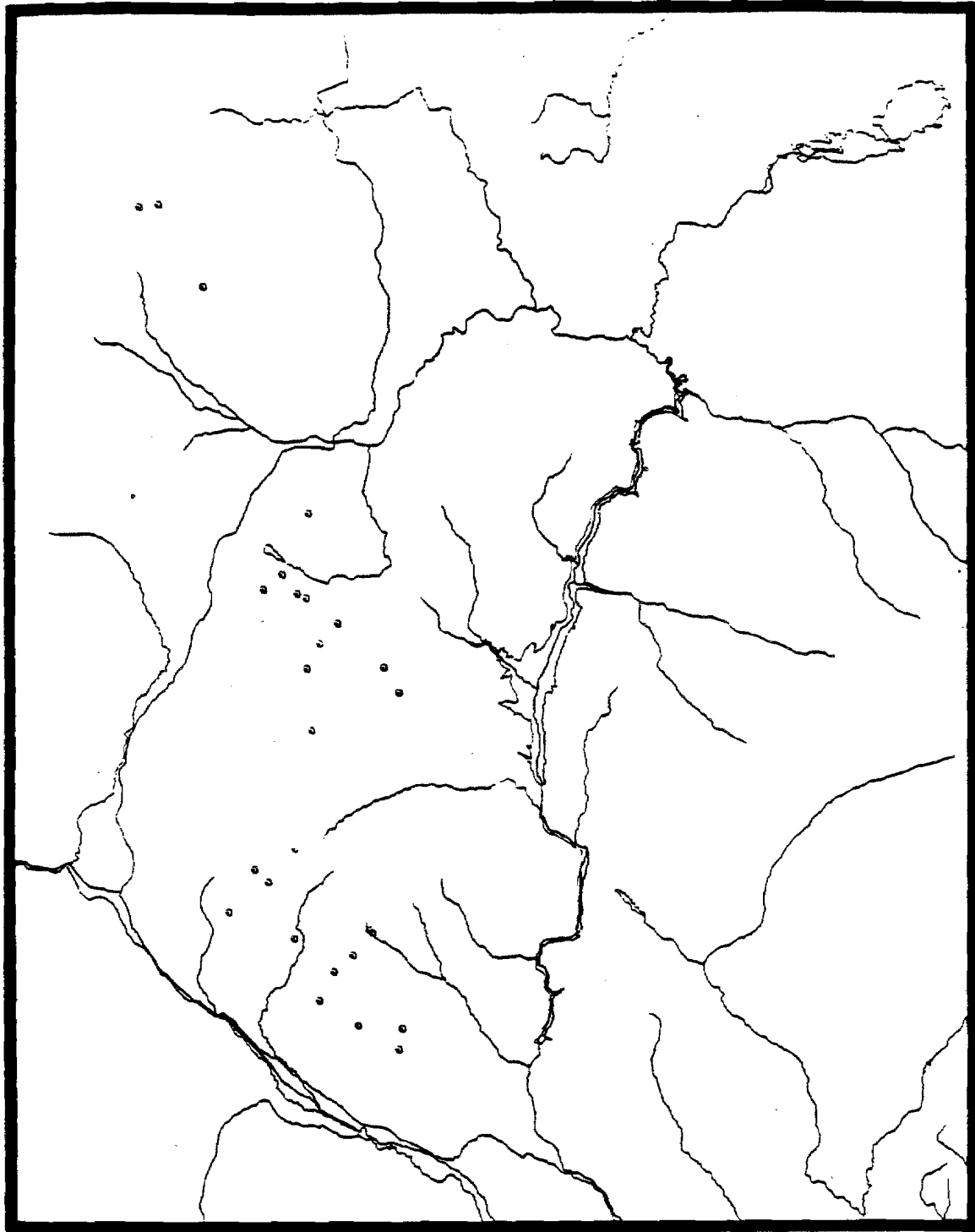


Figure 17. Distribution of Upper Susitna-Nenana female radio-collared caribou during summer, 11 June-31 July, 1980-1983.

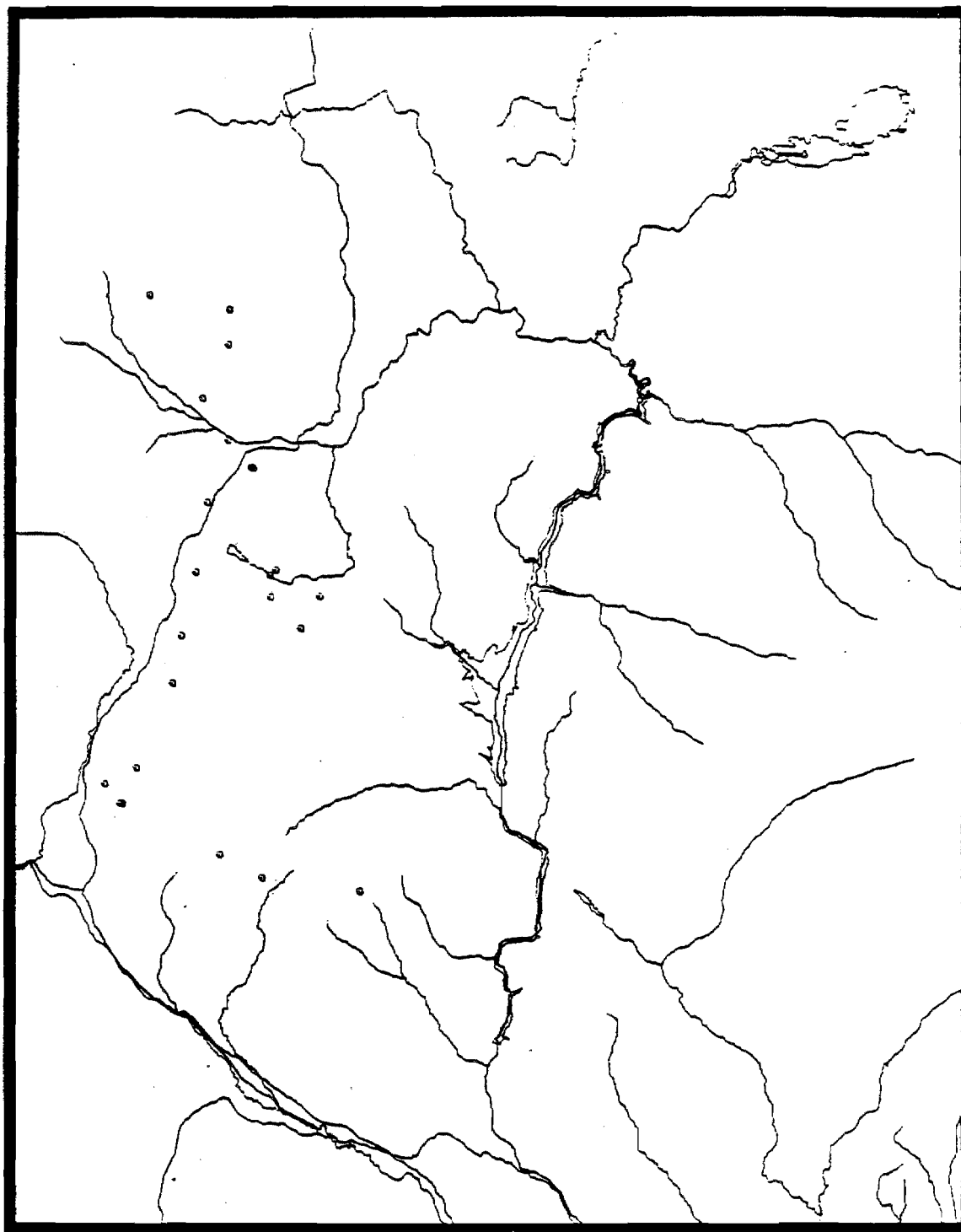


Figure 18. Distribution of Upper Susitna-Nenana female radio-collared caribou during winter, 1 December-31 March, 1980-1983.

caribou spend the summer in the Chulitna Mountains plus an unknown number of bulls from the main Nelchina herd.

Radio-collared caribou from the upper Susitna-Nenana subherd were found in an area covering about 1,536 mi² (Fig. 19).

POTENTIAL IMPACTS OF PROJECT CONSTRUCTION

Migratory barriers: both the proposed impoundments and associated transportation corridors are potential barriers to the free migration of Nelchina caribou between components of their range. The Devil Canyon impoundment and transportation routes to the west linking with the Parks Highway or the Alaska Railroad do not appear to be of serious concern as neither currently nor historically have many caribou occurred in this region. In contrast the Watana impoundment area was crossed regularly by the entire female-calf segment of the Nelchina herd during many years between 1950 and 1973 moving from the calving grounds to summer range north of the Susitna River (Skoog 1968, Hemming 1971, Bos 1974). This movement sometimes occurred in June after calving but more commonly took place in late July (Skoog 1968). Hemming (1971) stated that most crossings of the Susitna in the proposed impoundment area occurred between Deadman Creek and the big bend of the Susitna. Varying proportions of the herd have also wintered north of the impoundment area in drainages of the upper Susitna, Nenana and Chulitna Rivers in many years. Between 1957 and 1964 this was the major wintering area (Hemming 1971). Spring migration to the calving grounds crossed the impoundment area primarily between Deadman Creek and Jay Creek.

Massive movements of caribou across the proposed Watana impoundment have not occurred during the study period, nor have they been recorded since about 1976 (S. Eide, pers. commun.). Based on repetitive relocations of radio-collared caribou during this study it seemed that low to moderate level movements through the upper Watana impoundment area occurred during spring migration

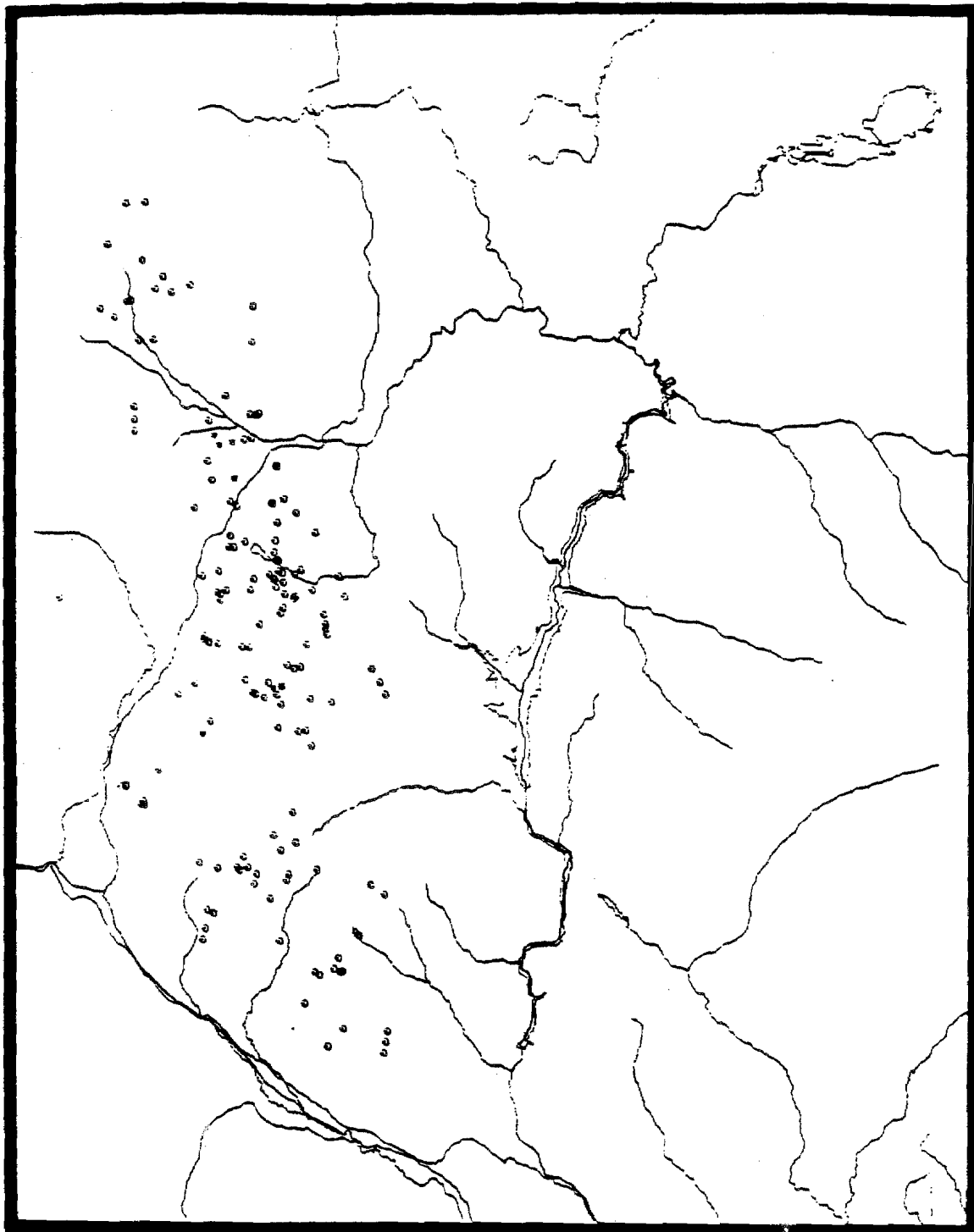


Figure 19. Distribution of Upper Sustina-Nenana radio-collared caribou during entire study period, 9 May, 1980-5 October, 1983. \circ = female, $*$ = male.

from the Lake Louise Flat to the Talkeetna Mountains. The main area utilized was the big bend of the Susitna near the confluence of the Oshetna River although some crossings took place downriver near the mouth of Watana Creek. During spring 1981 it appeared both from relocations of radio-collared animals and sightings of tracks and animals that many animals were using the frozen Susitna River as a travel route. They apparently traveled on the Susitna from the Tyone and Oshetna Rivers to Kosina Creek and Watana Lake where they moved west into the Talkeetna Mountains. During autumn dispersal about 10% of the herd has annually passed through the Watana impoundment area as they moved out of summer range in the Talkeetna Mountains. In mid-October 1982 perhaps 10% of the herd crossed the Susitna (south to north) in the area of Watana Creek. It is quite clear that the proposed Watana impoundment intersects a major migratory route which was intensively used in the past and currently receives low to moderate use. It is expected that one day Nelchina caribou will again use summer and winter ranges north of the impoundment area and therefore will again resume massive crossings of the proposed Watana impoundment area.

The proposed Denali access road from the Denali Highway to the Watana dam site neatly bisects summer and winter range for up to 50% of the upper Susitna-Nenana subherd. Relocations of radio-collared caribou indicate that the Chulitna Mountains are important calving and summer range and that most animals which summer in the area move to the east for the winter. Thus perhaps up to half of this subherd would be exposed to problems associated with road crossings in a treeless area twice a year. Some calving occurs in the vicinity of the proposed access road. However because calving females from this subherd do not congregate on a discrete calving ground but rather calve while dispersed over a large area it is probably impossible to route the Denali access road to completely avoid calving females. Conversely only a

small amount of calving would occur wherever the road is constructed. Resumption of use of summer and winter range north of the proposed impoundments would put the main Nelchina herd in contact with the Denali access road and would require crossings in order to reach and return from summer range in the Chulitna Mountains.

Studies and observations on the reactions of caribou to highways and vehicles are somewhat contradictory although most biologists agree that highways particularly those in open terrain with heavy vehicular traffic inhibit to some degree the free movement of caribou (Cameron *et al.* 1979, Horejsi 1981, Klein 1971). Severity of impacts of roads and traffic on caribou are unknown but undoubtedly vary depending on the local situation. Nelchina caribou continue to cross the Richardson Highway often in large numbers, and have done so during many years since about 1960 (Hemming 1971). The area where the Richardson crossings take place is timbered in contrast to the open tundra and shrublands of the proposed Denali access route. Nelchina caribou also cross the Glenn Highway (primarily the Tok-Cutoff), Denali Highway, Lake Louise Road and Nabesna Road on occasion. The Glenn Highway and Nabesna Road are crossed twice yearly during those years (perhaps half of recent years) when the Nelchina herd winters in the Wrangell Mountains-Mentasta Mountains area. Small numbers of caribou, primarily bulls, cross the Glenn Highway west of Glennallen during winter and spring each year. Most years small numbers of caribou cross the Lake Louise Road during the autumn dispersal period.

Direct Mortality: attempted movements of caribou across the Watana impoundment could result in increased mortality. Spring migration from winter range to the calving grounds in the Talkeetna Mountain foothills would occur from late April to mid-May.

This would be a period of transition from an ice covered reservoir at maximum drawdown with probable ice shelving and ice covered shores to an open reservoir filling from spring run off. Post-calving movements from the calving grounds to summer range north of the Susitna would occur in late June or July at which time the impoundment would be ice free and nearing maximum water level. Additional movements from August into October would likely occur but would probably involve smaller, dispersed groups of animals. At this time the impoundment would be at maximum water level and ice free.

Spring migration appears to hold the greatest potential for increased mortality. Pregnant females are in the poorest condition of the annual cycle at this time (Skoog 1968) and migratory barriers which normally would be easily circumvented could become significant mortality factors. Ice covered shores, ice sheets and steep ice shelves formed by winter drawdown of the reservoir could present hazardous obstacles to movement (Hanscom and Osterkamp 1980). Skoog (1968) mentioned several instances of injuries and death resulting from falls on or through ice. Both Klein (1971) and Vilmo (1975) mention ice shelving as a mortality factor of reindeer on reservoirs in Scandanavia.

Crossings during summer and fall when the reservoir would be ice free appear to pose considerably less hazard. Caribou are excellent swimmers and are known to cross much larger bodies of water than the proposed impoundment (Skoog 1968). Young calves might have problems with this distance if migrations occurred shortly after calving. Water crossings have been reported as mortality factors but usually involved rivers rather than more placid bodies of water such as a reservoir (Skoog 1968). Banfield and Jakimchuk (1980) suggested that open water posed a barrier, particularly during post-calving movements and mid-summer migration. Large lakes are often crossed at traditional sites, often

narrow points or where islands provide interim stopping points. They state "caribou prefer to avoid open water." Rafts of floating debris could cause problems for the first few years after filling the impoundment. Mortalities of moose which could not reach shore because of floating debris have been reported in reservoirs in Canada (W. Ballard, pers. commun.).

Some mortality of caribou from collisions with vehicles along the Denali access road may occur, although caribou-vehicle collisions at other highway crossings are infrequent. Number of mortalities will probably depend on the presence or absence of the main Nelchina herd in the area. Wolf predation may increase as wolves have been found to use roads to their advantage when hunting caribou (Robey 1978).

Loss of Habitat: this is not a serious problem as the proposed developments (impoundments, access corridors, borrow pits and settlements) are a small portion of total caribou habitat in the Nelchina range and are generally of poor quality.

Increased Human Access: project development would likely increase human access to the Nelchina herd calving grounds and summer range in the Talkeetna Mountains. The calving grounds are currently in one of the most remote and inaccessible regions within the Nelchina range. Increased human activity and development would likely occur which have been shown to adversely impact caribou use of calving areas. Cameron et al. (1977) documented abandonment of a portion of the calving grounds of the central Arctic herd concurrent with development of the Prudhoe Bay oil fields.

The Denali access road would also increase access to important caribou habitat which is currently used primarily by the upper Susitna-Nenana subherd. The area has in the past and probably

will again be an important summer and winter use area of the Nelchina herd.

Concern has been expressed that increased hunter access provided by project development could result in excessive hunter harvest. Alaska Department of Fish and Game regulatory procedures should be adequate to prevent this from happening. Illegal kills could increase with additional access.

Reduced Condition: should migratory barriers cause extended or more difficult migrations, particularly during spring migration to the calving grounds when pregnant females are in the poorest condition of their annual cycle (Skoog 1968), the population dynamics of the herd could be impacted. Mortality rates of adult animals could be increased while viability of newborn calves could be decreased.

Increased human activity particularly in the form of aircraft and vehicular traffic could result in chronic, higher levels of disturbance causing lowered physical condition. Several studies (Miller and Gunn 1979, Calef *et al.* 1976) have recorded responses of caribou to aircraft disturbance and speculated on deleterious impacts. Cows and calves were most responsive to disturbance (Miller and Gunn 1979). Caribou show the greatest sensitivity during the rut and calving (Calef *et al.* 1976).

Cumulative Impacts: perhaps the major impact of the Susitna hydroelectric development on the Nelchina caribou herd will be a contribution towards gradual, long term cumulative habitat degradation rather than immediate, severe impacts. The proposed hydroelectric project is only one (although the major one) of a number of developments which may occur on the Nelchina range. Considerable mining activity already is taking place in the southeastern Talkeetna Mountains, traditional summer range. A

state oil and gas lease sale is planned for the Lake Louise Flat, a major wintering area. The Bureau of Land Management is planning to open much of the Nelchina Basin to oil exploration.

Considerable land is passing from public to private ownership through the Alaska Native Claims Settlement Act and through state land disposal programs. While no single action may have a catastrophic impact it seems likely that long-term cumulative impacts will result in a lessened ability for the Nelchina range to support large numbers of caribou. Habitat destruction, increased access and human activity, disturbance, and barriers to free movement will all probably contribute to this.

RECOMMENDATIONS FOR CONTINUING STUDIES

Herd population status should be monitored with annual censuses and sex and age composition sampling. Range use and migration routes, particularly in the general area of the proposed developments, should be documented by maintaining and monitoring a pool of radio-collared caribou from the main Nelchina herd. Up to 10 radio-collared caribou should be monitored in the upper Susitna-Nenana subherd to document range use and seasonal movements, particularly in the area of the proposed access road and proposed impoundments and associated developments. Another census of the upper Susitna-Nenana subherd should be attempted in order to generate a more reliable estimate of population size.

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PERSONAL COMMUNICATION

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