DALL SHEEP IN THE UPPER MILL CREEK VALLEY:

An analysis of vegetation composition and range in *Ovis dalli dalli* habitat

STUDENT FINAL REPORT FOR THEIR FINAL PROJECT

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Introduction:

Climate change is a global phenomenon and is known to cause major fluctuations in glaciation. The effects of the resulting deglaciation are being felt both world wide and, more specifically, in northern latitudes where much of the land is covered all or most of the year by ice. Species adapted to living in glacial habitats are especially sensitive to climate change. This retreat in glaciation is causing the range of vegetation communities in these latitudes to shift and can potentially cause a shift in the range of other species that depend on this vegetation such as the Dall Sheep, Ovis dalli dalli.

O. dalli dalli is a member of the Bovidae family and is found in the upper northwest territories of the North American continent - Alaska, Yukon, and British Columbia. Usually ~1 meter in length and ~275kg in weight, both sexes have horns that are never shed and are not branched. They prefer habitats located in extremely sloped mountains and are most often seen in bands of 6 or more (Burt et al. 1961). The primary predators of sheep, besides human hunters, are the lynx, wolverine, coyote, timber wolf, and grizzly bear. To escape these predators, sheep use their superior climbing ability to disappear over dangerous crags at a speed much faster than their predators (Dufrense 1955).

In order to gauge how sheep are affected by climate change, Ed Pfeiffer et al. (USGS) are researching the extent of sheep habitat change as local glaciers recede. In conjunction with this macro scale project we conducted a more focused study into the characteristics of the preferred alpine-meadow habitat of sheep. We used evidence of sheep presence such as scat or tracks to identify habitats with more sheep use. We

hypothesized that an equal amount of sheep scat would be found in all vegetative communities throughout the study area.

Methods:

Study Site

Our study site was the upper Mill Creek Valley centered at 61°34'00" N and 143°29'00" W to the northwest of McCarthy, Ak. The elevation ranges from ~1200 meters at the valley floor to ~2100 meters at the surrounding mountain peaks. The upper end of the valley trends northwest - southeast ~~beggin~~ beginning at two glaciers to the north and northwest and bounded by the Lakina River to the southeast. Our study focuses on the north-facing slopes of the valley made of Nizina Limestone and McCarthy Formation and the south-facing slopes made of Chitistone Limestone. Both are characterized by alpine-meadows and some shrub-zones (Fig. 5). Our study was conducted from July 23-26, 2008. Our base camp was on the south side of the river and contained 14 people.

Vegetation Boundaries

We defined shrub-zone as a vegetation area covered by at least 50% woody shrub of 1 meter or taller and alpine-meadow zone as a vegetation area covered by less than 50% woody shrub. We recorded latitude/longitude coordinates at 20 meter intervals along the shrub/alpine-meadow boundary using GPS (Garmin 72). To account for poor satellite reception caused by bad weather and rugged topography, we plotted our GPS points on a USGS topographic map (Mill Creek Watershed, 1:63,000 7.5 minute) to calculate elevation.

Scat Collection

To collect sheep scat, we surveyed the Mill Creek Valley slopes using broad east-west sweeps on the north- and south-facing slopes until because of steepness, the terrain became inaccesible. We used GPS to record the location of sheep scat piles that contained a minimum of 10 pellets. To differentiate fresh scat from previous seasons, we broke open pellets and tested for moisture. New scat was labeled SSN (Sheep Scat New) and previous seasons scat was labeled SSO (Sheep Scat Old). Each sample was then numbered in ascending order, and fresh scat was placed in labeled canvas bags and shipped to USGS for nutritional analysis.

Vegetative Community Survey

We surveyed the composition of the vegetative communities in the upper Mill Creek Valley on both the north- and south-facing slopes using 8 plots, each 30m x 30m. The plots were oriented true north-south using a hand held compass. We then measured a transect oriented true north-south through the plot running from midpoint to midpoint. ~~$1m^2$~~ We placed $1m^2$ quadrats at 0m, 10m, and 20m along the eastside of the transect. Using GPS we recorded the latitude/longitude coordinates of each corner of the plot as well as the start and end points of the transect. We identified the overall community type within each plot as: tree, shrub, or herbaceous. Community type was defined as 30% coverage or more by the tallest canopy level, and we identified the three most abundant species within each level. The species within each quadrat along the plot transect were identified and each species was assigned a percentage range based on ground cover

within the quadrat: 1 = < 10%, 2 = 10-25%, 3 = 25-50%, 4 = 50-75%, 5 = > 75%.

In addition to the 8 plots, 2 separate $1m^2$ quadrats were set up near the snowline on the south-facing valley wall. We were unable to run a 30m x 30m plot in these areas because of slope steepness. The plots were oriented true north-south and the dominant species were identified and assigned a percentage cover as described before. For analysis, we divided the plots into 2 categories: sheep scat present and not present. We computed mean ground cover for each plant species within these categories from our quadrat data.

Results:

Vegetation Boundaries

Shrub areas were dominantly willow, Salix spp., throughout the upper valley. The north-facing slope was predominantly alpine vegetation such as low-lying shrub less than 10cm tall. The 2 outliers were willow islands at mean elevations of 1291m and 1312m with diameters of 470m and 220m respectively. (Fig. 5). The south-facing slope had a well defined shrub/alpine-meadow boundary at a mean elevation of 1280m (Fig. 4). The shrub-zone was confined laterally by a glacial moraine to the west and a limestone rockslide to the east. The valley floor surrounding the creek contained primarily willow on both sides at a mean elevation of 1235m.

Scat Collection

With the exception of 3 samples of sheep scat found on the valley floor, all scat samples were found above the shrub-alpine meadow boundary (Fig. 3). On the south-facing slope we found 5 fresh scat

samples and 7 samples from previous seasons. All 5 of the fresh samples were found above our observed snowline (Fig. 3). ~~3~~ Of the previous season scat samples, 3 were found above the snowline and 4 were found below. We found 6 scat samples from previous seasons but no new scat on the north-facing slope. On the valley floor we found 2 scat samples from previous seasons and 1 new scat sample. An established sheep trail was found near the previous season's scat samples on the north-facing slope, and recent beds characterized by melted snow, and soil disturbances, were found near the fresh scat located at higher elevations on the south-facing slope.

Vegetative Community Survey

Of the plots on the north-facing slope, 1 was herbaceous, 1 was shrub. On the south-facing slope 1 was herbaceous, 4 were shrub, and 1 plot was unvegetated limestone (rockslide scree ≤1m). Both of the single quadrats were herbaceous communities (Fig. 1). We identified 45 individual plant species within the 8 plots and 2 individual quadrats. Of the 45 species, 7 were found exclusively in plots where scat was present, 25 were found exclusively in plots when scat was not present, and the remaining 13 were found in plots both with and without scat (Fig. 2).

The average richness within each plot was 14 species with a minimum of 12 and maximum of 16. While the average richness was similar among all plots, scat-present plots had an overall lower diversity because of reoccuring plant species such as Salix reticulata and Dryas octopetela. In general, the north-facing slope was less diverse than the south-facing slope (Conner, 2008)

Discussion:

We found that sheep scat was not evenly distributed among vegetation communities in the upper Mill Creek Valley. Higher abundance of sheep scat was strongly correlated with higher elevation (Fig. 4). This is consistant with previous research observations that sheep inhabit steep slopes at higher elevations (Geist 1971).

Plant diversity was low in scat-present plots relative to non-scat plots. Scat-present plant species were dominantly low-lying shrubs, particularly D. octopetela and S. reticulata. Because sheep are known to be specific grazers (Geist 1971), this correlation could explain why particular plant species (i.e. food sources) were reoccuring. Although scat was not found on the north-facing slope, characteristic of relatively low plant diversity, the presence of previous season's scat suggests that sheep may use this slope as vegetation accessability changes throughout the year.

While we found multiple scat samples from various seasons, limitations did arise preventing a more thourough sweep of the valley. Weather conditions including an unusually low snowline hindered our ability to locate scat in higher elevations that may have otherwise been visible. Low lying clouds and rugged topography also interferred with satellite reception causing inconsistancy with our GPS units. The presence of our large group in the study area may have had an affect on sheep occupancy of the valley during the time of our field work.

Although our data were limited to 4 days of field work, it can be used in conjunction with ongoing research in Denali National Park and serve as a basis for future research in the Mill

Creek Valley. To ensure accuracy and completeness, future work for this project should be conducted in small, less intrusive groups. To account for the time scale of climate change, the research should be conducted perennially over many consecutive years to descriptively observe affects on vegetation boundaries and communities that may correspondingly change sheep habitats.

Acknowledgements:

This paper is dedicated to Megan Gahl. Her guidance and high spirits were pivotal to the success of our project. We would like to thank Bill Morris for nourishing our budding plant identification skills and for his unwavering dedication to the S.F. Society. Many thanks to our wonderful friends for all of their help in the field: Leif Mjos, Dave Mitchell, Michael Suttner, Devin Coogen, Vanessa Cunningham, Matt Holkeboer, Steve Morten. We thank the Wrangell Mountain Center and staff for providing an exceptional learning environment: Jessica Speed, Jared Steyaert, Kirsten Miller, Vanessa Milcox, Tim Bartholamus, and the Godfather Ben Shaine.

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PLOT & QUADRAT OVERVIEW

PLOT NO.	ELEVATION* (m)	DOMINANT SHRUB	DOMINANT HERBACEOUS	UNVEGETATIVE DESCRIPTION
1 erbaceous rth facing	1294m		1. M. paniculata 2. E. latifolium 3. P. sagitus	
2 hrub rth facing	1293	1. Salix spp.	1. L. arcticus 2. M. paniculata 3. E. latifolium	
3 shrub ith facing	1297	1. Salix spp. 2. P. fruticosa 3. S. reticulata	1. Carex/grass 2. S. stipulata 3. A. arctica	20m quadrat → soil cover 10-20%
4 shrub ith facing	1325	1. V. uliginosum 2. D. octopetala 3. S. reticulata	1. Carex/grass 2. L. arcticus 3. Bryophyte	<10% limestone <0.5m in diameter in quadrat #2 (10m)
5 shrub ith facing	1343	1. C. stelleriana	1. A. narcissiflora 2. E. latifolium	10m quadrat → 75% rock cover, limestone with veg. cover, <0.5m in diameter 20m quadrat → rocks, well vegetated, >1m in diameter
6 erbaceous ith facing	1346	1. S. reticnlata 2. S. aretica	1. S. stipulata 2. R. occidentalis	0m quadrat → <1m in diameter limestone
7 shrub th facing	1361	1. E. nigrum 2. V. uliginosum 3. D. octopetala	1. Carex/grass 2. Lycopodium 3. Lichen	
8 erbaceous ith facing	1377	1. S. reticulata	1. S. stipulata 2. A. narcissiflora 3. E. latifolium	~50% of plot dominated by rock slide, limestone ≤1m in diameter

* Elevations shown here are the average of the "Transect End" and "Transect Start" elevations for each plot

EPSCAT UADRAT	ELEVATION^Δ (m)	DOMINANT SHRUB	DOMINANT HERBACEOUS
SN-01 uth facing hrub	1500m	1. D. octopetala 2. S. reticulata	1. Carex/grass 2. S. acaulis 3. Lichen
N-05 th facing hrub	1500	1. S. arctica 2. S. rotundifolia	1. E. variegatum 2. A. richardsonii 3. Lichen

Elevations shown here were taken at the specific location

FIGURE 1 Summary of the study sites within Upper Mill Creek Valley, including location (north or south-facing slope), communi type (herbaceous or shrub), elevation, dominan species, and a description of any unvegetative observations within the site. Plots and quadrats outlined in bold indicate proximity to scat findings.

: | = <10% 2- 10 [illegible] 3- 25-50% 4- 50-75% 5- >75%

	SCAT NOT PRESENT			SCAT PRESENT (within 5m of plot)			
SPECIES	AVERAGE COVER	RANGE*	NO. OF QUADRATS	AVERAGE COVER	RANGE*	NO. OF QUADRATS	COMMON NAME
:mone narcissiflora	4.44%	0-2	11/18	9.06%	0-4	3/8	Windflower
emone richardsonii				7.8%	0-4	1/8	Yellow Anemone
rtemesia arctica	7.1%	0-2	13/18	8.4%	0-4	2/8	Frigid Wormwood
Carex / grass	17.5%	1-4	18/18	10.3%	0-3	5/8	
istilleja unalaschensis				0.6%	0-1	1/8	Paintbrush
ryas octopetala	5%	0-3	4/18	27.2%	0-5	4/8	
ilobium latifolium	7.5%	0-3	13/18	3.5%	0-2	3/8	River Beauty
Equisetum variegatum	0.8%	0-1	3/18	11.6%	1-5	2/8	Scouring Rush
Gentiana glauca				0.6%	0-1	1/8	Gentian
Lichen	1.9%	0-1	7/18	15.9%	0-5	4/8	
Lycopodium spp.	0.3%	0-1	1/18	7.8%	0-4	1/8	
Bryophyte	11.3%	0-4	5/18	10.6%	0-4	3/8	Moss
Oxyria digyna	0.3%	0-1	1/18	0.6%	0-1	1/8	Sorrel
dicularis spp.				0.6%	0-1	1/8	Lousewort
Salix arctica	1.8%	0-2	4/18	4.7%	0-3	1/8	Arctic Willow
alix reticulata	6.2%	0-4	7/18	35.3%	0-4	4/8	Dwarf Willow
alix rotundifolia				6.9%	0-3	2/8	Roundleaf Willow
Silene acaulis	0.3%	0-1	1/18	1.3%	0-3	2/8	Moss campion
Solidago				0.6%	0-1	1/8	Goldenrod
ccinium spp.				4.7%	0-3	1/8	Blueberry
contium delphinifolium	1.7%	0-1	6/18				Monkshood

FIGURE 9 Each of the 45 species identified within the study sites are categorized by average percentage cover through either or both of the following two categories: scat present (within five meters of site) or scat not present.

	SCAT NOT PRESENT			SCAT PRESENT (within 5m of plot)			
SPECIES	AVERAGE COVER	RANGE*	NO. OF QUADRATS	AVERAGE COVER	RANGE*	NO. OF QUADRATS	COMMON NAME
Aquilega formosa	1%	0-2	1/18				Columbine
Arctostaphylos alpina	1%	0-2	1/18				Bear Berry
Arnica alpina	1.3%	0-2	2/18				Alpine Arnica
Artemesia tilesii	5.6%	0-3	6/18				Wormwood
Astragalus umbellatus	1.5%	0-2	3/18				Hairy Arctic Milk Vetch
Cassiope stelleriana	11.8%	0-5	3/18				Moss Heather
Delphinium glaucum	0.8%	0-1	3/18				Larkspur
Empetrum nigrum	11.3%	0-5	5/18				Crow Berry
Equisetum arvense	0.8%	0-1	3/18				Horsetail
Geranium arianthum	3.9%	0-2	9/18				Crane's Bill
Heracleum lanatum	0.3%	0-1	1/18				Cow Parsnip
Lupinus arcticus	6.5%	0-4	7/18				Lupine
Mertensia paniculata	7.1%	0-3	6/18				Bluebell
Mysotis alpestrius	0.6%	0-1	2/18				Forget-Me-N
Petasites sagitus	6.5%	0-3	7/18				Colts foot
Polemonium acutiflorum	0.6%	0-1	2/18				Jacob's Ladde
Potentilla fruticosa	0.6%	0-1	2/18				Cinquefoil
Pyrola minor	0.3%	0-1	1/18				Lesser Wintergreen
Ranunculus occidentalis	2.5%	0-2	4/18				Western Buttercup
Salix spp.	7.2%	0-5	3/18				Willow
Sanguisorba stipulata	12.8%	0-5	4/18				Sitka Burne

FIGURE 2

	SCAT NOT PRESENT			SCAT PRESENT (within 5m of plot)			
SPECIES	AVERAGE COVER	RANGE*	NO. OF QUADRATS	AVERAGE COVER	RANGE*	NO. OF QUADRATS	COMMON NAME
Vaccinium uliginosum	1.5%	0-2	3/18				Bog Berry
Veronica wormskjoldii	0,6%	0-1	2/18				Alpine Veronica
Zygadenus elegans	0.6%	0-1	2/18				Death Camas

FIGURE 2

CONTRASTS BETWEEN NORTH & SOUTH-FACING SLOPES

		NORTH-FACING SLOPE	SOUTH-FACING SLOPE
ABIOTIC	Land / rock slides	· limestone present in slide · avalanches · more active slides than south-facing side	· larger clasts than north-facing side · avalanches · most slides covered with vegetation
	Glaciers		X
	Sun exposure	· sunlight later in the season · light blocked by topography	· sunlight earlier in the season · more sunlight during the season due to sun's high obliquity at this latitude
	Parent material for soil	· Nzina stone & McCarthy formations	· Chitistone limestone
	Topography	· mostly just one uniform steep slope	· rolling landscape with lots of knolls until higher elevations where there were steep slopes and cliffs
BIOTIC	P. fruticosa		X
	Ranunculus occidentalis		X
	M. paniculata	X	
	C. stelleriana		X
	Vaccinium spp.	X	
	S. rotundifolium	X	
	H. lanatum		X
	Solidago spp.	X	
	P. minor		X
	E. nigrum		X
	G. arianthum		X
	Sheep Scat	· ONLY OLD SCAT found on slopes · two new scats found on south side of valley floor	· new scat found high on slopes · old scat found high on slopes and in lower slopes and knolls

FIGURE 3 Summary of observed abiotic and biotic differences between the north and south-facing slopes of the study site. An (X) indicates presence on the respective slope. The species listed were found exclusively on either of the two slopes.

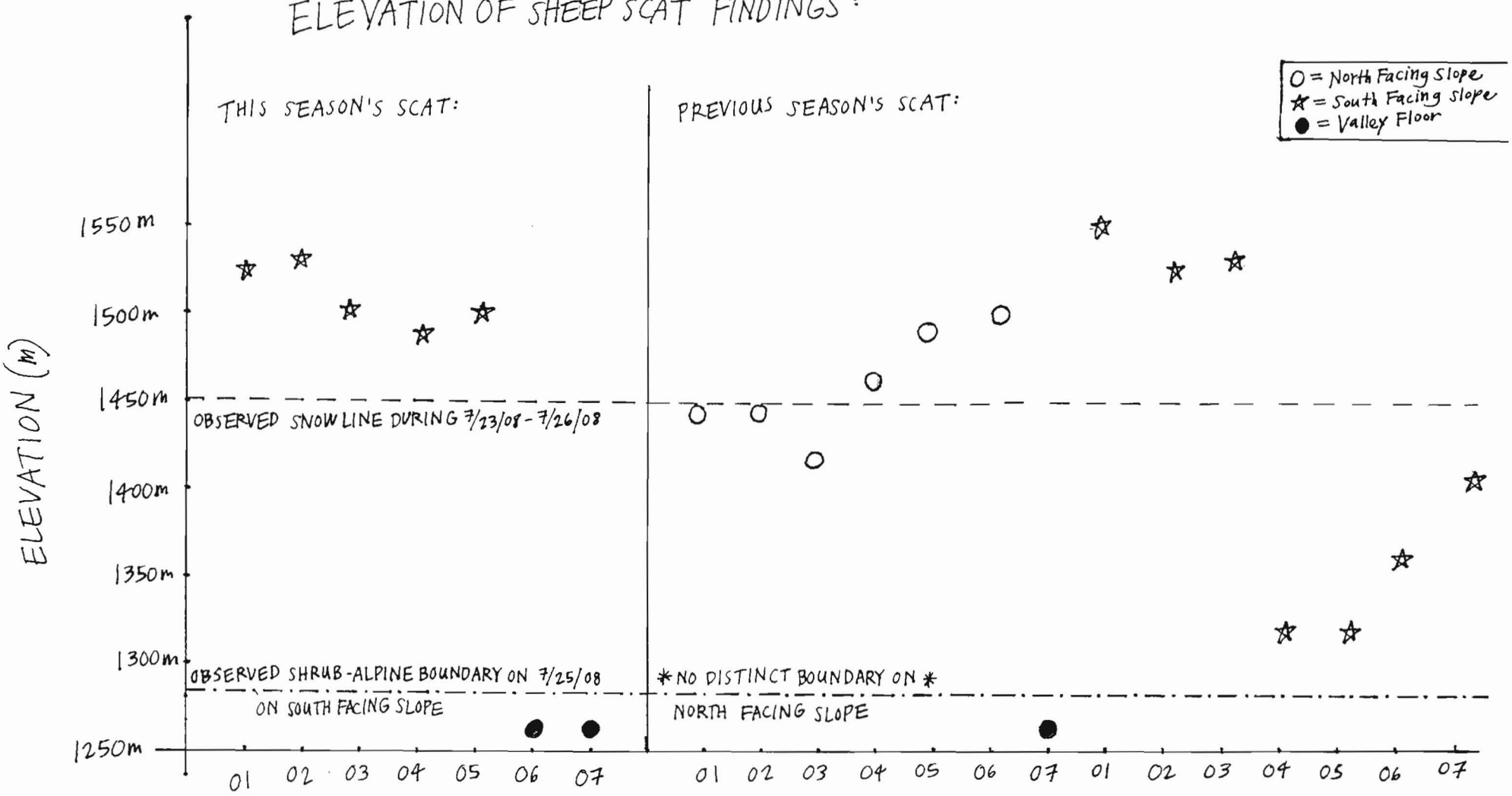


FIGURE 4 This graph delineates between this season's scat and previous season's scat as well as the elevations at which they were found

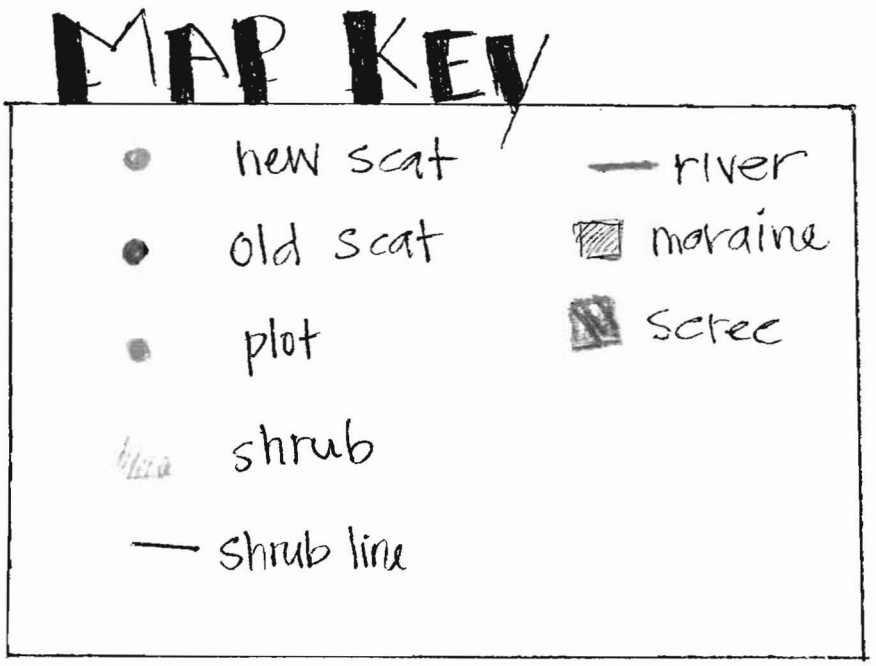
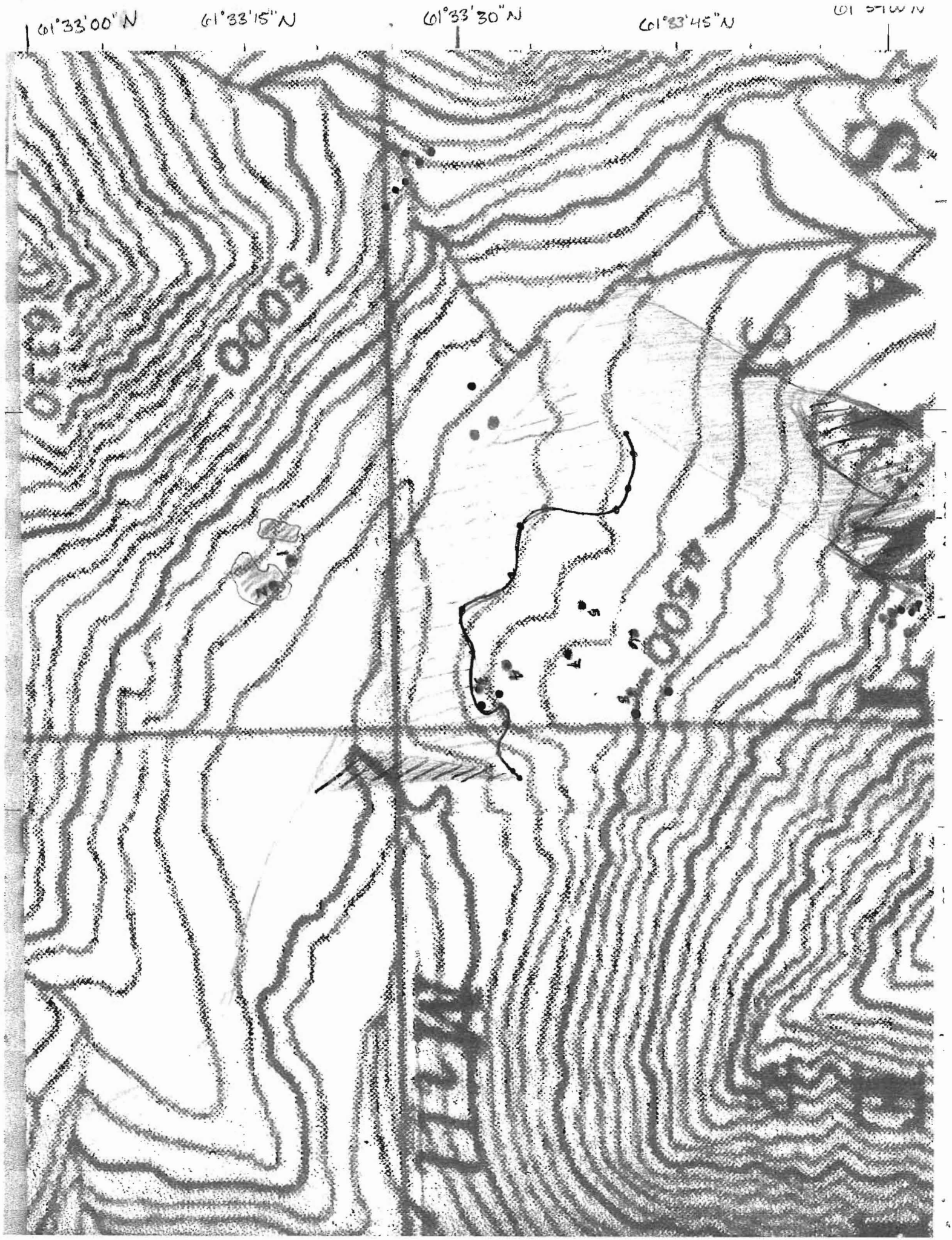


Figure 5 : Topographic map of study site including: the location of scat findings, plot and quadrat locations, the shrub-alpine boundary of the south-facing slope and the shrub islands on the north facing slope.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