

# GENETIC MARK-RECAPTURE SURVEY OF POLAR BEARS IN KANE BASIN

## INTERIM REPORT TO THE NUNAVUT WILDLIFE RESEARCH TRUST

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## SUMMARY

Kane Basin (KB) is a small polar bear sub-population managed jointly by Nunavut and Greenland. A mark-recapture study (1993-1997) estimated sub-population size at 164 bears in 1998. Subsequent population viability analyses (PVA) predict that abundance is currently declining and that harvest levels are unsustainable. Concurrently, changes in sea-ice conditions in the region have generated additional uncertainties about the status of this management unit as well as its degree of closure (i.e. the validity of the designated boundaries). In response to these concerns, and in accordance with commitments under the 2005 KB Polar Bear Memorandum of Understanding (MOU), a new 3-year research project was initiated in 2012 to provide updated information on KB. This collaborative project involving the Government of Nunavut and the Greenland Institute of Natural Resources (GINR) is guided and endorsed by the Canada-Greenland Joint Commission (CGJC) on the Management of Polar Bears. The research design includes two components. Sub-population size and status will be assessed by means of genetic mark-recapture. To assess closure, in particular the hypothesis that KB is a separate unit from the neighboring Baffin Bay sub-population, data from a sample of bears fitted with satellite instruments will be used, in combination with the mark-recapture data, to study movements.

Between April 27 and May 10, 2013 a total of 68 polar bears of various age classes and both sexes were biopsied darted or captured. Sampling was distributed across KB, covering a total distance of approximately 6000 km. Rate of sampling averaged 1.1 bears per hour of flying compared to 0.7 in 2012. Several factors may account for the higher rate of sampling in 2013 including the greater northward and westward extent of the north water polygna in 2013.

The number of bears sampled was equivalent to approximately 42% of the previous 1998 mark-recapture population estimate currently used for harvest management. Six of the 68 bears sampled in 2013 were known recaptures; 3 having been sampled in 2012. Additional recaptures will be identified once genetic analyses are complete. Genetic analyses have been completed for samples collected in 2012 and are underway for 2013 samples. Based on known rates of recapture in 2013, a third year of sampling is necessary to obtain a population estimate for KB.

In addition to mark-recapture sampling, twenty bears were instrumented with satellite collars or ear-tag transmitters to collect data on movements and habitat use. Similar to 2012, a notable proportion (34%) of captured bears were found to have extensive hair loss and ulcerations on their feet. Further investigations are underway into the cause of these lesions which appear to be most prevalent in adult males.



## **OBJECTIVES**

- 1) To estimate the abundance and composition of polar bears in KB.
- 2) To compare new estimates of abundance with those derived from earlier studies in-order to gain insight into population trend.
- 3) To estimate survival and reproductive parameters (to the extent possible) in-order to facilitate population viability analyses.
- 4) To delineate the boundaries of the KB sub-population and reassess the validity of this area as a demographic unit.
- 5) To evaluate polar bear distribution and habitat use with respect to environmental variables, particularly ice conditions, topography and food availability distribution.

## **MATERIALS AND METHODS**

### **Mark-Recapture**

The study design is similar to that of the previous mark-recapture conducted in KB (Taylor et al. 2008) but does not involve the capture and physical marking of every bear encountered. DNA extracted from skin samples is being used to genetically 'fingerprint' bears; effectively marking each individual (and permitting future identification) without the need for ear-tagging or lip-tattooing. The 'recapture' event occurs when a bear is re-sampled by researchers on a later occasion or when a tissue sample is recovered from a polar bear harvested in either Nunavut or Greenland.

From 2012-2014, sampling is being carried-out on the sea-ice and coastal areas around Kane Basin from late April to early May. A helicopter (Bell 206 LR) is used to search for bears. To reduce potential sampling bias resulting from differences in habitat use amongst various age, sex and reproductive classes of bears, information derived from previous mark-recapture and telemetry studies, combined with knowledge of sea-ice conditions at the time of sampling, is being used to allocate search effort across KB<sup>1</sup>.

Once a bear is located, a small sample of skin (Figure 1) is collected using a DNA dart (Pneu-Dart Inc.). The darts are designed to fall to the ground after impact and can be retrieved without handling a bear. In addition, skin samples are being collected from bears captured as part of the satellite telemetry component of the project (see below). To detect the recovery of previously 'marked' bears by hunters, tissue samples are being collected from all bears harvested in KB (and surrounding sub-populations) throughout the duration of the study.

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<sup>1</sup> Subject to logistical and safety considerations

For each bear sampled, GPS coordinates and information on location, behavior, body condition, estimated age/sex (when possible) and group/litter size are recorded. DNA extracted from the tissue samples will be analyzed in-order to assign each bear a unique genetic identity and determine its sex using validated techniques, similar to those described by Kendall et al (2009). Tissue samples collected during the previous KB mark-recapture (1993-97) are also being analyzed.

### Population Delineation

To support reassessment of the boundaries of the KB sub-population, in particular to examine the validity of the boundary between KB and BB, new data on the movements of polar bears are being collected. In 2012 and 2013, a sample of bears will be captured and fitted with satellite instruments. In each year, up to 10 satellite ear-tags will be placed on sub-adult bears of both sexes and adult males. Up to 10 satellite collars will be placed on adult females. Capture operations will be conducted in both the Canadian and Greenlandic sectors of the Kane Basin. To the extent possible, captures will be distributed throughout KB. Bears will be captured according to standard immobilization protocols using the drug Zoletil® administered at published doses (Stirling et al. 1989). Captured bears will be lip-tattooed and ear-tagged for subsequent identification. Standard morphological data will be collected along with samples for aging (a pre-molar tooth) and genetic identification (skin). The satellite collars will have a timed-release mechanism permitting removal and recovery of the collar without the need to recapture bears. Ear transmitters have been constructed using custom made attachment hardware designed to degrade rapidly under expected environmental conditions leading to release of the instrument without the need for recapture.

### PROJECT SCHEDULE

The project remains on schedule as originally proposed; with final results to be reported in 2014/15.

OUTPUT OR STEP	START DATE	END DATE	PERSON DAYS
Logistical preparations	Fall 2011	Spring 2012	15
	Fall 2012	Spring 2013	15
	Fall 2013	Spring 2014	15
Biopsy darting and telemetry instrumentation	April 2012	May 2012	18
	April 2013	May 2013	18
	April 2014	May 2014	18
Harvest sampling	Fall 2011	Spring 2014	75
Analysis of tissue samples	Winter 2012/13	Spring 2014	TBD

Final data analyses, preparation of reports and peer-reviewed publications	Winter 2013/14	Winter 2014/15	TBD
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## PRELIMINARY RESULTS & DISCUSSION

### Mark-Recapture Sampling

In 2013, mark-recapture sampling took place from April 27 to May 10 (as compared to April 25 to May 6 in 2012). During this period, approximately 6000 km was flown while searching for polar bears on sea-ice habitat across Kane Basin (KB) in Canada and Greenland (Figure 2). As expected, sea-ice habitat was variable across the study area. Central KB was dominated by highly fragmented, consolidated first-year pack-ice with a variable but generally thin layer of snow (i.e. <25cm). In contrast, the coastline of Ellesmere Island was dominated by smooth, first-year, shore-fast ice interspersed with ice-bergs and small flows of multi-year sea-ice around the mouths of bays and fiords. Similarly, coastal regions of Greenland were characterised by first-year shore-fast ice but with greater numbers of ice-bergs in Northwest KB near the Humbolt Glacier. Snow cover over sea-ice in near-shore regions along Ellesmere and Greenland was variable but noticeably deeper than in central, offshore parts of KB; at times exceeding 1 metre in areas close to glaciers. Relative to 2012, the north water polygna occupied a greater portion of Kane Basin in 2013 extending further north and west (Figure 2).

Subject to weather and other logistical constraints, search effort was distributed according to our perceptions of polar bear distribution with more time being allocated to searching in areas where densities were perceived to be highest. Polar bears and signs of polar bear activity (i.e. tracks, seal kills etc) appeared to be concentrated in near-shore habitats in bays, fiords and up to the flow-edge between pack-ice and shore-fast ice. Areas with high concentrations of ice-bergs in Northwest KB also appeared to be well used. Relatively little search effort was allocated to central KB. During the limited number of flights made across this region relatively few bears or signs of bear activity were encountered suggesting that densities of bears were low. Anecdotally, tracks observed in central KB also tended to be less meandering than those seen in near shore areas suggesting that bears spent less time searching for food and presumably more time travelling across this pack-ice habitat.

In total, 71 polar bears of various age classes and both sexes were encountered. Of these, 68 were either biopsied (36) or captured (32) including 12 family groups and 7 mating pairs (Table 1).<sup>2</sup> The spatial distribution of bears sampled in 2013 was similar to that of bears sampled in 2012 (Figure 2). However, the rate of sampling was notably higher; averaging approximately 1.1 and 0.7 bears per hour of flying<sup>3</sup> in 2013 and 2012

<sup>2</sup> Three cubs-of-the-year (COY's) whose mothers were biopsied were recorded but not sampled because COY's are too small to safely biopsy.

<sup>3</sup> Includes some non-search travel time

respectively. Several factors may account for the increased rate of sampling in 2013 including increased efficiency resulting from familiarity with the study area. More importantly, we speculate that the greater northward and westward extent of the north water polygna in 2013 versus 2012 may have increased densities of bears in some parts of KB, particularly in near-shore areas along Ellesmere Island, thus increasing probability of capture.

The number of bears sampled in 2013 was around the level expected *a priori* and is equivalent to approximately 42% of the previous 1998 mark-recapture population estimate currently used for harvest management (Taylor et al. 2008). A total of 110 bears have now been sampled in KB in 2012 and 2013 combined, including recaptures of some individuals. Among the 68 individuals sampled in 2013 there were 6 known recaptures (4 adult females, 2 adult males) of bears previously sampled in 2012 (3 bears<sup>4</sup>) or during mark-recapture sampling (3 bears) in the 1990's. The total number of recaptures will not be known until genetic analyses of biopsy samples are completed. However, the relatively low number of known recaptures to date suggests additional sampling of bears in Kane Basin will be required in-order to obtain an abundance estimate with suitable precision for on-going monitoring and management of this subpopulation. A third and final sampling session is therefore planned in KB for 2014. This session will involve biopsy darting only.

In addition to recaptures, 2 bears captured in 2013 were resighted 11 and 12 days after capture approximately 40 and 50 kilometers from their original capture locations, respectively.

## **Population Delineation**

In 2013, 10 adult females were fitted with ARGOS Gen IV satellite collars (Telonics Inc). The CR2A collar release mechanisms on these instruments were programmed to release on 24 April, 2015. In addition, 10 bears (5 adult males, 2 adult females, 3 sub-adult males) were each instrumented with Argos SPOT ear-tags (Wildlife Computers Inc.). Movement data collected from bears instrumented in KB in 2012 and 2013 will be pooled with similar data from research already in progress in neighboring Baffin Bay (2009-2013). Amongst other things, this dataset will be used to reassess population closure and delineate boundaries using methods similar to those of Taylor et al. (2001). Information on the movement and distribution of bears will also permit adjustment of mark-recapture sampling strategies while the study is in progress as well as *post hoc* evaluation of mark-recapture sampling upon completion of field work; in-order to minimize potential bias. Finally, telemetry data will be used in habitat selection modeling to assess habitat availability and use in KB and predict the responses of bears to future changes in sea-ice conditions.

## **Seal Distribution**

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<sup>4</sup> One of these bears was originally tagged in Baffin Bay in 2011 and 2012.

In 2013, data were collected opportunistically on the locations and numbers of seals encountered while searching for polar bears. Although subject to numerous potential biases (i.e. ice type weather, time of day etc), analyses of these opportunistic observations may provide some insight into the distribution, relative densities or availability of prey for polar bears in KB.

### **Body Condition**

In 2013, body condition scores on a scale of 1 to 5 (leanest to most obese; Stirling et al. 2008) ranged from 2 to 4. Similar to 2012, most bears (78.6%) rated in fair condition. However, in contrast to 2012 a smaller proportion of bears rated in poor condition and some (8.6%) rated in good condition (body condition score of 4). This difference in condition, although not statistically significant was most apparent amongst adult bears (figure 3). Subjectively, bears in KB appeared smaller in stature and mass than individuals of equivalent age and sex in some other sub-populations. Analyses of body size and condition will be conducted as the study progresses and more data are available.

Similar to 2012, a notable proportion (34%) of bears captured in 2013 were found to have locally extensive hair loss and in some cases multi-focal ulcerations of the skin and footpads on one or more of their feet (figure 4). Pooled data from 2012 and 2013 are presented in table 2. On average 40% of individuals captured exhibited these lesions indicating that this condition is prevalent amongst polar bears in KB. Prevalence was highest amongst adult males (72%) and lowest amongst cubs-of-the-years (0%). In 74% of cases all 4 foot were affected to some degree. The prevalence of bleeding ulcerations on the feet of some bears, an indication of the severity and/or chronicity of the condition, was highest amongst adult males with 72% exhibiting some degree of ulceration. Also of note were two bears captured in 2012 without lesions that were recaptured in 2013 with lesions. The etiology of these lesions is being investigated. Discussions with hunters from Grise Fiord suggest this phenomena is well known to occur in spring time and may be unique to bears in the region (M. Akeeagok, J. Kiguktak, D. Akeeagok, pers comms.). It is believed that increased rates of movement in spring, when bears are mating and hunting activity is high, result in abrasions to the feet. Preliminary consultations with scientists conducting research on polar bears in other parts of the Arctic suggest these lesions are occasionally encountered on bears in higher latitude populations, although the frequency and severity of cases encountered in KB appears to be high. Additional investigations to establish the geographic occurrence and potential causes of these lesions are in progress including consultations with hunters in Canada and Greenland and with polar bear scientists range-wide.

### **Genetic Analyses**

DNA extracted from tissue samples collected from bears captured or biopsied in 2012 has been genotyped to identify individuals and confirm genetic sex. Samples collected during 2013 field work have been submitted for analysis.



## REPORTING TO COMMUNITIES/RESOURCE USERS

Following a consultation meeting in 2012, the project received support from the Iviq HTO. One HTO member participated in fieldwork for a day in 2012. In 2013, an HTO member participated for the full duration of the fieldwork. Written progress reports summarizing the 2012 and 2013 fieldwork have been provided the HTO.

COMMUNITY/HTO	BEFORE	DURING	COMPLETION
Grise Fiord/Iviq HTO	Jan 2012, in-community	April 2012, 2013, 2014, in-community during fieldwork  Winter 2012, 2013 & 2014, by correspondence	Fall 2014, in-community

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Table 1. Sex and age-classes of polar bears sampled in Kane Basin, April/May 2013.

Age/Sex	Captured	Biopsy Darted	Instrumented (Collar/Ear-tag)
Adult male	6	6	5
Adult female (solitary)	4	13	4
Adult female (w/offspring)	8	4	8
Sub-adults	3	10	3
2-year-olds	1	1	0
Yearlings	2	2	0
Cubs-of-the-year <sup>5</sup>	8	0	0
<b>TOTAL</b>	<b>32</b>	<b>36</b>	<b>20</b>

Table 2. Frequency of hair-loss (alopecia) and skin ulcerations on the feet of polar bears captured in Kane Basin, Nunavut, 2012 and 2013.

Age/Sex		Number of Individuals	Proportion with Alopecia (n)	Proportion with Ulcerations
Adult male		11	0.72	0.72
Adult female	Solitary	9	0.22	0.00
	With COYs	7	0.29	0.00
	With yearlings	6	0.50	0.17
	With 2-year-olds	1	0.00	0.00
Sub-adults		5	0.60	0.40
2-year-olds		1	0.00	0.00
Yearlings		8	0.63	0.25
Cubs-of-the-year (COY)		11	0.00	0.00
<b>TOTAL</b>		<b>59</b>	<b>0.40</b>	<b>0.22</b>

Figure 1. A sample of skin and fat obtained by a DNA dart.



<sup>5</sup> Three additional cubs were recorded but not sampled because they were too small to biopsy. The accompanying adult females were biopsied.

Figure 2. Distribution of polar bears sampled in Kane Basin in (a) 2012 and (b) 2013. (Study area maps have been overlain on MODIS satellite images from the sampling periods to illustrate the extent of the north water polygna).

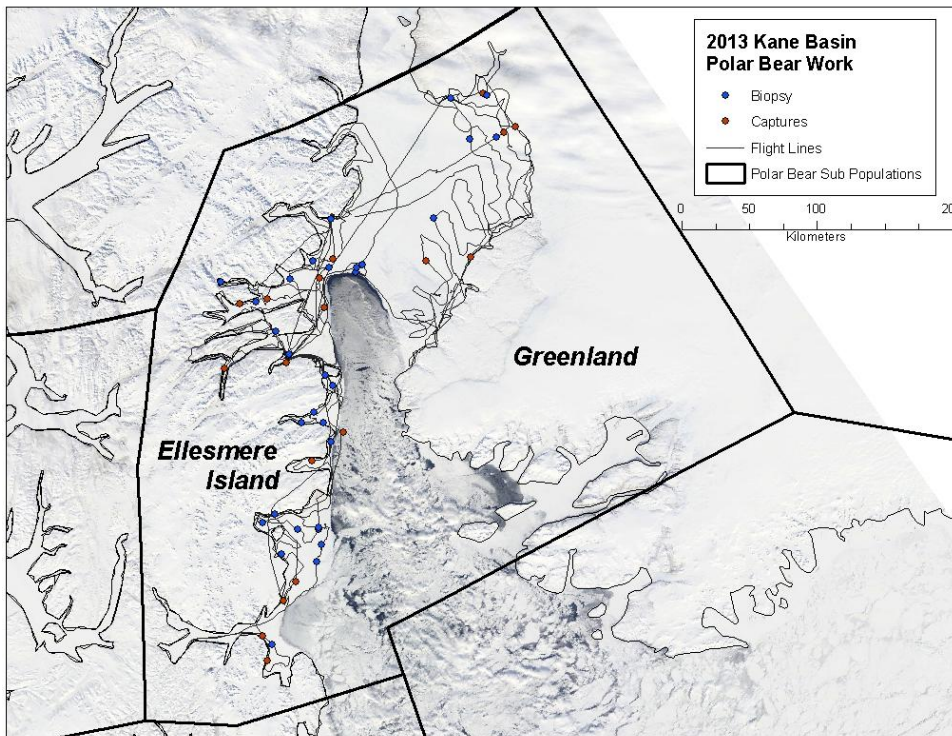
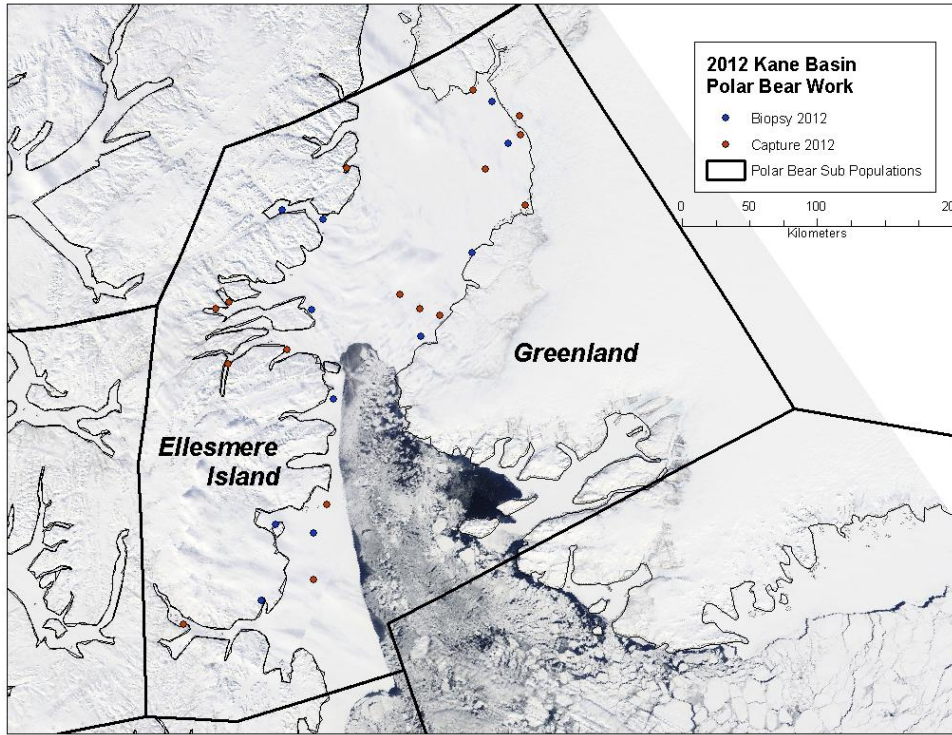


Figure 3. Distribution of body condition scores for bears encountered in Kane Basin, spring 2013. Pooled data for adult bears of both sexes.

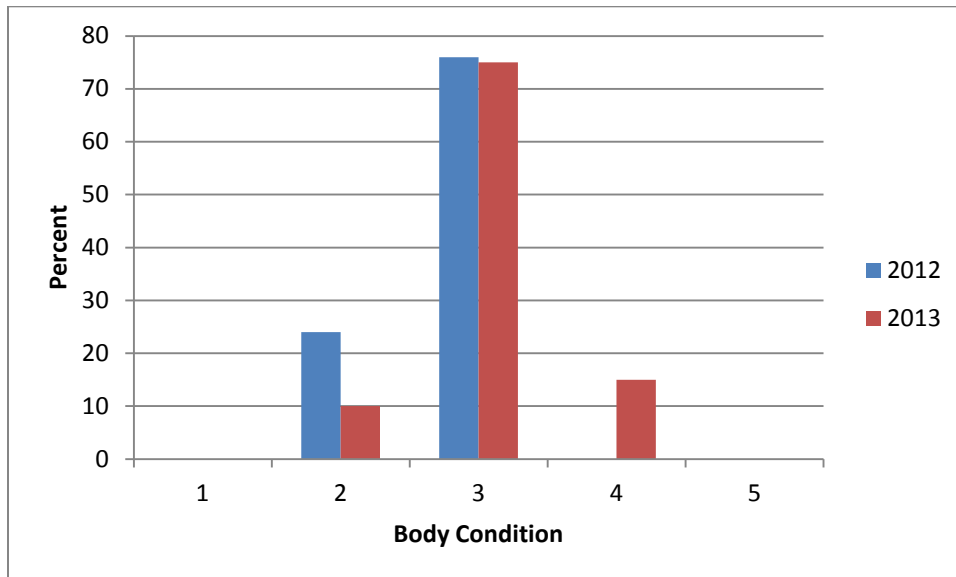


Figure 4. An example of hair loss and skin ulcerations on the foot of a polar bear captured in Kane Basin, Nunavut, May 2013.



