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-23 FY18

PROJECT NUMBER: 4.40

PROJECT TITLE: Investigation of grizzly bear use of the North Slope oil field region

PERIOD OF PERFORMANCE: July 1, 2017 -June 30, 2018
REPORT DUE DATE:

PRINCIPAL INVESTIGATOR: Richard Shideler

COOPERATORS: Kerry Nicholson

I. PROGRESS ON PROJECT OBJECTIVES DURING PERIOD OF PERFORMANCE

OBJECTIVE 1: Develop a probabilistic den habitat map to predict locations of dens.

Job 1a. Locate active dens in the fall, and collect their habitat attributes in the summer.

Accomplishments: We conducted site inspections at 2 dens (one of a marked bear and the other of an unmarked bear) in August 2017 (FY18) that we could not access the previous summer due to persistent snow drifts. Due to limited helicopter time in August we were only able to inspect the 2 dens we walked to in June and 2 additional high priority dens that were in the vicinity of human activities. One of those was in the bank of a spoil pile that had been removed from a large material site. The unmarked bear's den was in the bank of a drained lake, along with evidence of previous dens there as well. Of the 4 dens we inspected, of particular interest was the den of an adult female in the sand dunes along the Colville River that was by far the largest of >300 dens inspected to date. The tunnel length was 5.8m and the nest chamber was 1.2m x 1.6m. Equally impressive was that the den was essentially intact. Most dens have partially or totally collapsed by August due to thermal or hydraulic erosion. Because we were using the short helicopter availability primarily for captures we deferred other den inspections until August 2018.

In October 2017, the GPS locations from 2 of the newly collared bears suggested that they denned within the oilfields and might be visible from the road system. We visually confirmed one den from the Milne Point Road, and could hear the VHF signal from the other bear emanating from an island in the Sagavanirktok River. These were the only marked bears that denned near oilfield infrastructure. We inferred den locations from the

GPS coordinates of an additional 16 bears and transmitted these to industry so that they would avoid them during winter activities. These dens will be inspected after the snow drifts have melted and when a helicopter becomes available in August 2018 (FY 19). Results will be reported in FY19

Job 1b. Using habitat attributes collected from previously inspected dens, develop a predictive den habitat model to be applied to the study area.

Accomplishments: We continued to analyze data from the Repsol/Armstrong lidar and Nolan SfM Digital Elevation Models (DEM's; see Section II) for the test section. However, further input into the model has been delayed until we can create a DEM at a realistic scale to be used to test the model, and to compare attributes used for site selection by bears with attributes available in the study area. This will answer the question about den site *selection* (i.e., use vs. availability).

Job 1c. Select a sub-section of the study area for a "proof-of-concept" test, and couple the predictive model from Job 1b with a Digital Terrain Model (DTM) over the "proof-of-concept" test area, to evaluate the model's ability to identify known dens based on terrain characteristics such as slope and aspect.

Accomplishments: We expected to use the Department digital photogrammetric system to survey the test section (see Job 1b) to compare with the lidar and Nolan DEM's. The window for the survey was during the first 3 weeks of August, after persistent snow drifts had melted so that true ground surface image could be acquired, and before snowfall could disrupt the imagery. The survey required ferrying the 400 miles from the Fairbanks base, then at least 2 consecutive days of clear weather for the survey, then another day to return to Fairbanks. Unfortunately, the weather in August 2017 (FY18) was particularly poor for flying, and the flight was scrubbed and re-scheduled for August 2018 (FY19).

Late in FY17, the University of Minnesota 's Polar Geospatial Center released to the public a new DEM for the Arctic called ArcticDEM. It was acquired at 0.5m and resulted in 2-m resolution imagery. Although coarser than either the lidar of SfM imagery, since it was in the public domain it would be available for subsequent den modeling and mapping. As we already had a contract with Dr. Glen Liston (InterWorks Consulting, LLC) to model snow accumulation in the test area using the DEM's generated by lidar and SfM (see Job 1d), we asked Dr. Liston to compare ArcticDEM with the two other two.

Job 1d. Investigate the role of snow in den site selection. Compare the distribution of a subset of known dens with the distribution of snow drifts derived from a snow drift model (SnowDens-3D) originally developed to model polar bear den habitat.

We have long suspected that bears used areas where insulation was provided by drifting snow accumulation. However, there has been no feasible method to measure the accumulation and to compare the den location with annual snow drifting. We contracted with Dr. Liston to run his blowing snow accumulation model, SnowDens 3D, over the test area using the 3 DEM's mentioned in Job 1c. His conclusion were that: (a) all 9 dens were in areas with sizable snow drifts (often, but not always, in the deepest drift in the

immediate area); (b) the most realistic drifts were created on the lidar DEM, followed by the Nolan DEM, and a distant third with the ArcticDEM; (c) the Nolan DEM did not produce as sharp gradients and likely under-estimated the drift depth; and (d) the ArcticDEM would not be useful in either modeling the den site or in predicting where the drifts would accumulate.

OBJECTIVE 2: Investigate movements and home ranges of grizzly bears in the region in response to oil and gas facilities and activities and to natural or human-caused removals of food-conditioned bears from the oilfields.

Job 2a: Analyze movements (e.g., rates and sinuosity of travel) of bears when they enter the oilfields, especially in response to facilities, active work sites, and attractants.

Accomplishments: Although we have over 20 years of VHF location data on a few bears, we have much less on most of the 149 bears captured in the study prior to FY18. Locations for these bears were based on <7 radio-telemetry flights a year, often fewer, and movements in and out of the oilfields could easily have been missed. Our total sample size as of the end of FY17 was 13 VHF-collared bears. With the rejuvenation of the project and subsequent increase in funding in FY18 we switched to Iridium-based GPS collars to better meet project objectives, especially a more thorough understanding of grizzly bear movements in and near the oilfields. These collars are programmable from the investigator's computer, and acquire locations every 35 minutes during the active season, downloading the locations every 2 days onto a map in ArcGIS using a programming tool developed in-house. To save battery life the collars were programmed to reduce attempted fixes during denning to only 1/month then return to the normal schedule upon den emergence. To insure that we can find the collar in real time, each also has a VHF beacon. Each collar includes an automatic drop-off feature that is scheduled to separate the collar in August 2019, several weeks before anticipated battery end of life.

In FY18 we captured 34 bears and deployed GPS collars on 33 of them. One bear shed his collar and was recaptured. In August 2017 we replaced VHF collars with GPS collars on 14 bears and captured 6 bears new to the study (Table 1). Recapture of bear 073 was especially interesting. She was 39 years old and had a fat yearling with her. As far as we know, she is the oldest grizzly bear in the wild to have cubs, and one of the oldest wild bears known. In October, 2 food-conditioned adult females, each with 2 COY, were killed in defense of property in Deadhorse. An adult female was killed, possibly by another bear, in or just outside of her den in April. There was a large snowbank at the den so we had to defer further inspection until August 2018. In addition to the adult female a 30 year-old male died of unknown causes in early May after emerging from his den and traveling considerable distance. Of the remainder, all survived hibernation and the collars began transmitting on schedule.

In June 2018 we collared 14 bears including 3 adult males that had previously shed their collars. Two of these still had readable tattoos. One of those had been collared as a 5 year old in 2005 but shed his collar within a year. We also re-collared an adult male that had been collared in August 2017 but rubbed his GPS collar off on a steel post just a

week before we began June 2018 captures. As of the end of FY18 we had 29 bears, 17 females and 12 males, with functioning GPS collars.

Distribution of the captures was from the Kavik River in the east to near Teshekpuk Lake in the west, with a higher emphasis on the western portion of the study area where oil and gas development is expanding. The late spring complicated captures somewhat in that the large amount of surface water created a potential hazard for immobilized bears. Therefore, some bears had to be bypassed until they were in more favorable conditions. However, the latency between dart injection and immobilization was quicker than normal so that bears in favorable locations often remained there.

Because we had only 3 months of movement and distribution data by the end of FY18, we deferred actual analysis until we have at least one full year for comparison.

Job 2b: Compare movements of bears that eat only natural foods to bears that are conditioned to human food.

Accomplishments: Although food-conditioned bears have been a consistent problem over the course of the study (and indeed were the reason the study began in the early 1990s), there were only 3 radio-collared and food-conditioned bears alive at the beginning of FY18. One of these was subsequently removed before she could be re-collared with a GPS collar. The 2 others were re-collared with GPS collars in August but were killed in defense of life and property situations in October. Three subadult food-conditioned bears were captured and fitted with GPS collars in late August. Two of these spent considerable time around the landfill and Deadhorse in September and October. The third bear spent time around the landfill in September then moved to the area around the Alpine oilfield where she remained for the rest of FY18. As there are data for only 3 months for the August 2017 captures and less than a week for the June 2018 captures we will defer analysis until at least a full seasonal year is available.

Job 2c: Identify movement corridors into and within the oilfields.

Accomplishments: Similar to 2a and2b, we are still in the initial data-gathering phase; therefore, analysis is deferred until FY19.

Job 2d. (New) Compare movement corridors and rest areas obtained by telemetry to "hotspots" identified by the University of Alaska-Fairbanks analysis of Security reports.

Accomplishments: Completion of the UAF M.S. thesis has been delayed. When the locations become finalized and we have a full season's data we will compare the hotspots identified in the thesis with our movement data. This job has been deferred until FY19.

Job 2e. Compare the movements and home ranges of genetically related individuals within the oilfield.

Accomplishments: We had obtained individual identities on ca. 149 individuals as of the beginning of FY18. In FY18 we obtained tissue samples from 15 bears new to the study, and 5 hair samples from power pole and tripod hair snares. We added 4 power pole snares and 1 new tripod snare to the snare network for a total of 14 sites. Due to deep snow drifts and high water we could only access 5 of 14 sites in June 2018. We received

our CITES export permit so that we can send samples to our wildlife genetics lab in Canada, and are awaiting customs inspection of the samples. Analysis is pending.

OBJECTIVE 3: Prepare annual and final progress reports and a final Division technical report. Give presentations at scientific conferences and public forums. Publish results in peer-reviewed journals.

Accomplishments: See Section IV.

II. SUMMARY OF WORK COMPLETED ON PROJECT TO DATE.

Due to the decline in funding over the past several FY, the FY17 workplan was oriented toward ending all field work on the project. This would have included removing all radio collars, hair snares, and cessation of ground inspections of den sites. However, late in FY17 funding became available and jobs originally scheduled to end in FY17 were re-scheduled for FY18. This transition back to full funding was not completed until early FY18, and lack of helicopter availability resulted in many of those jobs being deferred until later in the field season, or until summer 2018. Therefore, there has been little progress to report other than that in previous FY Federal aid reports.

III. SIGNIFICANT DEVELOPMENT REPORTS AND/OR AMENDMENTS.

- Weather conditions on the North Slope continue to hamper operations. A 2-week delay in breakup in June 2018 created a potential hazard for capture operations. In spite of the marginal conditions, uncertainties associated with continued funding at the start of the new FY (July 1) forced us to conduct capture operations. Fortunately, the capture drug performed well and there was a short latency between drug induction and the bear's immobilization. This allowed us to confine the bears to suitable habitat (e.g., dry) so that they did not drown.

- Much of the current exploration and new construction is occurring in the northeastern portion of NPR-A, and much of the geographic focus of the study is >80 miles from Deadhorse. Deadhorse is the only helicopter refueling location, and the long ferry times greatly reduced our ability to operate there. However, we were able to obtain approval form ConocoPhillips-Alaska to establish a portable fuel site on one of their unused pads. All industry and agency requirements for fuel handling and temporary storage were met, and we were able to refuel. This has allowed us to spend more time operating in NPR-A and the southwestern Kuparuk oilfield.

IV. PUBLICATIONS

- A short report to industry titled "Oilfield grizzly project update, field season 2017." (attached);
- Kerry Nicholson and I gave a presentation to oil industry representatives at their annual winter projects meeting in Anchorage.

V. RECOMMENDATIONS FOR THIS PROJECT

- The most efficient programming for the GPS collars assumed that they would be deployed in early FY2018, run for 2 entire summers and are to drop off in August 2019 so they can be retrieved before snowfall. However, due to the delay in captures until June 2018, GPS collar data will be for only one year. Spring 2018 was unusually late, an anomalous year, and will likely not be typical of summer movements. Therefore, we recommend that the project continue for at least one additional year.

- We have gathered sufficient demographic data on this project to estimate lambda and other demographic parameters. This objective should be added to the FY19 workplan.

Prepared by: Richard Shideler

Date: 8/22/2018

Attachment 1

OILFIELD GRIZZLY BEAR PROJECT UPDATE
FIELD SEASON 2017

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INTRODUCTION

The North Slope oilfield grizzly project began in 1991 in response to the perception by oilfield and agency personnel that grizzly bears were increasing in the Prudhoe Bay and Kuparuk oilfields. Because previous grizzly bear studies on the North Slope had focused on the Brooks Range and Foothills, little was known about the ecology of bears in the oilfield region Coastal Plain, and especially in the oilfield region. Initial objectives of the study were:

- Document the number and locations of grizzly bears in the oilfield region;
- Determine the type and extent of interactions between bears and oilfield activities and personnel;
- Inspect recent den sites and identify characteristics of each site;
- Locate active dens of radio-marked bears prior to each winter's off-road exploration or transportation activities and provide locations to agencies and companies to support compliance with stipulations requiring those activities to avoid dens.

Initially, our limited capture activities focused on bears using the Greater Prudhoe Bay and Endicott units and adjacent Deadhorse where bears that were conditioned to obtain anthropogenic foods ("food-conditioned" bears) were most common. However, we soon learned that the home ranges of other bears overlapped the oilfields but these bears never approached human activity or became attracted to garbage and other anthropogenic food available there (i.e., "natural food" bears). The comparison between food-conditioned and natural food bears using the oilfields became an important objective. Other bears resided on the outskirts of the oilfield development but never entered it (i.e., "non-oilfield" bears). Therefore, we began to capture bears adjacent to the oilfield to evaluate the characteristics of the surrounding metapopulation and to compare with bears using the oilfields (both food-conditioned and natural food). Over the course of the project we have maintained a core group of radio-marked female bears in areas within and surrounding the oilfields to evaluate their movements, demography, and habitat use over multiple reproductive cycles. This core group of bears has provided long-term data that, together with additional bears we capture in the study area each year, allowed us to assess the long-term effects of oil development on the surrounding bear population and provided insights into bear ecology in this remote area. It is also has become the only long-term study of grizzly bears in an industrial setting in the world.

As new satellite developments were constructed (e.g., Badami, Pt. Thomson, Alpine, Meltwater) or proposed (e.g., Greater Moose's Tooth--GMT) we responded to requests for more information about grizzly bear use in those areas by expanding the study area (Figure 1) and increasing the number of bears fitted with VHF collars. For example, in 1998-99 we began collaring bears in northeastern NPRA in response to forthcoming development of the Alpine oilfield. Similar expansions occurred in response to the Meltwater development. Collar loss, bear mortality, and

elimination of bears whose home ranges were predominately outside the study area reduced the sample of marked bears to an annual average of 20-40.

Early articles and reports about the ecology of grizzly bears along the Beaufort Sea coast suggested that there was no suitable denning habitat there, and that bears moved to the foothills or mountains to den. We soon learned that in spite of the preponderance of wetlands, lack of trees, relatively flat terrain, and severe winter conditions all of the marked bears denned on the Coastal Plain. Therefore, we began to collect data about characteristics of their dens (e.g., slope, aspect, terrain type, substrate, vegetation, den dimensions). By 2016 we had data on >300 dens. We also recognized that a probabilistic model of grizzly bear den site selection that could be applied to digital terrain and vegetation maps would be useful to industry and agencies in order to predict the locations of dens so that winter off-road activities could avoid them. In support of such a model we compared den attributes with those derived from then existing remote sensing products. Unfortunately we soon learned that bears selected den sites on a much finer scale than portrayed on then existing digital elevation maps (DEM's). Therefore, there was poor correlation between what we observed on the ground and the terrain portrayed on these coarser DEM's. The exception was based on Lidar, but there was only small coverage in the study area. We initiated a pilot study over a 400 km^2 portion of the study area where we had 9 known dens. We obtained a Lidar-based DEM of this area from Armstrong Oil & Gas, Inc. We also contracted with Dr. Matt Nolan of the University of Alaska-Fairbanks who acquired high-resolution digital aerial photography using a technique called Structure from Motion (SfM)) to prepare a DEM over the same area. Evaluation of these techniques to create the base map for the model is ongoing.

The feeding ecology of bears along the coast was also generally unknown. We collected and analyzed scats, and from ground and air directly observed bear feeding. Bears fed on a variety of animals and plants that were seasonally available. Ground squirrels were an important component at all seasons but especially in fall, partially offsetting the scarcity of berry resources in the study area. Vegetation was critical at all times of year as well. Occasional microtine irruptions and early season availability of waterfowl eggs and hatchlings rounded out their diet. These observations gave us an indication of the food items in their diet, but did not provide much insight into annual diets, especially the contribution of anthropogenic food sources. Recent advances in chemical feeding ecology using analysis of stable isotopes of carbon and nitrogen allowed us to compare the isotope composition in the annual diets of food-conditioned bears with natural food bears. We analyzed isotopes N^{15} and C^{13} from hair and blood to detect food-conditioned bears (Bentzen et al. 2014). We also identified individuals that were likely to be highly predatory due to the high concentration of assimilated N^{15} in their tissues. Unfortunately, isotope analysis using these 2 isotopes cannot differentiate among caribou, muskox, or ground squirrels in the diet. We update this data annually from tissue and hair collected during captures.

In the 1990s we noticed that many of the food-conditioned bears in the Greater Prudhoe Bay-Deadhorse area appeared to be related. Advances in DNA "fingerprinting" allowed us to detect individuals and their relatives. By 2016 we had analyzed 149 bears in the study and obtained individual identification on 140 of them. We identified several "clans" of related females with their offspring that inhabited overlapping home ranges in the study area. Of special interest is that all but 4 of the 27 food-conditioned bears identified in the study area belong to one maternal

clan that inhabited the region between the Sagavanirktok and Kuparuk rivers, including the Greater Prudhoe Bay and Duck Island units. The 4 exceptions were an adult female and her two offspring from an adjacent clan, and a new subadult male in 2016 whose identity was confirmed from hair he left on the landfill fence. The case of the subadult male was especially interesting. We had collared his mother (a "natural food" bear) on the Colville River in 2003. He was apparently dispersing from his maternal home range. To our knowledge he is the first bear to become food-conditioned that was not a member of the two maternal clans mentioned above. Although most of our genetic samples have come from captured bears, we had observed bears rubbing on power poles and other vertical structures in the oilfields. In 2010 we set up several hair snares—power poles with a couple of wraps of barbed wire attached to them-- on selected poles in order to collect hair from bears that rubbed on them. Our intent was to identify bears that use the oilfield but had not been captured. As of 2016 we collected 22 samples from power poles but DNA could be extracted from only 18. None of these yielded enough microsatellites to confirm individual identification. The geneticist analyzing our specimens suggested that UV radiation associated with the long day length and, in some cases, creosote contamination from the pole, had denatured the DNA.

We have also been able to track movements of several genetically identified individual males that have dispersed from the core study area into NPRA, as well as bears from NPRA that have dispersed to the east. We have confirmed post-weaning fate of >40 cubs from genetic identification, and, together with direct observations, identified >140 mating pairs over the past 25 years. Most of these genetic samples were derived from bears sampled at capture.

FIELD SEASON 2017 UPDATE

GPS Collars**.** Until 2017 we had fitted bears with VHF radiocollars. To relocate them we had to fly periodic aerial tracking surveys. This meant that weather had to be suitable for flying in all 3 major weather systems between Fairbanks and the North Slope. Weather and daylight limited our ability to relocate all bears, especially during the fall den flights. In order to address these problems we replaced VHF collars with GPS collars that transmit to the Iridium satellite network every 35 minutes. Locations can be downloaded to our computers every 48 hours. We also are testing a "geofence" system that instructs the collar to increase the frequency of locations to every 15 minutes when the bear enters the polygon we digitally constructed around the oilfield. These locations are downloaded at an accelerated schedule. Our goal was to have 30 bears fitted with the GPS collars. We replaced VHF collars on 12 bears, recaptured 2 bears that had shed their collars (050 and 073), and caught 6 bears new to the study. Recapture of bear 073 was especially interesting. She was 39 years old and had a fat yearling with her. As far as we know, she is the oldest grizzly bear in the wild to have cubs, and one of the oldest wild bears known. By denning season, we had received almost 49,000 locations from 20 bears. Figure 2 shows a sample track of bear 151, between capture in August (blue dot) and den entrance in October (green dot). We are using these results along with the ~5000 locations obtained previously from VHF collars to develop a model of movements into and out of the oilfields, areas of seasonal habitat use, and potential responses to oilfield activity. Analysis is ongoing.

Denning and Den Habitat. We inspected 4 dens within the oilfield from den year 2016-2017. Two of these were within 500m of permanent facilities: one near Drillsite 9 and the other near the Spine Road southeast of the Milne Pt. Road intersection. A den in the dunes along the Colville River near Alpine had the longest entrance tunnel (6m) of any den we have ever

inspected, and one of the few still intact by August. In fall 2017 we acquired den locations from the GPS collars on 18 bears, and provided those putative den locations to industry for planning off-road winter activities. We will confirm those locations during ground inspections in field season 2018.

While we believe that snow drift accumulation drives den site selection, we have not had the tools to evaluate that hypothesis until recently. We are collaborating with Dr. Glen Liston of the Cooperative Institute for Research of the Atmosphere at Colorado State University to develop a snowdrift model for grizzly dens. Dr. Liston has developed a blowing snow model that predicts (and can hindcast) locations of snowdrifts by integrating local meteorological station data with a DEM. A similar model was used to successfully identify polar bear denning habitat (Liston et al. 2016). We are testing the grizzly model over the same pilot study area where we have 9 den locations from previous years and high-resolution DEM's from the Lidar and SfM sources. Results from this modeling will be available in June 2018.

Genetic Analysis: In 2017 we re-used 7 power pole snares from previous years, and added 5 new ones. One of the disadvantages of using power poles has been that they are not often located optimally for bear visitation. Therefore, in 2017 we tested 2 designs for portable tripods that could be staged at promising bear use areas. We set these up along the Kuparuk River and Endicott Road but only the Kuparuk River site collected hair. We collected genetic specimens from the 6 newly captured bears, from 2 bears harvested along the Dalton Highway near the study area, from a bear we biopsy-darted on the lower Colville River, from hair left on the landfill gate, and 6 hair samples from our oilfield hair snares.
We obtained our federal CITES permit to allow us to export the samples to the lab in Canada. Analysis is ongoing, and we hope to have results in early summer 2018.

Feeding Ecology. We continued to collect scats and hair and blood from all captured bears for stable isotope analysis to refine our understanding of feeding ecology of bears in the region. These are being analyzed for stable isotopes at the University of Alaska Stable Isotope Facility. Results from that analysis will be forthcoming.

Bear Conflict Management: Three food-conditioned females, bear 006 and 2 daughters (bear 147 and bear 149), were lethally removed in conflict situations associated with improper garbage storage in Deadhorse. Bear 006 was first captured in 1992, and spent much of her life in the oilfields and Deadhorse. She spent all summer 2017 feeding on natural foods south of the oilfield until returning to Deadhorse in October where she started breaking into buildings. Bear 147 had been in the oilfield and Deadhorse since 2007, and had 2 cubs with her. Both cubs were placed in zoos. Bear 149 was only 4 years old, also spending most of her life in the eastern oilfields and Deadhorse. She had 2 cubs also, her first litter. We could not place her cubs in suitable zoos so both were euthanized as well. These were the first lethal removal of bears in conflict situations in the oilfields and Deadhorse since 2002. Although there has been considerable progress in removing anthropogenic food sources since 2002, the death of these bears indicates that there is considerably more work necessary, especially in Deadhorse.

FIELD SEASON 2018 SCOPE OF WORK

Captures: In 2017 poor flying weather and tight helicopter schedules prevented us from deploying all 30 GPS collars. We will continue capture efforts in 2018 until the remaining collars are deployed. To the extent feasible we will apprise oilfield security officials about bears in their area.

Movements and Distribution within the Oilfields: We will continue to collate GPS collar data in order to understand bear movements and use of the oilfields. We will evaluate our ability to correlate the GPS locations with observations that oilfield security officers make from the ground, including their observations of the bear's behavior and potential interactions with other bears (collared and non-collared) in the oilfield region.

Den Habitat: Because this is our first experience identifying den locations with the GPS collars, we will inspect all 18 dens from winter 2017-2018 to test the correlation between the GPS collar location and the location on the ground. We will also compare the true den location with the snowdrift distribution identified by the SnowDens 3D model. Due to past funding shortages we have a backlog of dens which we have not inspected on the ground. We will increase our den inspection surveys, especially in frontier areas such as Greater Moose's Tooth. We will continue development of the den habitat model by collecting data on den site attributes from recent dens of marked bears.
ADFG has acquired a sophisticated digital camera system for its survey aircraft that can be used for SfM surveys from which DEM's can be constructed. In order to test the feasibility of using this system to generate DEM's for den mapping, we will conduct a SfM survey over the same 400 km^2 area where we have 9 dens, and compare with results from both the Lidar and the Nolan SfM DEM's.

Cub Survival: Although the GPS collars provide locations, they do not provide information about cub survival. Therefore, we will fly at least 2 radio-tracking surveys over the course of the summer to document cub survival or loss. These data will help inform our understanding of the demographics of both natural food and food-conditioned bears in the oilfield region.

Genetic Analysis: We will collect genetic samples from newly captured bears, hair from the power pole and tripod hair snares, and tissue from bears harvested in the study area. We will deploy 2 new tripods in the study area. These data will be used to define relationships between bears in the oilfield region, contribute to our ongoing pedigree analysis and understanding of the social order of bears in the region, and confirm post-weaning fate of cubs produced by marked females.

Feeding Ecology: We will continue to collect and analyze scats and hair and blood specimens from captured bears in order to measure stable isotope concentrations.

REFERENCES

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Liston, G.E., C. J. Perham, R. T. Shideler, and A. N. Cheuvront. 2016. Modeling snow habitat for polar bear dens. Ecological Modeling 320: 114-134.

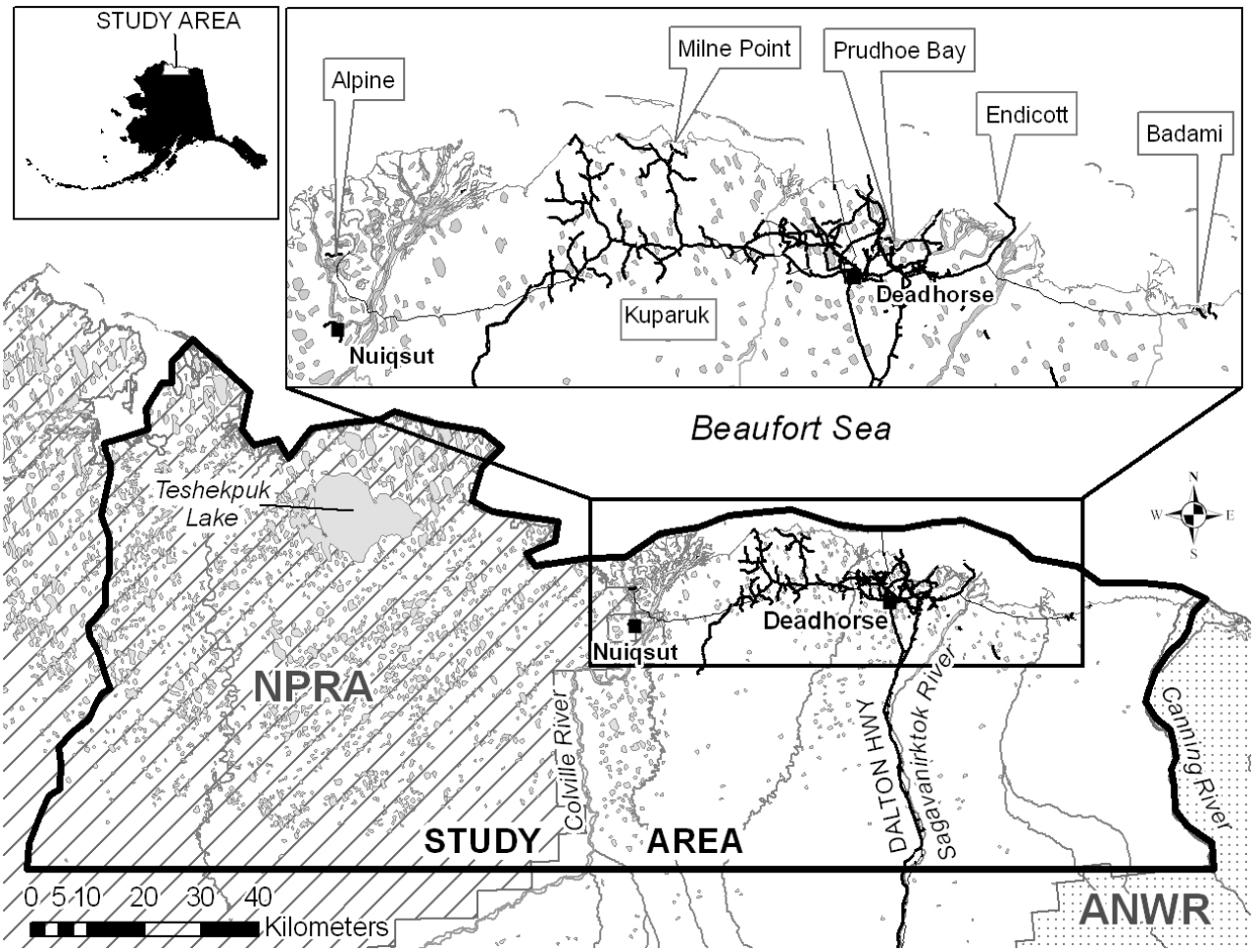

Figure 1. Grizzly bear project study area.

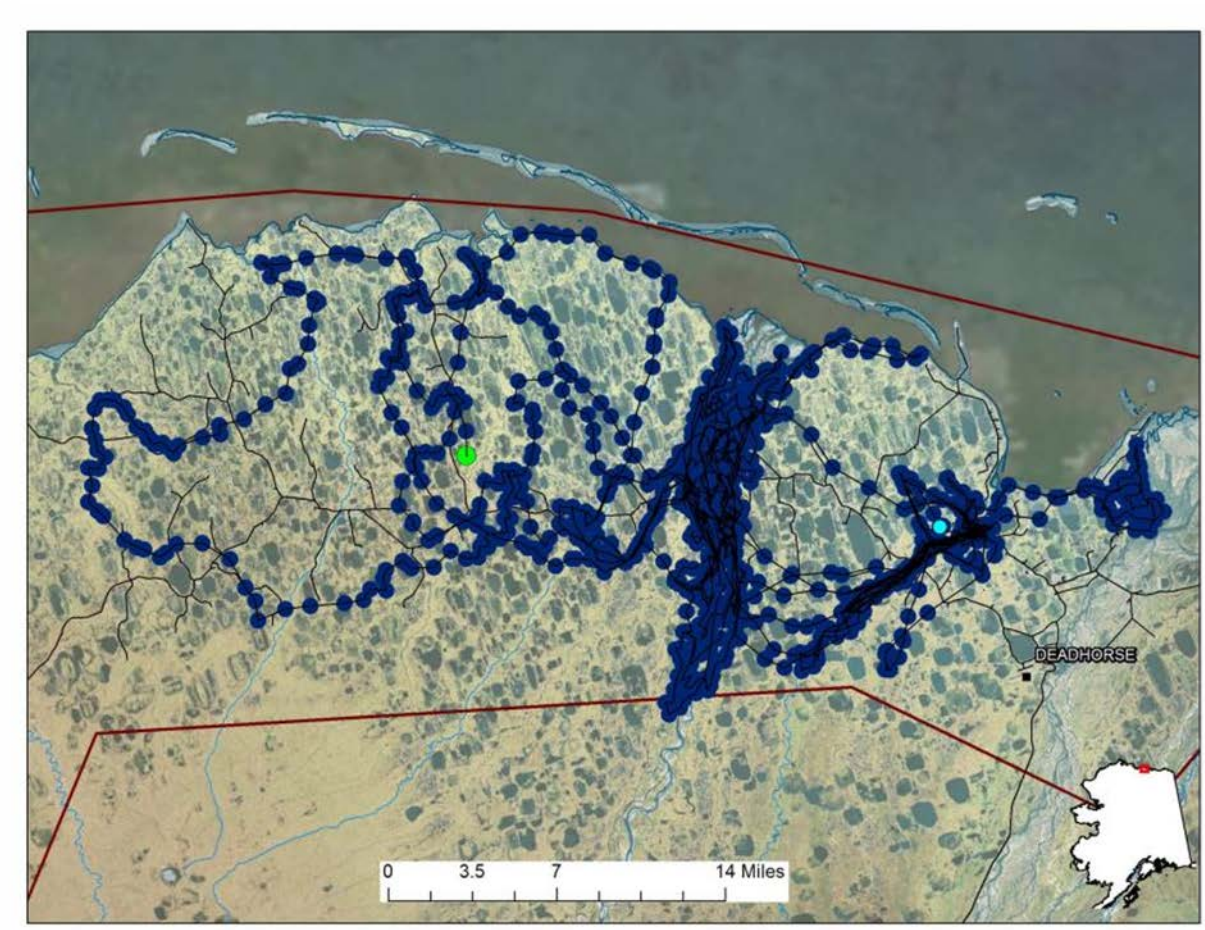

Figure 2. Example of bear 151 movements between capture (blue dot) August 11, 2017, and denning (green dot). Red line is geofence polygon.