ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 115526
Juneau, AK 99811-5526

Alaska Department of Fish and Game
Wildlife Restoration Grant

GRANT NUMBER: AKW-12

PROJECT NUMBER: #215793736

PROJECT TITLE: Resource use and distribution of Roosevelt elk and Kodiak brown bears on Afognak and Raspberry Islands

PERIOD OF PERFORMANCE: 1 July 2019 – 30 June 2020

PERFORMANCE YEAR: 1 July 2019 – 30 June 2020; year 4 of a 7-year grant

REPORT DUE DATE: Sept. 1, 2020

PRINCIPAL INVESTIGATOR: Nathan Svoboda

COOPERATORS: Koniag Native Corporation, Afognak Native Corporation (ANC), Ouzinkie Native corporation (ONC), Natives of Kodiak Native Corporation (NOK), Mississippi State University (MSU), State University of New York (SUNY), Rocky Mountain Elk Foundation (RMEF), Kodiak Brown Bear Trust (KBBT), and Old Harbor Native Corporation.

Authorities: 2 CFR 200.328
2 CFR 200.301
50 CFR 80.90

I. PROGRESS ON PROJECT OBJECTIVES DURING PERFORMANCE YEAR

OBJECTIVE 1: Examine habitat and forest stand characteristics impacting elk and brown bear distribution, resource use, and abundance and develop habitat and resource use models to guide forest and wildlife management decisions.

ACCOMPLISHMENTS: During this reporting period we aerially darted and chemically immobilized 6 brown bears (4 females, 2 males) on Sitkalidak Island. Bears were immobilized using 7 or 10 ml (229 mg/ml) of Telazol (Zoetis Services LLC; Parsippany, NJ, USA) with additional Telazol injected if necessary. Each bear was fitted with a Vectronic GPS iridium radio collar with built in accelerometer (model Vertex Plus-4 collar, Vectronic, Berlin, Germany). As soon as feasible after induction and throughout immobilization we monitored temperature to assess physiological state. We opportunistically weighed bears, ocularly estimated age based on tooth wear and extracted a vestigial premolar for cementum age analysis. We determined mean body condition

scores (BCS) by palpation of fat deposits (scale: 1 [moribund] –5 [obese]) by two independent observers, documented evidence of lactation, and recorded presence of dependent or other bears. We identified sex and collected morphometric measurements and collected tissue samples. We applied uniquely numbered tattoos to the upper and lower inside lip. We positioned brown bears sternal prior to departing capture location. We deployed cameras to monitor post-induction recovery time.

We collected 12 brown bear collars after collars released from animals. Due to an error in Telonics programming, many collars released before their expected date. We plan to capture an additional 30 bears on Afognak and Raspberry islands in spring 2020 to augment our current sample.

Since 2016 we captured 35 individual brown bears on Sitkalidak Island (27 females, 8 males) and 98 individual brown bears on Afognak and Raspberry islands (59 females, 39 males). On average in spring and fall, males weights (spring n = 40, mean = 222.79 kg, standard deviation = 75.33; fall n = 7, mean = 344.84, standard deviation = 94.71) were greater than females (spring n = 47, mean = 170.83 kg, standard deviation = 44.99; fall n = 29, mean = 216.67, standard deviation = 43.20) (one-tailed t-test, spring $P < 0.01$, t = -3.71; fall $P = 0.02$, t = -2.95). The estimated age of female brown bears captured (n = 82, mean = 10.62, standard deviation = 6.36) was greater than male brown bears captured (n = 41, mean= 8.12, standard deviation = 6.14) (two sample t-test, $P = 0.03$, t = 2.11). Estimated body conditions were similar for males and females (two-tailed t-test, spring $P = 0.06$, t = -1.91; fall $P = 0.96$, t = -0.05).

A principal components analysis of 9 morphometric measurements from 73 spring captures revealed that body condition was most closely associated with estimated age, while weight, head circumference, neck circumference, and chest girth were closely associated, and total body length and total length were closely associated. The principal components analysis from 26 fall captures showed similar trends, except estimated age was associated with weight and chest girth, while all other measurements except body condition were closely grouped. Pearson's correlation coefficients similarly revealed that both neck circumference and head circumference were highly correlated with weight in both spring (neck correlation coefficient = 0.86 and head correlation coefficient = 0.83) and fall (neck correlation coefficient = 0.87 and head correlation coefficient = 0.80), total body length and body length were highly correlated in both seasons (spring correlation coefficient = 0.80, fall correlation coefficient = 0.84), and neck circumference and head circumference were highly correlated in both seasons (spring correlation coefficient = 0.95, fall correlation coefficient = 0.91). Interestingly, both body condition and estimated age were not highly correlated with any of the morphometric measurements (all correlation coefficients < 0.60 for both measurements in both seasons) except body condition score was correlated with neck circumference in spring (correlation coefficient = 0.66).

Also during this reporting period, we aerially darted 16 elk (9 females, 7 males) on Afognak and Raspberry islands, 2 of which were recaptures. Elk were immobilized using 3 ml darts containing 1.22–2.50 ml (10 mg/ml) of thiafentanil oxalate (Thianil, Wildlife Pharmaceuticals, White River, 1240, South Africa) and 0.5 or 1 ml (100 mg/ml) of xylazine

(Bimeda Animal Health, Carrickmines, Dublin 18, Ireland or Akorn Animal Health, Lake Forest, IL, USA). If necessary, animals were administered an additional 0.8 to 2.0 ml of thiafentanil. Fifteen elk were fitted with Vectronic GPS iridium radio collars with built in accelerometers, programmed to obtain a location every hour (model Vertex Plus–4 collar, Vectronic, Berlin, Germany). All collars included a mortality switch (12-hour delay) and a release mechanism programmed to release from the animal during September 2021. We also attached a degradable leather link as a secondary collar release. We monitored temperature to assess physiological state as soon as feasible after induction and throughout immobilization. We ocularly estimated age based on tooth wear and collected mean BCS when feasible. We identified sex, documented evidence of lactation, recorded presence of dependent or adult elk, and capture location. We administered hand injections of naltrexone (1 mg/kg body weight) (Trexonil; Wildlife Pharmaceuticals, White River, 1240, South Africa, or ZooPharm; Laramie, WY, USA) and atipamezole (1 mg/10 mg of xylazine; ZooPharm; Laramie, WY, USA) intramuscularly to reverse the effects of thiafentanil and xylazine and released elk at their capture locations. We observed elk from a distance until they successfully recovered from immobilization.

The average time from first dart to induction was about eight minutes, with an average disturbance level of 3.68 (1 = standing still, 3 = light run, and 5 = hard run) and an average depth of tranquilization of 3.38 (1 = light, 3 = tactile, and 5 = deep). Elk recovery time (time of first dart to time of full recovery) was about 38 minutes. Two of the 16 elk were recaptures. Captured elk had a mean body condition score of 4.3. Five elk were weighed, with a mean weight of 287.85 kg.

Since 2016, we have captured 83 individual elk from the 8 herds on Afognak and Raspberry islands (44 males, 39 females). Average weights of captured female elk (n = 14, mean = 273.93 kg, standard deviation = 54.57) were lower than average weights of male elk (n = 14, mean = 326.29 kg, standard deviation = 65.45) (one-tailed t-test, $P < 0.05$, t = -2.30). Elk had an average body condition score of 3.63 (0–5); female and male body condition scores were not different (two sample t-test, $P = 0.08$, t = -1.74).

A principal components analysis of 7 morphometric measurements from 14 elk revealed that body condition was most closely associated with body length and total length. Weight and chest girth were closely associated along with top and bottom neck circumference. Pearson's correlation coefficients similarly revealed that chest girth and weight were highly correlated (correlation coefficient = 0.97), total body length and body length were highly correlated (correlation coefficient = 0.92), and lower and upper neck circumference were highly correlated (correlation coefficient = 0.91). Interestingly, body condition was not highly correlated with any of the morphometric measurements (all correlation coefficients < 0.55).

We also completed collection of historical logging data from Native corporations working on Afognak Island. Additionally, we obtained vegetation classification data from Afognak, Raspberry, and Sitkalidak islands from a previous United States Geological Service analysis in 2004. We have reclassified this data (originally 63 categories) into six

categories for analysis. This data will be used during analysis to understand how different timber stand ages affect brown bear and elk movements on Afognak Island.

We conducted a preliminary resource selection function for elk during November 2016–January 2017. We found that elk used grassland/meadow land cover type the most and dwarf shrub and non-vegetated land cover the least. We have also examined how elk use habitat over the entire year (26 October 2018–19 September 2019) with a resource selection function from data on 12 elk from six herds (Marka, Raspberry, Melina, Waterfall Lake, Duck Mountain, Seal Bay) and two elk from two herds (Tonki, Portage Lake). We found that elk preferentially select meadow, shrub, and dwarf shrub habitat while they avoid forest and non-vegetated habitat (Chi-squared test, df = 5, χ^2=25522.41, $P < 0.001$).

We will conduct further analysis on brown bear and elk data in 2020 using resource selection functions, utilization distributions, and mixed effects modeling on range size.

OBJECTIVE 2: Create annual GIS maps showing seasonal distribution, movements, and spatial and temporal shifts in elk and brown bear space use.

ACCOMPLISHMENTS: We obtained 159,452 elk locations from 48 individual elk and 125,360 bear locations from 24 individual bears during this reporting period. We have accumulated >937,573 elk locations from 83 individual elk and >512,233 bear locations from 133 individual bears since 2016. Collars currently deployed continue to record locations every hour.

We collected 12 brown bear collars and 31 elk collars that released from animals as intended on 1 September 2019. We will continue to download and monitor movements monthly to detect mortality events or dropped collars. In spring 2020, we plan to deploy 30 brown bear collars and 23 elk collars.

From data collected in 2018–2019, we created seasonal maps for elk showing temporal shifts. To demonstrate elk space use, we created 95% minimum convex polygons to preliminarily estimate each collared elk's home range in each season. As expected, elk demonstrated increased use of higher elevation inland areas in summer and moved to lower elevation and coastal areas in winter. We similarly created seasonal maps of brown bear distributions on Afognak, Raspberry and Sitkalidak islands.

On 11 September 2018, we immobilized female brown bear B1836 on Sitkalidak Island and fitted her with a GPS collar. At the time of capture, we estimated this female to be 10 years old. She had 3 yearlings and weighed 197 kg. On 27 September 2018, B1836 swam from Sitkalidak Island to the Kodiak mainland and proceeded to travel a distance of approximately 300km. During this period, she travelled to the Bells Flats area of Kodiak town and Saltry Cove before swimming across Ugak Bay and returning to Sitkalidak Island on 28 October 2018, where she denned for the winter. Another female, B607, also swam from Sitkalidak Island to the Kodiak mainland with her 2 yearlings in June 2018 then travelled to Larsen Bay before returning to Sitkalidak in November 2018. The movements of some individuals from Sitkalidak Island are revealing previously unknown movements for female bears on the Kodiak Archipelago. Typically, female bears with

offspring use smaller home ranges than males.

In February 2019, we calculated the average den entry dates for brown bears for 2018. The average den entry date for female brown bears on Afognak and Raspberry Islands was 24 October 2018, and 2 November 2018 for males. The average den entry date for female brown bears on Sitkalidak Island was 25 November 2018. Only one male brown bear remained collared on Sitkalidak Island for denning and entered a den on 6 January 2019. We will calculate average den entry dates from 2019 in 2020.

We deployed 28 cameras on 5 berry producing plant species: devil's club (*Oplopanax horridus*), high bush blueberry (*Vaccinium ovalifolium*), low bush blueberry (*V. uliginosum*), salmonberry (*Rubus spectabilis*), and red elderberry (*Sambucus racemose*) on Afognak Island from April through September to monitor berry phenology for the second year of data collection. We obtained 17,432 images in 2019. We have analyzed the images from 2018 and dates of ripening for the five species. During summer 2019, the Kodiak Archipelago experienced unusually prolonged high temperatures with little rain, which caused berries to ripen earlier than expected. Cameras will be redeployed in spring 2020 to continue monitoring berry phenology. We will analyze this data for use in our models on elk and bear seasonal resource use.

OBJECTIVE 3: Collect and evaluate elk fecal pellets to determine diet and seasonal changes in forage use.

ACCOMPLISHMENTS: In March 2019, we collected 155 fecal samples from 5 elk herds on Afognak and Raspberry islands to determine winter diet. In August 2019, we collected 103 fecal samples from 5 elk herds on Afognak and Raspberry islands in addition to 161 fecal samples collected in June 2018 which will be used to determine summer diet.

We have collected over 20 plant samples of potential elk food and plant samples are stored in a freezer for comparison with fecal samples.

We established a new partnership with Alyssa Hopkins, a scientist based at the Alaska Department of Fish and Game in Kodiak, to examine elk diet from fecal samples collected on Afognak Island using microhistological techniques. We plan to begin analysis by late 2020.

OBJECTIVE 4: Develop a long-term forest and wildlife management strategy that incorporates sustainable logging, responsible wildlife management, and increased sport and subsistence harvest opportunities.

ACCOMPLISHMENTS: We are currently considering different optimization techniques to develop an optimization model to maximize elk habitat suitability and revenue from timber harvest. We have contacted Dr. Charles Kroll (professor of environmental engineering) at SUNY-ESF to aid in developing this model. We will use this model along with forthcoming results on habitat suitability and risk to determine an optimal management strategy for elk.

Development of a long-term forest and wildlife management strategy will not occur until the final results of the project have been analyzed (likely during years 4 and 5 of the project); however, discussions with project partners regarding long-term management plans are ongoing and will continue throughout the duration of the project.

OBJECTIVE 5: Beginning in year 4, implement large scale land treatments, thinning techniques, and reforestation efforts using forest practices that bolster at-risk habitats and increase elk forage critical to long term elk sustainability.

ACCOMPLISHMENTS: In September 2018 a grant amendment was approved removing the implementation of large-scale land treatments, thinning techniques, and reforestation efforts. Reasons for this change are summarized in the grant amendment.

OBJECTIVE 6: Investigate seasonal shifts in brown bear space use relative to elk movements and vulnerability (i.e. calving) and develop seasonal elk predation risk maps identifying areas with increased predation probability.

ACCOMPLISHMENTS: We plan to use utilization distributions, accelerometer data, and GPS movement and location data to estimate elk response to brown bear habitat use, and how these responses may differ seasonally and with forage quality.

Additionally, we will begin analysis in 2020 on brown bear movement and resource use and examine whether bears select areas with high probability of use by elk during calving (late spring).

OBJECTIVE 7: Assess annual elk recruitment rates through aerial composition surveys.

ACCOMPLISHMENTS: These surveys are completed as part of another survey project and duplication is unnecessary. In September 2018 a grant amendment was approved removing aerial composition surveys from this project.

OBJECTIVE 8: Evaluate cause specific mortality through harvest monitoring and investigation of radio-collared elk using known-fates procedure in MARK

ACCOMPLISHMENTS: We made multiple attempts to investigate elk mortality events. Due to weather, terrain, pilot availability, and other circumstances beyond our control, reliable evaluation of mortality events could not be ascertained; therefore, this objective was removed in September 2018 as part of the approved grant amendment.

We continually update databases to reflect previously captured brown bears and elk that are harvested during hunting seasons and collect tissue, hair and tooth samples from harvested bears. Of the 83 individual elk that have been captured on Afognak and Raspberry islands since 2016, 15 elk have died, with 12 of those being confirmed harvests, two of which were harvested in 2019. There were 113 total elk harvested on Afognak and Raspberry islands in 2019 (33 cows, 80 bulls), with many permits still outstanding.

Of the 133 brown bears captured since 2016 on Afognak, Raspberry, and Sitkalidak islands, 11 died, with 7 bears harvested (3 in 2019). There were 20 brown bears harvested on Afognak and Raspberry islands in spring 2019 (2 females, 18 males) and 4 brown bears harvested on Afognak and Raspberry islands in fall 2019 (2 females, 2 males). There were 5 brown bears harvested on Sitkalidak Island in spring 2019 (3 males, 2 females) and 5 brown bears harvested on Sitkalidak Island in fall 2019 (4 males, 1 female).

OBJECTIVE 9: Estimate annual elk population size through aerial surveys

ACCOMPLISHMENTS: We attempt to estimate annual elk population size through aerial composition surveys. Composition surveys are usually conducted 3–4 times annually to estimate cow, calf, and bull ratios and estimate herd specific population size, recruitment rates, and gender composition.

We were only able to survey once in 2019 due to pilot availability, and staff time constraints. The survey flight was conducted on 4 September 2019. The main mission of the flight was to locate as many elk herds as possible and estimate herd numbers and bull percentages. We were planning on locating the herds using radiotelemetry, but the VHF tracking mechanism was disabled during this flight preventing radio tracking. Elk observations were in both high and low elevations and in both small and large herds. Due to light and wind conditions elk were difficult to classify. Calves were also difficult to identify due to their larger size this time of year. We currently estimate the elk population size at approximately 1120 animals.

In 2020 we plan to create a model to more accurately estimate population size and recruitment rates based on past data collected since 1958. Note: Composition surveys are completed as part of another survey project and duplication is unnecessary. In September 2018 a grant amendment was approved removing aerial composition surveys from this project.

OBJECTIVE 10: Provide annual progress reports outlining the progress that has occurred to date in all aspects of the study.

ACCOMPLISHMENTS: An annual progress report (attached) was issued 30 January 2020 and covers the time period from 1 January 2019 to 31 December 2019.

We will continue to provide quarterly and annual progress reports outlining the progress that has occurred to date in all aspects of the study. Progress reports will include the evaluation of results and plans for the upcoming field season. We will provide an in-depth narrative describing field and lab progress. We will work with our project partners to publish project results including management recommendations in scientifically peer-reviewed journals as soon as feasible following analysis

II. SUMMARY OF WORK COMPLETED ON PROJECT TO DATE.

Although in-depth analysis is currently underway and has not yet been completed there are several preliminary findings worth mentioning.

- To date, we have deployed collars on 164 (111 females, 53 males) individual bears and 86 (49 females, 37 males) individual elk.
- We obtained >750,000 elk and >500,000 bear locations to date and continue to record hourly locations
- We deployed a total of 63 remote cameras on 5 berry species to monitor vegetation phenology. We have obtained >25,000 images.

Additional findings can be located in the attached 2019 Annual Report.

III. SIGNIFICANT DEVELOPMENT REPORTS AND/OR AMENDMENTS.

An amendment was submitted on 17 July 2018 addressing some of the objectives previously outlined.

As previously reported, the Co-Principal Investigator on the project, Dr. Jerrold Belant, accepted an endowed professorship at State University of New York – College of Earth Sciences and Forestry (SUNY-ESF) in 2019. Dr. Belant and the PhD student working on the project (Shannon Finnegan) have both successfully made the transition to SUNY-ESF and continue to progress on the project. However, the Research Assistant (Jenell DelaPena) previously working on the project took another job opportunity and is no longer working on the project. As a result, a new employee (PhD student Sarah Schooler) was selected to work on the project for its duration and started in July 2019.

IV. PUBLICATIONS

We have continued to update our project website (www.campfirewildlife.com), Facebook page (www.facebook.com/campfirewildlife), and Twitter page (https://twitter.com/campfirewild) with project results.

V. RECOMMENDATIONS FOR THIS PROJECT

None

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Date: 5 October 2020