SUMMER MOUNTAIN GOAT ACTIVITY AND HABITAT PREFERENCE IN COASTAL ALASKA AS A BASIS FOR THE ASSESSMENT OF SURVEY TECHNIQUES

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Abstract: Weather conditions in coastal south-central and south-east Alaska greatly limit the amount of time available for mountain goat censusing. The large area occupied by goats necessitates use of aerial surveys in determining population indices but such surveys have been extremely variable in their results. Goat activity and location within available habitat will influence the ease with which they can be located and counted; in particular, movements and activity change related to the onset and duration of clear weather are an important concern. Results of this study indicate that on clear days goats tend to congregate in larger groups, move higher in their range, closer to ridgelines and farther from trees, use more smooth habitat including snowbanks and exhibit a synchronized activity period in the late afternoon. Surveys conducted in late afternoon on clear days and timed sufficiently after the cessation of cloudy and rainy weather should provide close to optimum results.

Mountain goat distribution in Alaska is restricted predominantly to the south-central and south-east coastal ranges with northern termini extending inland into the Wrangell and Talkeetna Mountains at just over 62°N latitude. The main concentrations are in the wet, rugged coastal ranges which has necessitated a reliance on aerial reconnaissance for obtaining population indices over much of the region. Although aerial goat counts have been conducted by the Alaska Department of Fish and Game since 1959, results have shown great variation in total numbers and adult-kid ratios for specific areas both within and between years, and comparison of results is questionable. Summer aerial goat surveys carried out by Fish and Game personnel in a coastal south-east region with fixed wing aircraft provided seven counts which ranged from 30 percent to 97 percent of the total number observed from a helicopter (Ballard 1975). Since current management is based on such surveys a more detailed determination of their reliability is essential. This should involve knowledge of expected goat location and activity under various weather conditions and provide a measure of comparison with simultaneous ground surveys. This paper addresses the relation of goat group size, activity and habitat preference to weather condition.

Past observations on goats have produced comments on typical daily morning and evening feeding periods and suggesting these as the best times for conducting survey counts (Casebeer et al. 1950, Merriam 1965). Chadwick (1973) suggested that late afternoon-evening was the best time for censusing since feeding activities were more synchonous at that time. With respect to weather, it has been observed that goats tend to increase activity and emerge onto open slopes for feeding immediately following a storm which had caused them to seek shelter (Casebeer et al. 1950, Brandborg 1955, Chadwick 1973). Prolonged warm, sunny weather is characterized by a retreat to shaded areas (forest) or to snowbanks (Brandborg 1955), both habitats which tend to conceal goats. Inclement weather induces irregularities in the timing of normal activity patterns (Brandborg 1955) and may result in significant movements. For example, although Klein (1953) states that summer movements are little affected by weather he qualifies this with the case of severe storms which precipitate moves to leeward slopes and often to the upper fringes of forest.

Coastal south-east Alaska presents a somewhat different situation than encountered in most of the studies cited above because the region has typically inclement weather. Hence, irregularities in goat activity patterns might best describe those changes induced by the short clear spells. Thus movements, activity and habitat changes related to the onset of clear weather and acceptable survey conditions are an important concern in the south-east.

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STUDY AREA

The study area is located in south-east Alaska, 58° 30'N, 134°35'W, 25 km northwest of Juneau. Coastal ranges in the vicinity vary in height from 2500 m mountains within the huge ice-fields bordering British Columbia to more common 1500 m to 2100 m peaks nearer the coast. Tree-line in the region, characterized by spruce (Picea sitchensis) and hemlock (Tsuga Mertensiana) forest interspersed with thickets of alder (Alnus crispa), is generally about 800 m. Scrub and krummoltz occasionally approach 900 m and precipituous cliffs virtually devoid of tree growth sometimes span the drop from alpine to sea-level. The study area is a relatively discrete alpine zone of approximately 40 km^2 dominated by Stroller White Mountain (1570 m). Bounded to the north and east by glaciers and ice-fields, the study area slopes west and south into forested lowlands along the inland waterways of lower Lynn Canal (Fig. 1).

METHODS

The study took place during the months June through August, 1976. Data consist of 2,021 point-in-time observations on goat groups taken at 15 min. intervals and catagorized as to elevation, topography, slope exposure, slope angle, snow cover in vicinity, basic vegetation type, group composition and individual activity. An estimate of distance from nearest ridgeline and that to treeline was recorded for each group. Weather information was recorded at least every two hours while animals were under observation and included air temperature, wind speed and direction, humidity, cloud cover and precipitation type and rate. Major weather changes (defined below) were also recorded as time since last such change in conjunction with the 15 min. observations.

About nine km^2 of the study area included terrain which could be observed easily given good visibility. Family groups comprised primarily of adult females, kids and juveniles were the predominant subjects of observation. These totalled between 30 and 35 animals of the approximately 70 goats inhabitating the entire study area.

A group was defined as an individual or aggregation of goats 100 m or more from the nearest other individual or aggregation. The term group observation refers to one point-in-time recording of data on a particular group; individual observations refer to records on each individual made during a group observation. Graphical presentations below are ordinated in terms of these individual or group observations. Major weather types were separated as: clear, 0-50 percent cloud cover; partly-cloudy, 51-95 percent cloud cover; and cloudy, 96-100 percent cloud cover, fog and rain included. Weather types were divided into two periods: less than or equal to 5 hr and greater than 5 hr from the initiation of a particular type. Unless otherwise specified, observations during the transition period of 5 hr are not included in calculations pertaining to a particular weather type.

RESULTS

Weather types and the percent of observations made within them were distributed as shown in Table 1. Note the relatively small percentage of clear weather over the summer. Partly cloudy conditions are even less frequent indicating their existence as a rather short transition stage. Convectional afternoon cloudiness and thunder storms characteristic of continental mountains are generally lacking here where the controlling influences are cyclonic weather patterns from the ocean with rather abrupt changes between clear and stormy conditions.

Table 1. Percent distribution of weather types over the study period and within the time sampled.

Weather Type	Study time Span 15 June-21 Aug.	Observation Time Span	Number of "Group Observations"
Clear	29	39	42
Partly Cloudy	13	32	32
Cloudy	58	29	26

Diurnal activity patterns are somewhat different under the various weather types. These patterns are displayed in Fig. 2 where activity is reflected in a running average of active animals summed for hour intervals. Active animals are on their feet and may be feeding, standing, walking, nursing or playing. The graphs include all individual observations in each weather type assuming that the animals react more rapidly to weather change in their activity than, say in their group size, habitat or elevation locus.

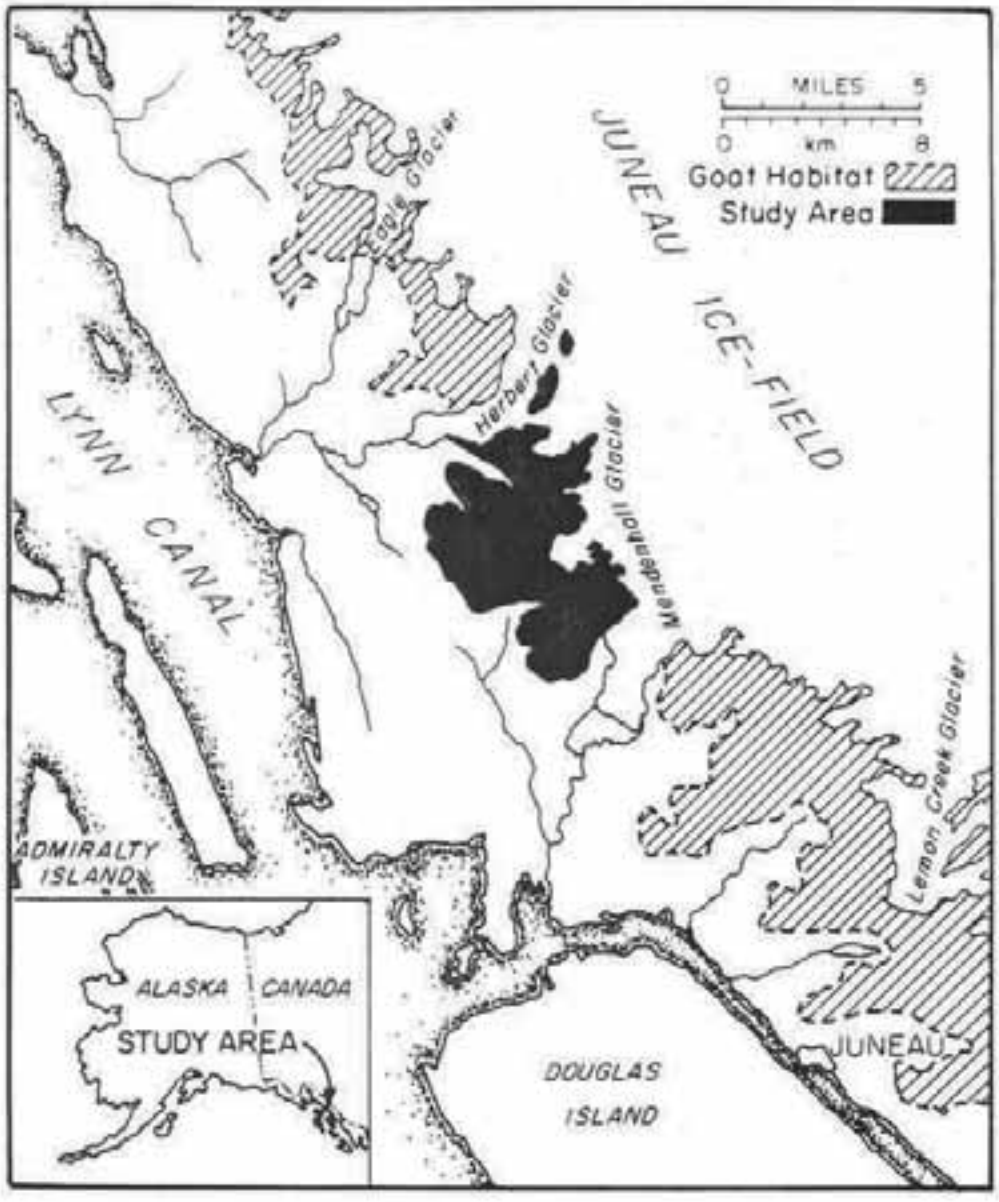

Figure 1. Location of study area.

Confidence limits (P=.05) have been established for at least two points on the graph (Fig. 2) in each weather type to provide a sample of variation within the data. Because of group synchrony in the activity of goats serial correlations between the activity observations exist and direct point to point comparisons between weather types would not be extremely meaningful. The confidence limits provide an approximation of the range in variance for all hours of the day and permits some comparison. The most significant differences between weather types in daily activity pattern are in the peaks during mid to late morning and late afternoon. A late afternoon (1900-2000 hr) activity peak in clear weather is evident as in an earlier (1700-1800 hr) but less pronounced peak during cloudy weather. A mid to late morning active period is demonstrable, though appearing successively later in partly cloudy and cloudy than in clear weather.

There may be differences in total daily active time under the various weather conditions. Through the hours 0800-2400 animals were overall less active in cloudy and rainy weather (53 percent active) and clear weather (56 percent active) with activity during partly cloudy conditions being greatest (61 percent active).

Groups ranged in number from 1 to 30 individuals. Group size, as exhibited by the mean of all group observations was 7.0; Table 2 outlines means, sample sizes and standard errors for group size relative to the weather types. The mean for partly cloudy conditions is intermediate and not significantly different from clear or cloudy weather respectively ($t=1.35$, $P > .1$; $t=52$, $P > .5$). However, a difference in means between clear and cloudy conditions is evident ($t=2.11$, $P < .05$) indicating that groups are larger on clear days.

Table 2. Group size under the different weather types

	Clear	Partly Cloudy	Cloudy
Mean Group Size	7.4	6.8	6.6
Sample Size (Groups)	n=781	n=276	n=289
Standard Error	.21	.39	.34

Use of different elevation zones during the various weather types is displayed in Fig. 3; percent of group observations is that within a specific weather type. Differential use or selection of elevation is very evident under the different weather regimes ($X^2=348$, $P < .005$). General elevation use was between 750 m and 1200 m with virtually no use below 750 m recorded here. Under partly cloudy conditions (>5 hr) goats are relatively high on the slopes, more closely approximating the distribution under clear weather. The indication is that a notable movement to higher elevations occurs following clearing weather.

Knowledge of distributional changes in elevation use under different weather regimes is important for planning and assessing surveys but general applicability may be somewhat limited due to effects of other habitat parameters on elevation range even at the same latitude. The recording of group distances from treeline and ridgeline was initiated in an attempt to provide a more common basis for comparing or combining altitudinally related information with other areas. Differences in goat distribution relative to ridgeline are evident under the various weather conditions ($X^2=137$, $P < .005$) as are use distribution differences relative to treeline ($X^2=280$, $P < .005$). Use of elevations above 1200 m (Fig. 3) virtually all of which is within 130 m of ridgeline in the study area, indicates increased use of ridgetop areas on clear days. Distance from ridgelines (Fig. 4) also indicates use of ridgetop zones on clear days, although the ridgeline data does not reflect as strongly the elevation changes related to weather as does the distance from treeline data (Fig. 4). This variation was probably effected by lateral movement of the goats toward the lower end of a watershed, thus bringing them in cloudy weather somewhat closer to the descending ridgeline without greatly changing the distance to treeline. Ridgeline elevation is generally more variable than treeline. Distance from ridgeline information would probably provide a rather equivocal comparison between areas of very different topography. Still it is evident that there is a significant movement bringing goats close to ridgeline and farther from treeline in clear weather.

Physical habitat selection is evident ($X^2=85$, $P < .005$) under the various weather conditions recorded (Fig. 5). Goats use smooth slopes and snowbanks more during clear weather than during cloudy weather. Use distribution of slope exposure was different ($X^2=243$, $P < .005$) according to weather type. Westerly aspects were preferred over southerly aspects in clearer weather. The overall use of slope exposure during this summer study period is shown in Fig. 6. In general it reflects the lay of the land, sloping to the west and south with peaks in the other directions abutting high icefields and glaciers, thus limiting available terrain to the east and north.

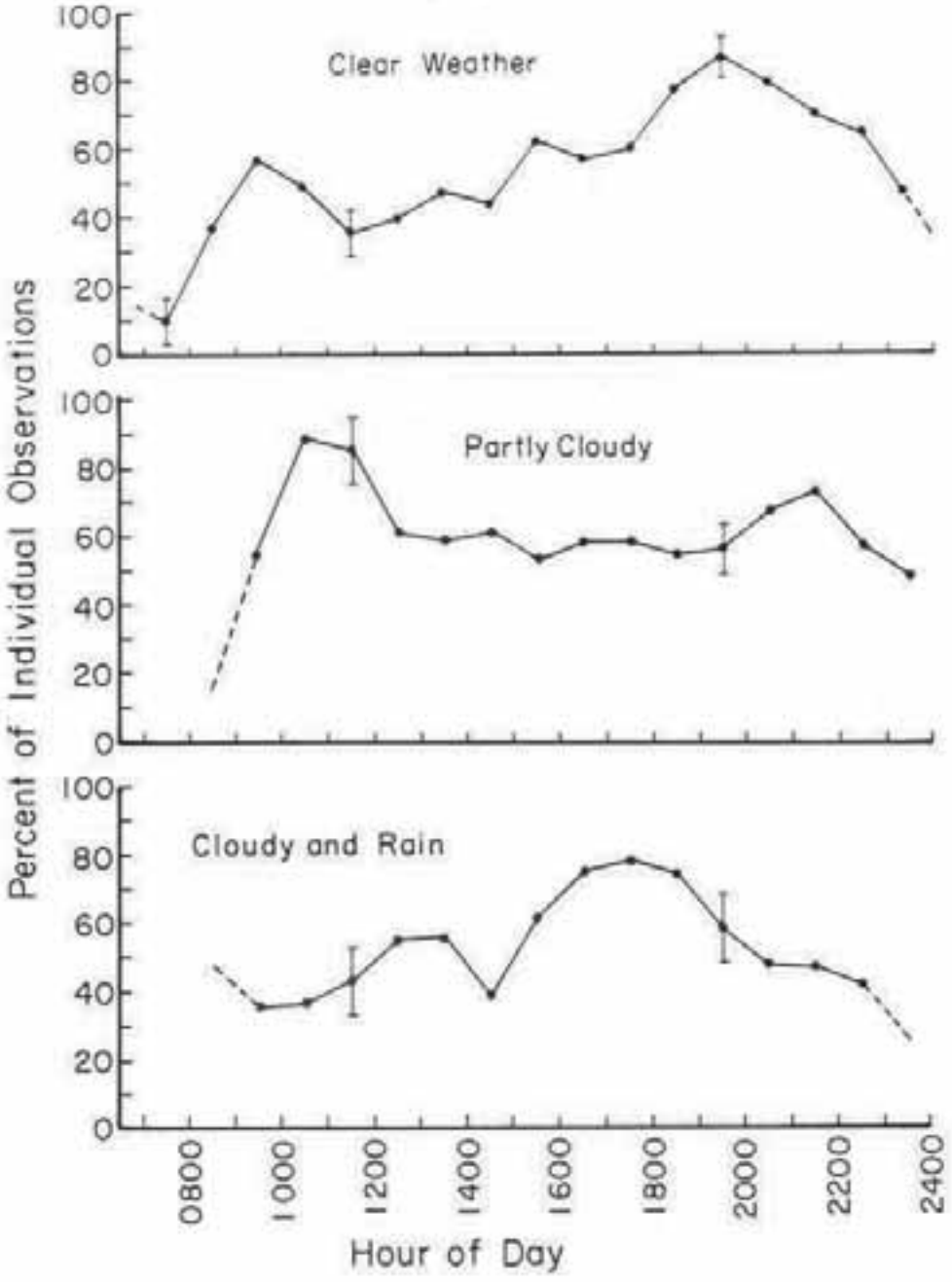

Figure 2. Daily activity pattern reflected in percent of active individuals.

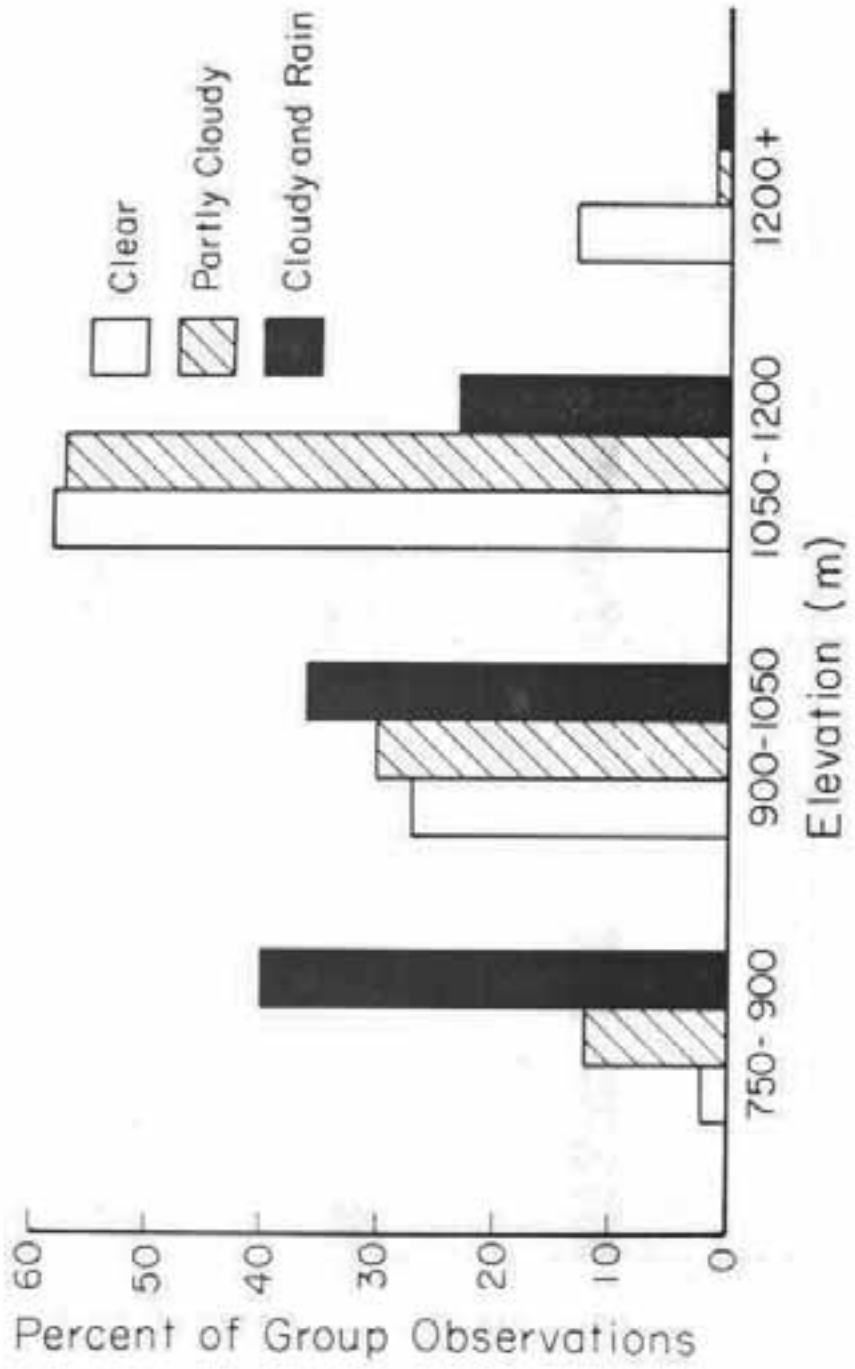

Figure 3. Differential use of elevation according to weather type.

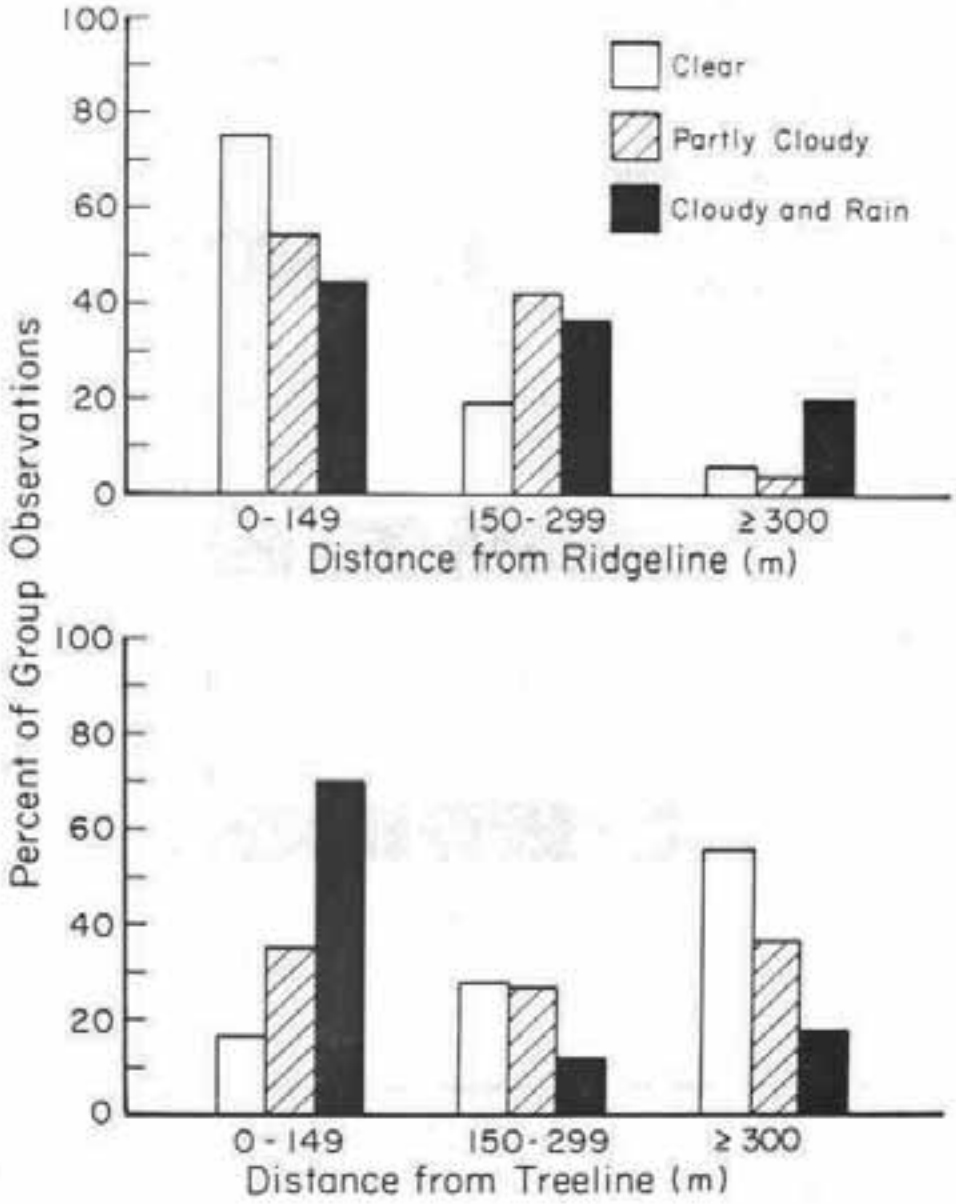

Figure 4. Differential use with respect to ridgeline (top) and treeline (bottom) according to weather type.

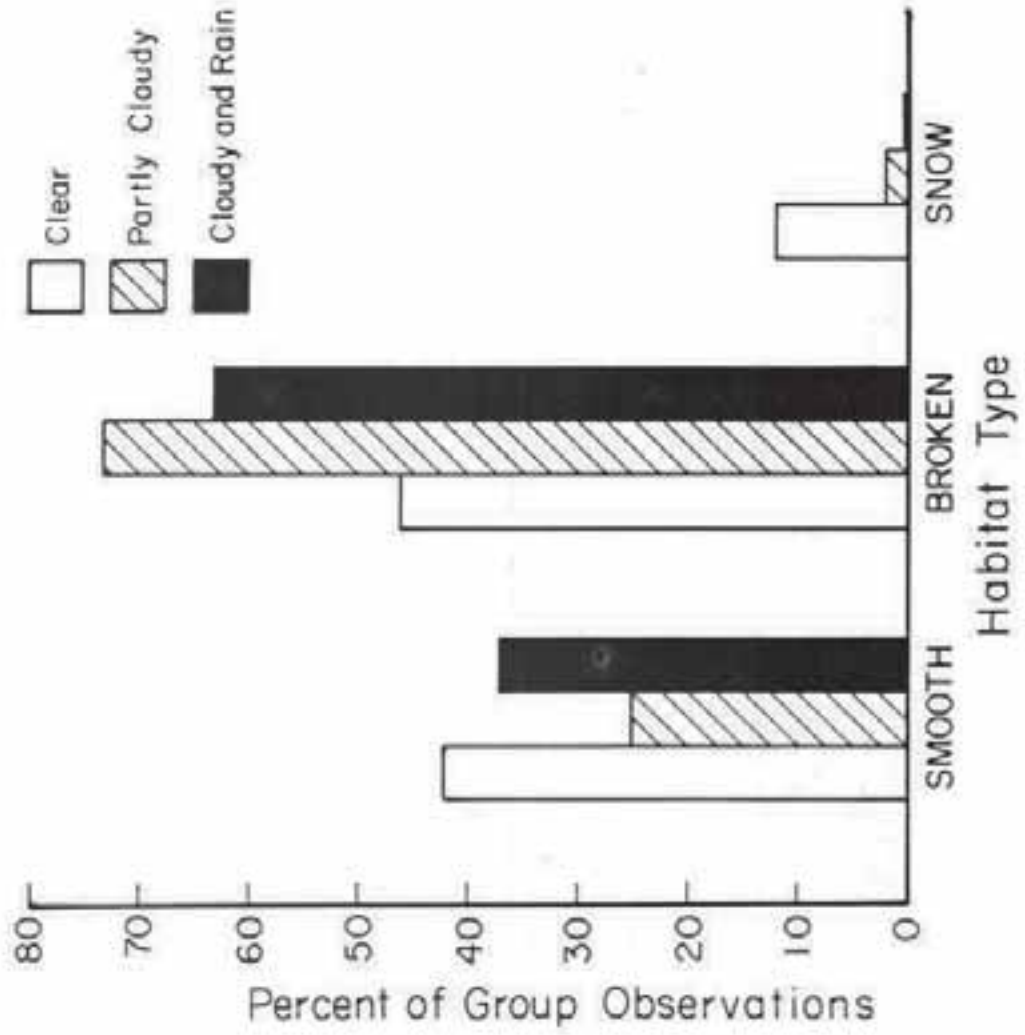

Figure 5. Physical habitat selection according to weather type.

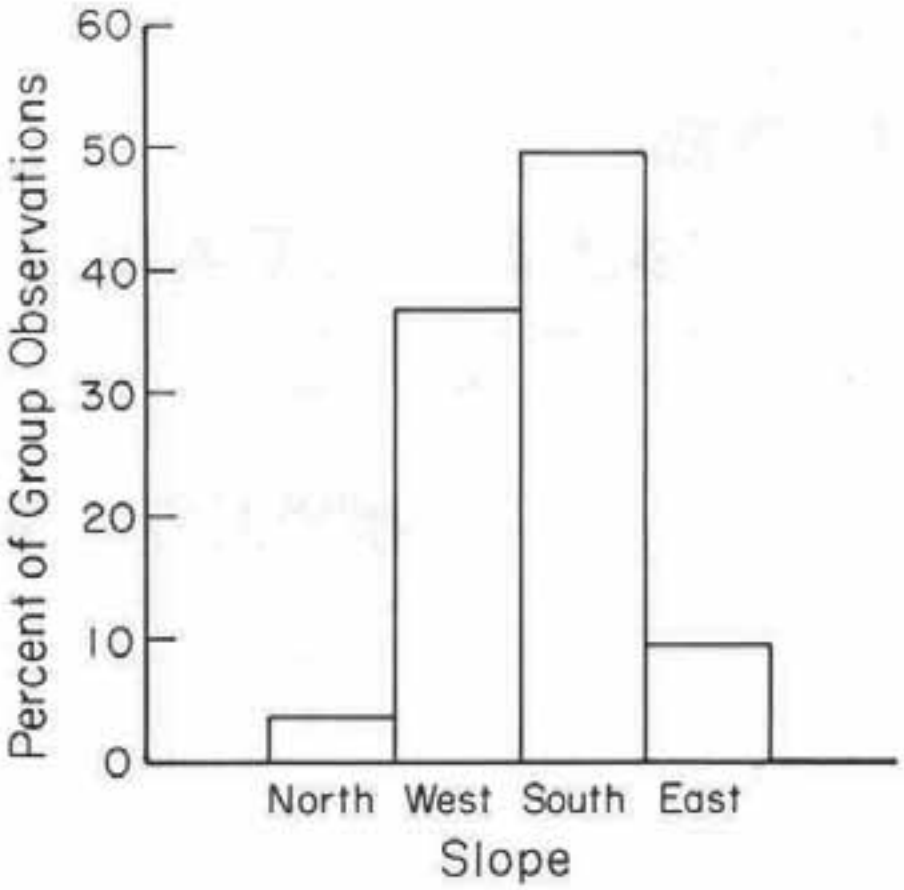

Figure 6. Overall use of slope exposure.

DISCUSSION

The results are somewhat site restrictive and will require a test of their applicability to other areas of goat habitat in the region. They suggest that in clear weather goats of coastal Alaska congregate in larger groups, use less rugged terrain and move higher, away from trees and nearer to ridgelines. Goats are also more active in the late afternoon during clear weather than under any other weather conditions or at any other time. Surveys conducted during late afternoon in clear weather should provide optimum results. Before surveying, at least 5-10 hours should follow the initiation of clearing weather to allow for goat movements to habitat typical of clear weather.

There are drawbacks to air surveying on sunny days in goat habitat. The strong light contrast between sunny and shaded slopes in late afternoon is difficult to adjust to in searching for goats. Mid-day conditions provide more even light but there is strong glare from the snowfields and goats will be less active. There have been suggestions that partly cloudy or cloudy weather with the clouds high and not obstructing visibility may provide good conditions for locating goats in a survey (Ballard 1975). Such a possibility deserves further investigation in light of evidence that goats are more active through the day under partly cloudy conditions and with close to full cloud cover light contrast would not be a problem in searching for goats. There should still, though, be a substantial (5-10 hr) wait following cessation of prolonged cloudy and especially rain or storm conditions before surveying is begun. The availability of such high cloud conditions will determine its usefulness.

Finally, in determining survey accuracy it is desirable and should be feasible to derive, through comparative simultaneous ground and aerial counts, a statistically acceptable accuracy for aerial surveys under a particular range of conditions such that a few yearly replicate counts would provide a good estimate of numbers and adult-kid ratios in selected trend determination areas.

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