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

Alaska Department of Fish and Game
Endangered Species Grant

GRANT NUMBER: AKW-ESA E-23-1

PROJECT NUMBER: 1

PROJECT TITLE: Genetic Mark-Recapture of Chukchi Sea Polar Bears

PERIOD OF PERFORMANCE: 1 October 2016 – 30 September 2019

REPORT DUE DATE: December 29, 2019

PRINCIPAL INVESTIGATOR: Lori Quakenbush, WB IV, ADF&G

COOPERATORS: North Slope Borough, University of Washington, U.S. Fish and Wildlife Service, U.S. Geological Survey

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This is the final report for a multi-year project. This template is applicable to both:

- the final closeout report of a multi-year grant; or
- the final closeout report of a multi-year *project* within the annual operating grant, summarizing all accomplishments for all objectives.

Authorities: 2 CFR 200.328
2 CFR 200.301
50 CFR 80.90

I. SUMMARY OF WORK COMPLETED ON PROJECT

The first objective of this project was to work with hunters to deploy hair sampling stations to collect DNA samples from polar bears using non-invasive methods. The Alaska Eskimo Whaling Commission clearly articulated in a 2019 resolution that polar bear research should involve hunters and use less invasive methods than capturing and chemically immobilizing bears to attach satellite-linked collars (Appendix A). This project accomplished the first objective by working with more than 20 Alaska Native hunters to collect 45 hair samples. The number of samples collected was lower than expected due to two very low ice years in the Bering and Chukchi seas during the winters of 2017/18 and 2018/19, limiting bear movements. Due to the ice conditions, we shifted some of our efforts to Wrangel Island, Russia, in 2017 and 2018 to collect more samples from Chukchi Sea polar bears. A total of 94 samples were collected from polar bears on Wrangel Island from hair collection boxes, daybeds, and feces.

Our second objective was to try to collect hair from stations deployed on the pack ice. This objective was not met. Although in spring of 2017 two stations were deployed by helicopter

on sea ice in the Chukchi Sea, poor sea ice conditions and rapid sea ice breakup prevented access via helicopter to retrieve them. As such, they drifted into Russian waters and were lost. Due to record low sea ice in the Chukchi Sea in 2018 and 2019, no additional opportunities were available.

Our third objective was to evaluate the quantity and quality of samples collected. The quantity of hair samples was lower than expected, as stated above, due to lack of ice in the Chukchi and Bering seas, but also bears on Wrangel Island were in good body condition in 2018 and less interested in the hair collection boxes than in 2017. Even so, during the three years of this project 139 samples of DNA belonging to polar bears from the Chukchi Sea subpopulation were collected. Annual collections could contribute substantially to a genetic mark-recapture analysis of the population. We did not analyze any samples during this study because all partners wanted to maximize comparability and cost effectiveness by analyzing the samples together, at the same lab, using the same methods. No lab was identified, and funding was insufficient for analysis, so samples were archived for later analysis. There is evidence from preliminary analysis of samples collected using barbed wire near Point Barrow that there is enough DNA in hair follicles collected by barbed wire and brushes that when analyzed using microsatellite DNA methods different individual bears are identifiable.

In summary, the boxes with wire brushes deployed by hunters, North Slope Borough (NSB) personnel in Alaska, and the crew on Wrangel Island in Russia were effective at collecting hair and could be used on a broad spatial scale to collect DNA samples annually. Polar bears are long-lived and thus sample size can accumulate across years. Given the need for high quality abundance estimates of two adjacent subpopulations of polar bears (Chukchi Sea and Southern Beaufort Sea) and the importance of understanding the dynamics of the area of overlap, this project should be expanded to include both subpopulations. Even if there is disagreement regarding the type of genetic analysis that should be done (e.g., microsatellite DNA or single nucleotide polymorphisms), or the laboratory that should conduct the analysis, the samples should be collected annually. Once collected they can be analyzed or archived, however, if they are not collected now and into the future, collection opportunities will be missed permanently.

This project was conducted with many partners including our agency partners (U.S. Fish and Wildlife Service (USFWS), NSB, University of Washington (U of W), and U.S. Geological Survey), the hunters who deployed and managed the stations (from Point Lay, Point Hope, Diomede, Wales, Shishmaref, Gambell, and Savoonga), and providers of funding (USFWS) and match (NSB and World Wildlife Fund).

Objective 1: Work with local hunters to deploy polar bear hair sampling stations for polar bears during the winters of 2016/17, 2017/18, and 2018/19.

Accomplishments: During the winter of 2016/17, a total of 19 hair collection stations were deployed at 28 locations along the Alaskan coast on shore-fast ice and land. A total of 22 hair samples were collected: 15 in Utqiaġvik, 3 in Point Hope, 2 in Diomede, 1 in Shishmaref, and 1 in Gambell.

During the winter of 2017/18, a total of 21 hair collection stations were deployed at 35 locations. A total of 20 hair samples were collected: 16 in Utqiaġvik, 2 in Point Hope, 1 in Diomede, and 1 in Shishmaref.

During the winter of 2018/19, the communities were very interested in deploying and managing stations again, however, because of the lack of sea ice and few bears observed in the two previous years, we asked samplers to wait until polar bears or their tracks were observed before setting up stations to maximize opportunity while conserving funding. A total of two hair collection stations were deployed at three locations and three hair samples were collected in Gambell. No hair collection stations were deployed at Utqiaġvik. The hair collection stations were checked every 3–7 days for a total of 535 station checks for 2,595 trap-days (a trap-day is defined as leaving an active station in an undisturbed location for 24 hours).

Except for Utqiaġvik, sea ice extents and concentrations were low, and few polar bears or bear tracks were seen near most villages. Savoonga participated but did not collect any hair samples. In addition to North Slope Borough (NSB) staff, a total of 20 local hunters deployed and checked stations during the first two field seasons. The field season was January–April or May in most locations; however Utqiaġvik had good sea ice conditions that lasted into the summer (mid-August) in some years.

The main component of Objective 1, to work with local hunters to collect polar bear hair, was met. Communities were receptive to these methods because they addressed concerns about invasive sampling methods. Hunters were very willing to participate and diligent in their efforts to check and maintain the stations, including rebuilding stations when they were lost during storms. The number of hair samples collected by the stations, however, was lower than expected because substantially less sea ice formed in the northern Bering and southern Chukchi seas than typical in winter during our project period, which limited the number of polar bears using the Alaska coast and islands. In general, when samplers reported seeing bears or tracks near their community, the stations collected samples. Therefore, although stations did not collect as many samples as expected, we have evidence that the few samples were due to the low number of bears near stations and not the capability of the boxes or brushes.

To expand our collection efforts, we worked with Dr. Eric Regehr from the University of Washington. Dr. Regehr is a collaborator on a U.S. - Russian polar bear research effort to conduct a ground-based bear survey on Wrangel Island in the Wrangel Island State Nature Reserve (WISNR). We supplied boxes, brushes, sample envelopes in 2017 and additional equipment and travel in 2018 for work on Wrangel Island. Bears on Wrangel Island are believed to be from the Chukchi Sea subpopulation[1] and many bears may be present there during the summer feeding on walrus and whale carcasses. Most of the

[1] There is high interest in learning more about the population of polar bears that use Wrangel Island and whether they may come from adjacent populations (e.g., Southern Beaufort Sea, Laptev Sea, and Arctic Basin).

maternal denning for the Chukchi Sea polar bear population occurs on this island. A total of 589 individual bears were counted during a ground-based survey in September–October 2017 (Appendix B) and 466 bears individual bears were counted in 2018 (Appendix C). See Objective 3 below for more results from Wrangel Island.

Objective 2: Investigate the possibility of deploying and checking hair collection stations on the pack ice.

Accomplishments: Our opportunity to deploy hair collection stations on pack ice relied on a polar bear research project conducted by USFWS that used a helicopter out of the Red Dog Mine facility near Kotzebue, Alaska. Two stations were deployed on sea ice in the Chukchi Sea during their polar bear capture activities. Stations were equipped with transmitting beacons so they could be relocated and recovered. The ice at both locations rapidly declined in quality, thereby preventing access to and recovery of the stations. These two stations, which remained on the surface of the ice, drifted with the sea ice. The beacons tracked the stations' movements with the ice into Russian waters.

Sea ice did not develop sufficiently to support the research project during the spring of 2018 prompting USFWS to cancel field work for this project for the first time. Lack of sea ice also prevented field work in 2019. Therefore, we had no opportunity to deploy hair collection stations on pack ice after 2017.

This is another example of how changing sea ice conditions restricted our ability to collect hair samples from polar bears at many locations which, led to our support of work on Wrangel Island to collect more genetic samples from this subpopulation.

Objective 3: Evaluate the number and quality of samples collected in 2016, 2017, and 2018.

Accomplishments: We collected fewer hair samples than expected in Alaska in 2016/17 (n = 22), 2017/2018 (n = 20), and 2018/19 (n = 3). These results were likely due to the project period coinciding with the lowest winter sea ice extents recorded in the Bering Sea and southern Chukchi Sea, which restricted the movements of bears, preventing them from moving south, near our sampling locations, and preventing us from deploying hair collecting stations on pack ice.

Results of a pilot project on Wrangel Island, Russia, in 2017, however, were positive; hair collection stations were set in 19 locations for approximately 35 trap-days and yielded 13 hair samples (Appendix B). To expand our collection success, we supported a dedicated collection effort at Wrangel Island in September–October 2018 by suppling field gear, travel, and salary for Dr. Regehr to deploy check stations on the island.

Hair collection stations were deployed at 25 locations and checked during 10 September–10 October for 56 trap-days, but only eight hair samples were collected. This focused

effort resulted in fewer hair samples than expected, presumably because bears were in good body condition and appeared to be less hungry and less interested in the stations in 2018 than in 2017 possibly due to a pink salmon run on the island in 2018 (Appendix C).

Stations were also deployed by WISNR personnel, in August and September, before Dr. Regehr arrived, and yielded nine hair samples. Hair was also collected from daybeds that had been recently used, which yielded 51 hair samples. In total, 68 hair samples were collected from Wrangel Island in 2018. It is important to note that some samples may contain hair from more than one individual. It is also possible that the same individual could be represented in multiple samples. Feces from 13 bears were also collected and could provide DNA from an additional 13 individuals for a total of 81 potential DNA samples.

Even though we collected fewer hair samples than expected in Alaska, we increased the sample size substantially by working with Dr. Regehr and his partners from WISNR. Therefore, the quantity of samples was maximized and that component of the objective was met.

The quality of the DNA to identify individuals from hair samples was not evaluated. No samples were analyzed because during meetings with our partners (USFWS, USGS, NSB, and U of W) we agreed that samples should be analyzed together at the same lab to maximize comparability and cost effectiveness; however, no lab has been identified and no partner has funding to analyze samples. Partners agreed to archive the samples until a lab was agreed upon and funding secured.

During a "proof of concept" effort in 2016, 46 polar bear hair samples were collected near Barrow (now Utqiaġvik) and wire brushes were found to retain more hair and be easier to manage than barbed wire (Appendix D). The samples were analyzed for quality (i.e., ability to extract DNA and determine identity at the individual level) at the USGS lab in Anchorage and 22 different bears were identified, 15 of which were identified once and 7 were identified more than once.

In a published study conducted near Point Barrow using barbed wire to collect hair, 165 of 200 (82.5%) samples analyzed were genotyped using microsatellite DNA at 11 loci, which was enough to identify polar bears at the individual level (Herreman and Peacock 2013).

Although another genetic technique, single nucleotide polymorphisms (SNPs) has advantages over microsatellites, SNPs need to be developed for polar bears and laboratories need to be available to conduct the analysis. Currently polar bears can be identified as individuals using established genetic methods to identify individuals from DNA in hair collected non-invasively at hair collection stations.

Samples collected in Alaska by this project during 2016/17 (n = 19) are archived at USFWS (Dr. Ryan Wilson) in Anchorage. All other samples collected by this project are archived at ADF&G, Fairbanks, and can be sent to any laboratory that is acceptable to

USFWS and other partners. Samples collected on Wrangel Island are currently archived in Russia.

II. SIGNIFICANT DEVELOPMENT REPORTS AND/OR AMENDMENTS.

An amendment was submitted during this project period (November 2017) to increase funding by $125,143 ($93,857 federal and $31,286 third party in-kind match; Appendix E).

III. PUBLICATIONS

No manuscripts can be prepared until the samples are combined with those of other researchers and analyzed. Photographs from the project are included in Appendices F–J and a presentation about the project is included in Appendix K.

IV. REVIEW OF PRIOR RESEARCH AND STUDIES IN PROGRESS ON THE PROBLEM OR NEED

The concept of working with hunters to deploy and maintain hair collection stations was successful. Hunters and communities were willing and motivated, however; sea ice in the southern Chukchi and Bering seas was historically low during the three winters of this project, which prevented polar bears from using much of their winter range and limited our ability to collect samples. Interestingly, the winter of 2019/20 appears to be a better ice year and hunters have reported seeing bears near their communities. It is likely hair samples could have been collected by hunters at many of the original locations if the project had continued to be supported in 2020.

We learned how polar bears interact with hair collection boxes from photographs and video taken at the stations and the brushes worked well for collecting hair and are easier to use and maintain than barbed wire. Brushes are also more socially acceptable. Communities were concerned that animals could get tangled in barbed wire. Although we do not know what proportion of the samples we collected can be genotyped to individual polar bears, we do know that hair collected by barbed wire was adequate to identify individuals using microsatellite techniques, as has been shown by more than one lab (Wildlife Genetics International and USGS Anchorage; Herreman and Peacock 2013, Appendix E). Similar projects with brown and black bears have also found DNA in hair to be useful for genetic mark-recapture abundance estimates using microsatellite DNA (Boulanger et al. 2004, 2008; Van Coeverden de Groot et al. 2012.).

When this project began there was an urgent need for an abundance estimate of the Chukchi Sea subpopulation of polar bears to ensure that the combined U.S. and Russia harvest was sustainable. A genetic mark-recapture study was a reasonable method to address that need if samples could be acquired and DNA analyzed to identify individuals. Samples were collected using the stations, but also from day beds and feces on Wrangel Island. During this study, however, an abundance estimate for the Chukchi Sea subpopulation was published (Regehr et al. 2018). This estimate used capture-recapture data from collared bears and life history information in an integrated population model framework and its results were generally accepted. Therefore, it may seem like pursuing a genetic mark-recapture estimate is no longer necessary, however, an independent estimate could be extremely useful to evaluate the accuracy of both methods of abundance estimation. In addition, the boundary between the Chukchi subpopulation and the

Southern Beaufort Sea subpopulation is not well understood despite its influence on abundance estimates for both, which has implications for the subsistence harvest quotas and the sustainability of both subpopulations. Finally, future monitoring efforts will be required to manage Alaska's two polar bear populations, and the changing sea ice conditions suggest that methods traditionally used may become less reliable. Refining methods such as hair DNA based population monitoring will address the need for researchers and managers to adapt to a rapidly changing Arctic.

Currently, an abundance estimate for the Southern Beaufort Sea polar bear population (the subpopulation that is shared with Canada) is greatly needed. Resource agencies in Canada and USGS in Alaska are collecting DNA samples (the U.S. is using biopsies from helicopters) as part of a genetic mark-recapture project in 2020 and 2021 to develop an abundance estimate[2].

Expanding the use of polar bear hair collection stations to include the Chukchi and the Southern Beaufort Sea subpopulations has benefits including:

1) deploying and maintaining ground-based hair collection stations by local hunters is inexpensive and assisting with an abundance estimate is of interest to hunters and their communities (Appendix A),
2) the need to develop an abundance estimate for each subpopulation and understand the area of overlap between the subpopulations is of high importance,
3) polar bears are long-lived, and samples accumulated across years can effectively increase sample size,
4) current genetic techniques (microsatellite DNA) can identify individuals and abundance estimates using this technique can be compared with estimates from other techniques to evaluate both,
5) although more advanced genetic methods (SNPs) could be developed to identify individual polar bears, foregoing the opportunity to collect samples until those methods are established may delay abundance estimates. It is critically important to collect as many samples as possible each year to maximize an individual's opportunity of being sampled. DNA from hair and other samples can be safely archived for future analysis once new methods are established.

[2] Changing sea ice conditions are also affecting research efforts in the Southern Beaufort Sea. Poor ice conditions in year-one of this survey have resulted in low numbers of sampled bears, due to difficulty in retrieving darts on unsafe ice. Alternate methods of sampling polar bear DNA can be integrated into this survey design. Polar bear hair sampling stations along Alaska's Beaufort Sea coast can make a meaningful difference in the management of SBS polar bears.

V. Literature Cited

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VI. List of Appendices

Appendix A. Alaska Eskimo Whaling Commission Resolution 2019-03 A Resolution Supporting Non-Invasive Research on Polar Bears.

Appendix B. 2017 Report – Collaborative Polar Bear Studies on Wrangel Island: a Summary of 2017 Fieldwork.

Appendix C. 2018 Report – Collaborative Polar Bear Studies on Wrangel Island: a Summary of 2018 Fieldwork.

Appendix D. Project Amendment

Appendix E. Preliminary Report – Use of hair to non-invasively sample DNA from polar bears (*Ursus maritimus*) in the Chukchi and Beaufort seas: project status update 2016.

Appendix F. Photo of samplers from Wales, Alaska, making boxes to collect polar bear hair. Photo by Elisabeth Kruger, World Wildlife Fund.

Appendix G. Photo of hair collection box with four clean brushes. Photo by J. Crawford, ADF&G.

Appendix H. Photo of samplers from Wales, Alaska, setting up a station to collect polar bear hair. Photo by Elisabeth Kruger, World Wildlife Fund.

Appendix I. Photo of polar bear investigating an early version (triangle not box) of the hair collection station near Utqiaġvik, Alaska. Photo by Peter Detwiler, NSB.

Appendix J. Photo of brushes with hair after removed from box. Photo by Andy Von Duyke, NSB.

Appendix K. Presentation to Point Hope, Alaska, to introduce the polar bear hair collection project.

Prepared by: Lori Quakenbush, Justin Crawford, and Andrew Von Duyke

Date: February 2020

Appendix A.

2019 CONVENTION RESOLUTION 2019 — 03

A RESOLUTION SUPPORTING NON-INVASIVE RESEARCH ON POLAR BEARS

AUGUST 1, 2019

WHEREAS, communities of the Alaska Eskimo Whaling Commission (AEWC) in part rely upon polar bears from the Beaufort and Chukchi seas to help meet nutritional and cultural needs; and

WHEREAS, the Federal government has listed polar bears as threatened under the Endangered Species Act because of concerns about the impacts of the rapidly changing Arctic, particularly from retreating and diminishing sea ice; and

WHEREAS, most of the research on polar bears in Alaska is conducted by the U.S. Fish and Wildlife Service and U.S. Geological Survey but has not adequately involved hunters from northern and western Alaska; and

WHEREAS, many residents of the AEWC communities recognize the importance of collecting sufficient and appropriate scientific data and traditional knowledge to inform management decisions about polar bears; and

WHEREAS, much of the research conducted by the Federal government on polar bears has involved the drugging, capturing, and collaring of polar bears; and

WHEREAS, there is concern among subsistence hunters in northern Alaska and across the Arctic about the potential negative impacts on polar bears by this invasive study approach; and

WHEREAS, some collars have impacted polar bears when they are too tight or do not break off; and

WHEREAS, there is also concern about the possible impacts to people who eat meat from polar bears that have been previously drugged and captured; and

WHEREAS, there may be suitable alternative methods that are not invasive for estimating the population size of polar bears, such as aerial visual or aerial photo surveys or genetic recapture that doesn't involve capture and tagging; and

NOW THEREFORE BE IT RESOLVED, the AEWC strongly encourages the Federal government to work with the Alaska Nanuut Co-management Council and other researchers to identify more humane and preferably non-invasive techniques to collect needed information on the biology, population size and trend of polar bear populations; and

NOW THEREFORE BE IT FURTHER RESOLVED, the AEWC calls upon the Federal government to work with the Alaska Nanuut Co-management Council to determine whether there is a need to impose a moratorium on drugging, capturing, and tagging polar bears in Alaska or permitting others to undertake such actions in order to (1) give polar bears relief ("a break") from the stress associated with the capture process and impacts from tags, and (2) allow for time for the development of more humane tracking technologies.

ADOPTED AS PRESENTED ON THIS 1st DAY OF AUGUST, 2019.

CHAIRMAN: _____ 8/1/19
John Hopson, Jr.

ATTEST: _____
Secretary

Collaborative polar bear studies on Wrangel Island:

a summary of 2017 fieldwork

Executive Summary

The Wrangel Island State Nature Reserve (WISNR) is critically important to the Alaska-Chukotka (AC) population of polar bears (*Ursus maritimus*). Most adult females in the AC population build their material dens on the island. Bears of all sex, age, and reproductive classes rely on this protected area as a terrestrial refuge during the ice-free season. The Russian Federation and the United States have initiated a collaborative three-year study of polar bears on Wrangel Island that is focused on systematic ground-based observational surveys and the non-invasive collection of genetic samples. Information from this study will help address key conservation challenges for the AC population, including sea-ice loss due to climate warming, increasing industrial activity and shipping in the region, and identification of a sustainable rate of subsistence harvest. A pilot study was conducted in 2016.

In 2017, we completed the first year of fieldwork, as summarized below†:

- From 19 September to 09 October we conducted a ground-based observational survey for polar bears on Wrangel Island, covering approximately 900 km. The survey was designed to sample important polar bear habitats in a systematic manner.
- We observed 589 individual polar bears during the survey. To our knowledge, this is the largest number of bears to be recorded on Wrangel Island.
- For bears that could be individually evaluated, the estimated sex, age, and reproductive composition was approximately 9% subadult, 23% adult male, 15% single adult female, 21% adult female with dependent young, and 34% unknown.
- We observed 78 family groups, consisting of an adult female with cubs-of-the-year (C0) or yearlings (C1). Mean litter size was 1.74 (SE = 0.09) for C0s, and 1.45 (SE = 0.10) for C1s. Six family groups consisted of an adult female with three dependent young, which is uncommon for polar bears in most areas.
- The majority of observed polar bears appeared to be in good nutritional condition. For bears that could be individually evaluated, the distribution of body condition index (BCI) scores was 3% BCI 1 and BCI 2 (thin), 64% BCI 3 (normal), and 33% BCI 4 (fat).
- Hair-snare boxes were deployed in 19 locations for approximately 35 trap-days, yielding 13 sets of hair samples. This suggests that hair-snare boxes are a viable method for collecting genetic samples from polar bears on Wrangel Island.
- On 20 September, we observed 181 polar bears in the immediate vicinity of a bowhead whale (*Balaena mysticetus*) carcass at Cape Thomas, on the southwestern coast of the island. On 30 September, we observed 10 bears feeding on a walrus (*Odobenus rosmarus*) calf near Cape Waring.
- Fieldwork in 2017 affirmed the critical importance of Wrangel Island to the AC polar bear population, especially in the context of longer ice-free seasons due to climate warming. Multiple years are required to evaluate trends in the data and to understand how the indices monitored in this study relate to population status. Russian and American collaborators intend to continue this study in 2018 and 2019.

†All findings are preliminary and subject to revision

Background

The Alaska-Chukotka (AC) polar bear population (also referred to as the "Chukchi Sea" subpopulation, with slightly different boundaries [Obbard et al. 2010]) ranges widely on the sea ice of the northern Bering, Chukchi, and eastern part of the East Siberian seas. Management and conservation of the AC population occurs under the *Agreement between the Government of the United States of America and the Government of the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population* (U.S.-Russia Agreement), a bilateral treaty signed in 2000. In the Chukchi Sea region, and throughout most of the polar bear range, sea-ice loss due to climate warming is the primary long-term threat to the species (Atwood et al. 2015, Regehr et al. 2016). There is empirical evidence that two of the Arctic's 19 subpopulations of polar bears have experienced sea-ice related declines (Bromaghin et al. 2015; Lunn et al. 2016). Several subpopulations show signs of stress (Obbard et al. 2016) or have been reported as stable or productive (e.g., Peacock et al. 2013, Rode et al. 2014), and others have unknown status due to deficient data (Obbard et al. 2010). Despite this variability, projected sea-ice loss in the 21st century is expected to negatively affect polar bears throughout much of their range, because the species depends fundamentally on sea ice for access to its primary prey (Atwood et al. 2016). In addition to climate warming, the AC population faces nearer-term management issues and potential threats including increased oil and gas activity, shipping, and other human activities in the Arctic. Furthermore, polar bears are an important traditional and subsistence resource for Native people in Alaska and Chukotka (Voorhees et al. 2014), and accurate scientific information is required to identify a sustainable rate of subsistence harvest (Regehr et al. 2017).

Satellite tagging studies indicate that a significant proportion of the AC population comes to Wrangel Island, Herald Island, and the Chukotski coast every year during the ice-free season, and that Wrangel Island is a particularly important seasonal resting habitat (Garner et al. 1994). From 2004-2011, an average of 220 polar bears per year were observed using Wrangel Island during the summer and autumn (Ovsyanikov 2012). Furthermore, the majority of pregnant females in the AC population appear to use Wrangel Island to construct their maternity dens (Garner et al. 1994). A recent study found that a larger proportion of the AC population used Wrangel Island each year, and spent a longer time on Wrangel Island, for the period 2008-2013 compared to the period 1986-1995 (Rode et al. 2015). This increased use was associated with declines in Arctic sea ice, which are projected to continue (IPCC 2013). Thus, the available scientific information indicates that Wrangel Island is of critical ecological importance to the AC polar bear population, and that its importance will likely increase as climate warming and human development of the region continue.

Up-to-date information on the AC population is required to address the conservation challenges listed above in accordance with the U.S.-Russia Agreement, the 1973 Agreement on the Conservation of Polar Bears, and national laws (which in the U.S. include the Endangered Species Act, Marine Mammal Protection Act, and the National Environmental Policy Act). Valuable information on the status of the AC population has been obtained by a live-capture study conducted by the U.S. Fish and Wildlife Service and partners in the American portion of the Chukchi Sea region (Rode et al. 2014, 2015; Wilson et al. 2014, 2016), although this study has provided only indirect information on the ecological role of Wrangel Island. Furthermore, findings of positive nutritional condition and reproduction from live-capture studies in the spring (Rode et al. 2014) have not been reconciled with indices of potentially declining body condition and reproduction collected on Wrangel Island in the autumn (Ovsyanikov 2012). Historically, more intensive observational studies occurred on Wrangel Island,

to evaluate the number and distribution of resting bears; and to evaluate the number and distribution of maternity dens (Kischinskiy and Uspenskiy 1973; Belikov 1977, 1980, 1982; Belikov et al., 1986; Uspenskiy 1989; Stishov 1991). However, in recent years these studies have not been conducted, or have been conducted intermittently or with an inconsistent sampling design.

The current study seeks to provide critical information on the status and ecology of the AC polar bear population through non-invasive observational and genetic studies on Wrangel Island. The collection, analysis, and interpretation of scientific data will be conducted collaboratively by Russian and American researchers using a consistent sampling design. In 2016, the Scientific Working Group (SWG) responsible for advising the Commissioners of the U.S.-Russia Agreement identified the current study as "high priority" with respect to management and conservation of the AC population (Scientific Working Group, 2016).

Fieldwork methods

In 2017 we conducted a ground-based observational survey using two all-terrain vehicles (ATVs; Honda TRX300 and TRX350) and one larger, low-impact tundra vehicle (Trakol; Figure 1). Personnel traveling in the vehicles (one per ATV, four or five in the Trakol) scanned continuously for polar bears while on survey. Additionally, the vehicles stopped periodically when a new portion of the landscape came into view, to perform focal observations using binoculars. The Trakol was fitted with a roof port that allowed a 360° field of view.

Figure 1. Two all-terrain vehicles (front) and one low-impact tundra vehicle (back) used for the ground-based observational survey of polar bears on Wrangel Island, autumn 2017.

The survey of Wrangel Island included 16 routes, each of which could be mostly covered in one day (Table 1). The routes were designed to sample key habitats including the coast, spits and barrier islands, tundra, hills, and mountains. The selection of routes was also based on terrain, traveling conditions, and the distances between shelters for overnight accommodation. Although small portions of some routes were covered more than once (e.g., when backtracking was required), observations were only recorded during the initial coverage to avoid double-counting bears. Routes in 2017 were nearly identical to the routes covered during the pilot study in 2016 (Appendix 1).

Date	Route	Length of route (km)	Bears observed on route
9/19/2017	Neozhidanaya to Cape Blossom	44	53
9/20/2017	Cape Blossom to Cape Thomas to Neozhidanaya	59	198
9/22/2017	Neozhidanaya to Ptichiy Bazar to Goose River	80	26
9/23/2017	Goose River to Comsomol	29	4
9/24/2017	Comsomol to Tundra Peak (via Dream-Head)	84	71
9/27/2017	Tundra Peak to Krasniy Flag	62	17
9/28/2017	Krasniy Flag Loop	61	14
9/29/2017	Krasniy Flag to Cape Waring	67	15
9/30/2017	Dragi Bay (Cape Waring Loop)	11	30
10/2/2017	Bruch Spit (Cape Waring Loop)	70	32
10/4/2017	Cape Pillar (Cape Waring Loop, INCOMPLETE)	31	7
10/5/2017	Cape Waring to Ushakovskoye	72	24
10/6/2017	Ushakovskoye Loop	48	19
10/7/2017	Ushakovskoye to Somnitelnaya	83	27
10/8/2017	Somnitelnaya Spit (Somnitelnaya loop)	28	25
10/9/2017	Krasin Bay (Somnitelnaya loop)	70	27

Table 1. Routes completed during the ground-based observational survey of polar bears on Wrangel Island, autumn 2017.

For each polar bear or family group (i.e., adult female with dependent young) that was sighted while on survey, the following information was recorded: date and time; cohort, which defined the sex, age class, and reproductive status of the bear or family group; a standardized body condition index (BCI) that ranged from 1 to 5, with 1 being very thin and 5 being very fat; behavior of the bear when first sighted; habitat of the bear when first sighted; a Global Positioning System (GPS) waypoint corresponding to the location of the observer; the distance and heading between the waypoint and the location of the bear; and the weather and visibility. Estimates of cohort and BCI were established by consensus among observers, when possible.

In addition to performing the observational survey, we evaluated the feasibility of non-invasive genetic sampling using hair-snare boxes (Figure 2). Hair-snare boxes were constructed of plywood, with sides measuring approximately 1 cm (thickness) × 38 cm (width) × 63 cm (length). The boxes were fitted with flexible stainless steel brushes at the open end, which were designed to collect hairs upon contact with the

arm or head of a polar bear. Most boxes were baited with approximately 5 cc of water solution containing decomposed fish and meat, which served as a scent attractant but did not provide bears with a food reward. In 2017, the boxes were deployed opportunistically along survey routes and in the vicinity of cabins. A primary goal of hair sampling is to obtain individual genetic identifications of polar bears on Wrangel Island, which could be used in conjunction with other genetic data available for the AC population (e.g., from live-capture research in the US) to evaluate polar bear movements, habitat use, and demography.

Figure 2. Hair-snare boxes used to collect genetic samples from polar bears on Wrangel Island, autumn 2017.

Summary of 2017 fieldwork

We completed the 16 routes of the survey between 19 September and 09 October, 2017. One route (Cape Pillar) was not entirely completed due to weather. The total distance traveled was approximately 900 km. During the survey period, daytime temperatures varied from approximately -7 to +5°C. In most areas the ground was snow free, or lightly snow covered, at elevations below approximately 100 m. Deeper snow above approximately 100 m elevation made travel difficult in some areas.

During the survey, complete individual information could not be recorded for some bears, for example because the bear was too far away or its sex and age could not be determined with confidence. Additionally, it was not possible to record complete individual information for two groups of bears due to logistical constraints. First, an aggregation of 181 bears was observed at Cape Thomas on 20 September (see below). For this aggregation, we recorded the total number of bears and the occurrence of family groups, which were clearly identifiable from a distance. We also recorded general observations for BCI and behavior. Second, 26

independent bears were observed on a portion of Dream-Head Mountain on 24 September. For these bears, we recorded the total number of bears, as well as general observations for BCI and cohort. Most of the bears in the Dream-Head mountain area appeared to be adult females waiting to construct maternal dens, and we observed several apparent den entrances in large snow banks at elevations above approximately 100 m.

Polar bear numbers and cohort

We observed a total of 589 polar bears during the survey (Figure 3). Because not all polar bears along the survey routes were detected, and because the routes did not cover the entire island, the actual number of polar bears on Wrangel Island during autumn 2017 was likely significantly higher than 589. For the 290 independent bears and family groups for which cohort was individually identified (i.e., excluding bears from Cape Thomas and a portion of Dream-Head Mountain), the approximate cohort composition was: 9% subadult, 23% adult male, 15% single adult female, 21% adult female with dependent young, and 34% unknown. Detailed cohort information is provided in Table 2.

Figure 3. Map of Wrangel Island, including the survey routes (blue lines) and locations from which polar bears were observed (purple dots) during the ground-based observational survey, autumn 2017. The large purple dot on the west coast represents the aggregation of 181 bears near a bowhead whale carcass at Cape Thomas.

Cohort	Description	Excluding Cape Thomas and partial Dream-Head Mountain	Including Cape Thomas and partial Dream-Head Mountain
C0	lone cub-of-the-year (approx. 9 mo.)	0	1
C1	lone yearling (approx. 21 mo.)	1	1
SF	subadult* female	3	3
SM	subadult male	9	9
SU	subadult unknown sex	13	13
AF	single adult** female	43	43
AF1C0	adult female with 1 cub-of-the-year	13	15
AF2C0	adult female with 2 cubs-of-the-year	18	24
AF3C0	adult female with 3 cubs-of-the-year	2	4
AF1C1	adult female with 1 yearling	16	20
AF2C1	adult female with 2 yearlings	8	11
AF3C1	adult female with 3 yearlings	1	2
AF1C?	adult female with 1 cub unknown age	2	2
AF2C?	adult female with 2 cubs unknown age	0	0
AM	adult male	65	67
AU	adult unknown sex	10	10
UU	unknown age and unknown sex	86	239

Table 2. Detailed sex, age class, and reproductive status information for polar bears observed on Wrangel Island, autumn 2017. *Subadults are bears age 2-4 years. **Adults are bears age ≥ 5 years.

Reproductive observations

We observed 78 family groups, consisting of an adult female with cubs-of-the-year (AFC0) or and adult female with yearlings (AFC1; Table 2). Mean litter size was 1.74 (SE = 0.09) for C0s, and 1.45 (SE = 0.10) for C1s. Six of the 78 family groups observed consisted of an adult female with three dependent young, which is uncommon for polar bears in most areas.

Nutritional condition

The majority of observed polar bears appeared to be in good nutritional condition. BCI scores were recorded for 166 independent bears and adult females with families; BCI was not recorded for dependent young. The distribution of BCI scores was: 1% BCI 1 (one apparently old and arthritic male bear), 2% BCI 2, 64% BCI 3, 33% BCI 4, and 0% BCI 5.

Behavior and habitat

Behavior and habitat were recorded for 464 individuals or family groups. The distribution of behaviors was: 39% at rest (i.e., lying on the ground), 32% Cape Thomas (see below), 19% walk, 5% sit, 2% stand, 2% run, and 1% other (one bear swimming, two bears feeding, and one bear interacting with a herd of musk ox). In some cases, the behavior of a bear when first observed may have reflected its reaction to a vehicle. The distribution of habitats occupied by bears was: 32% Cape Thomas (see below), 17% tundra, 17% mountain (elevated areas covered mostly by rock and snow), 16% spits and barrier islands, 11% hill (elevated areas covered mostly by tundra), 5% coast (rock and gravel beaches along the main coastline), and 2% human settlement (abandoned structures and cabins).

Genetic sampling

Hair-snare boxes were successfully used to collect hair samples for genetic analysis (Figure 4). Boxes were deployed in 19 locations for a total of approximately 35 trap-days (defined as the box being deployed for a 24-hour period). The boxes were visited by polar bears on 13 occasions, each occasion providing 2-4 wire brushes that each contained more than 10 hairs in most instances (Figure 4).

In addition to the hair-snare boxes, we collected hair samples from eight locations where polar bears had been seen resting (i.e., daybeds) immediately prior to sample collection. We also collected five fecal samples from polar bears, as well as muscle and fat samples from two walrus (*Odobenus rosmarus*) carcasses. Finally, we collected muscle, fat, hair, and a vestigial premolar from the decomposed carcass of one polar bear that was found near Cape Pillar. The skeleton size indicated this was a large adult male. Although the cause of death was unknown, the teeth were very worn and both lower canines were broken off at the gum line, which is common for senescent adult male bears.

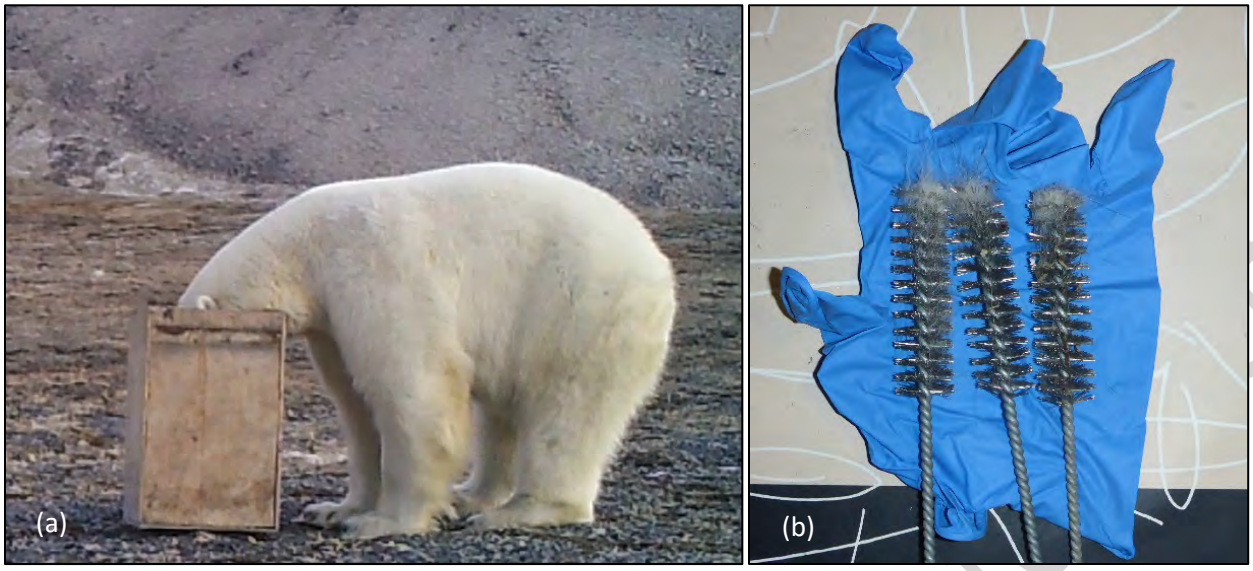

Figure 4. (a) A polar bear visiting a hair-snare box near Cape Waring, autumn 2017. This picture was taken using a motion-activated remote camera. (b) Brushes with hair samples from a hair-snare box that had been visited by a polar bear.

Aggregations of polar bears

On 20 September, 181 polar bears were observed in the vicinity of a bowhead whale (*Balaena mysticetus*) carcass at Cape Thomas (Figure 5). To our knowledge this is the largest aggregation of polar bears to be recorded for the AC population. The carcass appeared to be a mature whale and was not severely decomposed. While being observed on 20 September, approximately 35 bears of various cohorts, including adult females with dependent young, were located on the beach adjacent to the carcass. However, few bears appeared to be feeding successfully due to a high sea level and rough surf. The remaining bears were resting, sitting, walking, and interacting on the tundra, hillside, and mountainside within a radius of approximately 1 km from the carcass. On the preceding day, 19 September, Wrangel Island State Nature Reserve staff had observed the same aggregation of polar bears from the sea, while aboard the vessel Academic Shokalskiy operated by Heritage Expeditions. At that time, the whale carcass was more exposed and approximately 15 bears (mostly adult males) were actively feeding on the carcass (Figure 6). Additional analyses of the Cape Thomas aggregation will be performed based on high-resolution digital photographs and other materials.

On 30 September, we observed more than 10 polar bears feeding on a freshly-killed walrus calf along the coast of Dragi Bay, near Cape Waring (Figure 7). Earlier in the month, Wrangel Island State Nature Reserve staff reported approximately 3,000 walrus hauled out near Cape Waring. Although we were not able to see the walrus or complete the Cape Pillar route due to poor weather, we encountered a high concentration of bears in the vicinity of Cape Waring (Figure 3).

Figure 5. An aggregation of 181 polar bears on the beach, hillside, and mountain in the vicinity of a beach-cast bowhead whale carcass, observed at Cape Thomas on 20 September 2017. The yellow dots on the hills and beach are polar bears.

Figure 6. Polar bears feeding on the bowhead whale carcass at Cape Thomas, as observed by staff of the Wrangel Island State Nature Reserve from the vessel Academic Shokalskiy on 19 September 2017.

Figure 7. Polar bears feeding on a walrus calf near Cape Waring, 30 September 2017.

Future considerations and plans

This collaborative study of polar bears on Wrangel Island will continue in 2018 and 2019, conditional on the availability of funding. A primary objective is to repeat the ground-based observational survey, with the goal of developing a consistent time-series of data on polar bear occurrence, demographic composition, reproductive rates, nutritional condition, and habitat use. In 2018 we will evaluate options to expand the spatial and temporal scope of non-invasive genetic sampling. We also will consider evaluating the potential for the ground-based chemical immobilization of a limited number of polar bears, for the purpose of applying satellite radiocollars and collecting a broader suite of biological samples.

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Appendix 1. 2016 Wrangel Island Polar Bear Survey

During September and October 2016 a ground-based visual polar bear survey of Wrangel Island was conducted by members of the Wrangel Island State Nature Reserve and the U.S. Fish and Wildlife Service. This survey was conducted to estimate indices of abundance, distribution, demographic composition, and body condition of polar bears of the Alaska-Chukotka (AC) population on Wrangel Island during this time. The objectives of this first year of this cooperative study included:

a. Establish a working relationship between Russian and U.S. colleagues.
b. Evaluate polar bear body condition in autumn.
c. Evaluate polar bear diets during autumn while on land.
d. Evaluate activities of polar bears on land (for example, resting or feeding).
e. Gather field data on characteristics of observed polar bears: sex and age composition of animals encountered, family group composition (including their sex, age, and reproductive status).
f. Assess areas for placement of hair snare stations, possible biopsy darting and capture locations.
g. Train inspectors to identify bears by age and sex to help with consistent field information gathering in future surveys.

This was a cooperative effort between the Wrangel Island State Nature Reserve, the United States Fish and Wildlife Service, and the All-Russian Research Institute of Environment Protection.

The survey was conducted between 28 September and 16 October, 2016.

More than 1,000 km were surveyed on Wrangel Island.

179 bears were recorded:
- 52 adult males;
- 16 adult females;
- 3 adults of unknown sex;
- 3 sub adults of unknown sex; and
- 36 bears of unknown sex and unknown age.

This also included 27 family groups:
- 9 groups of a female and one cub-of-the-year;
- 10 groups of a female and two cubs-of-the-year;
- 3 groups of a female and one cub older than one year; and
- 5 groups of a female and two cubs older than one year.

The majority of the bears were observed on the eastern surveys in the vicinity of Cape Waring, Pillar Point, and Brutch Spit. Additional aggregations of bears occurred along the coast in the southern portion of the island – Cape Blossom/Cape Thomas, the spits along Zal Krasin, and near the Somnitilnaya and Hishnicki rivers.

Of those that could be identified, 75% of the individual animals (107/142) were classified as having a body condition of “3”, 24% of the individuals (34/142) were classified as having a body condition of “4”, and one

percent (one individual) was classified as having a body condition of "2." The bear with a body condition of "2" appeared to be either sick or injured as it did not move when passed. We also recorded one dead cub-of-the-year on Brutch Spit. This animal was not included in the count. It appeared to be a natural death, but we could not determine how it died.

The initial behavior of the bears upon observation were recorded. The majority of the bears (52%) were observed resting. The initial behavior of the bears observed included:

Rest (94/179): 52%;
Walk (44/179): 25%;
Run (27/179): 15%;
Climb (9/179): 5%;
Feed (2/179): 1%;
Curious (2/179): 1%; and
Swim (1/179): 1%

Of the two bears observed feeding, both were eating something old, not fresh. One was feeding on a piece of old walrus skin, while we could not identify what the other bear was eating.

Training of the inspectors also occurred to help them identify bears by age and sex. Polar bear age and sex identification forms and notebooks were distributed to help with consistent field information gathering in future surveys.

We also assessed areas that would be possible for the placement of hair snare stations, biopsy darting and capture locations. The coasts near Cape Waring in the east and the Somnitilnaya Ranger station in the south would be the most logical places to test and refine these data gathering techniques on the island. They are close to the larger ranger stations and could be accessed by them at regular intervals.

The survey was a successful first step in developing a relationship between international colleagues to help better understand the current ecological importance of Wrangel Island to the shared AC polar bear population.

Collaborative American-Russian Polar Bear Studies on Wrangel Island:

Summary of 2018 Fieldwork

Executive Summary

The Wrangel Island State Nature Reserve (WISNR), located in Russia north of mainland Chukotka, is critically important to the Alaska-Chukotka (AC) population of polar bears (*Ursus maritimus*), which is shared between the U.S. and Russia. Most adult females in the AC population build their maternal dens on the island, and bears of all types use this protected area as a terrestrial refuge during the ice-free season. American and Russian scientists are conducting collaborative polar bear studies on Wrangel Island, which include a systematic ground-based observational survey and non-invasive biological sampling. The resulting information will be used to address conservation challenges for the AC population including the effects of sea-ice loss due to climate warming, increasing industrial activity and shipping in the region, and the need to determine a sustainable rate of subsistence harvest. Fieldwork was previously conducted in 2016 (Appendix 1) and 2017 (Appendix 2). Fieldwork in 2018 is summarized below†.

- From 15 September to 03 October 2018 we conducted a ground-based observational survey covering approximately 948 km. The survey is designed to systematically sample important polar bear habitats.
- We observed 466 individual polar bears during the survey.
- The sex, age, and reproductive composition of observed polar bears was approximately 6% subadult, 17% adult male, 8% adult female without dependent young, 18% adult female with dependent young, 3% adult of unknown sex, and 47% unknown age class and unknown sex. The high proportion of unknown bears was associated with good weather and lack of snow, which allowed bears to be observed at long distances.
- We observed 68 family groups consisting of an adult female with dependent young. Mean litter size was 1.70 (standard error of the mean [sem] = 0.11) for cubs-of-the-year (C0s) and 1.39 (sem = 0.10) for yearlings (C1s).
- The majority of observed polar bears appeared to be in good nutritional condition. For bears that could be individually evaluated, the distribution of body condition index (BCI) scores was 4% BCI 2 (thin), 52% BCI 3 (normal), and 44% BCI 4 (fat).
- In 2018 polar bears were less active, and less likely to approach humans or the hair-snare boxes used for biological sampling, compared to 2016 and 2017. This may have been related to their apparently improved nutritional condition compared to previous years of this study.
- From 10 September to 10 October we conducted non-invasive biological sampling, resulting in 68 hair samples that will be used for genetic analyses and other purposes.
- On 16 September we revisited the site where 181 polar bears had been observed near a whale carcass in 2017. Only five bears were observed as this location, and no whale remains were seen.
- Fieldwork in 2018 reaffirmed that Wrangel Island is an ideal location for cost-effective research and monitoring of the AC polar bear population. We intend to continue this study in future years, and are starting to analyze the data and samples collected to date.

†Findings are preliminary and subject to revision. This report has not been subject to peer review and should not be cited. Data and images may not be used without permission of the authors.

Background

The Alaska-Chukotka (AC) polar bear population (also referred to as the "Chukchi Sea" subpopulation, with different boundaries [Durner et al. 2018]) ranges widely on the sea ice of the northern Bering, Chukchi, and eastern part of the East Siberian seas. Management and conservation of the AC population occurs under the *Agreement between the Government of the United States of America and the Government of the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population* (U.S.-Russia Agreement), a bilateral treaty signed in 2000. In the Chukchi Sea region, and throughout most of the polar bear range, sea-ice loss due to climate warming is the primary long-term threat to the species (Atwood et al. 2016, Regehr et al. 2016). Although the status of the Arctic's 19 subpopulations of polar bears is currently variable (Durner et al. 2018), projected sea-ice loss in the 21st century is expected to negatively affect polar bears throughout much of their range because the species depends fundamentally on ice for access to its marine mammal prey (Atwood et al. 2016). In addition to climate warming, the AC population faces other management issues and potential threats including increased oil and gas activity, shipping, and other human activities in the Arctic. Furthermore, polar bears are an important traditional and subsistence resource for Native people in Alaska and Chukotka (Voorhees et al. 2014, Kochnev and Zdor 2016, Braund et al. 2018), and accurate scientific information is required to identify a sustainable rate of subsistence harvest (Regehr et al. 2017, 2018, In press).

Satellite tagging studies indicate that a significant proportion of the AC population comes to Wrangel Island, Herald Island, and the coast of Chukotka every year during the ice-free season. Wrangel Island is a particularly important seasonal resting habitat (Garner et al. 1994). From 2004-2011, an average of 220 polar bears per year were observed using Wrangel Island during the summer and autumn (Ovsyanikov 2012). Furthermore, the majority of pregnant females in the AC population appear to use Wrangel Island to construct their maternity dens (Garner et al. 1994). A recent study found that a larger proportion of the AC population used Wrangel Island each year, and spent a longer time on Wrangel Island, for the period 2008-2013 compared to the period 1986-1995 (Rode et al. 2015). This increased use was associated with declines in Arctic sea ice, which are projected to continue (Intergovernmental Panel on Climate Change 2013). Thus, the available scientific information indicates that Wrangel Island is of critical ecological importance to the AC polar bear population, and that its importance will likely increase as climate warming and human development of the region continue.

Up-to-date information on the AC population is required to address the conservation challenges listed above in accordance with the U.S.-Russia Agreement, the 1973 Agreement on the Conservation of Polar Bears, and national laws (which in the U.S. include the Endangered Species Act, Marine Mammal Protection Act, and the National Environmental Policy Act). Information on the status of the AC population has been obtained by a live-capture study conducted by the U.S. Fish and Wildlife Service and partners in the American portion of the Chukchi Sea region (Rode et al. 2014, 2015; Wilson et al. 2014, 2016; Regehr et al. 2018, In press), although this study has provided only indirect information on the ecological role of Wrangel Island. Furthermore, findings of positive nutritional condition and reproduction from live-capture studies in the spring (Rode et al. 2014) have not been reconciled with indices of potentially declining body condition and reproduction collected on Wrangel Island in the autumn (Ovsyanikov 2012). Historically, more intensive observational studies occurred on Wrangel Island, to evaluate the number and distribution of resting bears and to evaluate the number and distribution of maternity dens (Kischinskiy and Uspenskiy 1973; Belikov 1977, 1980, 1982; Belikov et al. 1986; Uspenskiy 1989; Stishov 1991). However, in recent

years these studies have not been conducted, or have been conducted intermittently or with an inconsistent study design.

The current non-invasive study on Wrangel Island will provide important information on the status and ecology of the AC polar bear population. The collection, analysis, and interpretation of scientific data is conducted collaboratively by Russian and American scientists. The Scientific Working Group responsible for advising the Commissioners of the U.S.-Russia Agreement has identified this study as "high priority" with respect to management and conservation of the AC population (Scientific Working Group 2016).

Fieldwork methods

In 2018 we conducted a ground-based observational survey using a low-impact tundra vehicle (Trakol; Appendix 2), with logistical support provided by an all-terrain vehicle (ATV). Personnel traveling in the Trakol scanned continuously for polar bears while on survey. Additionally, the vehicles stopped periodically when a new portion of the landscape came into view, to perform focal observations. The Trakol was fitted with a roof port that allowed a 360° field of view.

The survey of Wrangel Island includes 15 routes, each of which can be covered in one day under favorable weather and travel conditions. The routes are designed to sample key habitats including the coastline and spits, riverbeds, tundra, hills (defined as tundra-covered areas distinctly raised above their surroundings), and mountains (defined as rock-covered areas distinctly raised above their surroundings, typically at elevations greater than 100 m). The selection of routes was also based on terrain, traveling conditions, and the distances between shelters. Although small portions of some routes were covered more than once (e.g., when backtracking was required), observations were only recorded during the initial coverage to avoid double counting.

For each polar bear or family group (i.e., adult female with dependent young) that was sighted while on survey, we attempted to record the following information: date and time; cohort describing sex, age class, and reproductive status; a standardized body condition index (BCI) that ranged from 1 to 5, with 1 being very thin and 5 being very fat (Stirling et al. 2008); behavior of the bear when first sighted; habitat of the bear when first sighted; a Global Positioning System waypoint corresponding to the location of the observer; the distance and heading between the waypoint and the location of the bear; and the weather and visibility. Bears were often watched through binoculars for several minutes to assess cohort and BCI. These assessments were established by consensus among 4–5 observers, when possible.

In addition to performing the observational survey, we performed non-invasive biological sampling to provide material for genetic identification and other analyses. Hair-snare boxes were deployed using a variety of scent and visual attractants (Appendix 2). We also collected hair samples from polar bear daybeds that were either confirmed to be recent by seeing a polar bear in them prior to sample collection, or were subjectively determined to be recent based on characteristics of the substrate (e.g., gravel that was loose and uncontaminated by debris) and the hair found in the daybed (e.g., individual hairs that were lying on the surface and not discolored).

Figure 1. A recent polar bear daybed on Wrangel Island.

2018 fieldwork summary

We completed the 15 routes of the ground-based observational survey between 15 September and 03 October 2018 (Table 1, Figure 2). Routes were the same as 2017 and 2016, with minor differences based on weather and logistical factors. Several supplemental segments were completed in addition to the established routes. The total distance traveled was approximately 948 km (this includes some backtracking).

During the survey period, daytime temperatures varied from approximately 2 to 9°C, and winds varied from 0 to 25 m/s. Weather and visibility were generally excellent for the Arctic and we did not miss any work days due to poor weather. The ground was snow free in all areas that were surveyed, including the higher elevations (e.g., 300 m). The only snow we observed was in small, melting patches on some mountain slopes.

During the survey, complete individual information could not be recorded for some bears. In 2018 this was a particular challenge because a large proportion of observed bears were in mountainous habitat, were lying down or otherwise inactive, or were observed from a long distance. Long-distance observations were possible because the visibility and lighting were often very good, and the mountains were snow free (Figure 3). To improve the assessment of individual polar bears, we photographed some bears using a digital camera with a telephoto lens (65× optical zoom) and then examined the photos onsite or when entering data that evening.

Route number	Date completed	Route description	Distance traveled* (km)	Bears observed on survey
1	15-09-2018	Neozhidannaya to Cape Blossom	57	42
2	16-09-2018	Cape Blossom to Neozhidannaya via Cape Thomas	70	6
3	17-09-2018	Neozhidannaya to Goose River	38	71
4	18-09-2018	Goose River to Ptichy Bazar to Comsomol	48	26
5	19-09-2018	Comsomol to Tundra Peak via Dream-Head	70	70
5. supp**	19-09-2018	Dream-Head cabin (supplemental segment)	40	8
6	21-09-2018	Tundra Peak to Krasniy Flag	57	19
7	22-09-2018	Central Mountains (Krasniy Flag Loop)	59	6
8	23-09-2018	Krasniy Flag to Cape Waring	64	11
9	24-09-2018	Dragi Bay (Cape Waring Loop)	10	3
9. supp	24-09-2018	Cape Waring cabin (supplemental segment)	9	16
10	25-09-2018	Bruch Spit and Andrianova Spit (Cape Waring Loop)	100	20
11	26-09-2018	Cape Pillar (Cape Waring Loop)	55	65
12	28-09-2018	Cape Waring to Ushakovskoye	69	21
12. supp	29-09-2018	Ushakovskoye settlement (supplemental segment)	23	2
13	01-10-2018	Ushakovskoye to Somnitelnaya	59	27
14	02-10-2018	Somnitelnaya Spit (Somnitelnaya loop)	48	7
15	03-10-2018	Krasin Bay (Somnitelnaya loop)	66	46

Table 1. Routes completed during a ground-based observational survey of polar bears on Wrangel Island, autumn 2018. *In some cases the distance traveled may include portions of the route that were off survey (e.g., due to backtracking). **Supplemental segments may not be part of the established route.

Polar bear numbers and cohort

We observed a total of 466 individual polar bears during the survey. In comparison with the 2017 survey, during which 589 individual bears were observed, we note two differences: (1) in 2018, 16 bears were observed on the Cape Waring cabin supplemental segment (segment 9. supp., Table 1), which was not covered in 2017; and (2) in 2018, 65 bears were observed during on the Cape Pillar route (route 11, Table 1), which was only partially covered in 2017 due to poor weather, with 7 bears observed (Appendix 2). Because not all polar bears along the survey routes were detected, and because the routes did not cover the entire island, the actual number of polar bears on Wrangel Island during autumn 2018 was necessarily higher than 466. Polar bears in 2018 were observed as 368 cohorts (i.e., independent bears or adult females with dependent young) that were categorized as 6% subadults of both sexes, 17% adult males, 8% adult females without dependent young, 18% adult females with dependent young, 3% adults of unknown sex, and 47% bears of unknown age class and unknown sex (Table 2).

We note that the probability of observing polar bears likely differed among cohorts due to differences in habitat selection, behavior, number of individuals in a cohort, and other factors. Furthermore, there were different

probabilities of accurately determining the cohort of polar bears that were observed. For example, nearly all observed family groups could be identified as such, even at long distances. Conversely, individual bears of small to middle size (e.g., subadults of both sexes and some single adult females) could only be assigned to a cohort at shorter distances or by watching the bear's movements or behavior.

Figure 2. Map of Wrangel Island, including the primary survey routes (light blue lines), supplemental survey segments (green lines), and locations from which polar bears were observed (dark blue dots) during the ground-based observational survey, autumn 2018.

Reproductive indices

We observed 68 family groups consisting of an adult female with cubs-of-the-year (AFC0), yearlings (AFC1), or dependent young of unknown age (e.g., if the family group was lying down and the dependent young could be seen, but their age could not be accurately assessed). Mean litter size was 1.70 (sem = 0.11) for C0s and 1.39 (sem = 0.10) for C1s. Two family groups consisted of an adult female with three C0s. We did not observe any family groups with three C1s.

Nutritional condition

The majority of observed polar bears appeared to be in good nutritional condition. BCI scores were recorded for 158 independent bears and adult females with families. BCI was not recorded for dependent young. The distribution of BCI scores was approximately 4% BCI 2, 52% BCI 3, and 44% BCI 4. We did not observe any bears with BCI 1 or 5. Of the six bears with BCI 2, one was an adult female with two C0s, and five were adult males that appeared to be old or, in one case, injured. Three of the BCI 2 males were near the location where a bowhead whale carcass was

deposited on the beach in 2017 (see below). In 2018, there was apparent spatial variation in the reproductive status and nutritional condition of polar bears on Wrangel Island.

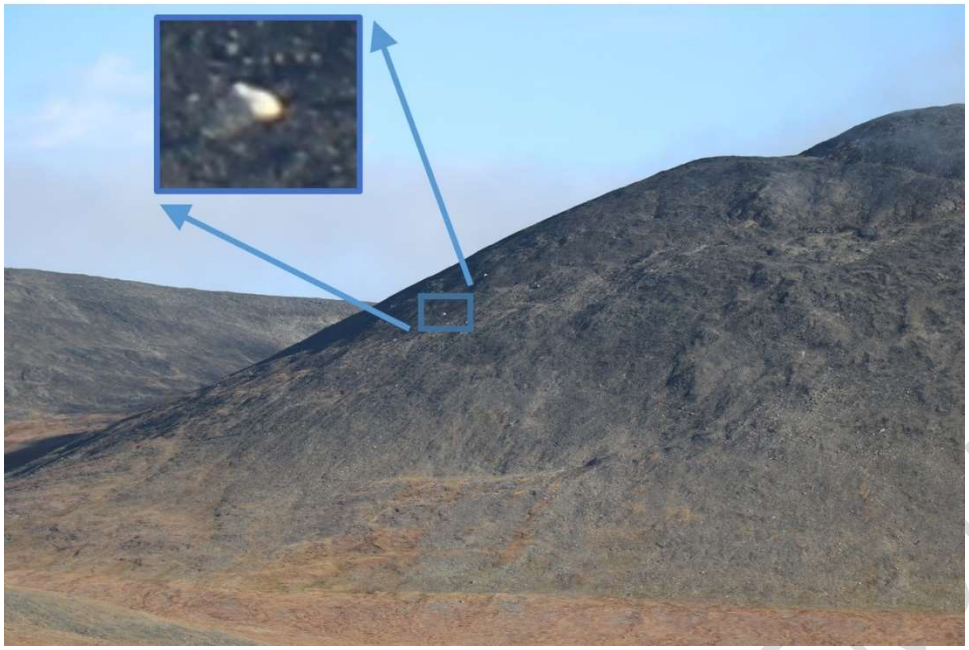

Figure 3. Example of a polar bear resting in mountainous habitat and visible from a long distance due to snow-free conditions and good visibility. This polar bear was assessed as cohort UU (unknown age class and unknown sex). Such observations were common during polar bear studies on Wrangel Island in 2018.

Behavior and habitat

Behavior and habitat were recorded for 368 individuals or family groups. The distribution of behaviors was approximately 69% rest (i.e., lying on the ground), 23% walk, 5% sit or stand, 2% run, and 2% other (feed, play or swim). The behavior of some bears when first observed may have reflected their reaction to a vehicle. In 2018, polar bears were less active at the time of initial observation compared to previous years of this study. Also, fewer bears approached the vehicles and, although we did not record detailed information on the response of bears to humans, bears seemed to flee the vehicles more readily and at farther distances than in 2017. We hypothesized that these behavioral differences were associated with the apparently improved nutritional condition of bears in 2018 compared to 2016 and 2017.

The distribution of habitats occupied by bears in 2018 was approximately 61% mountain, 18% tundra, 14% coastlines and spits, 4% hill, and 2% other (riverbed, water, or human settlements). The proportion of bears observed in mountainous habitat was likely influenced by our ability to sight these animals at long distances, as described above.

Cohort code	Cohort description	Cohorts observed on survey
1C0	lone cub-of-the-year (approx. 9 mo.)	0
1C1	lone yearling (approx. 21 mo.)	0
1SF	subadult* female	1
1SM	subadult male	6
1SU	subadult unknown sex	16
1AF	single adult** female	31
1AF1C0	adult female with 1 cub-of-the-year	11
1AF2C0	adult female with 2 cubs-of-the-year	17
1AF3C0	adult female with 3 cubs-of-the-year	2
1AF1C1	adult female with 1 yearling	14
1AF2C1	adult female with 2 yearlings	9
1AF3C1	adult female with 3 yearlings	0
1AF?C?	adult female with unknown number of cubs of unknown age	8
1AF?C0	adult female with unknown number of cubs-of-the-year	6
1AF?C1	adult female with unknown number of yearlings	0
1AF1C?	adult female with 1 cub unknown age	1
1AF2C?	adult female with 2 cubs unknown age	0
1AF3C?	adult female with 3 cubs unknown age	0
1AM	adult male	64
1AU	adult unknown sex	10
1UU	unknown age and unknown sex	172

Table 2. Detailed sex, age class, and reproductive status (i.e., cohort) information for polar bears observed during the ground-based observational survey on Wrangel Island, autumn 2018. *Subadults are bears approximately 2-4 years old. **Adults are bears approximately ≥ 5 years old.

Biological sampling

We used hair-snare boxes to collect hair samples for genetic analyses and other uses. In 2018, we deployed the boxes both opportunistically by placing them in the vicinity of cabins, and actively by transporting them by ATV to areas of high bear activity. During the period that the research team was on Wrangel (10 September to 10 October), boxes were deployed in approximately 25 locations for 56 trap-days (defined as leaving a baited box in an undisturbed location for 24 hours). The boxes were visited by polar bears, thus providing hair samples, on four occasions. This success rate (i.e., 4 out of 56 ≈ 7%) was significantly lower than during the pilot assessment of the hair-snare boxes in 2017 (Appendix 2). Potential reasons for lower success include random variation, changes in the density and distribution of bears, use of different attractants, and differences in polar bear behavior and metabolic state associated with the apparently improved nutritional condition of polar bears in 2018. On four occasions, boxes were deployed within 200 m of a polar bear that watched the deployment and subsequently remained in the same

location for 24 hours without visiting the box. In our experience, this behavior would be unusual for a polar bear that is searching for food or otherwise active.

Increasing the number of biological samples was an objective of the study in 2018. To accomplish this, we used two additional approaches. First, hair-snare boxes were deployed by WISNR staff in August and early September, before the research team arrived on Wrangel Island. This resulted in visits by polar bears and successful sample collection on nine occasions. Second, while traveling around the island we actively searched for, and collected hair samples from, recent polar bear daybeds. Daybeds occurred mostly along the coastline and spits. This approach resulted in 51 hair samples. We believe that selective sampling of daybeds produced hair samples that were deposited this summer or autumn, although this has not been confirmed. In total, sampling using hair-snare boxes, day beds, and other methods resulted in 68 hair samples. It is possible that some samples contain hair from more than one individual (e.g., if several bears visited the same hair-snare box). Although we tried to minimize such occurrences, it also is possible that multiple samples consist of hair from the same individual (e.g., if one bear visited several hair-snare boxes placed within a few km of each other). We also collected 13 samples of polar bear feces. Similar to previous years, biological samples (e.g., fat, muscle, hair, premolar tooth) were taken from any polar bear carcasses that were encountered, when possible to do so.

Aggregations of polar bears and other observations

On 16 September 2018 we revisited the location near Cape Thomas where approximately 181 polar bears were observed in the vicinity of a bowhead whale carcass in 2017 (Appendix 2). Only five bears were seen in the area, and there was no evidence of the whale carcass (Figure 4). WISNR staff observed 12 bears in this area on 12 August 2018, and more than 50 bears in this area on 26 August 2018. During both observations, the bears were not feeding and no edible remains of the bowhead were seen.

On 26 September we observed eight large adult males and one subadult male located within approximately 150 m of each other in a mountainous ravine near Cape Pillar, close to the location where approximately 3,000 walrus had hauled out in 2017. Most of these bears were in good nutritional condition (5 bears BCI 4, 3 bears BCI 3, and 1 bear BCI 2) and several had discolored fur, which often indicates recent feeding (i.e., dirt and debris adhere to marine mammal fat on the bear's fur). We hypothesized that these bears were resting together in the mountains and intermittently traveling approximately 1 km to the coast, to search for or consume walrus carcasses deposited there in 2017.

On 01 October we observed approximately 24 polar bears in the vicinity of the carcass of an adult walrus on the beach east of Somnitelnaya. Upon initial observation 5–6 animals were feeding on the carcass, and the number and composition of feeding animals changed as we watched (Figure 5).

In 2018, we were not aware of any stranded whale carcasses or large walrus haulouts on Wrangel Island prior to, or during, the ground-based observational survey. On 07 October, WISNR rangers reported two beluga carcasses on the beach near Cape Blossom with approximately 10 polar bears feeding on them.

Other interesting observations in 2018 included two sightings of wolverines in the mountainous interior of the island, a group of five wolves sighted on the southern tundra, and over 100 beluga whales sighted just offshore from

Somnitelnaya in early October. On 22 September, sockeye (red) salmon were observed spawning in the headwaters of the Clark River at approximately 250 m elevation (Figure 6).

Figure 4. Two musk ox and one polar bear (of a total of five) observed near Cape Thomas on 16 September 2018. In 2017 an aggregation of 181 polar bears and the carcass of a bowhead whale were observed at this same location.

Figure 5. A polar bear feeding on the carcass of an adult walrus, 01 October 2018.

Figure 6. Spawning sockeye (red) salmon in the headwaters of the Clark River.

Future plans

We plan to continue collaborative studies of polar bears on Wrangel Island in 2019, conditional on funding and other factors. It is important to repeat the ground-based observational survey using consistent methodology, thereby adding to the time-series of data on polar bear occurrence, demographic composition, reproductive status, nutritional condition, and habitat use. We intend to repeat or expand the spatial and temporal scope of non-invasive biological sampling, and will explore methods to improve the success rate of hair-snare boxes. We also will consider ground-based chemical immobilization of a limited number of polar bears to apply satellite radiocollars and collect biological samples.

In 2019 we will begin analyzing the data and samples collected to date, including the following:

- Biological samples will be transferred to the U.S. and submitted for genetic analysis.
- An analysis of the aggregation of polar bears observed around a bowhead whale carcass in 2017 will be submitted for publication.
- We will work on a methodological guide for the ground-based observational survey, to help establish consistent and effective monitoring of polar bears on Wrangel Island in the long term.
- We will begin to analyze the spatial distribution, habitat selection, and demography of polar bears on Wrangel Island.

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Appendix 1. 2016 Wrangel Island Polar Bear Survey

During September and October 2016 a ground-based visual polar bear survey of Wrangel Island was conducted by members of the Wrangel Island State Nature Reserve and the U.S. Fish and Wildlife Service. This survey was conducted to estimate indices of abundance, distribution, demographic composition, and body condition of polar bears of the Alaska-Chukotka (AC) population on Wrangel Island during this time. The objectives of this first year of this cooperative study included:

a. Establish a working relationship between Russian and U.S. colleagues.
b. Evaluate polar bear body condition in autumn.
c. Evaluate polar bear diets during autumn while on land.
d. Evaluate activities of polar bears on land (for example, resting or feeding).
e. Gather field data on characteristics of observed polar bears: sex and age composition of animals encountered, family group composition (including their sex, age, and reproductive status).
f. Assess areas for placement of hair snare stations, possible biopsy darting and capture locations.
g. Train inspectors to identify bears by age and sex to help with consistent field information gathering in future surveys.

This was a cooperative effort between the Wrangel Island State Nature Reserve, the United States Fish and Wildlife Service, and the All-Russian Research Institute of Environment Protection.

The survey was conducted between 28 September and 16 October, 2016.

More than 1,000 km were surveyed on Wrangel Island.

179 bears were recorded:
- 52 adult males;
- 16 adult females;
- 3 adults of unknown sex;
- 3 sub adults of unknown sex; and
- 36 bears of unknown sex and unknown age.

This also included 27 family groups:
- 9 groups of a female and one cub-of-the-year;
- 10 groups of a female and two cubs-of-the-year;
- 3 groups of a female and one cub older than one year; and
- 5 groups of a female and two cubs older than one year.

The majority of the bears were observed on the eastern surveys in the vicinity of Cape Waring, Pillar Point, and Brutch Spit. Additional aggregations of bears occurred along the coast in the southern portion of the island – Cape Blossom/Cape Thomas, the spits along Zal Krasin, and near the Somnitilnaya and Hishnicki rivers.

Of those that could be identified, 75% of the individual animals (107/142) were classified as having a body condition of “3”, 24% of the individuals (34/142) were classified as having a body condition of “4”, and one

percent (one individual) was classified as having a body condition of "2." The bear with a body condition of "2" appeared to be either sick or injured as it did not move when passed. We also recorded one dead cub-of-the-year on Brutch Spit. This animal was not included in the count. It appeared to be a natural death, but we could not determine how it died.

The initial behavior of the bears upon observation were recorded. The majority of the bears (52%) were observed resting. The initial behavior of the bears observed included:

Rest (94/179): 52%;
Walk (44/179): 25%;
Run (27/179): 15%;
Climb (9/179): 5%;
Feed (2/179): 1%;
Curious (2/179): 1%; and
Swim (1/179): 1%

Of the two bears observed feeding, both were eating something old, not fresh. One was feeding on a piece of old walrus skin, while we could not identify what the other bear was eating.

Training of the inspectors also occurred to help them identify bears by age and sex. Polar bear age and sex identification forms and notebooks were distributed to help with consistent field information gathering in future surveys.

We also assessed areas that would be possible for the placement of hair snare stations, biopsy darting and capture locations. The coasts near Cape Waring in the east and the Somnitilnaya Ranger station in the south would be the most logical places to test and refine these data gathering techniques on the island. They are close to the larger ranger stations and could be accessed by them at regular intervals.

The survey was a successful first step in developing a relationship between international colleagues to help better understand the current ecological importance of Wrangel Island to the shared AC polar bear population.

Collaborative polar bear studies on Wrangel Island:

a summary of 2017 fieldwork

Executive Summary

The Wrangel Island State Nature Reserve (WISNR) is critically important to the Alaska-Chukotka (AC) population of polar bears (*Ursus maritimus*). Most adult females in the AC population build their material dens on the island. Bears of all sex, age, and reproductive classes rely on this protected area as a terrestrial refuge during the ice-free season. The Russian Federation and the United States have initiated a collaborative three-year study of polar bears on Wrangel Island that is focused on systematic ground-based observational surveys and the non-invasive collection of genetic samples. Information from this study will help address key conservation challenges for the AC population, including sea-ice loss due to climate warming, increasing industrial activity and shipping in the region, and identification of a sustainable rate of subsistence harvest. A pilot study was conducted in 2016.

In 2017, we completed the first year of fieldwork, as summarized below†:

- From 19 September to 09 October we conducted a ground-based observational survey for polar bears on Wrangel Island, covering approximately 900 km. The survey was designed to sample important polar bear habitats in a systematic manner.
- We observed 589 individual polar bears during the survey. To our knowledge, this is the largest number of bears to be recorded on Wrangel Island.
- For bears that could be individually evaluated, the estimated sex, age, and reproductive composition was approximately 9% subadult, 23% adult male, 15% single adult female, 21% adult female with dependent young, and 34% unknown.
- We observed 78 family groups, consisting of an adult female with cubs-of-the-year (C0) or yearlings (C1). Mean litter size was 1.74 (SE = 0.09) for C0s, and 1.45 (SE = 0.10) for C1s. Six family groups consisted of an adult female with three dependent young, which is uncommon for polar bears in most areas.
- The majority of observed polar bears appeared to be in good nutritional condition. For bears that could be individually evaluated, the distribution of body condition index (BCI) scores was 3% BCI 1 and BCI 2 (thin), 64% BCI 3 (normal), and 33% BCI 4 (fat).
- Hair-snare boxes were deployed in 19 locations for approximately 35 trap-days, yielding 13 sets of hair samples. This suggests that hair-snare boxes are a viable method for collecting genetic samples from polar bears on Wrangel Island.
- On 20 September, we observed 181 polar bears in the immediate vicinity of a bowhead whale (*Balaena mysticetus*) carcass at Cape Thomas, on the southwestern coast of the island. On 30 September, we observed 10 bears feeding on a walrus (*Odobenus rosmarus*) calf near Cape Waring.
- Fieldwork in 2017 affirmed the critical importance of Wrangel Island to the AC polar bear population, especially in the context of longer ice-free seasons due to climate warming. Multiple years are required to evaluate trends in the data and to understand how the indices monitored in this study relate to population status. Russian and American collaborators intend to continue this study in 2018 and 2019.

†All findings are preliminary and subject to revision

Background

The Alaska-Chukotka (AC) polar bear population (also referred to as the "Chukchi Sea" subpopulation, with slightly different boundaries [Obbard et al. 2010]) ranges widely on the sea ice of the northern Bering, Chukchi, and eastern part of the East Siberian seas. Management and conservation of the AC population occurs under the *Agreement between the Government of the United States of America and the Government of the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population* (U.S.-Russia Agreement), a bilateral treaty signed in 2000. In the Chukchi Sea region, and throughout most of the polar bear range, sea-ice loss due to climate warming is the primary long-term threat to the species (Atwood et al. 2015, Regehr et al. 2016). There is empirical evidence that two of the Arctic's 19 subpopulations of polar bears have experienced sea-ice related declines (Bromaghin et al. 2015; Lunn et al. 2016). Several subpopulations show signs of stress (Obbard et al. 2016) or have been reported as stable or productive (e.g., Peacock et al. 2013, Rode et al. 2014), and others have unknown status due to deficient data (Obbard et al. 2010). Despite this variability, projected sea-ice loss in the 21st century is expected to negatively affect polar bears throughout much of their range, because the species depends fundamentally on sea ice for access to its primary prey (Atwood et al. 2016). In addition to climate warming, the AC population faces nearer-term management issues and potential threats including increased oil and gas activity, shipping, and other human activities in the Arctic. Furthermore, polar bears are an important traditional and subsistence resource for Native people in Alaska and Chukotka (Voorhees et al. 2014), and accurate scientific information is required to identify a sustainable rate of subsistence harvest (Regehr et al. 2017).

Satellite tagging studies indicate that a significant proportion of the AC population comes to Wrangel Island, Herald Island, and the Chukotski coast every year during the ice-free season, and that Wrangel Island is a particularly important seasonal resting habitat (Garner et al. 1994). From 2004-2011, an average of 220 polar bears per year were observed using Wrangel Island during the summer and autumn (Ovsyanikov 2012). Furthermore, the majority of pregnant females in the AC population appear to use Wrangel Island to construct their maternity dens (Garner et al. 1994). A recent study found that a larger proportion of the AC population used Wrangel Island each year, and spent a longer time on Wrangel Island, for the period 2008-2013 compared to the period 1986-1995 (Rode et al. 2015). This increased use was associated with declines in Arctic sea ice, which are projected to continue (IPCC 2013). Thus, the available scientific information indicates that Wrangel Island is of critical ecological importance to the AC polar bear population, and that its importance will likely increase as climate warming and human development of the region continue.

Up-to-date information on the AC population is required to address the conservation challenges listed above in accordance with the U.S.-Russia Agreement, the 1973 Agreement on the Conservation of Polar Bears, and national laws (which in the U.S. include the Endangered Species Act, Marine Mammal Protection Act, and the National Environmental Policy Act). Valuable information on the status of the AC population has been obtained by a live-capture study conducted by the U.S. Fish and Wildlife Service and partners in the American portion of the Chukchi Sea region (Rode et al. 2014, 2015; Wilson et al. 2014, 2016), although this study has provided only indirect information on the ecological role of Wrangel Island. Furthermore, findings of positive nutritional condition and reproduction from live-capture studies in the spring (Rode et al. 2014) have not been reconciled with indices of potentially declining body condition and reproduction collected on Wrangel Island in the autumn (Ovsyanikov 2012). Historically, more intensive observational studies occurred on Wrangel Island, to evaluate the number and distribution of resting bears; and to evaluate the number and distribution of maternity dens (Kischinskiy and Uspenskiy 1973; Belikov 1977, 1980, 1982; Belikov et al., 1986; Uspenskiy 1989; Stishov 1991). However, in recent

years these studies have not been conducted, or have been conducted intermittently or with an inconsistent sampling design.

The current study seeks to provide critical information on the status and ecology of the AC polar bear population through non-invasive observational and genetic studies on Wrangel Island. The collection, analysis, and interpretation of scientific data will be conducted collaboratively by Russian and American researchers using a consistent sampling design. In 2016, the Scientific Working Group (SWG) responsible for advising the Commissioners of the U.S.-Russia Agreement identified the current study as "high priority" with respect to management and conservation of the AC population (Scientific Working Group, 2016).

Fieldwork methods

In 2017 we conducted a ground-based observational survey using two all-terrain vehicles (ATVs; Honda TRX300 and TRX350) and one larger, low-impact tundra vehicle (Trakol; Figure 1). Personnel traveling in the vehicles (one per ATV, four or five in the Trakol) scanned continuously for polar bears while on survey. Additionally, the vehicles stopped periodically when a new portion of the landscape came into view, to perform focal observations using binoculars. The Trakol was fitted with a roof port that allowed a 360° field of view.

Figure 1. Two all-terrain vehicles (front) and one low-impact tundra vehicle (back) used for the ground-based observational survey of polar bears on Wrangel Island, autumn 2017.

The survey of Wrangel Island included 16 routes, each of which could be mostly covered in one day (Table 1). The routes were designed to sample key habitats including the coast, spits and barrier islands, tundra, hills, and mountains. The selection of routes was also based on terrain, traveling conditions, and the distances between shelters for overnight accommodation. Although small portions of some routes were covered more than once (e.g., when backtracking was required), observations were only recorded during the initial coverage to avoid double-

counting bears. Routes in 2017 were nearly identical to the routes covered during the pilot study in 2016 (Appendix 1).

Date	Route	Length of route (km)	Bears observed on route
9/19/2017	Neozhidanaya to Cape Blossom	44	53
9/20/2017	Cape Blossom to Cape Thomas to Neozhidanaya	59	198
9/22/2017	Neozhidanaya to Ptichiy Bazar to Goose River	80	26
9/23/2017	Goose River to Comsomol	29	4
9/24/2017	Comsomol to Tundra Peak (via Dream-Head)	84	71
9/27/2017	Tundra Peak to Krasniy Flag	62	17
9/28/2017	Krasniy Flag Loop	61	14
9/29/2017	Krasniy Flag to Cape Waring	67	15
9/30/2017	Dragi Bay (Cape Waring Loop)	11	30
10/2/2017	Bruch Spit (Cape Waring Loop)	70	32
10/4/2017	Cape Pillar (Cape Waring Loop, INCOMPLETE)	31	7
10/5/2017	Cape Waring to Ushakovskoye	72	24
10/6/2017	Ushakovskoye Loop	48	19
10/7/2017	Ushakovskoye to Somnitelnaya	83	27
10/8/2017	Somnitelnaya Spit (Somnitelnaya loop)	28	25
10/9/2017	Krasin Bay (Somnitelnaya loop)	70	27

Table 1. Routes completed during the ground-based observational survey of polar bears on Wrangel Island, autumn 2017.

For each polar bear or family group (i.e., adult female with dependent young) that was sighted while on survey, the following information was recorded: date and time; cohort, which defined the sex, age class, and reproductive status of the bear or family group; a standardized body condition index (BCI) that ranged from 1 to 5, with 1 being very thin and 5 being very fat; behavior of the bear when first sighted; habitat of the bear when first sighted; a Global Positioning System (GPS) waypoint corresponding to the location of the observer; the distance and heading between the waypoint and the location of the bear; and the weather and visibility. Estimates of cohort and BCI were established by consensus among observers, when possible.

In addition to performing the observational survey, we evaluated the feasibility of non-invasive genetic sampling using hair-snare boxes (Figure 2). Hair-snare boxes were constructed of plywood, with sides measuring approximately 1 cm (thickness) × 38 cm (width) × 63 cm (length). The boxes were fitted with flexible stainless steel brushes at the open end, which were designed to collect hairs upon contact with the arm or head of a polar bear. Most boxes were baited with approximately 5 cc of water solution containing decomposed fish and meat, which served as a scent attractant but did not provide bears with a food reward. In 2017, the boxes were deployed opportunistically along survey routes and in the vicinity of cabins. A primary goal of hair sampling is to obtain individual genetic identifications of polar bears on Wrangel Island, which could be used in conjunction with other genetic data available for the AC population (e.g., from live-capture research in the US) to evaluate polar bear movements, habitat use, and demography.

Figure 2. Hair-snare boxes used to collect genetic samples from polar bears on Wrangel Island, autumn 2017.

Summary of 2017 fieldwork

We completed the 16 routes of the survey between 19 September and 09 October, 2017. One route (Cape Pillar) was not entirely completed due to weather. The total distance traveled was approximately 900 km. During the survey period, daytime temperatures varied from approximately -7 to +5°C. In most areas the ground was snow free, or lightly snow covered, at elevations below approximately 100 m. Deeper snow above approximately 100 m elevation made travel difficult in some areas.

During the survey, complete individual information could not be recorded for some bears, for example because the bear was too far away or its sex and age could not be determined with confidence. Additionally, it was not possible to record complete individual information for two groups of bears due to logistical constraints. First, an aggregation of 181 bears was observed at Cape Thomas on 20 September (see below). For this aggregation, we recorded the total number of bears and the occurrence of family groups, which were clearly identifiable from a distance. We also recorded general observations for BCI and behavior. Second, 26 independent bears were observed on a portion of Dream-Head Mountain on 24 September. For these bears, we recorded the total number of bears, as well as general observations for BCI and cohort. Most of the bears in the Dream-Head mountain area appeared to be adult females waiting to construct maternal dens, and we observed several apparent den entrances in large snow banks at elevations above approximately 100 m.

Polar bear numbers and cohort

We observed a total of 589 polar bears during the survey (Figure 3). Because not all polar bears along the survey routes were detected, and because the routes did not cover the entire island, the actual number of polar bears on Wrangel Island during autumn 2017 was likely significantly higher than 589. For the 290 independent bears and

family groups for which cohort was individually identified (i.e., excluding bears from Cape Thomas and a portion of Dream-Head Mountain), the approximate cohort composition was: 9% subadult, 23% adult male, 15% single adult female, 21% adult female with dependent young, and 34% unknown. Detailed cohort information is provided in Table 2.

Figure 3. Map of Wrangel Island, including the survey routes (blue lines) and locations from which polar bears were observed (purple dots) during the ground-based observational survey, autumn 2017. The large purple dot on the west coast represents the aggregation of 181 bears near a bowhead whale carcass at Cape Thomas.

Cohort	Description	Excluding Cape Thomas and partial Dream-Head Mountain	Including Cape Thomas and partial Dream-Head Mountain
C0	lone cub-of-the-year (approx. 9 mo.)	0	1
C1	lone yearling (approx. 21 mo.)	1	1
SF	subadult* female	3	3
SM	subadult male	9	9
SU	subadult unknown sex	13	13
AF	single adult** female	43	43
AF1C0	adult female with 1 cub-of-the-year	13	15
AF2C0	adult female with 2 cubs-of-the-year	18	24
AF3C0	adult female with 3 cubs-of-the-year	2	4
AF1C1	adult female with 1 yearling	16	20
AF2C1	adult female with 2 yearlings	8	11
AF3C1	adult female with 3 yearlings	1	2
AF1C?	adult female with 1 cub unknown age	2	2
AF2C?	adult female with 2 cubs unknown age	0	0
AM	adult male	65	67
AU	adult unknown sex	10	10
UU	unknown age and unknown sex	86	239

Table 2. Detailed sex, age class, and reproductive status information for polar bears observed on Wrangel Island, autumn 2017. *Subadults are bears age 2-4 years. **Adults are bears age ≥ 5 years.

Reproductive observations

We observed 78 family groups, consisting of an adult female with cubs-of-the-year (AFC0) or and adult female with yearlings (AFC1; Table 2). Mean litter size was 1.74 (SE = 0.09) for C0s, and 1.45 (SE = 0.10) for C1s. Six of the 78 family groups observed consisted of an adult female with three dependent young, which is uncommon for polar bears in most areas.

Nutritional condition

The majority of observed polar bears appeared to be in good nutritional condition. BCI scores were recorded for 166 independent bears and adult females with families; BCI was not recorded for dependent young. The distribution of BCI scores was: 1% BCI 1 (one apparently old and arthritic male bear), 2% BCI 2, 64% BCI 3, 33% BCI 4, and 0% BCI 5.

Behavior and habitat

Behavior and habitat were recorded for 464 individuals or family groups. The distribution of behaviors was: 39% at rest (i.e., lying on the ground), 32% Cape Thomas (see below), 19% walk, 5% sit, 2% stand, 2% run, and 1% other (one bear swimming, two bears feeding, and one bear interacting with a herd of musk ox). In some cases, the behavior of a bear when first observed may have reflected its reaction to a vehicle. The distribution of habitats occupied by bears was: 32% Cape Thomas (see below), 17% tundra, 17% mountain (elevated areas covered mostly by rock and snow), 16% spits and barrier islands, 11% hill (elevated areas covered mostly by tundra), 5% coast (rock and gravel beaches along the main coastline), and 2% human settlement (abandoned structures and cabins).

Genetic sampling

Hair-snare boxes were successfully used to collect hair samples for genetic analysis (Figure 4). Boxes were deployed in 19 locations for a total of approximately 35 trap-days (defined as the box being deployed for a 24-hour period). The boxes were visited by polar bears on 13 occasions, each occasion providing 2-4 wire brushes that each contained more than 10 hairs in most instances (Figure 4).

In addition to the hair-snare boxes, we collected hair samples from eight locations where polar bears had been seen resting (i.e., daybeds) immediately prior to sample collection. We also collected five fecal samples from polar bears, as well as muscle and fat samples from two walrus (*Odobenus rosmarus*) carcasses. Finally, we collected muscle, fat, hair, and a vestigial premolar from the decomposed carcass of one polar bear that was found near Cape Pillar. The skeleton size indicated this was a large adult male. Although the cause of death was unknown, the teeth were very worn and both lower canines were broken off at the gum line, which is common for senescent adult male bears.

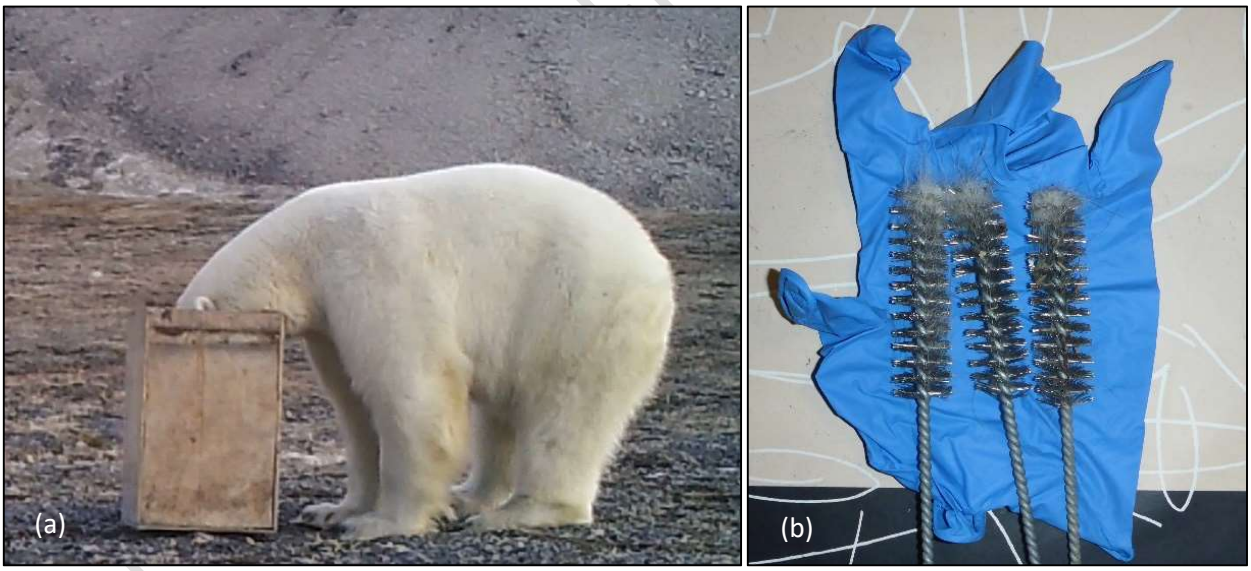

Figure 4. (a) A polar bear visiting a hair-snare box near Cape Waring, autumn 2017. This picture was taken using a motion-activated remote camera. (b) Brushes with hair samples from a hair-snare box that had been visited by a polar bear.

Aggregations of polar bears

On 20 September, 181 polar bears were observed in the vicinity of a bowhead whale (*Balaena mysticetus*) carcass at Cape Thomas (Figure 5). To our knowledge this is the largest aggregation of polar bears to be recorded for the AC population. The carcass appeared to be a mature whale and was not severely decomposed. While being observed on 20 September, approximately 35 bears of various cohorts, including adult females with dependent young, were located on the beach adjacent to the carcass. However, few bears appeared to be feeding successfully due to a high sea level and rough surf. The remaining bears were resting, sitting, walking, and interacting on the tundra, hillside, and mountainside within a radius of approximately 1 km from the carcass. On the preceding day, 19 September, Wrangel Island State Nature Reserve staff had observed the same aggregation of polar bears from the sea, while aboard the vessel Academic Shokalskiy operated by Heritage Expeditions. At that time, the whale carcass was more exposed and approximately 15 bears (mostly adult males) were actively feeding on the carcass (Figure 6). Additional analyses of the Cape Thomas aggregation will be performed based on high-resolution digital photographs and other materials.

On 30 September, we observed more than 10 polar bears feeding on a freshly-killed walrus calf along the coast of Dragi Bay, near Cape Waring (Figure 7). Earlier in the month, Wrangel Island State Nature Reserve staff reported approximately 3,000 walrus hauled out near Cape Waring. Although we were not able to see the walrus or complete the Cape Pillar route due to poor weather, we encountered a high concentration of bears in the vicinity of Cape Waring (Figure 3).

Figure 5. An aggregation of 181 polar bears on the beach, hillside, and mountain in the vicinity of a beach-cast bowhead whale carcass, observed at Cape Thomas on 20 September 2017. The yellow dots on the hills and beach are polar bears.

Figure 6. Polar bears feeding on the bowhead whale carcass at Cape Thomas, as observed by staff of the Wrangel Island State Nature Reserve from the vessel Academic Shokalskiy on 19 September 2017.

Figure 7. Polar bears feeding on a walrus calf near Cape Waring, 30 September 2017.

Future considerations and plans

This collaborative study of polar bears on Wrangel Island will continue in 2018 and 2019, conditional on the availability of funding. A primary objective is to repeat the ground-based observational survey, with the goal of developing a consistent time-series of data on polar bear occurrence, demographic composition, reproductive rates, nutritional condition, and habitat use. In 2018 we will evaluate options to expand the spatial and temporal scope of non-invasive genetic sampling. We also will consider evaluating the potential for the ground-based chemical immobilization of a limited number of polar bears, for the purpose of applying satellite radiocollars and collecting a broader suite of biological samples.

Acknowledgements

Primary funding for this study was provided by the Wrangel Island State Nature Reserve, the U.S. Fish and Wildlife Service, the University of Washington, and the All-Russian Research Institute for Environment Protection. Fieldwork in 2017 was conducted by E. Regehr (University of Washington), S. Belikov and P. Pestina (All-Russian Research Institute for Environment Protection), and D. Vasiliev and U. Babiy (Wrangel Island State Nature Reserve). Additional support for E. Regehr was provided by the Campion Foundation and the World Wildlife Fund. Fieldwork logistics were coordinated by A. Gruzdev and A. Skripnik (Wrangel Island State Nature Reserve). Assistance with financial coordination was provided by V. Burkanov (North Pacific Wildlife Consultants). Fieldwork during the pilot study in 2016 was conducted by C. Perham (U.S. Fish and Wildlife Service), and D. Vasiliev and G. Fedorov (Wrangel Island State Nature Reserve).

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Appendix D.

OMB Number: 4040-0004
Expiration Date: 10/31/2019

Application for Federal Assistance SF-424

* 1. Type of Submission:
- [ ] Preapplication
- [ ] Application
- [x] Changed/Corrected Application

* 2. Type of Application:
- [ ] New
- [ ] Continuation
- [x] Revision

* If Revision, select appropriate letter(s): A: Increase Award

* Other (Specify):

* 3. Date Received: 11/24/2017

4. Applicant Identifier: AKW-ESA E-23-1

5a. Federal Entity Identifier:

5b. Federal Award Identifier: Coop ES Cnsv Fnd Sec 6

State Use Only:

6. Date Received by State:

7. State Application Identifier: Chukchi Sea Polar Bears

8. APPLICANT INFORMATION:

* a. Legal Name: Alaska Dept. of Fish & Game, Div. of Wildlife Conservation

* b. Employer/Taxpayer Identification Number (EIN/TIN): 92-6001185

* c. Organizational DUNS: 8093874750000

d. Address:

* Street1: PO Box 115526
Street2:
* City: Juneau
County/Parish:
* State: AK: Alaska
Province:
* Country: USA: UNITED STATES
* Zip / Postal Code: 99811-5526

e. Organizational Unit:

Department Name: Fish & Game

Division Name: Wildlife Conservation

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:
* First Name: Brenda
Middle Name:
* Last Name: Bowers
Suffix:

Title: Federal Aid Coordinator

Organizational Affiliation:

* Telephone Number: (907) 465-6198
Fax Number: (907) 465-6142

* Email: brenda.bowers@alaska.gov

Application for Federal Assistance SF-424

*** 9. Type of Applicant 1: Select Applicant Type:**

A: State Government

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

US Fish & Wildlife Service

11. Catalog of Federal Domestic Assistance Number:

15-615

CFDA Title:

Cooperative Endangered Species Conservation Fund Sec. 6

*** 12. Funding Opportunity Number:**

F16AS00074

* Title:

Traditional Section 6 Conservation Grant

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

Add Attachment | Delete Attachment | View Attachment

*** 15. Descriptive Title of Applicant's Project:**

Chukchi Sea Polar Bears

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: AK-001 * b. Program/Project: AK-001

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 10/01/2016 * b. End Date: 09/30/2019

18. Estimated Funding ($):

* a. Federal	93,857.00
* b. Applicant	0.00
* c. State	0.00
* d. Local	0.00
* e. Other	31,286.00
* f. Program Income	0.00
* g. TOTAL	125,143.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

☐ a. This application was made available to the State under the Executive Order 12372 Process for review on .

☒ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

☐ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes," provide explanation in attachment.)**

☐ Yes ☒ No

If "Yes", provide explanation and attach

Add Attachment | Delete Attachment | View Attachment

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)**

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: Ms. * First Name: Carol

Middle Name:

* Last Name: Petraborg

Suffix:

* Title: Director, Division of Administrative Services

* Telephone Number: (907) 465-6077 Fax Number: (907) 465-6078

* Email: carol.petraborg@alaska.gov

* Signature of Authorized Representative: CBrown-Mills For Carol Petraborg * Date Signed: 1/18/18

THE STATE of ALASKA
GOVERNOR BILL WALKER

Department of Fish and Game
DIVISION OF WILDLIFE CONSERVATION
Headquarters

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December 11, 2017

Steve Klein, Chief
Wildlife and Sport Fish Restoration Program, Alaska
U.S. Fish and Wildlife Service
1011 East Tudor Road
Anchorage, Alaska 99503-6199

Re: AKW-ESA E-23-1 FY18 Amendment 1

Dear Mr. Klein:

Enclosed is a Federal Aid application asking for an amendment to increase funds to the Section 6 Endangered Species Conservation Fund grant (ESA) *AKW-ESA E-23-1 Chukchi Sea Polar Bears FY2016*, supporting the Alaska Department of Fish and Game – Division of Wildlife Conservation's (DWC) Threatened, Endangered, and Diversity program. The initial E-23-1 grant mistakenly did not include the full costs of polar bear project. There was additional salary cost that we intended to pay out of SWG T-32 Project #15, but those costs were not included in the initial budget for E-23-1 when the grant was submitted. The revised budget provided in this amendment package addresses that shortcoming by providing additional funds to fully fund the polar bear project. This amendment will obligate additional ESA Section 6 funds to cover fieldwork, travel, and most but not all, of the personnel costs of the project. A small portion of personnel costs to help coordinate the E-23-1 grant will still be paid with SWG T-32 Project #15.0, or a similar coordination project, in year 3.

	Current	Amendment 1	Total
Direct Costs	$155,955	$110,103	$266,058
Indirect Costs	(21%) $10,706	(22.74%) $15,040	$25,746
Total Grant	**$166,661**	**$125,143**	**$291,804**

Federal Share: 75%	$124,996	$93,857	$218,853
State Share: 25%	$41,665	$31,286	$72,951
TOTAL	**$166,661**	**$125,143**	**$291,804**

The total amendment amount requested is $125,143. We are requesting $93,857 in federal funds (75:25) from the Section 6 Endangered Species Conservation Fund to support the project. For the amendment, the State will match with third party in-kind match from the North Slope Borough and World Wildlife Fund, in the amount of at least $31,286.

The State assessed a 21% indirect cost rate on the subtotal of the grant from personnel services in FY17, and will assess the current 22.74% indirect cost rate in FY18 and FY19. We request that cost accounting be implemented at the grant level. The Department of Fish and Game provides budget estimates in the project statement—actual expenditures could vary between budget categories. We have requested a waiver of the 10% rule.

We have reviewed the proposal for meeting National Environmental Policy Act compliance and found that it is completely covered by 516 DM 8 categorical exclusions. This grant falls under the categorical exclusion A(2) personnel training, environmental interpretation, public safety efforts, and other educational activities which do not involve new construction or major additions to existing facilities.

This proposal will NOT (516 DM 2, Appendix 2):

1. *Have significant impacts on public health or safety.*
2. *Have significant impacts on such natural resources and unique geographic characteristics as historic or cultural resources; park, recreation or refuge lands; wilderness areas; wild or scenic rivers; national natural landmarks; sole or principal drinking water aquifers; prime farmlands; wetlands (Executive Order 11990); floodplains (Executive Order1 1988); national monuments; migratory birds; and other ecologically significant or critical areas.*
3. *Have highly controversial environmental effects or involve unresolved conflicts concerning alternative uses of available resources [NEPA Section 102(2)(E)].*
4. *Have highly uncertain and potentially significant environmental effects or involve unique or unknown environmental risks.*
5. *Establish a precedent for future action or represent a decision in principle about future actions with potentially significant environmental effects.*
6. *Have a direct relationship to other actions with individually insignificant but cumulatively significant environmental effects.*
7. *Have significant impacts on properties listed, or eligible for listing, on the National Register of Historic Places as determined by either the bureau or office.*
8. *Have significant impacts on species listed, or proposed to be listed, on the List of Endangered or Threatened Species, or have significant impacts on designated Critical Habitat for these species.*
9. *Violate a Federal law, or a State, local, or tribal law or requirement imposed for the protection of the environment.*
10. *Have a disproportionately high and adverse effect on low income or minority populations (Executive Order 12898).*
11. *Limit access to and ceremonial use of Indian sacred sites on Federal lands by Indian religious practitioners or significantly adversely affect the physical integrity of such sacred sites (Executive Order 13007).*
12. *Contribute to the introduction, continued existence, or spread of noxious weeds or nonnative invasive species known to occur in the area or actions that may promote the introduction, growth, or expansion of the range of such species (Federal Noxious Weed Control Act and Executive Order 13 112).*

Additionally, the actions for this grant will have NO EFFECT on listed species pursuant to the Endangered Species Act (16 U.S.C. 1531-1534).

If you have any questions or require additional information, please don't hesitate to contact me.

Sincerely,

Brenda Bowers

Brenda Bowers
Federal Aid Coordinator
907-465-6198

Cc:

Jeff Hoover, Administrative Operations Manager, ADF&G-DWC
Lori Quakenbush, Wildlife Biologist IV, ADF&G- DWC

Enclosures:

AKW-ESA E-23-1 FY2017 project statement, SF424, and budget summary.

Grant Budget Summary - Includes ALL projects

Federal Grant Program: Endangered Species Act	Section 6 ESA	Federal Grant Number: AKW-ESA E-23 FY2017
Grant Period:	October 1, 2016 - September 30, 2019	
Grant Title: Chukchi Sea Polar Bears		

Project #	71000 - Personal Services	72000 - Travel	73000 - Contracted Services	74000 - Supplies	75000 - Equipment	Project Total w/o indirect
Chuckchi Sea Polar Bears - Original AFA	$50,980.70	$28,820.00	$75,600.00	$555.00	$0.00	$155,955.70
Amendment 1	$66,141.00	$0.00	$40,885.00	$3,076.00	$0.00	$110,102.00
						$0.00
						$0.00
						$0.00
						$0.00
Totals	$117,121.70	$28,820.00	$116,485.00	$3,631.00	$0.00	$266,057.70

Personal Services Summary - 71000 - Original Grant

	Total
Personal Services Total	$50,980.70
Negotiated Indirect Rate 21%	$10,705.95
Total Personal Services + Indirect	$61,686.65

Personal Services Summary - 71000 - amendment #1

	Total
Personal Services Total	$66,141.00
Negotiated Indirect Rate 22.74%	$15,040.46
Total Personal Services + Indirect	$81,181.46

Grand Total Personnel Services - 71000 — $142,868.11

Your Negotiated Indirect Cost Rate should not be applied to expenses below this line

Travel Expenses - 72000

Travel Total	$28,820.00

Contractual Summary - 73000

Original	$75,600.00
Amendment	$40,885.00
Contracts Total	$116,485.00

Commodities Summary - 74000

Original	$555.00
Amendment	$3,076.00
Services and Supplies Total	$3,631.00

Equipment Summary - 75000

Equipment Total	$0.00

Match Summary

Original - North Slope Borough	$41,665.00
North Slope Borough 3rd Party In-Kind and World Wildlife Fund Cash Contribution	$31,286.00
Cost-Sharing/In-Kind Match Total	$72,951.00

Grant Funding Summary

Federal Dollars	75%	$218,853.08
In-Kind Match	25%	$72,951.03
State Match		$0.00
Total for Grant		$291,804.11

Initial AFA Obligation, June 2015:

Federal	75%	$124,996.24
State	25%	$41,665.41
Total		$166,661.65

Amendment #1 Obligation

Federal	75%	$93,857.00
State	25%	$31,286.00
Total		$125,143.00

Alaska Department of Fish & Game
Division of Wildlife Conservation
FEDERAL AID PROJECT STATEMENT

Funding Source(s):

COOPERATIVE ENDANGERED SPECIES CONSERVATION FUND (Section 6 ESA)

$124,966 matched with in-kind resources

$93,857 added for the remainder of the project matched with in-kind resources

$49,014 spent in FY17 (with indirect on personnel only at 21% in FY17 and 22.74% in FY18 and FY19)

Grant Number: **AKW-ESA E-23-1**
Starting Segment Number: **1**
Project Number: **1**

Project Title: Genetic Mark-Recapture of Chukchi Sea Polar Bears

Project Start and Ending Dates: 1 October 2017 – 30 September 2019

Location: Northwestern Alaska including the communities of Utqiaġvik (formerly Barrow), Wainwright, Point Lay, Point Hope, Shishmaref, Wales, Diomede, Gambell and Savoonga, Alaska

Need:

Polar bears (*Ursus maritimus*) were listed as threatened under the U.S. Endangered Species Act in 2008. Two subpopulations occur in the U.S. (Alaska) and each are shared with other countries; the Southern Beaufort Sea subpopulation is shared with Canada and the Chukchi Sea subpopulation is shared with Russia. These shared populations require international agreements for their management.

The Southern Beaufort Sea subpopulation is managed through the Inuvialuit-Iñupiat Polar Bear Management Agreement (I-I Agreement). The I-I Agreement established the Inuvialuit-Iñupiat Polar Bear Commission to establish harvest limits, which are voluntary in the U.S. and implemented by law in Canada. In Alaska, these harvest limits apply to the northern communities of Kaktovik, Nuiqsut, Utqiaġvik (formerly Barrow), and Wainwright.

The Chukchi Sea subpopulation is managed through the U.S.-Russia Bilateral Agreement, which established the U.S.-Russia Polar Bear Commission (Bilateral Commission). Like the I-I Commission, the Bilateral Commission determines an annual harvest quota for the shared subpopulation between Russia and the U.S. This proposal focuses on the Chukchi Sea polar bear subpopulation.

The status of the Chukchi Sea polar bear subpopulation is considered data deficient including scant data to support an abundance estimate with any confidence (IUCN 2006, USFWS 2010). Regardless of the lack of data, the Scientific Working Group of the Bilateral Commission was

tasked with providing a sustainable harvest quota for the shared population, and in 2010, the Scientific Working Group using an abundance estimate of 2,000 bears set a harvest quota of 58 bears, 29 for each country, which applied to communities located from Point Barrow south to the annual formation of drift ice (i.e., Utqiaġvik, Wainwright, Point Lay, Point Hope, Kivalina, Shishmaref, Wales, Little Diomede, Nome, Gambell, Savoonga, Emmonak, and Hooper Bay). Full implementation of the 2010 harvest quota is not expected to begin before 1 January 2020. An abundance estimate for the Chukchi Sea subpopulation is needed to balance subsistence and conservation needs of polar bears important to Chukotka and Alaska, and to fulfill Bilateral Agreement management obligations with Russia.

The U.S. Fish and Wildlife Service (USFWS) and U.S. Geological Survey (USGS) conduct research on polar bears in Alaska, and USFWS collects genetic samples from bears during their research based out of the Red Dog Mine port facility in the Chukchi Sea southwest of Point Hope, however, the areas north, between Point Hope and Barrow, and south, between Point Hope and Saint Lawrence Island are not sampled.

A preliminary study was conducted in 2016 to see if hair containing DNA could be collected without physically capturing bears. Hair collection stations using barbed-wire were placed near Utqiaġvik and Point Lay and 46 hair samples were collected. The samples were analyzed at the USGS laboratory in Anchorage and 22 individual bears were identified, 15 of which were sampled once and seven of which were sampled multiple times. Some of the samples are from related individuals, probably mother-cub pairs, but further analysis is needed to confirm those determinations.

There was local concern over the use of barbed-wire stations because barbed-wire might entangle wildlife. In addition, removing hair from barbed-wire was difficult in cold, windy conditions. The hair becomes brittle and can easily blow away between removing it from the wire and getting it in a sample envelope. The wire needed to be cleaned of any DNA so that previously sampled hair is not resampled resulting in false recaptures. A gas torch was used to burn the wire where hair was attached but this was also difficult in cold, windy conditions.

Modifications to the hair collecting stations were made in 2017 and barbed-wire was replaced with wire brushes that could easily be removed and replaced when they had hair on them. The brushes were positioned pointing inward in a wooden box, replacing the much larger wooden tripod frame on which the barbed-wire was attached. The boxes were easy to build, ship, deploy, check, and collect at the end of the season for re-use in subsequent years.

In 2017, 14 hair collection stations were deployed near six villages and stations were checked 223 times and five hair samples were collected. Two stations were deployed from Red Dog Mine on pack ice during USFWS research activities, but no hair was collected from either station and both stations moved with the ice when it broke free and were not retrieved.

This study uses non-invasive collecting stations to collect hair from which DNA can be extracted from the follicles. The DNA is used to genetically identify (mark) individual polar bears for mark-recapture analysis to eventually contribute to a collaborative Chukchi Sea subpopulation abundance estimate. Hair sampling stations will be placed between Utqiaġvik and Saint

Lawrence Island with the assistance of local hunters to determine the best locations, maintain the station and collect the hair on a regular schedule as weather allows.

Using what we learn each year we will refine methods and develop recommendations including whether a sufficient number of bears could be identified (using DNA) and combined with bears sampled during capture programs to provide an estimate of abundance for polar bears in the Chukchi Sea subpopulation. To increase the number of individually-marked bears in the subpopulation this study proposes to increase the current geographic sampling area by placing hair collection stations between Utqiaġvik and Saint Lawrence Island, such that samples are most likely from Chukchi Sea bears. Impediments to this sampling regime include the lack of sampling in the Russian portion of the Chukchi Sea, however, our methods (box design and brushes) were tried successfully on Wrangel Island, Russia, in 2017 during a Russian and United States collaborative study. With relatively little effort (35 trap-days), 13 polar bear hair samples were collected (E. Regehr pers. comm.). The boxes worked well, were easy to deploy and the team thought they could have collected many more samples but their main objective was a land-based survey and they did not have the manpower to do the hair stations and the survey. We plan to provide support (e.g., hair collecting boxes, brushes, and lab analysis support) to a 2018 effort as needed. This method could also be implemented in other locations in Russia.

An abundance estimate for the Chukchi Sea subpopulation is needed. If there are more than 2,000 bears the harvest could be higher than the 58 currently set by the quota. If there are fewer, a more restrictive quota may be needed to ensure a sustainable harvest.

Objectives:

Objective 1: Work with local hunters to deploy polar bear hair sampling stations for polar bears in 2018 and 2019.

Job/Activity 1a: Deploy up to 50 hair collection stations at up to 10 locations along the Alaskan coast on shore-fast ice and land accessible by snowmachine and ATV from participating villages. We have permission from the communities for up to five stations to be deployed per location, near Utqiaġvik, Wainwright, Point Lay, Point Hope, Shishmaref, Diomede, Wales, Gambell, and Savoonga.

Job/Activity 1b: Using standard protocols developed for brown and black bears, hair collection stations will be checked and samples collected during a 4–6 week field season. Hair collected will be processed and stored for later analysis. Details about frequency of station visits, status of station, presence of tracks if no hair is collected, etc., will be documented.

Job/Activity 1c: Analyze hair samples to identify individual bears using DNA/microsatellite analysis at Wildlife Genetics International, Inc., or other qualified genetics lab.

Job/Activity 1d: Evaluate the samples collected and bear identification data obtained at the end of the season to assess field methods. Adjust methods to improve hair collection in 2018.

Objective 2: Investigate the possibility deploying and checking hair collection stations on the pack ice.

Job/Activity 2a: Collaborate with USFWS research crew working out of Red Dog to deploy hair collection stations in the pack ice at several locations that could be checked by helicopter during their regular polar bear capture activities to determine whether pack ice stations would be cost effective.

Objective 3: Evaluate the number and quality of samples collected in 2017, 2018 and 2019.

Job/Activity 3a: Evaluate the quality of the samples by determining the proportion of samples tested that render DNA that can be used to identify individual bears. For example, DNA can be more difficult to extract from follicles of underfur than guard hairs and from loose guard hairs than those that are pulled.

Job/Activity 3b: Determine the number of between-year recaptures in 2018 by comparing individuals identified in 2016, and 2017 to those identified in 2018. The sample size of unique individuals, the subpopulation size, the pattern of movements, and survival will dictate how many recaptures may occur.

Job/Activity 3c: Determine how many hair samples are duplicates within a station visit and between stations in the same year. For example, if one bear leaves hair at three different places on one station and then travels to the next station and does the same, hair will be analyzed six times to reveal only one individual has been sampled. This will affect the lab costs per individual identified. The distribution and number of stations per location will be adjusted to minimize this duplication as much as possible.

Job/Activity 3d: Determine if sample size (i.e., number of individual bears sampled) attained in 2017, 2018, and 2019 is adequate when added to physical capture samples to justify additional years of collection to attain a sample size that will provide an abundance estimate with reasonable (~20%) precision. Because polar bears are long-lived with low birth rates and high survival accumulating marks across years is acceptable.

Approach and Methods:

Hair collection stations have been constructed of ¼ inch plywood boxes (36 x 18 inches) open at one end. Four wire brushes are placed through the corners of the box facing in and down. A scent source (attractant) is placed in the bottom of the box to encourage the bears to reach in the box. Hunters will be consulted for improvements to this design and for ways to use attractants and what those attractants should be. Visual attractants may also be tried, such as CDs and colorful or metallic flagging. Deployments may occur from as early as mid-February and sample collection may extend through the first week of May, depending on the latitude of the location. The stations will be checked at least once per week, and the schedule for checking will be modified as determined by field conditions.

In 2018, up to 50 hair collection stations will be deployed in areas near accessible prominent points of land near communities (Utqiaġvik, Wainwright, Point Lay, Point Hope, Shishmaref, Little Diomede, Wales, Teller, Gambell, and Savoonga on shore-fast ice or land with community participation. Stations will be checked at least once per week using a snowmachine and

following standard protocols. All hair collected will be processed and stored according to protocols established for DNA analyses. For example, clumps of hair will be placed in a paper envelope and kept dry. Envelopes are labeled with the collection information. In 2018, up to 50 hair collection stations will be deployed near the same locations as in 2017 unless results of 2017 or changes in community participation dictate changes.

Also in 2018 and 2019, we will work with USFWS polar bear research crew to see if placing hair collection stations on the pack ice within their research area is feasible. They will need to be able to visit the stations once per week and remove the station when their field project ends.

Hair samples will be processed, inventoried, and shipped to Wildlife Genetics International, Inc., or other qualified lab, where individual identification of polar bears will be made using microsatellite analyses from DNA extracted from hair follicles (Paetkau et al. 1999). Costs for lab analysis of hair will be shared by the North Slope Borough (NSB), World Wildlife Fund and are included in this proposal for FY 19. Individual bears can continue to be identified (as new or recaptured bears) in additional years and combined with other sources of DNA (e.g., research projects) to contribute to a sample size that may be adequate for an abundance estimate within ~5 years using mark-recapture models such the traditional formulation of the Jolly-Seber model using Program JOLLY (Pollock et al. 1990), and a POPAN formulation of a Jolly-Seber (Jolly 1965, Seber 1965, Schwarz and Arnason 1996).

Once all hair samples are analyzed, we will report the number of recaptures and if feasible calculate a preliminary subpopulation estimate. We conducted a genetic mark-recapture study on the Bristol Bay subpopulation of beluga whales using skin samples collected over a 10 year period from 516 uniquely identified individual belugas (Citta et al. *In press*). We recaptured 75 belugas in separate years and using a POPAN Jolly-Seber model estimated abundance at 1,928 belugas (95% CI = 1,611 to 2,337) not including calves, which were not sampled (Table 1). This is the first estimate of abundance of belugas in Bristol Bay with appropriate confidence limits.

Table 1. Unique belugas (as determined by genotyping) and genetic recaptures identified between 2002 and 2014.

Year	Unique belugas	Recaptures
2002	6	0
2003	5	0
2004	28	0
2005	11	0
2006	46	5
2007	70	3
2008	99	21

2009	15	2
2010	115	16
2011	121	38
Total	**468**	**85**

If non-invasive hair collection using stations managed at multiple locations by local hunters yields a reasonable sample size that can be added to annually at relatively low cost, samples from other sources can be added, including from Russia, to achieve the sample size necessary to calculate an abundance estimate with confidence intervals.

DNA samples are being collected during capture projects from 60–70 polar bears per year from the Chukchi Sea subpopulation. If 30–40 more could be added using hair collection stations it may be possible to calculate an abundance estimate in < 5 years. DNA from harvested bears can be used to increase the precision of the estimate by removing bears from the database that cannot be recaptured. This genetic dataset could also be used to apply Close-Kin Mark-Recapture (CKMR) methods. CKMR is a genetics-based method that uses information about relatedness to greatly widen the scope and enhance the power of traditional mark-recapture techniques for estimating abundance and demographic parameters. Although nuclear DNA loci can be used, CKMR is greatly enhanced by single nucleotide polymorphism (SNPs), which have not been developed for polar bears. CKMR is especially effective when combined with ongoing traditional DNA mark-recapture studies (i.e., self-recapture studies) and when applied to hunted populations (Bravington et al. 2016).

In 2019, after lab analyses have identified all unique individuals, a final technical report will produced by ADF&G. Project updates and reports will be provided to the villages. If the project PIs believe the results are worthy of publication in a scientific journal, a manuscript will be prepared.

Permitting – Polar bear hair will be collected under USFWS permit # MA134907-1, which covers all ESA and MMPA permitting requirements. ADF&G covers polar bear hair collection under is Institutional Animal Care and Use Permit (IACUC #0027-2017-27). The NSB will obtain a CITES permit for shipping polar bear hair samples to Wildlife Genetics International (Canada) for analysis or an existing one will be used as appropriate.

Schedule:

Date	Activity
2017 October-December	Review preliminary study results to implement recommendations, prepare hair collection stations, introduce project to new communities, contact interested hunters, and revisit participating communities. Provide U.S. with hair collection station methods and brushes for trial on Wrangel Island.
2018	
January-March	Train local hunters and deploy hair collection stations.
February-May	Conduct weekly station visits and collect and document hair samples.
May-June	Process hair samples for shipping to genetics lab.
July-September	Lab analysis of hair samples for DNA. Prepare interim report. Provide U.S. with hair collection station material for use on Wrangel Island.
October-December	Evaluate the quality of the DNA extracted, the number of within-season recaptures, and determined the number of unique bears identified. Make recommendations for the next field season. Prepare for the next field season.
2019	
January-March	Train local hunters and deploy hair collection stations.
February-May	Conduct weekly station visits and collect and document hair samples.
May-June	Process hair samples for shipping to genetics lab.
July-September	Lab analysis of hair samples for DNA; prepare final report and manuscript, if warranted.

Principal Investigators: Lori Quakenbush, Justin Crawford, ADF&G; Andy Von Duyke, NSB; Eric Regehr, USFWS.

Other Personnel: John Citta, ADF&G; Native Hunters of the Bering and Chukchi seas.

Cooperators: USFWS Marine Mammals Management, World Wildlife Fund.

Supporters: Alaska Eskimo Whaling Commission, Barrow Whaling Captains Association

Expected Results or Benefits:
This study will develop methods to collect polar bear hair samples within the range of the Chukchi Sea polar bear subpopulation and determine if the quantity and quality of samples will be adequate when combined with all other sources to develop an abundance estimate for the Chukchi Sea subpopulation. Such an estimate would help ensure sustainable harvests, provide for a subsistence harvest based on science, avoid unnecessary enforcement actions, and inform other conservation actions.

Budget:

The budget estimate for Section 6 funds is a total request of $291,804 for use in FY17 – FY19 with matching funds provided by the North Slope Borough and by the World Wildlife Fund totaling no less than $72,951. The budget also includes $26,477 of ADF&G salary costs covered by the Department in Year 3 only.

Project Budget and Amendment

E-23-1	Current	Amendment	Total
Personnel	$50,981	$66,141	$117,122
Operations	$104,974	$43,962	$148,936
Total Direct Project Cost	$155,955	$110,103	$266,058
ADF&G indirect on personnel (21% in current and 22.74% in amendment)	$10,706	$15,040	$25,746
Total Project Cost	$166,661	$125,143	$291,804
Section 6 Federal Share (75%)	$124,996	$93,857	$218,853
Matching Share (25%) required	$41,665	$31,286	$72,951
Total Project Budget	**$166,661**	**$125,143**	**$291,804**

Literature Cited:

Bravington, M.V., H.J. Skaug, and E.C. Anderson. 2016. Close-kin mark-recapture. Statistical Science 31(2):259-274. DOI:10.1214/16-STS552.

Citta, J.J., G. O'Corry-Crowe, L. Quakenbush, A. Bryan, T. Ferrer, and M. Olson. *In press*. Assessing the abundance of Bristol Bay belugas with genetic mark-recapture methods. Marine Mammal Science.

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org/10.1890/ES14-00193.1

***PRELIMINARY* Research Report** **NSB.DWM.PRR.2016-01**

Use of hair to non-invasively sample DNA from polar bears (*Ursus maritimus*) in the Chukchi and Beaufort Seas: Project status update 2016

Andrew L. Von Duyke, Kelly Nesvacil, Kim Titus, Lori Quakenbush, and Todd Sformo

November 2016

North Slope Borough **Department of Wildlife Management**

Use of hair to non-invasively sample DNA from polar bears (*Ursus maritimus*) in the Chukchi and Beaufort Seas: Project status update 2016

Andrew L. Von Duyke[1]*, Kelly Nesvacil[2], Kim Titus[2], Lori Quakenbush[2], and Todd Sformo[1]

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This research was supported by the North Slope Borough Department of Wildlife Management (NSB-DWM), through the Shell Baseline Studies Program and under USFWS Permit #MA 134907-1; the Alaska Department of Fish and Game, through the Coastal Impact and Assistance Program Grant #F12AF70139 and under Institutional Animal Care and Use Permit (IACUC #2016-23); and the World Wildlife Fund, through the Arctic Home Grant. This PRELIMINARY report was produced to comply with the NSB-DWM's commitments to publically disseminating research funded by the Shell Baseline Studies Program, and to keep North Slope Communities apprised of recent research findings.

DISCLAIMER

Preliminary Research Reports serve as recent "status updates" of ongoing research activities conducted along Alaska's North Slope by the North Slope Borough Department of Wildlife Management and its partners. This Preliminary Research Report details the objectives, methods, data, and preliminary findings (to date) for this research project. Also included is a description of anticipated future work related to furthering/completing this research. The intent of this preliminary research report is to provide affected communities within and outside of the North Slope Borough and interested stakeholders with timely feedback on the progress of research pertaining to the management of subsistence resources.

This preliminary research report is not considered FINAL. Additional data collection and analyses will be forthcoming. Also note that this report has not been subjected to a thorough review. Upon completion of this research project, a FINAL report will be generated that includes the full extent of the results, analyses, and conclusions and will undergo internal review prior to public release. Note that Final Research Reports may also be subject to further data analysis, which could result in future adjustments to any conclusions herein. As such, care should be taken with citing Preliminary or Final Research Report findings, and it is highly recommended that the author(s) be contacted prior to citing materials.

REPORT AVAILABILITY

Research Reports (final or otherwise) are available from:
North Slope Borough Department of Wildlife Management
P.O. Box 69, Barrow, Alaska 99723
(907) 852-0350
www.north-slope.org/departments/wildlife-management

Cover Photo: A young polar bear investigates a barb-wire hair sampling station set on the pack ice about 10 miles north of Point Barrow in April 2016.

INTRODUCTION

Polar bears (*Ursus maritimus*) are an iconic Arctic species. As an apex predator, they structure energetic flow through Arctic marine ecosystems, and therefore serve as an indicator species of ecosystem health. Polar bears are also a vitally important component of the cultural and nutritional well-being of Native Alaskans. Over the past three decades the length of the ice-free season has steadily increased throughout the Arctic. Given the importance of sea-ice to polar bear ecology, they were listed as threatened globally under the U.S. Endangered Species Act (USFWS 2008) due to anticipated losses of Arctic sea-ice habitat related to climate warming (IPCC 2014).

The U.S. shares two subpopulations of polar bears with other countries (Figure 1). The Southern Beaufort Sea (SBS) subpopulation is shared with Canada and is managed through the Inuvialuit-Iñupiat Polar Bear Management Agreement in the Southern Beaufort Sea (I-I Agreement; USFWS 2000b). The I-I Agreement established the Inuvialuit-Iñupiat Polar Bear Commission (I-I Commision) that sets harvest limits for the shared SBS subpopulation. In the U.S. these harvest limits are voluntary, but in Canada they are implemented under federal law. The U.S. portion of the SBS population's harvest limit applies to the communities of Wainwright, Barrow, Kaktovik, and Nuiqsut (Figure 2).

The Alaska-Chukotka (AC) subpopulation (also known as the Chukchi Sea subpopulation) is shared between the U.S. and the Russian Federation and is managed under the Agreement between the Government of the United States of America and the Government of the Russian Federation on the conservation and management of the Alaska-Chukotka polar bear population (Bilateral Agreement; USFWS 2000a). The Bilateral Agreement established the U.S.-Russia Polar Bear Commission (Bilateral Commission), which, like the I-I Commission, determines an annual sustainable harvest quota (quota) for the AC subpopulation shared by Russia and the U.S. Under the Marine Mammal Protection Act (MMPA) only coastal dwelling Native Alaskans are legally allowed to hunt polar bears. However, under Title V of the MMPA, Native Alaskan subsistence hunters are now legally bound to comply with the quota set forth by the Bilateral Agreement.

In 2010, the Scientific Working Group (SWG) used an abundance estimate of 2,000 bears (Aars et al. 2006) to develop a harvest quota recommendation for the Bilateral Commission (Scientific Working Group 2010), recognizing that the confidence in this abundance estimate is low (IUCN 2006; USFWS 2010a). The Bilateral Commission ultimately set a quota of 58 bears to be shared equally by both countries (USFWS 2010b), which applies to the communities located from Point Barrow south to the southern maximum extent of annual drift ice formation (Figure 2). Since

2010, the SWG has found insufficient evidence to justify making changes to its initial harvest recommendation (Scientific Working Group 2015).

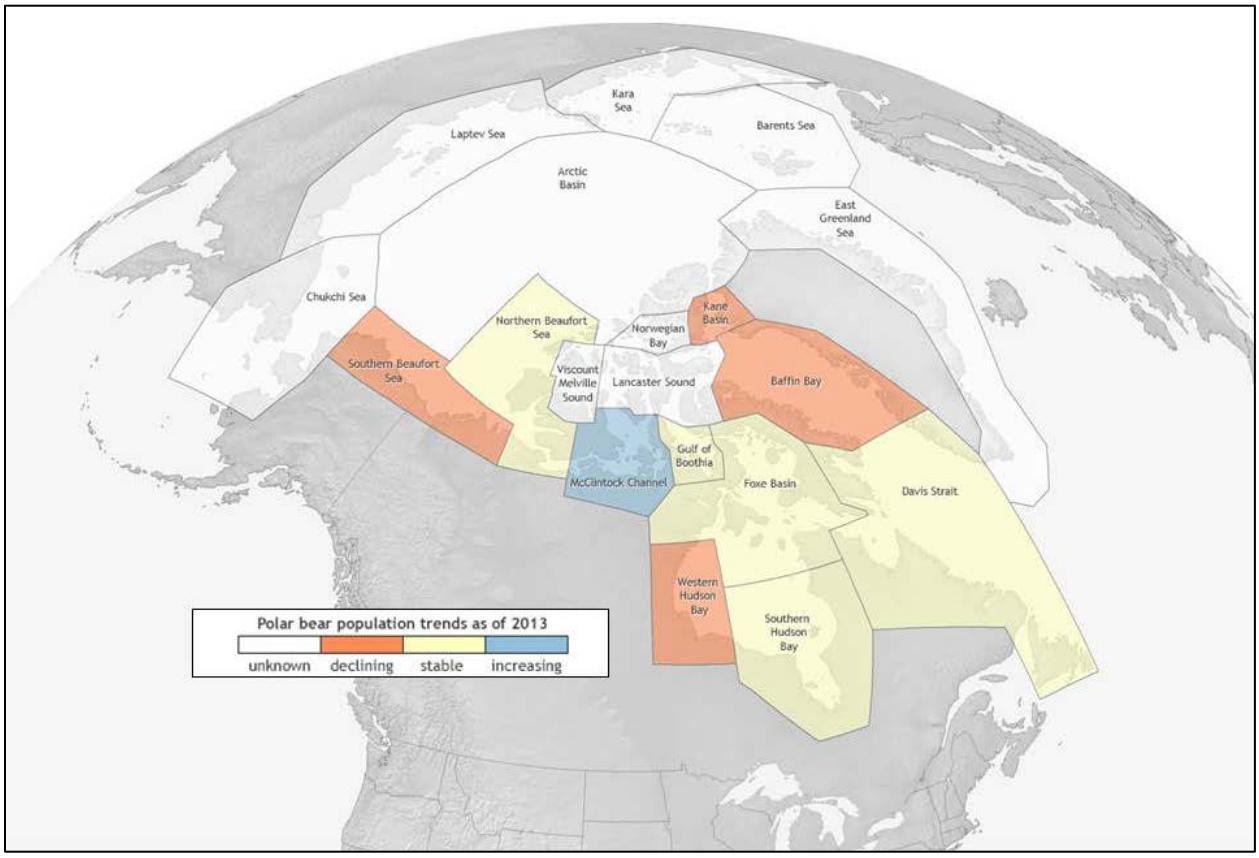

Figure 1 – Map of polar bear global distribution. There are 19 subpopulations of polar bears recognized by the IUCN Polar Bear Specialist Group (PBSG). Note that the well-studied Southern Beaufort Sea subpopulation has been designated as "declining", while the Chukchi Sea (also known as the Alaska-Chukotka) subpopulation status is "unknown". Map source: NOAA Climate.gov (2014).

Authorization of this quota has been criticized for several reasons. For example, although the quota is based on a polar bear abundance estimate (N) for the AC population, no credible abundance estimate was (or is) currently available. The abundance estimate used for the harvest quota was based on a "best guess" from Wrangell Island (Russia) den locations observed in the 1980s (Belikov 1992), which was considered to be a minimum number (Aars et al. 2006). Implicit in arguments leading up to the quota were comments about the health and reproductive status assessments of the polar bear; however, Rode et al. (2014) suggests a positive health and reproductive status assessment of the AC subpopulation. Furthermore, because all polar bear hunting in Russia is currently illegal, little data on Russian harvest is available (but see Kochnev and Zdor 2015). Finally, the boundaries of the AC and SBS

subpopulations overlap between Point Lay and Point Barrow in the Chukchi Sea (Figure 2), which greatly complicates the apportionment of harvested bears to the correct management population.

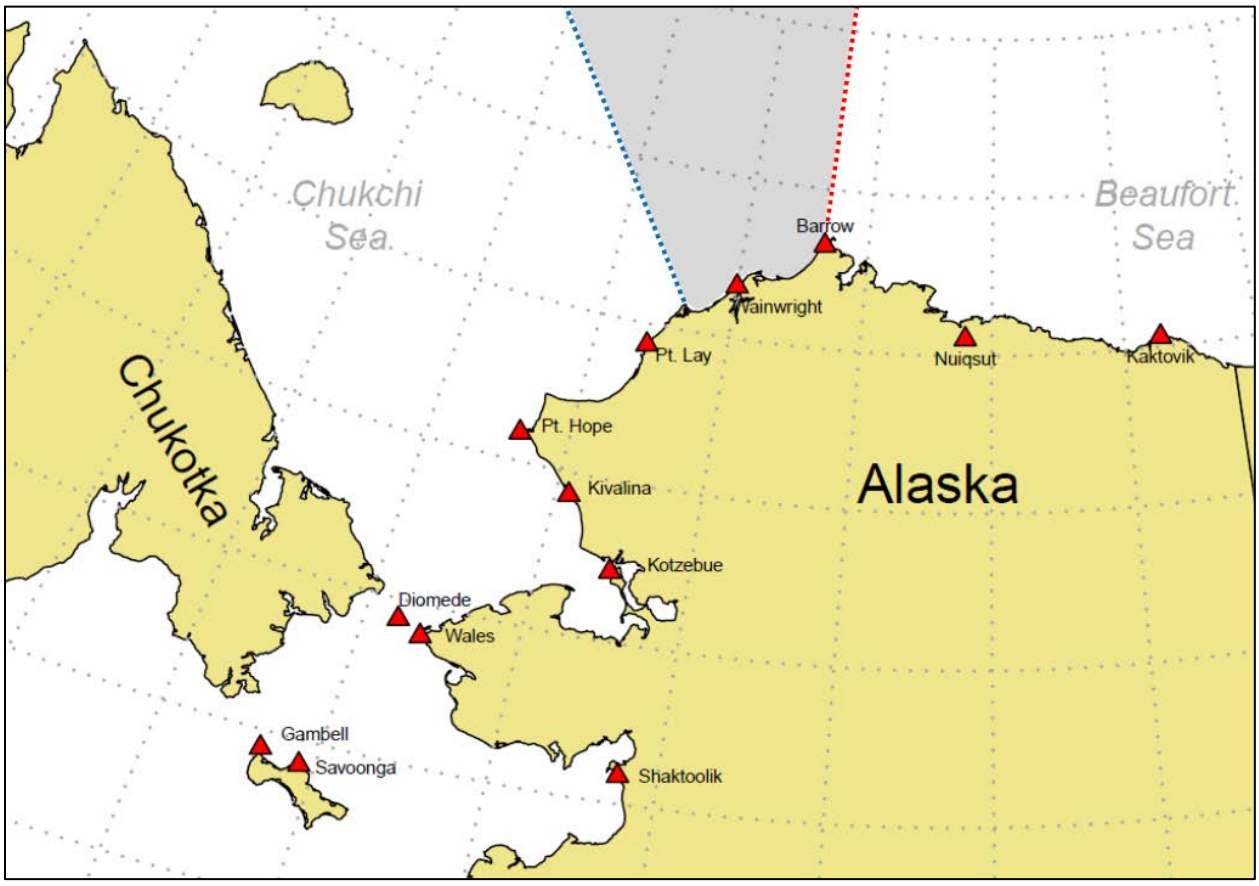

Figure 2 - Map of Intended Study Area. Our research area of interest currently falls between Pt. Hope and Barrow due to the interest in supporting an accurate abundance estimate of the AC subpopulation. We have also collected hair in Kaktovik and hope to increase systemic collecting throughout the North Slope. Two different management boundaries separate the AC and SBS subpopulations. The blue dashed line is the PBSG recognized boundary at Icy Cape, and the red dashed line is the boundary as described in the Bilateral Agreement. The gray shaded region is the overlap of the two subpopulations that results from the expanded AC boundary in the Bilateral Agreement. The USFWS conducts research based out of the Red Dog Mine port facility in the Chukchi Sea near Kivalina, with sampling extending north of Point Hope and the Lisburne Peninsula. The USGS conducts research primarily in the Beaufort Sea between Barrow and Kaktovik.

Several obstacles stand in the way of addressing these criticisms. First, though the U.S. Fish and Wildlife Service (USFWS) and U.S. Geological Survey (USGS) conduct capture-based polar bear research in northern Alaska, their study areas do not cover an enormous region between Point Hope and Point Barrow (Figure 2). Second, though there is significant conservation value in

conducting polar bear research in Chukotka (Russia), financial and logistical hurdles limit research in this region. Third, animal welfare and food safety concerns have been voiced by numerous stakeholders particularly over the invasive methods used for polar bear research in Alaska (i.e., helicopter darting, handling, and collaring). Local tolerance for continued polar bear research will likely decline if such concerns are not acknowledged meaningfully and good-faith attempts made to minimize invasive methods. And finally, the cost of polar bear research is exorbitant but budgets are continually tightened. Consequently, there is a need, not only for additional and improved data, but also for innovative and cost effective methods that address the challenges described above.

In response to these needs, the North Slope Borough (NSB) and the Alaska Department of Fish and Game (ADF&G), in partnership with the USFWS and the World Wildlife Fund (WWF), began a multi-year pilot study in 2016 to assess the viability of non-invasively collecting and analyzing polar bear DNA along the northern Chukchi Sea coast of Alaska as part of a comprehensive approach to understanding the dynamics of the AC subpopulation. In particular, the success rate of collecting polar bear hair (the DNA source) and the relative quality of these samples was evaluated for use in individual genetic identification of bears via DNA analysis. Previous studies have demonstrated the use of hair DNA to identify and count brown bears (*Ursus arctos*), black bears (*Ursus americana*), and gray wolves (*Canis lupus*) (Crupi et al. *In Prep.*; Gardener et al. 2010, and Roffler et al. 2016). Work in Canada also suggests that polar bears can be counted using similar methodologies (van Coeverden de Groot et al. 2013). Herreman and Peacock (2013) have also used non-invasive hair sampling methods to genetically identify bears that use bowhead whale carcasses, document seasonal use cycles of bowhead carcasses by individual bears, and determine relatedness of individuals that use carcasses near Barrow, Alaska. Finally, this methodology lends itself to involvement by local hunters whose traditional ecological knowledge (TEK) is valuable for improving methods and interpreting results (van Coeverden de Groot et al. 2013).

Although generating an abundance estimate through a mark-recapture analysis is beyond the scope of this pilot project, it is not unrealistic to expect that this information will enhance existing data sets by providing additional data on bear numbers, locations, and timing of movements (particularly for male bears). This information is useful for improving the precision and accuracy of abundance estimates; and enlarging the geographic sampling area such that estimates of abundance are more applicable to the polar bear population of biological and management interest; thereby contributing substantively to a cooperative population abundance estimate for the AC subpopulation that meets the *reliable science* criteria required by the Bilateral Agreement. Ultimately, this work will inform a more accurate abundance estimate for the AC subpopulation, support science-based sustainable harvest numbers, build

community engagement and trust, avoid unnecessary enforcement actions, and inform other conservation actions.

METHODS

Deployments of hair sampling stations occurred near the communities of Barrow (n = 11) and Point Lay (n = 10) from March-May 2016 (Figure 3). Stations were set on shore-fast ice near Barrow and on the coastal barrier islands near Point Lay due to the absence of shore-fast ice.

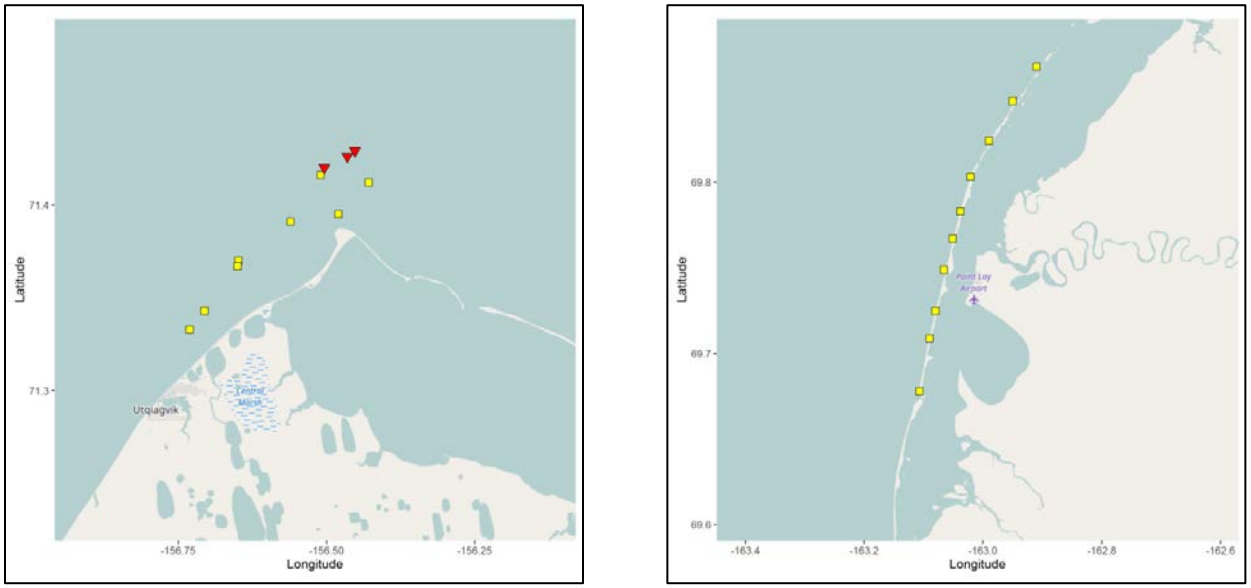

Figure 3 – Map of hair sampling station deployments. Yellow squares are barb-wire snares and the red triangles are wire-brush snares. (Left) Stations were set on the shore-fast ice near Barrow. (Right) The absence of shore-fast ice meant that the stations near Point Lay had to be set on the barrier islands rather than further offshore.

Two different types of hair sampling stations were tested: barb-wire and wire-brush (Figure 4). All hair sampling stations in Point Lay and most near Barrow (n = 8) were the barb-wire type. These were configured using a wooden frame with barb wire strung around its perimeter. The entire structure was free standing so it was not necessary to anchor into the ice. The barb-wire had 4-point barbs every 5 inches (13 cm). Two horizontal crossbars elevated a loop of barb wire about 30 inches (76 cm) above the ice surface. Scent and visual attractants were attached to the framework so that bears would be attracted to and would reach into the barb-wire, thereby snagging fur that would be collected later. Samples were collected from the barb-wire by manually pulling the hair free and depositing it into paper coin envelopes. Any remaining hair that could not be pulled from the barbs was burned off with a blow-torch to avoid cross

contamination. Three wire-brush hair sampling stations were also deployed near Barrow. This method uses brushes with stiff steel wire bristles mounted around the perimeter of a crate or plastic canister. A scent attractant was placed inside each crate at the bottom to encourage the bear to reach inside, thereby snagging its fur on the brushes. To collect the hair samples, the used brushes are simply removed, stored in paper envelopes, and replaced with new unused brushes that are re-attached to the perimeter of the crate.

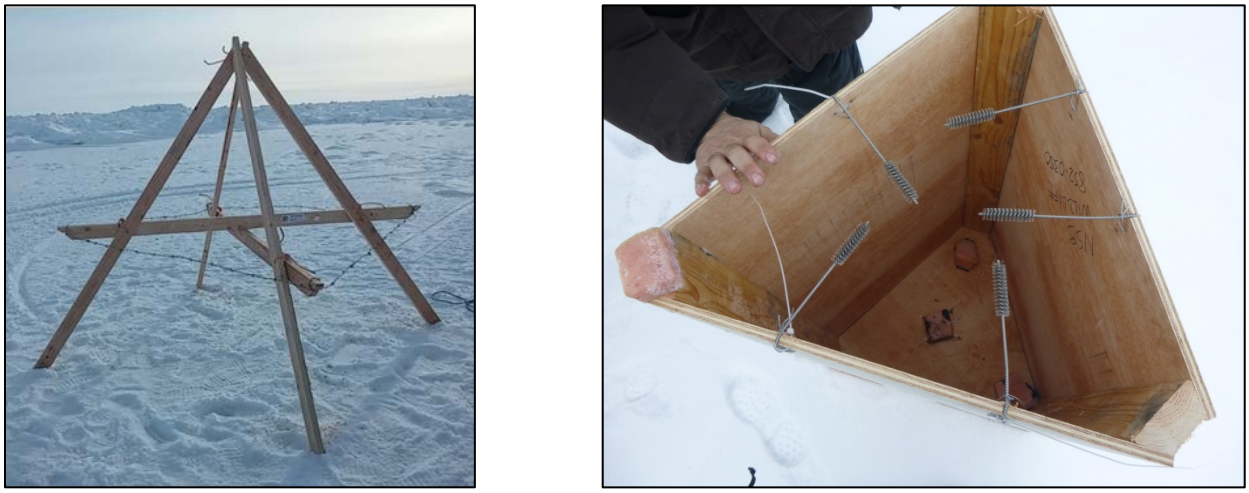

Figure 4 – Hair sampling station types. (Left) The barb-wire method used a 2"x4" lumber framework to elevate a loop of barb-wire about 30 inches (76 cm) above the surface of the ice. Scent lures were attached at the apex of the frame and at the intersection of the cross-bars. (Right) Wire-brush snares had stiff steel wire brushes mounted around the perimeter of a wooden crate. Scented attractants were dropped into the crate to encourage the bear to reach inside.

Beginning with protocols developed for brown and black bears, hair sampling stations were checked at least once (preferably twice) per week. However, given the unique conditions in northwest Alaska, protocols were reviewed and refined as needed during the season to ensure appropriate data collection in terms of timing between sampling occasions, station locations, and maintenance.

Basic trapping success data are reported for the entire study area, as well as for each geographic area, including the percentage of snare stations obtaining polar bear hair samples, number of trap nights (total number of days the hair sampling station was active), number of polar bear samples obtained (referred to as detections, Figure 5a and 5b), and number of polar bears detected per 100 trap nights. The quality of the samples collected was evaluated in terms of the abundance and type of the snagged hairs, and the ability to extract DNA from the hair. For example, DNA can be more difficult to extract from underfur compared to guard hairs. All

collected hair samples were processed and delivered to the USGS lab in Anchorage where positive species identifications will be determined and individual identification of polar bears will be made using microsatellite analyses from the DNA extracted from hair follicles (Paetkau et al. 1999).

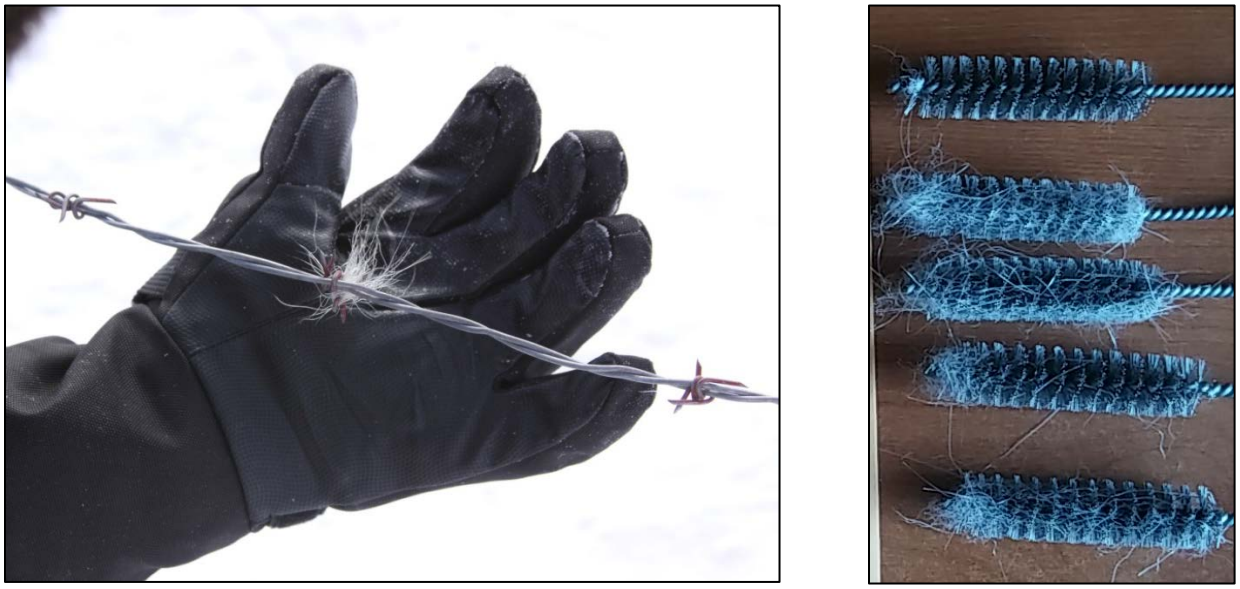

Figure 5a - Polar bear hair samples obtained from both types of hair sampling station. (Left) Polar bear hair that was snagged using the barb-wire method. Note, most hair samples collected in the barb-wire consisted of considerably fewer strands of hair (< 10 hairs) than shown and many were broken off with no DNA containing follicle attached. (Right) Detection of a polar bear using the wire-brush method. The wire brushes grabbed many more hairs per bear encounter, most of which had the follicles still attached.

Figure 5b – Hair sampling station visits. Polar bears visited both the barb-wire (left) and the wire-brush (right) stations. Note that the barb-wire station has two strands of wire strung around it. All barb-wire stations were eventually strung with two strands of barb-wire in a marginally successful effort to improve their performance.

RESULTS

Hair sampling stations (n = 21) were deployed in Barrow and Pt. Lay (514 trap nights) between 11 March 2016 and 5 May 2016 (Table 1), and a total of fifty-two bear hair samples were collected. Forty-seven percent of all stations (10 out of 21) successfully obtained polar bear hair. Forty-six of the 52 samples were from polar bears, for a total of 8.9 polar bear detections/100 trap night throughout the entire study area. Ten percent of the Point Lay stations (1 out of 10) obtained suspected brown bear hair, but none collected polar bear hair.

Table 1. Hair sampling station trapping effort for 2016.

Study Area	Snare Stations Deployed	Active Date Range	Number of Trap Nights	Number of Polar Bear Samples	Number of Brown Bear Samples	Polar Bear Detections/ 100 Trap Nights
Barrow	11	11 March - 15 May	340	46	0	13.5
Point Lay	10	14 April - 5 May	174	0	6	0

Barrow Results

A total of 11 hair sampling stations were deployed near Barrow between 11 March 2016 and 5 May 2016. Stations were active a total of 340 trap nights, with an average of 29 trap nights per station (range: 2 to 63 trap nights per station). Forty-six detections were obtained from the entire trapping effort and 100% of samples obtained were for polar bears. This is ~ 13.5 polar bear detections/100 trap nights for the Barrow study area. Nine of eleven (82%) stations deployed in Barrow were successful in collecting a sample of polar bear hair, and there was an average of 10.6 days to the first capture event for those snares (range: 1 to 21 days).

Point Lay Results

A total of 10 hair sampling stations were deployed in Point Lay between 14 April and 4 May 2016. Stations were active a total of 174 trap nights with an average of 16.5 trap nights per station (range: 13 to 22 trap nights per station). None of the stations in Point Lay were successful in capturing polar bear hair, but 6 samples of suspected brown bear hair were collected from one station.

Sample Quality

Nine polar bear hair samples from Barrow were examined for quality in terms of the ability to potentially extract DNA for individual-level identification. Two of the 9 samples (22%) had only

one guard hair present with a root, and 4 of the 9 samples (44%) had > 3 guard hairs present with roots (Table 2). Of the 6 guard hair samples with roots, 3 had tufts of underfur included. Assuming about 50% genotyping success from 1 guard hair root, which increases to > 75% with ≥ 3 guard hair roots, and needing about 5 times as many hairs with roots for underfur (D. Paetkau, *pers. comm.*), we estimate that about 4 of the 9 samples (44%) would produce an individual DNA identification.

Table 2. Polar Bear Hair Sample Quality Information.

	Total (%)	**Contains at least 1 guard hair with root (%)**	**Contains at least 3 guard hairs with roots (%)**	**Contains at least 3 guard hairs with roots plus underfur (%)**
Number of Polar Bear Hair Samples	9 (100%)	6 (66.7%)	4 (44.4%)	3 (33.3%)

Sample Analysis – Current Status

All collected hair samples were processed and delivered to the USGS lab in Anchorage. Lab analyses are expected to be completed by early 2017, hopefully in time to present at the Alaska Marine Science Symposium.

DISCUSSION AND RECOMMENDATIONS

Though this pilot effort was limited to shore-fast ice in areas close to Barrow and Point Lay, our long-term objectives include broadening our efforts in 2017 and beyond. Given successful project implementation beyond 2017, the partner agencies (NSB, ADF&G, and USFWS) recognize that a collaborative analytical approach that includes all individual identifications from U.S.-based polar bear research, in conjunction with samples obtained in Russia, as well as information such as movement and habitat use data from USFWS radio telemetry studies, represents the best approach to obtaining estimates of abundance.

Our first field season yielded not only genetic samples, but also a number of insights that will be useful for future planning. Summarized below, we suggest considerations to be taken into account when planning for the 2017 and 2018 field seasons.

1. ***Local cooperation is essential to the success of this project and requires a very large effort***

   The timing of sampling overlapped spatially and temporally with indigenous whaling and other subsistence activities out on the ice. As such, it was essential to meet with and develop working relationships with the whaling captains and communities prior to moving forward with field work. Accomplishing this level of communication prior to our 2016 field season required extraordinary efforts due to the logistical challenges of travelling to and communicating with the rural villages in our study area. Nevertheless, these partnerships are essential to project success.

   All things being equal, subsistence should take precedence over research; as such, substantial efforts were made to maintain the trust and tolerance for our research efforts out on the ice by mitigating conflicts with subsistence activities when/if they arose. For example, in an effort to minimize conflicts with whaling activities (from noise), we chose to refrain from monitoring several stations during certain hours of the day and/or days of the month. In another example, a concerned whaling captain requested that we remove one of our stations because it was too close to his whaling camp[1]. Meanwhile, a different whaling captain was happy to allow us to leave our station where it was, despite its proximity to his camp[1]. But, we were also encouraged and actively assisted by another whaling captain and crew who pointed out locations to place the snares.

   Recommendation 1: *Plan for flexibility in how hair sampling stations are used and the timing/location of their deployment. If in proximity to subsistence activities, expect and plan for public requests to move the stations. It may also be worthwhile to plan to end or temporarily halt sampling during the peak of subsistence activities if they are relatively close. A consequence of this is that measures of hair sampling efficiency may be underestimated because hair sampling stations may not be monitored to the maximum extent possible. An alternative would be to select a sampling area outside the radius of subsistence activities (but see recommendation 3).*

2. ***Hair sampling stations should be checked at a higher frequency***

   Our original plan to check the stations twice weekly was likely not frequent enough due to high bear densities in the area. A consequence of this is that some samples may include DNA from multiple bears, which cannot be differentiated in the field. Tracks and TEK may be helpful in deciphering what may have happened, but often there were too many tracks

[1] Both hair sampling stations were set up 6 weeks prior to whaling. The whaling camps were erected close to the stations at a later date.

to provide meaningful interpretations. Trail cameras may also help, but the logistics of providing power in the frigid cold are a factor, as is some local mistrust of trail cameras.

Recommendation 2: *Because of the possibility of multiple individual hair samples getting mixed, hair sampling stations should be checked more often and/or methods that are "single use" should be employed so that genetic cross-contamination is avoided. Note: there may be methods available to genetically screen mixed samples for multiple individuals (S. Talbot, pers. comm.).*

3. Adjust sampling design at different scales

At a small spatial scale (village), excessive numbers of hair sampling stations are not likely to yield substantially more information because evidence suggested that stations were likely revisited by individual polar bears, thereby leading to pseudo-replication. Furthermore, if the number of stations is excessive, it will become difficult to efficiently manage them all within the optimal interval that is most productive for collecting hair samples. While more samples per village will likely not be substantially more informative, sampling from more villages will provide meaningful data about the population.

Recommendation 3: *Reduce the number of hair stations to a manageable number at the village scale. Fewer high quality stations that are monitored more frequently should be more productive than a large number of stations that are checked less frequently. Increase the number of villages where hair sampling occurs to provide broader population scale information.*

4. Sampling design should better consider polar bear behavior

Polar bears are curious and will follow other bears' tracks. As such, a single station that was visited once may be more likely to receive visits from other bears, which tend to pass by over the course of a season (Herreman and Peacock 2013). A higher frequency of station monitoring should be able to account for this (see Recommendation 2). Furthermore, some polar bears may systematically return to previously visited stations, thereby causing multiple samples to be collected from an individual. For example, during the first season, most visited stations were left standing, but for a period of time, the stations were routinely flipped over (Figure 6). This may suggest that a single bear with a habit of routinely tipping over the stations occupied the area for that time period. Genetic analyses will provide further insights into whether this is the case. Moreover, after a time it became evident that bears were able to steal the scent attractants from the station without getting snagged; suggesting that individuals had visited often enough to learn how to work around the barbs.

Recommendation 4: *Hair sampling periods should be adjusted to minimize the number of bears that get resampled. For example, by establishing a schedule wherein the sampling is "active" then temporarily "halted", it is conceivable that "experienced" bears will move onward in the absence of attractants, and that "naïve" bears will move in (presumably following the previous bears' tracks) and get sampled during the next sampling session.*

Figure 6 – Aftermath of a visit from a polar bear. For a period of time, the stations were routinely flipped over. This behavior eventually stopped, possibly suggesting that the perpetrator had moved into a new area. Note that the barb wire has been broken, as planned, at breakaway links designed to minimize the risk of entanglement.

5. Barb-wire has many shortcomings

Barb-wire has a poor public perception despite its widespread use for collecting DNA "non-invasively". On numerous occasions, local residents expressed concerns for the welfare of polar bears. Barb-wire is difficult and somewhat dangerous to work with, and it is very heavy. There are also several serious risks, including the potential entanglement of polar bears. A bear entanglement would be a significant problem, posing great risks to both people and polar bears. Note that "breakaway links" were integrated into the barb-wire to reduce the chances of entanglement (Figure 6). There is also a small possibility that a person on a snow-machine may become injured if he or she were to strike a station during conditions of poor visibility. Furthermore, barb-wire was only marginally effective at plucking hair from polar bears. For example, many of our samples were composed of small quantities of hair (< 10). Other samples had broken hairs with no follicles (i.e., no DNA). Finally, "sterilizing" the barbs was difficult because blow torches work poorly in the cold and

windy environment, thereby increasing the chance of genetic cross contamination.

Recommendation 5: *Explore alternatives to barb-wire that: minimize entanglement risk, are easier to work with, are better at plucking hair, and minimize cross-contamination. This recommendation has been partially addressed through our experiments with the stiff wire brushes (see #6).*

6. ***Wire brushes appear to be superior to barb-wire for collecting polar bear hair***

Although bears were attracted to both styles of hair sampling station (Figure 5b), the barb-wire did not perform as well as the wire-brush method in terms of the quantity and quality of hair collected (Figure 5a). The wire brush option is safer, has a better public perception, is easier to work with, and lends itself to a "single use" configuration that eliminates any chance of genetic cross-contamination.

Recommendation 6: *Experiment with alternative ways to integrate wire brushes into hair sampling station designs. Currently the "bucket" approach in which a bear reaches inside a bucket or box has been tested. Though this was inspired by established methods used by fur trappers, other approaches may increase efficiency.*

7. ***Sea-ice dynamics can have a large influence on polar bear detection rates***

Not all sea-ice is equal. We benefitted greatly from the traditional knowledge (TEK) of native subsistence hunters. We also observed greater hair sampling frequency under conditions where bears were active, such as near open leads where bears were hunting and in proximity to subsistence activities such (e.g. whale carcass on the ice). Large pans and multi-year ice were poor in comparison to young ice, particularly the edges. In Point Lay, there was virtually no sea-ice present and almost no shore-fast ice, so the hair sampling stations were set on the outer barrier islands. It was clear from track data and TEK that no polar bears were present in this region[2].

Recommendation 7: *Place hair sampling stations carefully with respect to ice conditions and bear foraging ecology. Utilize local knowledge from hunters. Plan to move hair sampling stations as the sea-ice changes.*

[2] Brown bears are not uncommon in Point Lay and are known to forage upon stranded marine mammal carcasses along the coastline and even out on the sea-ice (P. Tukrook, *pers. comm.*; A. Von Duyke, *pers. obs.*). Brown bear tracks, which are readily distinguishable from polar bear tracks, were observed in the area where the hair sampling stations were set up. TEK indicated the presence of polar bears prior to our deployment of the hair sampling stations. Station deployment occurred relatively late in the season (15-April). Earlier deployment may have facilitated sampling of polar bears near Point Lay, particularly in low ice years.

SYNOPSIS OF 2017-18 RESEARCH ACTIVITIES

Objective 1:
Work with local hunters to deploy polar bear hair sampling stations for near coastal Alaskan villages in 2017 and 2018.

Objective 2:
Investigate the possibility of deploying and checking hair collection stations on the pack ice in 2017 and 2018.

Objective 3:
Evaluate the number and quality of samples collected in 2017 and 2018.

Approach and Methods:

Hair sampling stations will utilize a design that takes into consideration the lessons learned from the 2016 field season. Previously, barb-wire strung around the perimeter of a 2"x4" framework (Figure 4) was used. Shortcoming of this design and benefits of the wire brush method (Figure 4) suggest that the wire brush approach may be preferable. Hunters will be consulted for improvements to this design and for ways to use attractants, lures, etc. Visual attractants may also be tried again, such as CDs and colorful or metallic flagging.

Initial deployment may occur from as early as mid-February and sample collection may extend through the first week of May, depending on the latitude of the location and ice conditions. The stations will be checked at least once per week (preferably multiple times per week) via snow-machine, and the schedule for checking will be modified as determined by field conditions, according to best practices (Ancrenaz et al. 2012), and with respect to analytical capabilities for identification of multiple individuals from a single, mixed sample.

In 2017, with community participation, up to 50 hair collection stations will be deployed on shore-fast ice or land. Deployment will likely occur near Icy Cape (70.3° N, 161.9° W) and near the following communities: Point Lay, Point Hope, Shishmaref, Little Diomede, Wales, Nome, Teller, Gambell, and Savoonga (see Figure 2). Additional sampling may occur near Barrow and Wainwright. In 2018, up to 50 hair collection stations will be deployed near the same locations as in 2017 unless results of 2017 or changes in community participation dictate changes. Also in 2017 and 2018, we will work with USFWS polar bear research crew to see if placing hair collection stations on the pack ice within their research area near Kivalina is feasible.

As with 2016, all hair samples will be processed and stored according to protocols established for DNA analyses. For example, clumps of hair will be placed in a paper envelope and kept dry. Envelopes will be labeled with the ancillary data. All hair samples will be processed, inventoried, and shipped to Wildlife Genetics International, Inc. (Vancouver, BC Canada) or an equivalent qualified lab for analysis. Microsatellite analyses of the DNA extracted from hair follicles will be used to genetically identify individual polar bears (Paetkau et al. 1999).

Individual polar bears will continue to be identified (as new or recaptured bears) in additional years and combined with other sources of DNA (e.g., other research projects) to contribute to a sample size that may be sufficient for an abundance estimate within ~5 years using mark-recapture models, such as the traditional formulation of the Jolly-Seber model using Program JOLLY (Pollock et al. 1990), and a POPAN formulation of a Jolly-Seber (Jolly 1965, Seber 1965, Schwarz and Arnason 1996). Once all hair samples are analyzed, we will report the number of recaptures and if feasible calculate a preliminary subpopulation estimate. If non-invasive hair collection stations managed at multiple locations by local hunters yield a reasonable sample size that can be added to annually at relatively low cost, then samples from other sources can be added, including from Russia, to achieve the sample size necessary to calculate an abundance estimate with confidence intervals.

DNA samples are being collected during capture projects from 60–70 polar bears per year from the AC subpopulation (USFWS 2014). If 30–40 more could be added using hair collection stations it may be possible to calculate an abundance estimate in < 5 years. DNA from harvested bears can be used to increase the precision of the estimate by removing bears from the database that cannot be recaptured. This genetic dataset could also be used to apply Close-Kin Mark-Recapture (CKMR) methods. CKMR is a genetics-based method that uses information about relatedness to greatly widen the scope and enhance the power of traditional mark-recapture techniques for estimating abundance and demographic parameters. CKMR is especially effective when combined with ongoing traditional DNA mark-recapture studies (i.e., self-recapture studies) and when applied to hunted populations (Bravington et al. 2016).

In 2019, after lab analyses have identified all unique individuals, a final technical report will be produced. Periodic project updates and reports will be provided to villages and other stakeholders. If the project PIs believe the results are worthy of publication in a scientific journal, then a manuscript will be prepared.

ACKNOWLEDGEMENTS

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ATTENTION!!
PLEASE DON'T MOVE THIS BOX!!
Polar Bear Hair Collection Project


CHECKED BAG

ATTENTION!!
PLEASE DON'T MOVE THIS BOX!!
Polar Bear Hair Collection Project

State of Alaska
Department of Fish & Game
P.O. Box 115526
Juneau, Alaska 99811-5526

Bucket Hair Snare
(Snare #8)
Set up on 5-7-16

→ Hair Collected on 5-8-16 ←

Near Eider perch
71° 25.247' N
156° 30.701' W

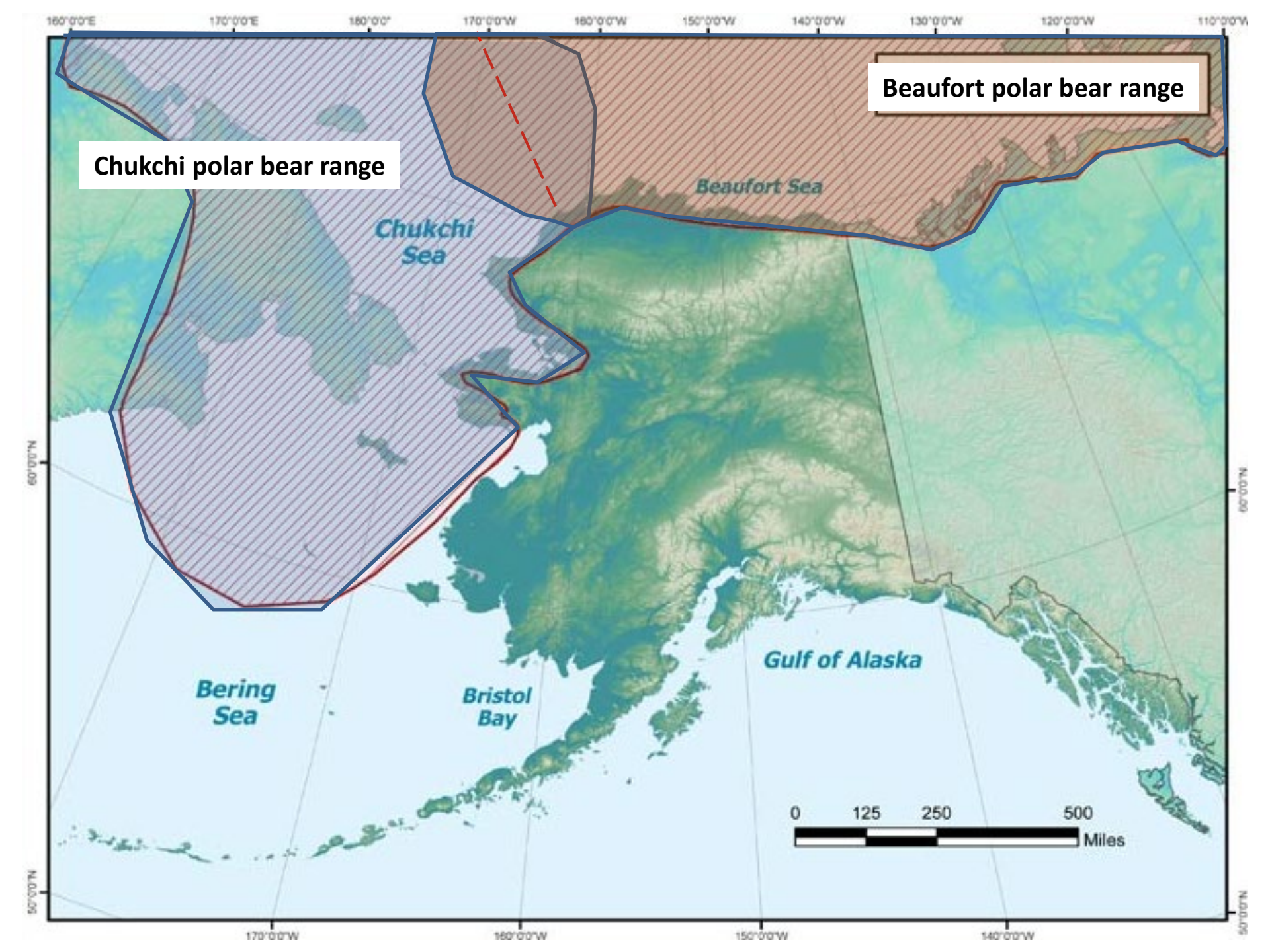
Appendix K.

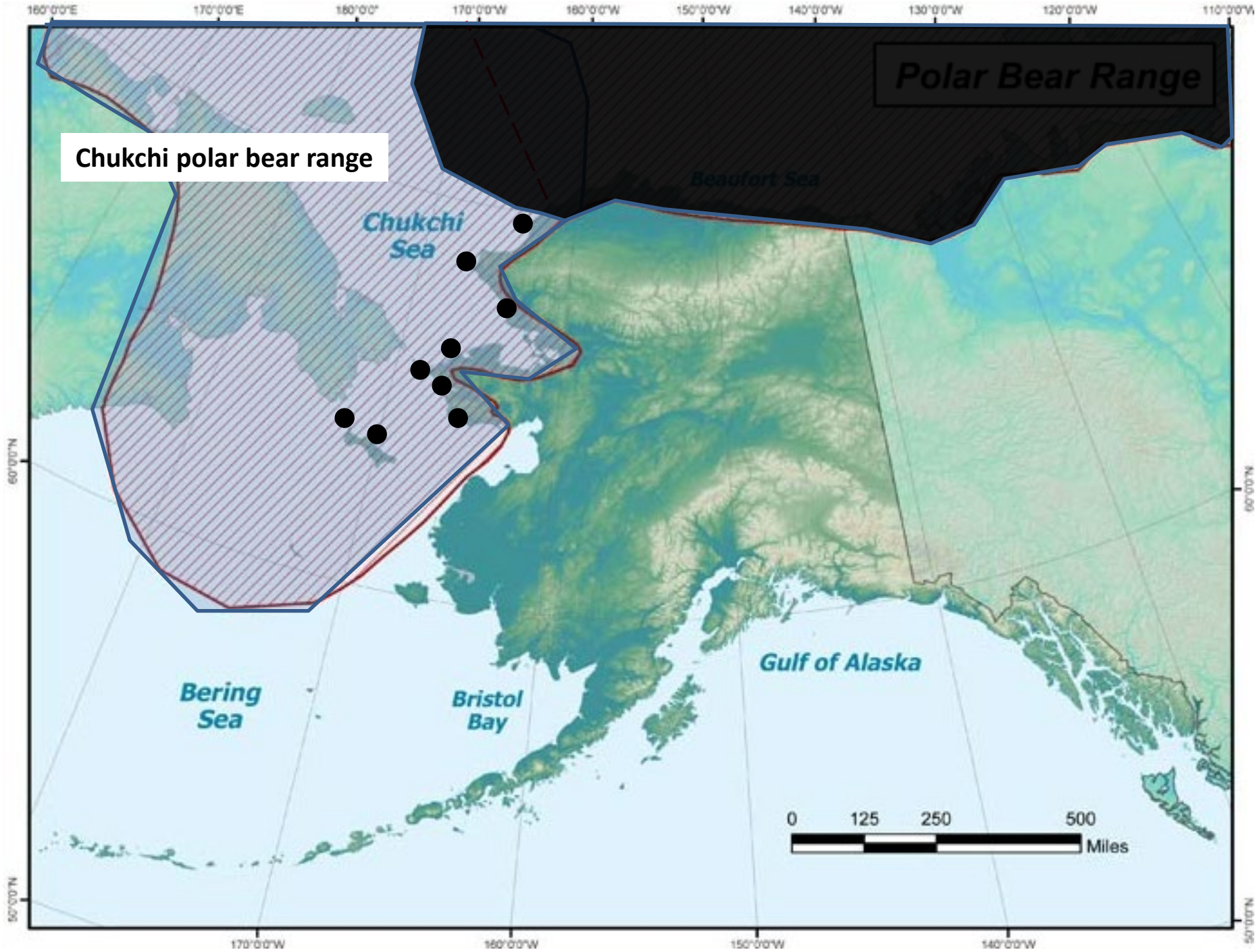
Polar bear hair collection

Andy Von Duyke, Billy Adams, Mark Nelson, and Anna Bryan

Point Hope, AK

October 25, 2016


Beaufort polar bear range
Chukchi polar bear range
Beaufort Sea
Chukchi Sea
Bering Sea
Bristol Bay
Gulf of Alaska
0 125 250 500
Miles


Polar Bear Range
Chukchi polar bear range
Beaufort Sea
Chukchi Sea
Bering Sea
Bristol Bay
Gulf of Alaska
0 125 250 500
Miles

The current population size - Unknown

- Chukchi Sea polar bears
  - Old data from 1980s says **~ 2000 bears**
  - US/Russia Treaty quota
    - Based on old/conservative pop. estimate
    - 58 bears (29 / year per country)

Need a current/reliable pop. estimate

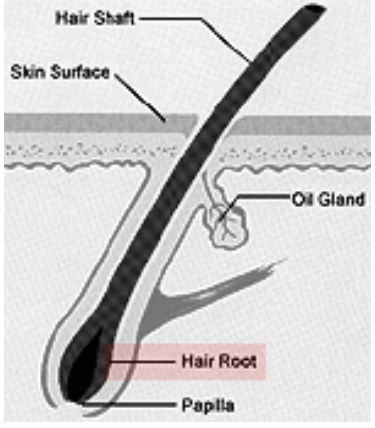
How to estimate population size?

- Aerial survey to count bears
  - Difficult and expensive

- Catch bears alive
  - Mark/recapture is invasive
    - darts, drugs, collars
  - Concerns among stakeholders
  - effects of drugging & collaring of bears

Hair Collection stations

- Simple, cheap, less invasive
- Used on other species
  - brown & black bears, wolves, wolverines
- Just need a little hair (w/root) for genetics



Research Plan

Set portable hair snares on sea ice

- 3 stations per village
- Check regularly
- Sample DNA from hair
- Identify individuals
  - When? Where?
  - Cross-reference with other studies
  - Recaptures

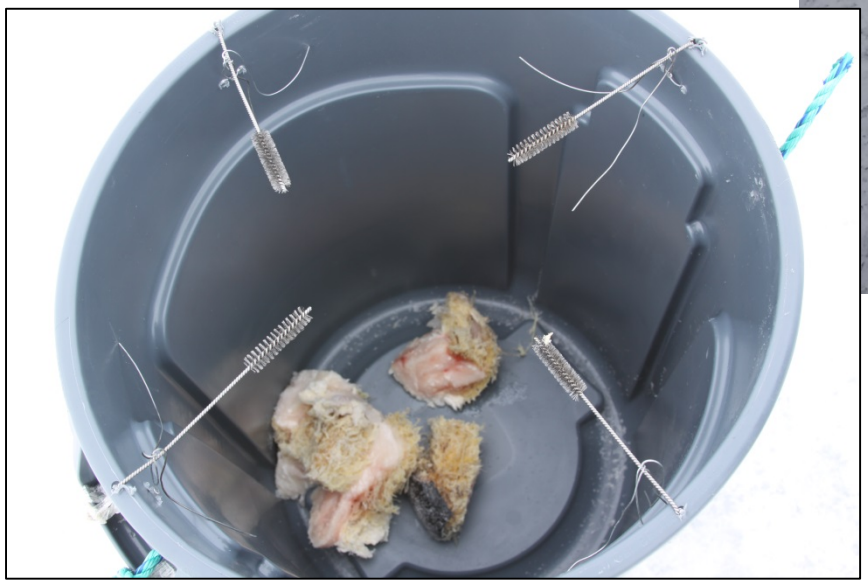
Research concept

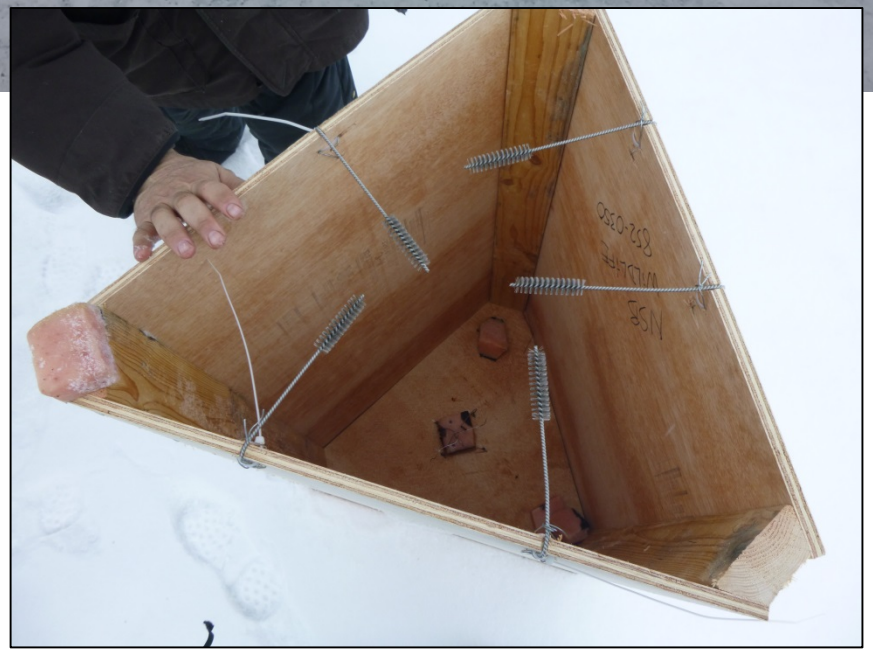
With enough data we can…

- Estimate population size
- Use a better, more current estimate in treaty negotiations
- better understand boundary

Variations

Bucket & brushes





Hair Samples

Considerations:

1. We do not want to interfere with subsistence activities

2. We want to work with you
   - Avoid subsistence areas or timing
   - Find local people to work with
   - Make the project successful

Work with communities

1. Received support from:
   - Alaska Eskimo Whaling Commission
   - Barrow Whaling Captains' Association
   - Alaska Nanuuq Commission
   - Villages of Point Lay and Wainwright

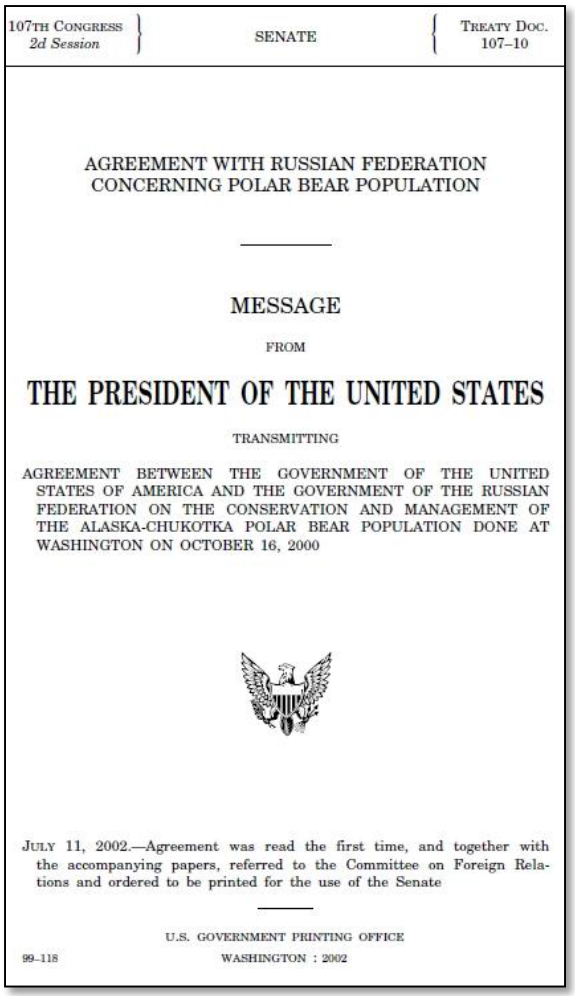
2. Community support is <u>essential</u> to this project
   - We need help from local hunters
     - Where? When? How?
   - Would like to hire local residents to collect data

Thankyou! Quyanaqpuk!

Questions?

US-Russia Polar Bear Agreement

Agreement imposes a quota on polar bear harvest



107TH CONGRESS
2d Session

SENATE

TREATY DOC.
107–10

AGREEMENT WITH RUSSIAN FEDERATION CONCERNING POLAR BEAR POPULATION

MESSAGE

FROM

THE PRESIDENT OF THE UNITED STATES

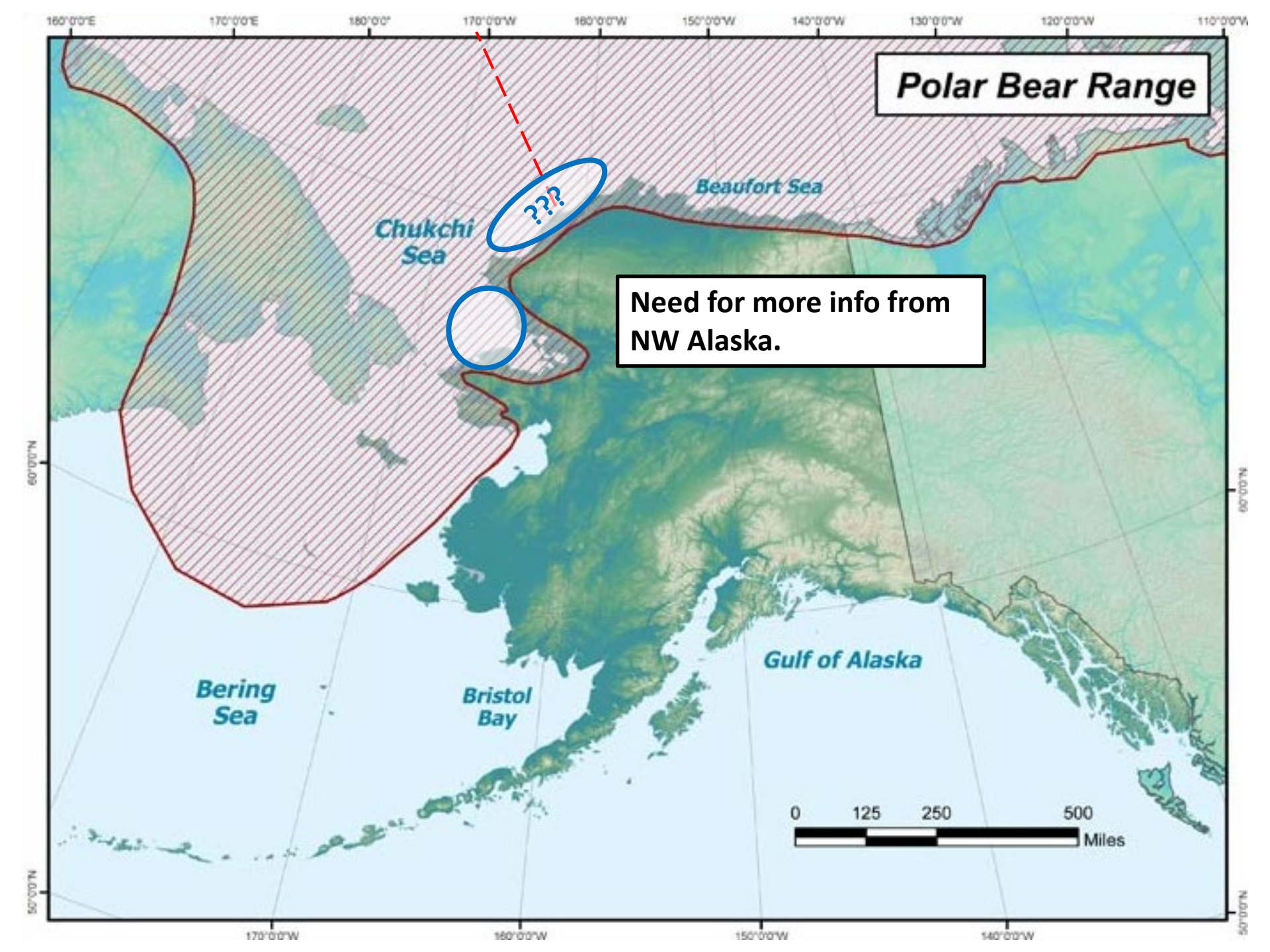
TRANSMITTING

AGREEMENT BETWEEN THE GOVERNMENT OF THE UNITED STATES OF AMERICA AND THE GOVERNMENT OF THE RUSSIAN FEDERATION ON THE CONSERVATION AND MANAGEMENT OF THE ALASKA-CHUKOTKA POLAR BEAR POPULATION DONE AT WASHINGTON ON OCTOBER 16, 2000

JULY 11, 2002.—Agreement was read the first time, and together with the accompanying papers, referred to the Committee on Foreign Relations and ordered to be printed for the use of the Senate

U.S. GOVERNMENT PRINTING OFFICE

99–118 WASHINGTON : 2002


Polar Bear Range
???
Chukchi Sea
Beaufort Sea
Need for more info from NW Alaska.
Bering Sea
Bristol Bay
Gulf of Alaska
0
125
250
500
Miles

Variations

Barb wire