Wildlife Research Annual Progress Report

Mountain Goat Movement Patterns and Population Monitoring on Baranof Island

Kevin S. White, Phil Mooney and Kent Bovee

Alaska Department of Fish and Game
Division of Wildlife Conservation

December 2010

Mountain Goat Movement Patterns and Population Monitoring on Baranof Island

Kevin S. White[1], Phil Mooney[1] and Kent Bovee[2]

[1]Alaska Department of Fish and Game
Division of Wildlife Conservation
P. O. Box 110024, Juneau, AK 99811

and

[2]601B Lincoln Street
Sitka, AK 99835

Annual Progress Report

December 2010

This report contains preliminary data and should not be cited without permission of the authors.

ACKNOWLEDGEMENTS
This project was funded by the State of Alaska Department of Fish and Game and the City of Sitka. Dean Orbison (Sitka), Rod Flynn (ADFG), Sandy O'Brien (ADFG) and David Thomsen (ADFG) coordinated project funding. Jeff Jemison and Holley Dennison provided assistance with field or related activities. Mark Pakila provided fixed-wing air charter services. Mitch Horton (Temsco Helicopters) provided unparallelled helicopter capture services.

Cover photo: ADFG wildlife biologist, Phil Mooney, handling an 8-yr old male mountain goat captured in the Katlian watershed, Baranof island, September 2010.

Contents

INTRODUCTION

The City and Borough of Sitka is planning to conduct hydroelectric development activities on central Baranof Island, specifically in the vicinity of Blue and Takatz Lakes. Among the key wildlife species potentially affected by this development project are mountain goats (City and Borough of Sitka Electric Department 2010). Specifically, mountain goat populations are expected to be sensitive to hydroelectric project activities associated with inundation of lakeshore winter habitat, construction activities, increased human access and cumulative effects of dual projects in both the Blue and Takatz Lake watersheds.

In response to the above concerns, the City and Borough of Sitka and the Alaska Department of Fish and Game (ADFG) have initiated cooperative mountain goat population monitoring activities to determine possible impacts of hydroelectric development on mountain goats and identify potential mitigative measures, to the extent feasible. Research activities include collection of movement and vital rate data on a sample of radio-marked mountain goats in addition to implementation of annual aerial population abundance and productivity surveys. These efforts are aimed at providing the Alaska Department of Fish and Game and local stakeholder groups with information necessary to appropriately manage mountain goats in the vicinity of proposed development activities and beyond. The four objectives of the proposed assessment and monitoring work include:

Objectives:

1) Characterize seasonal movement and habitat selection patterns of mountain goats on central Baranof island.

2) Assess reproductive success and survival of mountain goats on central Baranof island.

3) Estimate and monitor mountain goat population abundance and composition on central Baranof island.

Study Area:

Field research activities were concentrated in ca. 500 km^2 area surrounding the Blue and Takatz Lake hydroelectric project sites (Figure 1). This configuration was intended to enable collection of field data across an array of locally distinctive habitat complexes inhabited by mountain goats within the hydroelectric project areas (Figure 2). In addition, since mountain goats are capable of making routine annual movements of 10-15 km (and dispersal movements exceeding 30 km) it was considered necessary to delineate a study area large enough to encompass the area used by mountain goats potentially affected by development activities.

Figure 1: Map of the Baranof island study area. The Blue and Takatz Lake sites are specifically identified in addition to the nearby city of Sitka.

Figure 2: Image of Blue Lake taken from the central section of the study area (looking west) depicting the divesity of habitat types and ruggedness of the terrain.

METHODS

Mountain Goat Capture

Mountain goats were captured using standard helicopter darting techniques and immobilized by injecting 3.0 - 2.4mg of carfentanil citrate, depending on sex and time of year (Taylor 2000, White and Barten 2010), 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 (Figure 3). 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.

Figure 3: ADFG wildlife technician, Jeff Jemison, and an 8-yr old male mountain goat (BG-05) captured on central Baranof island, September 2010. The photograph was taken prior to deployment of the GPS-radiocollar and ear tags.

GPS Location Data

Telonics TGW-3590 and TGW-4500 GPS radio-collars (Telonics, Inc., Mesa, AZ) were deployed on most animals captured. In addition, lightweight Telonics MOD-400 VHF radio-collars were also simultaneously deployed on each animal to enable longer-term monitoring opportunities (collar lifespan: ~6 years, May 2016). GPS radio-collars were programmed to collect location data at 6-hour intervals (collar lifetime: 3-4 years for TGW-3590 and TGW-4500, respectively). 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. For Telonics TGW-3590 collars (n = 5), GPS location data-sets will be remotely downloaded (via fixed-wing aircraft) 3-4 times per year (pre-programmed download “windows” occur twice every 8 weeks). Telonics TGW-4500 radio-collars store all GPS data “on-board” and will not be downloaded until collars automatically release on 6/15/2014. Location data will be 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).

Movement Patterns and Habitat Use

Complete analyses of GPS location data to characterize movement patterns and habitat use of mountain goats will not be conducted until data have been downloaded for GPS collars (ie. 2014).

Reproduction and Survival

Kidding rates and subsequent survival will be estimated by monitoring individual study animals during surveys using fixed-wing aircraft (Piper PA-18 Super Cub) equipped for radio-telemetry tracking. During surveys, radio-collared adult female mountain goats will 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 can be reliably observed in open habitats. We will assume 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 will be filtered from the data set and not used for subsequent estimates of kid survival.

Mortality of individual radio-collared mountain goats will be determined by evaluating activity sensor data embedded in GPS location data and/or by detecting radio-frequency pulse rate changes during routine monitoring surveys. In cases where mortalities are detected, efforts were made to investigate sites as soon as possible via ground, helicopter or boat. To the extent possible, all mortalities were thoroughly investigated to ascertain the cause of death and relevant biological samples collected. Annual survival of radio-collared animals will be estimated using the Kaplan-Meier methodology (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. 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. Further, for each collared animal seen or not seen during surveys data were collected to characterize behavioral and habitat conditions expected a priori to influence sighting probabilities.

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 (G. Pendleton, ADFG, unpublished).

Results and Discussion:

Mountain Goat Capture and Handling

Capture Activities.—Mountain goats were captured during two days in September 2010. Overall, 12 animals (4 females and 8 males) were captured using standard helicopter darting methods (Table 1, Figure 4). Each animals was deployed with a Telonics TGW-3590 (n = 5) or TGW-4500 (n = 7) GPS radio-collar and a lightweight Telonics MOD-400 VHF radio-collar (370g). Double-collaring animals was conducted to extend to period of time individual animals could be monitored (lifespan, GPS: 3-4 years, VHF: 6 years), thereby increasing the long-term opportunity to gather mountain goat survival and reproduction data and reducing the frequency in which mountain goats must be captured. Overall, the combined weight of radio-collars attached to animals comprises 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.

Table 1: Characteristics of mountain goats (n = 12) captured on central Baranof island, September 2010.

Mtn Goat ID	Date	Sex	Est. Age	Kid at Heel	Weight (lbs.)	Horns[1] Total Length	Horns[1] Basal Circum.	GPS Collar Type
BG01	9/7/10	M	3	--	--	--	--	TGW-3590
BG02	9/7/10	M	1	--	134	7 1/16	4 11/16	TGW-3590
BG03	9/7/10	F	6	1	196	7 3/16	3 9/16	TGW-3590
BG04	9/7/10	M	2	--	150	8	4 12/16	TGW-3590
BG05	9/7/10	M	8	--	290	7 0/16*	4 14/16	TGW-3590
BG06	9/7/10	F	5	1	163	7 14/16	3 14/16	TGW-4500
BG07	9/7/10	M	1	--	119	6 2/16	4 5/16	TGW-4500
BG08	9/12/10	F	9	1	201	10 2/16	3 12/16	TGW-4500
BG09	9/12/10	M	4	--	--	8 13/16	5 1/16	TGW-4500
BG10	9/12/10	M	8	--	306	8 10/16	4 14/16	TGW-4500
BG11	9/12/10	M	8	--	--	9 7/16	--	TGW-4500
BG12	9/12/10	F	5	1	179	8 13/16	4	TGW-4500

[1] Horn dimensions reflect length or circumference of the largest horn; an asterisk denotes the horn tip was broomed.

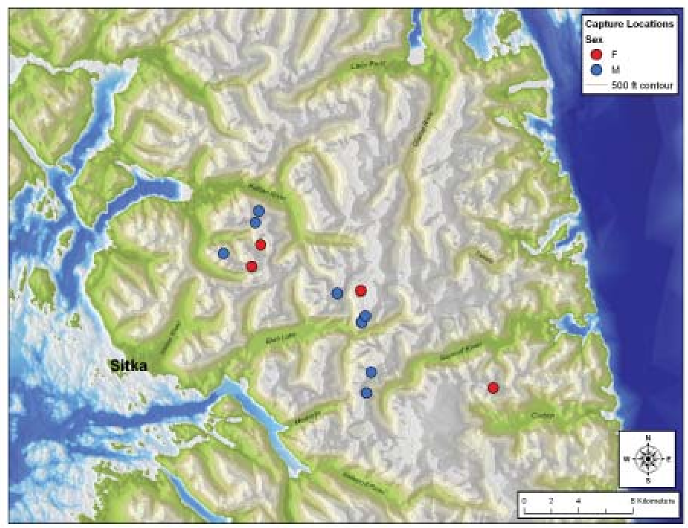

Figure 4: Location of mountain goat capture sites in central Baranof island, September 2010. Sex of animals captured and key geographic localities are identified.

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. While we were able to meet our sample size objectives for 2010 within the allotted helicopter time budgeted, the difficulty of capturing mountain goats (due to terrain ruggedness and animal abundance and distribution) exceeds that of other areas in southeastern Alaska where mountain goats have been captured in recent years (ie. Lynn Canal, Haines/Skagway, Cleveland Peninsula). Consequently, the distribution of collar deployments was less uniform than desired with a majority of collar deployments being concentrated on the central and western side of the study area. Nonetheless, given seasonal movement patterns, capture locations are not necessarily a reliable indicator of the annual distribution of individual animals. Thus, the possibility remains that the apparent bias, described above, may not persist over time.

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), red blood cells (8mL), ear tissue, 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, trace mineral analyses or archived at ADFG facilities in Douglas, AK.

In 2010, a subset of captured animals (n = 5) were tested for prevalence of respiratory bacteria associated with incidence of pneumonia (specifically *Pasteurella trehalosi* and *Mycoplasma ovipneumonia*). Its important to note that even if such bacteria are found in the upper respiratory tracts of animals sampled it does not necessarily mean that a given animal has pneumonia, only that the potential exists. In fact, it is not unusual for reasonably high proportions of animals in a population to have pneumonia associated bacteria and never show adverse effects, particularly if animals a subject to minimal stress (ie. nutritional limitation, severe winters, etc.). Overall, all of the animals sampled on Baranof island tested positive for *Pasteurella trehalosi*, though none tested positive for *Mycoplasma ovipneumonia*. While sampling was limited, these results differ from those acquired for samples collected in 2010 from three other populations in southeast Alaska (Table 2). Until additional samples are collected, the overall findings must be considered preliminary.

Tissue samples from all mountain goats captured (and a majority of animals harvested via ADFG registration hunts) have been sent Aaron Shafer (University of Alberta) for inclusion in a broad-scale mountain goat population genetics analysis. Results from this study (Shafer et al. 2010) indicate that substantial genetic structuring exists among mountain goats in southeast Alaska. Interestingly, such analyses suggest that mountain goats on Baranof island are derived from two separate source populations. One source population consists of animals translocated from Tracy Arm in 1923 (see Paul 2009). The other source population consists of animals originating from a population endemic to Baranof island, putatively occurring on Baranof island prior to the 1923 translocation and persisting in a coastal refugia during the last ice age (unbeknownst to contemporary historians). The conservation implications associated with the presence of two distinct genetic lineages (one introduced and one endemic) on Baranof island are provocative. Future analyses will focus on examining the spatial distribution of each lineage and determing the extent of overlap (relying primarily on data from harvested animals). In addition, animals captured during this study will be genotyped and assigned to the appropriate genetic lineage in order to more discretely link genetic identity to spatial distribution (via GPS collar location data) and, also, vital rates.

Table 2: Incidence of respiratory bacteria documented in mountain goats in the Baranof island study area (n = 5), 2010. Results are also provided for three other populations in southeast Alaska in 2010, for comparison.

Area	Lynn Canal	Klukwan	Baranof	Cleveland	All Areas
Pasteurella trehalosi	0	2	5	2	9
Pasteurella sp.	0	1	0	0	1
Pasteurella sp.*	0	0	0	2	2
Total Pasturella	0	3	5	3	11
Arcanobacterium pyogenes	1	1	0	1	2
Mannheimia haemolytica	1	0	0	0	0
Moraxella sp.	1	1	0	0	1
Staphylococcus aureus	0	0	1	1	2
Mycoplasma (culture)	0	0	0	--	0
Mycoplasma ovipneumonia (PCR)	0	0	0	0	0
n (tested)	5	5	5	5	20

Notes:
Pasturella sp. = not identifiable to species
Pasteurella sp.* = organism most like P. trehalosi but looks different than other P. trehalosi (grows on MacConkey agar)
Total Pasturella = # of animals with some form of Pasturella (CG012 had 2 forms)

Reproduction and Survival

At the time of capture, all four females had a kid at heel. However, during follow-up aerial telemetry surveys conducted 2-3 weeks after capture it was not possible to obtain a visual of radio-marked females and thus ascertain if kids were still alive. Subsequently, specific aerial survey efforts have not been made to obtain visual observations as snow conditions and winter habitat use patterns preclude a reasonable probability of seeing animals. Efforts to obtain visual observations of radio-marked females and attendent kids will resume in May 2011, following seasonal retreat of the snow pack and migration of mountain goats to high elevation habitats.

In general, it is not critical to regularly monitor radio-marked animals to gather data need to estimate survival rates since GPS radio-collars archive information needed to ascertain fates of individuals. Nonetheless, timely monitoring enables opportunity to investigate mortality sites shortly after death which increases the likelihood of determining cause of death. Overall, between September 12-December 12, 2010, 10 monitoring surveys have been conducted either from the ground or air. In two cases, aerial surveys were conducted to specifically determine fates of all marked animals. Whereas, in other cases aerial or ground based surveys were conducted incidentally to other activities. In the former case, not all animals were consistently detected. Overall, no animals died within 2-3 weeks of capture and since that period 8 of 12 animals have been detected on "live" mode during subsequent survey efforts; remaining animals not heard were not likely dead but rather in difficult or remote locations.

Population Abundance and Composition Estimation

One aerial survey of the study area was conducted over two days in mid-September. During this survey, mark-resight protocols were followed in order to estimate sighting probability and population size. Summary and analyses of these data, following White and Pendleton (2010), will be conducted in winter 2011.

Future Work/Recommendations:

Original project planning called for radio-marking and monitoring 30 mountain goats over a 4-5 year period in order to acquire scientifically defensible field data for management applications. To date, 36% of the funding required to implement the project, as described above, has been secured (approximately equal contributions have been made by the City of Sitka and ADFG). Prospects for additional funding from existing or other funding sources is uncertain. Consequently, planned project activities scheduled for 2011 are likely to be scaled back to fit with existing funds available, unless additional funding is secured.

Overall, continued efforts will be made to monitor fates of marked animals opportunistically from the ground or air. Specific efforts will be made to remotely download TGW-3590 GPS collars (n = 5) and ascertain reproductive success of radio-marked female mountain goats (n = 4) in spring 2011; over-winter mortalities will be investigated from the ground, as applicable. During August/September 2011, no more than 6 additional GPS radio-collars will be deployed via helicopter capture methods. Annual fall aerial population estimation and composition surveys will be conducted in September/October 2011. Finally, an annual project progress report will be prepared and submitted by December 31, 2011.

Literature Cited:

City and Borough of Sitka. 2010. Preliminary draft environmental assessment, Draft application for amendment. Blue Lake hydroelectric project (FERC No. 2230) expansion. Sitka, AK. 112 pp.

Paul, T. W. 2009. Game transplants in Alaska. Technical Bulletin No. 4, second edition. Alaska Department of Fish and Game, Juneau, AK. 150pp.

Shafer, A.B.A., S. D. Cote and D. W. Coltman. 2010. Hot spots of genetic diversity descended from multiple Pleistocene refugia in an alpine ungulate. Evolution, doi: 10.1111/j.1558-5646.2010.01109.x

Taylor, W.P. 2000. Wildlife capture and restraint manual. Alaska Department of Fish and Game, Anchorage, AK.

White, K. S. and N. L. Barten. 2010. Mountain goat assessment and monitoring along the Juneau access road corridor and near the Kensington Mine, Southeast Alaska. Wildlife Research Annual Progress Report. Alaska Department of Fish and Game, Division of Wildlife Conservation, Douglas, AK.

White, K. S. and G. P. Pendleton. 2010. Mountain goat population monitoring and survey technique development. Wildlife Research Annual Progress Report. Alaska Department of Fish and Game, Division of Wildlife Conservation, Douglas, AK. 4pp.