

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 (Figure 1). A mark-recapture study (1993-1997) estimated sub-population size at 164 bears in 1998. Subsequent population viability analyses (PVA) predicted that abundance was declining and that harvest levels were 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.

2014 was the final year of data collection for the study. Between April 28 and May 19, a total of 84 polar bears of various age classes and both sexes were encountered. Of these, 59 were biopsy darted to obtain DNA for the genetic mark-recapture. The remaining 25 individuals were cubs-of-the-year too small to safely dart. Sampling was distributed across KB, covering a total distance of approximately 11000 km. Rate of sampling averaged 1 bear per hour of flying; similar to 2013 but notably higher than 2012.

Concurrent with the mark-recapture sampling, an aerial survey of KB was conducted using sight-resight distance sampling protocols. For this survey, the study area was stratified into low and high density regions and transects were laid out at 15 km and 5 km intervals within each region, respectively. Mark-recapture sampling and aerial surveying followed the same transects. A total of 71 bears in 41 groups were observed during the survey. Estimates of polar bear abundance derived from the aerial survey and mark-recapture studies will facilitate comparison of these two techniques and the design of future monitoring programs for KB.

Collection of data on the movements of polar bears in KB continued in 2014. Twelve collars deployed in 2012 and 2013 are still active. These are due to release or be removed in 2015.

Analyses of mark-recapture, aerial survey and telemetry data are proceeding through 2014 and early 2015. Final results are expected in the spring of 2015.

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 KB¹.

Once a bear is located, a small sample of skin 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.

¹ 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 in-order to identify previously captured bears.

Population Delineation

To support reassessment of the boundaries of the KB subpopulation, 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, a total of up to 10 ear-tag mounted satellite transmitters will be placed on sub-adult bears of both sexes and adult males. Up to 10 satellite collars will be placed on adult females. 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

To date the project has remained on schedule as originally proposed. However, reporting of final project results is expected to be delayed until spring 2015 rather than winter 2014/15. This delay reflects additional time required for laboratory and data analyses.

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

PRELIMINARY RESULTS & DISCUSSION

Mark-Recapture Sampling (2014)

In 2014, mark-recapture sampling took place from April 28 to May 19 (as compared to April 25 to May 6 in 2012 and April 27 to May 10 in 2013). During this period, approximately 11000 km was flown while searching for polar bears on sea-ice habitat across Kane Basin (KB) in Canada and Greenland. In contrast to 2012 and 2013, search effort was distributed according to a set of transects that were laid out to facilitate an aerial survey of the sub-population concurrent with the final session of mark-recapture sampling (see Aerial Survey section below).

As in previous years, 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. Snow depth on the shore-fast ice along Ellesmere Island was highly variable but generally much deeper than other parts of KB; exceeding 1 metre in areas close to glaciers and in the fiords. The coastal regions of Greenland were characterised by first-year shore-fast ice but with greater numbers of icebergs in Northwest KB near the Humbolt Glacier. Snow depth was generally less than 25cm with the exception of sea-ice in front of the Humbolt glacier. Relative to 2012 and 2013, the North Water polygna occupied a greater portion of Kane Basin in 2014 extending further north and west (Figure 2).

In total, 84 polar bears of various age classes and both sexes were encountered including 25 cubs-of-the-year (COY), 21 family groups and 4 mating pairs (Table 1). With the exception of COYs, all bears encountered were biopsied². No bears were captured and handled.

The spatial distribution of bears sampled in 2014 was similar to that of bears sampled in 2012 and 2013 (Figure 2). 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 the pack-ice and shore-fast ice. Areas with high concentrations of icebergs in Northwest KB also appeared to be well used. Feeding activity was noted. Thirteen (15.5%) of the sampled bears were feeding on seal kills at time of encounter.

² COY's are too small to safely biopsy.

Overall rate of sampling in 2014 was approximately 1.0 bear per hour of flying³; similar to 2013 (1.1 bear/hr) but higher than 2012 (0.7 bear/hr). Several factors may account for the higher rates of sampling in 2013 and 2014 relative to 2012 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 and 2014 versus 2012 may have increased densities of bears in parts of KB, particularly near-shore areas along Ellesmere Island, thus increasing probability of capture.

Cub production in 2014 was relatively high in 2014. COYs comprised 30% of the bears encountered in 2014 in comparison to 13.5 and 15% in 2012 and 2013 respectively. For the 3 years of the study combined (2012-2014), COYs comprised 21% of the bears sampled. In comparison, during earlier mark-recapture studies from 1993-1997, cubs comprised approximately 19% of the total sample of bears with annual levels ranging from 8-24% (GN unpublished data).

Aerial Survey

As an addition to the project, an aerial survey of KB was flown in 2014 concurrent with mark-recapture sampling. This was carried out at no additional cost. The KB study area was stratified into high density and low density zones using;

1. Location data from bears captured or biopsied in 1993-97, 2012 and 2013 (Figure 3);
2. Telemetry data on bear movements for 2012-2013;
3. Anecdotal field observations regarding densities of tracks encountered in 2012 and 2013.

A series of transects were laid out within each stratum. Transects were spaced at 5 km and 15 km intervals within the high and low -density strata, respectively (Figure 4). Transects were laid out prior to the start of the field season before the full seasonal extent of the north water polygna was known. During the survey, transects that extended out over the open water of the polygna were truncated at the ice-edge.

The survey was flown using 4 observers following sight-resight distance sampling protocols similar to those previously used to count polar bears (Stapleton et al. 2014). Upon encountering a bear or group of bears, aerial survey data were first collected. Bears were then biopsy darted. Using this combined aerial survey and mark-recapture technique meant that mark-recapture and aerial survey search effort was identical and systematic in terms of geographic coverage and distribution.

³ Includes some non-search travel time

In total, 71 bears in 41 groups were encountered during aerial surveying. This is less than the total number of bears encountered during biopsy sampling because some bears were encountered while flying off transect. These “off transect” bears were not part of the aerial survey sample but were biopsy darted. All transects were flown with the exception of 6 that were inaccessible due to weather and/or other logistical constraints at the time of survey (Figure 5).

Aerial survey data will be analysed to derive an estimate of polar bear abundance in KB for comparison with the estimate derived from the mark-recapture biopsy darting. This cross-validation of the two techniques will facilitate design of future monitoring programs for KB and similar polar bear populations. If the two techniques yield similar results, wildlife managers will be able to design monitoring regimens that utilize these survey methods interchangeably dependent on information needs, desired frequency of monitoring and available financial resources. The ability to use aerial surveying as a basic monitoring tool may prove to be important for the management of small, remote, low-density populations such as KB that are logistically challenging and expensive to survey.

Telemetry Studies

Collection of satellite telemetry data on the movements of polar bears in KB continued in 2014. As of April 1, 2014, 12 collars deployed on adult females in 2012 and 2013 were still transmitting. These collars are scheduled for release or removal in the spring of 2014. No new instruments were deployed in 2014.

Movement data collected from instrumented bears in KB will be pooled with similar data from research in neighboring Baffin Bay. Amongst other things, this dataset will be used to reassess population closure and delineate boundaries using. The data will also 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.

Two collared bears were among the sample of bears encountered in 2014. Both were in good condition with the collars well fitted. One was accompanied by a COY; the other by a yearling.

Body Condition

In 2014, body condition scores (BCS) on a scale of 1 to 5 (leanest to most obese; Stirling et al. 2008) ranged from 2 to 4. Similar to 2012 and 2013, most bears (85.7%) were rated as being in fair condition. In contrast to 2012 a smaller proportion of bears were rated as being in poor condition ($BCS \leq 2$) and some (4.4%) rated in good condition ($BCS \geq 4$). This difference in condition, although not statistically significant, was most apparent amongst adult bears (Figure 6). Subjectively, bears in KB appeared

smaller in stature and mass than individuals of equivalent age and sex in some other sub-populations.

Genetic Analyses

DNA extracted from tissue samples collected from bears captured or biopsied in 2012 and 2012 have been genotyped to identify individuals and confirm genetic sex. Samples collected during 2014 fieldwork are currently being analyzed.

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 and 2014, an HTO member participated for the full duration of the fieldwork. Written annual progress reports summarizing the 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 class of polar bears sampled in Kane Basin, April/May 2014.

Age/Sex		Number of Individuals
Adult male		16
Adult female	Solitary	6
	With COYs	16
	With yearlings	4
	With 2-year-olds	1
Sub-adults		11
2-year-olds		1
Yearlings		4
Cubs-of-the-year (COY)		25
TOTAL		84

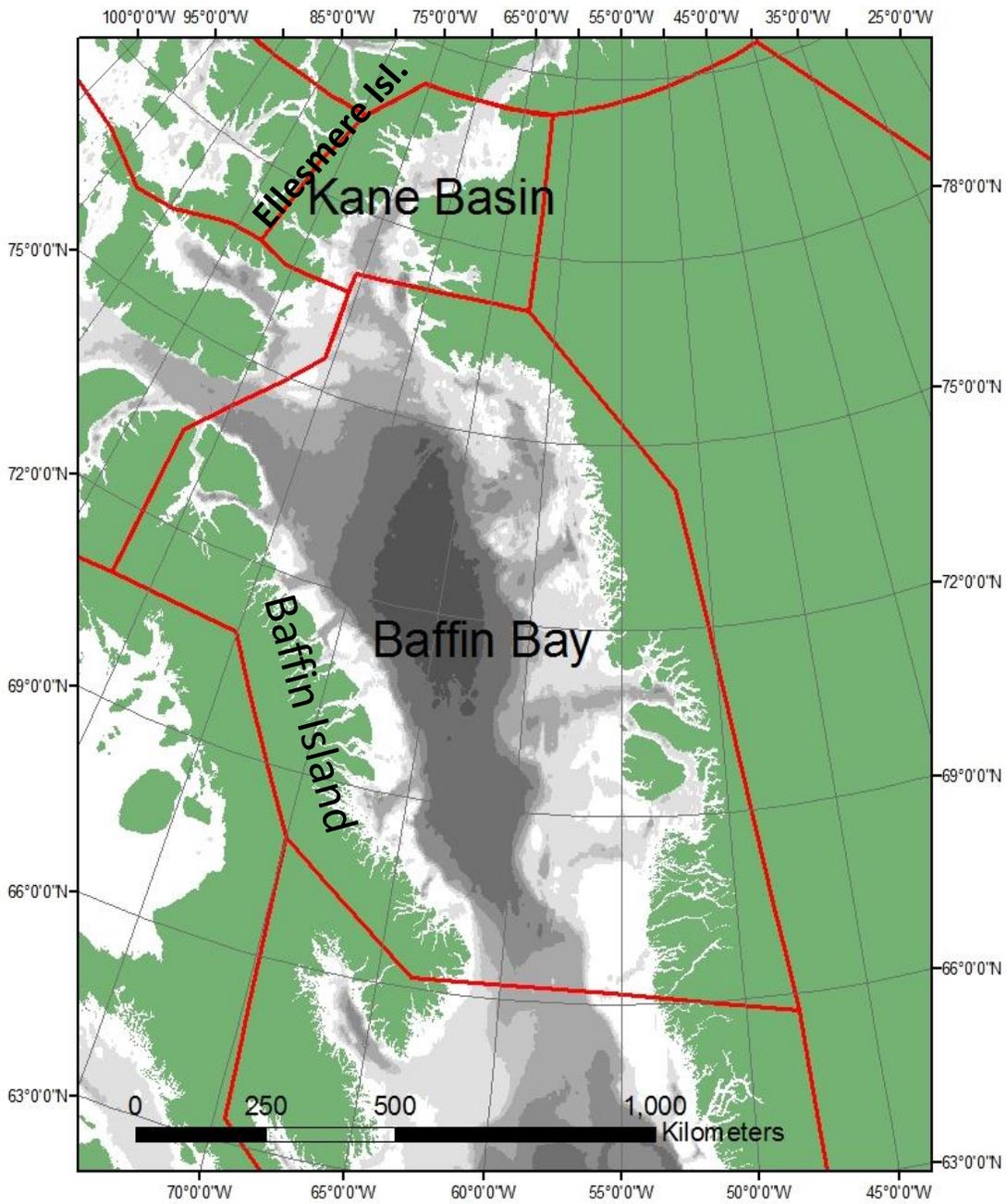


Figure 1. Kane Basin polar bear subpopulation

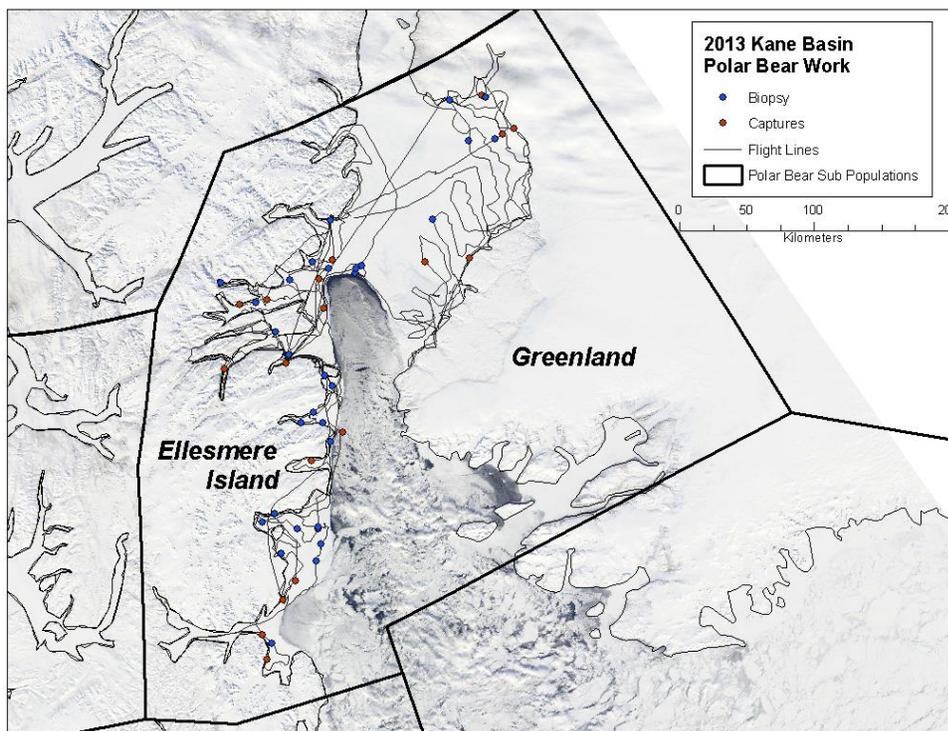
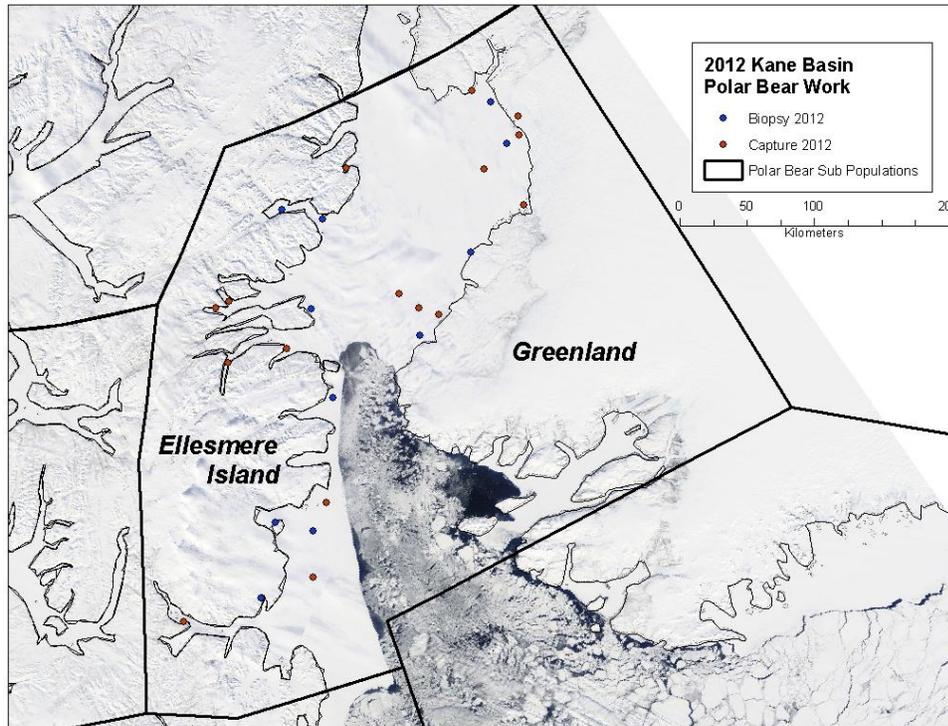


Figure 2a,b. Distribution of polar bears sampled in Kane Basin in 2012, 2013 and 2014. (Study area maps have been overlain on MODIS satellite images from the sampling periods to illustrate the extent of the north water polygna).

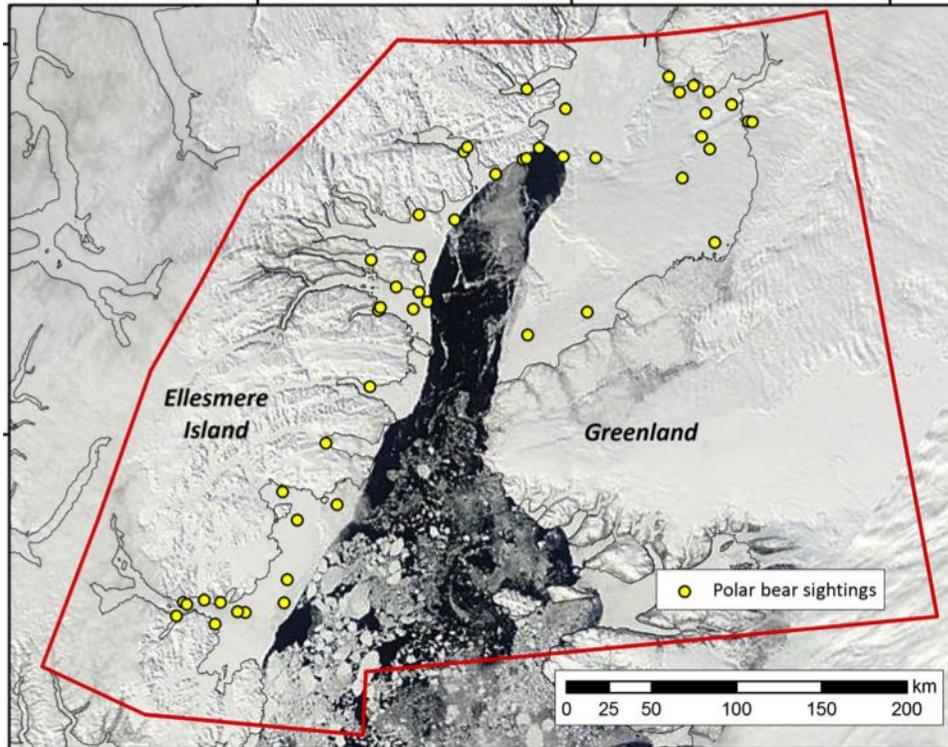


Figure 2c. Distribution of polar bears sampled in Kane Basin in 2014. (Study area maps have been overlain on MODIS satellite images from the sampling periods to illustrate the extent of the north water polynya).

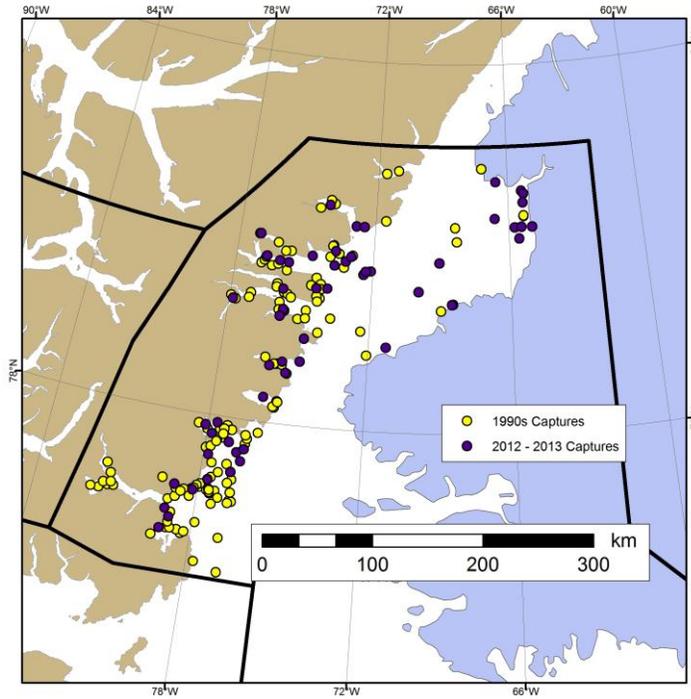


Figure 3. Locations of polar bears captured or biopsy darted during springtime mark-recapture studies in Kane Basin, Nunavut, in 1993-1997, 2012 and 2013.

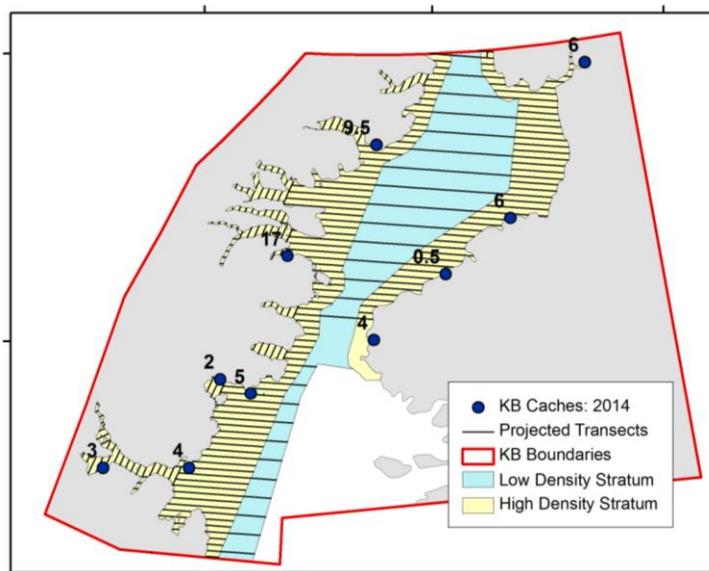


Figure 4. Strata and transects used during an aerial survey of the Kane Basin polar bear sub-population, April/May 2014.

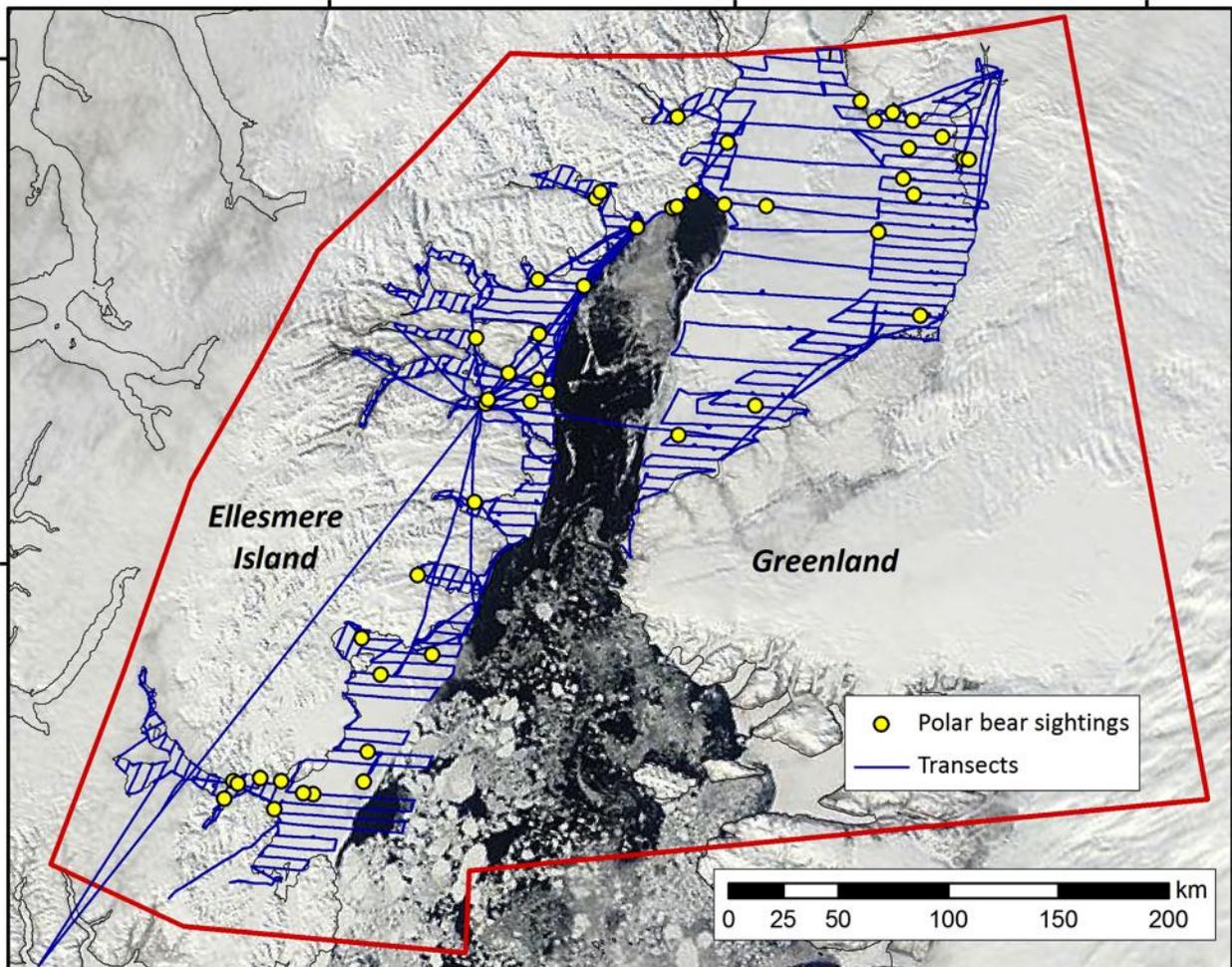


Figure 5. Transects flown and polar bears encountered during a combined aerial survey and genetic mark-recapture study in Kane Basin, April/May 2014.

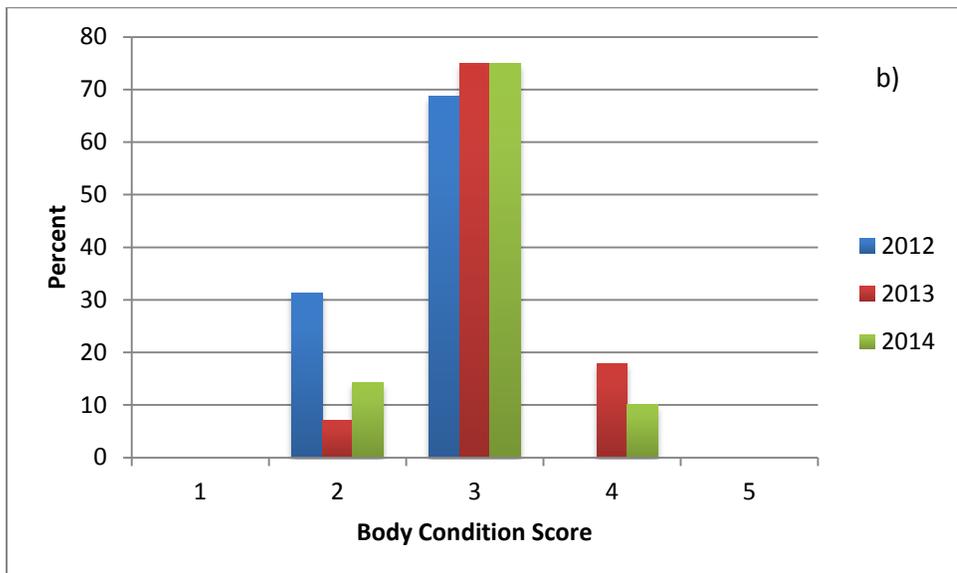
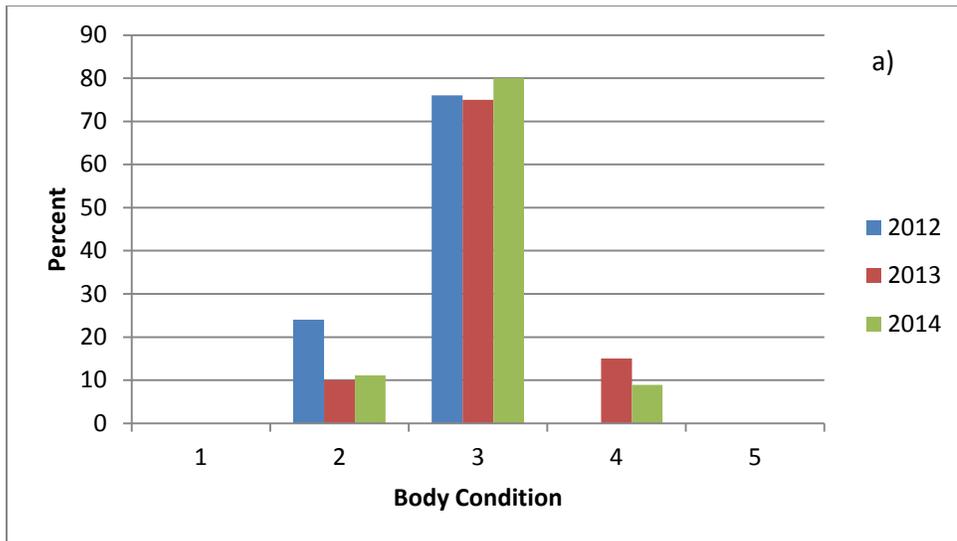


Figure 6. Distribution of body condition scores for bears encountered in Kane Basin during spring mark-recapture sampling 2012-14. Pooled data for: (a) adult bears (both sexes); (b) adult females only.