Wildlife Research Annual Progress Report

Mountain Goat Assessment and Monitoring along the Juneau Access Road Corridor and near the Kensington Mine, Southeast Alaska

Kevin S. White and Neil L. Barten

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Alaska Department of Fish and Game
Division of Wildlife Conservation
P. O. Box 110024, Juneau, AK 99811
Tel: 907-465-4353

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Cover photo: Mountain goat #LG-107 walking in front of the Meade Glacier in mid-August 2008. A seven year old male, this animal weighed 307 lbs. at time of capture.

Contents

INTRODUCTION

This annual progress report was prepared to meet the reporting requirements for State of Alaska Department of Transportation and Public Facilities and Coeur Alaska. Funding for this project was made available in September 2005 and this report summarizes activities completed by September 30, 2008.

Background

Coeur Alaska has recently re-initiated development activities at the Kensington mine site, located a short distance northwest of Berners Bay. In addition, the Department of Transportation and Public Facilities is planning to construct an all-season highway between Echo Cove and the Katzehin River. Among the wildlife species potentially affected by mine development and road construction activities are mountain goats (Oreamnos americanus). A small-scale study of mountain goats conducted in the vicinity of the Kensington mine by Robus and Carney (1995) showed that goats moved seasonally from high alpine elevations in the summer and fall to low, timbered elevations during winter months. One of the main objectives of the Robus and Carney (1995) study was to assess the impacts of the mine development activities on habitat use, movement patterns and, ultimately, productivity of mountain goats. However, the mine never became operational, thus these objectives could not be achieved, and by 1995 goat monitoring in the area wound down and eventually ended. Currently, the mine is in the process of re-opening and the Alaska Department of Fish and Game maintains that many of the same concerns that prompted the Robus and Carney (1995) study are still valid and need to be addressed. In addition, large-scale plans for development of the Juneau Access road raise new, potentially more substantial, concerns regarding not only the enlarged "footprint" of industrial development activities in eastern Lynn Canal, but also the cumulative impacts of both development projects on wildlife resources.

The potential effects of mining and road development activities on local mountain goat populations in the vicinity of the Kensington mine and eastern Lynn Canal are not well known. However, studies conducted elsewhere indicate that mountain goats can be negatively impacted by industrial development activities. Such effects include temporary range abandonment, alteration of foraging behavior and population decline (Chadwick 1973, Foster and Rahs 1983, Joslin 1986, Cote and Festa-Bianchet 2003). Consequently, information about the distribution of mountain goats proximate to the mine and road development corridor is needed to determine the extent to which populations may be affected by associated industrial activities. Information collected by Robus and Carney (1995), in the vicinity of Kensington mine, as well as Schoen and Kirchhoff (1982), near Echo Cove, suggest that spatial overlap between mountain goats and the proposed industrial activity will be most pronounced when goats are over-wintering in low-elevation habitats. In addition, it is not clear where goats spend non-winter months and, by extension, the spatial extent to which development activities are thereby translated across the landscape.

In response to the above concerns, the Alaska Department of Fish and Game, with funding provided by the Department of Transportation and Public Facilities and Coeur Alaska, has initiated monitoring and assessment activities to determine possible impacts of road construction and mine development on mountain goats and identify potential mitigation measures, to the extent needed. Assessment and monitoring work includes collection of vital rate, habitat use and movement data from a sample of radio-marked mountain goats in addition to conducting annual aerial population abundance and productivity surveys. These efforts are aimed at providing the Alaska Department of Fish and Game with information necessary to appropriately manage mountain goats in the proposed areas of development.

STUDY OBJECTIVES

This research is designed to investigate the spatial relationships, vital rates and abundance of mountain goats in the Berners Bay and upper Lynn Canal area. The specific objectives are as follows:

1) Determine seasonal movement patterns of mountain goats in areas near the Kensington mine and Juneau Access road corridor;

2) Characterize mountain goat habitat selection patterns and the extent of spatial overlap with areas impacted by Kensington mine and Juneau Access road corridor development activities;

3) Estimate reproductive success and survival of mountain goats in areas near the Kensington mine and Juneau Access road corridor; and

4) Estimate mountain goat population abundance and composition in areas near the Kensington mine and Juneau Access road corridor.

STUDY AREA

Mountain goats were studied in a ca. 600 km^2 area located in a mainland coastal mountain range east of Lynn Canal, a post-glacial fiord located near Haines in southeastern Alaska. The study area is oriented along a north-south axis and bordered in the south by Berners Bay (58.76N, 135.00W) and by Dayebas Creek (59.29N, 135. 35W) in the north. Within this area, three separate study sites were delineated based on the actual or expected extent of industrial activity occurring in or near each locality.

An additional study area located east of Berners Bay was established in spring 2006. This area was not originally included in the study design however recent information about road construction timelines resulted in a re-evaluation of the efficacy of conducting research activities in this area. Research efforts in this area will be limited in scope and low intensity sampling in this area is intended to provide managers with baseline information needed to assist future management efforts in light of the road construction, gravel crushing and/or stock-piling that is likely to occur in this area. Additional ADFG funding was allocated to partially offset costs associated with research activities in this area.

Elevation within the study areas range from sea-level to 6300 feet. This area is an active glacial terrain underlain by late cretaceous-paleocene granodiorite and tonalite geologic formations (Gehrels 2000). Specifically, it is a geologically young, dynamic and unstable landscape that harbors a matrix of perennial snowfields and small glaciers at high elevations (i.e. above 4000 feet) and rugged, broken terrain that descends to a rocky, tidewater coastline. The northern part of the area is bisected by the Katzehin river, a moderate volume (ca. 1500 cfs; USGS, unpublished data) glacial river system that is fed by a tributary of the Juneau Icefield.

The maritime climate in this area is characterized by cool, wet summers and relatively warm snowy winters. Annual precipitation at sea-level averages 55 inches and winter temperatures are rarely less than 5º F and average 30º F (Haines, AK; National Weather Service, Juneau, AK, unpublished data). Elevations at 2600' typically receive ca. 250 inches of snowfall, annually (Eaglecrest Ski Area, Juneau, AK, unpublished data). Predominant vegetative communities occurring at low-moderate elevations (<1500') include Sitka spruce (Picea sitchensis)-western hemlock (Tsuga heterophylla) coniferous forest, mixed-conifer muskeg and deciduous riparian forests. Mountain hemlock (Tsuga mertensiana) dominated 'krummholtz" forest comprises a subalpine, timberline band occupying elevations between 1500-2500 feet. Alpine plant communities are composed of a mosaic of relatively dry ericaceous heathlands, moist meadows dominated by grasses and forbs and wet fens. Avalanche chutes are common in the study area, bisect all plant community types and often terminate at sea-level.

Figure 1: Mountain goat capture site near Mt. Selby. Photo shows LG101 (5 yr-old male) and HD500 helicopter. Orange colored GPS radio-collar and red ear tags, used for monitoring purposes and identification during aerial surveys, are also visible.

METHODS

Mountain Goat Capture

Mountain goats were captured using standard helicopter darting techniques and immobilized by injecting 3.0 - 2.55mg of carfentanil citrate, depending on sex and time of year (Taylor 2000), via projectile syringe fired from a Palmer dart gun (Cap-Chur, Douglasville, GA). During handling, all animals were carefully examined and monitored following standard veterinary procedures (Taylor 2000) and routine biological samples and morphological data collected. Following handling procedures, the effects of the immobilizing agent was reversed with 100mg of naltrexone hydrochloride per 1mg of carfentanil citrate (Taylor 2000). All capture procedures were approved by the State of Alaska Animal Care and Use Committee.

GPS Location Data

Telonics TGW-3590 GPS radio-collars (Telonics, Inc., Mesa, AZ) were deployed on most animals captured (Figure 1); eight Telonics MOD-500 VHF radio-collars were deployed on an experimental basis. GPS radio-collars were programmed to collect location data at 6-hour intervals (collar lifetime: 2-3 years). During each location attempt, ancillary data about collar activity (i.e. percent of 1-second switch transitions calculated over a 15 minute period following each GPS fix attempt) and temperature (degrees C) were simultaneously collected. Complete data-sets for each individual were remotely downloaded (via fixed-wing aircraft) at 8-week intervals. Location data were post-processed and filtered for "impossible" points and 2D locations with PDOP (i.e. position dilution of precision) values greater than 10, following D'Eon et al. (2002) and D'Eon and Delparte (2005).

Diet Composition

Fresh fecal pellets were collected from live-captured animals during the summer-fall period (late-July to mid-October). Fecal pellet samples were also collected opportunistically during winter reconaissance and snow surveys. Individual samples collected from live-captured animals during 2005-2006 summer-fall period (Females, n = 18; Males, n = 28) and a single composite sample collected in february 2006 were sent to Washington State University (Wildlife Habitat Analysis Lab, Pullman, WA) for dietary analyses. Specifically, microhistological analyses of plant cell fragments in pellet samples were conducted to provide an estimate of diet composition for individual mountain goats and the winter composite sample. Data were subsequently summarized by sex-class to determine whether diet composition varied between males and females. This preliminary analyses did not account for differential digestability of each dietary food item identified in diets; an analysis is planned for the future. Nonetheless, while results do not provide an accurate estimate of actual diet intake patterns they do provide a relaible estimate of relative differences in diet composition between males and females.

Habitat Selection and Movement Patterns

Altitudinal Distribution.—Comprehensive analyses of mountain goat habitat use and movement patterns will not be conducted until all GPS location information is collected (i.e. 2011). Nevertheless, preliminary analyses focused on describing sex specific variation in terrain use, and movement patterns were conducted using a subset of the data (White 2006). Additional topics related to altitudinal and spatial distriution have been addressed in White et al. (2006, 2007).

Winter Severity and Snow Modeling Data Collection

Winter distribution of mountain goats is strongly influenced by snow depth and distribution. Since patterns of snow accumulation vary at both small and large spatial scales it is often necessary to collect site-specific field data in order to accurately characterize these relationships within focal areas. Unfortunately, standardized snow depth monitoring information is extremely limited within the study area and additional information is needed in order to properly characterize spatial patterns of snow accumulation and, ultimately, mountain goat winter distribution. Consequently, we initiated field efforts designed to create a snow depth database in order to generate spatially explicit snow depth models within the study area.

Standardized field surveys were conducted in order to estimate patterns of snow depth as it related to habitat type (i.e. forested/non-forested), altitude, and slope aspect (Figure 2). These preliminary efforts focused on four sites located in different mountain goat winter ranges. During surveys snow depth was measured at geo-referenced locations along an altitudinal gradient (beginning at sea level). Snow measurements were replicated at each sampling location (n = 5) and associated covariate information was collected. Sampling locations were spaced at regular (100-200m) intervals, depending upon terrain complexity. Steep (>35 degrees), exposed slopes were, generally, not sampled due to safety considerations. In addition, daily climate information for reference weather stations was acquired from the National Weather Service (Haines Weather Station).

Figure 2: Winter snow conditions at 3000 feet on Echo Ridge, 3/31/08. At this subalpine site, snow was heavily drifted and estimed at ca. 9 feet, about 10 inches less than 2007. Wolverine tracks were seen in this area though mountain goat sign was not evident above ca. 1500 ft.

Reproduction and Survival

Kidding rates and subsequent survival were estimated by monitoring individual study animals during monthly surveys using fixed-wing aircraft (Heliocourier, Piper PA-18 Super Cub) equipped for radio-telemetry tracking. During surveys, radio-collared adult female mountain goats were monitored to determine whether they gave birth to kids and, if so, how long they survived. Monitoring kid production and survival was only possible during the non-winter months when animals could be reliably observed in open habitats. We assumed that kids did not survive winter if they were not seen with their mothers the following spring. Cases in which kid status assessments were equivocal were filtered from the data set and not used for subsequent estimates of kid survival.

Mortality of individual radio-collared mountain goats was determined by detecting radio-frequency pulse rate changes during monthly monitoring surveys. In cases where mortality pulse rates were detected, efforts were made to investigate sites as soon as possible via helicopter or boat. To the extent possible, all mortalities were thoroughly investigated to ascertain the cause of death and relevant biological samples collected. We determined date of mortalities via examination of activity sensor data logged on GPS radio-collars. Annual survival of radio-collared animals was estimated using the Kaplan-Meier procedure (Pollock et al. 1989). This procedure allows for staggered entry and exit of newly captured or deceased animals, respectively.

Population Abundance and Composition Estimation

Aerial Surveys.—Population abundance and composition surveys were conducted using fixed-wing aircraft (Heliocourier and PA-18 "Super Cub") and helicopter (Hughes 500) during August-Septmeber 2007. Original project planning required flying 3 replicate surveys in the Lions Head, Sinclair and Villard study areas. Additional funding provided by the Alaska Department of Fish and Game provided the opportunity to fly surveys in the East Berners area and additional replicate surveys in the three focal study areas.

Aerial surveys were typically conducted when conditions met the following requirements: 1) flight ceiling above 5000 feet ASL, 2) wind speed less than 20 knots, 3) sea-level temperature less than 65 degrees F. Surveys were typically flown along established flight paths between 2500-3500 feet ASL and followed geographic contours. Flight speeds varied between 60-70 knots. During surveys, the pilot and experienced observers enumerated and classified all mountain goats seen as either adults (includes adults and sub-adults) or kids. In addition, each mountain group observed was checked (via 14X image stabilizing binoculars) to determine whether GPS-collared animals were present. Flight conditions, terrain complexity and animal behavior often complicated efforts to determine whether observed mountain goats were collared. As a result, the number of adults for which collar presence could be ascertained with a high degree of confidence was also recorded for each group observed.

Estimating the probability of observing mountain goats on a given survey (i.e. sightability) is critical for deriving population size estimates for focal areas. This is typically achieved by comparing the number of marked animals in an area to the number of marked animals actually seen (or re-sighted) during a survey. This fairly simple procedure can be complicated when its not always possible to assess whether observed animals are marked. This situation occurs on mountain goat surveys and requires additional refinement of standard mark-resight population estimators. New analytical methods appropriate for estimating mountain goat population size in this study are currently being developed. As a result, mountain goat survey data were summarized in this report to include estimates of population composition and the minimum number of mountain goats seen on surveys (i.e. the number observed) but not the estimated actual number of mountain goats in focal areas.

Figure 3: Photograph taken through a spotting scope of LG43 (and yearling) engaged in a dominace interaction with a unmarked adult female (and kid) that occurred during an GPS radio-collar activity sensor validation trial on July 1, 2008, Mt. Villard.

Ground Surveys.—Evaluation of ground-based techniques for estimating mountain goat population size and composition were conducted in a small portion of the Lions Head study area (i.e. 13.2 km^2) in June 2006, the Mt. Villard area during June 2007 and the Mt Villard and Mt Selby areas during June-July 2008. Previous research has concluded that aerial surveys are often inadequate for providing accurate estimates of the proportion of adult males and females, as well as sub-adults during aerial surveys (Cote and Festa-Bianchet 2003); only the proportion of adults and kids in a population can be reliably estimated. As a result, ground-based survey techniques were tested to evaluate whether this method might serve as a reliable tool for classifying individuals of separate sex and age classes during survey efforts.

Additional field efforts involved collection of GPS-collar activity sensor validation data. In these cases, individual study animals were observed during pre-programmed activity sensor evaluation periods (i.e. 15 minute intervals following fix initiation events)(Figure 3). During observation periods, detailed behavioral data were collected using focal animal sampling procedures (Altman 1974).

RESULTS AND DISCUSSION

Mountain Goat Capture and Handling

Capture Activities.—Mountain goats were captured over 5 days between August 16-17 and 19 and September 21 and 24, 2008. Overall, 33 animals were captured using standard helicopter darting methods (Appendix 1). Twenty-five animals were deployed with Telonics TGW-3590 GPS radio-collars and 8 were deployed with Telonics MOD-500 VHF radio-collars (including 4 re-captures). We deployed VHF radio-collars on a subset of captured mountain goats because battery life-span is significantly longer (radio-collar battery life span: VHF = 8 years, GPS = 2-3 years). The extended life span of VHF radio-collars will enable collection of supplementary mountain goat survival and reproduction data and reduce the frequency in which mountain goats must be captured.

Helicopter captures were attempted during periods when mountain goats were distributed at high elevations and weather conditions were favorable (i.e. high flight ceiling and moderate wind speed). Additionally, captures were scheduled to avoid periods within 8 weeks of parturition in order to avoid unnecessary disturbance of adult females and associated neonates. Captures were attempted in areas where mountain goat access to dangerously steep terrain was limited. As a result of these constraints, opportunities to capture mountain goats were fairly limited. Nevertheless, given the fairly large area of study and decent summer weather conditions, it was typically possible to capture approximately six mountain goats per day of effort.

Biological Sample Collection.—During handling procedures, standard biological specimens were collected and morphological measures recorded. Specific biological samples collected from study animals included: whole blood (4 mL), blood serum (8 mL), ear tissue, hair and fecal pellets. Whole blood, serum and fecal pellet subsamples were sent to Dr. Kimberlee Beckmen (ADFG, Fairbanks, AK) for disease screening. In addition, tissue sub-samples were sent Dr. Steeve Cote/Aaron Shafer (University of Laval, Quebec) for inclusion in a broad-scale mountain goat population genetics analysis.

Diet Composition.—Preliminary estimates of diet composition during the summer-fall period indicate that four major forage types were the most important constituents of mountain goat diets. Specifically, sedges/rushes, lichens, forbs and ferns (in order of decreasing importance) comprised 85% of diets (Appendix 2). Interestingly, some differences in diet composition between the sexes was evident. In particular, preliminary evidence suggests that sedges/rushes were more common in male diets while ferns were more common in female diets (Figure 4). Overall, the most common individual food items in diets during summer-fall were *Carex* sp. (20.7%), *Luzula/Juncus* sp. (14.4) (sedges/rushes), *Cladonia* sp. (11.4)(lichen), *Lupinus nootkatensis* (8.6%)(forb) and unidentified fern rhizomes (7.4%)(Figure 5a, Appendix 2). During winter, diets were overwhelmingly composed of confier needles (*Tsuga* sp., 72.5%) and also included *Lobaria* sp. lichen (11.7) and *Vaccinium* sp. (9.9%)(Figure 5b, Appendix 2).

Mountain Goat Body Mass.—Data relating to morphological characteristics of mountain goats were collected for all animals, when practicable. Preliminary analysis of age- and sex-specific body mass were conducted. Body mass data were standardized following Cote et al. (1998) to control for the effects of capture date on body mass and

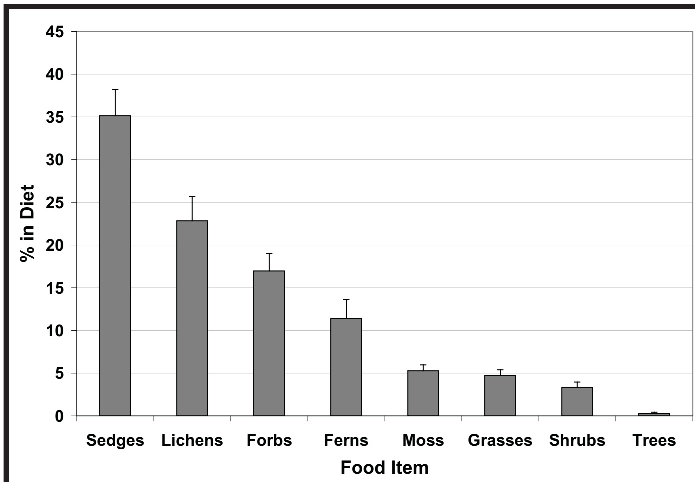

Figure 5a: Percent diet composition of all mountain goats (sexes combined) between late-July to mid-October, 2005-2006 in the Lynn Canal study areas. Estimates are not corrected for differential digestibility of food items.

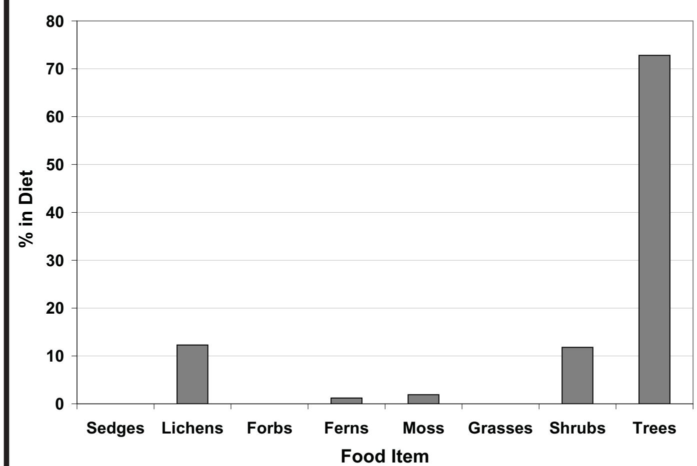

Figure 5b: Percent diet composition of mountain goats (unknown sex) in mid-February, 2006 in the Echo ridge area. Estimates are not corrected for differential digestibility of food items.

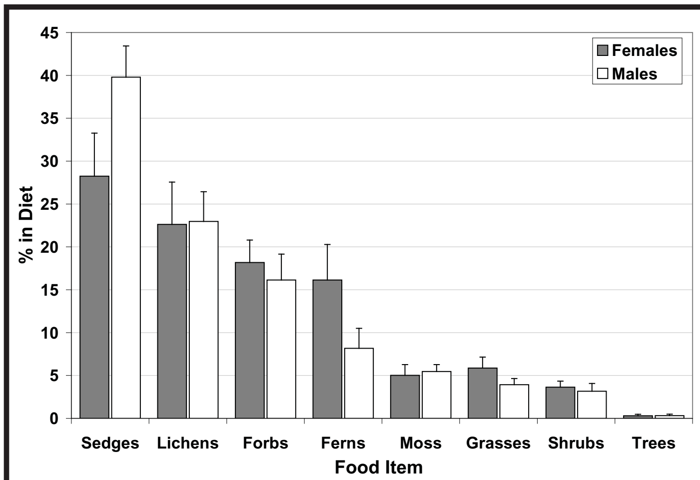

Figure 4: Percent diet composition of male and female mountain goats between late-July to mid-October, 2005-2006 in the Lynn Canal study areas. Estimates are not corrected for differential digestibility of food items.

allow for comparisons with other studies.
Preliminary analyses suggest that body mass of adult females is less for animals with kids in mid-summer than those that did not have kids (Figure 6). This relationship is consistent with past studies that demonstrate energetic costs associated with parturition and lactation negatively influence body condition in ungulates.

Standard morphological measurements such as chest girth can be reliable predictors of animal body mass. Preliminary analyses indicate chest girth measurements were better at predicting body mass for males than females, though in both cases relationships between these variables were reliable (Figure 7a, 7b). The chest girth/body mass relationship is likely to be of utility for individuals interested in a simple and reasonably precise technique for estimating body mass in the field such as hunters.

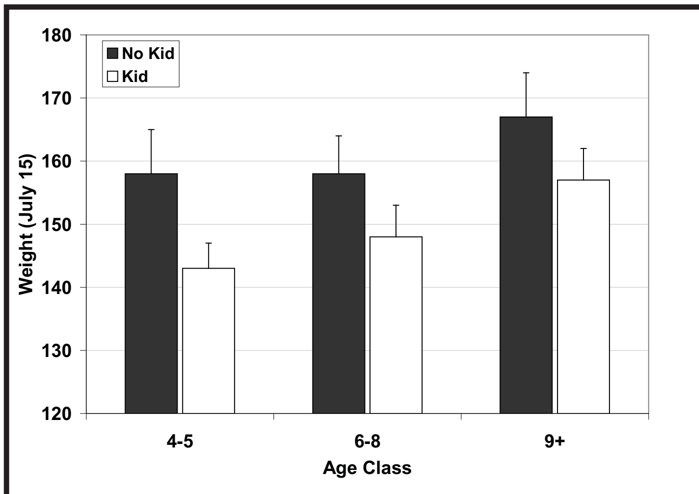

Figure 6: Standardized body weights for female mountain goats with and without kids at heel in late-summer.

GPS Location Data

GPS System Performance.—The performance of GPS radio-collars (as of 8/21/07) has been evaluated for 79 collars deployed since the beginning of the study. In general, the remote GPS data collection system used in this study worked as expected. We did not encounter any problems with GPS collar performance, nor did significant problems occur with remote data download attempts. This high level of success was achieved despite occasionally poor weather conditions and, in some cases, substantial download distances between aircraft and mountain goats (i.e. up to 3 miles). However, several pre-programmed bi-monthly GPS data download periods were missed due to weather conditions. Nevertheless, it was always possibly to download missed GPS data on subsequent surveys.

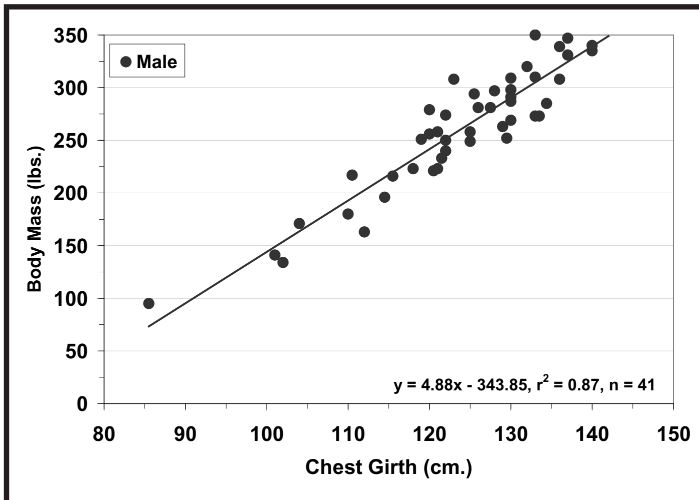

Figure 7a: Relationship between body mass and chest girth for male mountain goats, Lynn Canal, AK

Collar Retrieval.—Of the 11 animals that died during 2007/2008, all collars were retrieved from the field and GPS data downloaded from the collar. Twenty-six GPS collars deployed in fall 2006 had been pre-programmed to automatically release on September 11, 2007. Twenty-one of these collars were retrieved from the field by October 9, 2008 and subsequently downloaded. These data revealed every collar released on the exact day they were programmed to do so. This differs with results obtained in brown bear studies where collars can take up to a few weeks to release (Rod Flynn, Alaska Department of Fish and Game, personal communication).

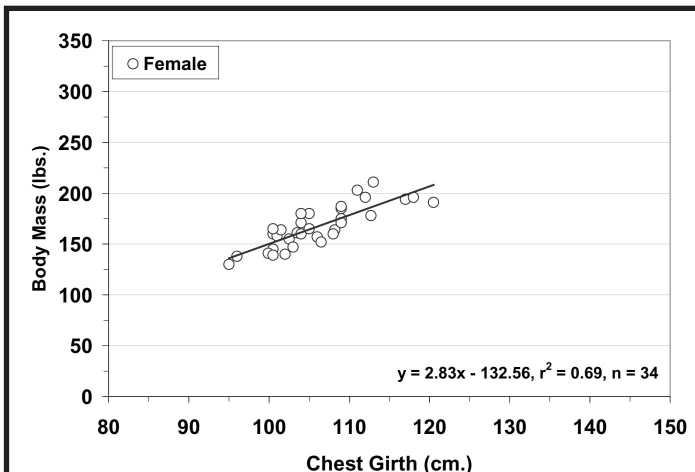

Figure 7b: Relationship between body mass and chest girth for female mountain goats, Lynn Canal, AK

Winter Severity and Snow Modeling

Snow Surveys.—Field-based snow surveys were conducted during March 31, 2008 on Echo Ridge. This survey was conducted within 3 days of an identical survey conducted in 2007. Preliminary analyses of these data quantified the degree to which snow depth differs with increasing elevation between forested and non-forested sites (White et al.

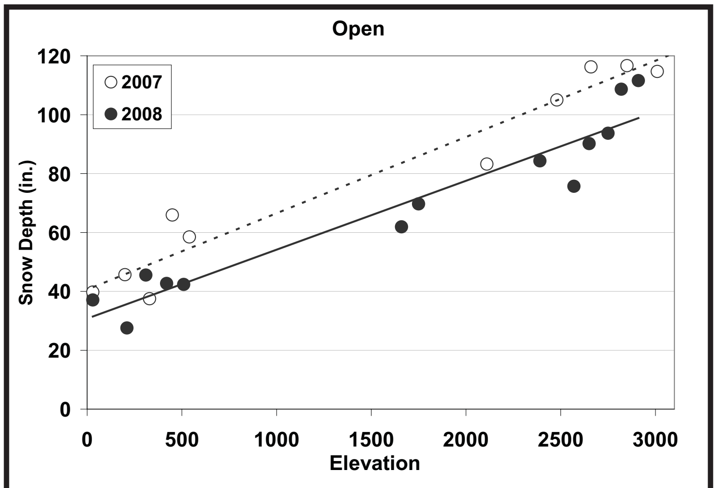

Figure 8: Relationship between snow depth and elevation in non-forested sites in late-March 2007 and 2008. Snow depth was about 10 inches less in 2008 than in 2007. Data were collected on Echo Ridge, AK.

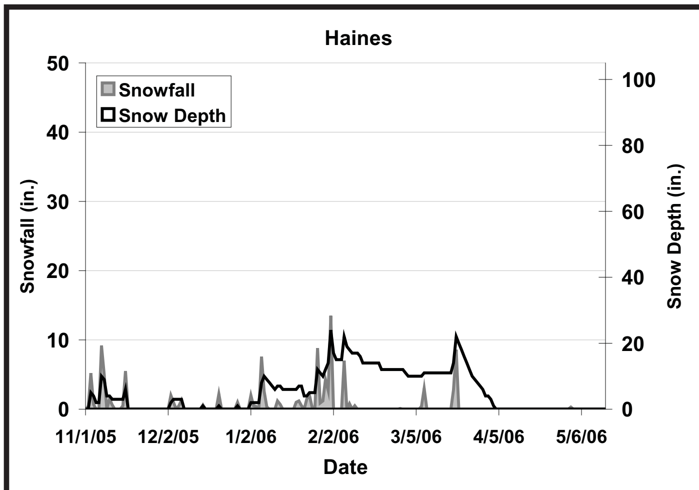

Figure 9a: Daily measures of snowfall and snow depth recorded at the NWS station in Haines, AK during the winter of 2005-2006. Snowfall events are depicted by the grey colored peaks; the black solid line describes snow depth patterns.

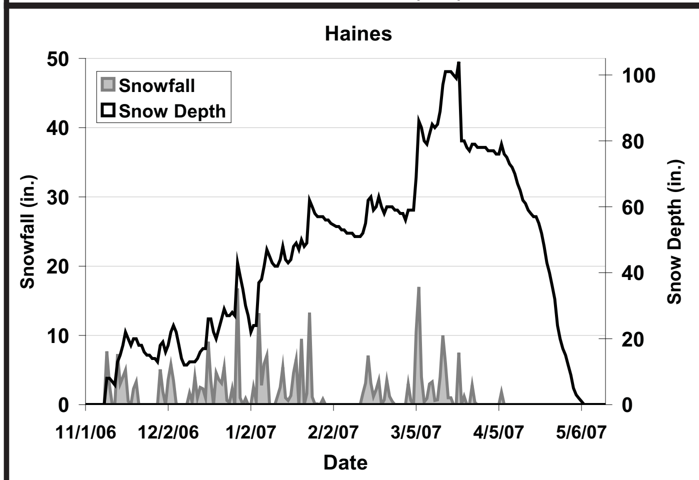

Figure 9b: Daily measures of snowfall and snow depth recorded at the NWS station in Haines, AK during the winter of 2006-2007. Snowfall events are depicted by the grey colored peaks; the black solid line describes snow depth patterns.

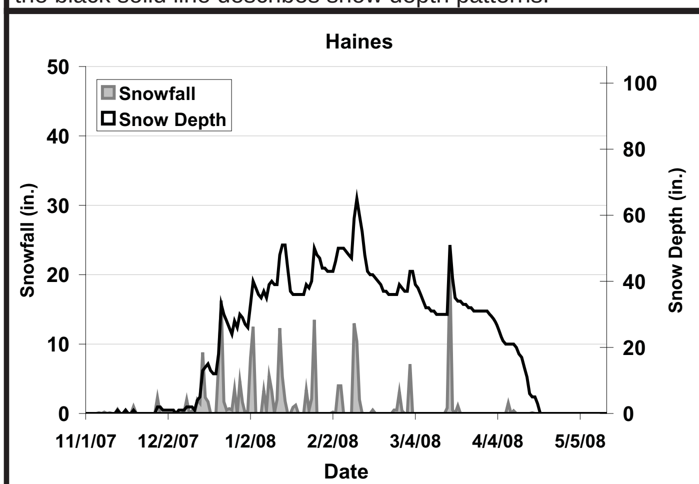

Figure 9c: Daily measures of snowfall and snow depth recorded at the NWS station in Haines, AK during the winter of 2006-2007. Snowfall events are depicted by the grey colored peaks; the black solid line describes snow depth patterns. These data indicate six snowfall events > 10 inches during the winter season. Substantial snow accumulation (snow depth > 20 in.) occurred between late-December to mid-April.

2007). Comparison of data collected in 2007 and 2008 indicated that snow depths were similar at elevation within forested habitats between years. However, in open habitats snow depth was 10 inches less, on average, in 2008 than in 2007 (Figure 8).

Climate Data.—Daily climate data were archived from the National Weather Service database to characterize broader scale climate patterns. Mean daily snow depth and snowfall data were summarized from data collected at the National Weather Service station in Haines, AK (Figures 9a, 9b, 9c). Mean snow depth during mid-winter (January-March) 2007/2008 was ca. 200% of normal in Haines (Figure 9c). While substantial, recorded snow depths were notably less than the historical record winter of 2006/2007 (Figure 9b, 9c). The previous two winters should be considered severe relative to the historical record for Haines. Nonetheless, the winter of 2007/2008 differed from 2006/2007 in two important ways. In 2007/2008, substantial snow accumulation (i.e. snow depth > 20 inches) was not evident until late-December while in 2006/2007 the equivalent snow depth threshold was reached by mid-November, six weeks earlier. Also, substantially more now accumulated during late-winter (i.e. March) in 2006/2007 as compared to 2007/2008 (Figure 9b, 9c).

Survival and Reproduction

Survival.—Mountain goats were monitored monthly during fixed-wing aerial telemetry flights. Of the 67 animals monitored during 2007/2008 (i.e. 6/1/2007– 5/30/2008), 9 animals died of various natural causes. An additional 15 animals had GPS radio-collars that released in mid-August 2007 (as planned). Consequently, for most of the biological year, we monitored 52 animals. Overall, preliminary survival estimates were 9% higher in 2007/2008 than in 2006/2007 (Table 1). In general, survival of females was higher than males (Table 1) and older animals were more likely to die than younger animals (White et al. 2007). Most mortality occurred during late winter (February-May), however, two adult males died during October-November, a period coinciding with the rut. The preliminary estimates of survival reported for 2006/2007 are lower than has been documented elsewhere (Smith 1986, Festa-Bianchet and Cote 2007), however, survival estimates for 2005/2006 and 2007/2008 are similar to previous studies. Given that winter snowfall accumulation during 2006/2007 was the highest on record, severe winter conditions likely played a key role on increased mortality of mountain goats during this period.

Causes of Mortality and Scavenging.—Unequivocally assigning cause of death for mountain goat mortalities was difficult. This results because known predators of mountain goats will also readily scavenge carcasses that die from other causes. Most mortality sites investigated in this study had also been previously visited by known predators of mountain goats (i.e. bears, wolves and wolverines) however in most cases it was not clear whether study animals were killed or died from other causes and subsequently scavenged.

In one notable case, we were able to clearly document a case of black bear scavenging on a mountain goat. Specifically, we determined that LG-55 (11-yro female) died on October 31, 2006 of unknown causes. On July 5, 2007, a black bear scavenged on the carcass of LG-55. In the course of scavenging activities, the black bear inadvertently attached the GPS radio-collar previously deployed by field researchers to LG-55 to itself. It is unclear exactly how this occurred. Nonetheless, due to the remote data downloading capability of the GPS radio-collars used in this study, it was possible to clearly document this event via GIS analysis and, later, via aerial and ground monitoring. To our knowledge, this is the first instance of radio-collar larceny by a black bear.

Kid Recruitment.—Kid recruitment of radio-marked female mountain goats was estimated by determining the percentage of radio-marked females seen with kids during

Table 1: Estimates of mountain goat survival for different sex classes during 2005-2008, Lynn Canal, AK.

	Males				Females				Total			
Year	At Risk	Died	Ŝ	SE	At Risk	Died	Ŝ	SE	At Risk	Died	Ŝ	SE
2005/2006	11	2	0.82	0.12	11	1	0.91	0.09	22	3	0.86	0.07
2006/2007	33	11	0.67	0.08	25	4	0.84	0.07	58	15	0.74	0.06
2007/2008	29	6	0.79	0.07	23	3	0.88	0.07	52	9	0.83	0.05
All years	73	19	0.74	0.05	59	8	0.85	0.04	132	26	0.79	0.03

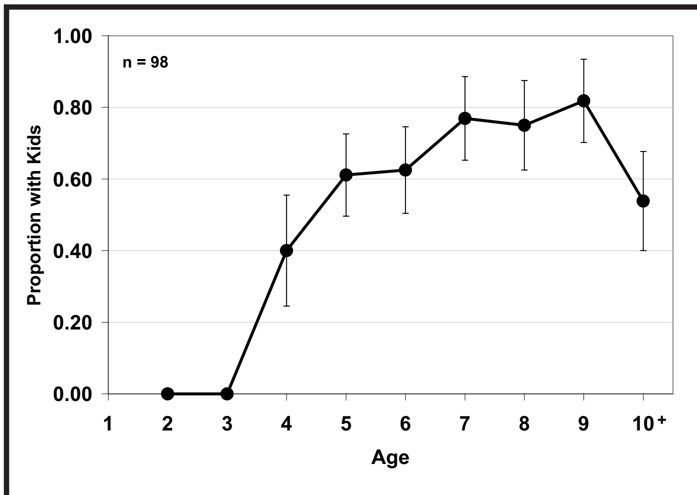

Figure 10: Age-specific estimates of kid production for female mountain goats in different age classes during 2005-2008, Lynn Canal, AK.

May-June aerial telemetry surveys (n = 3). Since each radio-marked female was not observed daily during the kidding period, it was not possible to determine if kids were born and subsequently died prior to, or between, surveys. As such, estimates of kid production reported here are presumably lower than the actual percentage of females that gave birth. Nevertheless, our estimates of kid production were similar to estimates of kidding rates reported elsewhere (Festa-Bianchet and Cote 2007).

Past studies have documented late age at first reproduction for mountain goats, as compared to other ungulates (Festa-Bianchet and Cote 2007, Galliard et al. 2000). Consistent with these findings, we did not document any cases where females less than four years of age had kids at heel in summer. Overall, kid production estimates varied with female age (range = 40-82%) such that younger and older females were generally less likely to have a kid at heel than prime-aged females (i.e. 7-9 years old; Figure 10). We did not observe cases of kid abandonment when females with kids were captured, as determined via post-capture aerial telemetry surveys.

Population Abundance and Composition

Aerial Surveys.—Overall, 10 fixed-wing and 2 helicopter surveys were conducted in August-September 2007 (Lions Head, n = 4, Sinclair Mountain, n = 3, Mount Villard, n = 3, East Berners, n = 2; Appendix 3). One survey was attempted but not completed in entirety. Incomplete surveys provide meaningful data but are not, at this point, directly comparable to other surveys. Of the complete surveys flown (n = 11), substantial variation was observed in the minimum number of mountain goats observed and the proportion of kids (Appendix 1). These findings underscore the value of conducting replicate surveys in each area.

The proportion of mountain goats for which the presence or absence of a collar could be ascertained was variable and primarily depended upon weather conditions and aircraft type. Use of 14X image stabilizing binoculars (Fujinon) significantly increased the ability to assess collar status, as compared to past years. During 2007, habitat and behavioral covariate data were collected for 47 marked mountain goats during surveys. These data were paired with records of whether animals were either seen or not seen during routine surveys in order to compile a database suitable for determining factors related to mountain goat survey sighting probability.

Ground-based Surveys.—Ground based surveys were conducted in the Mount Villard and upper Dayebas Creek area during June 24-July 2, 2008 and during July 29-August 3, 2008 in the Mt. Selby area. In addition to gathering age and sex composition data for mountain goats in these areas, detailed behavioral data was collected for GPS radio-collared adult females in order to validate data collected by activity sensors imbedded in radio-collars. In addition, focal animal and scan sampling behavioral data were collected to compile baseline activity budget and behavioral data for animals in these areas.

FUTURE WORK

Study animals will continue to be monitored monthly to assess reproductive status and survival. Additionally, at 8-week intervals GPS data will be downloaded from each animal during aerial surveys. These data will be post-processed and integrated with the existing GPS location database. Three replicate aerial surveys will be conducted in early-fall 2009, weather permitting, in order to estimate mountain goat sightability, population abundance and composition. Results of these efforts will be summarized and submitted as an annual research progress report by November 1, 2009.

PROJECT PUBLICATIONS

White, K. S., N. L. Barten and D. Larsen. 2006. Mountain goat assessment and monitoring along the Juneau Access road corridor and near the Kensington Mine, southeast Alaska. Research Progress Report, Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, AK. 65pp.

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White, K. S. 2006. Seasonal and sex-specific variation in terrain use and movement patterns of mountain goats in southeastern Alaska. Proceedings of the Biennial Symposium of the Northern Wild Sheep and Goat Council, 15: 183-193.

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Appendix 1: Summary of mountain goat capture and monitoring records, 2005-2008, Lynn Canal, AK (as of 10/4/08).

Mtn Goat ID	Area	Capture Date	Sex	Est. Age	Weight (lbs.)	Collar Type	Months Monitored	Status
LG-01	Lions Head	09/26/05	M	9	308	GPS	6.7	Died, 4/17/06
LG-02	Lions Head	09/26/05	F	11	140	GPS	6.6	Died, 4/16/06
LG-03	Sinclair Mtn.	09/26/05	F	7	180	GPS	18.5	Died, 4/10/07
LG-04	Sinclair Mtn.	09/26/05	F	7	196	GPS	22.9	Collar Released, 8/23/07
LG-05	Sinclair Mtn.	09/26/05	M	9		GPS	19.4	Died, 5/9/07
LG-06	Lions Head	10/02/05	M	8	347	GPS	4.3	Died, 2/10/06
LG-07	Lions Head	10/02/05	M	2	163	GPS	22.7	Collar Released, 8/23/07
LG-08	Lions Head	10/02/05	F	5	171	GPS	22.7	Collar Released, 8/23/07
LG-09	Lions Head	10/02/05	F	10		GPS	22.7	Collar Released, 8/23/07
LG-10	Sinclair Mtn.	10/03/05	F	7	187	GPS	22.7	Collar Released, 8/23/07
LG-11	Sinclair Mtn.	10/03/05	M	9	335	GPS	16.3	Died, 2/11/07
LG-12	Mt. Villard	10/03/05	F	8	196	GPS	22.7	Collar Released, 8/23/07
LG-13	Mt. Villard	10/03/05	F	9		GPS	0.1	Died, 10/5/05
LG-14	Mt. Villard	10/03/05	F	5	211	GPS	22.7	Collar Released, 8/23/07
LG-15	Mt. Villard	10/03/05	M	6	279	GPS	22.7	Collar Released, 8/23/07
LG-16	Sinclair Mtn.	10/14/05	M	5	273	GPS	22.3	Collar Released, 8/23/07
LG-17	Mt. Villard	10/14/05	F	7	161	GPS	22.3	Collar Released, 8/23/07
LG-18	Mt. Villard	10/14/05	M	3	196	GPS	22.3	Collar Released, 8/23/07
LG-19	Lions Head	10/15/05	M	5	273	GPS	8.4	Died, 6/26/06
LG-20	Lions Head	10/15/05	M	8	285	GPS	22.3	Collar Released, 8/23/07
LG-21	Lions Head	10/15/05	F	4	194	GPS	22.3	Collar Released, 8/23/07
LG-22	Lions Head	10/15/05	F	8		GPS	22.3	Collar Released, 8/23/07
LG-23	Lions Head	10/15/05	M	9	221	GPS	22.3	Collar Released, 8/23/07
LG-24	Lions Head	07/28/06	M	3	134	GPS	23.6	Died, 7/13/08
LG-25	Lions Head	07/28/06	F	6	130	GPS	9.4	Died, 5/11/07
LG-26	Lions Head	07/28/06	M	6	251	GPS	3.7	Died, 11/17/06
LG-27	Lions Head	07/28/06	M	10	274	GPS	17.1	Died, 12/31/07
LG-28	Lions Head	07/28/06	M	8		GPS	11.7	Died, 7/18/06
LG-29	Sinclair Mtn.	07/28/06	F	7	160	GPS	25.5	Collar Released, 9/11/08
LG-30	Lions Head	07/28/06	F	8		GPS	8.9	Died, 4/25/07
LG-31	East Berners	07/28/06	M	12	223	GPS	7.7	Died, 3/18/07
LG-32	East Berners	07/28/06	F	4	138	GPS	10.3	Died, 6/6/07
LG-33	East Berners	07/29/06	M	9	256	GPS	9.4	Died, 5/12/07
LG-34	East Berners	07/29/06	M	6	258	GPS	25.5	Collar Released, 9/11/08
LG-35	East Berners	07/29/06	F	5		GPS	25.5	Collar Released, 9/11/08
LG-36	Lions Head	07/29/06	M	6	308	GPS	25.5	Collar Released, 9/11/08
LG-37	Lions Head	07/29/06	M	4	216	GPS	18.7	Died, 2/18/08
LG-38	Lions Head	07/29/06	F	4	141	GPS	25.5	Collar Released, 9/11/08
LG-39	Sinclair Mtn.	08/29/06	F	10	165	GPS	8.4	Died, 5/10/07
LG-40	Sinclair Mtn.	08/29/06	M	8		GPS	24.5	Collar Released, 9/11/08
LG-41	Sinclair Mtn.	08/29/06	F	5		GPS	24.5	Collar Released, 9/11/08
LG-42	Mt. Villard	08/29/06	F	3	178	GPS	24.5	Collar Released, 9/11/08
LG-43	Mt. Villard	08/29/06	F	4	164	GPS	24.5	Collar Released, 9/11/08

Appendix 1 (cont.): Summary of mountain goat capture and monitoring records, 2005-2008, Lynn Canal, AK (as of 10/4/08).

Mtn Goat ID	Area	Capture Date	Sex	Est. Age	Weight (lbs.)	Collar Type	Months Monitored	Status
LG-44	Mt. Villard	08/29/06	M	12		GPS	1.7	Died, 10/19/06
LG-45	Sinclair Mtn.	09/25/06	F	6	185	GPS	23.6	Collar Released, 9/11/08
LG-46	Mt. Villard	09/25/06	M	8	331	GPS	23.3	Died, 9/1/08
LG-47	Mt. Villard	09/25/06	M	11	294	GPS	5.0	Died, 2/23/07
LG-48	Mt. Villard	09/25/06	M	12	291	GPS	7.0	Died, 4/26/07
LG-49	Mt. Villard	09/25/06	M	6	340	GPS	23.6	Collar Released, 9/11/08
LG-50	Sinclair Mtn.	10/07/06	M	8	250	GPS	6.3	Died, 4/17/07
LG-51	Sinclair Mtn.	10/07/06	F	2	145	GPS	23.2	Collar Released, 9/11/08
LG-52	Sinclair Mtn.	10/07/06	F	3	160	GPS	23.2	Collar Released, 9/11/08
LG-53	Lions Head	10/07/06	M	3	171	GPS	23.2	Collar Released, 9/11/08
LG-54	Mt. Villard	10/12/06	M	7	320	GPS	23.0	Collar Released, 9/11/08
LG-55	Mt. Villard	10/12/06	F	12	203	GPS	0.6	Died, 10/31/06
LG-56	Mt. Villard	10/12/06	M	9	339	GPS	6.1	Died, 4/16/07
LG-57	Mt. Villard	10/12/06	F	8	180	GPS	9.8	Died, 8/5/07
LG-58	Mt. Villard	10/12/06	M	4	263	GPS	23.0	Collar Released, 9/11/08
LG-59	Mt. Villard	10/12/06	F	5	158	GPS	23.0	Collar Released, 9/11/08
LG-60	Sinclair Mtn.	10/13/06	M	5	287	GPS	23.0	Collar Released, 9/11/08
LG-61	Sinclair Mtn.	10/13/06	M	10	350	GPS	22.2	Collar Removed, 8/18/08
LG-62	Sinclair Mtn.	10/13/06	M	10	310	GPS	23.0	Collar Released, 9/11/08
LG-63	Sinclair Mtn.	10/13/06	M	10	297	GPS	5.1	Died, 3/16/07
LG-64	Sinclair Mtn.	10/13/06	M	4	281	GPS	11.7	Died, 10/4/07
LG-65	East Berners	07/29/07	M	8	252	GPS	13.3	Died, 9/4/08
LG-66	East Berners	07/29/07	F	7	147	GPS	14.2	Alive
LG-67	East Berners	07/29/07	M	11	~300	GPS	1.7	9/20/2007
LG-68	East Berners	07/29/07	F	11	171	GPS	14.2	Alive
LG-69	Lions Head	07/29/07	M	1	95	GPS	14.2	Alive
LG-70	East Berners	07/29/07	F	5	139	GPS	14.2	Alive
LG-71	Mt. Villard	08/01/07	F	5	164	GPS	14.1	Alive
LG-72	Mt. Villard	08/01/07	F	5	165	GPS	2.8	Died, 10/24/07
LG-73	Mt. Villard	08/01/07	M	11	309	GPS	7.9	Died, 3/28/08
LG-74	Mt. Villard	08/01/07	M	6	298	GPS	14.1	Alive
LG-75	Sinclair Mtn.	08/02/07	M	3	141	GPS	11.2	Died, 7/7/08
LG-76	Sinclair Mtn.	08/02/07	F	4	155	GPS	14.1	Alive
LG-77	Sinclair Mtn.	08/02/07	M	6	249	GPS	14.1	Alive
LG-78	Sinclair Mtn.	08/02/07	F	9	175	GPS	13.4	Collar Released, 9/11/08
LG-79	Sinclair Mtn.	08/02/07	M	11	269	GPS	0.7	Died, 8/24/07
LG-80	Sinclair Mtn.	08/02/07	M	6	281	GPS	13.4	Collar Released, 9/11/08
LG-81	Sinclair Mtn.	08/02/07	M	4	217	GPS	13.4	Collar Released, 9/11/08
LG-82	Mt. Villard	08/02/07	F	6	152	VHF	1.1	Died, 9/3/07
LG-83	Lions Head	08/03/07	M	5	258	VHF	14.1	Alive
LG-84	Lions Head	08/03/07	M	4	180	VHF	14.1	Alive
LG-85	Mt. Villard	08/03/07	F	9	191	--	0.0	Died, 8/3/07
LG-86	Lions Head	08/11/07	M	4	223	VHF	13.8	Alive

Appendix 1 (cont.): Summary of mountain goat capture and monitoring records, 2005-2008, Lynn Canal, AK (as of 10/4/08).

Mtn Goat ID	Area	Capture Date	Sex	Est. Age	Weight (lbs.)	Collar Type	Months Monitored	Status
LG-87	Lions Head	08/11/07	M	5	233	GPS	13.8	Alive
LG-88	Sinclair Mtn.	08/11/07	F	8	160	VHF	13.8	Alive
LG-89	Sinclair Mtn.	08/11/07	M	4	240	VHF	13.8	Alive
LG-90	Sinclair Mtn.	08/11/07	F	3	157	GPS	13.8	Alive
LG-91	Mt. Villard	08/11/07	F	5	172	VHF	13.8	Alive
LG-92	East Berners	08/16/08	M	7	279	GPS	1.6	Alive
LG-93	East Berners	08/16/08	M	3	173	GPS	1.6	Alive
LG-94	East Berners	08/16/08	F	13	167	GPS	1.6	Alive
LG-95	East Berners	08/16/08	M	5	266	GPS	1.5	Died, 10/1/08
LG-96	East Berners	08/16/08	M	5	258	GPS	1.6	Alive
LG-97	Lions Head	08/16/08	F	5	151	GPS	1.6	Alive
LG-98	Lions Head	08/16/08	M	6	279	GPS	1.6	Alive
LG-99	Lions Head	08/18/08	M	6	266	GPS	1.5	Alive
LG-100	Sinclair Mtn.	08/18/08	F	10	163	GPS	1.5	Alive
LG-101	Sinclair Mtn.	08/18/08	M	5	277	GPS	1.5	Alive
LG-102	Sinclair Mtn.	08/18/08	M	7	328	VHF	1.5	Alive
LG-103	Sinclair Mtn.	08/18/08	F	7	185	GPS	1.5	Alive
LG-61	Sinclair Mtn.	08/18/08	M	12	301	GPS	1.5	Alive, Re-capture
LG-104	Sinclair Mtn.	08/18/08	F	6	192	GPS	1.5	Alive
LG-105	East Berners	08/19/08	F	5	179	GPS	1.5	Alive
LG-106	Lions Head	08/19/08	M	5	242	VHF	1.5	Alive
LG-107	Mt. Villard	08/19/08	M	7	307	GPS	1.5	Alive
LG-108	Mt. Villard	08/19/08	F	4	165	GPS	1.5	Alive
LG-109	Mt. Villard	08/19/08	M	3	166	VHF	1.5	Alive
LG-17	Mt. Villard	08/19/08	F	8	149	VHF	1.5	Alive, Re-capture
LG-110	Mt. Villard	08/19/08	M	6	298	GPS	1.5	Alive
LG-111	East Berners	09/21/08	F	4	194	GPS	0.4	Alive
LG-112	Lions Head	09/21/08	F	11	199	GPS	0.4	Alive
LG-113	Mt. Villard	09/21/08	F	4	182	GPS	0.4	Alive
LG-114	Mt. Villard	09/21/08	M	7	345	GPS	0.4	Alive
LG-115	Mt. Villard	09/21/08	M	8	306	GPS	0.4	Alive
LG-116	Mt. Villard	09/21/08	F	4	186	GPS	0.4	Alive
LG-117	Lions Head	09/24/08	F	3	170	GPS	0.3	Alive
LG-118	Lions Head	09/24/08	F	3	166	GPS	0.3	Alive
LG-15	Mt. Villard	09/24/08	M	8	303	VHF	0.3	Alive, Re-capture
LG-119	Sinclair Mtn.	09/24/08	M	4	237	VHF	0.3	Alive
LG-120	Sinclair Mtn.	09/24/08	F	5	175	GPS	0.3	Alive
LG-40	Sinclair Mtn.	09/24/08	M	10	309	VHF	0.3	Alive, Re-capture

Appendix 2: Percent diet composition of mountain goats in in Lynn Canal, AK. Summer-fall data (i.e. 7/28-10/15) were collected from live-captured animals (Females, n = 19; Males, n = 28) throughout the Lynn Canal study area. The winter diet summary is derived from a composite sample (n = 6 pellet-groups) collected in February 2006 in the Echo Cove area. These results are not corrected for differential digestability of food items.

	Summer-Fall			Winter (Composite Sample)		
	mean	SE	n	mean	SE	n
Alnus spp. leaf	0.0	0.0	47	0.0	--	1
Cassiope spp.	0.5	0.1	47	0.0	--	1
Dryas drummondii leaf	0.1	0.1	47	0.0	--	1
Dryas drummondii stem	0.0	0.0	47	0.0	--	1
Empetrum nigrum leaf	0.5	0.1	47	0.0	--	1
Rubus spectabilis leaf	0.1	0.0	47	0.0	--	1
Rubus spectabilis stem	0.3	0.2	47	0.0	--	1
Salix spp.leaf	0.6	0.2	47	0.0	--	1
Salix spp.stem	0.7	0.3	47	1.9	--	1
Vaccinium spp. leaf	0.2	0.1	47	0.0	--	1
Vaccinium spp. stem	0.1	0.1	47	9.9	--	1
Other Shrub leaf	0.2	0.1	47	0.0	--	1
Other Shrub stem	0.1	0.1	47	0.0	--	1
Total Shrubs:	***3.4***	***0.6***	***47***	***11.8***	***--***	***1***
Achillea borealis	0.1	0.0	47	0.0	--	1
Anemone narcissiflora	0.0	0.0	47	0.0	--	1
Symphyotrichum (Aster) subspicatum	0.1	0.1	47	0.0	--	1
Astragalus ?	0.0	0.0	47	0.0	--	1
Caltha leptosepala	0.0	0.0	47	0.0	--	1
Campanula lasiocarpa	0.1	0.0	47	0.0	--	1
Castilleja spp.	0.1	0.1	47	0.0	--	1
Cornus canadensis	0.5	0.3	47	0.0	--	1
Epilobium spp.	1.2	0.6	47	0.0	--	1
Equisetum spp.	0.1	0.1	47	0.0	--	1
Erigeron spp.	0.1	0.1	47	0.0	--	1
Geranium erianthum	0.6	0.2	47	0.0	--	1
Heracleum (lanatum) maximum	0.2	0.2	47	0.0	--	1
Lupinus nootkatensis	8.6	1.5	47	0.0	--	1
Maianthemum dilatatum	0.1	0.1	47	0.0	--	1
Moneses uniflora	0.2	0.1	47	0.0	--	1
Pedicularis spp.	0.2	0.1	47	0.0	--	1
Petasites spp.	1.1	1.0	47	0.0	--	1
Polygonum viviparum	0.3	0.1	47	0.0	--	1
Potentilla spp. (sh or forb)	0.6	0.2	47	0.0	--	1
Ranunculus spp.	0.8	0.3	47	0.0	--	1
Saxifraga spp.	0.1	0.0	47	0.0	--	1
Senecio triangularis	0.1	0.1	47	0.0	--	1
Solidago multiradiata	0.0	0.0	47	0.0	--	1
Stellaria spp.	0.1	0.1	47	0.0	--	1
Streptopus amplexifolius	0.6	0.2	47	0.0	--	1
Viola langsdorffii	0.0	0.0	47	0.0	--	1
Other Forbs	1.1	0.2	47	0.0	--	1
Total Forbs:	***17.0***	***2.1***	***47***	***0.0***	***--***	***1***
Carex spp.	20.7	2.0	47	0.0	--	1
Luzula / Juncus	14.4	1.5	47	0.0	--	1
Total Sedge/Rushes:	***35.1***	***3.0***	***47***	***0.0***	***--***	***1***
Agropyron spp.	0.1	0.1	47	0.0	--	1
Agrostis spp.	1.9	0.4	47	0.0	--	1
Calamagrostis spp.	0.1	0.1	47	0.0	--	1
Deschampsia spp.	0.1	0.1	47	0.0	--	1
Festuca spp.	0.1	0.0	47	0.0	--	1
Hierochloe alpina	0.3	0.1	47	0.0	--	1
Phleum alpinum (commutatum)	0.5	0.2	47	0.0	--	1
Poa spp.	1.2	0.3	47	0.0	--	1
Other Grasses	0.5	0.1	47	0.0	--	1
Total Grasses:	***4.7***	***0.7***	***47***	***0.0***	***--***	***1***
Populus balsamifera ssp.trichocarpa stem	0.1	0.1	47	0.0	--	1
Tsuga spp.	0.3	0.1	47	72.8	--	1
Total Trees:	**0.3**	**0.1**	**47**	**72.8**	**--**	**1**
Moss	***5.3***	***0.7***	***47***	***1.9***	***--***	***1***
Alectoria / Usnea	5.4	0.8	47	0.0	--	1
Cetraria	2.3	0.4	47	0.0	--	1
Cladonia	11.4	1.8	47	0.6	--	1
Peltigera	0.8	0.2	47	0.0	--	1
Lobaria	3.0	0.5	47	11.7	--	1
Other Lichen	0.0	0.0	47	0.0	--	1
Total Lichen:	***22.8***	***2.8***	***47***	***12.3***	***--***	***1***
Athyrium spp.	3.5	1.1	47	0.0	--	1
Dryopteris expansa (dilatata)	0.0	0.0	47	0.0	--	1
Gymnocarpium dryopteris	0.1	0.1	47	0.0	--	1
Fern rhizome	7.4	1.8	47	1.2	--	1
Other Fern	0.3	0.1	47	0.0	--	1
Total Ferns:	***11.4***	***2.2***	***47***	***1.2***	***--***	***1***
TOTAL	**100.0**	**0.0**	**47**	**100.0**	**--**	**1**

Appendix 3: Summary of mountain goat population abundance and composition survey data, 2007, Lynn Canal, AK.

Study Area	Date	Adults	Kids	Total	% Kids	Temp	Weather	Wind	Aircraft	# Observers
East Berners	9/2/2007	105	28	133	21.1	44F	Clear	0-5	Heliocourier	2
East Berners	9/22/2007	97	28	125	22.4	35-40	High Overcast	0-10	Cub	2
Lions Head	8/10/2007	18	2	20	10.0	51-57	Clear	2-7	Heliocourier	3
Lions Head	8/27/2007	43	3	46	6.5	44-50	High Overcast	0-5	Heliocourier	3
Lions Head	9/13/2007	46	5	51	9.8	~45-55F	High Overcast/ Low Fog	0-5	Cub	2
Lions Head	9/28/2007	78	15	93	16.1	35-40	Mostly Clear	0-10	Hughes 500	3
Sinclair	8/27/2007	57	4	61	6.6	44-50	High Overcast	0-5	Heliocourier	3
Sinclair	9/13/2007	75	13	88	14.8	~45-55F	High Overcast/ Low Fog	0-5	Cub	2
Sinclair	9/28/2007	173	38	211	18.0	35-40	High Overcast	0-10	Hughes 500	3
Villard	9/3/2007	88	23	111	20.7	47-54F	Clear	0-10	Heliocourier	3
Villard[1]	9/14/2007	74	23	97	23.7	44	Overcast/Fog	0-27	Heliocourier	3
Villard	9/22/2007	132	22	154	14.3	35-40	Overcast/Lt Snow/Fog	0-15	Cub	2

[1] surveyed to Paradise Ridge only