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-B-R2-2020

PROJECT NUMBER: 1.63

PROJECT TITLE: Evaluation and testing of techniques for ungulate management and operation of the Kenai Moose Research Center

PERIOD OF PERFORMANCE: July 1, 2019 - June 30, 2021

PERFORMANCE YEAR: July 1, 2019 - June 30, 2020; year 1 of a 2-year grant

REPORT DUE DATE: Submit to FAC August 28, 2020

PRINCIPAL INVESTIGATOR: John Crouse

COOPERATORS: Kenai National Wildlife Refuge (KNWR), Dr. Perry Barboza, Texas A&M University, Dr. Garrett Street, Mississippi State University, Dr. Alina Evans, Inland University of Applied Sciences, Norway, Vectronic Aerospace Inc., Coralville, IA, Dr. Guilherme Verocai, Texas A&M University.

Authorities: 2 CFR 200.328
2 CFR 200.301
50 CFR 80.90

I. PROGRESS ON PROJECT OBJECTIVES DURING PERFORMANCE YEAR

OBJECTIVE 1: MRC maintenance and operations. This objective provides for activities and expenses associated with maintaining and operating the Kenai Moose Research Center (MRC). Costs typically include purchase of animal feed to maintain the captive moose, utility costs associated with gas generated electricity and gas heating/lighting and cooking appliances. Costs not readily attributable to a single research job include maintenance and improvements of facilities, basic supplies, repairs, nonpermanent technician salaries, drugs, and equipment.

ACCOMPLISHMENTS: We maintained 13 adult moose (3 males and 10 females) throughout the last year. The males were fed 13% Reindeer Ration (20 -30 kg/animal/week) November through late-April to supplement their intake of native vegetation. The females were fed 13% Reindeer Ration (20 -30 kg/animal/week) January through late-April to supplement their intake of native vegetation. As previously

reported, 5 cows gave birth to 8 calves during May 2019 and we removed 3 female calves from their mothers for hand raising; the remaining 5 calves remained with their mothers. In addition, 4 orphan female calves were brought to the MRC (2 from the Anchorage Bowl and 2 from the Kenai Peninsula) to supplement our hand raised cohort. Two orphan moose calves died during the summer (June, July) of sepsis likely resulting from the failure of passive immunity transfer from the adult female via colostrum. The remaining 5 calves (3 MRC born, 2 orphans) were successfully hand raised and weaned from milk replacer on October 1, 2019. At weaning, we immobilized all 5 hand raised calves to collect blood samples and administer vaccines and supplements. We immobilized 1 bull (Rocky) in November to assess and clean wounds on his face and neck he suffered while fighting with a wild bull through the perimeter fence. All MRC animals (3 bulls, 10 adult cows, calves) were immobilized in December to provide annual vaccines and supplements. During January 2020, two of the hand raised calves became ill. The first calf (Vicky) was treated with antibiotics and transfaunation and made a full recovery. Subsequently, a second moose (Dolly) became ill and after 5 days of antibiotic treatment died on 16 January 2020. Initial necropsy results indicated peritonitis as cause of death. On 3 February 2020, a second hand raised calf (Wanda) was found dead in the pen, necropsy indicated peritonitis associated with a severe filarial nematode infection (the adult worms were subsequently identified as Setaria yehi). Histological samples from Dolly were then re-examined and intravascular microfilaria were detected in the lung and kidney tissue. The remaining 3 hand raised calves were subsequently treated with an anti-parasite medication (ivermectin) and blood samples were collected and tested for microfilaria. Blood test results of all 3 calves were positive for microfilaria. Further examination of the blood samples using a modified Knott's test determined the microfilaria were Setaria yehi. On 5 March 2020, a maternally raised calf (male) was found dead <24 hour after death. Adult Setaria yehi worms were documented in the peritoneal and pleural cavities of this calf and severely decreased femur marrow fat content of 6.9%. We immobilized the 3 hand raised calves on 23 April 2020 to collect blood for further microfilaria tests following ivermectin treatment and prior to emergence of biting insects. The ivermectin treatment appeared to be effective as all calves were negative for Setaria yehi.

OBJECTIVE 2: Costs and Consequences of Insect Harassment for Moose (*Alces alces*). We surmise moose habitat use, movement rates, and movement patterns differ between periods of high and low insect activity and the subsequent effects on activity budgets are reflected in moose body condition at the end of summer. As well, understanding the links among immunity, infection and fitness are poorly understood in moose. We will measure the costs and consequences of insect harassment on moose over the next two years. Our work will be conducted at the Kenai Moose Research Center in collaboration with Dr. Perry Barboza, Texas A&M University.

ACCOMPLISHMENTS: Bridgett Downs collected insects, climate data, and saliva samples from moose at the MRC during the summer of 2019, as part of her PhD dissertation titled "Effects of Biting Insects on North American Ungulates". Five bottle-fed calves were accustomed to collection of saliva and insects. She collected saliva from 5 calves on 3 days each week during July and August. Insects aggregating on the calves were collected with a collapsible insect net by swiping the net overhead and near the skin surface of the

calves. Insects were transferred to a kill jar with acetone. In addition, a variety of insect traps and climatological data loggers were deployed within each habitat type among 2 of the MRC enclosures (Pen 2 and Pen 3) and operated for 24 h periods weekly during June – August to determine the diversity, distribution, and abundance of insect fauna. All insects were identified and counted under a dissection microscope. A polymerase chain reaction (PCR) verified insect key with pictures was developed to aid in future insect identification.

OBJECTIVE 3: Quantifying moose behavior and energetics. Moose activity patterns are highly individual and environmentally dependent making it difficult to construct energy budgets and this limits our ability to accurately estimate requirements. Results from prior research using direct observation to determine activity is limited by small data sets and the use of simple biotelemetry devices has lacked sensitivity to identify specific activities. We will use triaxial animal-borne accelerometer (movement) and magnetometer (direction) biologgers in combination with heart-rate sensors to reconstruct full movement trajectories and determine the associated metabolic demands of specific behaviors. Our work will be conducted at the Kenai Moose Research Center in collaboration with Dr. Garrett Street, Mississippi State University.

ACCOMPLISHMENTS: The start of this project has been delayed a year due to restrictions associated with the COVID-19 pandemic. 12 each, Vertex Plus GPS collars with advanced 3-axis activity sensor (Vectronic Aerospace Inc., Coralville, IA) and 12 each, Daily Diary activity loggers (Wildbyte Technologies LTD, Swansea, Great Britain) were purchased. 9 each, Heart rate loggers (Star Oddi, Gardabaer, Iceland) will be provided by our collaborator Dr. Alina Evans, Inland University of Applied Sciences, Norway.

OBJECTIVE 4: Reproductive phenology in moose. An improved knowledge regarding the physiological and reproductive responses of moose to environmental conditions will allow us to better predict and mitigate responses to a changing climate. We will evaluate how summer and autumn climate affects timing of reproductive events in moose and determine whether gestation lengths are fixed or flexible in moose. Our work will be conducted at the Kenai Moose Research Center in collaboration with Dr. Alina Evans, Inland University of Applied Sciences, Norway.

ACCOMPLISHMENTS: The start of this project has been delayed a year due to restrictions associated with the COVID-19 pandemic. 9 each, UHF ID coded Vaginal Implant Transmitter (VIT) with temperature logger (Vectronic Aerospace Inc., Coralville, IA) were purchased.

OBJECTIVE 5: Vegetation management. This objective provides for the activities of MRC personnel in support of habitat management and fire protection actions. We will use vegetation management techniques to maintain at least 35% of each fenced enclosure at the MRC in deciduous woody vegetation less than 15 years old while maintaining enough mature forest to provide cover and diversity of summer and winter forages. In addition, we will take actions necessary to create and maintain a defensible space around the buildings, roads, and facilities at the MRC in order to minimize potential impact of wildfire. In the 2004 MOA between the KNWR and ADF&G, the KNWR agrees to

perform any and all prescribed burning and other habitat management actions mutually agreed upon within the MRC.

ACCOMPLISHMENTS: KNWR Fire Staff developed recommendations for hazardous fuels treatments and initiated work during the fall of 2018. Following the ignition of the 2019 Swan Lake Fire, which threatened the MRC, hotshot crews were assigned to the MRC during June and July. MRC staff assisted with the removal of materials operating equipment to consolidate the piles.

All standing, dead hazard trees with the potential to fall and impact any cabin or building or threaten the safety of the users of the trail system between the cabins and other buildings were removed.

Within 30 feet of structures, all conifer trees less than 6" DBH were removed and the remaining conifer trees were thinned to a spacing so the crowns are at least 20 feet apart (20' between drip lines). Branches on the remaining trees were pruned up 6 feet from the ground.

Between 30-100 feet of structures, conifer trees were thinned so that crowns are at least 15 feet apart (between drip lines). Branches on the remaining trees were pruned up 6 feet from the ground.

All of the material from the above treatments was removed and consolidated into 4 burn piles along the south side of the road in front of the cabins in an open field where they can be easily accessed by personnel and be moved by equipment. KNWR Fire Staff attempted to burn the piles during December 2019, but the material was not sufficiently dry and ignition could not be maintained. The current plan is to allow the material to dry for an additional season and burn the piles during the late fall of 2020.

OBJECTIVE 6: Preparation of study plans, reports, and publications.

ACCOMPLISHMENTS: Cook, R. C., **J. A. Crouse**, J. G. Cook, T. R. Stephenson. 2020. Evaluating indices of nutritional condition for caribou (Rangifer tarandus): which are the most valuable and why? Manuscript submitted for publication.

Thompson, D. P., et al. 2020. Hot days in the boreal forest: behavior influences thermoregulation in Alaskan moose during the summer. Manuscript submitted for publication.

Benedict, B. D., **D. P. Thompson**, **J. A. Crouse**, P. T. Shults, G. L. Hamer, P. S. Barboza. 2020. Moose tolerate insects: diurnal cortisol and environmental stressors. Manuscript in preparation.

McDonough, T. M., **J. A. Crouse**, **D. P. Thompson**, O. H. Badajos, B. W. Dale. 2020. An evaluation of short- and long-term health impacts of vaginal implant transmitter use in moose. Manuscript in preparation.

Cook, R. C., L. Shipley, S. Berry, and **J. A. Crouse** (and others). 2020. Evaluation of Video Collars for Use in Foraging Ecology Studies of Large Ungulates. Manuscript in preparation.

II. SUMMARY OF WORK COMPLETED ON PROJECT TO DATE.

Tracking pregnancy and calf production in hooves of moose – We immobilized 7 adult cows at the end of August 2019 to measure hoof growth and collect keratin samples. We collected 3-4 keratin samples from the front hoof of each animal and a hair sample from the top of the shoulder hump. Preliminary data analysis indicates moose hooves grew 4-5cm over a 1-year period, with most of the growth occurring between April and August. Once the laboratory analyses for hormone and isotope levels in keratin samples are completed a manuscript will be prepared for publication.

Selenium Study – In July 2019 we immobilized 4 adult cow moose to collect blood samples and to deploy a selenium bolus (~30g). Additionally, we attempted a liver biopsy. Site preparation for liver biopsy sampling took longer than expected with the dense new growth of hair that was difficult to trim and shave. The attending veterinarian, Dr. Mortenson, attempted to collect a liver biopsy from 1 cow; however, Dr. Mortenson was unable to obtain a liver sample after 2 biopsy attempts. Given the long preparation time and lack of adequate samples from the first moose, we did not attempt to collect a liver biopsy sample from the remaining 3 moose. In August of 2019, we immobilized the 5 maternally raised calves, collected blood samples, and deployed a selenium bolus in each. In October and December 2019, we immobilized all moose (n = 4 adults; n = 5 calves) that had received a selenium bolus to collect blood samples. Compared to hand raised calves, maternally raised calves that received a selenium bolus had lower whole blood and serum selenium levels in both October and December than hand raise calves that did not receive a selenium bolus. Whole blood and serum selenium levels were not different in December between adult cows with and without a selenium bolus. We euthanized one adult cow (Jackie) on 7 February 2020 to collect a liver sample and locate the selenium bolus within the rumen. We searched for the selenium bolus within the rumen, reticulum, omasum, and abomasum; however, we did not locate the rumen bolus. Similarly, we could not locate the rumen bolus from the maternally raised moose calf that died in March.

III. SIGNIFICANT DEVELOPMENT REPORTS AND/OR AMENDMENTS.

After determining the Setaria yehi infections in the MRC animals, we collected blood samples from 86 wild moose (56 adult females and 30 10-month-old calves) captured on the Kenai Peninsula, as part of other ongoing studies, to determine the prevalence of microfilaria. The infection rate was different between adults (28/56) and calves (28/30). Co-infections with both Seteria yehi and Rumenfilaria andersoni were generally low (adults 3/56 and calves 5/30). Rumenfilaria andersoni only infections were more common in adults (14/56) than in calves (1/30). Setaria species cause peritonitis outbreaks in wild ungulates and prevalence of infection is associated with unusually warm summer temperatures. Alaska experienced its hottest month on record in July 2019. Blood-sucking insects are thought to serve as vectors and transmission occurs in summer during periods of high insect densities. Still, filarioid nematode parasites, their vectors and diseases are relatively poorly studied in northern boreal systems. With the insect collections from work accomplished under Objective 2 (above) and archived blood samples from

both captive and wild caught moose we are planning to evaluate the temporal prevalence and distribution of microfilaria infection and examine the interactions among the intensity of infection, habitat use and body condition. This work will be completed in collaboration with Dr. Barboza and his PhD candidate Bridgett Downs. This project overspent allocation in line 3000, 'contractual services' by approximately $26.6K. These costs reflect 1. additional laboratory analyses required to diagnose the Setaria infection in MRC animals, and to assess the presence and prevalence of the parasite in wild herds; and 2. Additional laboratory analyses to ascertain nutritional content of archived browse samples from previous years' research. These data will be analyzed and ultimately written up for publication in peer reviewed journals in the future.

IV. PUBLICATIONS

Shively, R. D., **J. A. Crouse**, **D. P. Thompson**, and P. S. Barboza. 2019. Is summer food intake a limiting factor for boreal browsers? Diet, temperature, and reproduction as drivers of consumption in female moose. PloS ONE 14:e0223617.

Thompson, D. P., **J. A. Crouse**, T. J. McDonough, P. S. Barboza, and S. Jaques. 2020. Acute thermal and stress response in moose to chemical immobilization. Journal of Wildlife Management. Doi: 10.1002/jwmg.21871

Thompson, D. P., **J. A. Crouse**, S. Jaques, and P. S. Barboza. 2020. Redefining physiological responses of moose (Alces alces) to warm environmental conditions. Journal of Thermal Biology 90:102581. Doi: 10.1016/j.jtherbio.2020.102581

Thompson, D. P. Evaluating the physiological and behavioral responses of moose (Alces alces) to fluctuating environmental temperatures. PhD diss., (Texas A&M University, 2020).

Oral presentation (**D. P. Thompson**), "Acute thermal and stress response in moose to chemical immobilization" at The Wildlife Society's Annual Conference, Reno, NV; 2019.

Oral presentation (P. S. Barboza), "Tracking Winter Protein Stores for Productivity of Female Moose in Alaska" at The Wildlife Society's Annual Conference, Reno, NV; 2019.

Oral presentation (R. D. Shively), "Is summer food intake a limiting factor for female moose?" at The Wildlife Society's Annual Conference, Reno, NV; 2019.

Oral presentation (**D. P. Thompson**), "How do moose respond to temperature" at the Boone and Crockett Club's Annual Meeting, Tucson, AZ; 2019.

Oral presentation (**D. P. Thompson**), "Body Temperature Patterns Vary with Day, Season and Body Condition of Moose (*Alces alces*)" at the Alaska Chapter of The Wildlife Society's Annual Meeting, Anchorage, AK; 2020.

Moose Research: "Moose and their flying antagonists".
http://www.adfg.alaska.gov/index.cfm?adfg=wildlifenews.view_article&articles_id=922

V. RECOMMENDATIONS FOR THIS PROJECT

Project dates should be extended one more year considering the delays associated with the COVID-19 pandemic.

Prepared by: John Crouse and Dan Thompson

Date: August 27, 2020