PRE-AUTHORIZATION ASSESSMENT

OF THE

SUSITNA RIVER HYDROELECTRIC PROJECTS:

A LIMITED WILDLIFE STUDY

GAME DIVISION SECTION

BY

CARL MCILROY

GAME BIOLOGIST

AND

TED SPRAKER

GAME BIOLOGIST

ALASKA DEPARTMENT OF FISH AND GAME

GAME DIVISION

ANCHORAGE

TABLE OF CONTENTS

UPPER SUSITNA RIVER WILDLIFE STUDIES

by: Carl McIlroy
Game Biologist III
Alaska Department of Fish and Game

INTRODUCTION

Reconsideration of portions of the Susitna River as a source of hydroelectric power has necessitated a reevaluation of the effects of a dam or dams on the area's indigenous and transient wildlife. Former studies included an evaluation of the monetary values of the Susitna basin based strictly on estimated harvests (Anon. 1954). However, the applicability of those data to the present is limited because of changing harvest patterns and changing calculations placed on an animal's worth. A detailed report on the fish and wildlife resources of the Susitna basin and the impacts of the proposed Devil Canyon and Denali dams on those resources (Anon. 1960) was an excellent evaluation considering the limited information available at that time. This report is intended to supplement the 1960 study by updating inventory and harvest data, by reporting on big game distributions observed during the spring of 1974 and the winter of 1974-75, by reevaluating the main effects on wildlife caused by the proposed Devil Canyon and Watana Dams, and by suggesting mitigating actions and future studies based on the current perspective.

PROCEDURES

Moose distribution surveys during June, 1974 were flown with a PA-18 supercub by ADF&G biologists. The Susitna River above the proposed Devil Canyon Dam up to the Susitna Glaciers and the lower portions of its major tributaries were surveyed (Fig. 1). Flight lines within the surveyed area were approximately one mile apart, representing a survey of moderate intensity. Big game distributions during the winter of 1974-75 were assessed by making five aerial surveys over the Susitna study area at roughly monthly intervals. The Susitna study area for these flights was defined as the Susitna River upstream from Gold Creek and the lower portions of the Susitna River's major tributaries (Fig. 2). Observations of all larger mammals were recorded, and those observation numbers were located on a map. The upper limit of surveys was the highest elevation that moose were found. The initial flight during November was intensive, and moose sex and age composition were obtained along with big game distributions. Complete subareas were searched for moose. Because of poor weather, decreasing daylight, and increasing ratios of ferry time to count time, not all of the study area was surveyed. Subsequent flights, from January through April (Fig. 3-6), were less intensive, and roughly fixed flight patterns were flown with no attempt to search all subareas for moose. The November survey was

flown with PA-18 aircraft, January, February, and part of March flights were made with a Cessna 185, and the remainder of March and April surveys were made with a PA-18.

Moose condition evaluations were made during the April survey. A body fat condition evaluation of each moose observed was made based on a scale of (1) dead - due to natural mortality other than predation, (2) bony - poor coat, slab-sided, hips and ribs obvious, (3) moderately fat - fair coat, moderately rounded, hips and ribs not obvious, and (4) fat - good coat, rounded shape, hips and ribs well-covered. Range use evaluations during April were made to delineate areas of preferred or critical winter range that would be inundated by construction of the Devil Canyon and Watana dams. Classification of each area and boundaries for each area were determined by the relative density of cumulative moose tracks observed from early winter until April 23, 1975. The classification categories were: (1) light use - occasional tracks with little cratering, (2) moderate use - tracks and cratering common but not dense, and (3) heavy use - tracks dense and cratering extensive. The square miles of each range category were determined by overlaying a mileage grid over a map showing the classified areas.

Harvest data were obtained from harvest report returns. Because many hunters do not report where their animal was taken, reported harvests for specific areas are usually less than actual harvests.

RESULTS

Moose Distributions During June, 1974.

A survey of the upper Susitna River and lower portions of major tributaries was flown during June, 1974 to obtain spring moose distributions and to locate any areas with high densities of cows and calves (calving areas). Results of these surveys are shown on Figure 1. A high moose density was observed south of the MacLaren River, but no other areas with high moose densities were observed. Few moose were seen above 3,500 feet.

Moose Wintering Distributions, 1974-75.

Locations of moose observed during November, January, February, March, and April surveys are shown on Figures 2 to 6, respectively. The decrease in moose numbers observed with advancing winter was partly due to less intensive survey procedures and partly due to poorer visibility of moose as they move below timberline. A comparison of these maps shows that, in most cases, moose moved from higher to lower elevations along drainages as winter progressed. For example, moose seen near the Susitna glaciers during November (Fig. 2) apparently moved down to Valdez Creek by January (Fig. 3), and down to Windy Creek by February (Fig. 4). One possible exception to this movement pattern from high to low elevations within a drainage system was noted. The large moose concentration along the "big bend" of the Susitna River observed during

November was not apparent during later surveys. It is possible that these moose crossed the Susitna River to join wintering moose con-concentration along the "big bend" of the Susitna River observed during later surveys. It is possible that these moose crossed the Susitna River to join wintering moose concentrations observed along the Oshetna River and Sanona Creek during late winter. Heavy trailing on and along major drainages was commonly observed. Trails criss-crossed drainages within moose concentration areas, indicating that vegetation along both banks was being utilized.

Moose Abundance and Composition.

Within the Susitna study area as defined for the 1974-75 winter surveys, 2,225 moose were counted during intensive November surveys. However, not all of the drainages were surveyed (Fig. 2). Extrapolations for areas not counted can be made by multiplying the square miles of each unsurveyed area times the moose density that was observed in nearby similar habitat. Based on this procedure, we may have counted 2,826 moose if all of the Susitna study area were surveyed. In the Gulkana drainage system observers saw 40 percent (28 of 70) of the moose that were collared approximately two weeks prior to surveys. Assuming a similar sightability of moose in the Susitna River drainages, 7,065 moose may have been in the Susitna study area. Calculated composition ratios for the Susitna study area were 15 bulls per 100 cows and 26 calves per 100 cows.

Evaluation of Moose Winter Range, Moose Condition, and the Loss of Winter Range by Inundation.

Observations of moose distribution through the winter indicated that several habitat types were successively used as winter progressed. During November surveys (Fig. 2), most moose were at or near timberline or in riparian willow patches above timberline. A previous ground survey (May 31, 1974) of the vegetation near timberline habitat within the big bend of the Susitna River above the mouth of Goose Creek was the basis for the following observations. This slope just below tree line contains black spruce and alder as major tall shrubs and trees, dwarf birch, alder, Salix alaxensis and Salix arbusculoides as important low shrub species, and Ledum sp., Vaccinium vitis-idaea and Carex sp. as the more important ground vegetation. Salix alaxensis , mainly found along small drainages, was severely hedged with many decadent stems. A large percentage of terminal twigs of other willow species were utilized, and some utilization of alder was observed. Small willow shrubs were scattered among the more plentiful black spruce, dwarf birch, and alder away from drainages, and many of these willows had been repeatedly browsed by moose to snowline during previous winters. The usual snowline has apparently been at about 2 feet on flat portions of these slopes, perhaps indicating substantial wind in this area in the winter. Low bush cranberry is plentiful on this slope and is a potential food source. The annual available forage on this slope appears great, but Salix alaxensis has been over-utilized, and other willow species are at

least moderately-to-heavily utilized. Most moose observed below timberline were also near riparian willow habitat.

An increasing concentration of moose along the margins of larger, lower elevation drainages had become apparent by January (Fig. 3). This may have been partially due to increasing snow depths that reduced the availability of lower-growing alpine willows. An increasing use of vegetation growing on the steep slopes along the banks of the Susitna River below Goose Creek was noted during January and February surveys (Fig. 3 and Fig. 4). Many of the willow-supporting islands of the Susitna River were examined, and it was speculated that most of the available browse on these sites had been utilized, forcing the moose to go elsewhere for food.

Ground examination of these river bottom willow-covered sandbars were made during two different periods. A ground examination of a willow bar at the mouth of the Tyone River during May 31, 1974 was the basis for the following observations. We landed initially alongside a willow-covered river bar near the mouth of the Tyone River. Six to ten foot tall balsam poplar with a low density of taller willows dominated the vegetation in the center of the bar. Utilization of these willows was light to moderate. The periphery of the bar consisted of a 2 to 3 foot high moderately dense stand of willows that appeared to be almost evenly cropped (mainly moose cropping, some rabbit clipping) at the presumed snow line. Fred Williams, sport fish biologist conducting the sport fish studies at that time, stated that utilization of willows was also high on the sand bars he has visited. During April, 1975 two willow-covered sandbars on the Susitna River below the MacLaren River were examined and the willow bar near the mouth of the Tyone River was revisited. These willow bars were completely tracked over by moose. Although maximum snow depths had receded by the time of these surveys, it appeared that essentially all of the willow twigs above snowline had been cropped. A moose calf that had starved was lying on the Tyone River sandbar.

By late April, there were relatively few moose or moose tracks crossing the Susitna River below the mouth of the Tyone River. The snow had accumulated to above normal depths in the northern portion of the Susitna study area, and most moose were observed in relatively large concentrations. Moose range was evaluated during April and was placed into light, moderate, or heavy use categories depending on the density of cumulative tracking and cratering (Fig. 6). The contour intervals of areas that would be inundated by the proposed Devil Canyon and Watana Creek dams were superimposed on these moose range maps, and categories of moose range that would be inundated were measured to obtain the following results.

Proposed Dam	Maximum Water Level	Moose Range Category	Area Indundated, Sq. Mi.
Devil Canyon	1450	Light	6.8
		Moderate	5.6
		Heavy	0
Watana	2045	Light	0
		Moderate	20.2
		Heavy	44.0
Combined		Light	6.8
		Moderate	25.8
		Heavy	44.0

Our data indicated that 12.4 mi.^{2} would be inundated by the Devil Canyon Dam (vs 11.8 mi.^{2} calculated by the U.S. Corps of Engineers) and 64.2 mi.^{2} would be inundated by the Watana Dam (vs 67.1 mi.^{2} calculated by the U.S. Corps of Engineers). It is assumed that the differences are due to our necessarily crude methods of measuring areas. It is apparent that the Devil Canyon Dam will have less serious consequences by inundation of moose winter range than the Watana Dam. Examination of Figure 6 shows that any flooding of the Susitna River above Deadman Creek will result in the loss of heavy or moderately-used moose winter range.

Moose body condition was evaluated to compare moose in different drainages and to see how well moose fared during the 1974-75 winter. Samples were too small to compare moose in different drainages, so the pooled results for the upper Susitna study area are shown below.

Area	Condition Rating	Percent (No.) of Moose Adults	Calves
Combined Coal Creek, MacLaren River, and Clearwater Creek.	Dead:	0% (1)	3% (1)
	Bony:	18% (21)	72% (26)
	Moderate:	65% (75)	25% (9)
	Fat:	17% (20)	-- (0)

This information shows that the wintering areas used by adult moose during the 1974-75 winter (with above average snowfall) were adequate to maintain them in a moderately fat condition, but moose calves became food limited. An assessment of moose wintering on the Oshetna River indicated that the adults were moderatly fat but snow was shallower and browse was more available in comparison to the Clearwater Creek - MacLaren River area.

Caribou Distributions and Trails.

Observations of caribou during the winter surveys are shown on Figures 2 to 5. Generally, few caribou wintered in the Susitna study area. Several hundred caribou have been observed on the Susitna River above the Denali Highway and the adjacent higher country between Valdez Creek and the East Fork of the Susitna River during previous November surveys. A total of 255 were seen in this area during November 1974 (Fig. 2) but they were not seen during subsequent monthly surveys. In addition to the caribou groups shown in Figures 2 to 5, tracks of a band of caribou located just south of Devil Canyon during November (Fig. 2) indicated that perhaps 50-100 caribou were in that vicinity.

The observation of well-defined, rutted caribou trails crossing the Susitna River east of Watana Creek (Fig. 2) were of especial interest. These trails were observed on opposite banks of the Susitna River, indicating this is a traditional crossing area. Other trails north of Watana Mountain led to the Susitna River but could not be found on the opposing north bank. A substantial portion of the Nelchina caribou herd (numbering from 8,000 to 60,000 during the last twenty years) usually appears around the Deadman Lake - Butte Lake area during the summers, and it is possible that these animals may frequently use the observed crossing site of the Susitna River. No rutted trails crossing the Susitna River were seen elsewhere during the 1974-75 surveys.

Harvests and Hunting Pressure.

Reported harvests of moose, caribou and sheep and annual numbers of moose hunters are shown in Table 1. Since 1963, an average of 1,315 moose have been harvested annually from Unit 13 by an average of 3,666 hunters. A ratio of moose killed in the Susitna study area to moose killed in the center of Unit 13 was derived from 1974 harvest reports; if that ratio was constant in past harvests, the Susitna study area would have yielded an average of 413 moose annually harvested from the upper Susitna River drainages. Variance in hunter harvest reports over the years does not provide all data needed to fully qualify that figure.

Estimated caribou harvests from Unit 13 based on harvest reports indicate that an average of 5,386 caribou annually have been harvested since 1963. The portion of this kill from the upper Susitna River drainages has probably varied widely over the years, but it may have approximated one-third of the average annual harvest from Unit 13.

The reported harvest from the Watana Hills Dall sheep herd is usually about 3 sheep.

Observations of Other Mammals.

A group of approximately 200 Dall sheep inhabit the range of hills lying east of Watana Creek - Butte Creek and west of Jay Creek - Coal Creek. These sheep are partially isolated from the larger sheep population of the Talkeetna Mountains by low country. Although immigrations and emigrations may occasionally be expected, in most years the Watana Hills sheep herd is probably distinct. A portion of this sheep herd was seen during the April survey (Fig. 6), even though no effort was made during the surveys to fly at the higher elevations where sheep sightings would be expected.

Wolves, wolverines, and foxes were frequently seen distributed throughout the Susitna study area, but observations are not recorded here.

DISCUSSION AND CONCLUSIONS

Surveys to obtain moose distributions have shown moose to generally be at low elevations in the late winter and spring and at higher elevations in the late fall and early winter. The proposed Susitna River dams, therefore, may effect moose in entire drainage systems and not merely those moose seen within or near the areas of inundation.

Those situtaions where many moose have crossed or traveled along river corridors that will be flooded or will have fluctuating water or ice levels are of particular concern. As an example of major river crossings, the available information suggests that most moose seen during early winter within the "big bend" north of the Susitna River cross the Susitna River to join moose wintering on the lower Oshetna River vicinity. These moose may still mostly be south of the Susitna River during June. As another example, the dense moose concentration seen south of the MacLaren River during June may be mainly the same wintering moose concentration that was found during April on Clearwater Creek. Prevention of these seasonal movements may result in a sharp reduction in numbers of the affected moose. Ice shelves created by fluctuating water levels in the winter or deep, wide impoundments may act as complete or partial barriers to movements.

In addition to river crossings as part of seasonal migrations, the criss-crossing of rivers by moose that spend a portion of the winter near rivers is of concern. Tracks indicated that moose use vegetation on both sides of streams, and it seems possible that prevention of moose crossings may lower local carrying capacity by (1) isolating pockets of vegetation where ready access is only via the frozen river and (2) creating localized pockets of browse that are insufficient in quantity to attract and support moose but would have contributed to the support of those moose attracted by additional nearby browse.

Moose generally appeared to successively use different habitat types during the winter. During early winter, most moose were near timberline, but they were found increasingly at lower elevations among riparian browse and along the steep slopes of the Susitna River by midwinter. By late winter, the steep slopes of the Susitna River and mid-elevations along the Susitna River, that had previously supported moose, were infrequently used and more moose were mostly found in larger concentrations in willow patches on the Susitna River's major tributaries. Following snow recession during the spring, most moose were thinly distributed at lower elevations except for a concentration area south of the MacLaren River. While the importance of some areas to moose may be proportional to the extensiveness, quality, and availability of contained browse, some areas may be of importance out of proportion to the contained browse depending on the winter snow accumulation, slope, time of leafing out of browse, or other factors. The relevance of this possibility is suggested by the observed shifting concentrations of moose in various areas of the Susitna River or its major tributaries at different time periods.

Over 7,000 moose may have been within the study area. Natural mortality due to predation is probably high and calf survival over the last decade has been low. The contained moose population may be somewhat below its optimum size.

The Susitna study area below the Denali Highway was not utilized by substantial numbers of wintering caribou. However, a large portion of the Nelchina caribou herd traditionally crosses the Susitna River from its calving area near Kosina Creek to spend the summer in the Deadman Lake - Butte Lake vicinity. A major crossing site on the Susitna River was located just east of Watana Creek. The Susitna River appears to be a formidable obstacle to calf caribou. Changing of conditions at this crossing may or may not prevent the passage of adult caribou, but the effects on calves as they attempt to follow the cows must also be considered. Should modifications of this crossing site make the Susitna River a barrier to caribou passage, the loss of habitat would directly lower the potential maximum population size. Secondarily, a reduction in recreational value of the upper Susitna River would result from the loss of recreational caribou hunting.

The Watana Hills sheep herd lies within the Susitna study area, but these sheep will probably not be directly affected by construction of dams on the Susitna River. Other big game or fur bearer populations would probably be impacted by indirect effects of increased human access and altered numbers of prey species, but these potential impacts were not studied and are presently unknown.

From the standpoint of recreational hunting, the Susitna study area may be one of the most important areas in the state. Harvest data show that the Susitna study area contributes a token sheep harvest but a moderately large moose harvest. Most of the moose harvest from the

Susitna study area is from the Denali Highway - Coal Creek vicinity and from the upper Oshetna River vicinity. Access has rapidly been increasing in recent years, and the central portion of this area will probably contribute to an increasing extent if past access trends continue. The usual contribution of the Susitna study area to the annual caribou harvest was assessed as perhaps one-third of the total. During the past three years, most moose and caribou hunting activity within Unit 13 appeared to be on both the north and south sides of the Susitna study area.

An indirect effect that would probably result from construction of Susitna River dams would be increased access into the center of Game Management Unit 13 through road construction and waterway access. Although this has both positive and negative implications to wildlife, the negative aspects predominate. A major increase in access would probably require more intensive management activities with a resulting increase in wildlife management costs. A highway corridor alongside the Susitna River may increase the potential barrier to caribou movements. In addition, any increased human activity near the Nelchina caribou's calving grounds is undesirable.

In summary, moose and caribou are the key wildlife assets of the upper Susitna River, and the major effect of dams on these ungulates is negative. Moose may be impacted by blockage of seasonal movements across or along river corridors due to fluctuating ice levels or deep water impoundments and by direct loss of critical winter range through flooding. Caribou movements may be similarly impacted by impounded water or fluctuating ice levels, and the Nelchina caribou calving area will probably be exposed to more human activity secondary to better access and dam construction activities. Wildlife management costs will necessarily increase, and the overall effect of these dams will be to decrease numbers of moose and caribou. The effect of the Devil Canyon Dam alone will be mild; the effect of the Watana Dam is expected to be moderately severe. Any dam on the Susitna River that impounds water above Deadman Creek will inundate moderately or heavily-used moose winter range; any dam that impounds water above Watana Creek may disrupt moose and caribou movements with potentially severe effects.

The scope of this paper does not extend to downstream wildlife or the effects that the dam would have on those species; effects may prove considerable.

MITIGATIVE ACTIONS

Prior to dam construction activities, detailed studies should be conducted to more fully determine the use of this area by resident wildlife, to gain a better understanding of the potential effects of dams on the area's vegetation and wildlife, and to evaluate range improvement techniques for possible use to offset loss of moose range. Ungulate movements across drainages are largely seasonal. Where operation of dams results in fluctuating ice levels that may impede wildlife

movements, changes in timing of these operations perhaps could be made that would exchange a loss of operating efficiency for a reduced barrier to ungulate movements. Loss of moose winter range may be partially compensated for by well-planned, extensive range rehabilitation over a long period of time. However, even a good and extensive range improvement program probably won't fully mitigate any substantial losses of riparian willow habitat.

REFERENCES CITED

Anon. 1954. A progress report on wildlife of the Susitna River basin. 35 pp. U.S.D.I. Fish and Wildlife Service, Juneau.

Anon. 1960. A detailed report on fish and wildlife resources affected by the Devil Canyon Project, Alaska. 26 pp. U.S.D.I. Fish and Wildlife Service and Bureau of Commercial Fisheries, Juneau.

Table 1. Harvest Data from Game Management Unit 13.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Reported Moose Harvest, Unit 13:	1735	1607	1331	1553	1552	1512	1219	1329	1815	712	618	794
Reported Moose Harvest, Center Unit 13[a]:	578	691	299	353	506	512	405	427	540	302	324	394
Estimated Moose Harvest from upper Susitna River drainages[b]:	537	642	278	328	470	476	376	397	502	281	301	366
Total Moose Hunters, Unit 13:	——	——	——	4163	4027	4476	3381	3585	4881	3199	2513	2770
Estimated Caribou Harvest, Unit 13:	6300	8000	7100	5500	4000	6000	7800	7247	10,131	555	810	1192
Reported Sheep Harvest, Watana Hills:						5	1	7	2	2	2	3

[a] Actual harvests are higher because of harvests where location of kill was not reported. The center of Unit 13 is that portion of Unit 13 bounded by the Glenn, Richardson, Denali, and Anchorage-Fairbanks Highway.

[b] Estimated harvests from the upper Susitna River drainages during past years were obtained by multiplying annual moose harvests from the center of Unit 13 times the 1974 ratio of (moose harvest from upper Susitna River drainages/ moose harvest in the center of Unit 13).

Figure 1. Moose Distributions Seen During June 1974 Survey.

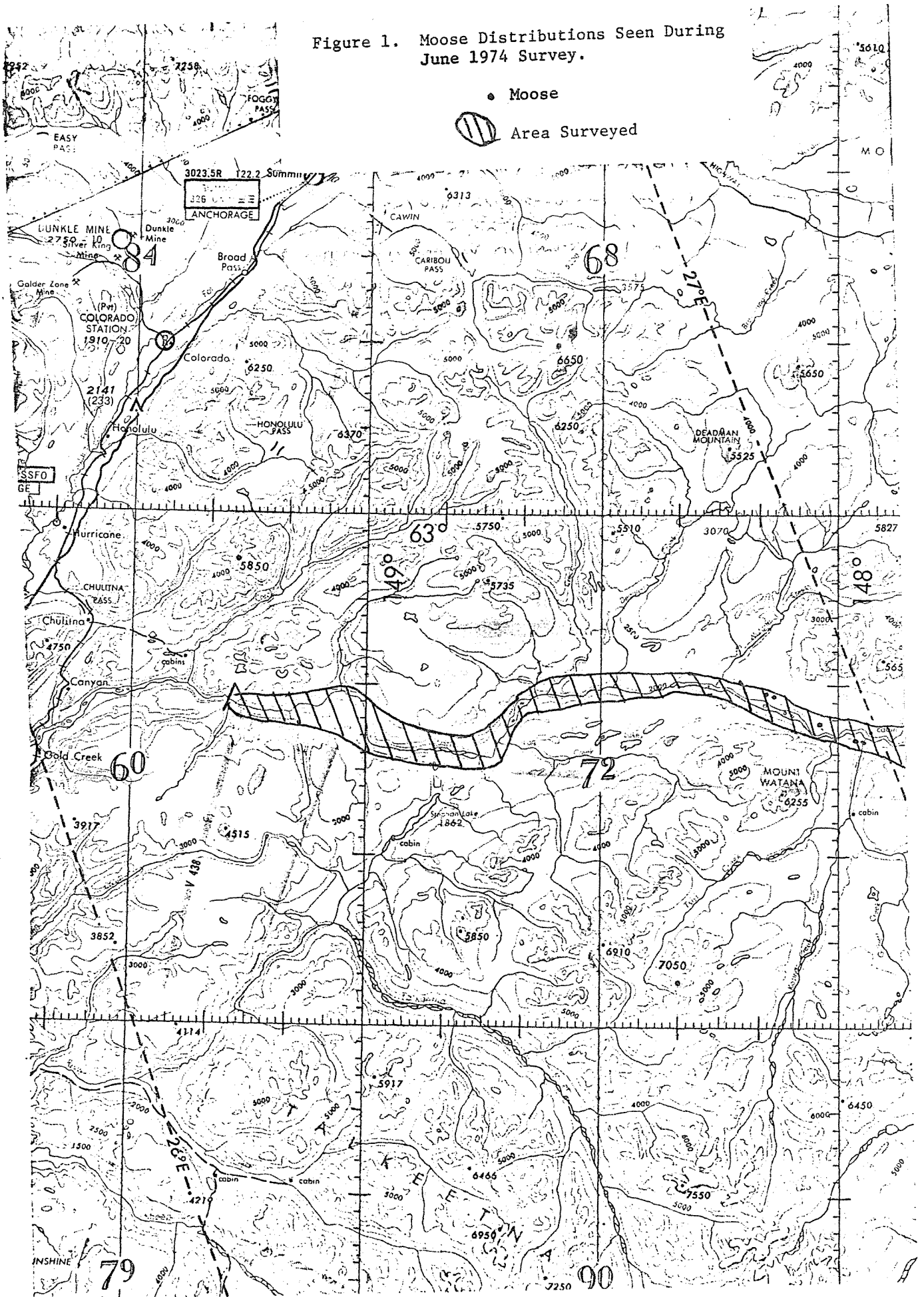
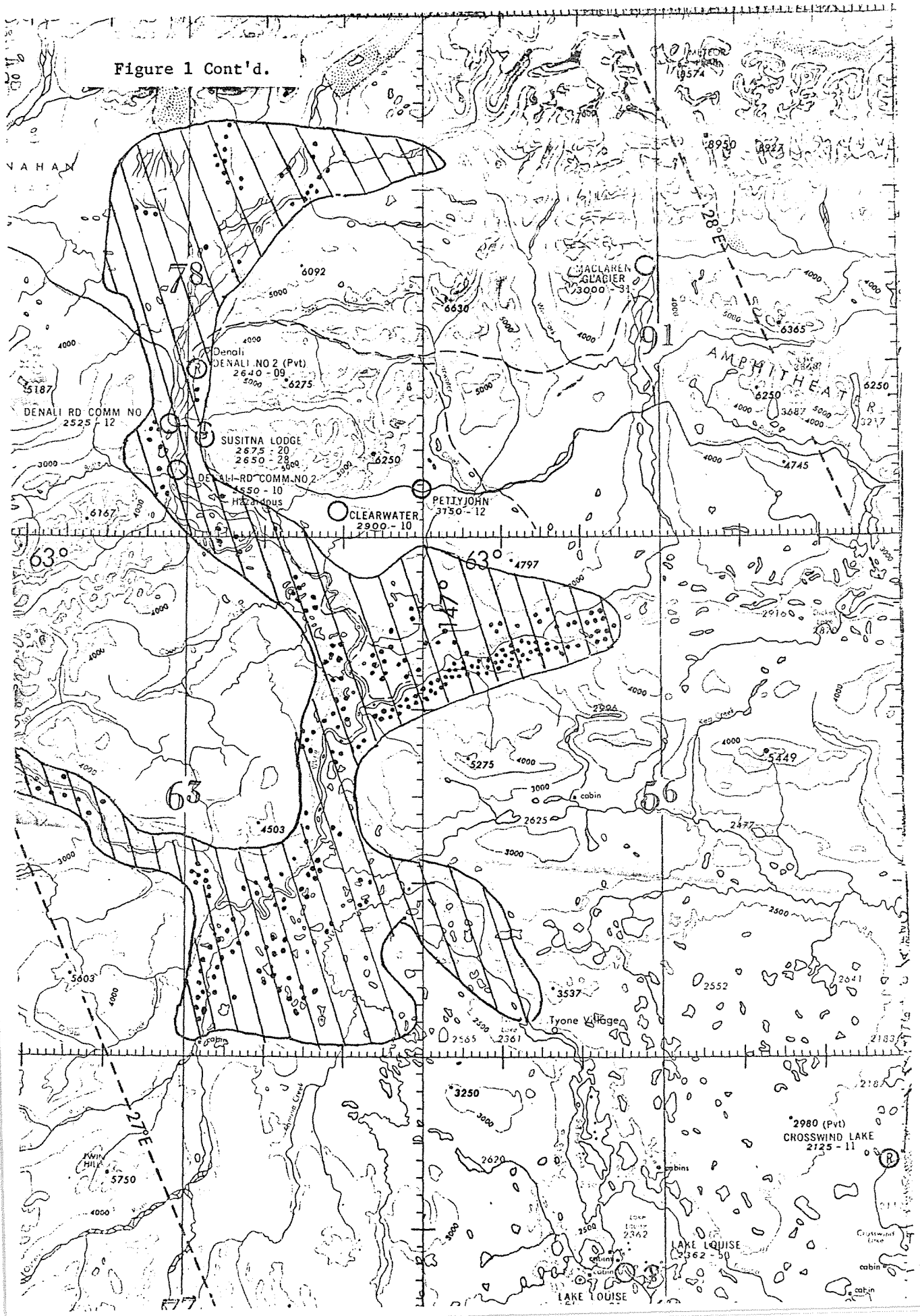


Figure 1 Cont'd.



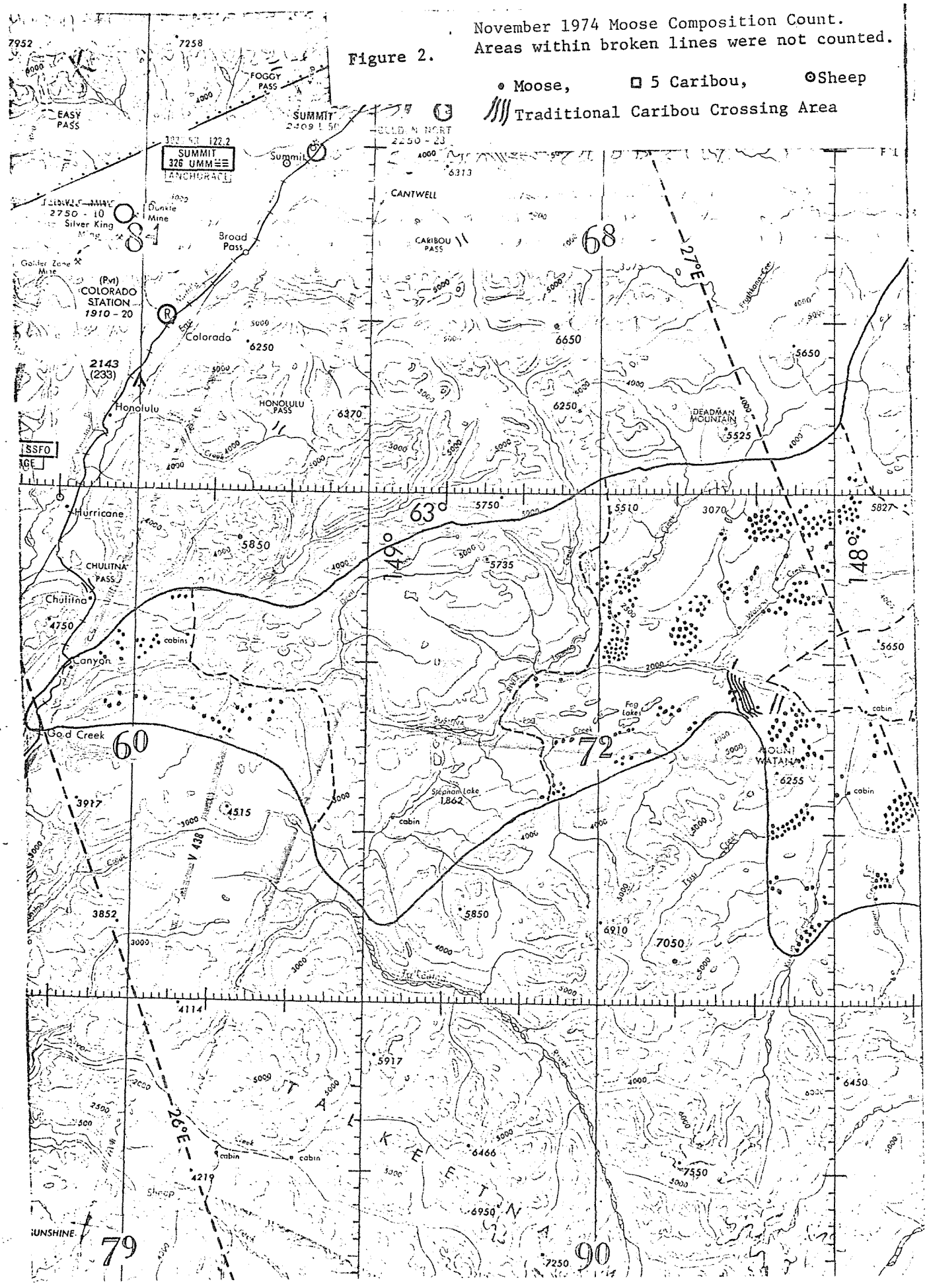

November 1974 Moose Composition Count.
Areas within broken lines were not counted.
Figure 2.
• Moose, □ 5 Caribou, ⊙Sheep
Traditional Caribou Crossing Area
SUMMIT
326 UMM
ANCHORAGE
EASY PASS
FOGGY PASS
SUMMIT
Summit
CANTWELL
CARIBOU PASS
Dunkle Mine
Silver King
Broad Pass
Golden Zone Mine
(Pvt)
COLORADO
STATION
1910 - 20
Colorado
6250
2143
(233)
Honolulu
HONOLULU PASS
6370
6650
6250
5650
DEADMAN MOUNTAIN
5525
SSFO
Hurricane
5850
CHULITNA PASS
Chulitna
4750
cabins
Canyon
5750
5735
5510
3070
5827
63°
149°
148°
68
60
72
Sod Creek
3917
4515
3852
4114
Stephan Lake
1862
cabin
Fog Lake
MOUNT WATAINA
6255
6910
7050
5850
5917
6450
6466
7550
6950
7250
4219
cabin
Sheep
SUNSHINE
79
90
ALASKA RANGE
27°E
26°E
V 438

Figure 2 Cont'd.

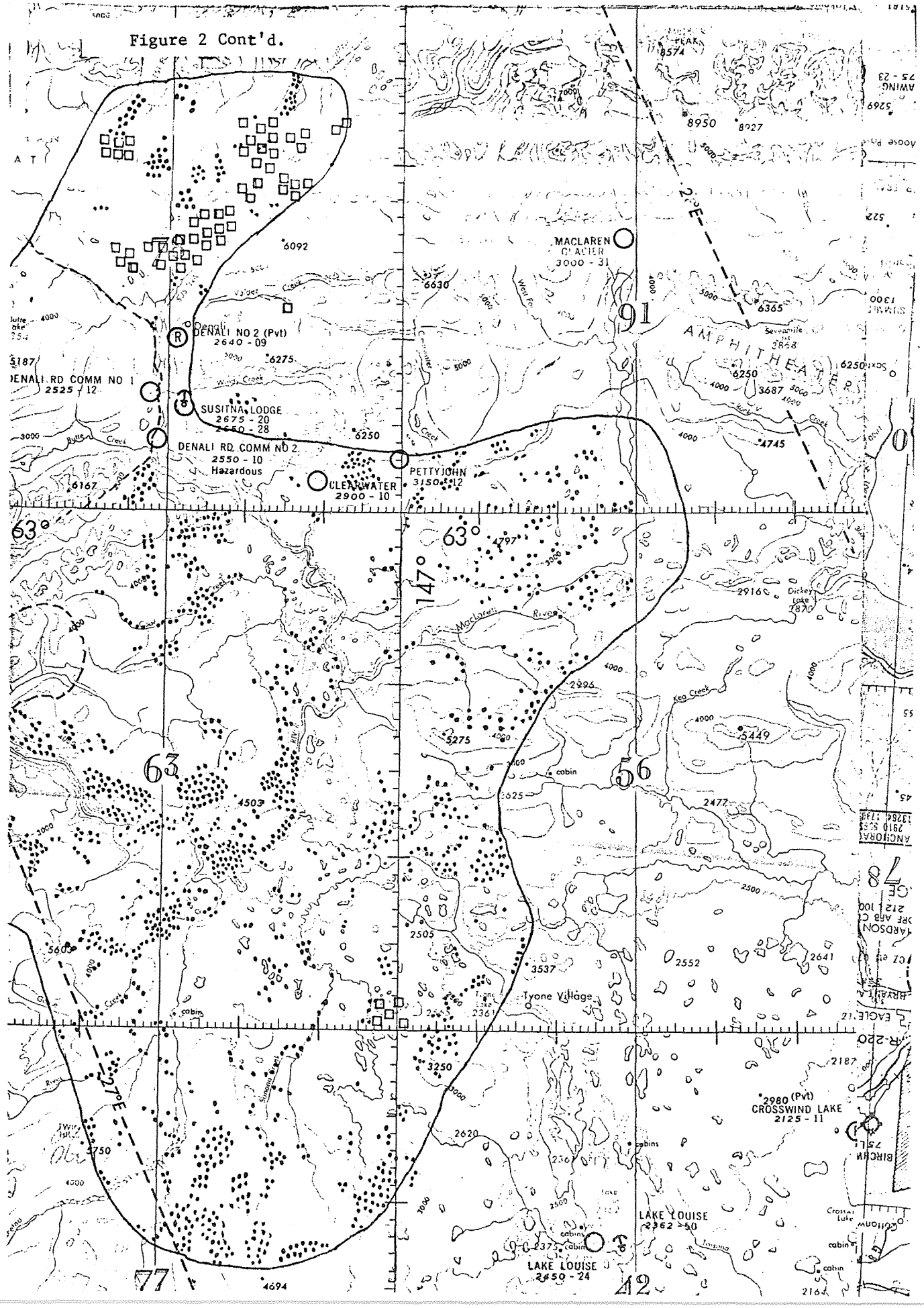


Figure 3. Moose concentrations during the January flight of the Susitna Project. 1975

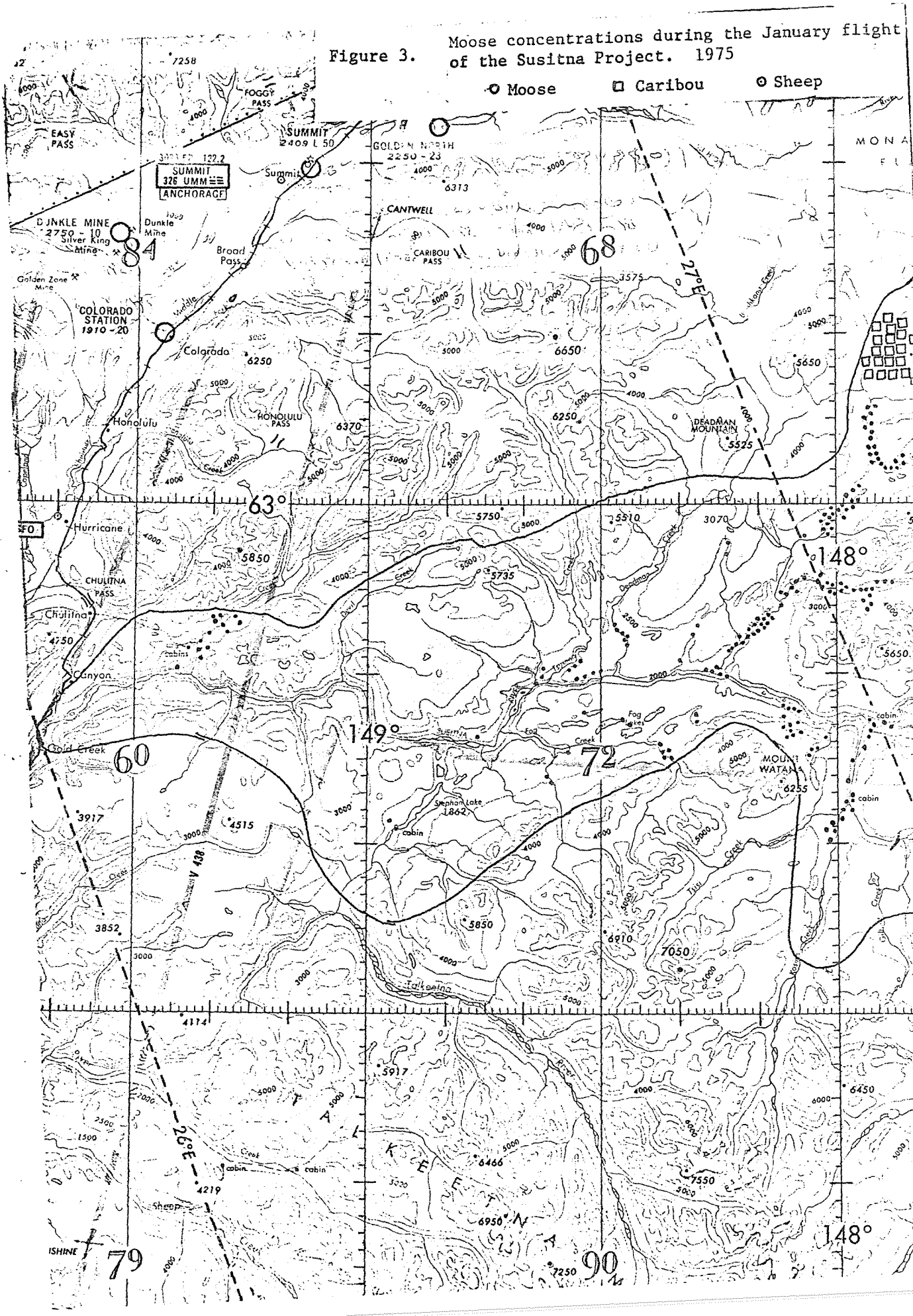
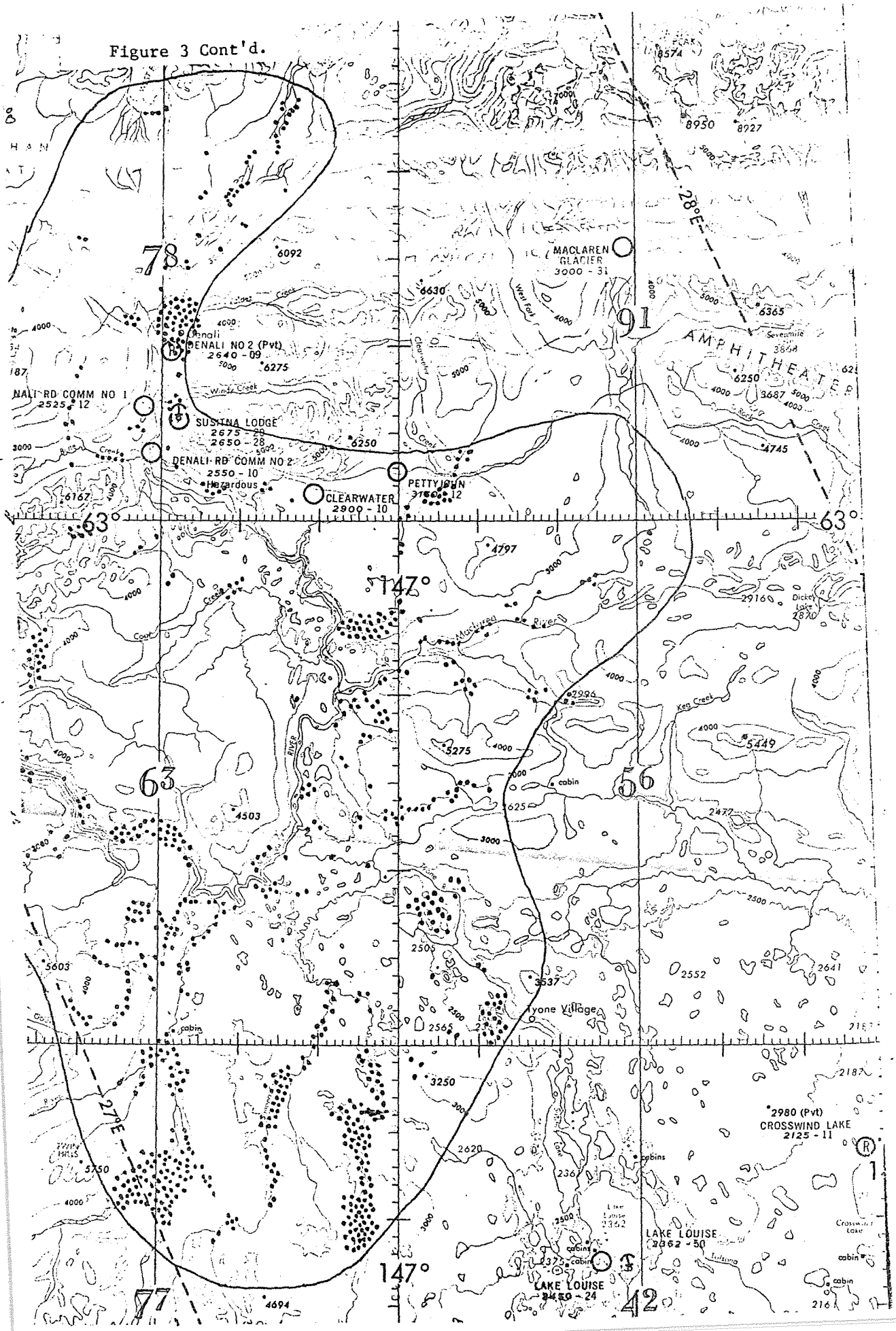


Figure 3 Cont'd.



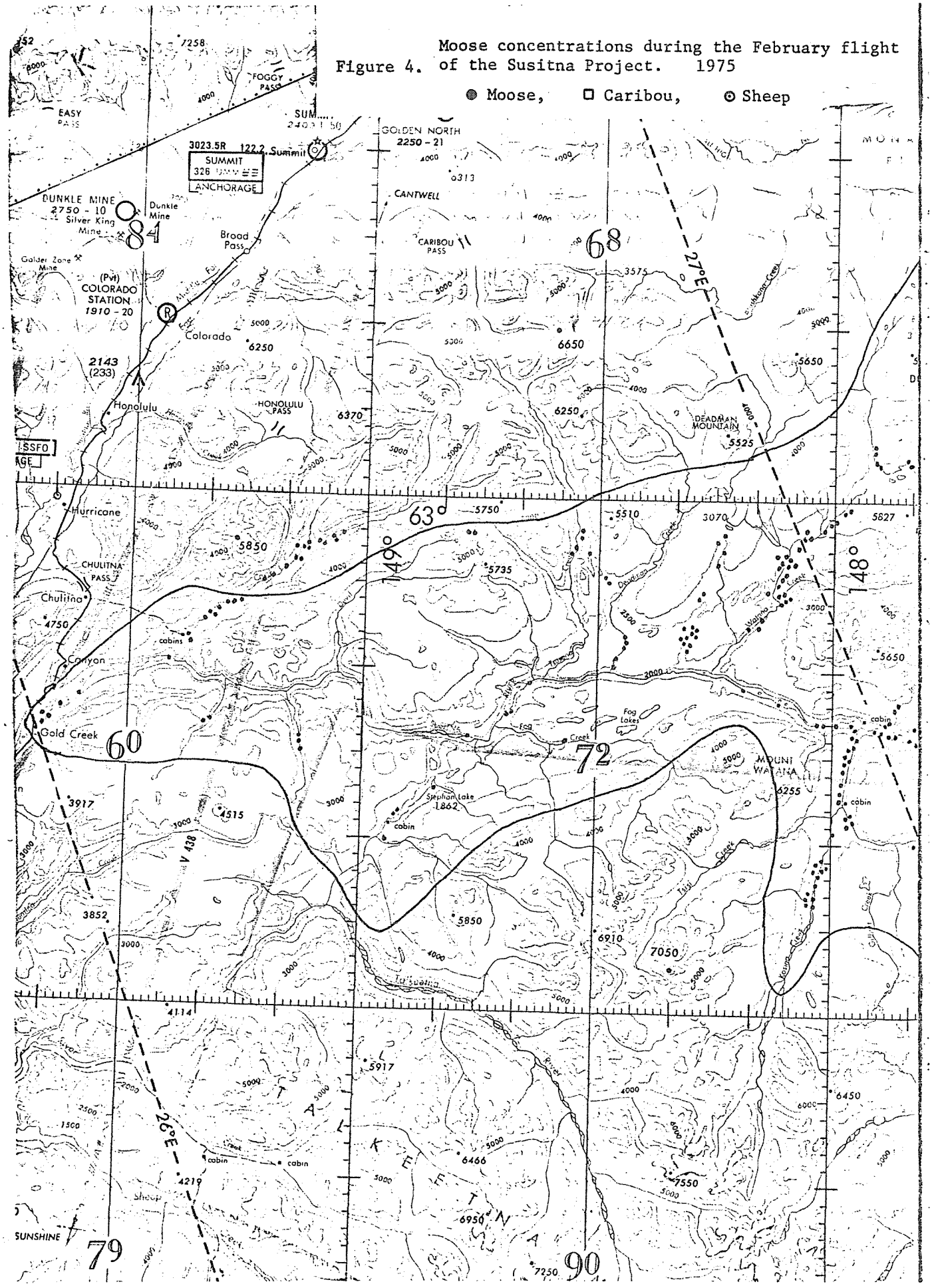
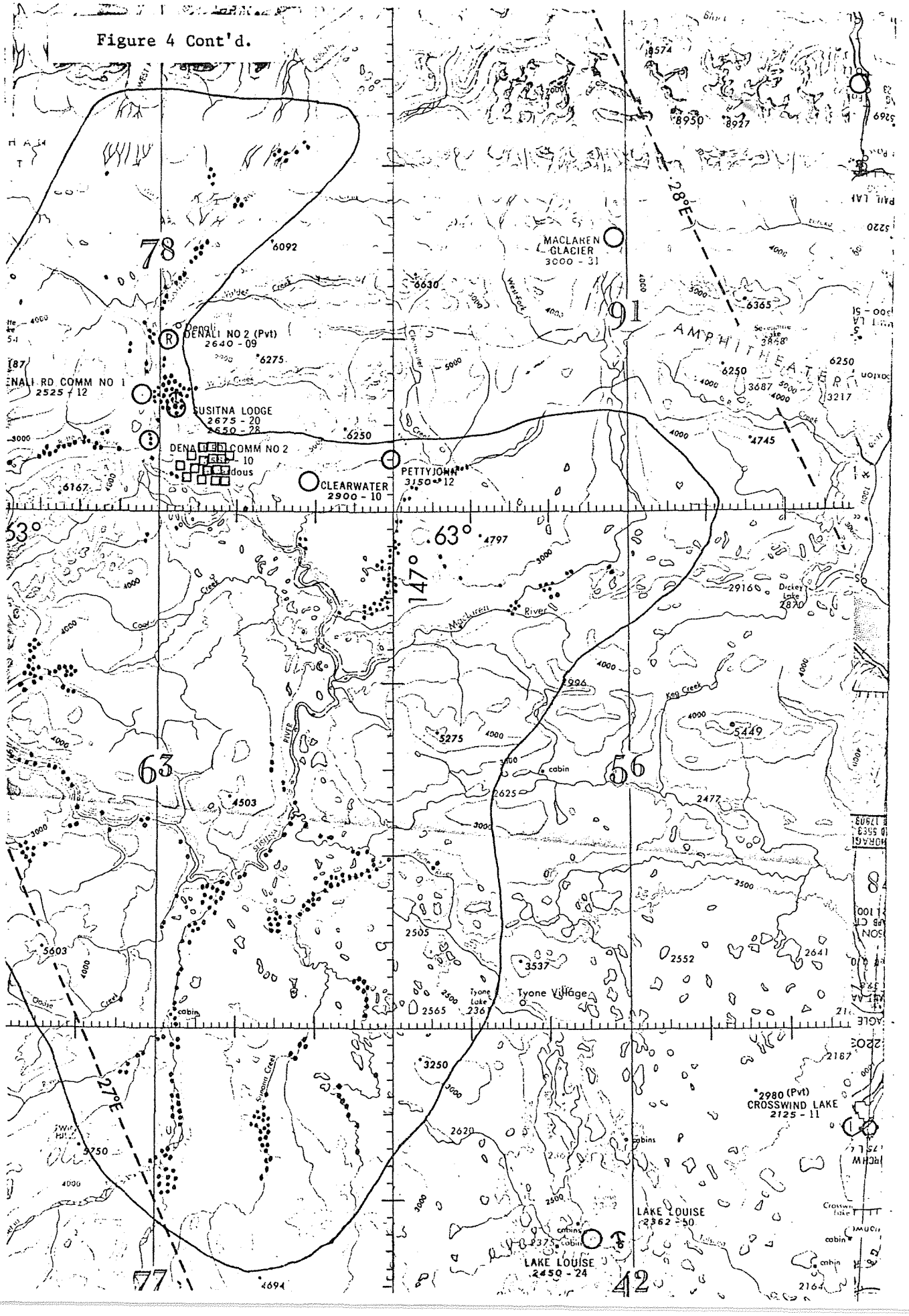

Moose concentrations during the February flight of the Susitna Project. 1975
Figure 4.
● Moose, □ Caribou, ⊙ Sheep
EASY PASS
FOGGY PASS
SUMMIT
3023.5R 122.2 Summit
SUMMIT
326
ANCHORAGE
DUNKLE MINE
2750 - 10
Silver King Mine
Dunkle Mine
Broad Pass
Golden Zone Mine
(Pvt) COLORADO STATION
1910 - 20
Colorado
2143
(233)
Honolulu
HONOLULU PASS
GOLDEN NORTH
2250 - 21
CANTWELL
CARIBOU PASS
DEADMAN MOUNTAIN
5525
Hurricane
CHULITNA PASS
Chulitna
Canyon
Gold Creek
Fog Lakes
Stephan Lake
1862
cabin
cabins
MOUNT WATANA
6255
TALKEETNA
SUNSHINE
84
68
63
60
72
79
90
27°E
26°E
49°
148°
6250
6650
6370
5850
5735
5750
5510
3070
5827
5650
4750
3917
4515
3852
4114
5917
6910
7050
6450
6466
6950
7550
4219
7258
3575

Figure 4 Cont'd.



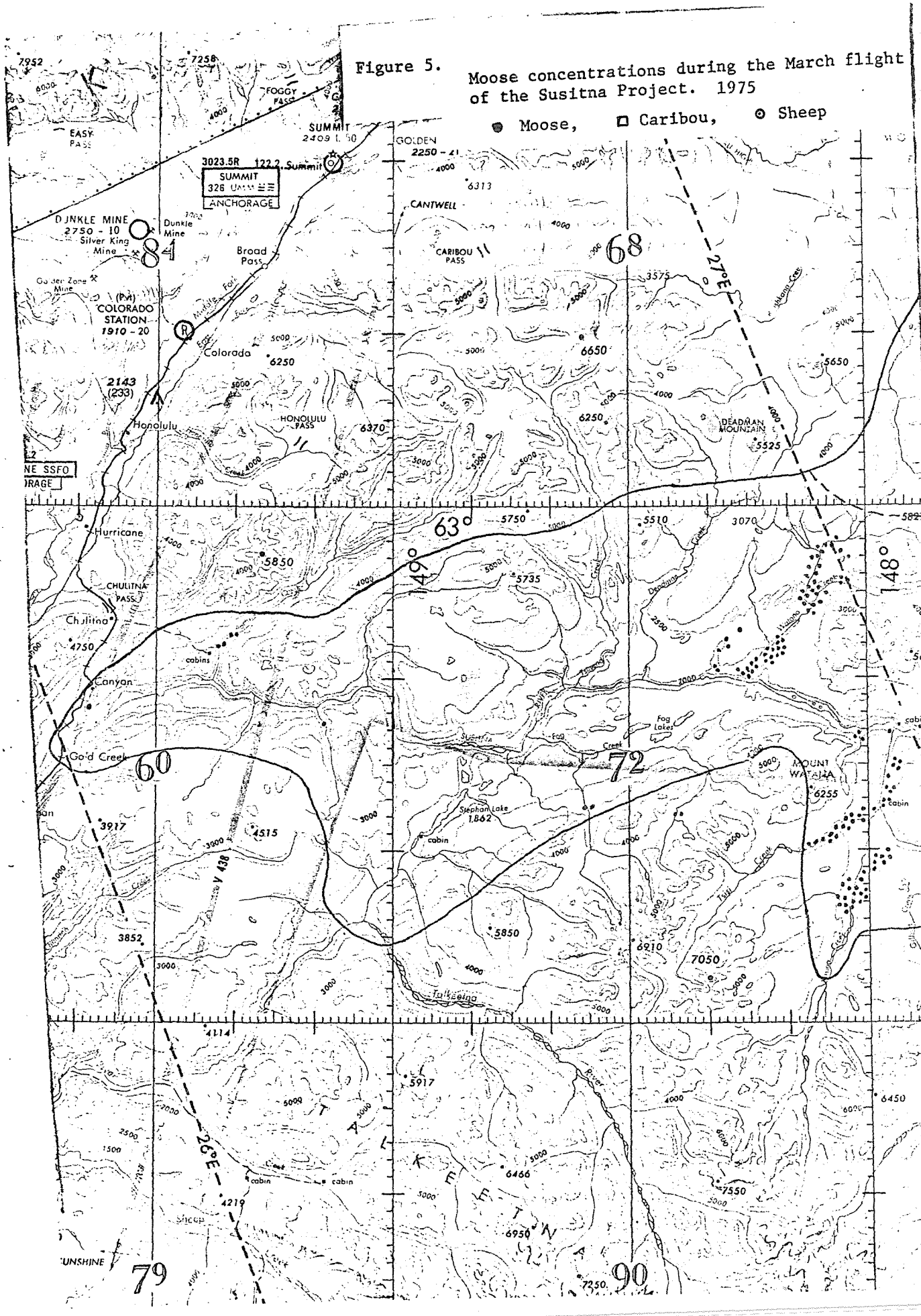
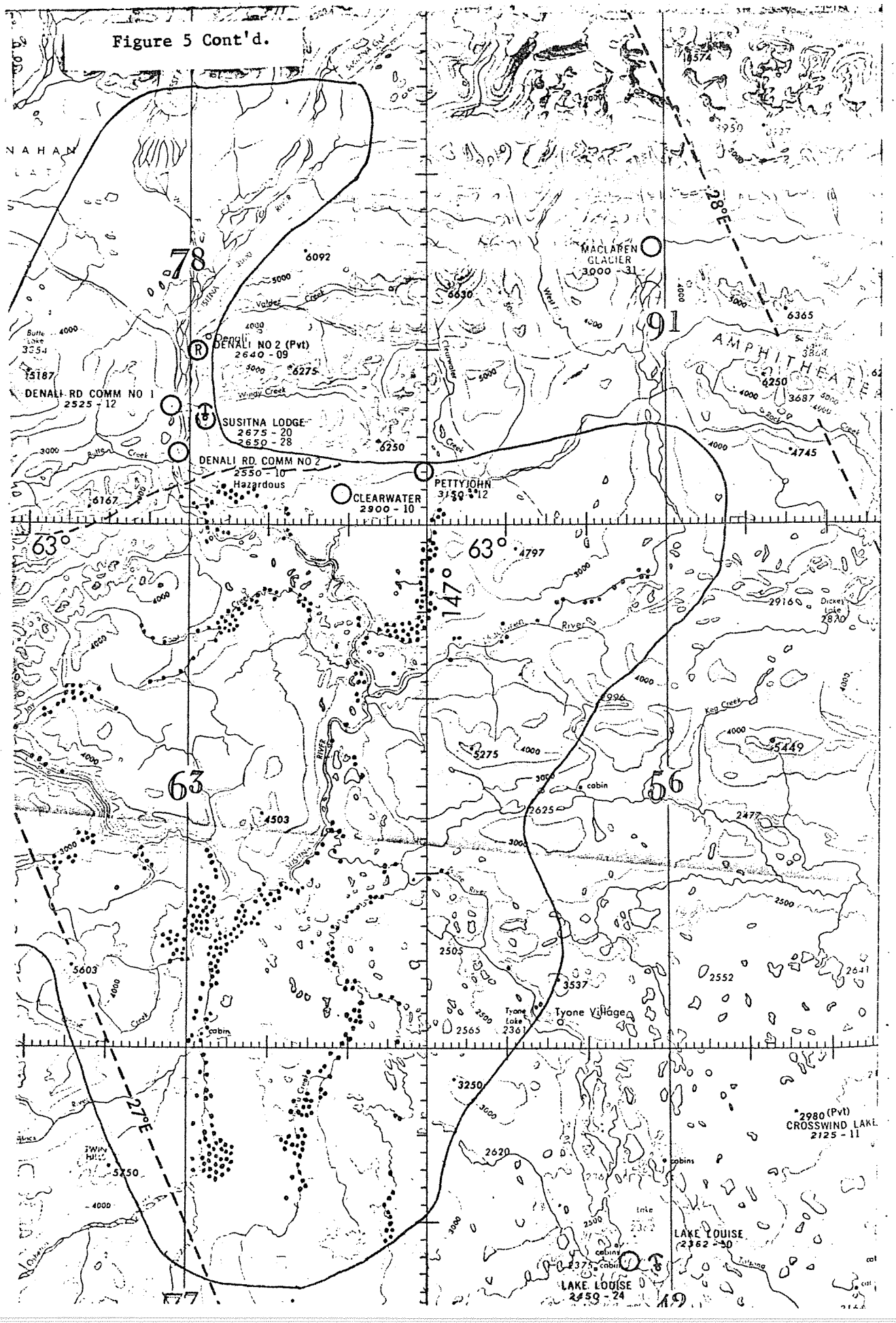


Figure 5.
Moose concentrations during the March flight of the Susitna Project. 1975
Moose, Caribou, Sheep
SUMMIT
2409
FOGGY PASS
EASY PASS
3023.5R 122.2 Summit
SUMMIT
328
ANCHORAGE
DUNKLE MINE
2750 - 10
Silver King Mine
Dunkle Mine
Broad Pass
Golden Zone Mine
(Pvt)
COLORADO STATION
1910 - 20
Colorado
6250
2143
(233)
Honolulu
HONOLULU PASS
6370
GOLDEN
2250 - 41
CANTWELL
6313
CARIBOU PASS
3575
6650
5650
DEADMAN MOUNTAIN
5525
5750
5510
3070
5827
Hurricane
5850
CHULITNA PASS
Chulitna
4750
cabins
Canyon
5735
Gold Creek
3917
4515
3852
Stephan Lake
1,862
cabin
5850
6910
7050
MOUNT WATAINA
6255
cabin
Fog Lakes
Talkeetna
5917
6466
6950
7550
6450
4219
SUNSHINE
63°
149°
148°
27°E
26°E
68
84
72
60
79
90

Figure 5 Cont'd.



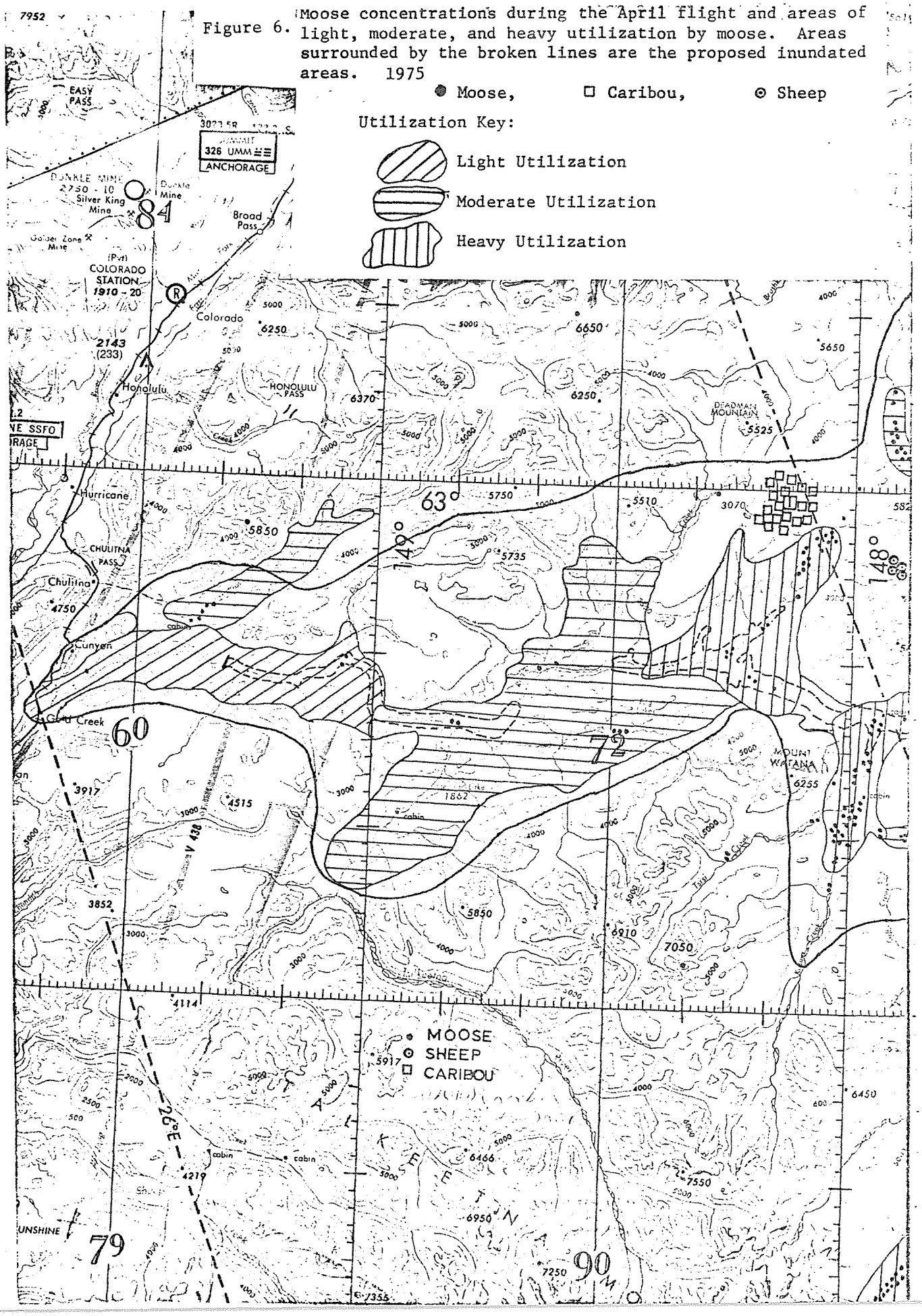


Figure 6. Moose concentrations during the April flight and areas of light, moderate, and heavy utilization by moose. Areas surrounded by the broken lines are the proposed inundated areas. 1975

● Moose, □ Caribou, ⊙ Sheep

Figure 6 Cont'd.