PRELIMINARY Research Report NSB.DWM.PRR.2016-01.01

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

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REVISED February 2, 2017

November 2016

North Slope Borough Department of Wildlife Management

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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 Assessment 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.

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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).

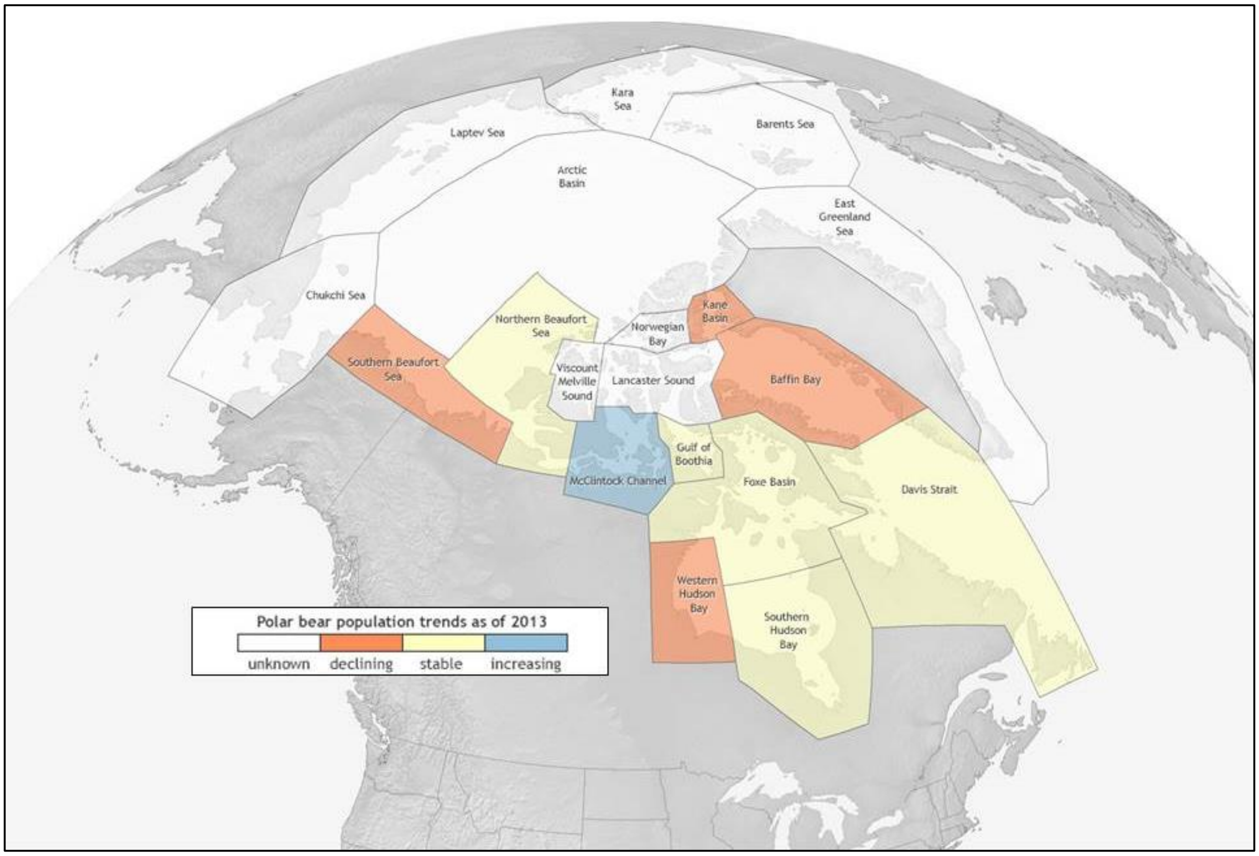


Figure 1 – Map of polar bear global distribution. There are 19 subpopulations of polar bears recognized by the IUCN Polar Bear Specialist Group (PBSG). Note that the well-studied Southern Beaufort Sea subpopulation has been designated as "declining", while the Chukchi Sea (also known as the Alaska-Chukotka)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

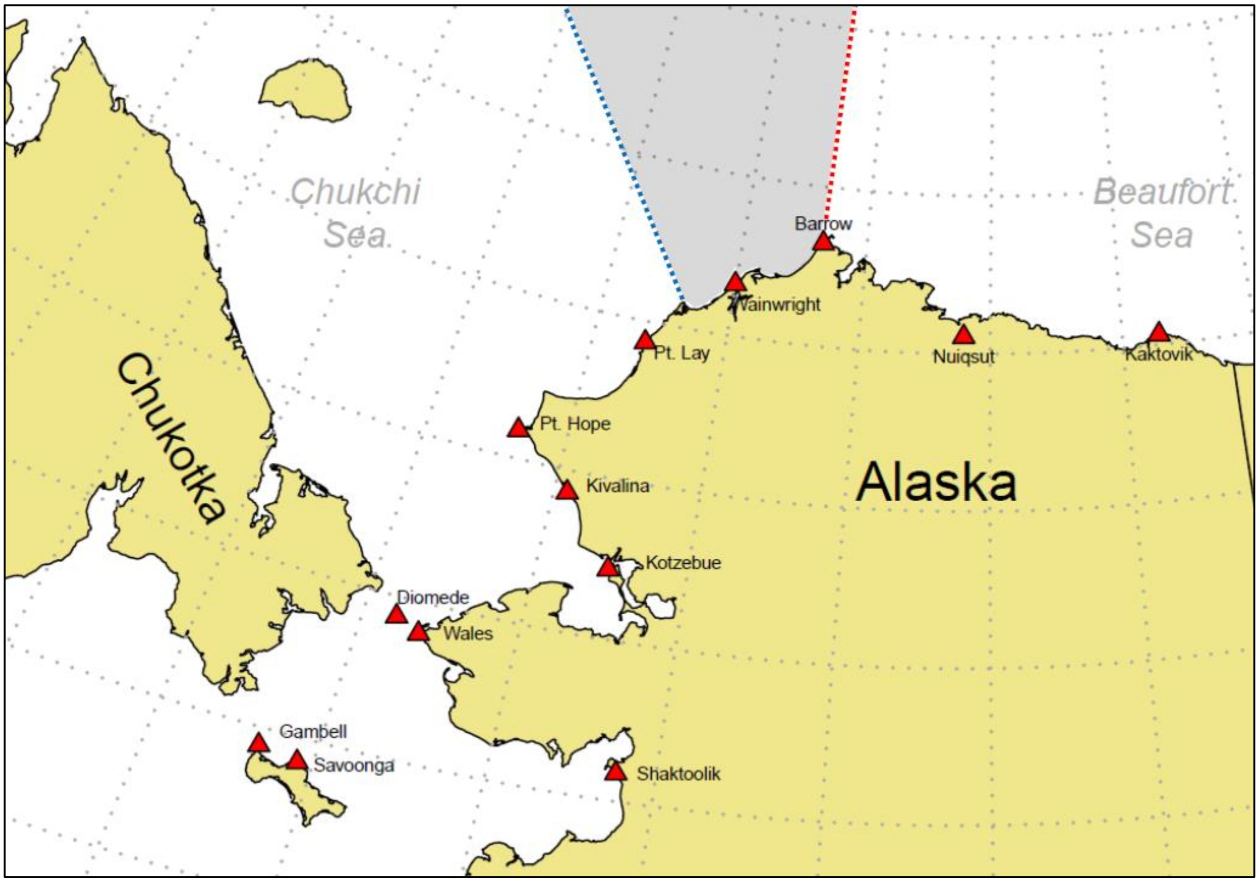


Figure 2 - Map of Intended Study Area. Our research area of interest currently falls between Pt. Hope and Barrow due to the interest in supporting an accurate abundance estimate of the AC subpopulation. We have also collected hair in Kaktovik and hope to increase systemic collecting throughout the North 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.

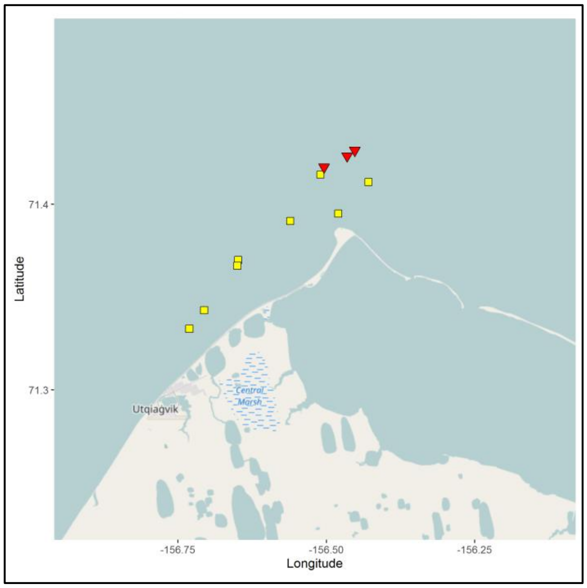
Several obstacles stand in the way of addressing these criticisms. First, though the U.S. Fish and Wildlife Service (USFWS) and U.S. Geological Survey (USGS) conduct capture-based polar bear research in northern Alaska, their study areas do not cover an enormous region between Point Hope and Point Barrow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



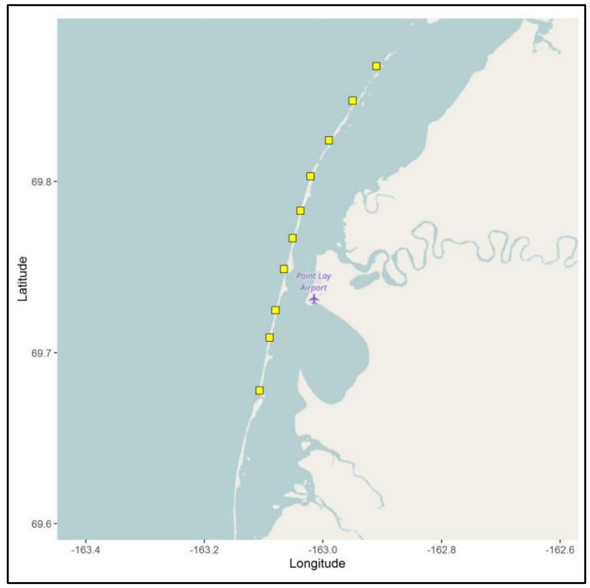


Figure 3 – Map of hair sampling station deployments. Yellow squares are barb-wire snares and the red triangles are wire-brush snares. (Left) Stations were set on the shore-fast ice near Barrow. (Right) The absence of shore-fast ice meant that the stations near Point Lay had to be set on the barrier islands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

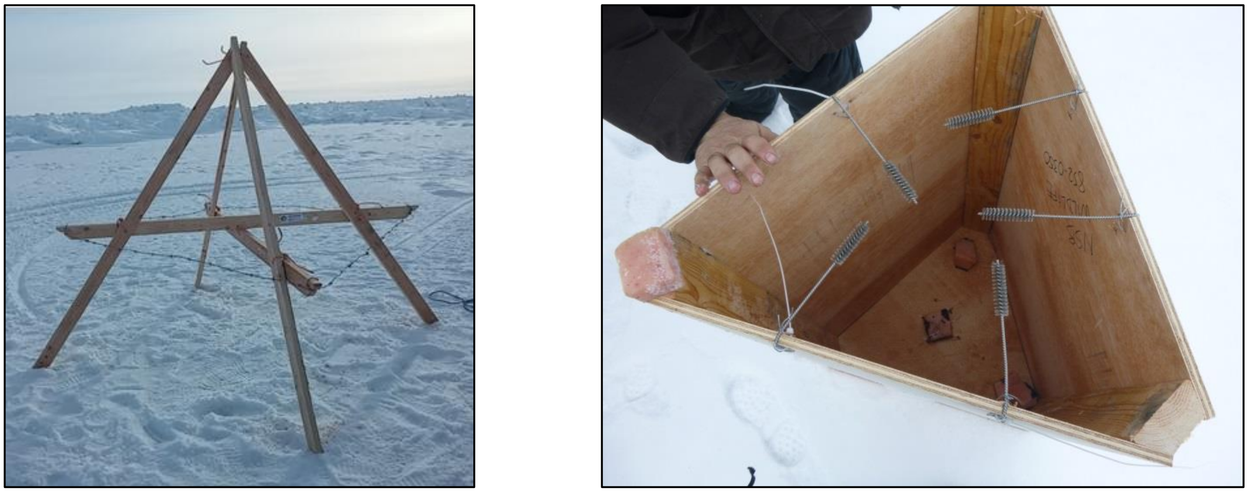


Figure 4 – Hair sampling station types. (Left) The barb-wire method used a 2”x4” lumber framework to elevate a loop of barb-wire about 30 inches (76 cm) above the surface of the ice. Scent lures were attached at the apex of the frame and at the intersection of the cross-bars. (Right) Wire-brush snares 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 weekly (preferably bi-weekly). 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, which includes daily sampling and re-setting.

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 bears samples obtained (referred to as detections, Figure 5), and number of polar bears detected per 100 trap nights. The quality of the samples collected was evaluated in terms of: (1) the abundance and type of the snagged hairs, and (2) 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 5 - 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 6 – 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

Twenty-one hair sampling stations were deployed in Barrow and Point Lay for a total of 514 trap nights between 11 March 2016 and 5 May 2016 (Table 1). Thirty-eight percent (8 out of 21) of the stations were successful in obtaining polar bear hair, and 9% of the Point Lay stations (1 out of 11) obtained suspected brown bear hair. A total of 52 bear hair samples were obtained from Point Lay and Barrow. Forty-six of those 52 samples were of polar bear hair for a total of 9.8 polar bear detections/100 trap nights throughout the entire study area.

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.

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%)

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 expected about 4 of the 9 samples (44%) to produce an individual DNA identification.

Preliminary genetic results

Microsatellite analysis (13 loci), using methods that are calibrated to Wildlife Genetics International (S. Talbot, *pers. comm.*), was used to genotype individual bears. Note that these results are preliminary, that other loci remain to be run, and that no quality assurance / control has been done. However, given that hair samples are typically run locus-by-locus, and that these samples did fine in some initial multiplex reactions, suggests that the quality of these samples was pretty good. Table 3 provides initial analytical results and a relative assessment of sample yield based on sample collection method, fur type, and whether follicles were visible on the ends of the hair shafts.

Table 3. Polar Bear Hair Sample Preliminary Microsatellite Analytical Results

Location	Method	N	Sample type	Follicles visible?	#hairs extracted	Percentage of loci amplified			Comment codes
						<50%	50-75%	>75%	
Barrow	brush	2	underfur	no	n/a	0	0	2	A
	barb	26	guard hair	yes	1-4	2	2	22	B
		7	guard hair	no	1-4	6	0	1	C
		11	underfur	no	n/a	2	6	3	D
Pt. Lay	barb	3	Underfur	no	n/a	3	0	0	E
		3	guard hair	yes	3	0	0	3	F

Comments: A and F – All samples yielded product at >75% of loci.
B – Most samples yielded product at >75% of loci.
C – Most samples yielded product at <50% of loci.
D – Most samples yielded product between 50 and 75% of loci.
E – No product.

These results suggest that the brush method is useful. However, given the small sample size, it is difficult to determine if the brush method performs better than the barb method in terms of hair quantity, quality, and/or genetic sample production. Qualitatively, the brushes lead to extracts that were “good enough”. Comparisons between underfur and guard hairs collected via the barb method suggest that the best quality data come from guard hairs with visible hair follicles.

Regarding the number of individual bears detected, preliminary data suggest about 21 bears in Barrow. The three samples from Point Lay came from the same individual, likely a brown bear (*Ursus arctos*). At the time of this report, these observations should be considered very preliminary, based on a very quick look at the data, and are subject to change as more data are collected.

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.

   Trust and tolerance for research efforts out on the ice can be lost if serious efforts are not made to mitigate conflicts with subsistence activities when/if they arise. All things being equal, subsistence should take precedence over research. 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]. Alternately, another whaling captain was happy to allow us to leave our station where it was, despite its proximity to his camp[1]. One captain actively encouraged us and pointed out locations to place the snares. A consequence of this is that measures of hair sampling efficiency may be underestimates because of our inability (or unwillingness) to monitor stations to the maximum extent possible.

[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.

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. An alternative would be to select a sampling area outside the radius of subsistence activities (but see recommendation 3).*

2. ***Frequency of checking stations should be higher***

   Our original plan of checking the stations bi-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 to provide meaningful interpretations. The use of trail cameras may 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 should be checked more often and/or employ methods that are "single use" 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 polar bears. Thus, excessive numbers of stations would be pseudo-replicates. Furthermore, if the number of stations is too large, it will become difficult to manage them all within the relatively short interval that is most productive for collecting hair samples. While more samples per village will likely not very helpful, more village sampling 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 are more productive than a large number of stations that are checked less frequently. Increase the number of villages with hair sampling stations to provide better population scale information.*

4. ***Sampling design should better consider polar bear behavior***

   Polar bears are curious and will follow the tracks of other polar bears. As such, a single station that was visited by one bear may be more likely to receive visits from other bears. This is why a higher frequency schedule of station monitoring (see Recommendation 2) is important. Furthermore, there is a chance that a polar bear will systematically return to previously visited stations, thereby causing multiple samples to be collected from the same 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. This may suggest that a single individual bear that tended to flip the stations was routinely visiting all stations 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 an attractant, and that "naïve" bears will move in (presumably following the previous bears' tracks) and get sampled during the next sampling session.*

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). 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). It was also difficult to "sterilize" the barb-wire because blow torches work poorly in the cold and windy environment.

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 6), the barb-wire did not perform as well as the wire-brush method in terms of the quantity and quality of hair collected (Figure 5). 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 local knowledge gained from 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 of multi-year ice were poor in comparison to young ice edges. In Point Lay, there was virtually no sea-ice present and so the hair sampling stations were set on the outer barrier islands. It was clear from track data 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] This region does have a relatively high number of brown bears, some of which forage along the coastline on stranded marine mammal carcasses. Brown bear tracks, which are readily identifiable, were observed in the area in which the hair sampling stations were set up.

SYNOPSIS OF 2017-18 RESEARCH ACTIVITIES

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

Objective 2:
Investigate the possibility 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 and according to best practices (Ancrenaz et al. 2012).

In 2017, up to 50 hair collection stations will be deployed in areas near prominent points of land like Icy Cape, and near communities (Point Lay, Point Hope, Shishmaref, Little Diomede, Wales, Nome, Teller, Gambell, and Savoonga on shore-fast ice or land with community participation (Figure 2). Additional sampling may also 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. They will need to be able to visit the stations at least once per week and remove the stations when their field project ends.

All hair collected will continue to 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. Hair samples will be processed, inventoried, and shipped to Wildlife Genetics International, Inc. (or an equivalent qualified lab) where individual identification of polar bears will be made using microsatellite analyses from DNA extracted from hair follicles (Paetkau et al. 1999).

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. 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. 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

This project was funded by the Shell Baseline project through the NSB and by CIAP Grant #F12AF70139 through ADF&G. Additional funding was provided by the Arctic Home Grant through the World Wildlife Fund. We would like to thank the following organizations for their support and cooperation: USFWS Marine Mammals Management, the Alaska Eskimo Whaling commission, the Barrow Whaling Captains Association, Alaska Nanuuq Commission, and the Native Village of Point Lay, and UIC Science. We are also grateful to Patrick Tukrook, Bryan Anniskett, Jane Tukrook, and Lupita Henry for their work on this project.

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