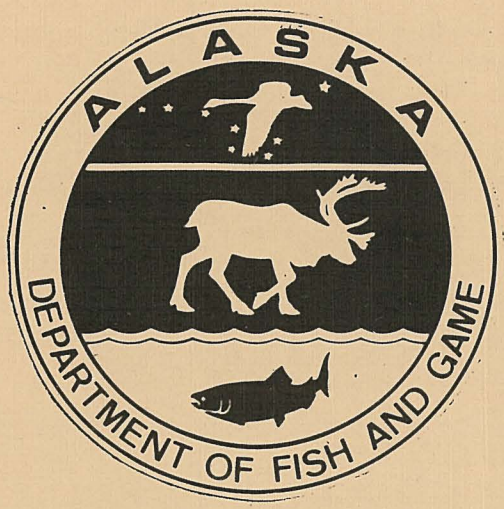
SUSITNA HYDROELECTRIC PROJECT

PHASE II PROGRESS REPORT



BIG GAME STUDIES

Volume VIII DALL SHEEP

Nancy G. Tankersley

ALASKA DEPARTMENT OF FISH AND GAME
Submitted to the Alaska Power Authority
April 1983

SUSITNA HYDROELECTRIC PROJECT

1982 ANNUAL REPORT

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VOLUME VIII. DALL SHEEP

by

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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 continued 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. During Phase II, we are narrowing the focus of our studies to evaluate specific impact mechanisms, quantify impacts and evaluate mitigation measures.

This is the first 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

During Phase 1 studies, a mineral lick used by Dall sheep was discovered in a location adjacent to the proposed Watana impoundment. The lick use area occurs on a steep bluff on the west bank of Jay Creek, from creek bottom (2000 ft/610 m in elevation) to the rim (2450 ft/747 m). The Watana impoundment normal maximum operating level is designated as 2185 ft/666 m with an average annual drawdown of 120 ft/36.6 m, which will cause inundation and erosion of some of the lick use area. Also, the lick's close proximity to the impoundment will make the sheep seasonally vulnerable to disturbance from construction, transportation and recreational activities. During 1982, aerial and ground observations were made of this site and other licks to observe sheep use. However, due to a lack of personnel, observations were infrequent and not sufficient to adequately determine the extent of lick use. Aerial sex and age composition surveys of the Watana Hills sheep population were conducted on 23 March and 3 August 1982. During the August survey, another possible lick was seen approximately 4 mi/6.5 km northwest of the Jay Creek lick. The effects of other increased human access and climatic changes due to the Watana impoundment on all Susitna basin sheep are discussed. Preliminary recommendations to reduce the project impacts on sheep are presented. Future study objectives are outlined.

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INTRODUCTION

Dall sheep occur in 3 areas in the vicinity of the Susitna Hydroelectric Project--near Mount Watana, the Watana Hills, and the Portage-Tsusena Creeks area (Fig. 1). Besides disturbance from construction activities, aircraft traffic, and possibly ground traffic in these areas, probably the major direct impact of the project on sheep will be disturbance of the Jay Creek mineral lick in the Watana Hills. This lick is adjacent to the proposed Watana impoundment and is used by sheep and possibly moose (Ballard *et al*. 1982) in early summer.

Many North American ungulates seek out mineral elements from places known as mineral licks (Stockstad *et al*. 1953, Hebert and Cowan 1971, Weeks and Kirkpatrick 1976, Fraser and Reardon 1980). Mineral licks are heavily used by Dall sheep in Alaska and Canada (Dixon 1939, Palmer 1941, Gross 1963, Pitzman 1970, Heimer 1973, Gill 1978). Some sheep have been documented to travel 12 mi/19.4 km out of their way to visit a lick before moving to summer range (Heimer 1973). Heimer (1973) has found that fidelity to the Dry Creek lick year after year is high, approximating 100% for ewes, and 80% for rams. Because of the apparent importance of mineral licks to Dall sheep in Alaska, Heimer (1973) recommended that licks be designated critical habitat areas.

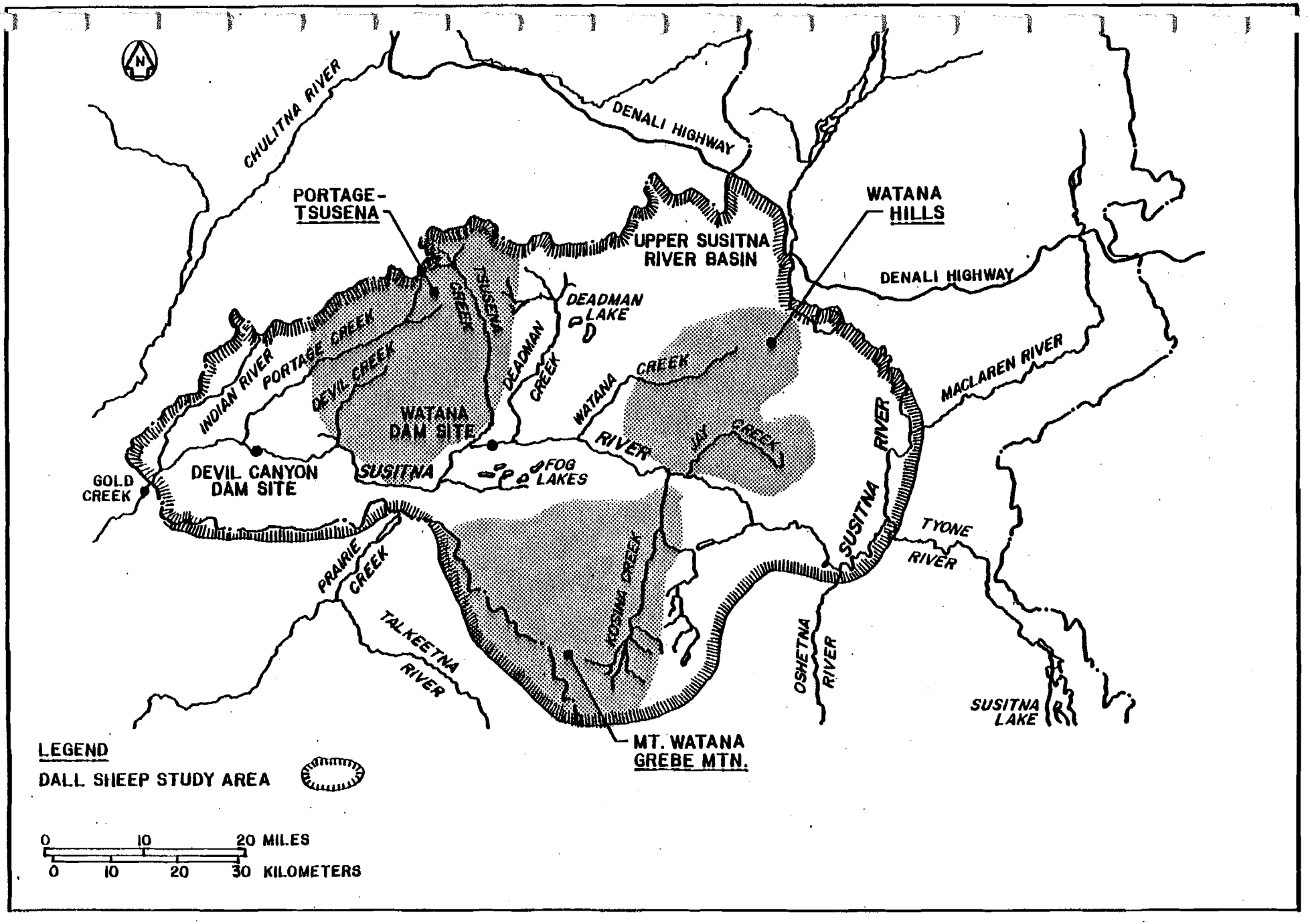

Fig. 1. Dall sheep study area showing the Watana Hills, Portage-Tsusena area, and the Mt. Watana - Grebe Mountain area.

Various elements have been suggested as the one sought by ungulates at mineral licks. Hanson and Jones (1976) hypothesized that sulfur may be a major lick attractant. However, as Weeks (1978) pointed out, sulfur is abundant in plant tissues and is not universally found in high levels in natural licks. Hebert and Cowan (1971), Weeks and Kirkpatrick (1976), Fraser and Reardon (1980) and others have presented convincing evidence that sodium is the desired element for mountain goats (*Oreamnos americanus*), white-tailed deer (*Odocoileus virginianus*) and moose. At the Dall sheep lick at Dry Creek, Heimer (1973) found 7.3 times as much sodium, 3.0 times as much potassium, 3.6 times as much calcium and 14.9 times as much magnesium in the lick soil compared to soil from nearby areas not eaten by sheep. Because of the high phosphorus content of sheep forage in spring, Heimer (1973) suggested that calcium and magnesium may be the desired elements. However, Geist (1971a) and Heimer (pers. commun.) have shown that bighorn and Dall sheep exhibit an appetite for sodium by using table salt (NaCl) to bait sheep. Denton and Sabine (1961) have shown that a sodium deficiency in domestic sheep leads to an increased appetite for that element.

Mineral lick use is highly seasonal, occurring mostly in spring and early summer (mid-May through mid-July in Alaska). The Dry Creek lick in the Alaska Range has received heaviest use during June with peak use occurring from 0400 to 1200 hours, and moderate use continuing until 2000 hours (Heimer 1973). The timing

and intensity of use varies somewhat from year to year depending on weather patterns, which influence sheep movement to licks (Heimer 1973).

The Jay Creek lick will be subjected to flooding and erosion, and sheep attracted to the lick will be seasonally vulnerable to human disturbance. The lick area is a steep bluff on west bank of Jay Creek exposing some dry mineralized substrate interspersed with rock outcrops, steep slide areas, and trails to the creek and upper plateau. Sheep ingest the mineralized substrate, travel, and rest in various areas of the bluff from the creek bottom (2000 ft/610 m in elevation) up to the top (2450 ft/747 m) (Ballard *et al*. 1982). Portions of the lick area will be flooded, and the annual cycle of filling and draining in the impoundment will probably cause additional erosion of the bluff. The Watana impoundment normal maximum operating level is designated at 2185 ft/666 m in elevation, with possible flooding levels up to 2201 ft/670.8 m (FERC exhibit B). During the heaviest lick use season (May and June), the target minimum reservoir levels are 2092 ft/637.6 m (May) and 2125 ft/647.7 m (June). The highest annual target minimum reservoir level is 2190 ft/667.5 m for September (FERC, Exhibit B). Even at the normal minimum operating level of 2065 ft/629.4 m (Wayne Dyok, Acres, pers. commun.), the lower portion of the bluff will be flooded. The lick's close proximity to the impoundment makes the sheep seasonally vulnerable to disturbance from construction, transportation and recreational activities in this area. These

impacts could reduce lick use or force abandonment of the area, with possible detrimental effects on this small sheep population.

Additional sheep licks occur in the Watana Hills. Along Jay Creek, secondary lick areas occur intermittently upstream from the main lick area for roughly 2 miles, and occur on a low ridge across the creek from the main lick. Another lick on the East Fork of Watana Creek (approximately 12 km northwest of the Jay Creek lick) is used by Dall sheep. Tobey (1981) reports a lick in northeastern Watana Hills (Fig. 2); however, this has not been confirmed. Another possible lick was seen during an aerial survey in August for this study (Fig. 2). The extent and overlap of use among these licks by the same sheep, as well as the similarity of lick elements, are unknown at this time. If only certain sheep traditionally use specific licks, different segments of the sheep population may not be aware of the existence of alternative areas (Geist 1971).

The goal of this study is to document the use and importance of the Jay Creek lick to the Watana Hills sheep population. This includes observing and quantifying use of the lick area, classifying the sexes and ages of lick users, determining the seasonal and daily timing of use, and various other pertinent parameters. An additional goal is to document seasonal use of sheep habitat in the Watana Hills, Portage-Tsusena Creeks area and Mt. Watana area that may be affected by project activities.

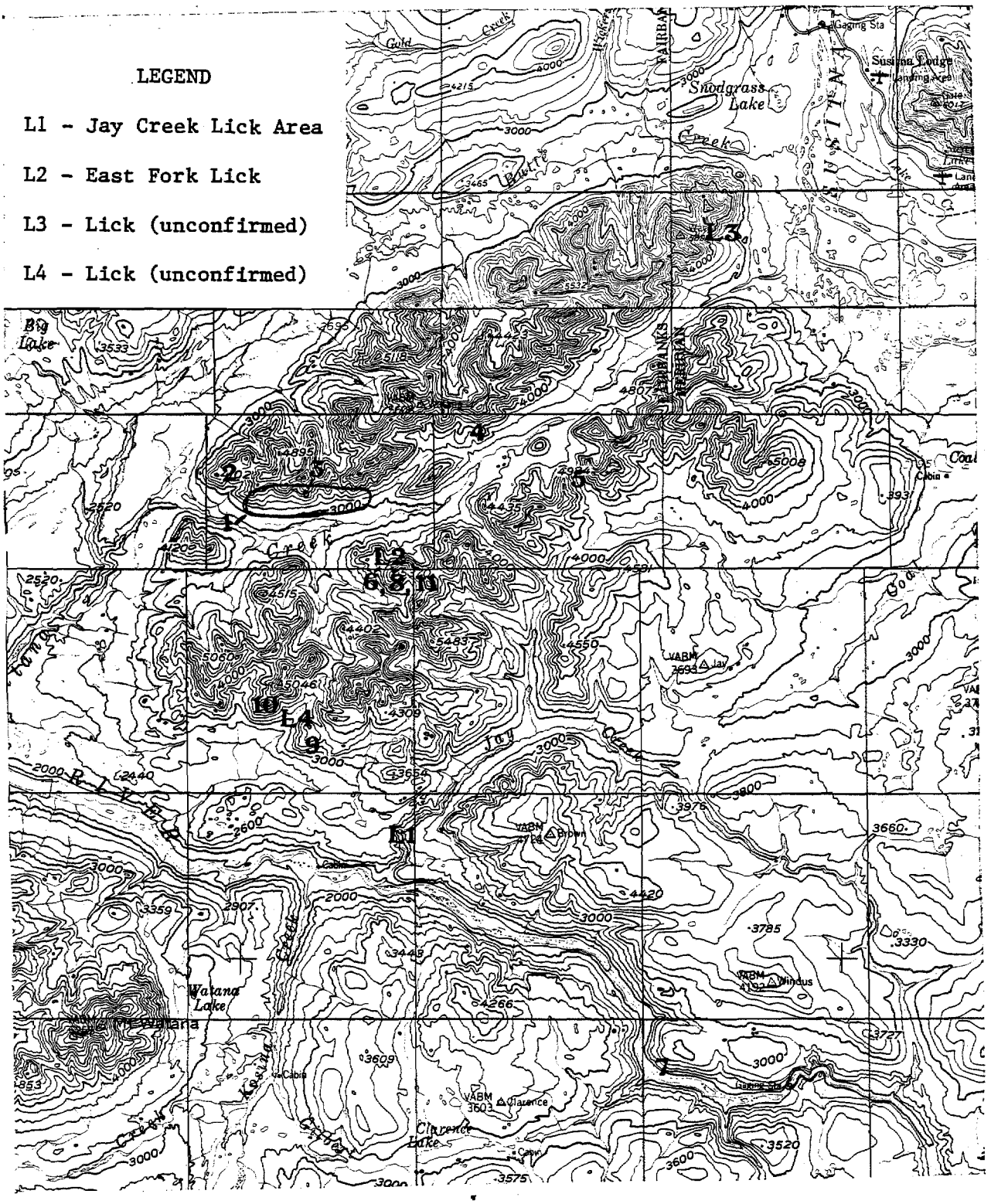

Fig. 2. Lick sites and locations by observation number (see Table 2) of sheep recorded during incidental flights over the Watana Hills during 1982.

METHODS

Lick Observation

Ground observations were made in the Jay Creek lick area during 27-30 May 1982, but these were discontinued due to a lack of personnel. The auxiliary lick area on the east ridge across the creek from the main lick was sampled, photographed, measured, and an altitude reading was recorded by a hand-held Thommen 2000 altimeter. Aerial observations of sheep at the Jay Creek and East Fork licks and other areas were recorded on 1:63,360 scale U.S.G.S. topographic maps incidentally during flights for other Susitna Hydroelectric Project big game studies during 1982.

Aerial Surveys

A late winter aerial survey of the Watana Hills sheep population was done with a Piper PA-18 Super Cub on 23 March 1982. The survey was completed in 2 hours and 25 minutes under fair to good observation conditions by a moderately experienced observer and a seasoned pilot. The temperature was 40°F/4.4°C with sunshine and patchy clouds. The wind was 10-15 mph/16-24 kph from the southeast. A summer survey with the same aircraft, pilot, and observer was flown on 3 August 1982. This survey was completed in 1 hour and 45 minutes under excellent observation conditions. The weather was sunny and clear with no wind. All sheep observed on these surveys were classified as legal or sublegal rams, ewes

and yearlings (during March survey), unclassified individuals (usually young rams or ewes, during August survey) or lambs, counted by group, and their locations plotted on a 1:63,360 scale U.S.G.S. topographic maps.

RESULTS

Lick Use

No sheep were seen using the Jay Creek lick during 27-30 May from ground-based observations 0.5 mi/0.81 km from the lick (Table 1). Incidental aerial observations of sheep using the Jay Creek lick were recorded between 8 June and 8 July 1982 (Table 1). Incidental aerial observations in other parts of the Watana Hills recorded sheep at or near the East Fork lick on 10 June, 28 July and 15 October 1982 (Fig. 2, Table 2).

The auxiliary lick on the east ridge across Jay Creek from the main lick was inspected on 28 May. It was estimated at 2270 ± 50 ft/692 ± 15.2 m in elevation. This lick is a "cave," eaten into the ground approximately 16 ft/4.9 m in length and a few feet deep. The cave is large enough for a ram to enter and hide from aerial observers. No sheep were observed using this lick in 1982. Samples taken of the clay from this area have not been analyzed.

Table 1. Observations at the Jay Creek lick during 1982.

Date	Time	Total Sheep	Rams	Unclassified	Observer
23 March		0			J. Westlund (aerial obs.)
27 May	1600-2000	0			J. Westlund (ground obs.)
28 May	0600-1000	0			J. Westlund (ground obs.)
29 May	0900-1100 1600-2000	0			J. Westlund (ground obs.)
30 May	0700-1300	0			J. Westlund (ground obs.)
8 June	1530	12	12		J. Whitman (aerial obs.)
10 June	1400	15	15 (3 at lick, 12 0.6 km south)		J. Whitman (aerial obs.)
17 June	1030	15	9	6	R. Fleming (aerial obs.)
24 June	1539	1		1	St. Miller (aerial obs)
29 June	1400	0			St. Miller (aerial obs.)
8 July	1533	2		2	St. Miller (aerial obs.)
3 August		0			J. Westlund (aerial obs.)
14 October	1200, 1700	0 (no tracks seen either)			J. Whitman (aerial obs.)

Table 2. Dates, numbers, and classification of sheep from miscellaneous aerial observations made by ADF&G personnel in the Watana Hills during 1982.

Observation # for Fig. 2	Date	Total Sheep	Rams	Ewes	Yearlings	Lambs	Notes
1	1 June	25-30					
2	10 June	3					
3	10 June	17					
4	10 June	2	2				
5	10 June	3					
6	10 June	5	5				0.6 km E. East Fork lick
7	12 June	2					
8	28 July	8		5		3	At East Fork lick
9	14 October	6					
10	14 October	2		1		1	
11	15 October	3	(½ curl)				0.6 km E. East Fork lick

Aerial Surveys

Eleven groups of sheep totalling 77 individuals, were recorded during the aerial survey of the Watana Hills on 23 March 1982 (Fig. 3). Many sheep were seen on south-facing slopes, which is typically preferred winter range due to low or no snow accumulation there. No legal rams were observed (Table 3).

On the 3 August survey, 25 groups of sheep, totalling 200 individuals were recorded (Fig. 4). Again, no legal rams were observed (Table 4). The number of sheep seen on this summer survey is comparable to the summer survey counts of past years (Table 5). During this survey, another possible lick was located approximately 4 mi/6.5 km northwest of the Jay Creek lick (Fig. 2, L4).

No comprehensive aerial surveys were made in the Portage-Tsusena Creeks area or the Mt. Watana-Grebe Mountain area. A few incidental observations of sheep were recorded in the Portage-Tsusena Creeks area (Table 6), although most were in high country (Fig. 5) 7 mi/11.3 km or more from the proposed impoundments, Denali access route, the northern route of the transmission corridor, and Borrow Sites C and F on Tsusena Creek. Likewise, a few observations of sheep in the Mt. Watana-Grebe Mountain area were recorded (Table 7). Again, these few sightings (Fig. 6) were distant from the proposed impoundments, access route and transmission corridor.

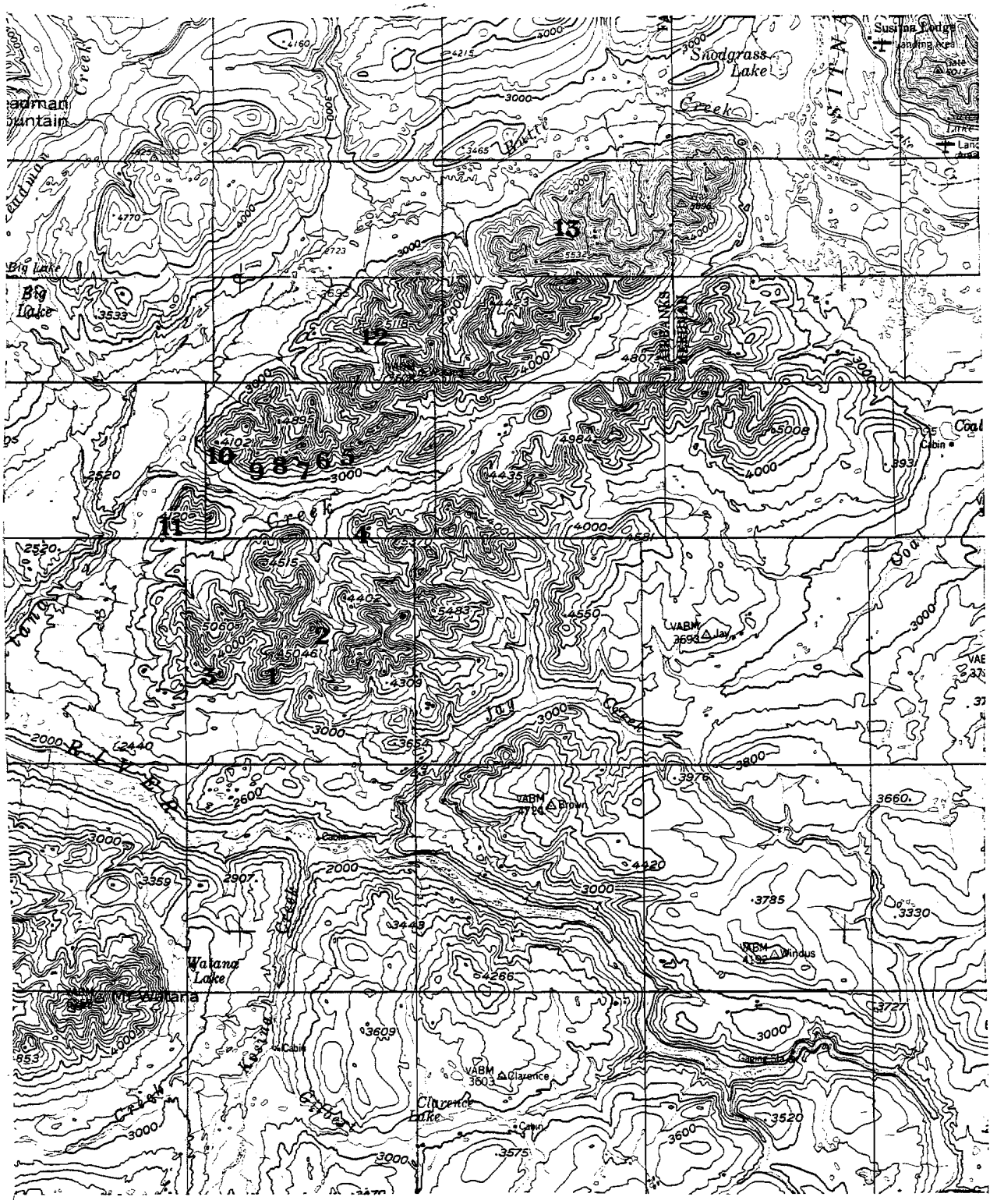

Fig. 3. Locations by observation number (see Table 3) of Dall sheep observed during an aerial survey of the Watana Hills on 23 March 1982.

Table 3. Number of Dall sheep observed in the Watana Hills sheep count area by John Westlund (ADF&G) on 23 March 1982.

Observation # for Fig. 3	Legal Rams 1/	Sub-legal Rams	Ewes and Yearlings
1			5 (3 ewes, 2 yrlgs.)
2			4 (ewes)
3 (2 sets of tracks only)			
4			6
5			6
6		3	
7		1	4 (ewes)
8			7
9			14
10		2	17
11		1	4
12 (2-3 sets of tracks only)			
13			3 (2 ewes, 1 yrlg.)
Total	0	7	70

1/ A legal ram is one with 7/8 curl or greater horn.

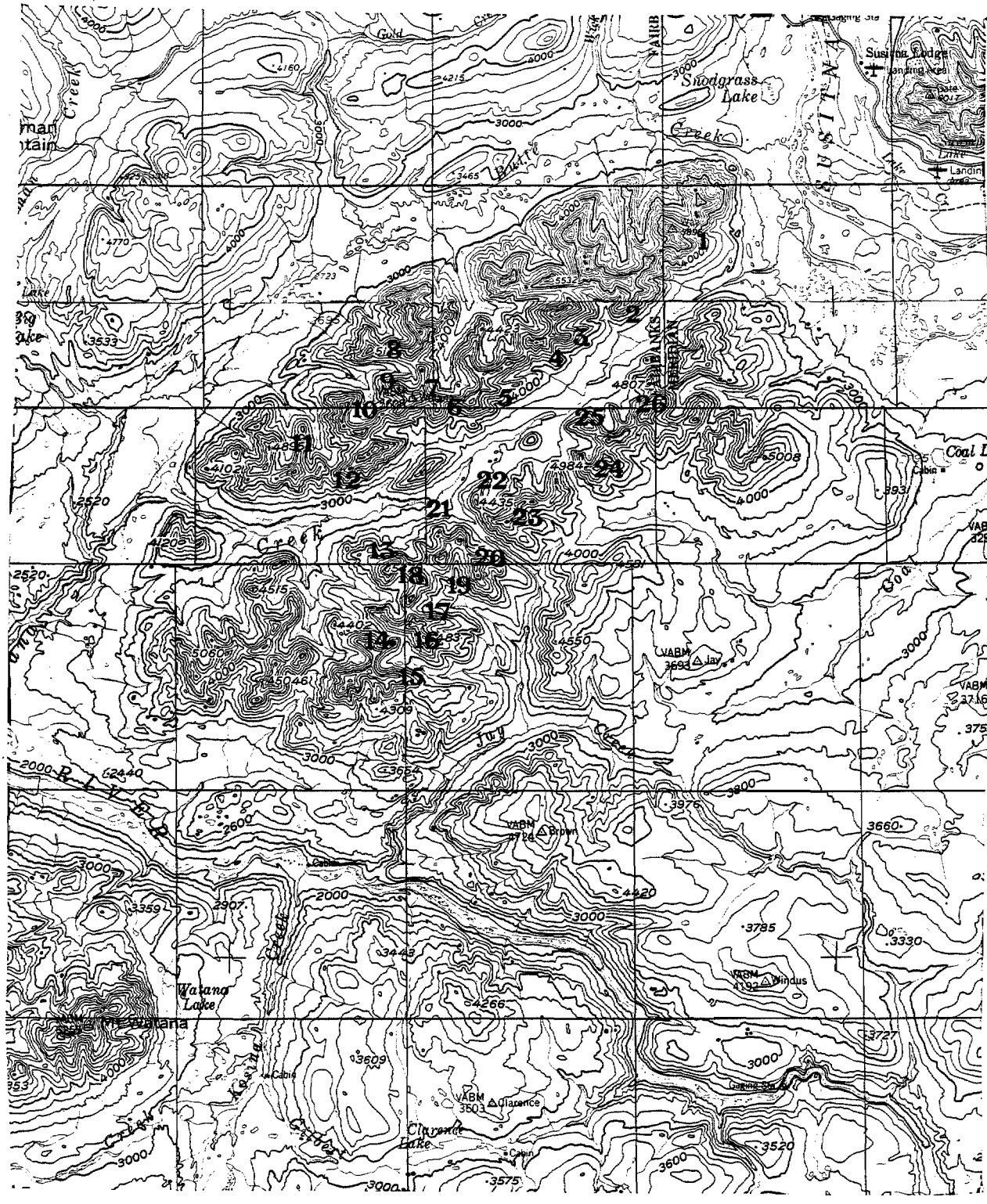

Fig. 4. Locations by observation number (see Table 4) of Dall sheep observed during an aerial survey of the Watana Hills on 3 August 1982.

Table 4. Number of Dall sheep observed in the Watana Hills sheep count area by John Westlund (ADF&G) on 3 August 1982.

Observation # for Fig. 4	Legal Rams 1/	Sub-legal Rams	Unclassified	Lambs
1			3	1
2		2		
3			1	
4			10	3
5			6	1
6			5	3
7			15	
8			3	1
9			2	
10			6	1
11			1	
12			6	
13 (at East Fork lick)			10	3
14			19	8
15			1	
16		5		
17			16	
18			2	2
19			3	1
20			2	2
21		1	19	7
22			3	1
23			6	3
24		1	4	1
25		1		
26		9		
Total	0	19	143	38

1/ A legal ram is one with 7/8 curl or greater horn.

Table 5. Highest summer counts completed in Watana Hills sheep trend count area.

	Legal Rams 1/	Sub-legal Rams 2/	Lambs	Total	% Legal Rams	% Sub-legal Rams	% Lambs	Surveyor	Date
1950				0				Scott	summer
1967	--		--	220	--		--	Nichols	8 Sept.
1968	--		--	183	--		26.6	Nichols	Aug.
1973	10		40	176	5.6		22.7	McIlroy	3 Aug.
1976	4		30	130	3.1		23.0	Eide	24 Aug.
1977	4		33	152	2.6		21.7	Spraker	11 July
1978	5		34	189	2.6		18.0	Eide	23 July
1980	9	19	42	174	5.1	10.9	24.1	Tobey	22 July
1981	2	37	43	209	1.0	17.7	20.6	Westlund	28 July
1982	0	19	38	200	0	9.5	19.0	Westlund	3 Aug.

1/ A legal ram was defined as having a 3/4 curl or greater horn on the 1980 and earlier surveys. Beginning in 1981, a legal ram is defined as having a 7/8 curl or greater horn.

2/ New category begun in 1980.

Table 6. Miscellaneous aerial observations of sheep in the Portage-Tsusena Creeks area during 1982.

Observation # for Fig. 5	Date	Total Sheep	Rams	Ewes	Yearlings	Lambs	Observer
1	14 Jan	7		4	3		J. Westlund
2	2 March	7		4	3		J. Westlund
3	2 March	1		1			J. Westlund
4	2 July	58		(ewes and lambs)			J. Whitman
5	9 July	9		(ewes and lambs)			J. Whitman
6	9 July	4	4				J. Whitman

Table 7. Miscellaneous aerial observations of sheep made by Jack Whitman (ADF&G) in the Mt. Watana-Grebe Mountain area during 1982.

Observation # for Fig. 6	Date	Total Sheep
1	1 June	21
2	10 June	8
3	28 July	9 (ewes and lambs)

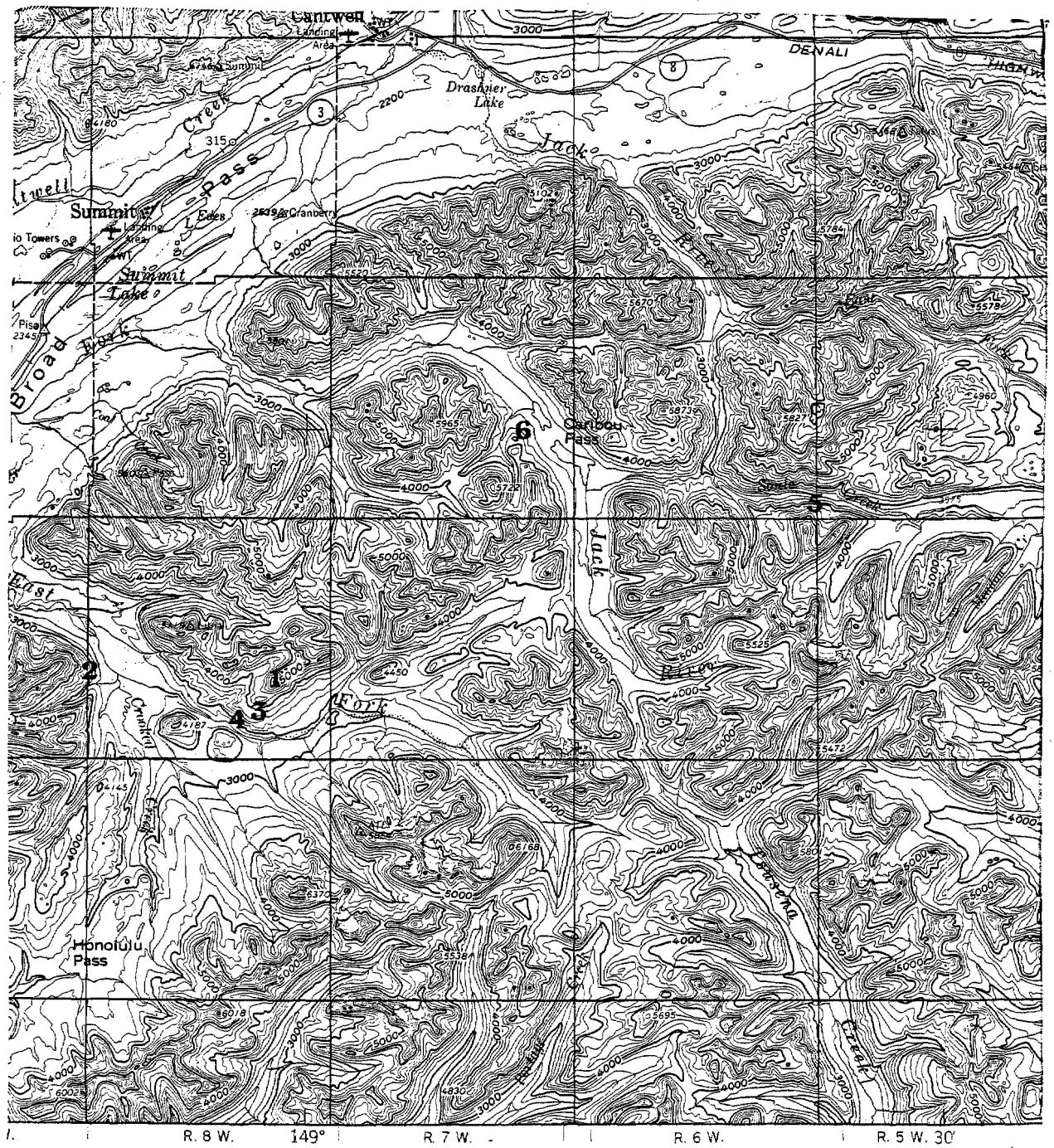

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Fig. 5. Locations by observation number (see Table 6) of Dall sheep observed in the Portage-Tsusena area during incidental flights in 1982.

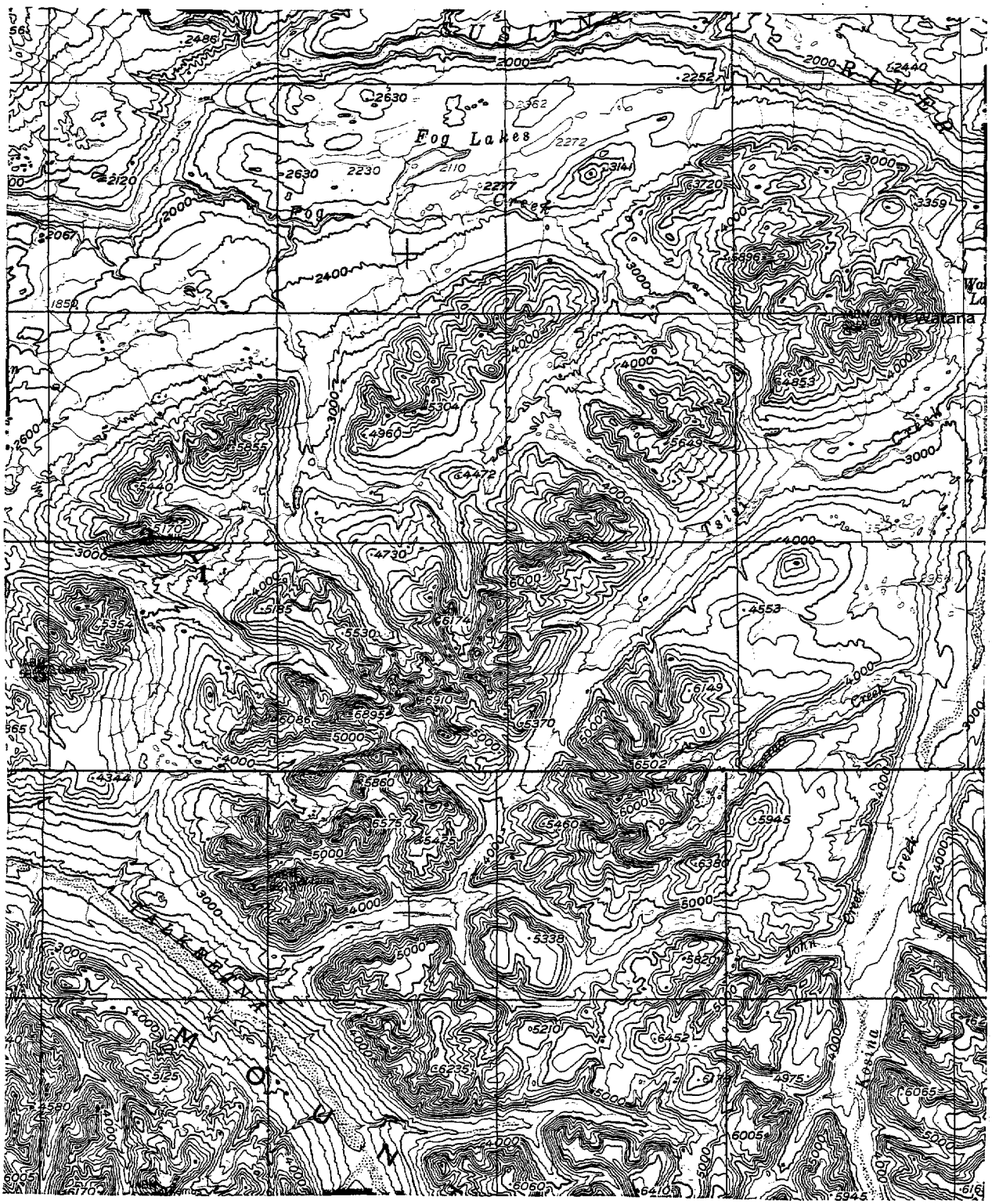

Fig. 6. Locations by observation number (see Table 7) of Dall sheep observed in the Mt. Watana - Grebe Mountain area during incidental flights in 1982.

Hunter Harvest

Preliminary reports indicate that 4 legal rams, 2 with horn lengths of 32 in, 1 with 37 in and 1 unknown, were shot during August 10-September 20 in the Watana Hills. However, the exact kill locations of 2 rams are not verified and could have occurred outside the study area. At least 3 of the 4 successful hunters (non-residents) were on guided hunts. No sheep harvest has been reported elsewhere in the Susitna study area.

DISCUSSION

Impacts of Watana Impoundment

The Watana Hills sheep population appears to be vulnerable to severe impact from the proposed Watana impoundment because of disturbance to the Jay Creek lick area. This lick, adjacent to the proposed Watana impoundment, is used by sheep in early summer. A group of 15 sheep (7.5% of the surveyed summer population) was the largest seen using the lick during 1982. Up to 23 sheep (13% of the observed 1980 population) have been seen at the lick at one time (Tobey 1981), indicating that a significant portion of the population uses this lick. It is likely that sheep travel some distance to use this lick as both winter and summer surveys have located most of the population 7 or more air mi/11.3 km from the Jay Creek lick. The Jay Creek lick area and much of the terrain traveled from observed summer and winter

range (Figs. 2, 3 and 4) is atypical sheep habitat, being relatively flat with shrubland and trees and little rocky cliff escape habitat. This indicates the importance of the Jay Creek lick, especially when the East Fork lick is so much closer to the majority of sheep sightings and in more typical sheep habitat.

The cycle of filling and draining in the Watana impoundment will subject the lick area to flooding and erosion and possibly will leave ice shelves on portions of the lick area during the peak lick use season. Together, the mineralized lick substrate, rock outcrops providing escape cover, other resting areas, and trails are used by the sheep. Flooding, erosion and ice shelves on portions of these components may lessen or destroy the value of the lick to the Watana Hills' sheep. In addition, sheep attracted to the lick area may be seasonally vulnerable to disturbance and habitat degradation from timber harvest in the impoundment and other human activities.

The Watana Hills is a small isolated sheep population, used by local guides and sheep hunters (see also Ballard *et al*. 1982). The nearest additional sheep habitat occurs southwest across the Susitna River around Mt. Watana, and also farther northeast in the Clearwater Mountains across a larger valley. Aerial surveys, other sightings and the distances involved suggest that the Watana Hills sheep may have more interchange with the Talkeetna Mountains population to the southwest. This interchange may provide the opportunity to maintain a viable sheep population in

the Watana Hills, by emigration from the larger Talkeetna Mountains population. The Watana impoundment, with seasonal hazards of a large width of open water, ice shelving and unstable ice conditions and mud shelving may depress or eliminate sheep immigration from the southwest. This would make any detrimental impacts of the project on the Watana Hills sheep population even more serious, as population recovery from a project impact could be greatly slowed or made impossible by loss of immigration opportunities.

Climatic Impacts

A delay in spring plant growth in areas near the Watana impoundment (Exhibit E, FERC License application) may degrade some of the Watana Hills and Mt. Watana sheep habitat. If the Watana impoundment causes additional snow accumulation in nearby areas, important south-facing slopes in the Watana Hills may become poorer winter habitat.

Increased Human Access

The project development will undoubtedly increase fixed-wing and helicopter traffic. Low-flying aircraft, especially helicopters, are known to disturb Dall sheep (Linderman 1972, Nichols 1972, Lenarz 1974). Groups of ewes and lambs (possibly including young rams) react most strongly to helicopters (Lenarz 1974). The dangers of aircraft disturbance include injuries sustained by

sheep while fleeing (Linderman 1972), wasted metabolic energy expense (which could become critical if the disturbance is repeated during stressful winter or lambing periods) (Geist 1971b), and abandonment of habitat (Linderman 1972), which could lower the population size. However, some sheep show habituation to aircraft that maintain regular flight patterns and do not approach sheep closely (Lenarz 1974, Summerfield 1974, Reynolds 1974). MacArthur *et al.* (1982) found no cardiac or behavioral responses by unhunted adult bighorn sheep to helicopters and fixed-wing aircraft flying 400 m or more away.

Roads and reservoirs developed by the project will allow increased access by vehicles and hikers who can also disturb sheep (Tracy 1976, MacArthur 1982). One area where the Denali National Park road was built directly through sheep habitat receives less use by sheep now than in the early 1940's, but the exact cause of this apparent abandonment is not clear (Tracy 1976). Tracy (1976) also reported that a few Dall sheep (mostly ewe and lamb groups) in Denali National Park were disturbed while crossing a small valley with a road when vehicles were present. Tour buses stopping, people exiting and making loud noises increased (respectively) the disturbance to the sheep (observed by their behavior). Reactions of sheep to moving vehicles more than 200 m away were minimal (Tracy 1976). These sheep were habituated to traffic and not hunted. Among unhunted sheep populations, sheep may habituate more readily to human presence (Geist 1971b).

MacArthur *et al*. (1982) documented relatively few cardiac responses (8.8% of trials) and fewer behavioral responses (0.9% of trials) of bighorn sheep to vehicle passes. Most of these responses (73.7%) occurred when the vehicle passed within 25 m. Humans approaching on foot, especially accompanied by a dog, elicited stronger responses (MacArthur *et al*. 1982). These sheep were living in an unhunted sanctuary and had been regularly exposed to humans and vehicles along a nearby road. No ewes with lambs were monitored, which are more sensitive to disturbance (Murie 1944, Smith 1954, Jones *et al*. 1963).

MacArthur *et al*. (1982) recommended restricting human activities to roads and established trails, and discouraging dogs in areas of sheep habitat.

Population Distribution

The difference in sheep numbers between the winter and summer surveys in the Watana Hills may be due to the poorer observation conditions during the winter survey or because fewer sheep inhabit the Watana Hills during winter. Future surveys and scrutiny of sheep movements may help clarify this discrepancy.

The few observations of sheep in the Mt. Watana-Grebe Mountain range do not indicate that these sheep will be directly affected by the impoundments or other ground construction activities.

However, sheep have been observed in the past on Mt. Watana near the proposed impoundment (Tobey 1981) and may continue to do so. More surveys and observations of sheep in this area are needed to delineate seasonally important range.

The few observations of the Portage-Tsusena Creeks sheep also indicate that they do not occupy areas close to the impoundments, Denali access route or the northern route of the transmission lines. However, more complete seasonal surveys are needed to confirm this.

Mitigation Recommendations

Lowering Watana's maximum reservoir level to 2000 ft/609.6 in elevation would eliminate much of the physical disturbance to the Jay Creek lick. Also, certain methods and scheduling of construction activities and access would reduce the impacts of the Susitna Hydroelectric project on sheep.

Timber harvest within 2 air mi/3.2 km of the Jay Creek lick should be restricted to the months of September through April. The area within a 0.5 mi/0.8 km of the lick should remain untouched by clearing activities, including roads, logging equipment and debris, except for those portions below the minimum operating level (2065 ft/629.4 m). Any clearing within 2 air

mi/3.2 km of the lick should be delayed as long as possible until just before the reservoir begins filling. This will condense the physical effects of the Watana development into a shorter time period.

Access for project personnel and recreational users should be restricted to minimize disturbance in areas of sheep habitat. Limiting off-road access to certain trails (away from lambing areas and mineral licks) should be considered. Air traffic should be prohibited below 1000 ft/304.8 m above ground level in areas of sheep habitat. Helicopter landings within 1.0 mi/1.6 km of mineral licks should be prohibited during 1 May - 15 July or later, depending on the results of seasonal lick use studies. Boat and ground access within 1.0 mi/1.6 km of the Jay Creek lick and other mineral licks should be prohibited from 1 May - 15 July, or later, if lick use continues through the summer.

If the project substantially reduces availability of mineralized substrate at the Jay Creek lick, options of mining or blasting the lick area to expose additional substrate, or supplying appropriate mineral elements near the Jay Creek lick or other areas could be considered.

RECOMMENDATIONS FOR FURTHER STUDY

The goal of this study is to document sheep habitat use and how it may be affected by the hydroelectric development. Emphasis is

on the use and importance of the Jay Creek lick to the Watana Hills sheep population. This includes observing and quantifying use of the lick area, classifying the sexes and ages of lick users, determining the seasonal and daily timing of use, and various other pertinent parameters. Other areas of sheep habitat that may be disturbed by project-related construction activities, and aircraft and vehicle traffic will be monitored for sheep use.

Primary Objectives:

1. Map, record elevations and quantify use of licking areas, trails, rocky outcrops used as escape terrain, and other resting areas used by sheep at the Jay Creek lick bluff.

2. Document the sexes, ages, and estimate the number of sheep (and moose) using the Jay Creek lick and ridge across the creek.

3. Determine seasonal and daily timing of lick use in the Jay Creek area and compare to daily weather conditions (temperature, precipitation, and wind speed).

4. Quantify the amount of lick use by individuals in the Jay Creek lick area.

5. Analyze water and acid soluble mineral element content of samples from the Jay Creek lick and compare analyses with samples taken away from the lick.

6. Assess the physical effects of the impoundment filling and draw down on the lick site.

7. Suggest mitigation options for all project impacts on sheep.

Secondary Objectives

7. Monitor seasonal habitat use of potential sheep range in the Watana Hills, Mt. Watana and Portage-Tsusena Creek areas that may be disturbed by project-related construction activities, and aircraft or vehicle traffic.

8. Document general summer and winter range of sheep using the Jay Creek lick.

9. Determine the preference for various mineral elements of sheep coming to the Jay Creek lick.

10. Document sexes, ages, numbers, and seasonal and daily timing of lick use by sheep at other licks in the Watana Hills.

11. Analyze and compare mineral element content of samples taken from the East Fork lick, secondary Jay Creek licks and other mineral licks used by sheep in the Watana Hills to samples taken nearby outside the licks and to the Jay Creek lick samples.

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