# 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 2017 – 30 June 2018

PERFORMANCE YEAR: 1 May 2016 – 30 June 2022

**REPORT DUE DATE:** 28 September 2018

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: We purchased 40 elk and 40 brown bear GPS collars including drop off mechanisms and accelerometers from Telonics Inc. and programmed them to collect hourly locations. We deployed collars in June/July and September 2017 and re-deployed prematurely dropped collars in June 2018. Due to a programming error made by the collar manufacturer, all 40 deployed brown bear collars prematurely dropped off the animals on 1 September 2017 resulting in the need to collect and re-deploy all 40 bear collars in September 2017 and June 2018. All deployed collars were monitored regularly, and all locations collected were downloaded and implemented into ArcMap software. A PhD student, Shannon Finnegan, was hired on the project and, working with the Native

corporation partners, began collecting, compiling, and entering landcover and forestry data into a database. Because radiocollars were recently deployed a limited amount of location data has been collected preventing the development of resource use models this reporting period.

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

ACCOMPLISHMENTS: Capture operations occurred in June/July and September 2017 and again in June 2018. In total, 110 bears and 48 elk were captured and fitted with GPS radio collars. All deployed collars were monitored regularly, and all locations collected were downloaded and implemented into a Geographic Information System (GIS) using ArcMap software. The PhD student and Research Assistant (Jenell DelaPena) are continuing to compile and organize forestry and landcover data. Compiled and organized landcover data has been implemented into GIS. The collection of location data is ongoing. Because radiocollars were recently deployed a limited amount of location data has been collected preventing the creation of GIS maps this reporting period.

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

ACCOMPLISHMENTS: In June 2018 we collected 161 fecal pellet samples from 7 of 8 elk herds to estimate spring/summer diet. Additional elk pellets will be collected in December 2018 to estimate winter diet. After an extensive search we identified a microcomposition lab at Colorado State University to conduct the fecal pellet analysis. Preparation and analysis is planned to begin in fall 2018.

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: 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: We are currently in year 2 of the study so no large-scale land treatments have occurred. In addition, 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: Radiocollars were deployed on elk and bear. Collection of location data is ongoing. Project staff continue to compile and organize forestry and landcover data for implementation into GIS. A limited amount of location data has been collected to date preventing the investigation of seasonal movements and shifts in space use this reporting period.

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 on numerous occasions to investigate elk mortality events. Unfortunately, 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.

OBJECTIVE 9: Estimate annual elk population size through aerial surveys

ACCOMPLISHMENTS: Aerial surveys to estimate herd demographics and population size occurred on 31 August and 11 September 2017. A total of 748 elk were observed (438 cows, 95 bulls, 61 calves, and 154 unclassified). Based on 2017-18 counts and historical knowledge regarding herd demographics we estimate the current elk population to be between 1000-1100 animals. Note: 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 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 8 December 2017 and covers the time period from 1 May 2017–30 September 2017. Due to the delayed implementation of the project few project activities occurred prior to 1 May.

# II. SUMMARY OF WORK COMPLETED ON PROJECT TO DATE.

No significant project findings or relevant results have been identified to date. Due to the delayed start of the project, a limited amount of data has been collected thus far. Although the project was scheduled to begin in 2016, administrative and logistical hurdles prevented the project from

commencing until spring 2017 resulting in 2017 being Year 1 of 6 in a 6-year project. Nonetheless, several preliminary findings are worth mentioning.

- We obtained >210,000 elk and >35,000 bear locations for 2017 and continue to record hourly locations
- We deployed 18 remote cameras on 4 berry species to monitor vegetation phenology. We obtained 6,751 images.
- Based on cementum age analysis of 75 teeth (44 female and 31 male), the average age for captured bears was 7.6 years old (SD: 5.9) for males and 9.9 (SD: 5.6) for females. Age range of captured bears was estimated to be 1 24 years old and 2 27 years old, for males and females, respectively.
- The average weight for captured bears was 238.7 kg (SD: 85.7) for males and 181.5 kg (SD: 47.9) for females. Weight ranges of captured bears was 75.6 428 kg and 97 341kg for males and females, respectively.
- Based on dental visual inspection and coronet development, the average age for captured elk was 3.2 years old (SD: 1.1) for males and 5.8 (SD: 2.6) for females. Age range of captured elk was estimated between 2–6 years old and 2–13 years old for males and females, respectively.
- The average weight for captured elk was 319.0 kg (SD: 68.3) for males and 264.8 kg (SD: 51.6) for females. Weight range of captured elk ranged between 227 412 kg and 128 315 kg for males and females, respectively.
- Average den entrance date for bears was estimated to be November 4<sup>th</sup> (SD: 16.9), with October 12<sup>th</sup> and December 3<sup>rd</sup> earliest and latest recorded den entrances, respectively.

Additional findings can be located in the attached 2017 Annual Report.

# III. SIGNIFICANT DEVELOPMENT REPORTS AND/OR AMENDMENTS.

No Significant Development Reports or Amendments were submitted during this reporting period; however, an amendment was submitted shortly after the close of this reporting period on 17 July 2018.

# IV. PUBLICATIONS

News Broadcast:

KMXT Kodiak, Alaska. 25 July 2017. "Afognak Island Elk Study Looks at Balancing Logging With Game Management". Website: <<u>http://kmxt.org/2017/07/afognak-island-elk-study-looks-balancing-logging-game-management/</u>>.

# IPR AKW-12 Afognak Elk 2018

KMXT Kodiak, Alaska. 10 August 2017. "Sun'aq Intern Helps Collar Bears and Elk". Website: <<u>http://kmxt.org/2017/08/sunaq-intern-helps-collar-bears-elk/</u>>.

Popular Articles:

The Kodiak Daily Mirror. 3 August 2017. "Biologists study logging's effect on elk, bears". Website: < <u>http://www.kodiakdailymirror.com/news/article\_26f31934-77f1-11e7-9e25-0bf63c948473.html</u>>. *Contributing writer:* Kathi Bloomfield.

# V. RECOMMENDATIONS FOR THIS PROJECT

None

Prepared by: Nathan Svoboda – Principal Investigator, Alaska Department of Fish and Game

Date: 27 September 2018

# Resource use and distribution of Roosevelt elk and Kodiak brown bears on Afognak and Raspberry Islands, Alaska

Progress Report: 1 May 2017 – 30 Sept 2017

Date Issued: 8 December 2017

Prepared by: Dr. Florent Bled – Research Associate II, Mississippi State University Shannon Finnegan – Ph.D. student, Mississippi State University Nathan Svoboda –Area Wildlife Biologist, Alaska Department of Fish and Game Jenell de la Peña- Research Technician, Mississippi State University

> Principal Investigators: Nathan Svoboda – Area Wildlife Biologist, ADF&G Dr. Jerrold Belant – Professor, MSU

> > Alaska Department of Fish and Game Wildlife Division 351 Research Court

> > > Kodiak, AK 99615













SIPPI STATE

UNIVERSITY CARNIVORE ECOLOGY LABORATORY

The Kodiak Brown Bear Trust

Abstract We chemically immobilized 43 (23 female, 20 male) Roosevelt elk (Cervus canadensis roosevelti) and 79 (47 female, 32 male) Kodiak brown bears (Ursus arctos middendorffi). All 122 animals were aerial darted from 10 June 2017 to 16 September 2017 by helicopter. One elk and one bear mortality occurred during captures. Capture operations were conducted across Afognak and Raspberry Islands (Figure 1). Seventy-three bears and 41 elk were fitted with global positioning system (GPS) collars containing accelerometers. Currently, 50 elk and 23 bears are being monitored. We deployed 18 remote cameras across Afognak to monitor phenology on four prominent berry species found throughout Afognak and Raspberry Islands; salmonberry (Rubus spectabilis), Devil's club (Oplopanax horridus), highbush blueberry (Vaccinium ovalifolium) and red elderberry (Sambucus racemose). Two cameras were set up on each berry species and 1 additional camera on salmonberry and low bush blueberry (Vaccinium uliginosum L.). We have obtained a total of 6,751 images. We conducted berry count surveys on 2 salmonberry and 2 highbush blueberry transects to estimate and monitor berry production and abundance. We created 4 vegetation transects for elderberry and Devil's club.

# **Summary**

- We darted and immobilized 43 (23 female, 20 male) Roosevelt elk (*Cervus canadensis roosevelti*) and 79 (47 female, 32 male) Kodiak brown bears (*Ursus arctos middendorffi*).
- After capturing 65 bears between 10 June 2017 and 3 July 2017, and following premature collar drop-offs due to faulty equipment, we captured 20 more individuals (14 new captures and 6 recaptures from the year) between 12 September 2017 and 16 September 2017.
- ▶ We collared 73 bears and 41 elk with GPS radio collars containing accelerometers.
- We investigated 1 bear mortality post-capture and determined cause of death as capture myopathy.
- A total of 50 (28 female and 22 male) elk collars, including 12 elk collared in 2016, and 23 bears (20 female and 3 male) are currently being monitored.
- ➤ We have obtained 207857 elk and 32254 bear locations for 2017 (as of December 8<sup>th</sup>, 2017) and continue to record locations every hour.
- We deployed 18 remote cameras on 4 berry species to monitor phenology. We have obtained 6,751 images.
- We created 8 vegetation transects on 4 berry species and conducted berry counts on 2 salmonberry and 2 blueberry plots to estimate and monitor berry production and abundance.
- We are updating a historical logging map of harvest and hand planted units throughout Afognak Island.
- Based on cementum age analysis of 75 records (44 female and 31 male), the average age for captured bears is 7.6 y.o. (SD: 5.9) for males and 9.9 (SD: 5.6) for females. Age range of captured individuals for bears was estimated to [1 24] and [2 27], for males and females respectively.
- The average weight for captured bears is 238.7 kg (SD: 85.7) for males and 181.5 kg (SD: 47.9) for females. Weight ranges of captured bears was [75.6 428 kg] and [97 341kg], for males and females respectively.
- Based on dental visual inspection, the average age for captured elk is 3.2 y.o. (SD: 1.1) for males and 5.8 (SD: 2.6) for females. Age range of captured elk was estimated between [2 6 y.o.] and [2 13 y.o.], for males and females respectively.
- The average weight for captured elk is 319.0 kg (SD: 68.3) for males and 264.8 kg (SD: 51.6) for females. Weight range of captured elk ranged between [227 412 kg] and [128 315 kg], for males and females respectively.

- Average den entrance date for bear is estimated to be November 4<sup>th</sup>, 2017 (SD: 16.9), with October 12<sup>th</sup>, 2017 and December 3<sup>rd</sup>, 2017 earliest and latest recorded den entrances, respectively.
- A comprehensive review of the literature on resource use and distribution of Roosevelt elk and Kodiak brown bears is in progress.

# Introduction

Wildlife management is based on an understanding of factors that impact wildlife populations. To ensure long term sustainability of a population, wildlife managers must possess information on factors that limit a population. Once these limiting factors are identified managers can manipulate one or more factors to increase or decrease its effect on a desired outcome. The degree to which a limiting factor impacts a population may vary by time of year, location, or some other environmental condition. Roosevelt elk (Cervus elaphus roosevelti) have significant subsistence, sport, economic, and ecological value for residents and non-residents of Alaska. Common factors that can limit Roosevelt elk populations include availability and quality of forage (Mereszczak et al. 1981, Starkey et al. 1982), and abundance and distribution of thermal cover (Starkey et al. 1982, Quayle and Brunt 2003), both of which are influenced by forest management practices (Nyberg and Janz 1990). Changes in these limiting factors result in changes in elk distribution, and abundance. Extensive commercial logging has occurred on Afognak Island since 1979 resulting in a patch-work of harvested and unharvested forest stands of varying age. The quantity and quality of food and cover available is influenced by understory type, successional stage, and forest history (Quayle and Brunt 2003). For example, elk rely heavily on older forest stands with increased canopy cover during winter to avoid temperature extremes and minimize energy expenditure (Nyberg and Janz 1990). Alternatively, in spring and summer elk focus their habitat use along edges between relatively open areas that provide forage and densely vegetated areas that provide escape cover (Skovlin 1982, Quayle and Brunt 2003).

Quantifying the relative role of factors potentially limiting elk distribution and abundance, and how these factors vary with different successional stages and forest management practices is critical to understanding elk population dynamics and implementing effective forest and wildlife management strategies. Considerable research has been conducted demonstrating the effects of forage quality and availability on elk abundance and distribution (Mereszczak et al. 1981, Starkey et al. 1982, Fryxell 1991, Wilmshurst et al. 1995, Clark et al. 2000). In addition, the importance of available cover, particularly during winter, has also been documented (Sweeney and Sweeney 1984, Nyberg and Janz 1990, Jones and Hudson 2002). Finally, the effects of various forest management practices on these factors have also received considerable attention (Irwin and Peek 1983, Unsworth et al. 1998, Ager et al. 2003, Boyce et al. 2003, Sawyer et al. 2007). However, much of this research focuses on Rocky Mountain elk (C. e. nelsoni) populations. Because of differing evolutionary histories, significant differences in behavior, physiology, and habitat requirements may exist (Starkey et al. 1982). These differences may preclude managers from applying management strategies suitable for Rocky Mountain elk to Roosevelt elk populations. This project seeks to identify and minimize the effects of logging on Roosevelt elk while increasing the herd to maximize sport and subsistence hunting opportunities. To provide the maximum benefit to elk and ensure forest management regimes are properly administered, a temporal and spatial understanding of elk suitability to forest stands is critical. Specifically, we are interested in examining elk distribution and space use in unharvested and harvested forest stands of varying age and identifying potential areas for habitat improvement. We will also investigate elk resource abundance, distribution, and use across varying forest stand ages and examine reforestation efforts and thinning techniques to increase forage for elk. Information gained through this project will be used to develop a long-term

management strategy that incorporates sustainable logging, responsible wildlife management, and continued sport and subsistence hunting opportunities.

In addition to forest management practices, another common factor impacting elk survival is the Kodiak brown bear (*Ursus arctos middendorfii*). Brown bears are the only natural predator of elk on Afognak Island and presumably influence elk calf survival and recruitment. Therefore, a secondary resource concern to be addressed includes the potential impacts of logging on brown bear distribution, resource use, and elk predation. We will 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.

Our overall goal is to identify habitat conditions and management practices that result in enhanced wildlife habitat and sustainable wildlife harvest opportunities. We will examine elk and brown bear distribution, space use and resource abundance in unharvested and harvested forest stands of varying age and identify forest stands critical to their sustainability. Little information exists on Afognak and Raspberry Islands Roosevelt elk and brown bear populations and no large scale research has previously occurred on these rare and unique populations.

# **Objectives**

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.

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

3. Collect and evaluate elk fecal pellets to determine diet and seasonal shifts in forage use.

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.

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

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.

7. Evaluate cause-specific elk mortality through harvest monitoring and investigation of radiocollared elk using the known-fates procedure in MARK.

## **Study Area**

Afognak Island (Figure 1) is a 700 square mile island located 3.1 miles north of Kodiak Island and was set aside by President Benjamin Harrison in 1892 as a fish culture and forest and wildlife preserve. It is the second largest island in the Kodiak Archipelago and is comprised of various wildlife habitat types. The island has very few year round residents (~200) located

primarily in 2 logging camps. The island lies between  $58^{\circ} 00' - 58^{\circ} 30'$  N and  $152^{\circ} 00 - 153^{\circ} 15'$  W, and has a subarctic maritime climate. Steep rocky shores surround most bays. Sitka spruce (*Picea stichensis*) dominates the over-story on most of the island and devil's club (*Oplopanax horridus*), blueberry (*Vaccinium* spp.), salmonberry (*Rubus spectabilis*), and willow (*Salix* spp.) comprise much of the understory. The island has been commercially logged for the past 35 years, with regeneration implemented in harvested units. The island is primarily owned by Native corporations (~55%) and federal and state governments. The island supports the largest elk population in Alaska with about 840 elk on Afognak Island and 210 on nearby Raspberry Island. The island also supports around 300 brown bears which are the only natural predator of elk on the island. Elk and bear hunting in the area are by permit only. Upland wildlife management and forest treatments will occur on Native Corporation land primarily used for commercial logging operations. This area was selected because extensive commercial logging has exposed large tracts of the island impacting the Roosevelt elk population and putting critical elk habitat at-risk.

#### Accomplishments

## Roosevelt Elk Capture

Beginning on 11 June 2017 we captured, radio-collared and collected samples from Roosevelt elk. Forty-three elk were captured (23 female, 20 male) and 42 were fitted with Telonics GPS radio collars (model TGW-4677), fitted with Gulf Coast Data Concepts (model X16-mini) accelerometers, programmed to obtain a location every 60 minutes from capture to collar release. All collars include a mortality mode (12 hour delay) and a CR-2A collar release mechanism programmed to drop-off the animal on 1 September 2019. We attached all collars with a 2" by 2" piece of leather in case the drop-off mechanism malfunctions. Leather links are designed to degrade over time (3-5 years) to release the collar. After induction, we applied ophthalmic ointment to the posterior border of the lower eyelids and blindfolded each animal to reduce visual stimulation. We then opportunistically weighed the animals with a weigh tarp lifted by the helicopter and transported them to a flat open area for processing. We examined elk for capture related injuries and treated accordingly. When possible, we cleaned dart wounds following ADF&G dart wound cleaning protocols. We measured body temperature as soon as feasible after induction and intermittently throughout immobilization. We ocularly estimated age based on tooth wear and eruption and determined mean body condition scores based on palpation of soft tissue at the withers, ribs, and rump. Body condition scoring ranged from 1 (emaciated) to 5 (obese) and was obtained by 2 independent observers. We documented evidence of lactation, recorded presence of calves or adult elk, herd location and documented any previous injuries. We attached 2 individually numbered plastic ear tags and attempted to collect morphometric measurements (Table 1), blood, hair, tissue, vitals, and identify sex. Based on dental visual inspection, the average age for captured elk is 3.2 y.o. (SD: 1.1) for males and 5.8 (SD: 2.6) for females. Age range of captured individuals for elk was estimated between 2 -6 years old and 2 - 13 years old, for males and females respectively. We applied uniquely

numbered tattoos to the upper and lower inside lips and opportunistically hand injected oxytetracycline and penicillin (3 cc per 100 lbs) intramuscularly prior to release. We hand injected naltrexone and Atipamezole intramuscularly into the rump to antagonize the effects of Carfentanil and xylazine, respectively. We released all elk at the capture location.

# Brown Bear Capture

Beginning 10 June 2017 we captured, radio-collared and collected samples for Kodiak brown bear. Seventy-nine bears were captured (47 female, 32 male) and 73 were fitted with Telonics GPS radio collars (model MOD-600) and attached accelerometers. In mid-September 2017, we carried out additional brown bear immobilizations over a five-day period in order to re deploy collars that were slipped by bears after initial June 2017 captures. A similar capture protocol for elk was followed for bear with minor adjustments. We measured body temperature as soon as feasible after induction and intermittently throughout immobilization. We weighed the bears; ocularly estimated age based on tooth wear, administered 0.4ml of lidocaine around one upper premolar and extracted the tooth once the area became numb. We determined mean body condition scores, documented evidence of lactation, recorded presence of young or other bears, and documented any previous injuries. We collected morphometric measurements (Table 2), blood, hair, tissue, vitals, and identified sex. Age was determined using cementum age analysis. Based on this analysis, the average age for captured bears is 7.5 y.o. (SD: 5.9) for males and 9.9 (SD: 5.6) for females. Age range of captured individuals for bears was estimated between 1 - 24years old and 2 - 27 years old, for males and females respectively. We applied unique number ID tattoos to the upper and lower inside lips and opportunistically hand injected oxytetracycline and penicillin (4 cc per 100 lbs) intramuscularly prior to release. We positioned bears sternal, left the scene and allowed bears to metabolize the drug on their own to wake up naturally.

### Collar Collection

During captures we recovered 9 dropped elk collars deployed in 2016 and redeployed them on elk and bear. We closely monitored new collar locations as captures were underway and retrieved any slipped bear collars and redeployed them as necessary.

#### Capture Mortality

We recorded two mortalities during 11 June 2017 - 03 July 2017 captures. We determined one female elk's cause of death as asphyxiation/drowning shortly after induction. We investigated one female bear death 3-4 days after capture; we located the carcass half submerged in a lake, transported it to dry land, performed a necropsy and determined cause of death as capture myopathy.

#### <u>Telemetry</u>

As of December 8<sup>th</sup>, 2017, we have obtained 240111 GPS locations (207857 for elk and 32254 for bears) of our radio collared animals for 2017. We will continue to download and monitor movements weekly in order to monitor for uniformly stationary locations that would be caused by death or collars slipping.

# Vegetation Surveys

We established 8 transects for 4 different berry species along Afognak Island's logging road system. We conducted plot-based berry count surveys on 2 salmonberry and 2 highbush blueberry transects to record number of berries, forage availability and density.

# Public Outreach

# News Broadcast:

KMXT Kodiak, Alaska. 25 July 2017. "Afognak Island Elk Study Looks at Balancing Logging With Game Management". Website: <<u>http://kmxt.org/2017/07/afognak-island-elk-study-looks-balancing-logging-game-management/</u>>.

KMXT Kodiak, Alaska. 10 August 2017. "Sun'aq Intern Helps Collar Bears and Elk". Website: <<u>http://kmxt.org/2017/08/sunaq-intern-helps-collar-bears-elk/</u>>.

#### *Popular Articles:*

The Kodiak Daily Mirror. 3 August 2017. "Biologists study logging's effect on elk, bears". Website: < <u>http://www.kodiakdailymirror.com/news/article\_26f31934-77f1-11e7-9e25-0bf63c948473.html</u>>. *Contributing writer:* Kathi Bloomfield.

## Work to be completed

#### Vegetation Surveys

We will develop a formal protocol for the collection, management, analyses, and interpretation of berry data for future abundance monitoring. We will gather, organize, and summarize vegetation phenology data collected in 2017 and determine berry ripening date and berry availability during the spring, summer and fall. We will purchase and program 4-10 additional remote cameras to monitor vegetation phenology.

# Monitoring

We will download and map radio-collared animal locations monthly. If a collar is found to be stationary for longer than 3 days we will investigate the site as soon as practical to determine the cause (e.g., death, slipped collar). All dropped collars will be retrieved when possible. We will investigate all mortalities identified using radio-telemetry.

## Composition and Recruitment Survey

We will estimate annual elk population size through aerial composition surveys. Composition surveys are conducted 3-4 times annually to estimate cow: calf and bull: cow ratios and estimate herd specific population size, recruitment rates, and gender composition. We will assess success of forest treatments by evaluating herd specific elk estimates and to determine if recruitment and population size are expanding.

# Equipment Inventory, Storage and Ordering

We will inventory, organize, repair and store all immobilization equipment. We will order all materials and equipment needed for bear immobilizations in spring 2018. We will tune our boat and purchase new outboards.

#### **Reports**

We will 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.

### Logging Data

We will obtain current timber harvest information and incorporate it into an ArcGIS database as well as determine additional forest age stand classifications based on vegetation structure characteristics and historical logging activity.

## Literature review

We will pursue our comprehensive review of the literature available on resource use and distribution of Roosevelt elk and Kodiak brown bears, and write a review article summarizing our findings.

## Model development and initial data analyses

We will develop an initial model to describe resource use and co-occurrence of elk and brown bear on Afognak and Raspberry island, and test its validity and available data.

### Acknowledgements

We thank the following for their support: Rocky Mountain Elk Foundation (RMEF) Afognak Native Corporation (ANC) Koniag Native Corporation Koncor Natives of Kodiak Native Corporation (NOK) **Ouzinkie Native Corporation** Koniag Inc. Regional Native Corporation Kodiak Brown Bear Trust Tyler Petroelje – Mississippi State University Andy Christofferson – Afognak Native Corporation Rob Graff - Afognak Native Corporation Alan Jones – Alaska Wildlife Troopers Jonathan Larivee- Soloy Helicopters Jessica Rich-Sun'ag Wildlife Intern Doug Dorner – Alaska Dept. of Fish and Game Melissa Berns- Native Village of Old Harbor Howard Valley – Afognak Native Corporation Christina Coulter – Koncor Forest Products Keith Coulter – Koncor Forest Products

Gerry Engel – Afognak Native Corporation Matthew Van Daele – Koniag Native Corporation Alaska Wildlife Troopers

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	Sex				
	Female	Male			
Estimate	$\boldsymbol{\bar{x}} \pm SD$	$\bar{x}\pm SD$			
Body Weight (kg)	$264.8\pm51.6$	$319.0\pm68.3$			
Chest Girth(cm)	$152.9\pm7.5$	$159.5\pm14.5$			
Front Shoulder (cm)	$140.5\pm5.9$	$147.0\pm8.1$			
Body Length (cm)	$218.0\pm8.5$	$225.1 \pm 15.3$			
Hind Foot (cm)	$64.8\pm4.8$	$68.9\pm3.6$			
Body Condition	$3.0\pm0.5$	$3.4 \pm 0.6$			

Table 1. Mean ( $\bar{x}$ ) and standard deviation (SD) of 65 captured female (n = 23) and male (n = 20) Roosevelt elk, Afognak and Raspberry Island, Alaska, USA, 10 June 2017 – 03 July 2017.

	Sex				
	Female	Male			
Estimate	$\boldsymbol{\bar{x}} \pm SD$	$\boldsymbol{\bar{x}} \pm SD$			
Body Weight (kg)	$181.5\pm47.9$	$238.7\pm85.7$			
Body Length (cm)	$188.6 \pm 13.0$	$196.8\pm29.2$			
Body Condition	$3.1 \pm 1.0$	$3.0\pm0.7$			
Chest Girth (cm)	$118.4 \pm 11.4$	$125.3\pm27.1$			
Front Shoulder (cm)	$101.5\pm8.1$	$110.2 \pm 11.7$			
Head Circumference(cm)	$68.9\pm5.2$	$75.9 \pm 11.3$			

Table 2. Mean ( $\bar{x}$ ) and standard deviation (SD) of 79 captured female (n = 47) and male (n = 32) brown bears, Afognak and Raspberry Island, Alaska, USA, 10 June 2017 – 16 September 2017.

			Left Ear	Right			Body Weight
Elk ID	Capture Date	Sex	Tag	Ear Tag	Ear Tag Color	Lip Tattoo #	(kg)
17-01	11-Jun-17	М	23	23	Orange	1701	407
17-02	12-Jun-17	Μ	7	7	Orange	1702	379
17-03	12-Jun-17	Μ	38	38	Orange	1703	327
17-04	12-Jun-17	Μ	17	17	Orange	1704	384
17-05	14-Jun-17	Μ	16	16	Orange		
17-06	15-Jun-17	Μ	8	8	Orange	1706	249.5
17-07	15-Jun-17	Μ	22	22	Orange	1707	240
17-08	16-Jun-17	Μ	33	33	Orange	1708	317
17-09	16-Jun-17	Μ	15	15	Orange	1709	227
17-10	16-Jun-17	F	35	35	Orange	1710	295
17-11	16-Jun-17	F	11	11	Orange	1711	315
17-12	17-Jun-17	F	40	40	Orange		
17-13	17-Jun-17	Μ	18	18	Orange	1713	412
17-14	17-Jun-17	Μ	4	4	Orange	1714	
17-15	18-Jun-17	F	2161	2105	Orange	1715	128
17-16	18-Jun-17	F					
17-17	18-Jun-17	F	3	3	Orange	1717	
17-18	18-Jun-17	F	10	10	Orange	1718	314
17-19	18-Jun-17	F	20	20	Orange	1719	233
17-20	18-Jun-17	Μ	24	24	Orange	1720	
17-21	18-Jun-17	F	30	30	Orange	1721	269
17-22	18-Jun-17	F	34	34	Orange	1722	
17-23	19-Jun-17	F	25	25	Orange	1723	247
17-24	19-Jun-17	F	32	32	Orange		298
17-25	19-Jun-17	F			Orange		
17-26	20-Jun-17	F	6	6	Orange	1726	
17-27	20-Jun-17	F	26	26	Orange	1727	
17-28	23-Jun-17	Μ	5	5	Orange	1728	296
17-29	23-Jun-17	Μ					
17-30	23-Jun-17	F	36	36	Orange	1730	
17-31	23-Jun-17	Μ	12	12	Orange	1731	
17-32	23-Jun-17	F	37	37	Orange	1732	253
17-33	23-Jun-17	F	28	28	Orange	1733	248
17-34	24-Jun-17	F	1	1	Orange	1734	
17-35	25-Jun-17	F	2096	2095	White	1735	308
17-36	25-Jun-17	Μ	14	14	Orange	1736	271
17-37	25-Jun-17	F	19	19	Orange	1737	
17-38	25-Jun-17	F	2	2	Orange	1738	269
17-39	26-Jun-17	Μ	39	39	Orange	1739	
17-40	30-Jun-17	Μ	13	13	Orange	1740	
17-41	1-Jul-17	F	31	31	Orange	1741	
17-42	2-Jul-17	Μ			Orange	1742	
17-43	2-Jul-17	М			Orange	1743	

Table 3. Elk capture data, Afognak and Raspberry Islands, Alaska, 11 June 2017- 2 July 2017.

			Cementum		Body Weight
Bear ID	Capture Date	Sex	Age	Lip Tattoo #	(kg)
17-01	10-Jun-17	Μ	3	17-01	137.5
17-02	10-Jun-17	Μ	24	17-02	327.5
17-03	11-Jun-17	Μ	6	17-03	249.0
17-04	11-Jun-17	Μ	3	17-04	144.0
17-05	11-Jun-17	F	17	17-05	204.0
17-06	11-Jun-17	Μ	2	17-06	96.0
17-07	12-Jun-17	Μ	5	17-07	207.0
17-08	12-Jun-17	F	11	17-08	204.0
17-09	12-Jun-17	F	2	17-09	107.0
17-10	12-Jun-17	Μ	13	17-10	339.0
17-11	13-Jun-17	F	13	17-11	159.5
17-12	13-Jun-17	Μ	1	17-12	75.6
17-13	13-Jun-17	Μ	3	17-13	168.8
17-14	13-Jun-17	F	19	17-14	175.4
17-15	13-Jun-17	F	9	17-15	157.0
17-16	13-Jun-17	Μ	15	17-16	335.0
17-17	13-Jun-17	Μ	8	17-17	254.0
17-18	14-Jun-17	Μ	4	17-18	225.0
17-19	14-Jun-17	F	9	17-19	165.0
17-20	14-Jun-17	Μ	4	17-20	168.0
17-21	14-Jun-17	F	9	17-21	132.0
17-22	14-Jun-17	F	16	17-22	135.0
17-23	14-Jun-17	F	12	17-23/17-22	182.0
17-24	14-Jun-17	F	9	17-24	139.5
17-25	14-Jun-17	F	11	17-25	147.0
17-26	15-Jun-17	F	8	17-26	176.0
17-27	15-Jun-17	F	27	17-27	341.0
17-28	15-Jun-17	Μ	12	17-28	179.0
17-29	15-Jun-17	F	7	17-29	218.0
17-30	16-Jun-17	F	7	17-30	188.0
17-31	16-Jun-17	F	14	17-31	148.0
17-32	16-Jun-17	F	4	17-32	137.5
17-33	17-Jun-17	Μ	10	17-33	314.0
17-34	17-Jun-17	F	12	17-34	176.5
17-35	17-Jun-17	F	8	17-35	167.0
17-36	17-Jun-17	Μ	17	17-36	137.0
17-37	17-Jun-17	Μ	4	17-37	
17-38	18-Jun-17	Μ	11	17-38	329.0
17-39	19-Jun-17	Μ	3	17-39	247.0
17-40	19-Jun-17	F	2	17-40	97.0
17-41	20-Jun-17	F	12	17-41	179.0
17-42	20-Jun-17	F	4	17-42	142.0

Table 4. Brown bear capture data, Afognak and Raspberry Islands, Alaska, 10 June 2017- 16 September 2017. \* *No cementum age estimate available, estimated age based on visual inspection of teeth.* 

17-43	23-Jun-17	F	2	17-43	169.0
17-44	24-Jun-17	Μ	5	17-34	267.0
17-45	24-Jun-17	Μ	21	17-45/17-35	368.0
17-46	25-Jun-17	Μ	9	17-46	269.0
17-47	26-Jun-17	F	9	17-47	199.0
17-48	26-Jun-17	F	7	17-48	159.0
17-49	26-Jun-17	F	18+*	316	157.0
17-50	30-Jun-17	Μ	1	17-50	114.0
17-51	30-Jun-17	Μ	5	17-51	260.0
17-52	30-Jun-17	F	4-5*	17-52	
17-53	1-Jul-17	Μ	6	17-53	209.0
17-54	1-Jul-17	Μ	3	17-54	185.0
17-55	1-Jul-17	Μ	9	17-55	343.0
17-56	1-Jul-17	F	12	17-56	
17-57	1-Jul-17	F	5*	17-57	184.0
17-58	1-Jul-17	Μ	5	17-58	278.0
17-59	2-Jul-17	F	12	17-59	180.0
17-60	2-Jul-17	F	10	17-60	225.0
17-61	2-Jul-17	F	12-15*	309	183.0
17-62	2-Jul-17	Μ	6-8*	17-62	265.0
17-63	2-Jul-17	Μ	6	17-63	227.0
17-64	2-Jul-17	F	4	17-64	131.0
17-65	3-Jul-17	F	13	17-65	
17-66	12-Sep-17	F	7	17-66	181.0
17-67	12-Sep-17	F	2	17-67	126.5
17-68	12-Sep-17	F	12	17-68	237.0
17-69	13-Sep-17	F	3	17-69	147.0
17-70	13-Sep-17	F	11	17-70	248.0
17-71	13-Sep-17	F	10	17-71	215.0
17-72	13-Sep-17	F	8	17-72	249.0
17-73	13-Sep-17	F	24	17-73	304.0
17-74	14-Sep-17	Μ	16	17-74	428.0
17-75	14-Sep-17	F	14	17-75	244.0
17-76	14-Sep-17	F	16	17-76	219.0
17-77	15-Sep-17	Μ	2	17-77	254.0
17-78	16-Sep-17	F	4	17-78	191.5



Figure 1. Afognak Island located off the southwest peninsula of the state of Alaska and north of Kodiak Island, Alaska.



Figure 2. Roosevelt elk and Brown bear capture locations on Afognak and Raspberry Island, Alaska from 10 June 2017 – 16



Figure 3. Brown bear GPS locations on Afognak and Raspberry Island, Alaska from 10 June 2017 – 18 January



Figure 4. Roosevelt elk GPS locations on Afognak and Raspberry Island, Alaska from 10 June 2017 – 16 September 2017



Figure 5. Locations of 18 game cameras, Kazakof Bay and Duck Bay, Afognak Island north of Kodiak Island, Alaska, USA 24 July 2017.



Figure 6. Locations of 2 salmonberry and 2 highbush blueberry transect sites, Kazakof Bay and Duck Bay, Afognak Island, Alaska, USA, 22 July 2017.



Figure 7. Cross section of Kodiak brown bear tooth used to determine age.



Figure 8. Cross section of Kodiak brown bear tooth.



Figure 9. Wildlife Research Assistant setting and deploying game camera to monitor vegetation phenology and Afognak Island, Kodiak Archipelago, Alaska.



Figure 10. Devil's club (*Oplopanax horridus*) vegetation phenology photos taken on Afognak Island, Kodiak Archipelago, Alaska.