Wildlife Research Annual Progress Report

Mountain goat population monitoring and movement patterns near the Kensington Mine, Alaska

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Alaska Department of Fish and Game Division of Wildlife Conservation

Cover Photo: An adult female mountain goat (LG-35) in the upper Berners River, August 2006

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INTRODUCTION

This report was prepared to meet the annual reporting requirements for Coeur Alaska, Inc.. Funding for this project was originally made available in September 2005 and this report summarizes activities completed by December 30, 2020.

Background

In 2005, Coeur Alaska, Inc. re-initiated development activities at the Kensington mine site, located a short distance northwest of Berners Bay. In addition, the Alaska Department of Transportation and Public Facilities (ADOT/PF) proposed construction an all-season highway between Echo Cove and the Katzehin River. In the context of these proposed industrial development activities, mountain goats were identified as an important wildlife species likely to be affected by mine development and road construction activities.

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. In 2005, when the mine development activities were re-initiated, the Alaska Department of Fish and Game (ADFG) maintained that many of the same concerns that prompted the Robus and Carney (1995) study were still valid and needed to be addressed. In addition, large-scale plans for development of the Juneau Access road raised new and 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 have potentially important ramifications for management and conservation of the species in the area. Studies indicate that mountain goats can be negatively impacted by industrial development activities (NWSGC 2020). 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, Cote et al. 2013, White and Gregovich 2017). Consequently, information about the distribution of mountain goats proximate to the mine and road development corridor is critical for determining the extent to which populations may be affected by associated industrial activities. Information collected by Robus and Carney (1995), White et al. (2012) and White and Gregovich (2017), in the vicinity of Kensington mine, as well as Schoen and Kirchhoff (1982) near Echo Cove, suggest that spatial overlap between mountain goats and industrial activity are most pronounced when goats are over-wintering in low-elevation habitats.

In response to the above concerns, ADFG, with operational funding provided by ADOT/PF, Federal Highway Administration (FHWA) and Coeur Alaska, Inc., 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 has included 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 ADFG and stakeholders with information necessary to appropriately manage mountain goats and their habitat in the areas of development and provide guidance relative to mitigation measures, to the extent possible.

Implementation of field objectives were initiated in 2005 and consisted of a 5-year monitoring program (2005-2011) jointly funded by ADOT/PF, FHWA, Coeur Alaska, Inc. and ADFG. Beginning in 2007, the ADFG committed additional annual funding for a complementary aerial survey technique development project within and adjacent to the project area. In 2009, the USDA-Forest Service (Tongass National Forest) also began contributing funding to further support aerial survey technique development data collection efforts. And, in 2010, Coeur Alaska, Inc. resumed funding of mountain goat monitoring near the Kensington Mine and adjacent areas (as per the Kensington Plan of Operations, USFS 2005). In 2012, the project components funded by ADOT/PF and associated with the Juneau Access project were completed (see White et al. 2012). In 2017, at the requested on ADFG - Habitat Division (J. Timothy, pers. comm.) analyses were completed to assess the effects of mining development on mountain goat spatial use patterns (White and Gregovich 2017). Results indicated avoidance of mountain goat habitats in proximity to the mine and reinforced the importance of long-term monitoring of the population. Currently, mountain goat monitoring activities are focused on the area surrounding the Kensington mine and north to the Katzehin river, an area considerably smaller than the original Juneau Access/Kensington joint study area.

STUDY OBJECTIVES

Research efforts were designed to investigate the spatial relationships, vital rates, and abundance of mountain goats near the Kensington Mine and upper Lynn Canal. The research objectives were to:

1) determine seasonal movement patterns of mountain goats;

2) characterize mountain goat habitat selection patterns;

3) estimate reproductive success and survival of mountain goats; and

4) estimate mountain goat population abundance and composition.

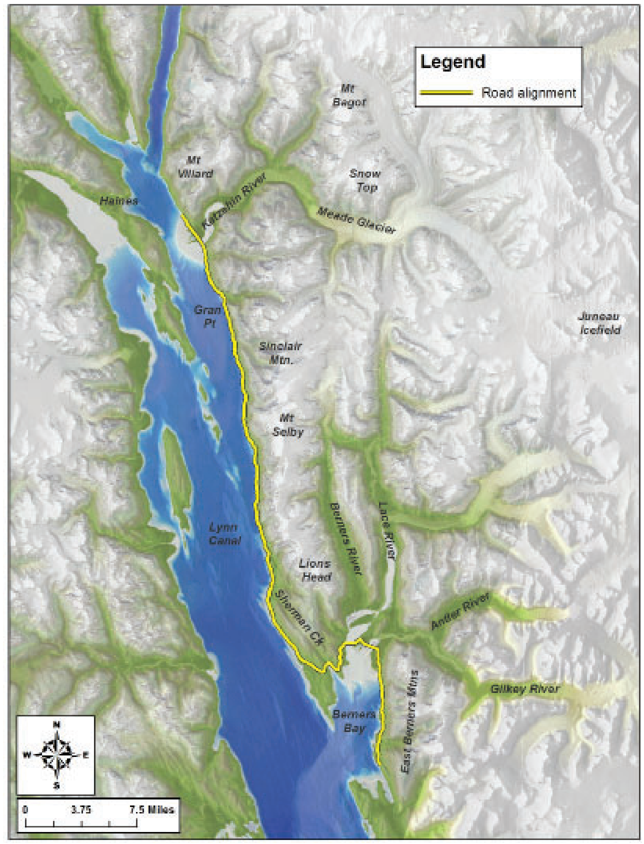

Figure 1: Map of the Lynn Canal and Berners Bay area. Local place names referenced in this report are identified. Mountain goats were studied in this area during 2005-2020.

STUDY AREA

Mountain goats were studied in a ca. 491 km^2 area located in a mainland coastal mountain range east of Lynn Canal, a marine fjord located between Juneau and Haines in southeastern Alaska (Figure 1 and 2). The study area was located in the Kakuhan Range and oriented along a north-south axis and bordered in the south by Berners Bay (58.76N, 135.00W) and the Katzehin River (59.27N, 135.14W) in the north. The Kensington Mine, a hard rock gold mine, is located at the southern end of the study area, immediately south of Lions Head mountain in the Johnson, Slate and Sherman creek watersheds. A majority of above ground mining activity occurs in four principal locations situated between 200–300 meters in elevation. The overall mine "footprint" comprises 56.6 km^2 of patented claims; a significant amount of activity is at low elevation (<300 m) and underground. This study has occurred during both construction and production phases of the mine and possible sources of disturbance to mountain goats in the vicinity included blasting, heavy equipment operation, helicopter operation, and vehicle traffic.

Elevation within the study area ranges from sea level to 2070 m. This area is an active glacial terrain underlain by late cretaceous-paleocene granodiorite and tonalite geologic formations (Stowell 2006). 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. >1200 m) and rugged, broken terrain that descends to a rocky, tidewater coastline. The northern boundary of the area is defined by the Katzehin River, a moderate volume (ca. 1500 cfs; USGS, unpublished data) glacial river system (and putative barrier to mountain goat movement) that is fed by the Meade Glacier, a branch of the Juneau Icefield.

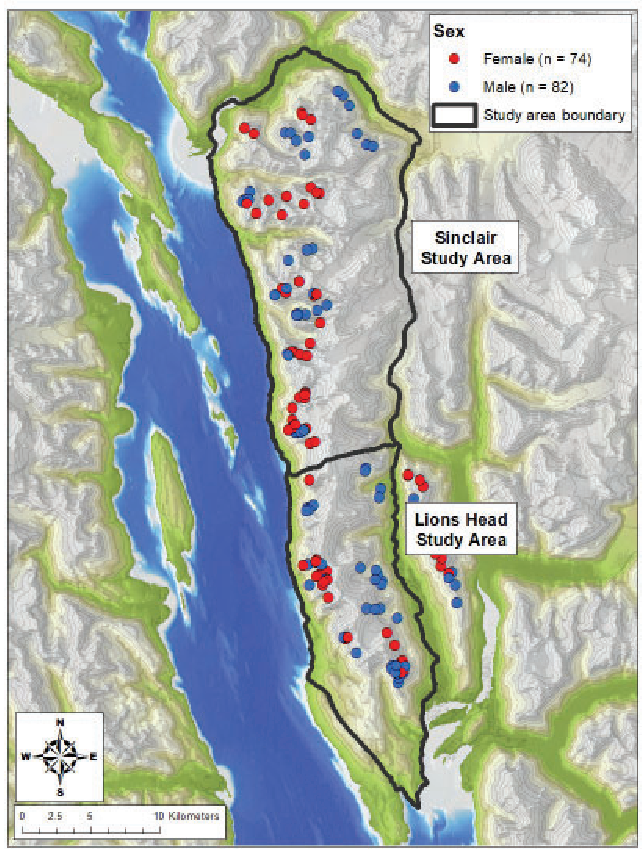

Figure 2: Locations of mountain goats captured and subsequently monitored in the Lynn Canal study area, 2005-2020.

The maritime climate in this area is characterized by cool, wet summers and relatively warm snowy winters. Annual precipitation at sea-level averages 1.4 m and winter temperatures are rarely less than -15° C and average -1° C (Haines, AK; National Weather Service, Juneau, AK, unpublished data). Elevations at 790 m typically receive ca. 6.3 m of snowfall, annually (Eaglecrest Ski Area, Juneau, AK, unpublished data). Predominant vegetative communities occurring at low-moderate elevations (<460 m) 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 ~460–760 meters. Alpine plant communities are composed of a mosaic of relatively dry ericaceous heathlands and moist meadows dominated by sedges, forbs and wet fens. Avalanche chutes are common in the study area and bisect all plant community types and often terminate at sea-level.

METHODS

Mountain Goat Capture

Mountain goats were captured using standard helicopter darting techniques and immobilized by injecting 2.4 - 3.0 mg of carfentanil citrate or 6.0 - 7.0 mg of thiafentanil oxalate via projectile syringe fired from a dart gun (Cap-Chur, Douglasville, GA or Pneudart, Williamsburg, PA) (Taylor 2000, White et al., in review). Carfentanil and thiafentanil are both effective chemical immobilization agents however, in recent years, commercial production of carfentanil has been discontinued and replaced by thiafentanil. Drug doses varied depending upon time of year to accommodate seasonal changes in body mass. During handling, all animals were carefully examined and monitored following standard veterinary procedures (Taylor 2000, White et al., in review) and routine biological samples and morphological data collected. Following handling procedures, the effects of the immobilizing agent was reversed with 100 mg of naltrexone hydrochloride per 1 mg of carfentanil citrate or 40 mg of naltrexone hydrochloride per 1 mg of thiafentanil (Taylor 2000, White et al., in review). All capture procedures were approved by the State of Alaska Animal Care and Use Committee.

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 could be reasonably contained.

Figure 3: Photograph of a chemically immobilized adult male mountain goat (LG213) following capture and handling, N of Met Point, Lynn Canal, September 2020.

GPS Location Data

Telonics TGW-3590 or TGW-4590 GPS radio-collars (Telonics, Inc., Mesa, AZ) were deployed on most animals captured (Figure 3). (Telonics MOD-500 VHF radio-collars were deployed on a subset (n = 23) of animals during 2009 to enable longer-term monitoring opportunities). During 2009-2020, animals were simultaneously marked with GPS and lightweight (Telonics MOD-410) VHF radio-collars (370 g)(Figure 3). Double-collaring animals was conducted to extend the period of time individual animals could be monitored (lifespan, GPS: 3 years, VHF: 6 years), thereby increasing the long-term opportunity to gather mountain goat survival, reproduction and mark-resight population estimation data and, ultimately, reducing the frequency that mountain goats must be captured. The combined weight of radio-collars attached to animals comprise 1.2% of average male body weight and 2.0% of average female body weight and is well within the ethical standards for instrument deployment on free-ranging wildlife.

GPS radio-collars were programmed to collect location data at 6-hour intervals (collar lifetime: 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 satellite link and/or manually downloaded upon recovery collars from the field (i.e. following scheduled collar release or animal mortality). 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).

Resource Selection and Movement Patterns

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 reconnaissance and snow surveys. Samples 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 a composite winter sample. Results of these analyses were reported in White et al. (2012).

Activity, Movement Patterns and Resource Selection.—Analyses of mountain goat GPS location data (i.e. data collected during 2005-2015) to characterize activity, movement and resource selection patterns were summarized in White (2006), Shafer et al. (2012), White et al. (2012) and White and Gregovich (2017). In 2018, further analyses of GPS radio-collar location data were initiated to characterize seasonal and sex-specific variation in home range size and site fidelity (Shakeri et al. 2018).

Snow and Winter Severity Monitoring.—
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, in 2006 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 in relation to habitat type (i.e. forested/non-forested), altitude, and slope aspect. These efforts focused on four sites located in different mountain goat winter ranges in 2007 but consistent annual monitoring was conducted at only one site located on Echo Ridge, near Davies Creek. 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 (100-200 m) 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 COOP and Juneau Airport Weather Stations).

Figure 4: Remains of a male mountain goat (LG189, 6 years old) that died in avalanche on 1/3/2020, east of Independence Lake. The animal was subsequently scavenged by a black bear.

Reproduction and Survival

Kidding rates and subsequent survival were estimated by monitoring individual study animals during monthly surveys using fixed-wing aircraft (usually a Piper PA-18 Super Cub) equipped for radio-telemetry tracking or via ground-based observations. During surveys, radio-collared adult female mountain goats were observed (typically using 14X image stabilizing binoculars) to determine whether they gave birth to kids and, if so, how long individual kids survived. Monitoring kid production and survival was only possible during the non-winter months when animals could be reliably observed in open habitats. Consequently, we were only able to assess kid survival during the summer period (May-September). Cases in which kid status assessments were equivocal were filtered from the data set and not used for subsequent estimates.

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 (Figure 4). We determined date of mortalities via examination of activity sensor and location data logged on GPS radio-collars or, if not avaliable, VHF collar monitoring histories. 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.

Figure 5: Photograph illustrating the character and juxtaposition of terrain and habitats observed during mountain goat aerial surveys, Katzehin Lake area, AK.

Population Abundance and Composition

Aerial Surveys.—Population abundance and composition surveys were conducted using fixed-wing aircraft (Heliocourier, PA-18 Super Cub, Bellanca Scout) and helicopter (Hughes 500) during August-October, 2005-2020. 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 (Figure 5). 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 radio-collared animals were present.

Sightability Data Collection.—During aerial surveys, data were simultaneously collected to evaluate group-level sighting probabilities. These data were used to parameterize aerial survey “sightability” models which were subsequently used to convert minimum counts to actual population size (i.e. White et al. 2016). Specifically, we characterized behavioral, environmental and climatic conditions for each radio-collared animal seen and not seen (i.e. missed) during surveys. In cases where radio-collared animals were missed, it was necessary to back-track and use radio-telemetry techniques to locate animals and gather associated covariate information. Since observers had general knowledge of where specific individual radio-collared animals were likely to be found (i.e. ridge systems, canyon complexes, etc.), it was typically possible to locate missed animals within 5-15 minutes after an area was originally surveyed. In most cases, it was possible to completely characterize behavioral and site conditions with minimal apparent bias, however in some cases this was not possible (i.e. animals not seen in forested habitats, steep ravines, turbulent canyons) and incomplete covariate information was collected resulting in missing data.

Evaluation of Population Trends.—In order to assess how mountain goat abundance changed over space and time we delineated nine geographically distinct survey areas and summarized the maximum number of adult and kid mountain goats seen in each area, by year. The number of animals seen during aerial surveys is a commonly used metric of mountain goat population abundance; termed the “minimum count”. Since the quantity does not account animals “missed” during surveys, the minimum count typically underestimates actual population size (i.e. by 30-45%, White et al. 2016). In order to account for variation in survey conditions and mountain goat aerial survey sighting probabilities we used a “sightability” model to derive population estimates based on aerial survey observations and associated covariate values (White et al. 2016). Specifically, the model is based on aerial survey mark-resight data collated in Lynn Canal and other areas of southeastern Alaska. The model accounts for variation in sky conditions, group size, terrain and habitat type and converts minimum counts to actual population size (White et al. 2016). In 2020, the White et al. (2016) sightability model was refined and also re-parameterized using new sightability field data collected since White et al. (2016). Consequently, all survey data (2005-2020) was re-analyzed to derive revised population estimates to ensure inter-annual consistency in methodology.

While the sightability model enables estimation of mountain goat abundance at relatively small survey area scales, it is possible to employ more robust “real-time” mark-resight procedures (i.e. Chapman 1954) to estimate population size at the study area scale. At the larger, study area scale a sufficiently large sample size of marked animals are available to be seen during a given survey thereby allowing estimation using this technique. Consequently, for evaluating trends over time we used mark-resight estimates to characterize trends at the broader, study area scale and sightability model derived estimates at the smaller, survey area scale. This complementary approach allows for multi-scale assessment of population trends using the best available estimates.

To assess population trends, estimates of population size and density (based on the amount of summer range habitat determined via RSF modeling; White and Gregovich 2017) were compiled across the entire time series (2005-2020) for all survey areas and scales. Examination of population estimates (and other ecologic data) at the study area scale suggested the population exhibited a significant decline following a period of severe winter conditions between 2006 - 2012. Thereafter, the population exhibited a stable or less distinct declining trajectory, following a period dominated by more favorable average or below-average winter conditions. To examine whether population trends differed across the time series in relation to these contrasting periods of differing winter conditions, segmented regression analyses were implemented treating the year 2006 as an a priori starting point (i.e. when the population was at its peak) and 2012 as the a priori breakpoint (i.e. the end of the severe winter period). Specifically, the rate of population change (number of mountain goats per year) was estimated during 2006-2012 and 2013-2020. Further analyses were conducted to determine whether trends differed between periods within each given area, and at the broader study area scale.

RESULTS AND DISCUSSION

Mountain Goat Capture and Handling

Capture Activities.—During August 2020, 6 animals (males, n = 3; females, n = 3) were captured in the Lions Head-Mt. Sinclair areas (Figure 6). All animals were simultaneously marked with GPS (TGW-4590) and lightweight VHF (Telonics MOD-410) radio-collars. Since 2005, 153 mountain goats have been radio-marked GPS = 130, VHF = 23) in the Lions Head and Sinclair Mountain study areas; GPS location data has been compiled for 99 animals within this area. Currently (as of 1/1/2021), 25 animals are marked in these two areas; all other previously deployed collars have either remotely released or animals have died. Annual capture activities are important for maintaining adequate sample sizes and compensating for natural or scheduled collar losses.

Biological Sample Collection.—During handling procedures, standard biological specimens were collected and

Figure 6: Photograph illustrating the use of a pulse oximeter (sensor attached to the tongue) used to monitor relative oxygen saturation and pulse rate during chemical immobilization of an adult male mountain goat. Vital rates, also including body temperature, respiration rate and central nervous system depression, are monitored throughout during post-capture handling procedures.

morphological measures recorded. Specific biological samples collected from study animals included: whole blood (4 mL), blood serum (8 mL), red blood cells (8 mL), ear tissue, nasal swabs, hair and fecal pellets. Whole blood, serum, red blood cells and fecal pellet sub-samples were either sent to Dr. Kimberlee Beckmen (ADFG, Fairbanks, AK) for disease screening, submitted for trace mineral analysis (Iowa State University), or archived at ADFG facilities in Douglas, AK.

Disease Surveillance.—In 2010 and 2014, a subset of captured animals were tested (Washington Animal Disease Diagnostic Laboratory, Pullman, WA) for prevalence of respiratory bacteria associated with incidence of pneumonia (specifically *Mycoplasma ovipneumoniae*). Results of these analyses were summarized in White et al. (2012) and Lowrey et al. (2018). Further surveillance testing for *Mycoplasma ovipneumoniae* was conducted in 2016 - 2020 but analytical results are not yet available.

During 2005-2020, blood serum samples collected from captured animals have been tested each year for a suite of 15 different diseases relevant to ungulates (Appendix 1). With few exceptions, serology analyses indicated that mountain goats rarely show evidence of exposure to any of the diseases considered. Yet, of particular interest is contagious ecthyma (CE), a viral disease previously documented among mountain goats in Juneau, Haines and other areas of southeastern Alaska. Common symptoms of CE include presence of grotesque lesions on the face, ears, and nose which can lead to death of animals, primarily those in young or old age classes; healthy adults commonly survive the disease. Because of the regional prevalence of CE, most samples collected during 2005-2020 have been tested for this disease. Of the 86 animals successfully tested for CE in the Lions Head and Mt Sinclair areas, four animals (5%) tested positive for CE-specific antibodies; a level of prevalence comparable to other southeastern Alaska populations tested (Appendix 1).

Trace Mineral Testing.—In 2016-2020, whole blood and serum samples were analyzed to determine trace mineral concentration for 33 mountain goats in order to examine whether mineral deficiencies were prevalent in our study population (Appendix 2a). While experimental data is limited to assess deficiency threshold values for Selenium, a trace mineral that can influence pregnancy, values less than 0.08 ppm are generally considered low (based on domestic livestock). In the Lions Head/Sinclair study areas 45% of animals had blood Selenium values below this threshold (Appendix 2b); a proportion similar to the nearby Haines-Skagway population but higher than Baranof Island. Presumably, deficiencies are related to site productivity and geologic substrate. In the absence of species-specific studies it is unclear whether the observed degree of deficiency is sufficient to influence reproduction, as has been reported for domestic livestock.

Genetic Analyses.—Tissue samples from all mountain goats captured between 2005-2020 have been genotyped by Aaron Shafer (Trent University/University of Alberta). (Duplicate samples are archived at ADFG, Douglas, AK). A subset of these data were analyzed and included in continent-wide analyses of mountain goat population genetics (Shafer et al. 2010). Shafer et al. (2010) indicated that substantial genetic structuring exists among mountain goats in southeastern Alaska (and across the western North American range of the species). More recent analyses indicated that three genetically distinct mountain goat populations occur in our study area [east Berners mountains, Kakuhan range (including Lions Head and Sinclair Mountain), and Mt. Villard]; population boundaries generally coincide with our specific study area boundaries (Shafer et al. 2012). These findings indicate that gene flow between our study areas (with the exception of the Lion Head and Sinclair study areas, which are genetically indistinct) is limited. In 2016, a state-wide mountain goat population genetics project was initiated and will include more spatially extensive analyses that utilize both microsatelite and genomic techniques. This project is funded by ADFG and Trent University but will benefit our knowledge of mountain goat genetics in this study area as well.

GPS Location Data

GPS System Performance.—The performance of GPS radio-collars (Telonics TGW-3590) was evaluated for 124 collars deployed since the beginning of the study (see White et al. 2012). In general, the remote GPS data collection system used in this study worked as expected during 2005 - 2018. However, in 2019 a GPS collar manufacturing malfunction compromised location data collection for a sub-set of collars deployed. Specifically, 12 GPS radio-collars deployed during 2016-2018 stopped collecting location data in April 2019 (but could still be monitored via VHF telemetry). GPS radio-collars subsequently deployed during 2019-2020 have operated without problems.

Winter Severity and Snow Modeling

Snow Surveys.—Field-based snow surveys were conducted within 5 days of April 1 during 2007-2008, 2010-200 on Echo Ridge. Analyses of these data quantified the degree to which snow depth differs with increasing elevation between forested and non-forested sites (White et al. 2012). Overall, these data quantify the extent to which snow depth varied relative to elevation and habitat type (i.e. open vs. forest). Specifically, snow depth was 30-40 inches deeper in open relative to forested habitats, on average. Further, snow depth increased 2.3-2.7 inches per 100 foot gain in elevation, on average (White et al. 2012). Importantly, these data provide quantitative information about winter severity in areas representative of where mountain goats in our study area are wintering. Such data will be able to be used as covariates in future analyses of survival, reproduction and resource selection.

Climate Data.—Daily climate data were archived from the National Weather Service database to characterize broader scale climate patterns (Appendix 3a-e). Total annual snowfall, average daily temperature during July-August, and total precipitation (summer and annual) were summarized from data collected at the National Weather Service station in Haines, AK (Appendix 3a-e). Total annual snowfall and average temperature during July-August are important predictors of mountain goat survival (White et al. 2011). Mean snowfall in Haines during the study period (2005-2020) was 114% of the long-term normal (i.e. 1950-2020). Overall, snowfall in Haines during 5 of the 7 initial winters of the study was above normal (including 5 of the 10 highest snowfall winters on record; 41 years of data). However, 6 of the last 8 winters have been below average. During the winter of 2019/2020, a total 220 inches (145% of normal) of snowfall was recorded in Haines.

Reproduction and Survival

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: Proportion of radio-marked adult female mountain goats observed with kids at heel during parturition in the Lynn Canal study area, 2005-2020. Data are also presented from other study areas, for comparative purposes.

Area	Year	Kids	AdF	Prop	SE
Lynn Canal					
	2005	8	12	0.67	0.14
	2006	16	25	0.64	0.10
	2007	20	32	0.63	0.09
	2008	19	33	0.58	0.09
	2009	15	25	0.60	0.10
	2010	18	26	0.69	0.09
	2011	18	27	0.67	0.09
	2012	9	15	0.60	0.13
	2013	9	13	0.69	0.13
	2014	8	14	0.57	0.13
	2015	15	17	0.88	0.08
	2016	14	17	0.82	0.09
	2017	13	17	0.76	0.10
	2018	12	15	0.80	0.10
	2019	13	18	0.72	0.11
	2020	9	14	0.64	0.13
	Total	216	320	0.68	0.03
Haines-Skagway					
	2010	5	10	0.50	0.16
	2011	8	10	0.80	0.13
	2012	8	11	0.73	0.13
	2013	10	12	0.83	0.11
	2014	10	17	0.59	0.12
	2015	14	18	0.78	0.10
	2016	11	15	0.73	0.11
	2017	6	11	0.55	0.15
	2018	8	14	0.57	0.13
	2019	12	18	0.67	0.11
	2020	14	22	0.64	0.10
	Total	106	158	0.67	0.04
Baranof					
	2010	4	4	1.00	0.00
	2011	5	6	0.83	0.15
	2012	3	5	0.60	0.22
	2013	5	10	0.50	0.16
	2014	9	12	0.75	0.13
	2015	7	14	0.50	0.13
	2016	8	12	0.67	0.14
	2017	4	11	0.36	0.15
	2018	8	12	0.67	0.14
	2019	5	12	0.42	0.14
	2020	7	16	0.44	0.12
	Total	65	114	0.57	0.05

May-June aerial telemetry surveys (Table 1). 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 consistently collected each year and similar to estimates of kidding rates reported elsewhere

Table 2. Apparent survival of mountain goat kids associated with radio-marked females during summer (May - September) during 2006-2020 in Lynn Canal, AK. Data from other areas are summarized for comparison.

	Survival			
	At Risk	Alive	$\hat{S}$	SE
Lynn Canal	115	94	0.82	0.03
Haines-Skagway	71	51	0.72	0.05
Baranof	42	40	0.95	0.03
Lynn Canal + Haines-Skagway	186	145	0.78	0.03
All Areas	228	185	0.81	0.02

suggesting our methodology is subject to limited bias (Festa-Bianchet and Cote 2008).

Annual estimates of kid production in Lynn Canal ranged from 57-88% between 2005-2020 (Table 1). During 2020, 64% of radio-marked females (n = 14) had a kid at heel; four percent below average (Table 1). As described above, the previous winter snowfall was 145% of normal and likely contributed to the observed decrease in reproduction; preliminary analyses suggest that reproduction is negatively related to total snowfall during the preceding winter (White 2020).

Observations of individual mountain goat kids associated with attendant radio-marked females indicated that, on average, 72±5% of kids survived during the summer period (May-Sept, 2005 - 2020; Table 2). This estimate is intermediate, as compared to regional populations in the Haines-Skagway area and Baranof Island (Table 2), and similar to estimates reported from a long-term study in Alberta (Festa-Bianchet and Cote 2008).

Survival.—Mountain goats were monitored monthly during fixed-wing aerial telemetry flights and/or via GPS-telemetry. During 2019/2020 biological year, 7 radio-marked animals died. Overall, 74±8% of animals survived during 2019/2020; a relatively low proportion (i.e. 3% lower than the long term average; Table 3). Yet, this result is not surprising given that winter snowfall, an important determinant of winter survival (White et al. 2011), was 145% higher than normal. Avalanches were the cause of death in 2 of 7 mortality cases, and an additional animal died from documented wolf predation (the remaining 4 radiocollared animals died of unknown, but non-avalanche related, causes).

Adult survival, particularly adult females, can strongly influence population growth rate in mountain goats (Hamel

Table 3: Estimates of mountain goat survival for different sex classes during 2005-2020, Lynn Canal, AK. Data are also presented from other study areas, for comparative purposes.

	Males				Females				Total			
	At Risk	Died	Ŝ	SE	At Risk	Died	Ŝ	SE	At Risk	Died	Ŝ	SE
Lynn Canal												
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	0.05
2007/2008	36	7	0.77	0.08	31	4	0.83	0.08	67	11	0.80	0.05
2008/2009	36	10	0.66	0.09	34	6	0.73	0.09	70	16	0.69	0.06
2009/2010	28	4	0.86	0.07	26	4	0.85	0.07	54	8	0.85	0.05
2010/2011	25	3	0.88	0.06	24	2	0.91	0.06	49	5	0.90	0.04
2011/2012	23	6	0.72	0.10	23	3	0.85	0.08	46	9	0.77	0.07
2012/2013	19	8	0.56	0.11	16	7	0.60	0.11	34	15	0.58	0.08
2013/2014	14	4	0.71	0.12	11	2	0.83	0.11	25	6	0.76	0.08
2014/2015	12	5	0.60	0.13	14	1	0.93	0.07	26	6	0.77	0.08
2015/2016	9	1	0.88	0.10	17	2	0.88	0.08	26	3	0.88	0.06
2016/2017	14	6	0.57	0.13	17	3	0.82	0.09	31	9	0.71	0.08
2017/2018	12	1	0.92	0.08	18	6	0.67	0.11	30	7	0.77	0.08
2018/2019	13	3	0.76	0.12	14	0	1.00	0.00	27	3	0.89	0.06
2019/2020	12	4	0.67	0.13	17	3	0.80	0.10	29	7	0.74	0.08
All years	272	75	0.73	0.03	264	48	0.82	0.02	533	123	0.77	0.02
Haines-Skagway												
2010/2011	13	4	0.69	0.13	10	3	0.70	0.14	23	7	0.70	0.10
2011/2012	16	2	0.87	0.09	10	1	0.90	0.09	26	3	0.88	0.06
2012/2013	18	2	0.89	0.07	11	1	0.91	0.08	29	3	0.90	0.06
2013/2014	22	2	0.91	0.06	12	1	0.92	0.08	34	3	0.91	0.05
2014/2015	19	2	0.89	0.07	16	2	0.85	0.08	35	4	0.88	0.05
2015/2016	18	5	0.72	0.10	16	3	0.79	0.10	34	8	0.75	0.07
2016/2017	13	6	0.56	0.13	14	4	0.71	0.11	26	10	0.64	0.09
2017/2018	12	3	0.73	0.12	11	0	1.00	0.00	23	3	0.86	0.07
2018/2019	13	1	0.91	0.08	12	2	0.83	0.10	25	3	0.87	0.07
2019/2020	21	4	0.77	0.09	11	3	0.73	0.12	32	7	0.77	0.07
All years	162	31	0.80	0.03	119	20	0.83	0.03	281	51	0.82	0.02
Baranof Island												
2010/2011	8	1	0.88	0.11	4	0	1.00	0.00	12	1	0.92	0.08
2011/2012	12	0	1.00	0.00	6	0	1.00	0.00	18	0	1.00	0.00
2012/2013	17	3	0.82	0.09	6	0	1.00	0.00	23	3	0.87	0.07
2013/2014	17	3	0.82	0.09	10	0	1.00	0.00	27	3	0.89	0.06
2014/2015	17	3	0.82	0.09	12	1	0.92	0.08	29	4	0.86	0.06
2015/2016	14	0	1.00	0.00	13	2	0.84	0.11	27	2	0.92	0.06
2016/2017	23	3	0.85	0.08	13	2	0.82	0.12	36	5	0.84	0.06
2017/2018	21	5	0.76	0.09	11	2	0.80	0.13	32	7	0.77	0.07
2018/2019	18	1	0.94	0.06	13	1	0.90	0.09	31	2	0.93	0.05
2019/2020	19	8	0.47	0.10	12	2	0.82	0.11	31	10	0.63	0.08
All years	162	27	0.83	0.03	100	10	0.89	0.03	262	37	0.85	0.02

At Risk = maximum number of animals monitored per month (per time period) et al. 2006, Festa-Bianchet and Cote 2008, White et al. 2021). Consequently, the reduced survival documented in 2019/2020 suggests the population was unlikely to have sustained growth during the most recent biological year. Given the population has experienced relatively low overall survival (2005-2020, annual survival = 77±2%) and associated population decline it will be important to monitor the population for indication of recovery in future years.

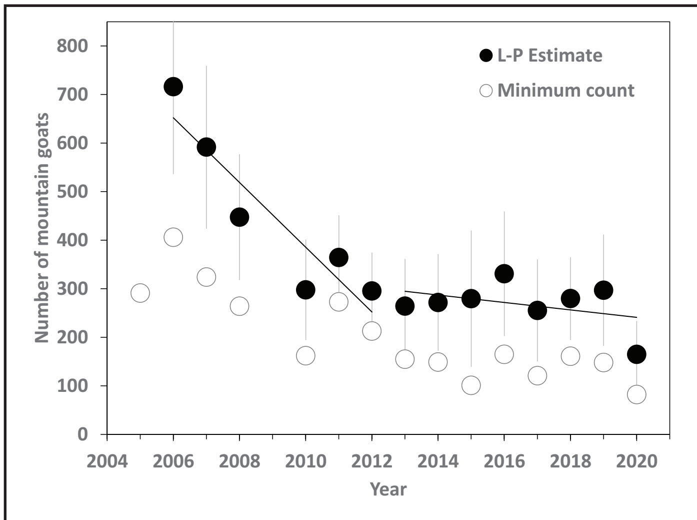

Figure 7. Number of mountain goats in the Kakuhan Range, AK (Lions Head and Mt. Sinclair study areas combined) during 2005 - 2020. White circles designate the number of mountain goats seen during aerial surveys, and the black circles represent the associated mark-resight population estimates. Due to small sample size, a mark-resight estimate was not calculated for 2005.

Population Abundance and Composition

Aerial Surveys.—During September 2020, aerial surveys were conducted in nine different survey areas in the Lions Head and Sinclair Mountain study areas, and the Berners-Lace ridge area (Appendix 4, 5a-c). The Berners-Lace ridge was surveyed because seasonal movement (albeit limited) by male mountain goats has been documented from the Lions Head study area to this site in past years.

Evaluation of Population Trends.— Geographic and temporal trends were characterized using segmented regression for eight survey areas within the Lions Head and Sinclair study areas, the Berners-Lace ridge as well as the entire Kakuhan Range (Appendix 4, 5a-c). Analyses were based on population estimates derived using the White et al. (2016) aerial survey sightability model and aerial survey data collected during 2005-2020. At the broader, Kakuhan Range study area scale mark-resight estimates (i.e. Chapman 1954) were derived and used for analyses.

Winter snowfall, an important determinant of mountain goat survival (White et al. 2011) was above average during 5 of 6 winters during 2006 – 2012. However, winter snowfall was average, or below average, in 6 of 8 years during 2013-2020. Because of the contrasting periods of winter conditions and associated a priori expectations about how snowfall would differentially influence mountain goat survival and subsequently population abundance during these two periods, we used segmented regression techniques to independently characterize population trends during each period. This approach allowed for more detailed characterization of population trends, as compared to previous analyses which examined population trends across the entire time-series inclusively (i.e. White 2019).

At the Kakuhan Range (study area-wide) scale, population size declined significantly (-59±14 mountain goats/year) during 2006-2012, however during the following period of moderate, or below average, winter conditions (2013-2020) the population was stable, or slightly declining (-8±7 mountain goats/year)(Table 4, Figure 7). Overall, the population trends during the two periods were significantly different (P<0.01, Table 4, Figure 7). These analyses indicate that the population experienced a significant decline during the period of severe winter conditions and subsequently stabilized during the period of more moderate winter conditions. However, the population has not yet shown significant evidence of recovery despite the recent eight year period of largely favorable winter conditions.

Analyses at the smaller, survey area-scale provide insight about spatial and tempral patterns of abundance within the broader study area. Overall, similar patterns in population trajectories were evident between the 2006-2012 and 2013-2020 periods yet substantial variability was evident among survey areas. During the severe winter period (2006-2012), the most substantial declines occurred in the S Katzehin (-20±5 mountain goats/year), Yeldagalga (-14±6 mountain goats/year), Met (-7±3 mountain goats/year) and Kensington (-6±4 mountain goats/year) areas, as compared to surrounding areas (Table 4, Figure 8). During the moderate winter period (2013-2020), the abundance of mountain goats showed evidence of increase in the S Katzehin survey area (4±3 mountain goats/year) but in other key areas exhibited evidence of stability or slight, non-significant decline (Yeldagalga: -3±4 mountain goats/year, Met: 0±3 mountain goats/year, Kensington, 0±2 mountain goats/year)(Table 4, Figure 7). Differences in population trends between periods were most pronounced in the S Katzehin and Katzehin Lake areas, indicating trends in the initial decline and subsequent period of stability were most distinct in these areas (Table 4, Figure 7).

Despite the relatively long time series available for analyses (2006-2012 = 7 years, 2013-2020 = 8 years), it is important to recognize that inter-annual variability in population estimates within survey areas is evident and constrains precision of trend analyses. Utilization of

Table 4: Estimated change in population size minimum count densities, based on mountain goats observed during aerial surveys during 2005-2018, Lynn Canal, Alaska.

	2006-2012			2013-2020			Difference
Area	Slope	SE	P-value	Slope	SE	P-value	P-value
Study area:							
Kakuhan Range	-59.0	14.3	<0.01	-7.7	7.3	0.33	<0.01
Survey Areas:							
W Berners	-2.3	2.1	0.32	-1.5	1.6	0.39	0.76
Kensington	-6.0	4.0	0.19	-0.3	1.9	0.89	0.19
Met	-6.9	2.9	0.06	-0.1	2.7	0.96	0.12
Yeldagalga	-14.2	6.2	0.08	-2.5	3.8	0.54	0.12
S Katzehin	-19.5	5.2	0.02	3.5	3.0	0.29	0.00
Katzehin Lk	-4.7	1.9	0.07	-0.2	0.8	0.81	0.03
S Meade	-1.3	2.2	0.60	-0.8	1.1	0.50	0.84
U Lace	1.1	0.9	0.30	0.1	0.8	0.86	0.45
BL Ridge	-0.8	3.0	0.83	-1.9	0.9	0.08	0.63

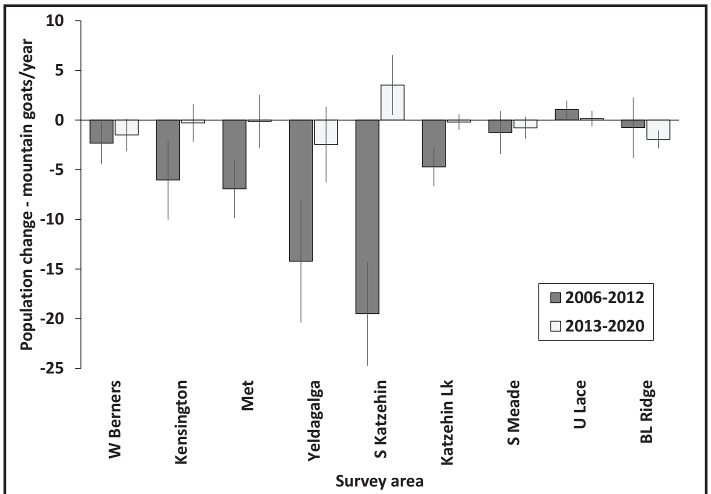

Figure 8: Estimated change in minimum count densities, based on mountain goats observed during aerial surveys during 2005-2018, Lynn Canal, Alaska.

aerial survey sightability models substantially increases the accuracy and precision of survey area-level population estimates, in comparison to raw, minimum count data. However, not all sources of variability are likely accounted for and confidence intervals overlap previous estimates, or zero (in the case of trend analyses), in some instances. Consequently, survey area-level analyses should be interpreted cautiously until additional data are collected in future years to assess current population trends and, ultimately, evidence of population recovery. However, study area-wide mark-resight population estimates are conducted in "real-time" and inherently integrate more variation in aerial survey conditions enabling more reliable assessments of population trends over time; yet, applications are constrained by the larger spatial scale of inference. In this regard, implementation of integrated population models (IPMs; sensu Johnson et al. 2010), that quantitatively integrate independent data streams (i.e. mark-resight and sightability estimates), offer a promising approach for further refining the accuracy and precision of survey-level population estimates and trends. Implementation of this approach could enable scaling down more accurate and precise broad-scale estimates to the survey area-level and offer an improvement in our ability to articulate spatial variation in population trends.

Sightability Modeling and Population Estimates.—During all surveys, data were collected for purposes of developing group-level aerial survey sighting probability models (2020, n = 25 trials). In addition, complementary aerial surveys were conducted in areas outside of the study area (Haines, Baranof Island) where mountain goats were marked as part of independent studies. Collection of data in other areas has enabled acquisition of additional sightability data resulting in opportunity to more accurately parameterize sightability models; however, a majority of the data used to develop models was collected in the Lynn Canal/Berners Bay study areas. Details of this modeling effort are summarized in White et al. (2016). During 2020 all newly acquired data collected since 2016 was used to refine and re-parameterize models, as well as re-analyze data to derive updated estimates for the entire 2005-2020 time-series (described above).

FUTURE WORK

The mountain goat population monitoring and assessment work in the vicinity of the Kensington Mine is planned to continue during the operational phase on mining operations. The project area for ongoing mine-related monitoring work encompasses the area between Slate cove and the Katzehin River (i.e. the "Lions Head" and "Sinclair" study areas). In this area, study animals (2020/21, n = 25) will continue to be monitored monthly to assess reproductive status and survival. Mortalities will be investigated during April - October, or as conditions allow. GPS location data will be downloaded from radio-collars following field recovery efforts or via satellite-link; GPS radio collars automatically release 3 years after capture/deployment (or at the time or mortality). GPS data will be post-processed and appended to the existing GPS location database. During late-summer, 6-8 mountain goats will be captured to ensure scientifically defensible sample sizes are maintained. Three replicate aerial surveys will be conducted in early-fall 2020, weather permitting, in order to estimate mountain goat sightability, population abundance and composition. During 2020-2021, efforts will continue to refine mountain goat aerial survey sightability models and, ultimately, derive population estimates. Results of project activities will be summarized and submitted to Coeur Alaska, Inc. and associated stakeholders as an annual research project report in spring 2022.

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Appendix 1: Incidence of disease prevalence of mountain goats in the Kakuhan Range (includes the Lions Head and Sinclair study areas combined) during 2005-2020. Results are also provided for three other populations in southeastern Alaska, for comparison.

	Baranof			Cleveland			Haines			Berners			Kakuhan			Villard			Total		
Disease	**n**	**Pos.**	**Prop**	**n**	**Pos.**	**Prop**	**n**	**Pos.**	**Prop**	**n**	**Pos.**	**Prop**	**n**	**Pos.**	**Prop**	**n**	**Pos.**	**Prop**	**n**	**Pos.**	**Prop**
Contagious Ecthyma	68	2	0.03	10	1	0.10	73	3	0.04	20	1	0.05	86	4	0.05	24	0	0.00	281	11	0.04
Chlamydia	34	1	0.01	12	0	0.00	44	1	0.02	27	0	0.00	49	3	0.06	30	1	0.03	196	6	0.03
Q Fever	54	0	0.00	11	0	0.00	66	0	0.00	29	0	0.00	80	3	0.04	32	1	0.03	272	4	0.01
Bluetongue	17	0	0.00	10	0	0.00	20	0	0.00	20	0	0.00	17	0	0.00	18	0	0.00	102	0	0.00
Bovine respiratory synctial virus (BRSV)	17	0	0.00	10	0	0.00	20	0	0.00	21	0	0.00	17	0	0.00	16	0	0.00	101	0	0.00
Infectious bovine rhinotrachetis (IBR)	17	0	0.00	10	0	0.00	20	0	0.00	21	0	0.00	17	0	0.00	17	0	0.00	102	0	0.00
Parainfluenza-3 (PI-3)	17	0	0.00	10	0	0.00	20	0	0.00	21	0	0.00	17	0	0.00	17	0	0.00	102	0	0.00
Epizootic hemorrhagic disease (EHD)	17	0	0.00	9	0	0.00	20	0	0.00	21	0	0.00	17	0	0.00	17	0	0.00	101	0	0.00
Caprinae arthritis encephalitis (CAE)	17	0	0.00	9	0	0.00	20	0	0.00	21	0	0.00	17	0	0.00	16	0	0.00	100	0	0.00
Malignant cataharral fever-ovine (MCF)	17	0	0.00	9	0	0.00	20	0	0.00	21	0	0.00	17	0	0.00	16	0	0.00	100	0	0.00
Leptospirosis cannicola	17	0	0.00	9	0	0.00	20	0	0.00	21	0	0.00	17	0	0.00	17	0	0.00	101	0	0.00
Leptospirosis grippo	17	0	0.00	9	0	0.00	20	1	0.05	21	0	0.00	17	1	0.06	17	1	0.06	101	3	0.03
Leptospirosis hardjo	17	0	0.00	9	0	0.00	20	0	0.00	21	0	0.00	17	0	0.00	17	0	0.00	101	0	0.00
Leptospirosis ictero	17	0	0.00	9	0	0.00	20	3	0.15	21	2	0.10	17	3	0.18	17	3	0.18	101	11	0.11
Leptospirosis pomona	17	0	0.00	9	0	0.00	20	0	0.00	21	0	0.00	17	0	0.00	17	0	0.00	101	0	0.00

Positive titers: PI3>1:120, IBR> 1:64, BRSV >1:32, Leptospirosis sp.>1:100

Appendix 2a: Blood serum trace mineral concentration documented for mountain goats in the Lions Head and Sinclair study areas, 2016-2020. Results are also provided for two other populations in southeastern Alaska in 2016-2020, for comparison. (Lynn Canal includes the Lions Head and Sinclair study areas combined).

	Selenium (ppm) (0.08 - 0.20)			Copper (ppm) (0.7 - 1.2)			Iron (ppm) (1.1 - 2.3)			Calcium (ppm) (87 - 101)			Zinc (ppm) (0.65 - 2.70)		
Area	**mean**	**SE**	**n**	**mean**	**SE**	**n**	**mean**	**SE**	**n**	**mean**	**SE**	**n**	**mean**	**SE**	**n**
Baranof	**0.12**	**0.00**	**40**	**1.0**	**0.0**	**40**	**3.6**	**0.3**	**40**	**104**	**1**	**40**	**0.80**	**0.02**	**40**
Lynn Canal	**0.10**	**0.01**	**33**	**1.0**	**0.0**	**33**	**3.9**	**0.4**	**33**	**106**	**1**	**33**	**0.82**	**0.02**	**33**
Haines	**0.11**	**0.01**	**41**	**0.9**	**0.0**	**41**	**4.8**	**0.5**	**41**	**107**	**1**	**41**	**0.83**	**0.03**	**41**
All Areas	**0.11**	**0.01**	**114**	**1.0**	**0.0**	**114**	**4.1**	**0.2**	**114**	**106**	**1**	**114**	**0.82**	**0.01**	**114**

Appendix 2b: Blood serum Selenium concentration for mountain goats in the Lions Head and Sinclair study areas, 2016-2020. Results are also provided for two other populations in southeastern Alaska in 2010-2014, for comparison. (Lynn Canal includes the Lions Head and Sinclair study areas combined). Bloos serum Selenium concentrations < 0.08 denote deficiency.

Area	**mean**	**SE**	**Min**	**Max**	**# <0.08**	**Prop <0.08**	**n**
Baranof	**0.117**	**0.003**	**0.077**	**0.162**	**8**	**0.20**	**40**
Lynn Canal	**0.095**	**0.007**	**0.034**	**0.195**	**15**	**0.45**	**33**
Haines[a]	**0.111**	**0.014**	**0.021**	**0.534**	**23**	**0.56**	**41**
All areas	**0.108**	**0.006**	**0.021**	**0.534**	**46**	**0.40**	**114**

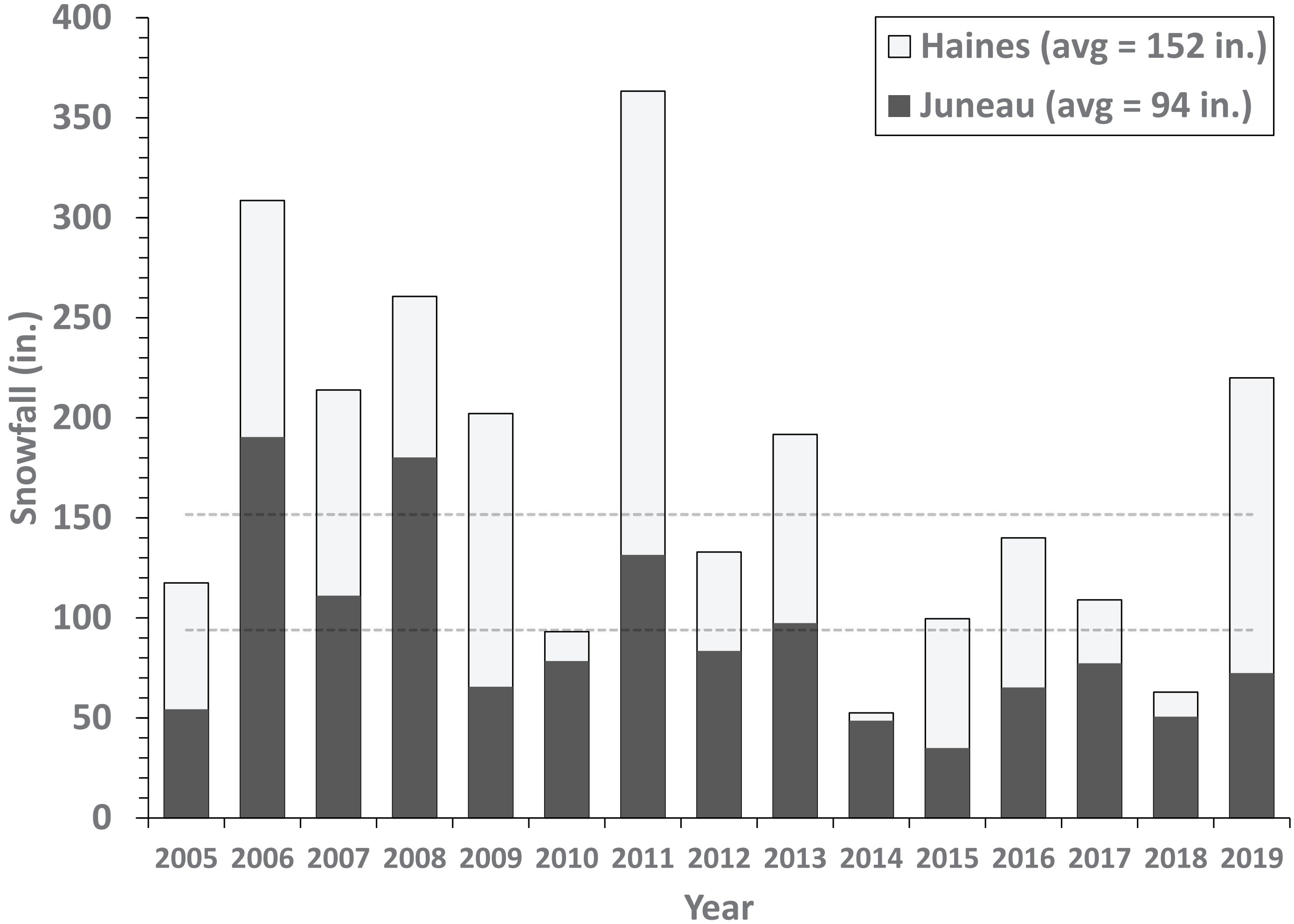
[a]3 above normal range (Porcupine area)

Appendix 3a: Monthly snowfall (in.) recorded at the Haines 2 COOP NWS Station in Haines, AK between 2005-2020.

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total	% of normal
2005/2006	0	30	9	40	22	16	0	0	118	77%
2006/2007	0	42	78	81	28	78	3	0	309	203%
2007/2008	0	6	56	78	41	31	3	0	214	141%
2008/2009	22	24	56	62	45	43	9	0	261	172%
2009/2010	0	48	19	68	8	59	0	0	202	133%
2010/2011	0	24	25	19	20	3	3	0	93	61%
2011/2012	0	126	40	121	20	56	0	0	363	239%
2012/2013	4	20	41	21	23	10	14	1	133	88%
2013/2014	0	20	92	22	23	35	1	0	192	126%
2014/2015	0	0	5	14	18	16	0	0	53	35%
2015/2016	0	21	43	18	16	2	0	0	100	66%
2016/2017	13	11	43	22	19	33	0	0	140	92%
2017/2018	0	28	2	27	17	34	0	0	109	72%
2018/2019	0	15	28	5	11	3	1	0	63	41%
2019/2020	4	3	55	78	54	17	9	0	220	145%
Average, Study period	3	28	39	45	24	29	3	0	171	113%
Average, Long-term[1]	3	22	38	37	28	20	3	0	152	100%

[1]Haines Airport (1950-1955, 1973-1998) and Haines COOP NWS Station (1999-2019)

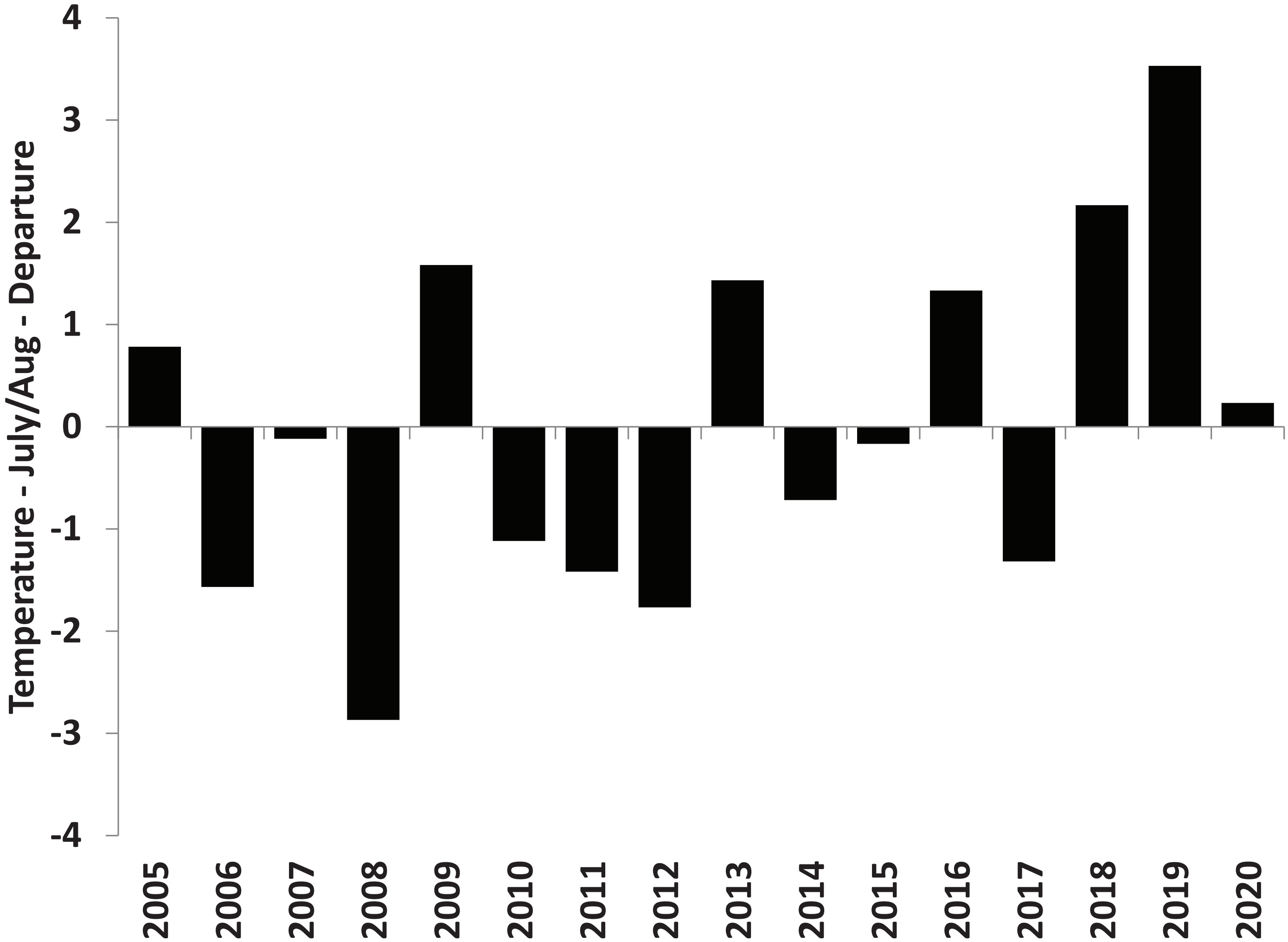
Appendix 3b: Total annual snowfall (in.) recorded at the Haines 2 COOP NWS Station in Haines, AK and the Juneau Airport between 2005-2020. The dashed lines designates the long-term average [upper line: Haines - Haines Airport (1950-1955, 1973-1998) and Haines 2 COOP NWS Station (1999-2020), lower line: Juneau - Juneau Airport (1950-2020)].



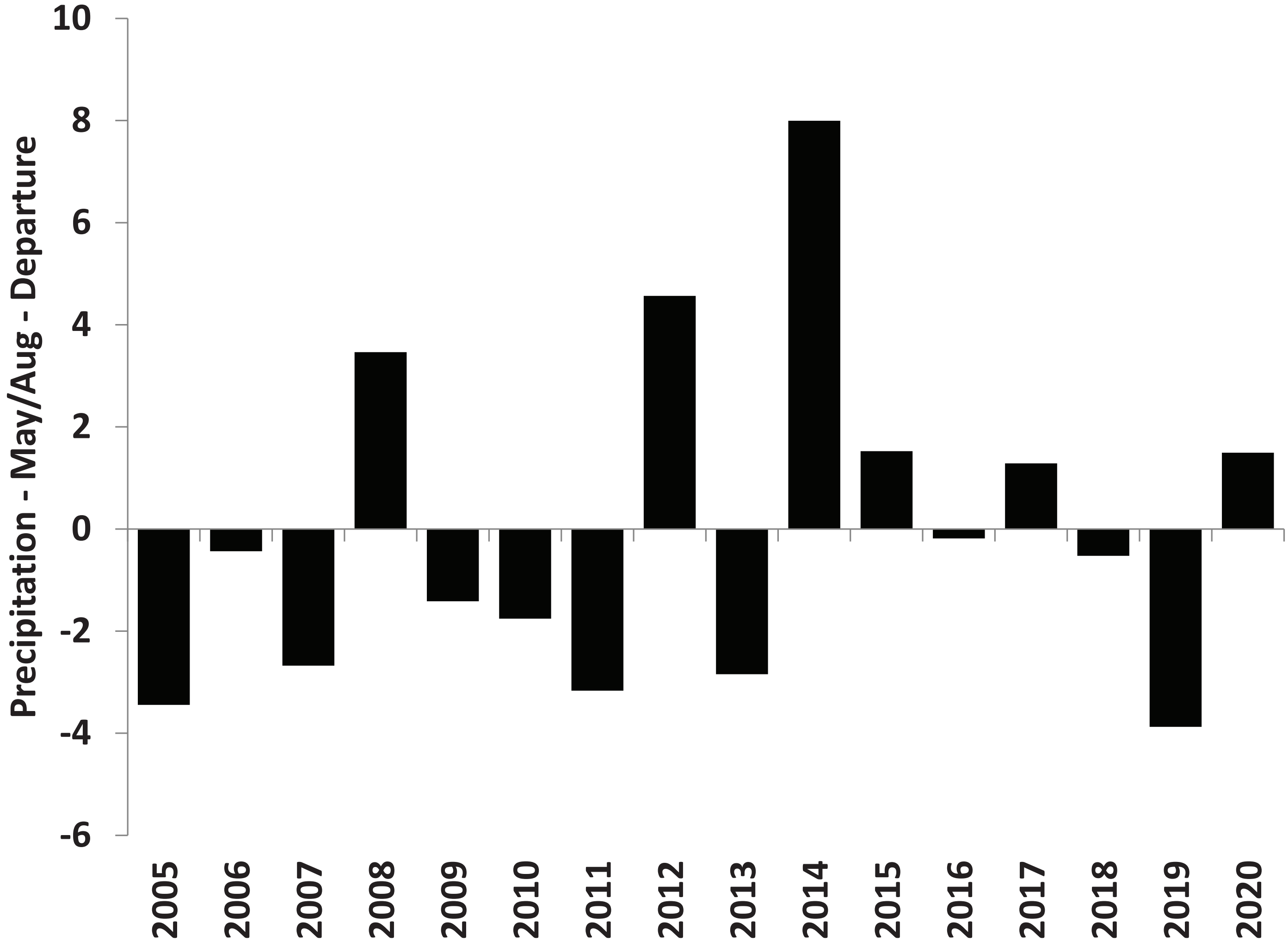
Appendix 3c: Summer temperature and precipitation (in.) recorded at the Haines 2 COOP NWS Station in Haines, AK between 2005-2020.

	Temperature - July/August						Precipitation				
	Farenheit			Celcius			Inches				
Year	Mean - 0 ft.	Mean - 3000 ft.[1]	Departure	Mean - 0 ft.	Mean - 3000 ft.[1]	Departure	May/ June	July/ Aug	May- Aug	May-Aug Departure	Annual[2]
2005/2006	58.30	47.61	0.78	14.61	8.67	0.43	3.2	3.8	7.0	-3.4	64.1
2006/2007	55.95	45.26	-1.57	13.31	7.36	-0.87	6.4	3.6	10.0	-0.4	66.7
2007/2008	57.40	46.71	-0.12	14.11	8.17	-0.07	1.9	5.9	7.7	-2.7	56.5
2008/2009	54.65	43.96	-2.87	12.58	6.64	-1.59	4.6	9.3	13.9	3.5	62.6
2009/2010	59.10	48.41	1.58	15.06	9.11	0.88	0.7	8.3	9.0	-1.4	76.7
2010/2011	56.40	45.71	-1.12	13.56	7.61	-0.62	5.1	3.5	8.7	-1.8	49.1
2011/2012	56.10	45.41	-1.42	13.39	7.45	-0.79	1.3	5.9	7.2	-3.2	84.9
2012/2013	55.75	45.06	-1.77	13.19	7.25	-0.98	8.6	6.4	15.0	4.6	53.7
2013/2014	58.95	48.26	1.43	14.97	9.03	0.80	4.9	2.7	7.6	-2.8	54.4
2014/2015	56.80	46.11	-0.72	13.78	7.84	-0.40	6.6	11.8	18.4	8.0	69.2
2015/2016	57.35	46.66	-0.17	14.08	8.14	-0.09	3.0	9.0	11.9	1.5	73.4
2016/2017	58.85	48.16	1.33	14.92	8.98	0.74	6.8	3.4	10.2	-0.2	60.8
2017/2018	56.20	45.51	-1.32	13.44	7.50	-0.73	5.4	6.3	11.7	1.3	54.1
2018/2019	59.69	48.99	2.17	15.38	9.44	1.20	6.2	3.7	9.9	-0.5	50.1
2019/2020	61.05	50.35	3.53	16.14	10.20	1.96	3.4	3.1	6.5	-3.9	56.7
2020/2021	57.75	47.06	0.23	14.31	8.36	0.13	3.3	8.6	11.9	1.5	--
Average, Study period	57.52	46.82	0.00	14.18	8.24	0.00	4.4	6.0	10.4	0.0	62.2

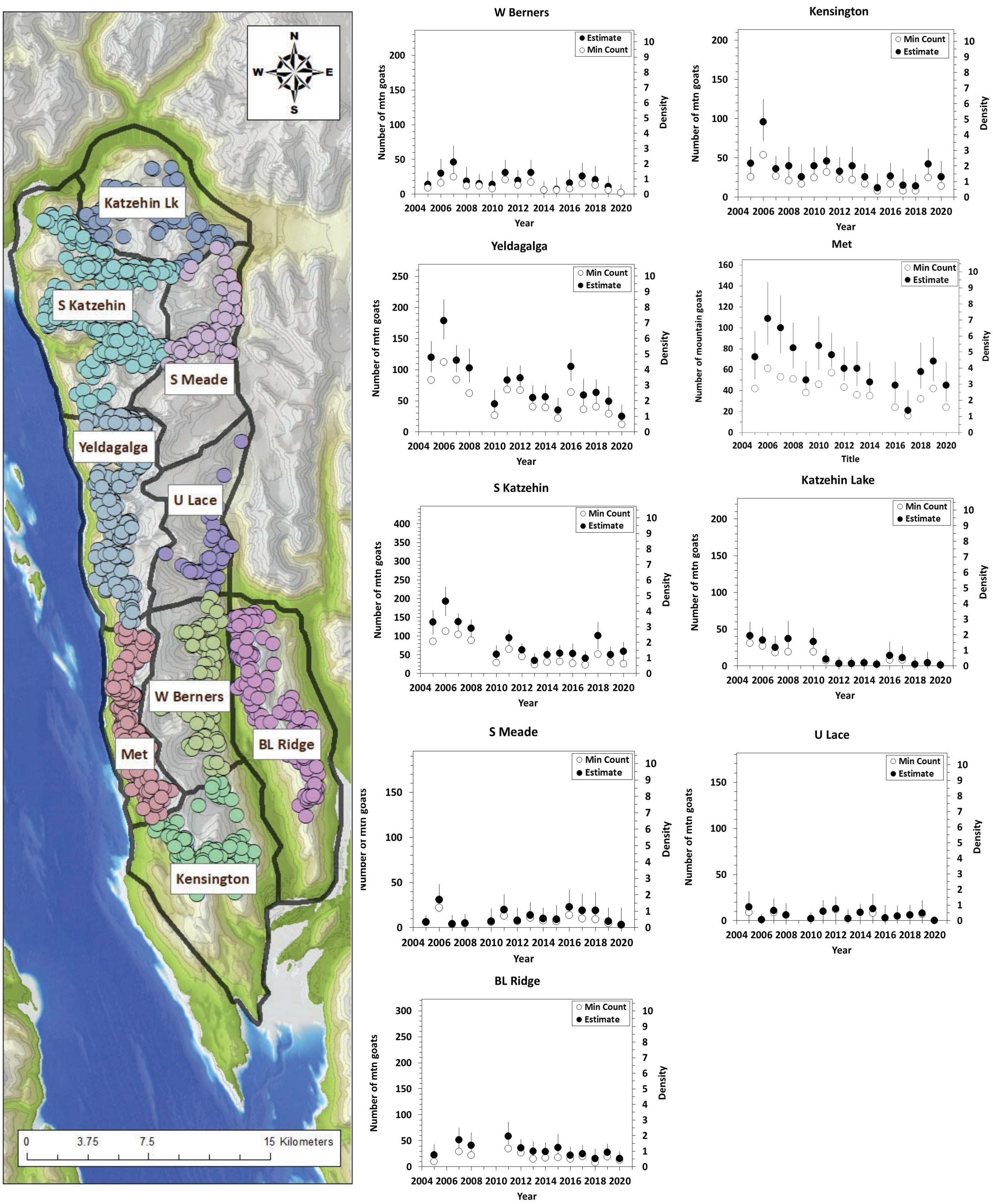
Appendix 3d: Departure from normal average temperature (F) during July-August recorded at the Haines 2 COOP NWS Station in Haines, AK between 2005-2020.



Appendix 3e: Departure from normal precipitation (in.) during May-August recorded at the Haines 2 COOP NWS Station in Haines, AK between 2005-2020.



Appendix 4: Mountain goat aerial survey areas in the Kakuhan Range (Lions Head, Sinclair and Berners-Lace Ridge study areas). Each area was surveyed by fixed- and/or rotor-wing aircraft during August-October, 2005-2020. Summer range population size and density (mountain goats/km^2) estimates were derived using sightability and RSF modeling and described in associated figures.



Appendix 5a: Summary of mountain goat population composition, minimum count and population estimates based on data collected during aerial surveys on the Lions Head study area (and associated survey areas), 2005-2020. “Minimum counts” represent the number of mountain goats seen during aerial surveys and do not account for variation in sighting probabilities between surveys/years. Population estimates explicitly account for variation in group-level sighting probabilities among surveys/years.

				Minimum Count				Population Estimate				
Study Area	Survey Area	Year	Weather	Adults	Kids	Total	Prop. Kids	Total	LHPDI	UHPDI	Density	Area (km^2)
Lions Head	W Berners	2005	Clear	9	0	9	0.00	14	5	18	0.6	22.0
Lions Head	W Berners	2006	Partly Cloudy	16	0	16	0.00	30	12	21	1.4	22.0
Lions Head	W Berners	2007	Clear	18	7	25	0.28	46	17	24	2.1	22.0
Lions Head	W Berners	2008	Partly Cloudy	11	1	12	0.08	19	7	20	0.9	22.0
Lions Head	W Berners	2009	Overcast	9	3	12	0.25	15	3	14	0.7	22.0
Lions Head	W Berners	2010	Clear	7	1	8	0.13	14	6	19	0.6	22.0
Lions Head	W Berners	2011	Overcast	17	4	21	0.19	31	9	18	1.4	22.0
Lions Head	W Berners	2012	Overcast	11	2	13	0.15	20	7	15	0.9	22.0
Lions Head	W Berners	2013	Partly Cloudy	15	2	17	0.12	31	12	18	1.4	22.0
Lions Head	W Berners	2014	Overcast	5	1	6	0.17	6	0	12	0.3	22.0
Lions Head	W Berners	2015	Clear	5	1	6	0.17	7	1	17	0.3	22.0
Lions Head	W Berners	2016	Clear	7	1	8	0.13	16	8	19	0.7	22.0
Lions Head	W Berners	2017	Clear	14	1	15	0.07	26	11	19	1.2	22.0
Lions Head	W Berners	2018	Clear	10	3	13	0.23	21	8	20	1.0	22.0
Lions Head	W Berners	2019	Partly Cloudy	6	0	6	0.00	11	5	15	0.5	22.0
Lions Head	W Berners	2020	Clear	2	0	2	0.00	2	0	12	0.1	22.0
Lions Head	Kensington	2005	Clear	21	5	26	0.19	43	14	21	2.2	19.9
Lions Head	Kensington	2006	Partly Cloudy	48	6	54	0.11	96	24	29	4.8	19.9
Lions Head	Kensington	2007	Overcast	24	3	27	0.11	36	9	16	1.8	19.9
Lions Head	Kensington	2008	Clear	17	4	21	0.19	40	15	24	2.0	19.9
Lions Head	Kensington	2009	Overcast	13	4	17	0.24	26	9	16	1.3	19.9
Lions Head	Kensington	2010	Clear	18	7	25	0.28	40	12	23	2.0	19.9
Lions Head	Kensington	2011	Overcast	25	7	32	0.22	46	12	19	2.3	19.9
Lions Head	Kensington	2012	Overcast	20	3	23	0.13	33	9	18	1.7	19.9
Lions Head	Kensington	2013	Partly Cloudy	17	5	22	0.23	40	14	24	2.0	19.9
Lions Head	Kensington	2014	Overcast	16	1	17	0.06	26	9	16	1.3	19.9
Lions Head	Kensington	2015	Clear	6	2	8	0.25	12	4	18	0.6	19.9
Lions Head	Kensington	2016	Clear	13	4	17	0.24	27	10	16	1.4	19.9
Lions Head	Kensington	2017	Clear	8	0	8	0.00	15	7	21	0.8	19.9
Lions Head	Kensington	2018	Clear	7	1	8	0.13	14	6	15	0.7	19.9
Lions Head	Kensington	2019	Partly Cloudy	19	6	25	0.24	42	14	20	2.1	19.9
Lions Head	Kensington	2020	Clear	14	0	14	0.00	26	11	20	1.3	19.9
Lions Head	Met	2005	Clear	35	7	42	0.17	72	21	25	4.7	15.4
Lions Head	Met	2006	Clear	47	14	61	0.23	109	25	35	7.1	15.4
Lions Head	Met	2007	Clear	48	5	53	0.09	100	24	31	6.5	15.4
Lions Head	Met	2008	Clear	38	13	51	0.25	81	20	24	5.3	15.4
Lions Head	Met	2009	Overcast	29	9	38	0.24	50	11	18	3.3	15.4
Lions Head	Met	2010	Clear	32	14	46	0.30	83	23	28	5.4	15.4
Lions Head	Met	2011	Overcast	42	15	57	0.26	74	12	21	4.8	15.4
Lions Head	Met	2012	Overcast	36	7	43	0.16	61	12	21	4.0	15.4
Lions Head	Met	2013	Partly Cloudy	27	9	36	0.25	61	17	26	4.0	15.4
Lions Head	Met	2014	Overcast	26	9	35	0.26	48	11	19	3.1	15.4
Lions Head	Met	2015	--	--	--	--	--	--	--	--	--	15.4
Lions Head	Met	2016	Clear	17	7	24	0.29	45	17	22	2.9	15.4
Lions Head	Met	2017	Clear	12	4	16	0.25	21	5	19	1.4	15.4
Lions Head	Met	2018	Clear	25	7	32	0.22	58	16	28	3.8	15.4
Lions Head	Met	2019	Partly Cloudy	29	13	42	0.31	68	19	23	4.4	15.4
Lions Head	Met	2020	Clear	19	5	24	0.21	45	16	22	2.9	15.4

Appendix 5b: Summary of mountain goat population composition, minimum count and population estimates based on data collected during aerial surveys on the Mt. Sinclair study area (and associated survey areas), 2005-2020. "Minimum counts" represent the number of mountain goats seen during aerial surveys and do not account for variation in sighting probabilities between surveys/years. Population estimates explicitly account for variation in group-level sighting probabilities among surveys/years.

				Minimum Count				Population Estimate				
Study Area	Survey Area	Year	Weather	Adults	Kids	Total	Kids	Total	LHPDI	UHPDI	Density	Area (km^2)
Sinclair	Yeldagalga	2005	Clear	67	16	83	0.19	120	24	26	4.8	25.1
Sinclair	Yeldagalga	2006	Clear	95	17	112	0.15	179	30	34	7.1	25.1
Sinclair	Yeldagalga	2007	Overcast	69	15	84	0.18	115	19	24	4.6	25.1
Sinclair	Yeldagalga	2008	Clear	50	12	62	0.19	103	23	31	4.1	25.1
Sinclair	Yeldagalga	2009	--	--	--	--	--	--	--	--	--	25.1
Sinclair	Yeldagalga	2010	Clear	20	7	27	0.26	45	14	23	1.8	25.1
Sinclair	Yeldagalga	2011	Overcast	54	14	68	0.21	83	11	21	3.3	25.1
Sinclair	Yeldagalga	2012	Overcast	58	9	67	0.13	87	15	20	3.5	25.1
Sinclair	Yeldagalga	2013	Overcast	32	8	40	0.20	55	12	20	2.2	25.1
Sinclair	Yeldagalga	2014	Overcast	30	9	39	0.23	56	13	19	2.2	25.1
Sinclair	Yeldagalga	2015	Clear	15	7	22	0.32	35	12	20	1.4	25.1
Sinclair	Yeldagalga	2016	Clear	49	15	64	0.23	105	23	28	4.2	25.1
Sinclair	Yeldagalga	2017	Clear	26	10	36	0.28	59	16	26	2.4	25.1
Sinclair	Yeldagalga	2018	Clear	30	10	40	0.25	63	18	21	2.5	25.1
Sinclair	Yeldagalga	2019	Partly Cloudy	23	6	29	0.21	49	16	24	2.0	25.1
Sinclair	Yeldagalga	2020	Clear	10	2	12	0.17	25	11	18	1.0	25.1
Sinclair	S Katzehin	2005	Clear	72	13	85	0.15	137	26	33	3.3	41.6
Sinclair	S Katzehin	2006	Clear	94	19	113	0.17	193	33	39	4.6	41.6
Sinclair	S Katzehin	2007	Overcast	84	20	104	0.19	138	19	23	3.3	41.6
Sinclair	S Katzehin	2008	Overcast	69	19	88	0.22	121	20	23	2.9	41.6
Sinclair	S Katzehin	2009	--	--	--	--	--	--	--	--	--	41.6
Sinclair	S Katzehin	2010	Clear	23	6	29	0.21	51	16	24	1.2	41.6
Sinclair	S Katzehin	2011	Overcast	51	14	65	0.22	95	19	22	2.3	41.6
Sinclair	S Katzehin	2012	Overcast	39	6	45	0.13	63	14	18	1.5	41.6
Sinclair	S Katzehin	2013	Overcast	20	4	24	0.17	35	9	19	0.8	41.6
Sinclair	S Katzehin	2014	Overcast	26	5	31	0.16	50	14	21	1.2	41.6
Sinclair	S Katzehin	2015	Clear	25	7	32	0.22	54	16	22	1.3	41.6
Sinclair	S Katzehin	2016	Clear	21	6	27	0.22	53	20	27	1.3	41.6
Sinclair	S Katzehin	2017	Clear	22	1	23	0.04	40	15	21	1.0	41.6
Sinclair	S Katzehin	2018	Clear	38	13	51	0.25	101	25	36	2.4	41.6
Sinclair	S Katzehin	2019	Partly Cloudy	26	4	30	0.13	50	16	21	1.2	41.6
Sinclair	S Katzehin	2020	Clear	22	4	26	0.15	59	23	25	1.4	41.6
Sinclair	Katzehin Lk	2005	Clear	23	8	31	0.26	41	10	19	1.9	21.2
Sinclair	Katzehin Lk	2006	Overcast	25	2	27	0.07	35	7	17	1.6	21.2
Sinclair	Katzehin Lk	2007	Overcast	16	2	18	0.11	25	7	16	1.2	21.2
Sinclair	Katzehin Lk	2008	Clear	15	4	19	0.21	37	15	24	1.7	21.2
Sinclair	Katzehin Lk	2009	--	--	--	--	--	--	--	--	--	21.2
Sinclair	Katzehin Lk	2010	Clear	14	5	19	0.26	33	14	19	1.6	21.2
Sinclair	Katzehin Lk	2011	Overcast	6	1	7	0.14	9	2	14	0.4	21.2
Sinclair	Katzehin Lk	2012	Overcast	3	0	3	0.00	3	0	9	0.1	21.2
Sinclair	Katzehin Lk	2013	Overcast	2	1	3	0.33	3	0	9	0.1	21.2
Sinclair	Katzehin Lk	2014	Overcast	3	1	4	0.25	4	0	7	0.2	21.2
Sinclair	Katzehin Lk	2015	Clear	2	0	2	0.00	2	0	7	0.1	21.2
Sinclair	Katzehin Lk	2016	Clear	7	1	8	0.13	14	6	19	0.7	21.2
Sinclair	Katzehin Lk	2017	Clear	7	1	8	0.13	11	3	16	0.5	21.2
Sinclair	Katzehin Lk	2018	Clear	2	0	2	0.00	2	0	10	0.1	21.2
Sinclair	Katzehin Lk	2019	Partly Cloudy	4	0	4	0.00	4	0	15	0.2	21.2
Sinclair	Katzehin Lk	2020	Clear	1	0	1	0.00	1	0	7	0.0	21.2

Appendix 5c: Summary of mountain goat population composition, minimum count and population estimates based on data collected during aerial surveys on the Meade Icefield and Berners-Lace Ridge study areas (and associated survey areas), 2005-2020. “Minimum counts” represent the number of mountain goats seen during aerial surveys and do not account for variation in sighting probabilities between surveys/years. Population estimates explicitly account for variation in group-level sighting probabilities among surveys/years.

				Minimum Count				Population Estimate				
Study Area	**Survey Area**	**Year**	**Weather**	**Adults**	**Kids**	**Total**	**Kids**	**Total**	**LHPDI**	**UHPDI**	**Density**	**Area (km^2)**
Icefield	U Lace	2005	Clear	9	0	9	0.00	15	6	17	0.9	16.9
Icefield	U Lace	2006	Partly Cloudy	1	0	1	0.00	1	0	6	0.1	16.9
Icefield	U Lace	2007	Overcast	8	1	9	0.11	11	2	13	0.7	16.9
Icefield	U Lace	2008	Overcast	6	0	6	0.00	6	0	13	0.4	16.9
Icefield	U Lace	2009	--	--	--	--	--	--	--	--	--	16.9
Icefield	U Lace	2010	Clear	1	1	2	0.50	2	0	7	0.1	16.9
Icefield	U Lace	2011	Overcast	6	4	10	0.40	10	0	12	0.6	16.9
Icefield	U Lace	2012	Overcast	9	3	12	0.25	13	1	13	0.8	16.9
Icefield	U Lace	2013	Overcast	2	0	2	0.00	2	0	10	0.1	16.9
Icefield	U Lace	2014	Overcast	6	3	9	0.33	9	0	9	0.5	16.9
Icefield	U Lace	2015	Clear	7	1	8	0.13	13	5	16	0.8	16.9
Icefield	U Lace	2016	Clear	3	0	3	0.00	3	0	14	0.2	16.9
Icefield	U Lace	2017	Clear	3	2	5	0.40	5	0	11	0.3	16.9
Icefield	U Lace	2018	Clear	4	2	6	0.33	6	0	11	0.4	16.9
Icefield	U Lace	2019	Partly Cloudy	4	3	7	0.43	8	1	14	0.5	16.9
Icefield	U Lace	2020	Clear	0	0	0	0.00	0	0	0	0.0	16.9
Icefield	S Meade	2005	Clear	5	1	6	0.17	6	0	8	0.3	18.2
Icefield	S Meade	2006	Overcast	19	3	22	0.14	31	8	17	1.7	18.2
Icefield	S Meade	2007	Overcast	3	1	4	0.25	4	0	10	0.2	18.2
Icefield	S Meade	2008	Overcast	5	0	5	0.00	5	0	10	0.3	18.2
Icefield	S Meade	2009	--	--	--	--	--	--	--	--	--	18.2
Icefield	S Meade	2010	Clear	4	2	6	0.33	7	1	14	0.4	18.2
Icefield	S Meade	2011	Overcast	10	3	13	0.23	20	7	17	1.1	18.2
Icefield	S Meade	2012	Overcast	7	0	7	0.00	8	1	14	0.4	18.2
Icefield	S Meade	2013	Overcast	10	1	11	0.09	14	3	14	0.8	18.2
Icefield	S Meade	2014	Overcast	5	3	8	0.38	10	2	12	0.5	18.2
Icefield	S Meade	2015	Clear	5	2	7	0.29	9	2	16	0.5	18.2
Icefield	S Meade	2016	Clear	12	2	14	0.14	23	8	19	1.3	18.2
Icefield	S Meade	2017	Clear	9	1	10	0.10	19	9	19	1.0	18.2
Icefield	S Meade	2018	Clear	8	1	9	0.11	19	10	20	1.0	18.2
Icefield	S Meade	2019	Partly Cloudy	5	0	5	0.00	7	2	15	0.4	18.2
Icefield	S Meade	2020	Clear	3	0	3	0.00	3	0	19	0.2	18.2
BL Ridge	BL Ridge	2005	Clear	10	0	10	0.00	23	12	20	0.8	30.0
BL Ridge	BL Ridge	2006	--	--	--	--	--	--	--	--	--	30.0
BL Ridge	BL Ridge	2007	Clear	25	4	29	0.14	52	18	23	1.7	30.0
BL Ridge	BL Ridge	2008	Clear	19	3	22	0.14	41	15	25	1.4	30.0
BL Ridge	BL Ridge	2009	--	--	--	--	--	--	--	--	--	30.0
BL Ridge	BL Ridge	2010	--	--	--	--	--	--	--	--	--	30.0
BL Ridge	BL Ridge	2011	Clear	26	9	35	0.26	59	15	27	2.0	30.0
BL Ridge	BL Ridge	2012	Overcast	24	3	27	0.11	36	9	17	1.2	30.0
BL Ridge	BL Ridge	2013	Partly Cloudy	13	2	15	0.13	30	13	19	1.0	30.0
BL Ridge	BL Ridge	2014	Overcast	15	2	17	0.12	29	11	18	1.0	30.0
BL Ridge	BL Ridge	2015	Clear	15	3	18	0.17	37	14	26	1.2	30.0
BL Ridge	BL Ridge	2016	Overcast	13	2	15	0.13	22	7	16	0.7	30.0
BL Ridge	BL Ridge	2017	Overcast	16	4	20	0.20	25	5	17	0.8	30.0
BL Ridge	BL Ridge	2018	Clear	7	1	8	0.13	16	8	19	0.5	30.0
BL Ridge	BL Ridge	2019	Overcast	13	6	19	0.32	28	9	16	0.9	30.0
BL Ridge	BL Ridge	2020	Overcast	11	2	13	0.15	16	3	14	0.5	30.0

Appendix 6: Summary of mountain goats captured and monitored in the Lions Head and Mt. Sinclair study areas during 2005-2021, Lynn Canal, AK.

Mtn Goat ID	Date - Capture	Year	Sex	Est. Age	Kid	Weight (lbs.)	Fate	Date - Fate	Days Monitored
LG001	9/26/05	2005	M	9	--	308	Died	4/17/06	203
LG002	9/26/05	2005	F	11	1	140	Died	4/16/06	202
LG003	9/26/05	2005	F	7	1	180	Died	4/10/07	561
LG004	9/26/05	2005	F	7	1	196	Release	8/15/07	688
LG005	9/26/05	2005	M	9	--		Died	5/9/07	590
LG006	10/2/05	2005	M	8	--	347	Died	2/10/06	131
LG007	10/2/05	2005	M	2	--	163	Release	8/15/07	682
LG008	10/2/05	2005	F	5	0	171	Died	7/8/13	2836
LG008	8/15/10	2010	F	7	1	172	Died	7/8/13	1058
LG009	10/2/05	2005	F	10	0		Release	8/15/07	682
LG010	10/3/05	2005	F	7	?	187	Release	8/15/07	681
LG011	10/3/05	2005	M	9	--	335	Died	2/11/07	496
LG016	10/14/05	2005	M	5	--	273	Release	8/15/07	670
LG019	10/15/05	2005	M	5	--	273	Died	6/26/06	254
LG020	10/15/05	2005	M	8	--	285	Release	8/15/07	669
LG021	10/15/05	2005	F	4	0	194	Release	8/15/07	669
LG022	10/15/05	2005	F	8	?		Release	8/15/07	669
LG023	10/15/05	2005	M	9	--	221	Release	8/15/07	669
LG024	7/28/06	2006	M	3	--	134	Died	7/13/08	716
LG025	7/28/06	2006	F	6	?	130	Died	5/11/07	287
LG026	7/28/06	2006	M	6	--	251	Died	11/17/06	112
LG027	7/28/06	2006	M	10	--	274	Died	12/31/07	521
LG028	7/28/06	2006	M	8	--		Died	7/18/07	355
LG029	7/28/06	2006	F	7	?	160	Release	9/11/08	776
LG030	7/28/06	2006	F	8	?		Died	4/25/07	271
LG036	7/29/06	2006	M	6	--	308	Release	9/11/08	775
LG037	7/29/06	2006	M	4	--	216	Died	2/18/08	569
LG038	7/29/06	2006	F	4	?	141	Release	9/11/08	775
LG039	8/29/06	2006	F	10	0	165	Died	5/10/07	254
LG040	8/29/06	2006	M	8	--		Died	4/24/12	2065
LG040	9/24/08	2008	M	10	--	309	Died	4/24/12	1308
LG041	8/29/06	2006	F	5	1		Release	9/11/08	744
LG045	9/25/06	2006	F	6	0	185	Release	9/11/08	717
LG050	10/7/06	2006	M	8	--	250	Died	4/17/07	192
LG051	10/7/06	2006	F	2	0	145	Release	9/11/08	705
LG052	10/7/06	2006	F	3	0	160	Release	9/11/08	705
LG053	10/7/06	2006	M	3	--	171	Release	9/11/08	705
LG060	10/13/06	2006	M	5	--	287	Release	9/1/08	689
LG061	10/13/06	2006	M	10	--	350	Died	5/15/09	945
LG061	8/18/08	2008	M	12	--	301	Died	5/15/09	270
LG062	10/13/06	2006	M	10	--	310	Release	9/1/08	689
LG063	10/13/06	2006	M	10	--	297	Died	3/16/07	154
LG064	10/13/06	2006	M	4	--	281	Died	10/4/07	356
LG069	7/29/07	2007	M	1	--	95	Died	10/31/08	460
LG075	8/2/07	2007	M	3	--	141	Died	7/7/08	340
LG076	8/2/07	2007	F	4	1	155	Died	8/8/09	737
LG077	8/2/07	2007	M	6	--	249	Died	10/17/08	442

Appendix 6 (continued): Summary of mountain goats captured and monitored in the Lions Head and Mt. Sinclair study areas during 2005-2021, Lynn Canal, AK.

Mtn Goat ID	Date - Capture	Year	Sex	Est. Age	Kid	Weight (lbs.)	Fate	Date - Fate	Days Monitored
LG078	8/2/07	2007	F	9	1	175	Release	9/11/08	406
LG079	8/2/07	2007	M	11	--	269	Died	8/24/07	22
LG080	8/2/07	2007	M	6	--	281	Release	9/11/08	406
LG081	8/2/07	2007	M	4	--	217	Release	9/11/08	406
LG083	8/3/07	2007	M	5	--	258	Died	6/11/11	1408
LG084	8/3/07	2007	M	4	--	180	Died	4/12/11	1348
LG086	8/11/07	2007	M	4	--	223	Died	10/7/08	423
LG087	8/11/07	2007	M	5	--	233	Died	2/21/10	925
LG088	8/11/07	2007	F	8	0	160	Died	11/1/09	813
LG089	8/11/07	2007	M	4	--	240	Died	11/1/09	813
LG090	8/11/07	2007	F	3	0	157	Release	9/11/08	397
LG097	8/16/08	2008	F	5	1	151	Release	6/7/11	1025
LG098	8/16/08	2008	M	6	--	279	Died	2/15/14	2009
LG098	8/16/12	2012	M	10	--	302	Died	2/15/14	548
LG099	8/18/08	2008	M	6	--	266	Release	6/7/11	1023
LG100	8/18/08	2008	F	10	1	163	Died	10/6/08	49
LG101	8/18/08	2008	M	5	--	277	Died	10/8/09	416
LG102	8/18/08	2008	M	7	--	328	Died	4/3/13	1689
LG103	8/18/08	2008	F	7	0	185	Died	10/14/12	1518
LG103	9/10/11	2011	F	10	0		Died	10/14/12	400
LG104	8/18/08	2008	F	6	0	192	Release	6/7/11	1023
LG106	8/19/08	2008	M	5	--	242	Died	4/17/10	606
LG112	9/21/08	2008	F	11	1	199	Died	2/4/09	136
LG117	9/24/08	2008	F	3	0	170	Release	6/7/11	986
LG118	9/24/08	2008	F	3	0	166	Release	6/7/11	986
LG119	9/24/08	2008	M	4	--	237	Release	10/31/18	3689
LG120	9/24/08	2008	F	5	1	175	Died	3/22/09	179
LG124	8/5/09	2009	M	5	--	291	Died	3/2/12	940
LG125	8/5/09	2009	F	4	0	150	Died	4/11/14	1710
LG126	8/5/09	2009	F	6	1	175	Died	10/15/12	1167
LG127	8/5/09	2009	F	11	1	182	Died	3/9/10	216
LG128	8/5/09	2009	F	6	0	170	Died	7/27/10	356
LG136	9/1/09	2009	F	2	0	131	Died	10/18/09	47
LG137	9/1/09	2009	M	9	--	342	Died	6/19/12	1022
LG141	8/15/10	2010	M	7	--	307	Died	1/15/15	1614
LG143	8/15/10	2010	F	6	1	175	Died	5/7/13	996
LG144	8/15/10	2010	F	6	1	163	Died	6/14/11	303
LG145	8/15/10	2010	F	6	1	192	Release	9/20/17	2593
LG146	8/15/10	2010	M	2	--	134	Died	7/12/12	697
LG147	9/10/11	2011	F	3	0	145	Died	10/11/12	397
LG148	9/10/11	2011	F	6	0	182	Died	9/11/17	2193
LG149	9/10/11	2011	F	6	0	164	Died	8/28/12	353
LG150	9/10/11	2011	M	5	--	234	Died	5/19/13	617
LG151	9/10/11	2011	F	5	1	180	Died	6/24/12	288
LG152	9/10/11	2011	M	11	--	296	Died	5/21/12	254
LG153	9/10/11	2011	M	5	--	243	Died	11/8/16	1886
LG154	8/16/12	2012	F	2	0	151	Died	8/7/17	1817

Appendix 6 (continued): Summary of mountain goats captured and monitored in the Lions Head and Mt. Sinclair study areas during 2005-2021, Lynn Canal, AK.

Mtn Goat ID	Date - Capture	Year	Sex	Est. Age	Kid	Weight (lbs.)	Fate	Date - Fate	Days Monitored
LG155	8/16/12	2012	F	12	0	186	Died	5/8/13	265
LG156	8/16/12	2012	M	6	--	265	Died	1/24/14	526
LG157	8/16/12	2012	M	4	--	282	Died	1/18/18	1981
LG158	8/16/12	2012	M	4	--	192	Died	1/5/14	507
LG159	8/16/12	2012	M	3	--		Died	10/11/14	786
LG160	10/10/12	2012	F	2	0	172	Release	11/27/19	2604
LG161	10/10/12	2012	F	3	0	160	Release	2/11/20	2680
LG162	8/15/13	2013	M	8	--	325	Died	1/7/17	1241
LG163	8/15/13	2013	M	3	--	170	Died	7/7/15	691
LG164	8/15/13	2013	F	7	1	180	Died	2/10/17	1275
LG166	8/15/13	2013	M	2	--		Died	6/29/14	318
LG167	8/20/14	2014	F	11	0	208	Died	1/17/17	881
LG168	8/20/14	2014	F	5	1	193	Alive	3/8/21	2392
LG169	8/20/14	2014	F	9	0	155	Died	10/15/16	787
LG170	8/20/14	2014	M	7	--	254	Died	11/7/14	79
LG172	8/20/14	2014	M	3	--	174	Died	8/3/18	1444
LG173	8/20/14	2014	M	6	--	268	Died	11/19/16	822
LG174	8/20/14	2014	F	10	1		Died	11/7/17	1175
LG175	8/25/15	2015	F	4	0	202	Alive	3/8/21	2022
LG176	8/25/15	2015	M	6	--		Alive	7/5/20	1776
LG177	8/25/15	2015	F	11	1	211	Alive	10/30/19	1527
LG178	8/25/15	2015	M	6	--	300	Alive	11/14/20	1908
LG179	8/25/15	2015	F	4	1		Release	7/5/18	1045
LG180	8/25/15	2015	F	1	0		Died	4/15/16	234
LG181	9/2/16	2016	M	7	--	295	Died	12/28/16	117
LG182	9/2/16	2016	M	6	--	331	Died	4/5/17	215
LG183	9/2/16	2016	F	9	1	191	Died	10/10/17	403
LG184	9/2/16	2016	M	5	--	321	Died	12/2/18	821
LG185	9/2/16	2016	F	5	0	193	Died	8/7/17	339
LG186	9/2/16	2016	F	7	1	200	Alive	5/5/20	1341
LG187	9/2/16	2016	M	5	--		Died	10/23/16	51
LG188	9/2/16	2016	M	4	--		Alive	3/8/21	1648
LG189	8/10/17	2017	M	4	--	321	Alive	1/3/20	876
LG190	8/10/17	2017	M	3	--		Alive	3/8/21	1306
LG191	8/10/17	2017	F	6	1	170	Alive	3/8/21	1306
LG192	8/10/17	2017	F	6	1	172	Alive	6/3/20	1028
LG193	8/10/17	2017	M	9	--		Alive	5/5/20	999
LG194	8/10/17	2017	F	8	1	179	Alive	3/8/21	1306
LG195	8/10/17	2017	F	3	0	156	Alive	3/8/21	1306
LG196	8/10/17	2017	M	4	--	209	Alive	8/18/19	738
LG197	7/31/18	2018	M	4	--	261	Alive	3/13/20	591
LG198	7/31/18	2018	F	4	0		Alive	2/18/20	567
LG199	7/31/18	2018	M	2	--		Alive	3/8/21	951
LG200	7/31/18	2018	F	5	1	172	Alive	3/8/21	951
LG201	8/1/18	2018	M	2	--	168	Alive	3/8/21	950
LG202	8/1/18	2018	F	7	0	170	Alive	11/14/20	836

Appendix 6 (continued): Summary of mountain goats captured and monitored in the Lions Head and Mt. Sinclair study areas during 2005-2021, Lynn Canal, AK.

Mtn Goat ID	Date - Capture	Year	Sex	Est. Age	Kid	Weight (lbs.)	Fate	Date - Fate	Days Monitored
LG204	7/31/19	Makalu	M	5	--		Alive	3/8/21	586
LG205	8/2/19	Kame	F	3	0	158	Alive	3/8/21	584
LG206	8/2/19	Alicia	F	1	0	133	Alive	3/8/21	584
LG207	8/2/19	Lago	M	2	--	145	Alive	3/8/21	584
LG208	8/2/19	Wags	M	4	--	226	Alive	3/8/21	584
LG209	8/2/19	Moulin	F	2	0	127	Alive	3/8/21	584
LG210	8/2/19	Pika	F	3	1	151	Alive	3/8/21	584
LG211	8/20/20	Hogback	F	11	0	180	Alive	3/8/21	200
LG212	8/20/20	Rampart	M	2	--	157	Alive	3/8/21	200
LG213	9/11/20	Finn	M	3	--	226	Alive	3/8/21	178
LG214	9/11/20	Raindrop	F	4	1	182	Alive	3/8/21	178
LG215	9/11/20	Scout	M	2	--	172	Alive	3/8/21	178
LG216	9/11/20	Bolt	F	9	1	205	Alive	3/8/21	178