BINDER INDEX FOR THE NUNAVUT WILDLIFE MANAGEMENT BOARD IN-PERSON PUBLIC HEARING TO CONSIDER THE PROPOSAL FOR MODIFICATION OF THE WESTERN HUDSON BAY POLAR BEAR TOTAL ALLOWABLE HARVEST

AGENDA FOR THE NUNAVUT WILDLIFE MANAGEMENT BOARD PUBLIC HEARING TO CONSIDER THE GOVERNMENT OF NUNAVUT'S WESTERN HUDSON BAY POLAR BEAR TAH PROPOSAL

Day 1: January 9th, 2018

TIME OF DAY	PROPOSED TIMING FOR SUBMISSIONS, QUESTIONS AND COMMENTS	MAXIMUM PROPOSED TIME
9:00 – 9:20 AM	Introductions, Chairperson opening remarks & opening prayer, NWMB review and approval of the Day 1 Agenda	20 minutes
9:20 – 10:00 AM	Government of Nunavut-Department of Environment *Proposal for Decision*	40 minutes
10:00 – 10:15 AM	Mid-morning Break	15 minutes
10:15 – 11:15 PM	Questions and comments on Government of Nunavut *Proposal for Decision*	1 hour
10:15 – 11:55 PM	Nunavut Tunngavik Incorporated submissions	40 minutes
11:55 – 1:00 PM	Lunch Break	1 hour and 5 minutes
1:00 – 1:40 PM	Questions and comments on Nunavut Tunngavik Incorporated submissions	40 minutes
1:40 – 2:20 PM	Kivalliq Regional Wildlife Board submissions	40 minutes
2:20 – 3:00 PM	Questions and comments on Kivalliq Regional Wildlife Board submissions	40 minutes
3:00 – 3:15 PM	Mid-afternoon Break	15 minutes
3:15 – 3:55 PM	Arviat HTO submissions	40 minutes
3:55 – 4:15 PM	Questions and comments on Arviat HTO submissions	30 minutes
4:15 – 4:55 PM	Whale Cove HTO submission	40 minutes
4:55 – 5:25 PM	Questions and comments on Whale Cove HTO submission	30 minutes

AGENDA FOR THE NUNAVUT WILDLIFE MANAGEMENT BOARD PUBLIC HEARING TO CONSIDER THE GOVERNMENT OF NUNAVUT'S WESTERN HUDSON BAY POLAR BEAR TAH PROPOSAL

Day 2: January 10th, 2018

TIME OF DAY	PROPOSED TIMING FOR SUBMISSIONS, QUESTIONS AND COMMENTS	MAXIMUM PROPOSED TIME
8:30 – 8:45 AM	Chairperson opening remarks & opening prayer, NWMB review and approval of the Day 2 Agenda	15 minutes
8:45 – 9:25 AM	Rankin Inlet HTO submissions	40 minutes
9:25 – 10:00 AM	Questions and comments on Rankin Inlet submissions	35 minutes
10:00 – 10:15 AM	Mid-morning Break	15 minutes
10:15 – 10:55 AM	Chesterfield Inlet HTO submissions	40 minutes
10:55 – 11:30 AM	Questions and comments on Chesterfield Inlet submissions	30 minutes
11:30 – 12:10 PM	Baker Lake HTO submissions	40 minutes
12:10 – 1:10 PM	Lunch Break	1 hour
1:15 – 1:45 PM	Questions and comments on Baker Lake HTO submissions	30 minutes
1:45 – 2:25 PM	Environment and Climate Change Canada submissions	40 minutes
2:25 – 2:55 PM	Questions and comments on Environment and Climate Change Canada submissions	30 minutes
2:55 – 3:10 PM	Mid-Afternoon Break	15 minutes
3:10 – 4:40 PM	World Wildlife Fund (WWF-Canada) submissions	30 minutes
4:40 – 5:00 PM	Questions and comments on WWF-Canada submissions	20 minutes
5:00 – 6:00 PM	Public statements/questions and responses	1 hour
6:00 – 6:50 PM	Final comments from hearing parties and the NWMB	50 minutes

RULES FOR THE NUNAVUT WILDLIFE MANAGEMENT BOARD IN-PERSON PUBLIC HEARING TO CONSIDER TO CONSIDER THE PROPOSAL FOR MODIFICATION OF THE WESTERN HUDSON BAY POLAR BEAR TOTAL ALLOWABLE HARVEST

October 20th 2017

THE PURPOSE of this Nunavut Wildlife Management Board (NWMB) in-person public hearing is to consider the Government of Nunavut- Department of Environment's Proposal for Decision to the Board (Proposal) concerning the total allowable harvest for the Western Hudson Bay polar bear subpopulation. The Proposal, along with other documents comprising the best available information to date, is available for review or download from the NWMB's website (www.nwmb.com).

HEARING RULES:

1. The NWMB (the Board) shall provide notice to the public at least thirty (30) days prior to the deadline for filing hearing submissions.

2. Any interested person or body may file with the Board a written submission and supporting documentation[1] in response to the Proposal concerning the total allowable harvest for the Western Hudson Bay polar bear subpopulation — duly translated into Inuktitut or English as the case may be – by no later than 5:00 p.m. (Iqaluit time) on November 24th 2017.

3. Unless persuasive written and translated reasons are provided to the Board for late filing, the Board will not consider materials for this hearing that are not filed on time.

4. The requirements for translation of submissions and supporting documentation filed with the Board does not apply to individual members of the public.

5. For all others who file supporting documentation with the Board, the requirement for translation does not apply to such documents over ten (10) pages in length, as long as each supporting document that is not translated is accompanied by a concise, translated summary (English and Inuktitut) at least two (2) pages in length.

6. The Board shall ensure that all materials filed with it or produced by it are made publicly available, subject to relevant confidentiality or privacy concerns.

7. The NWMB shall provide simultaneous English and Inuktitut translation at the hearing, to the extent reasonably possible.

8. A quorum of NWMB members shall be present at the hearing.

9. Any representative or agent of the Government of Canada or Government of Nunavut, any Hunters and Trappers Organization or Regional Wildlife Organization, and any Inuk shall be accorded the status of party for the hearing.

10. Unless invited by the Board to be a party, any other person or body wishing to be named as a party by the Board shall make an appropriate request in writing to the Board.

11. All parties and other participants at the hearing are required to treat one another and the NWMB with respect.

12. The NWMB shall provide a reasonable opportunity for oral presentations from each of the parties at the hearing by their choice of official, expert or counsel.

13. Any member of the NWMB, the NWMB's Director of Wildlife or the NWMB's Legal Counsel may ask relevant questions of any other party at the hearing.

14. Any party may ask relevant questions of any other party at the hearing.

15. The NWMB shall provide members of the public in attendance at the hearing a reasonable opportunity to make statements and to ask questions of the parties and the NWMB.

16. Every person at the hearing wishing to speak or ask a question shall raise his or her hand, and shall only speak once the NWMB Chairperson has recognized him or her.

17. The NWMB Chairperson reserves the right to place reasonable time limits on presentations, statements and questions.

18. The NWMB shall make an audio recording of the hearing available upon request.

SUBMISSION TO THE

NUNAVUT WILDLIFE MANAGEMENT BOARD

FOR

Information: **Decision: X**

Issue: Polar Bear Total Allowable Harvest Recommendations for the Western Hudson Bay Sub-population

Background:

- The Western Hudson Bay (WH) polar bear subpopulation is shared with Manitoba (Figure 1).
- In 2005/2006, polar bear Memoranda of Understanding (MOUs) came into effect and the Total Allowable Harvest (TAH) for WH polar bears was increased from 47 per year to 56 per year. The WH MOU (Section 5.7.1) states that when new research information becomes available the TAH will be corrected as necessary.
- New information from Canadian Wildlife Service (CWS), Environment and Climate Change Canada (ECCC) in February 2005 indicated that the estimated abundance had decreased by approximately 22% from 1200 to 935 bears between 1984 and 2004. The researchers attributed this decline in population size to the combined effects of progressive sea-ice decline causing reductions to survival and recruitment rates, and subsequent unsustainable control and harvest removals.
- In contrast to the scientific findings, the observations by local hunters in Nunavut and Inuit traditional ecological knowledge (TEK) suggested that the population may not be declining.
- Climate change may have altered polar bear distribution patterns and behaviour, giving Inuit hunters the impression that there are more bears because there are more bear-human encounters. However, it may also be true that both population numbers and population performance have been underestimated by previous scientific studies which failed to include the entire summer retreat area used by WH polar bears.
- The Nunavut TAH for WH was reduced to 38 bears for 2007-2008, and then set at 8 bears per year for the 2008-2009, 2009-2010 and 2010-2011 seasons. Removals for control actions (defense kills), combined with regular harvest, exceeded the TAH (8) every year following the reduction.

- In 2011, the TAH was set at 21 bears as an interim measure in anticipation that new research results would be available in 2012.
- An aerial survey of the entire summer range of the WH population was conducted by the Government of Nunavut (GN) in 2011 in collaboration with the Government of Manitoba. The survey estimated the population size at approximately 1030 bears (754 – 1406, 95% CI). The report stated that, “the aerial survey-derived estimate is consistent with the 2004 capture-based estimate but inconsistent with projections suggesting continued decreases in abundance”.
- The Nunavut Wildlife Management Board (NWMB) set a new TAH for WH at 24 polar bears for three years, to be formally reviewed following the 2014-15 harvest season, or at such time as new relevant information becomes available.
- The NWMB made an initial decision on 31 March 2015 to increase the TAH for WH by 14 to a total of 38 bears, which the Minister disallowed in his initial reply. The NWMB’s final decision was made on 7 October 2015 which remained at 38 bears. The Minister varied the NWMB decision on 23 October 2015 to an increase of 4 bears to a total regional TAH of 28 bears for the 2015/2016 harvest season (Figure 2).
- Since the 2011 aerial survey of the WH subpopulation, new information became available from the analyses of long-term mark-recapture work (1984 – 2011) conducted by ECCC. Their results indicated that the 2011 WH polar bear estimate was 806 bears (715-1398, 95% CI), which was roughly consistent with the abundance estimate derived from the aerial survey.
- A declining trend in population size was detected between 1987 and 2004, but the population appears to have remained relatively stable over the past decade. Female growth (the proportion of females in the population) also appeared to have been stable with a female population growth rate of 2% annually for the period 1991-2011(Lambda = 1.02 (0.98-1.06, 95% CI)).
- The study also indicated that survival of females of all ages was correlated with sea ice conditions, and was generally lower in years of earlier break-up. However, although the study found long-term (1979-2012) trends in earlier break-up and freeze-up, no such trends were apparent during the last decade (2001-2011), suggesting there has been a period of relative stability in sea-ice conditions.

Current Status:

- A new collaborative aerial survey study was conducted between 12 – 22 August, 2016 to re-assess the abundance of the WH polar bear subpopulation (Figure 3).
- The new sub-population estimate was assessed at 842 bears (562-1121, 95% CI; 16.9% Coefficient of Variation) during August of 2016.
- During the time of the survey, very few bears (~5.3%) were sighted in Nunavut, with the vast majority summering in Manitoba.

- As with the last survey, indicators of reproductive performance were poorer in WH polar bears during 2016 when compared to any other subpopulation in the Hudson Bay complex (e.g. polar bear cubs-of-the-year and yearlings presented a small proportion of the total observations).
- The new population estimate is lower than that of the previous (2011) aerial survey, but not significantly since confidence intervals overlap. The current estimate is not significantly different from the 2011 aerial survey estimate of 949 bears (618–1280, 95% CI) based upon similar transect sampling methods and analysis of covariates (t=0.48, df=452,p=0.63).

Consultations:

- Community consultations were held with HTO representatives from Rankin Inlet, Arviat, Whale Cove and Chesterfield Inlet between 4 and 7 July 2017, also including participants from Nunavut Tunngavik Inc. (NTI) and the Kivalliq Wildlife Board (KWB).
- During those meetings, results of the 2016 GN-led aerial survey were discussed, in addition to the GN recommendation of no change to the current TAH of 28 bears, given the results of the study.
- Several communities indicated their support for fall coastal surveys to assess bear distribution that could assist in preventing problem bear occurrences, as well as support for a more detailed traditional knowledge study.
- The Arviat HTO requested that polar bear tag credits be zeroed so that full allocation of tags becomes available for the polar bear harvest but also for potential problem bears.
- The Government of Manitoba was provided with the 2016 WH aerial survey report, and notified of the Government of Nunavut's TAH recommendation of no change to the current TAH of 28 bears, with a recommendation to the NWMB to re-set credits and TAH.
- The Report has also been provided to ECCC and Parks Canada Agency. Government of Manitoba and ECCC officials have been encouraged to participate in the NWMB's decision-making process, and to provide any additional information, concerns or recommendations they consider relevant, in the interest of helping the Board make an informed decision.

Recommendations:

1. DOE recommends **no change** to the current WH TAH of 28 bears.
2. DOE recommends a **re-set to the TAH** by zeroing-out existing polar bear tag credits so that all communities harvesting from WH will be in a position to have

their full allocation available to cover any harvested bears and problem bears if necessary.

This recommendation was derived by taking various sources into consideration, and by carefully evaluating additional important relevant data, as follows:

- The GN aerial survey results of 2011 and 2016 are both very similar in that they are not statistically significantly different. That means that although a decline of approximately 18% in the population was observed, results and comparisons of both studies indicate that the WH polar bear population has remained relatively stable.
- The ECCC analysis indicated that the WH subpopulation has remained relatively stable over the past decade, whereas a declining trend was apparent between 1987 and 2004.
- Sea-ice freeze-up and break-up patterns over the past decade have not indicated any significant trends; however, when a larger time-frame (1979-2012) is considered, break-up and freeze-up of sea-ice has been occurring three weeks earlier and three weeks later on average, respectively.
- Average body condition (body mass) of solitary adult female polar bears has been declining since 1980. As body condition declined over this period so did recruitment rates (or litter production). Similar observations were made during both aerial surveys, where both cubs-of-the-year and yearling observations were lower as compared to any other seasonal ice-free polar bear population with available data.
- The mean combined annual Nunavut-Manitoba removal for the WH subpopulation was approximately 32 bears (harvest season 2003/2004 – 2015/2016). Manitoba in the past has retained 8 tags for potential defense of life and property kills (their removal for the same time period was 2.8 bears/year).
- DOE will continue to work with communities to ensure that public safety is maintained, and bear-human interactions are minimized through a strong emphasis on polar bear deterrent efforts.
- DOE recommends that as per section 5.7.6 of the Nunavut Land Claims Agreement, the TAH should be distributed among the communities that share the WH polar bear sub-population as identified by the Regional Wildlife Organization, and that consideration should also be given to communities that endure a higher level of polar bears that become a risk to public safety and property.
- DOE believes the recommendation to maintain the current TAH of 28 bears balances the best current available scientific information and Inuit observations to ensure that the harvest does not cause a conservation concern for the WH polar bear sub-population over the short and long-term.

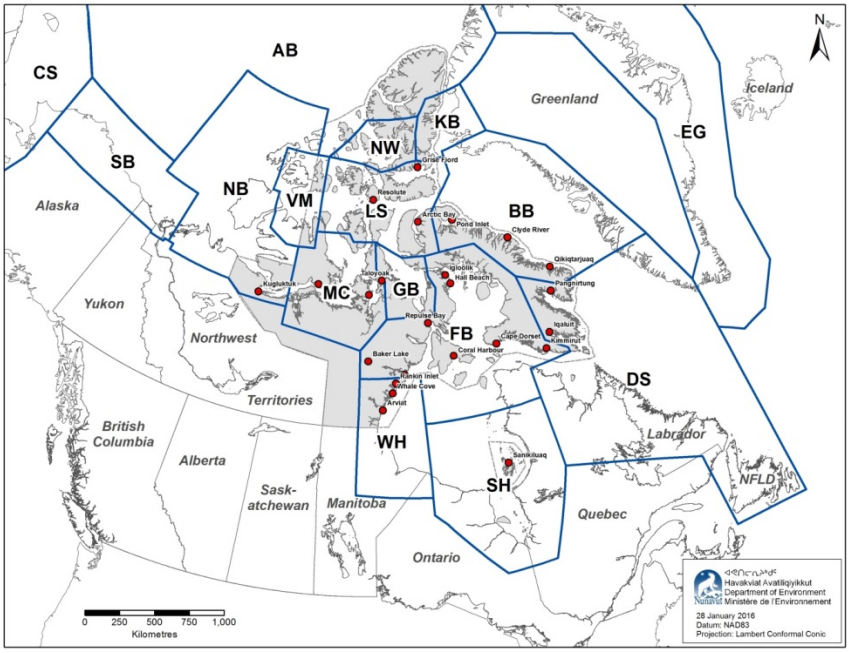

Figure 1. Overview of Nunavut polar bear subpopulations (WH = western Hudson Bay; SH = southern Hudson Bay, FB = Foxe Basin).

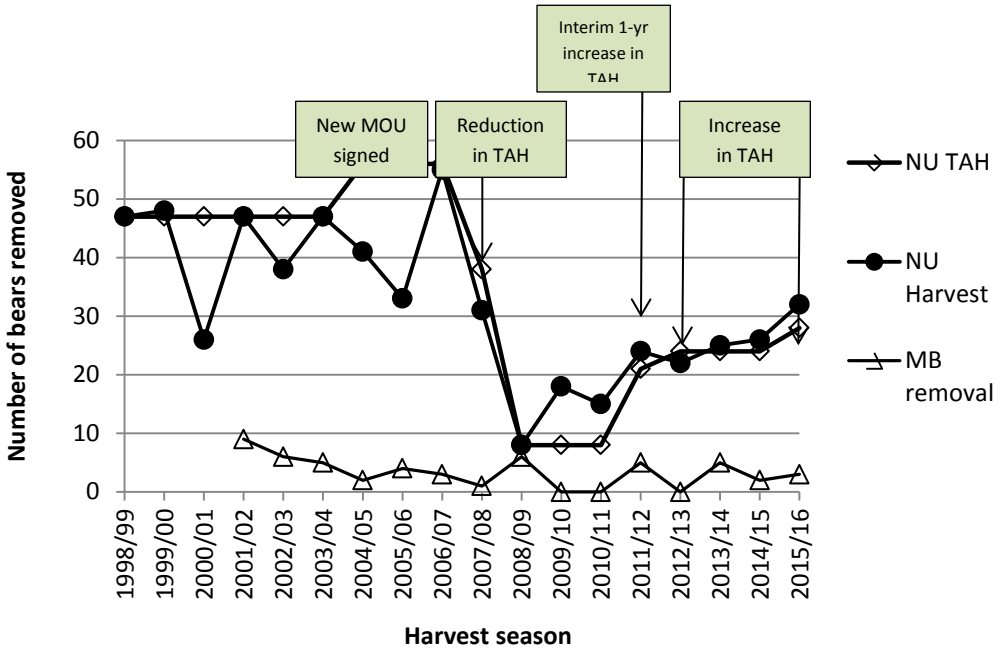

Figure 2. Overview of the removals from the western Hudson Bay polar bear population and management actions between 1998/99 and 2015/16

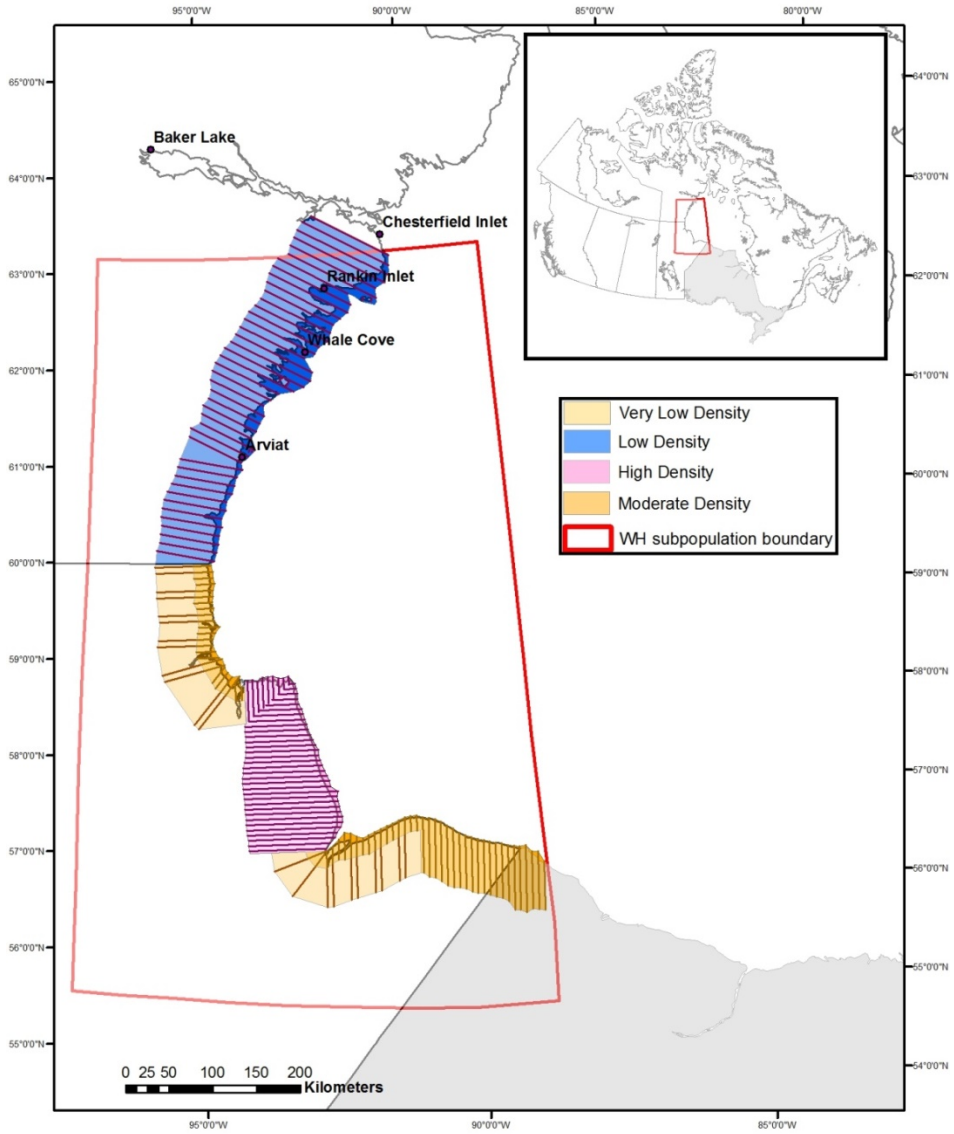

Figure 3. An overview of the various strata that were employed during the August 2016 aerial survey in western Hudson Bay.

2016 AERIAL SURVEY OF THE WESTERN HUDSON BAY POLAR BEAR SUB-POPULATION

FINAL REPORT

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June 26, 2017

Submitted to meet requirements of:

Wildlife Research Permit WL 2016-004
Nunavut Wildlife Research Trust Project 2-16-04
Wapusk National Park Research and Collection
Permit Number WAP-2016-21838

STATUS REPORT 2017-xx
NUNAVUT DEPARTMENT OF ENVIRONMENT
WILDLIFE RESEARCH SECTION
IGLOOLIK, NU

M. Dyck, Campbell, M., Lee, D.S., Boulanger, J., and Hedman, D. 2017. Aerial survey of the western Hudson Bay polar bear sub-population 2016. 2017 Final Report. Government of Nunavut, Department of Environment, Wildlife Research Section, Status Report 2017-xx, Igloolik, NU. 82 pp + 2 Supplements.

Disclaimer

The opinions in this report reflect those of the authors and not necessarily those of the Government of Nunavut, Department of Environment.

Summary

Climatic change has been experienced across the globe during the past 30 years with some transformations now being observed in the Arctic. For example, the sea-ice habitat for some polar bear subpopulations is now experiencing later freeze-up and earlier melt. Other studies documented correlations between these environmental changes and reduction of body mass, survival rates, and reproductive performance of a few polar bear subpopulations. These type of population-wide changes require careful, and at times intense, monitoring in order to inform the status of these subpopulations.

In August 2016, the Government of Nunavut (GN) conducted an aerial survey of the Western Hudson Bay (WH) polar bear subpopulation in order to update its status. Pre-survey consultations with Nunavut HTOs and communities, and with the Manitoba Department of Sustainable Development were conducted in order to utilize local and traditional knowledge in the study design. Nunavummiut living within the range of this subpopulation have repeatedly indicated that they feel the abundance of polar bears has increased within Nunavut. Other studies of WH suggest that numbers appear to have stabilized between 2001-2011 following a period of decline between 1987-2004. The last GN aerial survey produced an estimate of 1030 bears (95% CI: 745–1406) in 2011. Final survey results of this study (2016) produced an estimate of 842 bears (95% CI: 562–1121). The estimate is not significantly different from the 2011 aerial survey estimate of 949[1] bears (95%CI: 618–1280) based upon similar transect sampling methods and analysis of covariates.

A double observer distance-sampling method was employed to estimate abundance. During this survey, bears were observed by front and rear observers from aircraft following inland transects oriented perpendicularly to the coastline. During August 2016, the majority of bears were distributed within 10km of the coast, with the exception of Wapusk National Park where some bears were observed greater than 80 km inland. Very few bears were observed in Nunavut, and a substantial proportion of

[1] During the 2011 aerial survey, coastal and inland transects were flown, which were not identical to the 2016 survey and therefore these estimates are not directly comparable. Regardless, when the derived abundance estimate of 1030 bears from the 2011 survey is statistically compared with the 2016 estimate, no significant difference between those two estimates can be detected.

bears, mostly adult males, were encountered in large concentrations in the south-east section of the study area towards the Manitoba-Ontario border. Cubs and yearlings comprised a small proportion of the sample size, which was also observed during previous studies. This suggests that reproductive performance is low for this subpopulation but this was not a specific objective of this study.

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ᓯᓚᐅᑉ ᐊᓯᔾᔨᖅᐸᓪᓕᐊᓂᖓ ᖃᐅᔨᔪᑕᐅᓯᒪᖕᒪᑦ ᓄᓇᕐᔪᐊᓕᒫᒥ ᐊᕐᕌᒍᑦ 30 ᐊᓂᒍᖅᑎᓪᓗᒋᑦ ᐊᓯᔾᔩᓂᖃᖅᑐᓂ ᖃᐅᔨᓴᖅᑕᐅᓪᓗᓂ ᐅᑭᐅᖅᑕᖅᑐᒥ. ᐆᒃᑑᑎᒋᓗᒍ, ᐃᒪᕐᒥᐅᑕᓄᑦ ᐃᓚᖏᓐᓄᑦ ᓇᓄᕐᓄᑦ ᓇᓅᖃᑎᒃᑳᓂᖏᓐᓄᑦ ᖃᐅᔨᔾᔪᑎᖃᖅᓯᒪᓕᕐᒪᑕ ᖁᐊᖅᓭᕋᐃᙱᓐᓂᖅᓴᐅᓕᖅᑐᒥᒃ ᐊᒻᒪ ᐊᐅᒃᓵᓕᓂᖅᓴᐅᓕᖅᑐᒥᒃ. ᐊᓯᖏᑦ ᖃᐅᔨᓴᕆᑕᐅᔪᑦ ᑎᑎᖅᑕᐅᔪᑦ ᐊᕙᑎᒧᑦ ᐊᓯᔾᔨᕐᓂᒃᑯᑦ ᐊᒻᒪ ᐊᑦᑎᒃᓯᒋᐊᕐᓂᒃᑯᑦ ᑎᒥᐅᑉ ᐅᕐᑯᒪᐃᓐᓂᖓᓂᒃ, ᖃᓄᖅ ᐊᑯᓂᐅᑎᒋᔪᖅ ᐆᒪᕙᒻᒪᖕᒋᑕ, ᐱᓕᕆᔪᓐᓇᑦᑎᐊᕐᓂᕐᒧᑦ ᐱᓕᕆᓂᕆᔭᖏᑦ ᓇᓄᕐᓄᑦ ᓇᓅᖃᑎᒃᑳᓂᖏᓐᓄᓪᓗ. ᑕᒪᒃᑯᐊ ᐃᓄᒋᔭᐅᔪᓕᒫᓄᓪ-ᐊᔾᔨᒌᙱᑦᑐᓘᔭᖅᑐᓄᑦ ᐊᓯᔾᔨᕐᓃᑦ ᐅᔾᔨᖅᓱᑎᐊᕐᓗᓂ, ᐃᓛᓐᓂᒃᑯᓪᓗ ᐊᒃᓱᕈᕐᓴᕐᓗᓂ, ᓇᐅᑦᑎᓱᖅᐸᓪᓕᐊᓂᖅ ᓇᓗᓇᐃᖅᓯᓂᕐᒧᑦ ᖃᓄᐃᓕᖓᓕᕐᓂᕆᔭᐅᔪᓂᑦ ᑖᒃᑯᐊ ᓇᓅᖃᑎᒃᑳᓂᖏᓪᓗ.

ᐊᐅᒍᒃᑎ 2016-ᒥ, ᓄᓇᕗᑦ ᒐᕙᒪᖓ ᐱᓕᕆᐊᖃᓚᐅᕐᒪᑦ ᖃᖓᑕᓲᒃᑯᑦ ᓈᓴᐃᓂᕐᒥᒃ ᑕᓯᐅᔭᕐᔪᐊᑉ ᐱᖓᓇᖓᓂ ᓇᓄᖏᑦ ᓇᓅᖃᑎᒃᑳᓂᖏᓪᓗ ᓄᑖᙳᕆᐊᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᓄᐃᓕᖓᓕᕐᓂᕆᔭᐅᔪᒥᒃ. ᓇᐃᓴᖅᑕᐅᓚᐅᙱᑎᓪᓗᒋᑦ ᐅᖃᖃᑎᒌᒃᑎᑦᑎᓂᖅ ᓄᓇᕗᒻᒥ ᐊᖑᓇᓱᒃᑐᓕᕆᔨᖏᓐᓂᒃ ᓄᓇᓕᖕᒥᐅᓂᓪᓗ, ᐊᒻᒪ ᒫᓂᑑᐸᒥᑦ ᐃᑯᐱᒃᕿᓕᕆᔨᒃᑯᑦ ᐱᓕᕆᐊᖃᓚᐅᖅᑐᑦ ᐊᑐᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᓄᓇᓕᖕᓂ ᐊᒻᒪ ᐃᓄᐃᑦ ᖃᐅᔨᒪᓂᑐᖃᖏᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐋᖅᑭᐅᒪᓂᖓᓂᒃ. ᓄᓇᕗᒻᒥᐅᑦ ᓄᓇᖃᖅᑐᑦ ᐊᔪᙱᓐᓂᖃᖅᖢᑎᒃ ᓇᓅᖃᑎᒃᑳᓂᖏᓐᓂᒃ ᓇᓗᓇᐃᖅᔫᓇᖅᑐᑦ ᖃᓄᖅ ᐅᓄᖅᑎᒋᓂᖏᓐᓂᒃ ᓄᓇᐃᑦ ᐅᓄᖅᓯᒋᐊᖅᓯᒪᔪᖅ ᓄᓇᕘᑉ ᐃᓗᐊᓂ. ᐊᓯᖏᑦ ᖃᐅᔨᓴᕈᑎᑦ ᑕᓯᐅᔭᕐᔪᐊᑉ ᐱᖓᓇᖓᓂ ᐅᖃᖅᓯᒪᔪᖅ ᖃᑦᓯᐅᓂᖏᑦ ᓴᖅᑭᓂᖏᓐᓄᑦ ᓇᖏᐊᕐᓇᖅᑐᑏᑦᑎᑦᑐᓃᖅᑎᑕᐅᔭᕆᐊᖃᕐᓂᖏᓐᓄᑦ 2001-ᓗ 2011-ᓗ ᐊᑯᓐᓂᖓᓂᒃ ᒪᓕᒡᓗᓂ ᐊᖏᖅᑕᐅᓚᐅᖅᓯᒪᙱᑦᑐᑦ 1987-ᒥᑦ 2004-ᒧᑦ. ᑭᖑᓪᓕᖅᐸᖅ ᓄᓇᕗᑦ ᒐᕙᒪᖓᑕ ᖃᖓᑕᓲᒃᑯᑦ ᖃᐅᔨᓴᕐᓂᖓᑦ ᓴᖅᑭᑦᑎᓚᐅᖅᐳᖅ ᐃᒪᓐᓇᐅᓇᓱᒋᔭᐅᔪᓂᒃ 1030 ᓇᓄᐃᑦ (95% CI: 745-1406) 2011-ᒥ. ᐋᖅᑭᑦᐊᖅᑕᐅᒃᑲᓂᔾᔫᙱᑦᑐᑦ ᓇᐃᓴᖅᑕᐅᓂᖏᑦᑕ ᓴᖅᑭᓐᓂᖏᑦ ᑕᒪᑐᒧᖓ ᖃᐅᔨᓴᕐᓂᐅᔪᒧᑦ (2016ᒧᑦ) ᓴᖅᑭᑦᑎᓚᐅᖅᐳᑦ ᐃᒪᓐᓇᐅᓇᓱᒋᔭᐅᔪᓂᒃ 842 ᓇᓄᐃᑦ (95% CI: 562–1121). ᑕᒪᓐᓇ ᐃᒪᓐᓇᐅᓇᓱᒋᔭᐅᓂᖅ ᐅᔾᔨᕐᓇᖅᑐᒻᒪᑎᖕᒥ ᐊᓯᔾᔨᕐᓂᖃᕐᒪᑦ 2011-ᒥᑦ ᖃᖓᑕᓲᒃᑯᑦ ᖃᐅᔨᓴᕐᓂᖅ ᐃᒪᓐᓇᐅᓇᓱᒋᔭᐅᔪᖅ 949[2] ᓇᓄᐃᑦ (95% CI: 618-1280) ᐊᑐᖅᖢᑎᒃ ᐊᔾᔨᑲᓴᖏᓐᓂᒃ ᐃᓂᖏᓐᓂᒃ ᖃᐅᔨᓴᒐᒃᓴᑦ ᓇᓗᓇᐃᔭᖅᓯᒪᔪᑦ ᐅᕝᕙᓘᓐᓃᑦ ᖃᐅᔨᓴᕈᑕᐅᓯᒪᔪᑦ ᓇᓗᓇᐃᔭᖅᓯᒪᓂᖏᑦ.

ᖃᐅᔨᓴᐃᒃᑲᓂᖅᑎ ᐅᖓᓯᒃᑎᒋᔪᓐᓇᕐᓂᔭᖓᓂᒃ ᐊᑐᖅᑕᐅᔾᔪᖓᓄᑦ ᐃᖅᑲᓇᐃᔭᕝᕕᐅᓚᐅᖅᑐᖅ ᒥᐊᓂᕆᔭᐅᓯᒪᔪᑦ ᖃᓄᖅ ᐅᓄᖅᑎᒋᓂᖏᑦ. ᑕᒪᑐᒪᓂ ᓇᐃᓴᐃᓂᕐᒥ, ᓇᓄᐃᑦ ᖃᐅᔨᔭᐅᓯᒪᔪᑦ ᓯᕗᓂᐊᒍᑦ ᑭᖑᓂᐊᒍᓪᓗ ᖃᐅᔨᓴᖅᑎᓂᒃ ᖃᖓᑕᓲᒃᑯᑦ ᒪᓕᒃᓱᑎᒃ ᖃᕝᕙᓯᒃᑐᖅ ᐃᓂᖏᑦ ᖃᐅᔨᒪᑎᑕᐅᓂᖅ ᓴᓐᓂᖓᔪᓕᖓᓂᒃ ᓯᒃᓴᒧᑦ. ᐊᐅᒍᒃᑎ 2016-ᒥ, ᐅᓄᕐᓂᖅᓴᐃᑦ ᓇᓄᐃᑦ ᓇᓂᔭᐅᓚᐅᖅᑐᑦ 10km ᒥ ᐅᖓᓯᒃᑎᒋᔪᒥ ᓯᒃᓴᒥ, ᑕᐃᒪᓐᓇᐅᓚᐅᖅᓯᒪᒐᓗᐊᕋᓗᓂ ᕗᐊᕚᒃ ᒥᕐᒍᐃᖅᓯᕙᖏᑦ ᓇᓄᐃᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ 80km ᐅᖓᑖᓂ ᖃᕝᕙᓯᒃᑐᒥ. ᖃᔾᔫᓇᑯᓗᐃᑦ ᓇᓄᐃᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ ᓄᓇᕗᒻᒥ, ᐊᖏᕐᕋᑎᒻᒪᕆᖕᓂᒃ ᓄᓇᓕᒃ, ᐃᓇᐅᓂᖅᓴᐅᓪᓗᑎᒃ ᐊᖑᓵᓗᐃᑦ, ᓇᓂᔭᐅᓚᐅᖅᑐᑦ ᓂᒋᖅᑲᖕᓇᖅᐸᖏᒥ ᖃᐅᔨᓴᖅᑕᐅᓂᕆᔭᖏᓐᓂᒃ ᒫᓂᑑᐸᐋᓐᑎᐅᕆᐊ ᑭᓪᓕᖓᓂ. ᐊᑎᖅᑕᓛᑦ ᐊᒻᒪ ᐊᑎᖅᑕᕕᓃᑦ ᐃᓕᒋᔭᐅᓚᐅᖅᑐᑦ ᒥᑭᑦᑑᒐᓗᐊᒥᑦ ᖃᐅᔨᓴᒐᒃᓴᓄᑦ, ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᐃᓚᐅᖅᑎᓪᓗᒋᑦ. ᑕᐃᒪᓐᓇ

[2] 2011-ᒥ ᖃᖓᑕᓲᒃᑯᑦ ᖃᐅᔨᓴᕐᓂᖅᑕᖅᑎᓪᓗᒍ, ᓯᕗᖅᐸᓯᖏᒥᐅᑦ ᐊᒻᒪ ᖃᕝᕙᓯᒃᑐᑦ ᐃᓂᖏᑦ ᓇᒃᓯᐅᔾᔭᐅᓚᐅᕐᒪᑕ, ᐊᔾᔨᒌᙱᑦᑐᓂᒃ 2016-ᒥ ᓇᐃᓴᖅᑕᐅᓯᒪᔪᓂ ᑕᐃᒪᐃᓐᓂᖓᓄᑦ ᑖᒃᑯᐊ ᒥᓴᐅᓴᒃᑕᐅᓯᒪᔪᑦ ᐊᔾᔨᒎᔭᓇᙱᓐᓂᖏᓐᓄᑦ. ᑕᐃᒪᐃᒃᑲᓗᐊᖅᑎᓪᓗᒍ, ᐱᔭᐅᓚᐅᖅᑐᑦ ᖃᓄᖅ ᐅᓄᖅᑎᒋᓂᖏᑦ ᒥᓴᐅᓴᒃᑕᐅᓯᒪᔪᑦ 1030 ᓇᓄᐃᑦ 2011-ᒥ ᓇᐃᓴᖅᑕᐅᓂᖏᑦ ᐊᔾᔨᙱᓐᓂᖏᓐᓂᒃ ᐊᔾᔨᒌᙱᓐᓂᖏᓐᓂᓪᓗᓃᑦ ᖃᐅᔨᓴᕐᓂᒃᑯᑦ 2016-ᒥ ᒥᓴᐅᓴᒃᑕᐅᓯᒪᔪᓂᑦ, ᐊᔾᔨᙱᓂᖃᓗᐊᓚᐅᙱᑦᑐᑦ ᑖᒃᑯᐊ ᒪᕐᕉᒃ ᒥᓴᐅᓴᒃᑕᐅᓯᒪᔪᑦ ᐅᔾᔨᕆᔭᐅᔪᓇᕐᓂᖏᓐᓄᑦ.

ᐃᓱᒪᒋᔭᐅᖕᒪᑦ ᐃᕐᓂᐅᕐᓂᖅ ᐊᑦᑎᖕᓂᖕᑲᓄᑦ ᓇᓅᖃᑎᒋᖕᓄᑦ ᑭᓯᐊᓂ ᑕᒪᓐᓇ ᑐᕌᒐᕆᔭᐅᙱᒻᒪᑦ ᑕᒪᑐᒧᖕᑲ ᖃᐅᔨᕐᓂᕐᒧᑦ.

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Person Days

Field work during the 2016 field season (12 – 21 August) involved approximately 76 person days (24 person days by Twin Otter, 52 person days by helicopters).

Aircraft Hours

We flew a total of approximately 132.5 hrs during our field study, including ferry times. These hours were distributed as follows: 55.2 hrs by Twin Otter, 33.7 hrs by the EC135, and 43.6 hrs by the Bell 206 L4.

Field Dates

Field activities for the aerial survey of the western Hudson Bay (WH) polar bear subpopulation took place between 12 and 21 August 2016. There was only one weather delay day during the survey affecting only the EC135 crew. The Bell LR4 crew was stationed in a different field location and was able to fly all survey days.

Fieldwork Location

The survey began with a Twin Otter aircraft positioned initially in Rankin Inlet, Nunavut. We worked the Nunavut coastline including islands, south towards Churchill, Manitoba. During the Nunavut portion of the survey we were positioned in Rankin Inlet and Arviat, finally completing the Twin Otter portion in Churchill, Manitoba. Once in Churchill, the survey utilized two helicopters including an EC135, which was based in Churchill and working south, and a Bell LR4 which was positioned in the York Factory area (Marsh Point) and working north within Wapusk National Park. Once the high-density area between Churchill and the Nelson River was completely surveyed, the EC135 relocated to York Factory National Historic Site while the LR4 remained positioned at Marsh Point, and surveyed the Cape Tatnam area west to Kaskattama near the Manitoba/Ontario border. Both field camps were used to complete the survey area between the Nelson River and the eastern extent of the study area (Figure 1). For this survey we flew a total (transect) distance of approximately 9,700 km.

1. INTRODUCTION

Polar bears (*Ursus maritimus* Phipps, 1774) hold a place of cultural and spiritual significance in Inuit traditional lifestyles (Honderich 2001; Henri et al. 2010). Aside the spiritual value, in many communities polar bears are also utilized as a source of food, material for clothing and crafts, social/cultural bonding, transfer of hunting and land-use skills, and economic benefits through sport hunting and the sale of hides and skeletal materials (Wenzel 1983, 1995, 2004; Freeman and Wenzel 2006; Freeman and Foote 2009). As the Arctic became more attractive to European explorers in their efforts to map northern sea routes, other resource exploitation including the harvest and sale of marine mammal products including the fur trade, polar bears began facing threats largely due to their prized hides. Historical records estimate a non-native harvest of 55,000 polar bears within the Canadian arctic alone between 1700 and 1935 (Honderich 2001; Wenzel 2004). With seemingly unsustainable harvest rates, and drastically reduced abundance levels on a global scale, the polar bear was becoming endangered (Prestrud and Stirling 1994; Freeman 2001). Concern over such depletion caused the five range states (Canada, United States, Russia, Greenland [Denmark before Home Rule Government], and Norway) to sign an international agreement and to implement conservation and management actions, including quotas, protection of family groups, and hunting prohibitions/restrictions to allow recovery (Fikkan et al. 1993; Prestrud and Stirling 1994; Freeman 2001).

After approximately 45 years of conservation actions as laid out in the international agreement (Fikkan et al. 1993; Prestrud and Stirling 1994), global polar bear abundance estimates increased from a questionable 5,000-19,000 in 1972 to about 26,000 (95% CI: 22,000-31,000) in 2015 (Freeman 1981, 2001; Wiig et al. 2015). This increase in abundance also was confirmed and supported by many Inuit living across the Canadian Arctic (Tyrrell 2006, 2009; Dowsley and Wenzel 2008; Henri et al. 2010). Despite this management success (Prestrud and Stirling 1994; Freeman 2001), polar bears are facing a new potential threat in the form of climatic changes (Derocher et al. 2004; Stirling and Derocher 2012). Across the Arctic, warming temperatures and changes in circulation patterns have led to a deterioration of sea-ice availability, quality

and quantity (Maslanik et al. 2007; Stroeve et al. 2012; Intergovernmental Panel on Climate Change 2013; Overland and Wang 2013; Stern and Laidre 2016).

Out of the 19 polar bear subpopulations recognized world-wide (Obbard et al. 2010), the western Hudson Bay subpopulation (WH) in Canada is one of the most-studied large carnivore populations (Jonkel et al. 1972; Stirling et al. 1977; Derocher and Stirling 1995; Regehr et al. 2007; Stapleton et al. 2014). Long-term monitoring and research, predominantly through a capture-mark-recapture program, suggest that the abundance increased during the 1970s, remained somewhat stable, and then declined by an estimated 22% between 1987 and 2004 (Derocher and Stirling 1995; Lunn et al. 1997; Regehr et al. 2007). A more recent analysis suggests that the population remained stable between 2001 and 2011 which appears to be due to temporary stability in sea-ice conditions (Lunn et al. 2016; but see Castro de la Guardia et al. 2017).

In more recent decades polar bear research and monitoring has increased though not without challenges. Concerns over wildlife handling (e.g., immobilization, collaring, tagging, etc.) were expressed by Nunavut hunters and Inuit organizations over the past decade (Henri et al. 2010; Lunn et al. 2010; Wong et al. 2017). As a response to these apprehensions the Government of Nunavut collaborated with the University of Minnesota to develop less-invasive monitoring techniques, such as aerial surveys (Stapleton et al. 2014). Although only fairly recently applied to study polar bear abundance, aerial surveys have not only proven effective in monitoring the abundance of other wildlife species but have also become more technically advanced over the last two to three decades (e.g., through the introduction of survey methods such as distance sampling and double observer sight and re-sight methodologies) (e.g., Norton-Griffiths 1978; Caughley et al. 1976; Tracey et al. 2008; Aars et al. 2009; Stapleton et al. 2014, 2015; Obbard et al. 2015; Lee and Bond 2016). Aerial surveys have become the method of choice in Nunavut to monitor this sentinel polar bear subpopulation over the long-term to provide less invasive, less expensive, up-to-date information to decision makers and user groups (Yuccoz et al. 2001; Nichols and Williams 2006; Peters 2010; Stapleton et al. 2014). In keeping with community recommendations and previous aerial survey methods used in August 2011, we set out to up-date the status of the WH

subpopulation using a distance sampling, and double observer sight re-sight method in August 2016 during the ice-free period.

2. METHODS

2.1. Study Area

The WH polar bear subpopulation is part of the Hudson Bay complex that includes the neighboring Foxe Basin and southern Hudson Bay subpopulations (Obbard et al. 2010; Thiemann et al. 2008, Peacock et al. 2010; Figure A4.1). Although there is spatial overlap of polar bear movements from these three subpopulations apparent on the sea-ice (e.g., Stirling et al. 1999; Obbard and Middel 2012; Sahanatien et al. 2015), past capture-mark-recapture studies (Stirling et al. 1977; Derocher and Stirling 1990; Ramsay and Stirling 1990; Kolenosky et al. 1992; Taylor and Lee 1995; Derocher et al. 1997; Lunn et al. 1997, 2016), genetic studies (Paetkau et al. 1995, 1999; Crompton et al. 2008; Malenfant et al. 2016), and analyses of satellite telemetry data (Stirling et al. 1999; Sahanatien et al. 2015; Obbard and Middell 2012) support the currently accepted WH subpopulation boundary (Obbard et al. 2010).

Our study area has been well-described by Brook (2001), Dredge and Nixon (1992), Ritchie (1962), Clark and Stirling (1998), Peacock et al. (2010) and Richardson et al. (2005) and includes the areas described by Stapleton et al. (2014) and Lunn et al. (2016). The terrestrial portion of the study area stretches for approximately 1,500 km from about 35 km southeast of the Manitoba-Ontario border all the way into Nunavut (approximately 20 km south of Chesterfield). In general, the southern portion of the study area displays the characteristics of the Hudson Plains ecozone and the Coastal Hudson Bay and Hudson Bay Lowlands. The northern portion exhibits Taiga and the Southern Arctic ecozone (Ecological Framework of Canada 2016). Where trees (black spruce [*Picea mariana*], white spruce [*P. glauca*], and tamarack [*Larix laricina*]) are quite common in the southern extents, dwarf birch (*Betula nana)*, willows (*Salix* spp.), and ericaceous shrubs (*Ericaceae* spp.) are the norm to the north. The near-coastal southern areas exhibit elevated beach ridges, marshes and extensive tidal flats. There is very little relief (<200 m) with underlying continuous and semi-continuous permafrost.

Sea-ice is absent in this region generally from July to November (Stirling et al. 1999; Scott and Marshall 2010; Stern and Laidre, 2016), and biting insects are plentiful during the summer (Twinn 1950).

Polar bears of WH come ashore when sea ice levels diminish to ≤ 50% (Stirling et al. 1999; Cherry et al. 2013, 2016), which generally occurs during July (Stern and Laidre, 2016). Once on land, the bears segregate by sex, age class, and reproductive status within the study area where they exhibit fidelity to their terrestrial summer retreat areas (Stirling et al. 1977; Derocher and Stirling 1990). Adult males are generally found along the coastline, pregnant females and females accompanied by offspring are found in the interior denning area which is mostly included within Wapusk National Park, and subadults are distributed throughout the study area (Stirling et al. 1977; Derocher and Stirling, 1990; Ramsay and Stirling 1990; Clark and Stirling 1998; Clark et al. 1997; Richardson et al. 2005). When sea ice reforms during November all bears except pregnant females return to the ice. Pregnant females give birth in terrestrial dens during December and early January, and family groups generally depart their dens in March and April to return to the sea ice (Jonkel et al. 1972; Stirling et al. 1977; Ramsay and Stirling 1988).

2.2. Survey design

The 2016 WH polar bear distance sampling abundance survey used double observer pairs (sight/re-sight) and was based out of the communities of Rankin Inlet and Arviat within the Nunavut Settlement Area, and Churchill and the remote camps of York Factory and Marsh Point within northern Manitoba. The comprehensive stratified aerial survey was flown between 12 and 21 August. The survey was timed to coincide with the ice-free period because; (a) all polar bears of the WH population are forced to be on land during this time, (b) any overlap with neighboring subpopulations is very likely minimal, and (c) bears are readily visible against the terrestrial landscape. In addition, females will likely not have begun to den yet and can be detected while moving towards their inland denning area (Stapleton et al. 2014). The survey was structured into two main components: 1) Pre-stratification using telemetry, past survey results and

traditional, local, and ecological knowledge collected during the consultation process, and 2) Distance sampling double observer pair (sight re-sight) aerial visual survey methods using fixed and rotary wing aircraft.

The establishment of the survey area and the division of that study area into strata of individually consistent relative densities of polar bears was modeled after Stapleton et al. (2014). Modifications were based on their 2011 aerial survey results as well as previous and current telemetry findings (n = 8 collared bears in summer of 2016, A. Derocher, University of Alberta and Environment and Climate Change Canada, unpublished data; Manitoba Sustainable Development, unpublished data; Derocher and Stirling 1990; Lunn et al. 1997; Stirling et al. 2004; Richardson et al. 2005; Towns et al. 2010; Stapleton et al. 2014). In addition, we consulted coastal survey maps and den emergence information provided by Manitoba Sustainable Development.

Following a thorough review and spatial plotting of past survey observations across the WH polar bear population boundary, an in-depth round of HTO (Hunters and Trappers Organizations) and community-based consultations were undertaken in January and February of 2016. During those consultations, HTOs from the communities of Baker Lake, Rankin Inlet, Chesterfield Inlet, Whale Cove and Arviat were invited to comment on preliminary stratification of polar bear densities as well as transect placement. Comments and concerns raised during these meetings were incorporated into the survey design. The merging of past survey observations and telemetry data, with the mapped density distributions from consultations, yielded 4 survey strata that slightly varied from those used by Stapleton et al. (2014) in 2011. The 2016 survey strata included the following derived polar bear density distributions: 1) very low, 2) low, 3) moderate, and 4) high (Figure 1).

All survey transects were oriented perpendicular to the bear density to improve precision and to reduce possible bias during sampling (Buckland et al. 2001) (Figure 1). Survey effort, measured as transect spacing, was then allocated across survey strata based on the following constraints: strata with the highest estimated polar bear density for the survey period would receive the highest level of coverage with survey effort for

the remaining strata being allocated proportionally to the approximate relative density of polar bears. Effective strip width varied depending on sightability, which in turn was dependent on measured covariates including cloud cover, speed, ground cover, terrain, and observer ability.

The very low density strata and transects represented the inland portions of the survey area outside of the Wapusk National Park high density stratum boundaries (Figure 1). These strata were divided further into two main areas, one north and west of the Churchill River up to the Nunavut/Manitoba boundary in the north, and the second south and east of the Nelson River bounded to the east by Cape Tatnam. The very low density strata covered only inland transects generally ending within 20 to 30 km of the Hudson Bay coastline. Transect spacing was irregular but averaged 17 km across the strata.

The low-density stratum and transects occupied the northern extents of the WH polar bear population boundary (approximately 20 km south of Chesterfield Inlet) to the Nunavut/Manitoba border (Figure 1). Modifications from Stapleton et al. (2014) included IQ-based transect extensions both over water and inland within the northern extent of this stratum. Overwater extensions within the remaining extents including 2 transects bi-secting Sentry Island were derived solely from *Inuit Qaujimajatuqangit* (IQ) reports and recommendations. Transect lines in this stratum were spaced 10 km apart, and extended up to 90 km inland, and up to 30 km into Hudson Bay beyond the coast to incorporate the many off-shore islands characterizing this coastline. The development of this stratum was largely based on local knowledge which strongly recommended the extension of coastal transects inland and across open water and coastal islands.

The moderate-density strata and transects were divided into two areas, one north and west of the Churchill River up to the Nunavut/Manitoba boundary in the north, and the second south and east of the Nelson River, approximately 60 km east into Ontario to the eastern extent of the WH polar bear population boundary. These strata primarily covered a Hudson Bay coastal strip that was approximately 20 to 30 km wide. Transect spacing within this strata was 7 km with transects extended beyond the tidal flats into

open water. Recent information collected by the Manitoba Department of Sustainable Development on summer and spring polar bear habitat including denning sites, spring emergence habitat, and coastal summer retreat, led this survey effort to modify Stapleton et al. (2014) survey design to define a moderate-density stratum from Cape Tatnam east toward East Penn Island with transects extending beyond the coastal strip up to 70 km inland into known denning habitat (Figure 1).

The high-density survey stratum and transects followed those described by Stapleton et al. (2014). The stratum boundary ran between the Churchill River in the west to the coast of Hudson Bay in the east with Churchill forming the northern boundary and the Nelson River approximating the southern boundary. The core of the high density stratum included Wapusk National Park which is known to be a high density summering area, and further inland, a heavily used denning area (Lunn et al. 2016). Transects in this stratum extended up to 100 km inland and were spaced 6 km apart. As with all other survey strata, all transects were extended 5-30 km beyond the coast into Hudson Bay which enabled the survey design to include bears either in water or on the extensive tidal flats known to be occupied by bears during summer and fall periods (Dyck, 2001; Clark and Stirling 1997).

Financial and logistical constraints as well as examination of weather patterns dictated the survey window and total number of aircraft required to successfully and efficiently complete the survey without the concern over long-disance polar bear movements between survey days. One de Haviland Twin Otter fixed wing aircraft with radar altimeter, a Eurocopter (model EC135) twin engine rotary wing aircraft with radar altimeter, and a Bell Long Ranger (model L4; Bell LR4) single-engine rotary wing aircraft with pop-out floats were used to complete the August 2016 WH polar bear abundance survey. All aircraft throughout the survey maintained, as close as possible, an altitude of 400 feet above ground level (AGL) and an air speed of between 70 and 90 knots for the fixed wing, and 70 to 80 knots for the rotary wing aircraft while flying on transect. The Twin Otter fixed wing aircraft was used to complete the low density stratum within Nunavut and the very low and moderate density strata west and north of the high density stratum bounded by the Churchill River, Manitoba, in the south. The

twin engine fixed wing configuration and its ability to fly on one engine was chosen to increase safety while flying over extensive water transects characteristic of the northern half of the survey study area within Nunavut.

The Eurocopter EC135 helicopter was incorporated into the survey study design as it has the ability to seat six (6) forward facing observers, four dependent observers (two on the left side of the aircraft and 2 on the right) and two non-dependent observers (a data recorder/observer on the left and a pilot/observer on the right; Appendix 1). We utilized this configuration to test the assumptions that the pilot and navigator, considered non-dedicated observers due to their additional roles that at times would impact continuous observations and associated search patterns. The goal of this configuration was to test whether these non-dedicated observer positions could observe polar bears as effectively as a dedicated observer.

The LR4 was used within the more remote extents of identified survey strata south of Churchill due to its greater fuel economy while operating out of remote fuel caches. The LR4 was configured for four (4) observers: two dedicated observers in the left and right secondary (rear) positions and a data recorder/observer in the front left primary position and a pilot/observer in the front right primary position. Both rotary wing aircraft were used to complete the remaining high, moderate, and very low density strata within the southern half of the survey study area in northern Manitoba.

2.2.1. Double observer pair

The double observer pair (sight/resight) method is a variation of physical mark-recapture (Pollok and Kendall 1987). Simply, the aircraft's front and rear observers comprise two independent survey teams, visually 'marking' (i.e., front observers' sighting) and 'recapturing' (i.e., rear observers' resighting) polar bears. Observer teams must be independent to estimate detection probabilities (see Appendix 2). This resultant information provides an independent estimate of the number of bears present in the survey strip that were not observed by either team (Laake et al. 2008; Buckland et al. 2010).

The double observer pair method requires two pairs of observers on each of the left and right hand sides of the aircraft (Figure 2) (Buckland et al. 2001; Pollock and Kendall 1987). One "primary" observer sits in the front seat of the aircraft and a "secondary observer" is located behind the primary observer on the same side of the aircraft. To insure visual isolation, a barrier was installed between same side observers to remove any visual cues that could modify an observer's ability to sight the animal (Appendix 1). Observers waited until bear groups passed before calling out the observation to ensure independence of observations. The data recorder/recorders, categorized and recorded counts of each bear (group) into "primary only", "secondary only", and "both"; The observers switched places approximately half way through each survey day (i.e. at lunch or during re-fueling stops) as part of the survey methods to address possible differences in sightability between the primary and secondary positions. Though the methods during all phases of the survey followed these 4 basic steps, there were differences in the methods deployment made between the three aircraft.

2.2.2. Fixed wing

Within the fixed wing aircraft we utilized an 8 person platform; 4 dedicated observers, 2 data recorders (for each of the left and right primary and secondary observer pairs) and a pilot and co-pilot. Observers within the fixed wing survey crew included two experienced Hunters and Trappers Organization (HTO) observers (one from Rankin Inlet and one from Arviat), 3 experienced wildlife biologists (two from the Government of Nunavut – Department of Environment and one NTI wildlife biologist), and one experienced wildlife technician. The observers were further divided into primary and secondary teams, each isolated from the other using visual barriers between the seats as well audio barriers through the use of two independent intercom systems monitored by each of a primary data recorder/navigator and a secondary data recorder/navigator (Appendix 2). The pilot's responsibilities were to monitor air speed and altitude while following transects pre-programmed on a Garmin 650T Geographic positioning system (GPS). The data recorder/navigators were responsible for monitoring a second and third identically programmed GPS unit for the purposes of

double-checking the position as well as to record the geographic position, body condition, composition and numbers of observed polar bear groups on data sheets. The pilots, data recorders, one right side observer, and both left side observers remained consistent throughout the fixed wing portion of the survey, while one right observer position was occupied by 3 different individuals. The primary and secondary observer pairs were alternated between the front and rear positions halfway through the day during scheduled re-fueling stops.

2.2.3. Rotary wing

The EC135 rotary wing platform was configured to have 6 forward facing seats with observation windows, 3 on the left side of the aircraft and 3 on the right. We utilized a 6 person configuration for the first two days of surveying and a 5 person platform for the remainder of the survey to address weight and balance issues as they pertained to extending endurance.

Within the EC135 six (6) person configuration, 4 were dedicated observers, two on the left side of the aircraft and 2 on the right. The remaining 2 positions were within the forward most seats and included a data recorder/observer on the left side and a pilot/observer on the right. Though the final population analysis utilized the observations exclusively from the 4 dedicated observers, the data recorder/observer and pilot/observer observations were also recorded to compare with the observations from respective side dedicated observers for an assessment of a non-dedicated observer's ability to sight bear groups. As only one data recorder could be accommodated using this configuration, front and rear audio isolation was not possible leading to a modification of the fixed wing configuration where the two front most observers (pilot and data recorder) waited until the observation moved to their 5 and 7 o'clock positions respectively to ensure all same side dedicated observers had ample time to independently sight the group. Additionally the primary dedicated observers waited until the bear observation passed their 4 o'clock (right) and 8 o'clock (left) position to allow the secondary observers ample opportunity to make their sighting. As in the fixed wing, the same-side dedicated observers changed between primary and

secondary positions half way through the day. Only one change was made between dedicated observers over the two day period. Additionally all but one dedicated observer remained consistent over the period.

The EC135 five (5) person configuration followed the same basic configuration indicated for the 6 person configuration with the single exception of the removal of the pilot as an observer. The data recorder/observer position continued to further test the comparability between a dedicated and non-dedicated observer. All observers were experienced and remained consistent throughout the remainder of the survey. For this configuration the data recorder/observer position moved back one seat to the left primary position opposite the right primary dedicated observer. Once again primary and secondary positions were exchanged half way through the day.

The Bell LR4 only allowed for a four person configuration due to weight and balance issues while carrying full fuel as well as seating configuration. Using this configuration only the secondary observers were dedicated observers while the left primary observer seat was occupied by a data recorder/observer and the right primary position by a pilot/observer. Additionally, observers could not exchange primary and secondary positions using this configuration to determine sightability differences between seating positions. Though only two dedicated observers could be accommodated within the LR4 configuration, this study used the assessment of non-dedicated observers within the EC135 to inform on the reliability of the non-dedicated observers within the LR4. While the methods used during this study generally followed those used by Stapleton et al. (2014), it is important to note that no pooling of front and rear observers was made. All observations made during this study were independent.

2.2.4. Distance Sampling

In addition to the deployment of the double observer pair method within all aircraft, we also collected observations using distance sampling. The distance sampling method followed Buckland et al. (1993, 2004, 2010) and used Program Distance, Version 6.0

(Thomas et al. 2009), to model stratified line transect observation data and estimate density and abundance for polar bears. Using the conventional distance sampling approach (CDS), we modeled the probability of detecting a group of polar bears and their densities within five delineated strata as a function of distance where the detection function represents the probability of detecting a group of polar bears, given a known distance from the transect (Buckland et al. 2001). Recognizing that other variables may affect the detection probability, density estimates were also derived using multiple covariate distance sampling (MCDS), which allowed us to model probability of detection as a function of both distance and one or more additional covariates (Buckland et al. 2004). This approach was explored in order to increase the reliability of density estimates made on subsets of the data based on terrain, vegetation, and environmental conditions, and to increase precision of the density estimates within each unique density-derived strata (Marques et al. 2007).

For the fixed wing portion of the survey only, and in addition to flying to the observed bears for position and data collection, we also used distance bins marked out with streamers and tape on the wing struts after Norton-Griffiths (1978) (Figure 4). In total, 6 distance bins were used including the following; 0-200 meters, 200-400 meters, 400-600 meters, 600-1,000 meters, 1,000-1,500 meters, and 1,500-2,000 meters. Though binned observations were not used during analysis, they did inform on the precision of binning for distance sampling platforms when compared to the actual observation waypoint recorded.

2.2.5. Observations

Polar bears observed while flying along a transect line were considered on-transect while those observed while ferrying to, from, or between transects, or to bear and/or wildlife sightings, where considered off-transect. Because polar bears are often found in groups, each observation (whether individual or group) represented a group of polar bears. In this work a group of polar bears was defined as one or more individuals within a visually estimated 100 meter radius of one another. All observations were investigated by moving off the transect line to the center of the group as they were

initially observed, to record the location, group size, sex/age classes, body condition, and activity. Additional covariates including topography, habitat, visibility, cloud cover, and ground speed were also recorded for each observation. Observation times were kept to a minimum to reduce disturbance and stress. All distances to the observations were measured perpendicularly (90^0) from the transect line to the center of the observation, and recorded along with the observation's date and time of day.

We determined gender and body condition, to the extent possible, from approximately 30 meters altitude. A general, relatively robust though subjective fat index has been successfully used in past studies to assess body condition of polar bears (Stirling et al. 2008; SWG 2016; Government of Nunavut, unpublished data). Gender of bears was determined based on body size, the presence of morphometric characteristics (e.g., such as scars, large head, thick neck, long fur on front legs, vulva patch and urine stains) and behavior when encountered (SWG 2016). Age class assessment from the air can be accomplished reliably for adult males, pregnant females, and members of family groups (Government of Nunavut, unpublished data; SWG 2016). Based on these methods, polar bears were classified as male or female, and as adult males (6+ years), adult females (5+ years), sub-adult males (2 to 5 years), sub-adult females (2 to 4 years), yearlings (>1 and < 2 years), and cubs of the year (<1 year). Standardized body condition indices [i.e., poor (1), fair (2), good (3), excellent (4) and obese (5)] were scored for each individual bear (Stirling et al. 2008) as was the activity at the time of observation (i.e., either laying down, sitting, walking, running or swimming). Each aircraft had at least one experienced biologist on board that could identify age classes and body conditions of observed bears with confidence.

For each observation, habitat structure and topography were recorded as covariates as well as cloud cover, visibility and ground speed. Habitat structure was recorded as rocky (1), boulders (2), trees (3), high shrubs (4), grassland (5), sand/mudflats (6), open water (7) and lichen tundra (8). Topography was broken down into an index for slope measured as flat (1), moderate (2) or steep (3), and an index for terrain measured as flat (1), rolling (2) and mountainous (3). By way of example a moderate slope within a rolling terrain would receive a score of 2/2. Visibility of 100%

was indexed as excellent (1), moderate or 75% to 100% (2), and poor or less than 25% (3). All aircraft deployed the distance sampling methods and collection of covariate data consistently across the study.

2.3 Analyses

2.3.1. Data screening and truncation

Data were initially screened for outlier observations that occurred at far distances therefore creating a tail on the detection function that can be difficult to fit. A right truncation distance that eliminated the upper 5% of observations was considered to minimize the influence of these observations (Buckland et al. 1993, Stapleton et al. 2014). Unlike the previous survey (Stapleton et al. 2014) we left-truncated both the front (pilot and data recorder) observations from the Bell helicopter rather than only left truncating the rear observations. The rationale for this was that we wanted to keep the data sets as similar as possible for the double observer analysis. There were 3 observations of 7 bears that were only observed in the rear observer blind spot by the front observers in the Bell helicopter. Therefore, the degree of reduction due to left truncation of the Bell helicopter data was not large.

The blind spot under each aircraft was estimated using geometric formulas. From this, left truncation distances were estimated for the twin otter as 98.9m, 67.2m for the EC135 helicopter, and 73.5 m for the Bell L-4 helicopter. Adjusted distance from the transect line was then estimated as the distance from the transect line minus the left truncation distance for each aircraft.

2.3.2. Co-variates

Covariates that affected bear sightability were considered that included environmental, observer and survey factors (Table 1). These covariates included group size, aircraft type, observer, and visibility. Visibility was reasonably good during the survey where only 15 of 178 observations were recorded as non-optimal conditions. Therefore, visibility was reduced to a binary covariate as was done in previous analyses (Stapleton et al. 2014).

A habitat (*hab*) category based on classification by observers was derived from field observations. This classification included open, shore, shrub, tree, and water habitat classes. A shrub habitat category was also initially considered, however, the number of observations was low and the distribution of observations was disjoint. Therefore, this category was pooled with shore category for observations that occurred on the shore and tree for inland observations.

A remote sensing based covariate (*RSveg*) based on LANDSAT 8 vegetation classification was also considered (Figure 5). The rationale behind this covariate was that it would systematically index dominant vegetation types in the proximity of observations therefore providing the best comparison of habitat and potential obstruction of observations across all observations. Remote sensing covariates based upon the habitat class of the pixel ($625m^2$) where the observation occurred as well as the dominant habitat class within a 90X90m and 150X150m area around the observation were used. The main categories in Figure 5 that were present in the study area were gravel, shrub, trees, low vegetation, and water.

A combination of remote sensing and observer-based habitat scores was also considered (*RSveg-hab*) which re-classified the *RSveg* water category based upon observer habitat scores. For this category *RSveg* that were classified as water were reassigned to gravel (habitat class shore or habitat class water), low-vegetation (habitat class open), shrub (habitat class shrub), and tree (habitat class tree).

All of the survey aircraft except the Bell LR4 (and 3 survey days in the EC135 with only 3 dedicated observers and one observer-recorder on the left hand side) helicopter had 2 dedicated observers per side. The Bell LR4 had 2 dedicated surveyors in the back seat of the helicopter and the pilot and data recorder/navigator as observers in the front. The pilot and data-recorder did not have the same view as the observers, and were distracted by piloting the helicopter and navigating/data recording. Therefore, special covariates were formulated for the pilot and data recorder/observers in this aircraft.

We also noted that the angle of the sun in the afternoon affected our ability to sight bears given that cloud cover was minimal during the survey. This occurred when the sun was lower on the horizon and was directed towards the observers reflecting of the many lakes and ponds characteristic of the survey area. To test for this effect we calculated sun azimuth (e.g., the direction of the sun in the sky) and altitude relative to the path of the survey aircraft. From this we were able to determine when the sun was directed towards the observers (based on sun azimuth relative to flight path) and sun altitude based on time of day. Using this information we constructed a sun covariate which was only considered if the sun was facing the observers. If the sun was facing the observers then sun altitude relative to the horizon was tested as a sightability covariate with the expectation that sightability would be lower at lower sun angles.

2.3.3. Models and modeling approach

Mark-recapture distance sampling methods were applied to the survey data (Buckland et al. 2004, Laake et al. 2008a, Laake et al. 2008b, Buckland et al. 2010, Laake et al. 2012). A mark-recapture/distance sampling model assuming point independence was used which allows estimation of the detection probabilities at the transect line (or left truncation distance) using independent double observer pair methods with distance sampling methods used to model the decline in sighting probabilities as a function of distance from the survey line.

A sequential process was used for model building. First, parsimonious distance sampling models were formulated using a mark recapture model with constant detection probabilities. Once the most supported distance model was determined, parsimonious mark-recapture models were formulated using the most supported distance model as a base model in the mark-recapture model analysis. As a final step, optimal distance and mark-recapture models were combined and assessed for goodness of fit and overall parsimony. Information theoretic methods (Burnham and Anderson 1992) were used to assess relative model fit. More exactly, Akaike Information Criterion (AIC) were used as an index of model parsimony with lower scores indicating a model that explained the most variation in the data set with the least number of parameters. The difference between the most supported model and given model was evaluated (ΔAIC) to indicate

relative support with models at ΔAIC values of less than 2 being of interest. Akaike weights were used to estimate proportional support of models. Models were averaged based on AICc weights using the *AICcmodavg* (Mazerolle 2016) package in program R (R Development Core Team 2009). The AIC score indexes relative fit but does not provide a test of overall goodness-of-fit. Goodness-of-fit tests incorporated in program DISTANCE were used to further evaluate fit of the most supported models.

The 2016 data set was also analyzed using only distance sampling methods to assess if estimates were significantly different when mark-recapture double observer methods were used given that previous surveys did not use the mark-recapture method.

One of the primary objectives of the analysis was to compare the 2011 and 2016 distance survey estimates given that the field sampling designs for the 2 surveys were nearly identical. To ensure that estimates were comparable, the 2011 data set was re-analyzed with the remote sensing based *RSveg* habitat classes to assess whether inclusion of this covariate would influence abundance estimates compared to the structure covariate used in the 2011 analysis (Stapleton et al. 2014). A t-test was used to compare estimates with degrees of freedom estimated using the formulas of Gasaway et al. (1986).

Analyses were conducted using program DISTANCE 7.0 (Thomas et al. 2009) for initial model input and fitting with additional analyses conducted in the *mrds v2.1.1.17* (Laake et al. 2012) R package version 3.3.3 (R Development Core Team 2009). Data were explored graphically using the *ggplot2 R* package v 2.2.1 (Wickham 2009) and QGIS program (QGIS Foundation 2015).

3. RESULTS

3.1. Sightings, Habitat, and Detection

The WH polar bear survey was flown between August 12 and 21, 2016. Survey strata flown between Chesterfield Inlet and Churchill with the Twin Otter took 4 days to complete. The remainder of the study area was completed utilizing 2 rotary wing aircraft

in 5 days. During the survey we flew approximately 35 hrs with the Twin Otter and 80 hrs total with the two rotary wing aircraft for an estimated total distance of approximately 17,100 km, including ferry time.

In total, 339 bears were observed during the survey (Table 2). Of these observations, 17 were in the blind spot of the plane and 25 were beyond the right truncation distance. The remaining 297 bears were in the survey strip, however, 280 of these were seen by one or both of the dedicated observers and only 17 were observed by non-dedicated observers including the data recorder/observers and pilot/observers.

Graphical illustration of the distribution of observations revealed differences for our initially selected habitat types. More distant observations occurred within coastal as well as more open habitats whereas reduced detections and detection distances were observed for the water and tree habitat categories (Figure 6). The majority of observations occurred at distances of less than 2700 meters from survey aircraft (Figure 7). The 95th percentile of this observation data was within 2250 meters of the aircraft and therefore the data was right truncated to this distance value. Sensitivity analyses were conducted at a later stage of the analysis to determine if estimates were sensitive to both left and right truncation distances.

The distribution of LANDSAT remote sensing categories (*RSveg* covariate) revealed a broad distribution for the gravel category with sparse distributions of low vegetation (Figure 8). The tree category had most observations close to the survey line suggesting lower sightability, while the shrub distribution suggests moderate sightability. In contrast to the observation-based habitat water classification (Figure 6), the LANDSAT classification of water in Figure 8 reflected habitat in and around water as opposed to water alone as indicated by the presence of non-water habitat class observations, such as shore, in the water *RSveg* class. As a result, the water category had higher sightability with more observations further from the survey line than the water observation-based habitat class. Most of the gravel category corresponded to observations that occurred on the shore line with mixed distributions of habitat categories for the other *RSveg* classes. The distribution of the low vegetation class was

potentially problematic due to few observations close to the survey line. This issue, which was most likely due to sparse data, was alleviated by pooling the shrub and low vegetation classes (Figure 9). This new pooled covariate class was called *RSveg2*.

Distributions of detections for aircraft type were relatively similar with relatively similar ranges of distance for observations (Figure 10). The main difference was the relative number of observations for each aircraft which created distributions that were more disjoint when the number of observations was lower.

Twelve observers were used during the survey of which 2 also were data recorders for at least part of the survey (Table 3). Naïve detection probabilities were estimated as the total number of times a bear was detected when an observer was active divided by the total number of observation event/trials. This is a naïve estimate given that other factors such as distance from the aircraft of the bear is not considered and therefore this probability will underestimate the detection probability on the survey line for any observer. In addition, the actual probability of detection on any side of the aircraft is based on 2 observers and will be higher than a single observer detection probability. Regardless, the average naïve detection probability for an observer was 0.77. Of most interest were detection probabilities below this amount. The Bell LR4 pilot and recorder both had lower detection probabilities and were therefore considered in detail in subsequent analyses.

We observed 39 cubs of the year (COY), and 10 yearlings (YRLG), which resulted in a mean COY and YRLG litter size of 1.63 (SD: 0.49; n = 24) and 1.25 (SD: 0.46; n = 8), respectively. COYS and YRLGs represented 11.5% and 2.9% of the entire observed sample of 339 bears. Approximately 53% of all observations were adult males (Table 4).

3.2. Distribution

A break-down of observed bears by strata, and across the study area is shown in Figure 11 and Table 2. The distribution of bears within the study area during August 2016 was not uniform. The majority (93.5%) of observations occurred in the high and moderate density strata. When the WH polar bear population study area was broken down into

areas according to Lunn et al. (2016), Nunavut (their area A or our low density strata) exhibited the lowest bear density whereas area C (i.e., the high density area) contained 50% of all observed bears (Table 4). Area D (or the area east of the high density area) had the highest density of adult males. We only report the pooled mean ± SD distance from coast for areas C and D since these are the areas with the highest sample size. In general, adult males were found near the coast (1.3 ± 1.8 km; range: 0.02 – 12.1 km), whereas adult females were found an average of 25.5 ± 23.4 km (range: 0.5 – 84.3 km) from the coastal areas. For family groups, the mean distance from shore was 11.5 ± 16.2 km (range: 0.1 – 54.2 km).

3.3. Distance/Mark-recapture analyses

3.3.1. Distance analysis

The distance component of the analysis used a constant mark-recapture model probability which basically assumed that detection at the left truncation distance did not vary (but was less than 1). Initial fitting revealed that both the hazard rate and half normal models showed some support from the data with a tendency of the hazard rate to be supported when covariates were not used (Table 5, model 13). Of covariates considered, models with group size (*size*), habitat (*hab*), remote sensing veg (*RSveg2*) and visibility (*vis*) were more supported than constant models. Of all models considered, a model with a hazard rate detection function with sightability varying by *RSveg2* and *size* was most supported. However, models with just *RSveg2* as well as models with the half normal detection function with habitat and visibility as covariates (model 3) also showed some support as indicated by ΔAICc values of less than 2. Therefore, these models were considered further in the joint distance/mark-recapture phase of the analysis.

The most supported hazard rate (*RSveg2+size*) model was used for the mark-recapture analysis phase. Estimated abundance varied between 770 and 966 for models with abundance around 850 for the more supported models in the analysis (Table 5).

3.3.2. Mark-recapture analysis

The most supported distance model (HR (*RSveg2+size*) was then used as a baseline distance model for the mark-recapture component of the analysis (Table 6). Of covariates considered, *group size, aircraft type, sun*, and *observers* were more supported than a constant model (model 12). Of the observer models, a model with unique detection probabilities for the Bell LR4 pilot (*Bellp*) and data recorder/navigator (*Bellr*) and equal probabilities for all other observers (model 4) was more supported than a model with all observer detection probabilities being different (model 6). Overall, a model with the Bell pilot, Bell recorder, sun, and group size was most supported (model 1). A model without group size included (model 2) also had marginal support as indicated by ∆AICc values of less than 2.

3.3.3. Distance/mark-recapture analysis

The most supported covariates for distance sampling (Remote sensing vegetation (*RSveg2*), observer-based habitat class (*hab*), visibility (*vis*), and group size (*size*)) and mark-recapture (group size (*size),* Bell pilot *(Bellp),* Bell recorder *(Bellr), and sun angel (sun)*) were considered in the joint distance/mark-recapture analysis. Of the models considered, a model with the most supported stand-alone distance sampling covariates (Table 7; *RSveg2+size*) and most supported mark-recapture covariates (Table 5; (*Bellp +Bellr+sun+size*) was most supported (Table 7; model 1). Other models that did not include group size for distance (model 2), used a half-normal detection function with habitat visibility (model 3) as well as other combinations of covariates with a hazard rate detection function (models 4-6) were supported as indicated by ∆AICc values of less than 2. Estimates from the most supported models were close ranging from 774 to 896 with reasonable levels of precision for all models.

3.3.4. Goodness of fit

Goodness of fit for the most supported model (Table 7) revealed acceptable fit for the distance component (χ^2=4.33,df=2, p=0.11) with 250meter bin intervals and the mark-recapture component (χ^2=12.4,df=13, p=0.49) leading to an overall acceptable

goodness of fit score of (χ^2=16.7,df=15, p=0.34). Kolmogorov-Smirnov tests (0.045, p=0.91) and Cramer-Von-Mises tests (0.035, p=0.89) also suggested reasonable fit.

Predictions for various combinations of distance sampling and mark-recapture covariates were plotted to explore the effect of covariates on detection probabilities as well as assess fit to the main *RSveg2* classes (Figure 12). If model fit is adequate then the general pattern of points should parallel the histogram bars. The size of each data point was proportional to group size with larger groups having larger symbols. Larger groups had higher detection probabilities than smaller groups which created the most scatter in the observation points at different distance intervals. In addition, observations that were most affected by sun altitude (as indicated by a sun altitude of less than 30 degrees) are denoted as red dots with yellow dots representing situations where the sun was facing the observer but was higher in altitude (with less of an estimated effect on detection probabilities). Finally, black dots indicate when the sun was behind the observer therefore not affecting detection probabilities. A few patterns arise from Figure 12. First, the fit of the data to each *RSveg2* class is reasonable with the general pattern of observations following the shape of the histograms. Most notably, the tree observations decline steeply with distance with moderate declines in vegetation-shrub, lesser declines in habitat areas in and around water, and minimal decline in the gravel categories. Larger group sizes of bears show a less substantial decline compared to smaller group sizes with some large groups having higher sighting probabilities at further distances from the survey aircraft. However, observations that were affected by the sun (denoted by red points) have lower detection probabilities than other observations at similar distances and group sizes.

The other factor affecting sightability was reduced sightability near the line for the Bell helicopter recorder and pilot. This basically reduced the y-intercept of the detection probability to be lower than one; an effect that is most noticeable when group size is smaller (Figure 13). A plot of pooled detection probabilities superimposed on the detection frequencies also suggests reasonable fit (Figure 14). The points on Figure 14 are for each observation whose probability will vary by covariates such as habitat, visibility, group size, and observer as described in Figures 12 and 13.

Average front observer detection probabilities for the front and rear observer was 0.63 and 0.76 which resulted in a combined double observer detection probability of 0.90 at the survey line (Figure 15). Plots of detections by front (observer=1) and rear observer (observer=2) reveal similar detection function shapes for situations when a bear was only detected by a single observer as well as both observers (duplicate detections) (Figure15). The conditional detection probabilities were similar with distance for observer 1 given detection by observer 2 but slightly higher for observer 2 when detected by observer 1 at further distances. This could be due to cueing or more time for the rear observer to spot animals at further distances.

3.3.5. Abundance estimates

A model averaged estimate of abundance that considered all of the candidate models in the analyses (Tables 5-7) was 842 bears (SE=142.6, CV=16.9%, CI-562-1121) during August 2016. This estimate was very close to the most supported model estimate of 831 (Table 7). The corresponding model averaged estimate of density is 9.9 bears per 1000 km^2 (SE=1.67, CI=6.62 -13.18).

Abundance estimates are given by strata for the most supported model (model 1) in Table 7. One issue we encountered was that only one observation of 8 bears occurred in the very low strata leading to very imprecise estimates. The low and very low could be pooled into a single strata to confront this issue. However, the actual estimates will not be affected greatly (Table 8).

3.3.6. Sensitivity of estimates to truncation

The most supported model (model 1, Table 7) was rerun at various right truncation distances to determine the overall sensitivity of estimates to deletion of observations that occurred far from the transect line. Decreasing the right truncation distance to 1800 meters which is closer to the data limit by the previous survey (Stapleton et al. 2014) decreased the estimate slightly to 826 bears whereas increasing the right truncation distance to 2700 m include further observations (Figure 7) decreased the estimate by 6 bears. Overall, the effect of truncation was minimal on estimates (Table 9).

3.3.7. Analysis of the 2016 data set using only distance sampling methods

The data were also run through the most supported distance model (HR(*RSveg2*+size) to assess estimates if data observed by non-dedicated observers was included but with sightability assumed to be 1 on the survey line. For this analysis the 17 bears that were not observed by the 2 dedicated observers were included in the analysis given that they were observed from the aircraft by data recorders or pilots . Of the 17 bears not seen by the dedicated observers, 7 were observed by the front left data recorder at 696 meters on the EC135, 7 were observed on the twin otter by the front right data recorder, and 3 were observed by the front left pilot on the twin otter. All of these bears were within the survey strip.

The HR (*RSveg2*+size) displayed adequate fit to the data ($\chi 2=7.71$,df=6, p=0.26). Kolmogorov-Smirnov tests (0.041, p=0.95) and Cramer-Von-Mises tests (0.032, p=0.97) also suggested reasonable fit. The resulting abundance estimate was 843 bears (SE=104.2, CV=16.8%, CI=607-1170) which is very close to the mark-recapture/distance sampling estimate of 831 (Table 8).

3.3.8. Additional analyses

We conducted additional analyses with the main objective of comparing abundance estimates from the 2011 and 2016 surveys to allow a robust estimate of trend. The rationale behind these analyses was to ensure similar modelling and analysis methods were used in each survey year therefore allowing direct comparison of the estimates.

3.3.8.1. Re-analysis of 2011 data set using LANDSAT covariates

We re-analyzed the 2011 data set using the remote sensing (LANDSAT) based habitat classification scheme to determine if this covariate was also supported as a detection function covariate for the 2011 data set, and to assess any change in estimates with this covariate. A full suite of models were considered including those from the original analysis (Stapleton et al 2014). A model with the LANDSAT covariate (along with visibility and habitat structure) with a hazard rate detection function was most

supported. The model averaged estimate of abundance from this analysis was 949 bears, (SE=168.9, CI=618-1280, CV=17.7%). This analysis is detailed in Supplemental Material 1.

3.3.8.2. Trend analysis based on distance sampling and coastal surveys

The 2011 estimate of 949 derived from the LANDSAT covariate analysis was used to estimate trend between the two surveys with the rationale that the most comparable estimates would be obtained by models that used the same covariates for sightability and employed similar survey methodologies. We note that another estimate of abundance of 1030 that combined coastal surveys and inland samples was produced for the 2011 data set (Stapleton et al 2014). Coastal surveys were not conducted in unison with distance sampling in 2016 and therefore this type of estimate could not be derived for 2016. Therefore, the most comparable estimates in terms of assessing trends are the distance sampling only estimates from the two years which used similar methodologies and detection function covariates.

A comparison of model averaged abundance estimates from 2011 using the LANDSAT covariate of 949 bears (SE=168.9, CI=618-1280, CV=17.7%) and the 2016 estimate of 842 bears bears (SE=142.6, CV=16.9%, CI-562-1121) using t-tests suggested the difference between the 2 estimates was not significant (t=0.48, df=452,p=0.63). The ratio of the 2 estimates resulted in a 5-year change of 0.89 which translates to an annual change (λ) of 0.98 (0.89-1.07). The λ estimate in this case suggests a very slight annual decline in abundance, however, the confidence intervals overlap 1 and therefore this decrease is not significant.

We also performed a trend analysis that used coastal survey data collected by the government of Manitoba and compared trend estimates from these surveys to trend based on the ratio of the distance sampling estimates. Estimates of trend based on coastal surveys from 2011 to 2016 suggested a non-significant annual increase (λ=1.06, CI=0.98-1.14) in abundance based on coastal surveys.

One relevant question was whether changes in abundance were apparent in adult male and adult female bears. To explore this we conducted a post-stratified analysis with age-sex groups defined by adult males and adult females (lone and with offspring). Subadults and unknown bears, for which classification is less certain, were excluded from this analysis. The 2011 and 2016 distance sampling estimates were post-stratified to produce estimates for each age-sex group. In addition, trend analyses were conducted for coastal surveys based on these 2 groups.

Results from both the distance sampling and coastal survey analyses suggest a stable to declining adult female segment of the population and an increasing adult male segment. While trends are apparent in both data sets, neither are statistically significant. These results suggest that any apparent increase in abundance may be more based upon increase in adult males compared to adult females. The details of this analysis are described in Supplementary Material 2.

4. DISCUSSION

4.1. Distribution

As with the previous 2011 aerial survey (Stapleton et al. 2014), the 2016 data provide a comprehensive and detailed overview of summer polar bear distribution across the entire study area. The recent data suggest that, at least during the summer, the majority of WH polar bears reside in Manitoba; only about 5.3% of the sightings occurred in Nunavut. These findings are consistent with previous studies (Stapleton et al. 2014, Peacock and Taylor 2007) but are in contrast to local knowledge where communities along the Nunavut coastline report increasing numbers of polar bears (Tyrell 2006, 2009; Kotierk 2012). Kotierk (2012) suggested that Inuit see more bears in coastal areas than they ever have and that this creates a number of public safety concerns. However, that report is not specific about the time of year. It is generally understood that more bears frequent the Nunavut coastline during fall before freeze-up when compared to summer, but more empirical or traditional data should be collected to verify the timing.

With the exception of the high density strata, bears generally occupied a narrow strip along the coastline (Figure 11), rarely farther inland than 20 km. Most adult males were observed < 10 km from the coastline. Polar bears are sexually dimorphic with males being about twice as large as females (Derocher et al. 2005, 2010). Being near the coastline likely offers opportunities to reduce thermal stress, and may also be beneficial in reducing attacks by biting insects due to the cooler temperature and ability to enter the water. In the high density stratum (or area C in Lunn et al. 2016) bears were distributed throughout the general area with distances ranging up to > 80 km from the coastline for solitary adult females. Sexual segregation became most apparent in this stratum, which has been reported in previous studies (Derocher and Stirling 1990; Jonkel et al. 1972; Stirling et al. 1977).

4.2. Abundance

As in 2011, the 2016 WH polar bear study represents a systematic and geographically comprehensive survey of the WH polar bear population (Stapleton et al. 2014). Thus, we provide an updated abundance estimate for the WH polar bear population as well as a comparison between the two aerial study results. Additionally the current study's methods parallel those of Obbard et al. (2015) who also used a distance mark-recapture sampling method to estimate polar bears in southern Hudson Bay.

Stapleton et al. (2014) produced two population estimates. An estimate of 1030 bears was derived that combined coastal surveys and inland transect observations for the 2011 data set (Stapleton et al 2014). In 2016, because two helicopters were utilized to conduct a systematic transect survey to cover the entire study area, a separate coastal strip survey was not required. Therefore, we used estimates that were the most comparable between 2011 and 2016 to assess trend. In general it is challenging to detect declines in abundance between two surveys unless the change is quite large (Gerrodette 1987, Thompson et al. 1998). In addition, comparison of two survey estimates does not allow separation of sampling variance from natural "process" variance in the population (Buckland et al 2004). For this reason we also considered annual coastal survey trend estimates (conducted by Manitoba) as well as an estimation of age-sex group specific trends to allow further inference on overall population trend

and demography. Coastal surveys assume that similar proportions of the population occur on the coast during the survey each year. This assumption needs to be vigorously investigated prior to validation of this key assumption. For example, documented long range movements of male bears suggest that their aggregation points and localized movement rates may not be consistent and less predictable. A comparison of counts of adult males in coastal surveys suggest a larger degree of annual variation compared to females with offspring (as detailed in Supplementary Material). Despite these differences, the coastal surveys and distance sampling surveys suggest similar trends with the adult male segment increasing and adult females (with offspring) stable to decreasing from 2011– 2016.

Very few bears were observed in Nunavut, and a substantial proportion of bears, mostly adult males, were encountered in the south-east section of the study area towards the Manitoba-Ontario border. Cubs and yearlings comprised a small proportion of the sample size, which was also observed during previous studies. This suggests that reproductive performance is low for this subpopulation but this was not a specific objective of this study (Table 10). These findings are consistent with previous mark-recapture studies (Regehr et al. 2007). Of three polar bear subpopulations that inhabit the Hudson Bay complex, WH had the lowest reproductive performance values (Table 10). Whether this phenomenon is linked to a reduction in sea ice (e.g., Stirling et al. 1999), high intra-species offspring predation due to a high proportion of adult males in the population (Table 4), or a combination would require further examination. Until recently, the neighboring southern Hudson Bay (SH) polar bear subpopulation has exhibited a relatively healthy reproductive performance despite observed long-term changes in sea-ice conditions in the area (Gagnon and Gough 2005, Etkin 1991, Hochheim and Barber 2014, Stern and Laidre 2016, Obbard et al. 2016).

Southern Hudson Bay polar bears have been experiencing a significant decline in body condition between 1984 and 2009 that was linked to a later sea ice freeze-up (Obbard et al. 2016). The decline in body condition for cubs, however, was less than for adult males, suggesting that adult females may be allocating a greater amount of energy to their dependent offspring at an energetic cost to themselves. Obbard et al.

(2016) argue that declines in reproductive success are likely in the future if body condition of reproductive-age females continues to decrease.

Aerial surveys (e.g., distance sampling methods) rely on techniques that minimize heterogeneity of sighting conditions with one of the assumptions that similar sighting probabilities exist by a given observer for all encountered animals or animal groups. Sightability may also be affected by internal factors (e.g., observer fatigue, observer skill, and/or aircraft type), external factors such as animal behavior, group size, and distance from observer, and environmental factors (e.g., cloud cover, topography, vegetation cover, sun angle, etc.) (Ransom 2012, Fleming and Tracey 2008, Lubow and Ransom 2016). The 2016 WH survey protocol and analyses included several topographical and vegetation indices, and land classification studies (including post-survey inclusion of LANDSAT imagery), sun angle and position, and observer position and function as covariates which were most supported through our modeling approach (Tables 1, 3, 5-7).

It has been assumed that there was little difference between a dedicated and non-dedicated observer's ability to observe and detect wildlife during an aerial survey, meaning that sightability is equal. We were able to demonstrate for this survey that the ability of the pilot and data recorder for all aircraft to detect animals appeared to be influenced by their primary responsibilities (e.g. flying the aircraft and observing weather conditions and aircraft equipment, and recording observation data and monitoring transects and survey equipment, respectively). Even when animals are conspicuous against their background and environment (e.g., polar bears during the summer against a white/green environment), we recommend individually assessing the detection ability of animals by all dedicated and non-dedicated observers, so that the option to include observer performance as a co-variate into final models remains open and some assurances that model assumptions are not being violated.

We included sun angle and position into our modeling approach because observers found that this factor reduced sightability. When facing the sun during aerial surveys, additional glare is created on lighter-coloured background (e.g., lichen, water

body surfaces) that makes the detection of animals more difficult, which can subsequently lead to missed observations, even within a double observer pair platform.

4.3. Assumptions and potential biases

One assumption during aerial surveys is that animals are detected at their initial location (Buckland et al. 2001). During the 2016 WH survey, behavioral response to survey aircraft varied depending on age and sex class and distance from aircraft. Adult males appeared to be the least affected by aircraft, while other age and sex classes appeared to react more strongly to aircraft when groups were approached that were close to transect lines or being overflown by survey aircraft to record detailed group and animal observational data. The majority (approximately 88%) of bears when first observed from survey transects were either laying down, sitting, standing, or swimming. Given an aircraft speed of 130 to 148 km per hour, any movement that may have occurred prior to detecting the bears further away from transects was minimal (Buckland et al. 1993, 2001). Bears did, however, display greater avoidance behaviors when aircraft broke off transect and flew to the observed group for age and sex determination. In many cases and depending on proximal habitat, bears fled into water in order to avoid the aircraft while some moved into thick shrub to hide from the oncoming aircraft. Large mature males appeared to be the least disrupted upon initial approach of the aircraft, with some exceptions.

The analysis also assumed that the distance from the survey line was measured accurately and that detections were independent of each other. Each observation was marked at the exact point at which the group was observed from transect even in the instance where bears had moved off that location assuring accurate off transect measurements. We used groups to define observations and ensured that observers did not search for additional bears while flying to observed groups to waypoint and classify the animals, therefore ensuring independence of observations. Additionally, observers on the same side were at all times visually separated by a screen therefore ensuring that detections were independent between observers.

It is possible that some bears were missed during the survey because they were unavailable for observations when in a den or visually obscured by vegetation. Dens are used quite frequently during the ice-free period by WH polar bears, at times as early as mid-to-late August, where pregnant adult females are more likely to be missed if inside a den (Stirling et al. 1977, Clark et al. 1997, Clark and Stirling 1998, Richardson et al. 2005, Jonkel et al. 1972). We encountered several freshly constructed dens excavated into peat. In several instances the bear was standing near the den entrance and could be observed. Moreover, our methods allowed for aerial inspection of any den to check for bear presence. Most freshly excavated dens that were observed during the 2016 survey effort also observed a polar bear and/or polar bear group in the vicinity. Therefore, the number of bears hidden from sight inside dens was low.

Habitats within the 2016 survey study area are diverse ranging from both coastal and fresh water shoreline, open tundra, to densely vegetated areas of shrubs and trees farther inland, where the detection of bears becomes challenging (Appendix 3). Including vegetation as a covariate into our modeling approach was important to capture the variation of detection among these varying habitats (Figure 9). Detection distances were reduced in treed habitat when compared to the other habitat types.

The point independence mark-recapture distance sampling model that we used in our analysis assumes that sightability at the left truncation distance (closest distance to the plane) is in part accounted for by covariates. However, variation in sightability due to vegetation and other factors away from the survey line can occur with minimal effect on estimates (Laake et al. 2008, Burt et al. 2014). Similar to Obbard et al. (2015) we found that sightability at the left truncation distance was not exact (or 1). Through the use of covariates in our analysis, factors influencing sightability both on the survey line as well as the shape of the detection functions were utilized to account for these potential biases to produce more robust abundance and density estimates.

5. CONCLUSION

The WH polar bear population has been subjected to changes in sea ice conditions reported in other studies resulting in reductions of body condition and vital rates (Gagnon and Gough 2005, Scott and Marshall 2010, Regehr et al. 2007, Stirling et al. 1999, Lunn et al. 2016). Under such conditions, and in order to provide goal-oriented conservation and management recommendations, up-dated information is needed in regular monitoring intervals. Traditional capture-mark-recapture studies are logistically challenging, locally unpopular, and they are time-consuming until results are disseminated. Comprehensive aerial surveys have become a useful monitoring tool for this subpopulation especially in response to the apprehension by Inuit toward intrusive physical handling of wildlife. As with any research methods, aerial surveys have their own limitations in terms of the scientific information that they can provide. Nevertheless, they have been proven to be an additional tool that can provide quick and updated information on the abundance, trend, distribution, and insights into reproductive success of a population.

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7. LITERATURE CITED

Aars, J., Marques, T.A., Buckland, S.T., Andersen, M., Belikov, S., Boltunov, A., Wiig, Ø., 2009. Estimating the Barents Sea polar bear subpopulation size. Mar. Mammal Sci. 25, 35–52.

Amstrup, S.C., 2003, Polar Bear (*Ursus maritimus*), *in* Feldhamer, G.A., Thompson, B.C., and Chapman, J.A., eds., Mammals of North America—Biology, management, and conservation: (2d ed.): Baltimore, Maryland, John Hopkins University Press, p. 587–610.

Brook, R.K. 2001. Structure and dynamics of the vegetation in Wapusk National Park and the Cape Churchill Wildlife Management Area of Manitoba: community and landscape scales. M.N.R.M. thesis, Natural Resource Institute, The University of Manitoba, Winnipeg, MB.

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L., and Thomas, L. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, Oxford, UK. 432 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance sampling. Estimating abundance of biological populations. Chapman & Hall, London.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2004. Advanced Distance Sampling - Estimating abundance of biological populations. Oxford Press.

Buckland, S. T., J. Laake, and D. L. Borchers. 2010. Double-observer line transect methods : levels of independence Biometrics 66:169-177.

Burnham, K. P., and D. R. Anderson. 1992. Data-based selection of the appropriate model: The key to modern data analysis. Pages 16-30 *in* D. R. McCullough, andR. Barrett, editors. Wildlife 2001: Populations. Elsevier, New York, USA.

Burt, M. L., D. L. Borchers, K. J. Jenkins, and T. A. Marques. 2014. Using mark–recapture distance sampling methods on line transect surveys. Methods in Ecology and Evolution 5:1180-1191.

Castro de la Guardia, L., Myers, P.G., Derocher, A. E., Lunn, N.J., Terwisscha van Scheltinga, A.D. 2017. Sea ice cycle in western Hudson Bay, Canada, from a polar bear perspective. Marine Ecology Progress Series, 564: 225-233.

Caughley, G., R. Sinclair, and D. Scott-Kemmis. 1976. Experiments in aerial survey. Journal of Wildlife Management 40:290–300.

Cherry, S.G., Derocher, A.E., Thiemann, G.W., and Lunn, N.J., 2013. Migration phenology and seasonal fidelity of an Arctic marine predator in relation to sea ice dynamics. Journal of Animal Ecology, http://dx.doi.org/10.1111/1365-2656.

Cherry, S.G., Derocher, A.E., and Lunn, N.J., 2016. Habitat-mediated timing of migration in polar bears: an individual perspective. Ecology and Evolution, 6: 5032-5042.

Clark, D.A., and Stirling, I. 1998. Habitat preferences of polar bears in the Hudson Bay Lowlands during late summer and fall. Ursus, 10:243-250.

Clark, D.A., Stirling, I., and Calvert, W., 1997. Distribution, characteristics, and use of earth dens and related excavations by polar bears on the Western Hudson Bay lowlands. Arctic, 50:158–166.

Crompton, A.E., Obbard, M.E., Petersen, S.D., and Wilson, P.J., 2008. Population genetic structure in polar bears (*Ursus maritimus*) from Hudson Bay, Canada: implications for future climate change. Biological Conservation, 141:2528–2539.

Derocher, A.E., and Stirling, I., 1995. Estimation of polar bear population size and survival in western Hudson Bay. Journal of Wildlife Management, 59:215–221.

Derocher, A.E., Lunn, N.J., and Stirling, I. 2004. Polar bears in a warming climate. Integrative and Comparative Biology, 44:163–176.

Derocher, A.E., and Stirling, I. 1990. Distribution of polar bears (*Ursus maritimus*) during the ice-free period in western Hudson Bay. Canadian Journal of Zoology, 68:1395-1403.

Derocher, A.E., Stirling, I., and Calvert, W., 1997. Male-biased harvesting of polar bears in western Hudson Bay. Journal of Wildlife Management, 61:1075–1082.

Derocher, A.E., Andersen, M. Wiig, Ø. 2005. Sexual dimorphism of polar bears. Journal of Mammalogy, 86:895-901.

Derocher, A.E., Andersen, M. Wiig, Ø., and Aars, J. 2010. Sexual dimorphism and the mating ecology of polar bears (*Ursus maritimus*) at Svalbard. Behaviour, Ecology, and Sociobiology, 64:939–946.

Dyck, M. 2001. Effects of tundra vehicle activity on polar bears (*Ursus maritimus*) at Churchill, Manitoba. M.N.R.M. thesis, University of Manitoba, Winnipeg, MB.

Dowsley, M., and Wenzel, G. 2008. "The time of the most polar bears": a co-management conflict in Nunavut. Arctic, 61:177-189.

Dredge, L.A., and Nixon, F.M. 1992. Glacial and environmental geology of northeastern Manitoba. Geological Survey of Canada Memoir 432. Ottawa, ON. 80 pp.

Ecological Framework of Canada. 2016. Accessed on 15 November 2016. Available at: http://ecozones.ca/english.

Etkin, D.A. 1991. Break-up in Hudson Bay: its sensitivity to air temperatures and implications for climate warming. Climatol. Bull. 25: 21–34.

Fleming, P, and Tracey, J. 2008. Some human, aircraft and animal factors affecting aerial surveys: how to enumerate animals from the air. Wildlife Research,35:258–267.

Freeman, M.M.R., and Wenzel, G. 2006. The nature and significance of polar bear conservation hunting in the Canadian Arctic. Arctic, 59:21-30.

Freeman, M.M.R. 2001. Culture, commerce, and international co-operation in the global recovery of polar bears. Pacific Conservation Biology, 7:161-168.

Freeman, M.M.R., and Foote, L. (eds). 2009. Inuit, polar bears and sustainable use: local, national and international perspectives. CCI Press, University of Alberta, AB, Canada.

Fikkan, A., Osherenko, G., and Arikainen, A. 1993. Polar bears: the importance of simplicity. Pp. 96-151 *in* Young, O. R., and Osherenko, G. (eds). Polar politics: creating international environmental regimes. Ithaca, NY: Cornell University Press.

Gagnon, A.S., and Gough, W.A. 2005. Trends in the dates of ice freeze-up and break-up over Hudson Bay, Canada. Arctic. 58: 370–382.

Gasaway, W. C., S. D. Dubois, D. J. Reed, and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Biological Papers of the University of Alaska No 22:1-108.

Gerrodette, T. 1987. A power analysis for detecting trends. Ecology 68:1364-1372.

Henri, D., Gilchrist, H.G., and Peacock, E. 2010. Understanding and managing wildlife in Hudson Bay under a changing climate: some recent contributions from Inuit and Cree ecological knowledge. Pp. 267 – 289 in S.H. Ferguson, L.L. Loseto, and M.L. Mallory (eds). A little less Arctic: top predators in the world's largest northern inland sea, Hudson Bay. Springer Science, New York, New York.

Hochheim, K.P., and Barber, D.G. 2014. An update on the ice climatology of the Hudson Bay system. Arct. Antarct. Alp. Res. 46:66–83. doi: 10.1657/1938-4246-46.1.66.

Honderich, J. E. 2001. Wildlife as a hazardous resource: an analysis of the historical interaction of humans and polar bears in the Canadian Arctic 2000 B.C. to 1935 A.D. M. A. thesis, University of Waterloo, ON, Waterloo. 193 pp.

Intergovernmental Panel on Climate Change. 2013. Summary for policymakers, climate change 2013—The physical science basis—Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change: Cambridge, United Kingdom, and New York, Cambridge University Press.

Jonkel, C.J., Kolenosky, G.B., Robertson, R.J., and Russell, R.H., 1972. Further notes on polar bear denning habits. International Conference on Bear Research and Management, 2:142–158.

Kolenosky, G.B., Abraham, K.F., and Greenwood, C.J., 1992. Polar bears of southern Hudson Bay. Polar Bear Project, 1984–88. Final Report, Ontario Ministry of Natural Resources, Maple, Ontario.

Kotierk, M. 2012. Public and Inuit interests, western Hudson Bay polar bears and wildlife management: results of a public opinion poll in western Hudson Bay communities. Unpublished Report, Government of Nunavut, Igloolik, Nunavut. 55 pp.

Laake, J., D. L. Borchers, L. Thomas, D. Miller, and J. Bishop. 2012. Mark-recapture distance sampling (MRDS) 2.1.0. R statistical package program.

Laake, J., M. J. Dawson, and J. Hone. 2008a. Visibility bias in aerial survey: mark-recapture, line-transect or both? Wildlife Research 35:299-309.

Laake, J., R. J. Guenzel, J. L. Bengtson, P. Boveng, M. Cameron, and M. B. Hanson. 2008b. Coping with variation in aerial survey protocol for line-transect sampling. Wildlife Research 35:289-298.

Lee, D.E., and Bond, M.L. 2016. Precision, accuracy, and costs of survey methods for giraffe *Giraffa camelopardalis*. Journal of Mammalogy, DOI: 10.1093/jmammal/gyw025.

Lubow, B.C., and Ransom, J.I. 2016. Practical bias correction in aerial surveys of large mammals: validation of hybrid double-observer with sightability method against known abundance of feral horse (*Equua caballus*) populations PLoS One DOI: 10.1371/journal.pone.0154902.

Lunn, N.J., Stirling, I., Andriashek, and D., Kolenosky, G.B., 1997. Re-estimating the size of the polar bear population in western Hudson Bay. Arctic, 50:234–240.

Lunn, N.J., Stirling, I., Andriashek, D., Richardson, E. 2004. Selection of maternity dens by female polar bears in western Hudson Bay. Polar Biol. 7, 350–356.

Lunn, N. J. et al. 2010. Polar bear management in Canada 2005-2008. Pages 87-114 *in* M. E. Obbard, G. W. Thiemann, E. Peacock, and T. DeBruyn, editors. Polar Bears – Proceedings of the 15th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, Copenhagen, Denmark, 29 June – 3 July 2009. IUCN, Gland, Switzerland and Cambridge, United Kingdom.

Lunn, N.J., Servanty, S., Regehr, E.V., Converse, S.J., Richardson, E., and Stirling, I. 2016. Demography of an apex predator at the edge of its range: impacts of changing sea ice on polar bears in Hudson Bay. Ecological Applications, 26: 1302-1320.

Malenfant, R.M., Davis, C.S., Cullingham, C.I., and Coltman, D.W. 2016. Circumpolar genetic structure and recent gene flow of polar bears: a reanalysis. PLoS ONE, 11: e0148967. doi:10.1371/journal. pone.0148967

Marques, T., Andersen, M., Christensen-Dalsgaard, S., Belikov, S., Boltunov, A., Wiig, Ø., Buckland, S., and Aars, J. 2006. The use of global positioning systems to record distances in a helicopter line-transect survey. Wildlife Society Bulletin, 34:759-763.

Maslanik, J.A., Fowler, C., Stroeve, J., Drobot, S., Zwally, J., Yi, D., and Emery, W. 2007. A younger, thinner Arctic ice cover—increased potential for rapid, extensive sea-ice loss: Geophysical Research Letters, 34: L24501, doi: 10.1029/2007GL032043.

Mazerolle, M. J. 2016. AICcmodavg: Model selection and multimodel inference based on (Q)AIC(c). . R package version 2.1-0.: https://cran.r-project.org/package=AICcmodavg

Nichols, J. D., and B. K. Williams. 2006. Monitoring for conservation. Trends in Ecology and Evolution 21:668–673.

Norton-Griffiths, M. 1978. Counting animals. 2nd ed. Pp. 139. African Wildlife Foundation technical handbook No. 1 (J. J. R. Grimsdell, ed.). African Wildlife Foundation, Nairobi, Kenya.

Obbard, M.E., Thiemann, G.W., Peacock, E., and DeBruyn, T.D. (eds) (2010). *Polar Bears: Proceedings of the 15th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, Copenhagen,Denmark, 29 June–3 July 2009.* Gland, Switzerland and Cambridge, UK: IUCN. vii + 235 pp.

Obbard, M.E., and Middel, K.R. 2012. Bounding the southern Hudson Bay polar bear subpopulation. Ursus, 23:134-144.

Obbard, M.E., S. Stapleton, K.R. Middel, I. Thibault, V. Brodeur, and C. Jutras. 2015. Estimating abundance of the Southern Hudson Bay polar bear subpopulation using aerial surveys, 2011 and 2012. Polar Biology 38: 1713-1725.

Obbard, M.E., Cattet, M.R.L., E.J. Howe, K.R. Middel, E.J. Newton, G.B. Kolenosky, K.F. Abraham, and C.J. Greenwood. 2016. Trends in body condition in polar bears (*Ursus maritimus*) from the Southern Hudson Bay subpopulation in relation to changes in sea ice. Arctic Science 2:15-32.

Overland, J.E., and Wang, M. 2013. When will the summer Arctic be nearly sea ice free? Geophysical Research Letters, 40:2097–2101.

Paetkau, D., Calvert, W., Stirling, I., and Strobeck, C. 1995. Microsatellite analysis of population structure in Canadian polar bears. Molecular Ecology, 4:347–354.

Paetkau, D., Amstrup, S.C., Born, E.W., Calvert, W., Derocher, A.E., Garner, G.W., Messier, F., Stirling, I., Taylor, M.K., Wiig, Ø., and Strobeck, C. 1999. Genetic structure of the world's polar bear populations. Molecular Ecology, 8:1571–1584.

Peacock, E., Derocher, A.E., Lunn, N.J., and Obbard, M.E. 2010. Polar bear ecology and management in Hudson Bay in the face of climate change. Pp. 93 -115 *in* S. H. Ferguson, L.L. Loseto, M.L. Mallory. (eds). A little less Arctic: top predators in the world's largest northern inland sea, Hudson Bay. Springer Science + Business Media B. V. doi: 10.1007/978-90-481-9121-5_5.

Peacock, E., Sonsthagen, S.A., Obbard, M.E., Boltunov, A., Regehr, E.V., Ovsyanikov, N., Aars, J., Atkinson, S.N., Sage, G.K., Hope, A.G., Zeyl, E., Bachmann, L., Ehrich, D., Scribner, K.T., Amstrup, S.C., Belikov, S., Born, E.W., Derocher, A.E., Stirling, I., Taylor, M.K., Wiig, Ø., Paetkau, D., and Talbot, S.L. 2015. Implications of the circumpolar genetic structure of polar bears for their conservation in a rapidly warming Arctic: Plos One, 10(1): e112021, doi:10.1371/ journal.pone.0112021.

Peacock, E., and Taylor, M.K. 2007. Polar bears of western Hudson Bay: survey extension investigation. Unpublished Report, Government of Nunavut, Igloolik, Nunavut.

Peters, D. P. C. 2010. Accessible ecology: synthesis of the long, deep, and broad. Trends in Ecology and Evolution 25:592–601.

Pollock, K., and Kendall, W. 1987. Visibility bias in aerial surveys: a review of estimation procedures. Journal of Wildlife Management, 51:502-510.

Prestrud, P., and Stirling, I. 1994. The international polar bear agreement and the current status of polar bear conservation. Aquatic Mammals, 20:113-124.

QGIS_Foundation. 2015. QGIS: A free and open geographic information system (www.qgis.org).

R_Development_Core_Team. 2009. R Foundation for Statistical Computing, Vienna, Austria.

Ramsay, M. A., and Stirling, I. 1988. Reproductive biology and ecology of female polar bears (*Ursus maritimus*). Journal of Zoology (London), 214:601-634.

Ramsay, M. A., and Stirling, I. 1990. Fidelity of polar bears to winter den sites. Journal of Mammalogy, 71:233–236.

Ransom, J.I. 2012. Detection probability in aerial surveys of feral horses. Journal of Wildlife Management,76:299–307.

Regehr, E.V., Lunn, N.J., Amstrup, S.C., and Stirling, I., 2007. Effects of earlier sea ice breakup on survival and population size of polar bears in western Hudson Bay. Journal of Wildlife Management, 71: 2673–2683.

Richardson, E., Stirling, I., and Hik, D.S. 2005. Polar bear (*Ursus maritimus*) maternity denning habitat in western Hudson Bay: a bottom-up approach to resource selection functions. Canadian Journal of Zoology, 83:860-870.

Ritchie, J.C. 1962. A geobotanical survey of northern Manitoba. Technical Paper of the Arctic Institute of North America, 9. 48 pp.

Sahanatien, V., Peacock, E., and Derocher, A.E. 2015. Population substructure and space use of Foxe Basin polar bears. Ecology and Evolution, doi: 10.1002/ece3.1571.

Scott, J.B.T., and Marshall, G.J. 2010. A step-change in the date of sea-ice breakup in western Hudson Bay. Arctic, 63:155-164.

Stapleton, S., Atkinson, S., Hedman, D., and Garshelis, D. 2014. Revisiting Western Hudson Bay: using aerial surveys to update polar bear abundance in a sentinel population. Biological Conservation, 170:38-47.

Stapleton, S., E. Peacock, and D. Garshelis. 2015. Aerial surveys suggest long-term stability in the seasonally ice-free Foxe Basin (Nunavut) polar bear population. Marine Mammal Science 32: 181-201.

Stern, H.L., and Laidre, K.L. 2016. Sea-ice indicators of polar bear habitat. The Cryosphere, 10:1-15.

Stirling, I., Lunn, N.J., Iacozza, J., Elliott, C., Obbard, M., 2004. Polar bear distribution and abundance on the southwestern Hudson Bay coast during open water season, in relation to population trends and annual ice patterns. Arctic 57, 15–26.

Stirling, I., and Derocher, A.E. 2012. Effects of climate warming on polar bears - a review of the evidence. Global Change Biology, 18:2694-2706.

Stirling, I., Lunn, N.J., and Iacozza, J. 1999. Long-term trends in the population ecology of polar bears in western Hudson Bay in relation to climatic change. Arctic, 52:294-306.

Stirling, I., Thiemann, G.W., and Richardson, E. 2008. Quantitative support for a subjective fatness index for immobilized polar bears. Journal of Wildlife Management, 72:568-574.

Stirling, I., Jonkel, C., Smith, P., Robertson, R., and Cross, D. 1977. The ecology of the polar bear (*Ursus maritimus*) along the western coast of Hudson Bay. Canadian Wildlife Service Occasional Paper 33. Ottawa: Canadian Wildlife Service. 64 p.

Stroeve, J.C., Kattsov, V., Barrett, A., Serreze, M., Pavlova, T., Holland, M., and Meier, W.N. 2012. Trends in Arctic sea ice extent from CMIP5, CMIP3 and observations. Geophysical Research Letters, 39: doi: 10.1029/2012GL052676.

SWG [Scientific Working Group to the Canada-Greenland Joint Commission on Polar Bear]. 2016. Re-Assessment of the Baffin Bay and Kane Basin Polar Bear Subpopulations: Final report to the Canada-Greenland Joint Commission on Polar Bear. 31 July 2016: x+636 pp.

Taylor, M.K., and Lee, L.J. 1995. Distribution and abundance of Canadian polar bear populations: A management perspective. Arctic, 48:147–154.

Thiemann, G.W., Derocher, A.E., and Stirling, I. 2008. Polar bear *Ursus maritimus* conservation in Canada: an ecological basis for identifying designatable units. Oryx 42:504-515.

Thompson, W. L., G. C. White, and C. Gowan. 1998. Monitoring Vertebrate Populations. Academic Press, San Diego, California, USA.

Towns, L., Derocher, A.E., Stirling, I., Lunn, N.J., 2010. Changes in land distribution of polar bears in Western Hudson Bay. Arctic 63, 206–212.
Tracey, J. P., P. J. S. Fleming, and G. J. Melville. 2008. Accuracy of some aerial survey estimators—contrasts with known numbers. Wildlife Research 35:377–384.
Twinn, C. R. 1950. Studies of the biology and control of biting flies in northern Canada. Arctic, 3:14-26.
Tyrrell, M. 2006. More bears, less bears: Inuit and scientific perceptions of polar bear populations on the west coast of Hudson Bay. Etudes/Inuit/Studies, 30:191-208.
Tyrrell, M. 2009. West Hudson Bay polar bears: the Inuit perspective. Pp. 95-110 in Freeman, M. M. R., and Foote, L. (eds). Inuit, polar bears and sustainable use: local, national and international perspectives. CCI Press, University of Alberta, AB, Canada.
Wenzel, G. 2004. Polar bear as a resource: an overview. Third northern research forum open meeting position paper. URL: http://www.nrf.is/open_meetings_files/ Yellowknife_2004/Wenzel.pdf.
Wenzel, G. 1983. Inuit and polar bears: observations from a hunt near Resolute Bay, N.W.T. Arctic, 38:90-94.
Wenzel, G. 1995. Ningiqtuq: Inuit resource sharing and generalized reciprocity in Clyde River, Nunavut. Arctic Anthropology, 32:43-60.
Wickham, H. 2009. ggplot2: Elegant graphics for data analysis. Springer, New York.
Wiig, Ø., Amstrup, S., Atwood, T. Laidre, K., Lunn, N., Obbard, M. Regehr, E., and Thiemann, G. 2015. *Ursus maritimus*. IUCN Red List Assessment of Threatened Species 2015: e.T22823A14871490.
Wong, P.B.Y., Dyck, M.G., Arviat Hunters and Trappers, Ikajutit Hunters and Trappers, Mayukalik Hunters and Trappers, and Murphy, R.W. 2017. Inuit perspectives of polar bear research: lessons for community-based collaborations. Polar Record, DOI: 10.1017/S003224741700031.
Yuccoz, N. G., J. D. Nichols, and T. Boulinier. 2001. Monitoring of biological diversity in space and time. Trends in Ecology and Evolution 16:446–453.

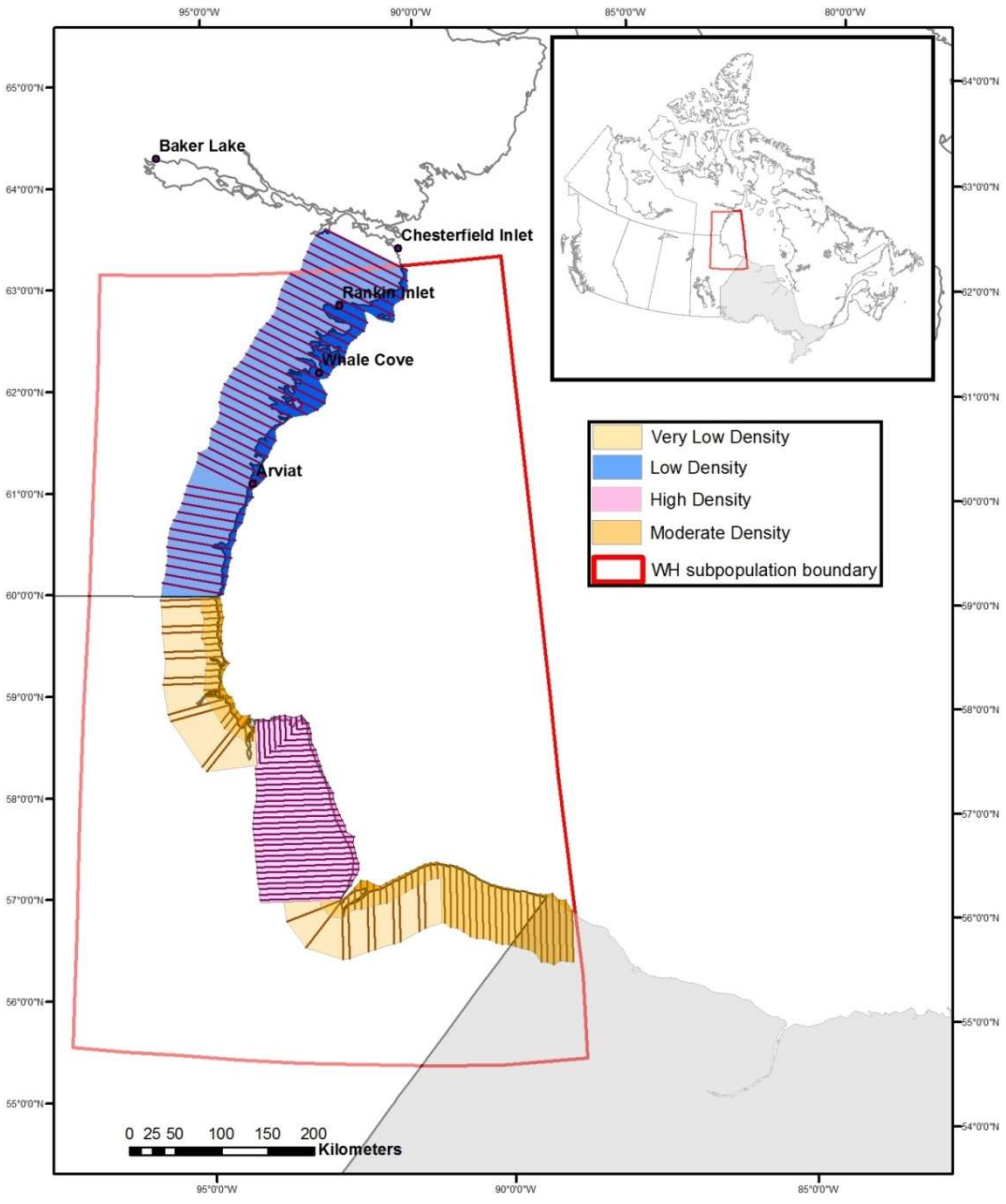


Figure 1. The August 2016 western Hudson Bay (WH) polar bear abundance survey strata and transects. All transects were run perpendicular to known polar bear densities. Extension of transects outside of the delineated WH polar bear population boundaries were based on Inuit knowledge of the area.

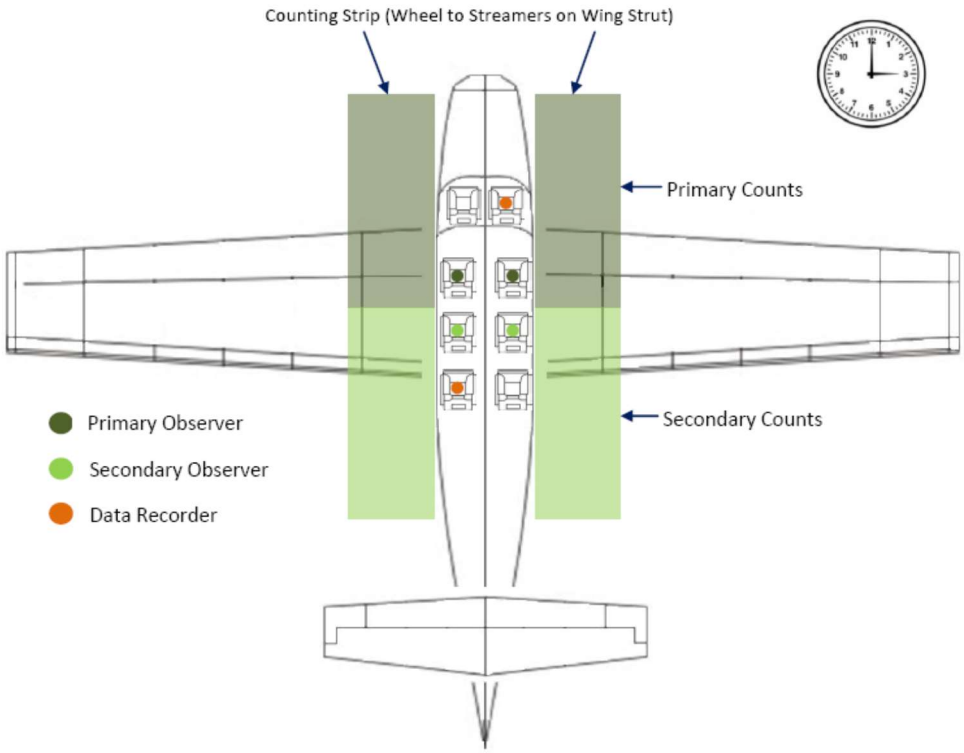


Figure 2. Observer position for the double observer method employed on this survey. The secondary observer calls polar bears not seen by the primary observer after the polar bear/bears have passed the main field of vision of the primary observer at a point half way between same side primary and secondary observers. The small hand on a clock is used to reference relative locations of polar bear groups (e.g. "Polar bear group at 3 o'clock" would suggest a polar bear group 90o to the right of the aircrafts longitudinal axis.).

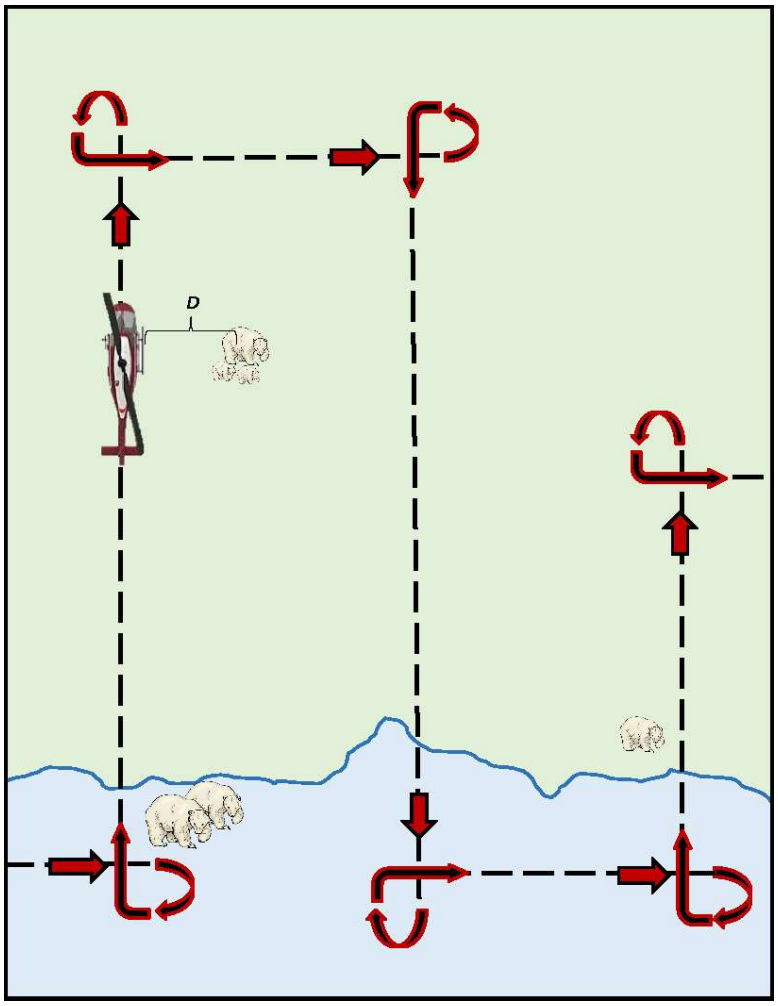
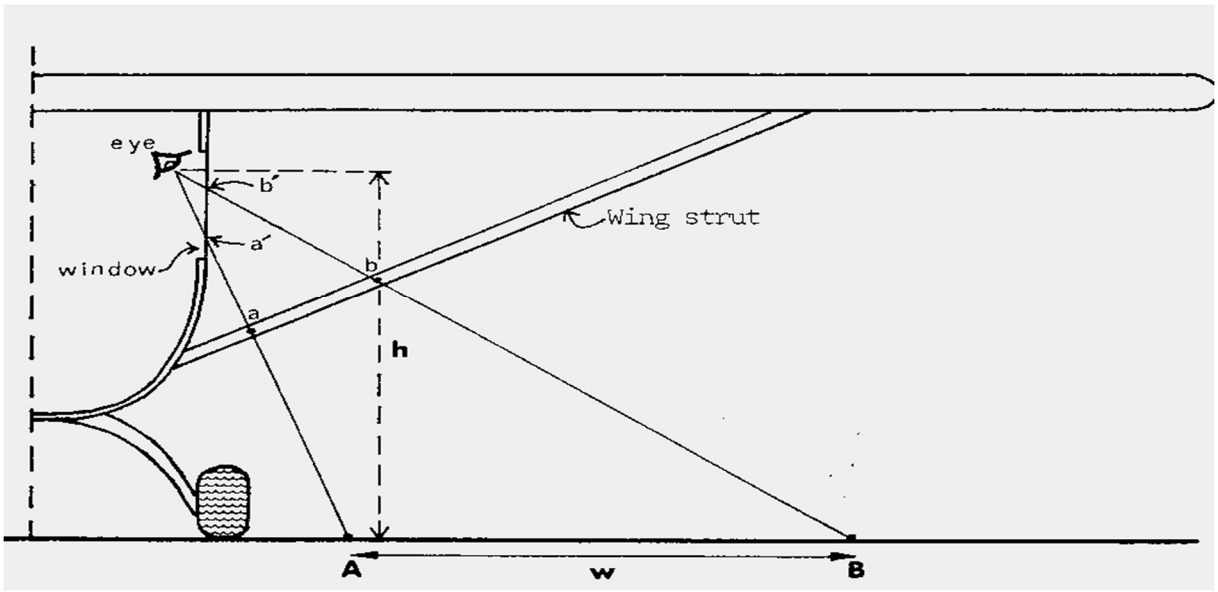


Figure 3. Application of the distance sampling method during the August 2016 polar bear aerial survey in western Hudson Bay. Once observed the aircraft would move off the transect to the center of the observation to record location via a GPS, and assess and record field age, sex, and body condition for all individuals within the group as well as environmental covariate information (Note: D = the distance as measured 900 from the transect to the center of the observation/group).



$$w = W * h/H$$

Where:

***W** = the required strip width;*

***h** = the height of the observer's eye from the tarmac; and*

***H** = the required flying height*

Figure 4. Schematic diagram of aircraft configuration for strip width sampling (Norton-Griffiths, 1978). W is marked out on the tarmac, and the two lines of sight a' – a – A and b' – b – B established. The streamers are attached to the struts at a and b, whereas a' and b' are the window marks.

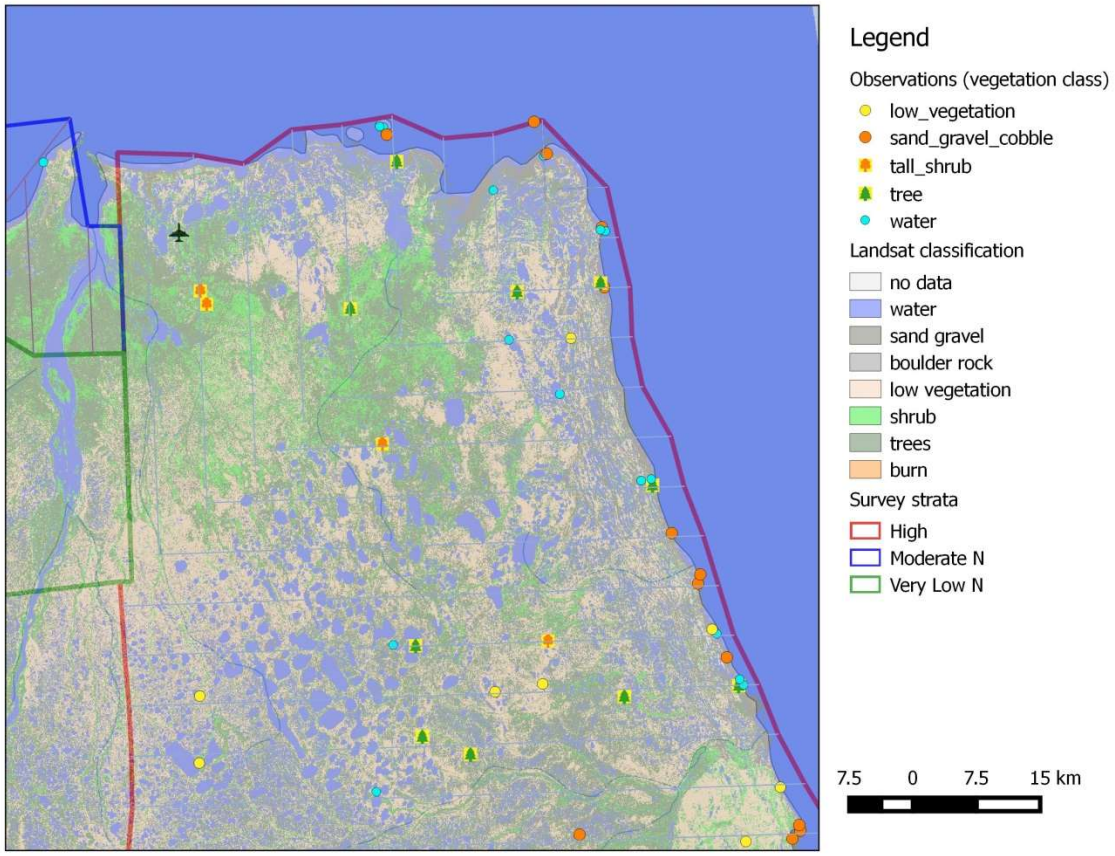


Figure 5: Landsat habitat classification and observations for a section of the high-density stratum of the 2016 study area.

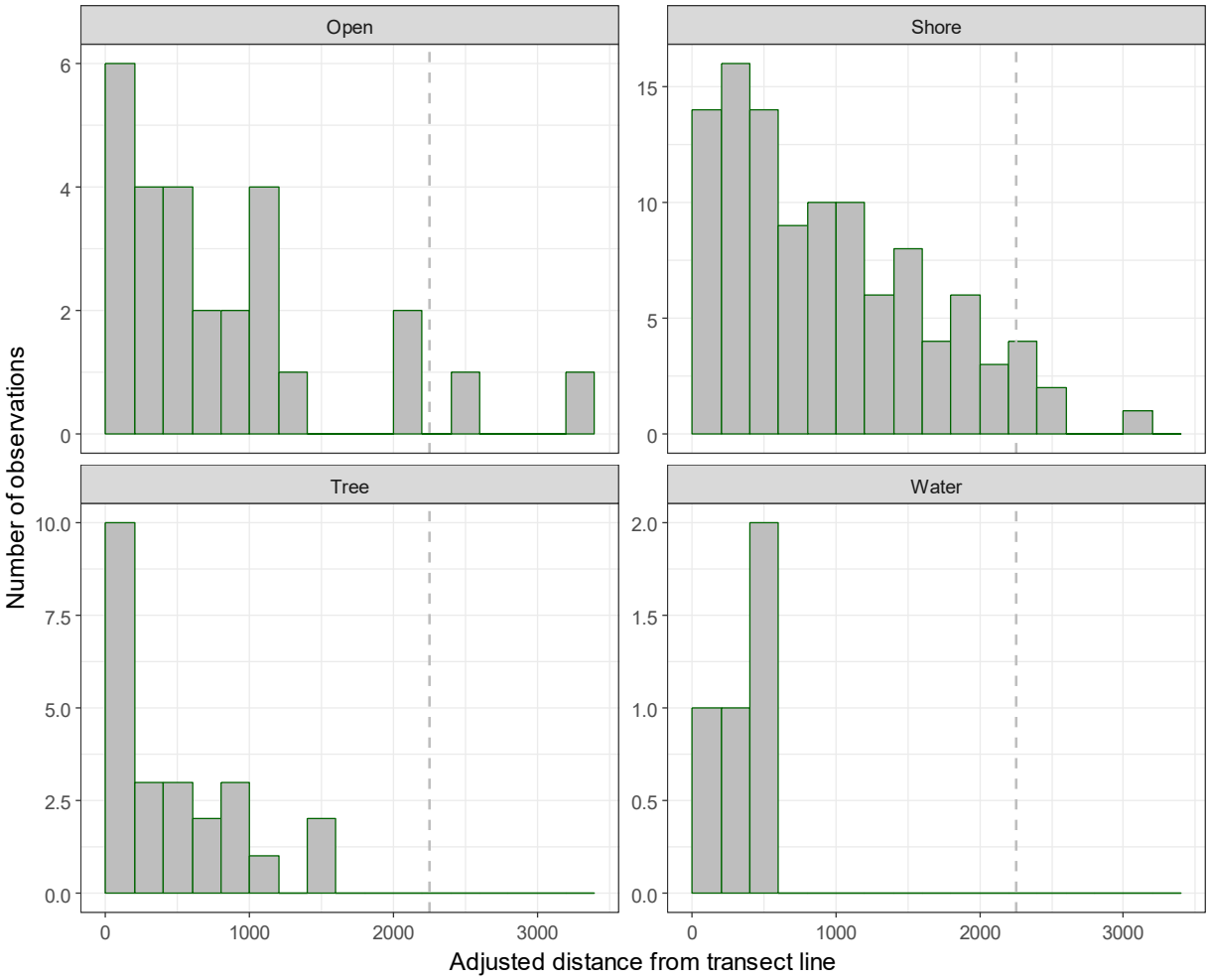


Figure 6. Distributions of detections for habitat classes.

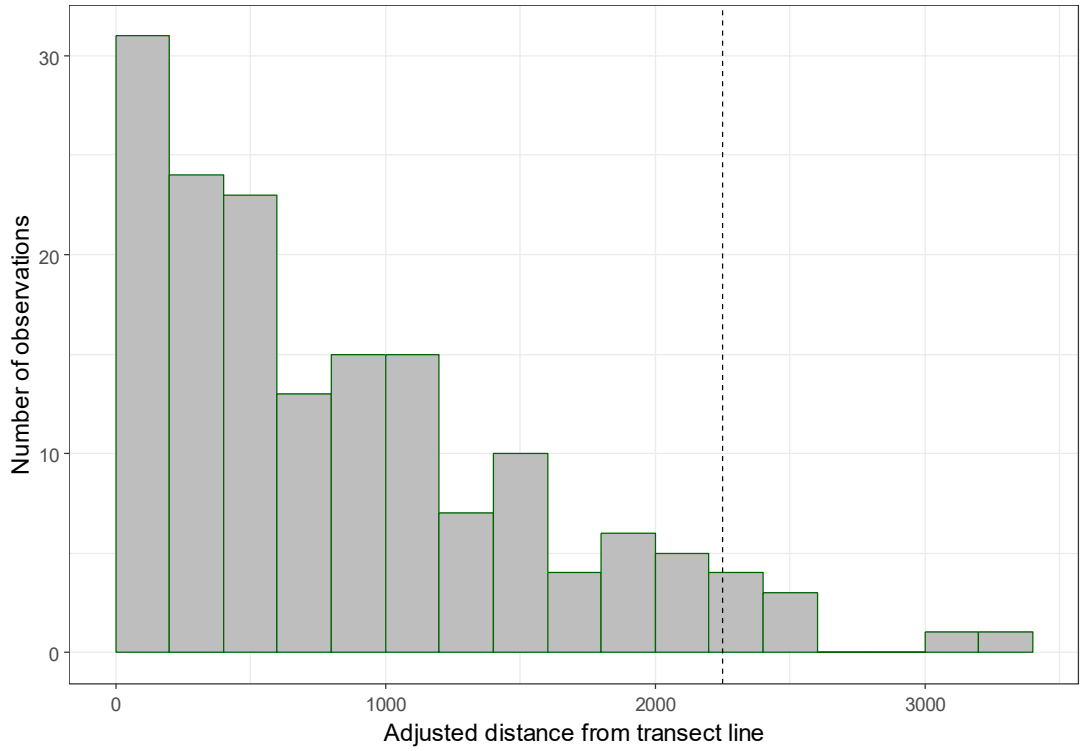


Figure 7. The distribution of observations relative to adjusted distance from the survey line (Distance from transect line-blind spot distance for each aircraft). The right truncation distance of 2250 meters used in the analysis is shown as a vertical line.

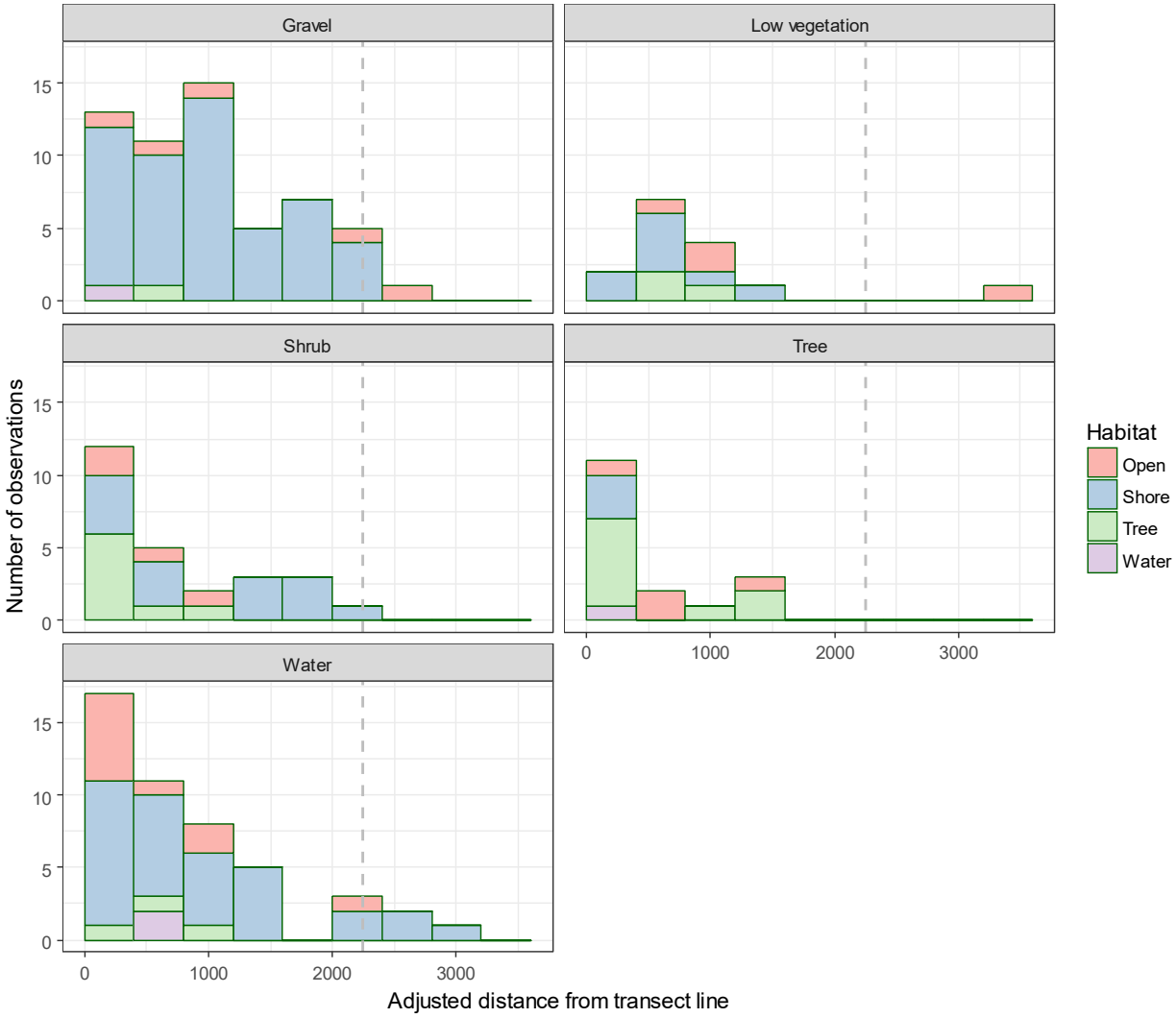


Figure 8. Distributions of detections for Landsat remote sensing-based covariates with observer-based habitat classes shown as sub-bars to allow comparison of the 2 methods of habitat classification.

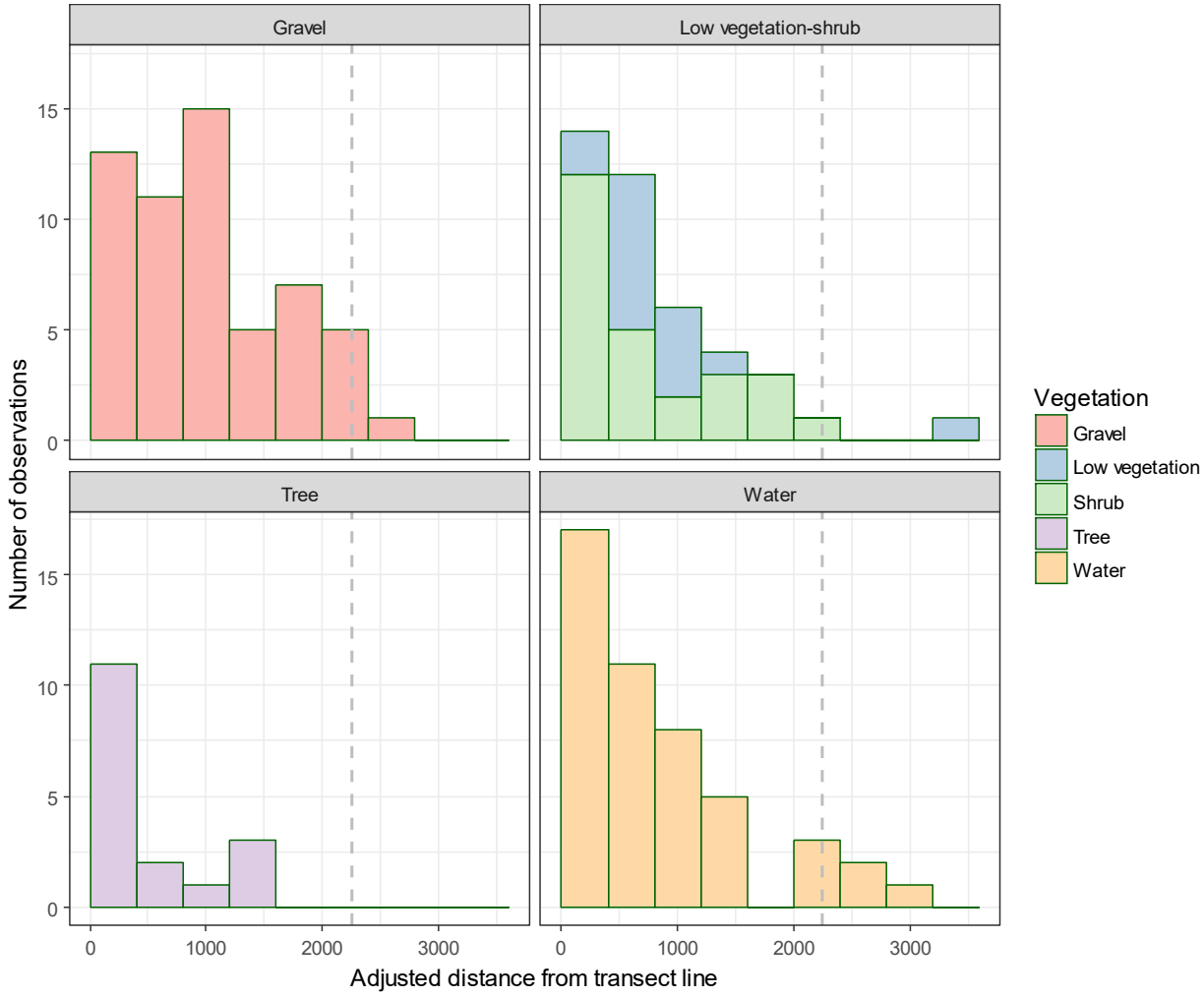


Figure 9. Remote sensing vegetation classes with the shrub and low vegetation category pooled. This covariate was termed RSveg2.

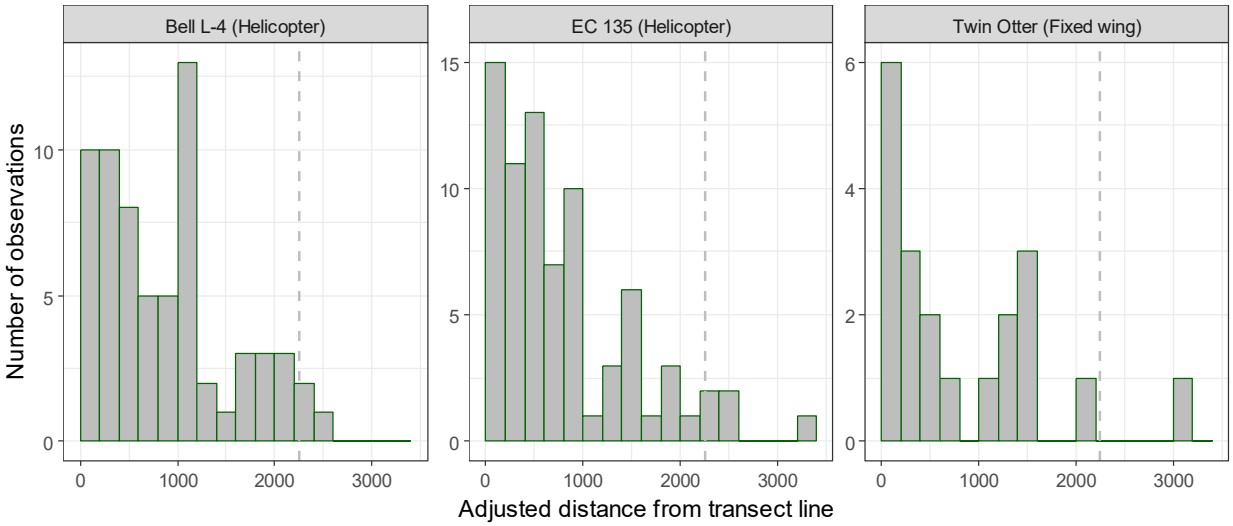


Figure 10. Distributions of detection for aircraft type.

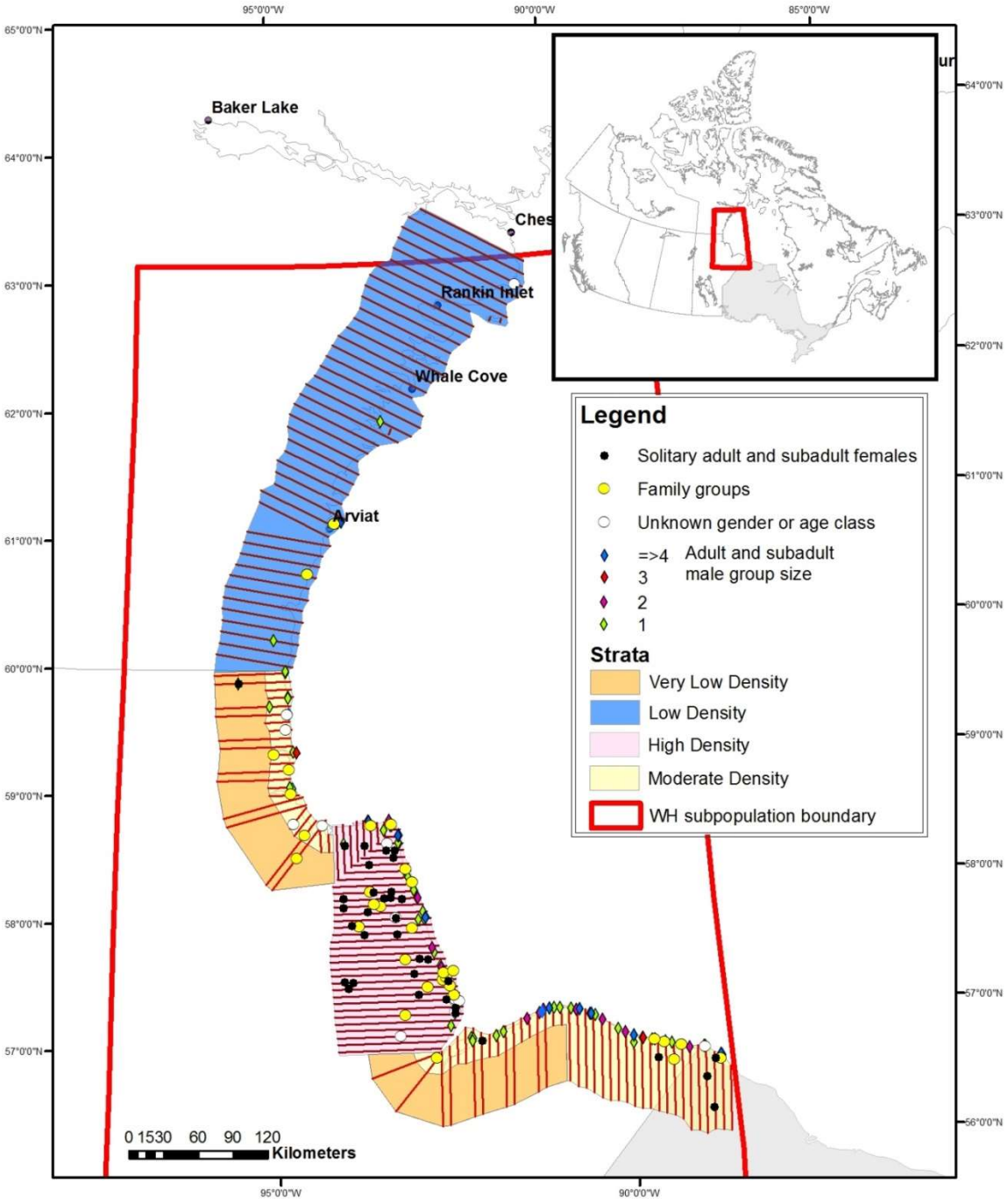


Figure 11. Distribution of polar bear group observations by age/sex class and strata within the study area during the 2016 western Hudson Bay aerial survey. Note that classifications of bears are based on aerial inspection.

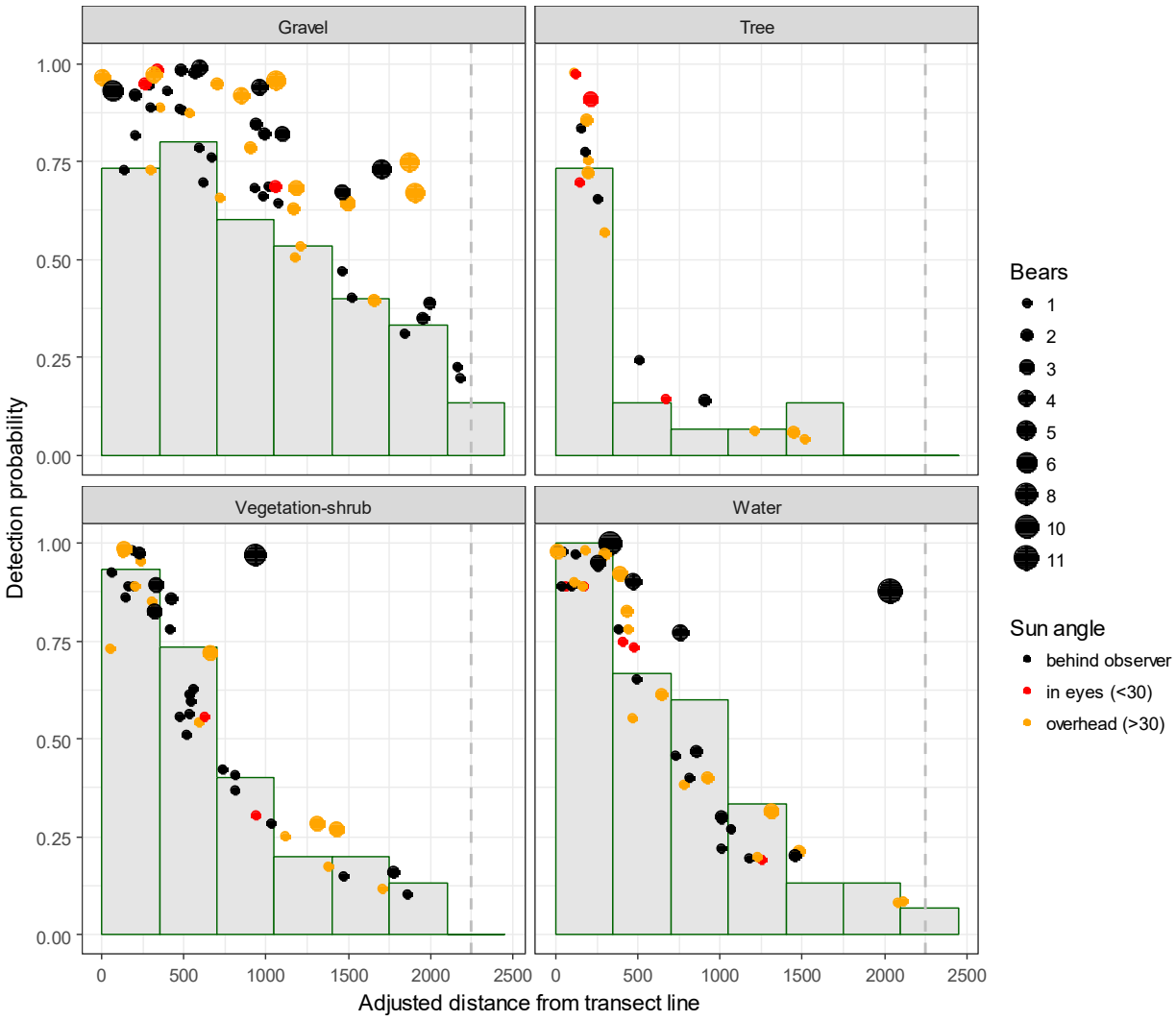


Figure12. Comparison of the observed detection distributions with predicted detection probabilities as a function of remote sensing vegetation classes (RSveg2) , group size (Bears), and angle of the sun from model 1 (Table 6).

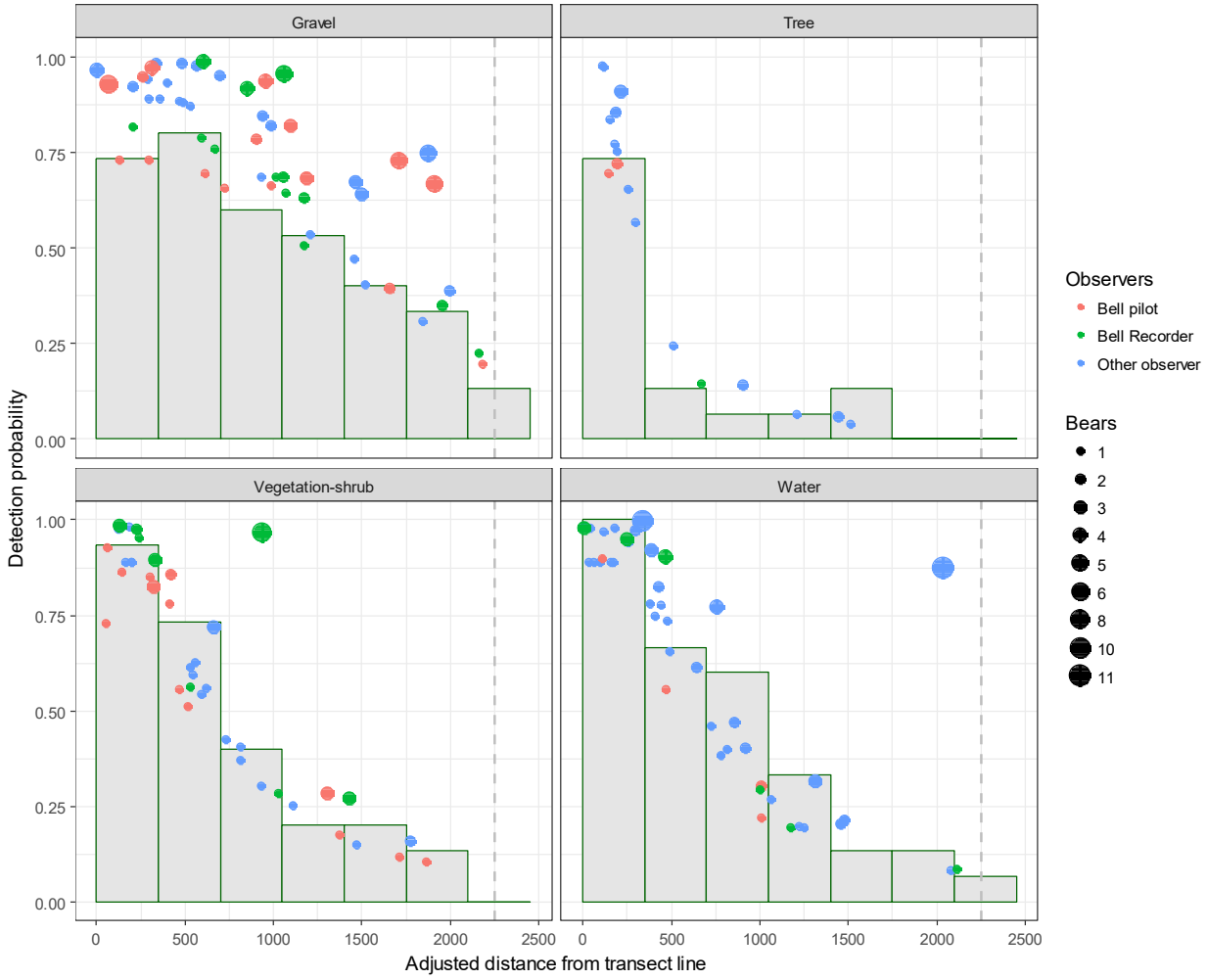


Figure 13. Comparison of the observed detection distributions with predicted detection probabilities as a function of RSveg2 class, group size (Bears), and observer type from model 1 (Table 6).

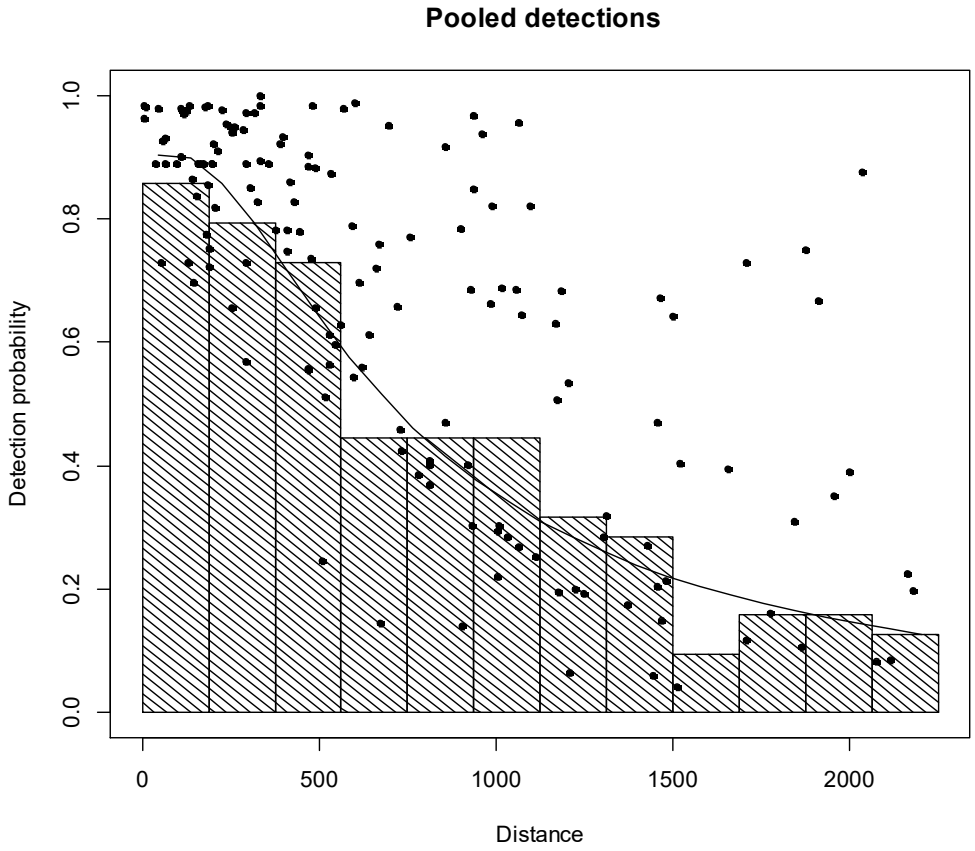


Figure 14. Predicted double observed detection probabilities (points) and mean detection (line) superimposed on detection frequencies for model 1 (Table 6).

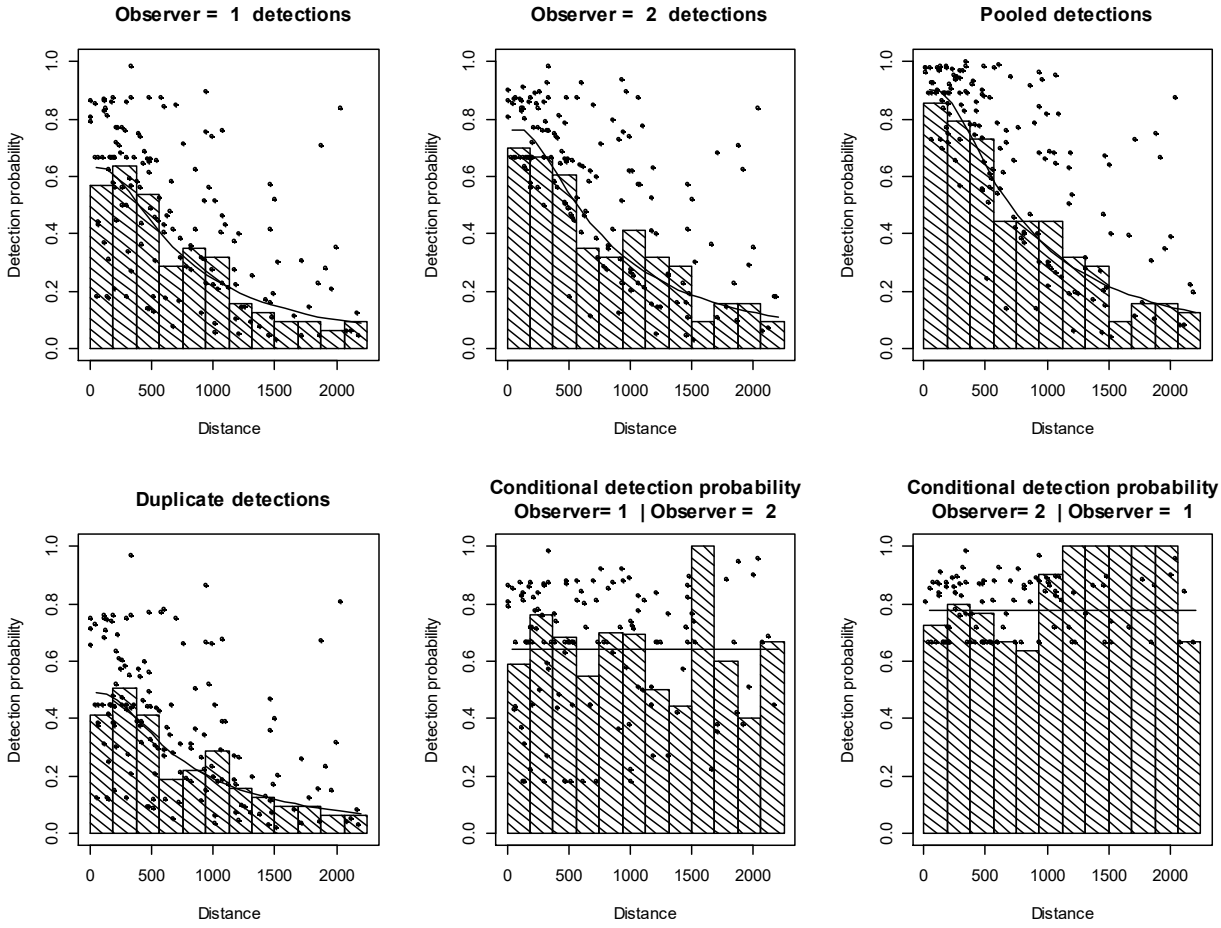


Figure 15. Detection plots for the front observer (1) and rear observer (2), pooled observers and duplicate observations (where both observers saw a bear. Conditional probabilities are also given for detection of bear by observer 1 given detection by observer 2 and vice versa. All estimates are from model 1 in Table 6.

Table 1. Covariates considered in the mark-recapture/distance sampling analysis. The primary use of the covariate for distance sampling analysis (DS) and mark-recapture analysis (MR) is denoted.

Covariate	Type	DS	MR	description
size	continuous	x	x	group size
aircraft	categorical	x	x	aircraft (Twin Otter, Bell, or EC135)
heli	binary	x	x	helicopter or airplane
Bell	binary	x	x	Bell helicopter
Bellp	binary	x	x	Pilot of Bell helicopter
Bellr	binary	x	x	Recorder/Navigator of Bell helicopter.
hab	categorical	x	x	habitat within 30m of observation as classified by observers (Open, Water, Shore, and Tree)
RSveg	categorical	x	x	Landsat habitat (Gravel,Low vegetation, Shrub, Tree, and water) at pixel (625 m^2) scale
RSveg2	categorical	x	x	RSveg habitat category with the Low vegetation and shrub category pooled.
RSveg90	categorical	x	x	RSveg at 90X90m scale
RSveg150	categorical	x	x	RSveg at 150X150m scale
RSveg-hab	categorical	x	x	RSveg water class re-assigned based on habitat classes.
vis	binary	x	x	ideal (163) or marginal (15 observations)
obs	categorical		x	Observers (12)
Sun	continuous	x	x	Sun altitude; only in equation if sun was facing observer
pilot	binary	x	x	if observer was a pilot
rec	binary	x	x	if observer was a data recorder

Table 2. Summary of observations by strata. Mean group sizes and numbers of bears by distance category are shown. LT (Blind spot) observations occurred under the planes and were usually only seen by the pilot and front seat navigator. Bears in the survey strip were observed by at least one of the 2 observers, or only seen by data recorders or non-observer personnel.

Strata	Group size				Numbers of bears by distance category				
	n	mean	std	min	max	LT (Blind spot)	Observed	Not observed	RT >2250m	Total
High	98	1.72	1.17	1	7	5	150	7	7	169
Low	8	2.25	2.12	1	7	1	6	4	7	18
Moderate	69	2.14	1.98	1	11	8	123	6	11	148
Very Low	3	1.33	0.58	1	2	3	1	0	0	4
Totals	178					17	280	17	25	339

Table 3. Summary of observer data during the Hudson Bay polar bear survey. The naïve probability is the number of detections divided by the total trials. The Bell pilot had the lowest probability.

Individual	Role	Bear observations			Naïve probability
		Not detected	detected	Total trials	
1	observer	2	22	24	0.92
2	observer	3	28	31	0.90
3	Bell recorder	11	20	31	0.65
4	observer	6	16	22	0.73
5	observer	4	10	14	0.71
6	observer	1	6	7	0.86
7	observer	5	15	20	0.75
8	observer	12	35	47	0.74
9	Recorder	1	14	15	0.93
10	observer	3	37	40	0.93
11	Bell pilot	22	13	35	0.37
12	observer	4	34	38	0.89
		74	250	324	0.77

Table 4. Overview of observed polar bears during the western Hudson Bay aerial survey, August 2016, by field age class and spatial occurrence. Areas A-D are defined as in Lunn et al. (2016).

Age Class[§ 1]	Area					
	NU (A)	MB (B)	MB/WNP (C)	MB EAST (D)	Total (bears or km)	PPN
ADF+1COY	0	2	7	0	18	0.053
ADF+2COY	2	2	7	4	45	0.132
ADF+1YRLG	0	1	4	1	12	0.035
ADF+2YRLG	0	0	2	0	6	0.018
ADF+1 2-yr old	0	0	1	0	2	0.006
ADF	0	1	27	5	33	0.097
ADM	11	23	63	84	181	0.532
SAM	0	0	21	4	25	0.074
SAF	0	0	2	0	2	
U	1	5	9	1	16	0.047
Flown distance (km)	4 900	1 870	6 200	4 300	17 270	
Transect flights (km)	3 511	1 053	2 881	2 237	9 682	
TOTAL bears observed	18	41	173	108	340	
PPN	0.053	0.121	0.509	0.318		

§ ADF=adult female; COY=cub-of-the-year; ADM=adult male; SAM=subadult male; SAF=subadult female; U=unknown; YRLG=yearling; 2-yr=2-year old.
[1] all classifications are based on aerial assessments from helicopters

Table 5. Model selection results for distance sampling analysis. The mark-recapture component of the MRDS model was set at constant for this analysis step. Covariates are listed in Table 1. Estimated abundance is given for reference purposes. Constant models are shaded. Akaike information criterion (AIC), the differences between AIC of the given model and most supported model ΔAIC, Akaike weight (wi), and Log-likelihood of each model is also shown.

No	DF	Distance	AIC	ΔAIC	w_i	K	LogL	N	Conf. int		CV
1	HR	Rsveg2 +size	2611.6	0.00	0.22	7	-1298.8	836	602	1160	16.7%
2	HR	Rsveg2	2612.3	0.78	0.15	6	-1300.2	908	644	1279	17.5%
3	HN	hab+vis	2612.9	1.31	0.12	6	-1300.4	816	625	1067	13.6%
4	HR	RSveg2+size+vis	2613.2	1.67	0.10	8	-1298.6	833	603	1152	16.5%
5	HN	hab+vis+size	2613.5	2.00	0.08	7	-1299.8	779	588	1033	14.4%
6	HR	RSveg-hab	2613.7	2.14	0.08	6	-1300.8	900	643	1262	17.2%
7	HR	Rsveg2+vis	2613.7	2.19	0.07	7	-1299.9	898	641	1258	17.2%
8	HN	hab	2613.8	2.26	0.07	5	-1301.9	813	622	1065	13.7%
9	HN	hab+size	2614.0	2.46	0.06	6	-1301.0	770	581	1019	14.3%
10	HR	hab+vis	2617.0	5.48	0.01	7	-1301.5	862	633	1173	15.7%
11	HR	size	2617.4	5.82	0.01	4	-1304.7	773	578	1035	14.9%
12	HN	vis	2619.2	7.68	0.00	3	-1306.6	800	615	1040	13.4%
13	HR	Constant	2619.9	8.33	0.00	3	-1306.9	931	658	1316	17.7%
14	HR	RSveg90m	2619.9	8.33	0.00	7	-1302.9	966	675	1381	18.3%
15	HR	RSveg150m	2620.0	8.42	0.00	7	-1303.0	955	670	1362	18.2%
16	HR	bellheli	2620.5	8.91	0.00	4	-1306.2	904	644	1269	17.3%
17	HN	Constant	2620.6	9.05	0.00	2	-1308.3	799	614	1040	13.4%
18	HR	bellpilot+bellrec	2621.4	9.80	0.00	5	-1305.7	922	652	1302	17.7%
19	HR	Sun	2621.6	10.04	0.00	4	-1306.8	939	661	1333	18.0%
20	HR	vis	2621.7	10.17	0.00	4	-1306.9	917	652	1290	17.5%
21	HR	aircraft	2622.1	10.59	0.00	5	-1306.1	944	661	1348	18.2%

Table 6. Model selection results for mark-recapture analyses. The most supported distance model (HR(RSveg2+size)) was used in all the models in this analysis. Covariates are listed in Table 1. Estimated abundance is given for reference purposes. . Akaike information criterion (AIC), the differences between AIC of the given model and most supported model ΔAIC, Akaike weight (wi), and Log-likelihood of each model is also shown.

No	Mark-recapture model	AIC	ΔAIC	w_i	K	LogL	N	Conf. Limit		N CV
1	Bellp+Bellr+sun+size	2575.5	0.00	0.65	11	-1278.1	896	638	1258	17.4%
2	Bellp+Bellr+sun	2577.0	1.48	0.31	10	-1279.9	911	647	1282	17.5%
3	Bellp+Bellr+size	2582.2	6.70	0.02	10	-1282.5	884	630	1240	17.3%
4	Bellp+Bellr	2584.0	8.52	0.01	9	-1284.4	897	638	1260	17.4%
5	aircraft+Bellp+Bellr	2585.1	9.61	0.01	11	-1282.9	893	634	1256	17.5%
6	observers	2591.9	16.47	0.00	18	-1279.4	891	633	1255	17.5%
7	sun	2605.1	29.64	0.00	8	-1295.9	922	654	1301	17.6%
8	aircraft	2605.6	30.08	0.00	9	-1295.2	926	658	1304	17.5%
9	heli	2607.9	32.37	0.00	8	-1297.3	914	648	1288	17.5%
10	size	2611.2	35.75	0.00	8	-1299.0	896	637	1259	17.4%
11	constant	2611.6	36.08	0.00	7	-1300.2	908	644	1279	17.5%
12	vis	2612.2	36.72	0.00	8	-1299.5	908	645	1279	17.5%
13	pilot	2612.2	36.73	0.00	8	-1299.5	908	645	1279	17.5%
14	hab	2613.2	37.71	0.00	10	-1298.0	921	652	1300	17.7%
15	recorder	2613.5	38.06	0.00	8	-1300.2	908	644	1279	17.5%
16	distance	2613.5	38.06	0.00	8	-1300.2	908	644	1279	17.5%
17	Rsveg	2617.0	41.55	0.00	11	-1298.9	915	648	1292	17.7%

Table 7. Model selection results for the combined distance and mark-recapture analysis. The most supported distance model and mark-recapture models given in Tables 4 and 5 were considered in this analysis. Covariates are listed in Table 1. Estimated abundance is given for reference purposes. Akaike information criterion (AIC), the differences between AIC of the given model and most supported model ΔAIC, Akaike weight (wi), and Log-likelihood of each model is also shown.

No	DF	Distance	MR	AIC	ΔAIC	wi	K	LogL	N	Conf. Limit		N CV
1	HR	Rsveg2+size	Bellp+Bellr+sun+size	2575.5	0.00	0.22	11	-1276.7	831	599	1151	16.7%
2	HR	Rsveg2	Bellp+Bellr+sun+size	2576.3	0.78	0.15	10	-1278.1	896	638	1258	17.4%
3	HN	Hab+vis	Bellp+Bellr+sun+size	2576.8	1.30	0.11	10	-1278.4	808	619	1056	13.6%
4	HR	Rsveg2+size	Bellp+Bellr+sun	2577.0	1.48	0.10	10	-1278.5	840	605	1165	16.7%
5	HR	Rsveg2+size+vis	Bellp+Bellr+sun+size	2577.1	1.67	0.10	12	-1276.6	828	600	1143	16.5%
6	HN	Hab+vis+size	Bellp+Bellr+sun+size	2577.5	2.00	0.08	11	-1277.7	774	585	1024	14.3%
7	HR	Rsveg2+vis	Bellp+Bellr+sun+size	2577.7	2.19	0.07	11	-1277.8	887	635	1238	17.1%
8	HR	RSveg2	Bellp+Bellr+sun	2577.7	2.26	0.07	9	-1279.9	911	647	1282	17.5%
9	HN	Hab+vis	Bellp+Bellr+sun	2578.3	2.78	0.05	9	-1280.1	823	627	1079	13.8%
10	HN	Hab+vis+size	Bellp+Bellr+sun	2578.9	3.47	0.04	10	-1279.5	785	590	1045	14.6%

Table 8. Strata-specific and total estimates of abundance for model 1 (Table 6).

Strata	Individuals	N	SE	CV	Conf. Limit	
High	150	471	103.0	21.9%	307	723
Low	6	27	13.8	50.8%	10	71
Moderate	123	323	63.4	19.6%	220	475
Very Low	1	9	9.7	102.2%	2	54
Total	280	831	138.5	16.7%	599	1151

Table 9. Sensitivity of MRDS models to left and right truncation. The most supported MRDS model from Table 6 was used for estimates.

Right Truncation	N	CV	Conf. Limit	
2250	831	16.7%	599	1,151
2700	825	16.4%	599	1,136
1800	826	17.9%	581	1,173

Table 10. Mean (standard error) polar bear cub-of-the-year (COY) and yearling (YRLG) litter sizes of populations that inhabit the Hudson Bay complex, also presented as proportion of total observations during the respective studies.

Subpopulation	Litter size		Proportion of total observations		Source
	COY	YRLG	COY	YRLG	
Western Hudson Bay (2016)	1.63 (0.10)	1.25 (0.16)	0.11	0.03	GN (unpublished data)
Western Hudson Bay (2011)	1.43 (0.08)	1.22 (0.10)	0.07	0.03	Stapleton et al. (2014)
Southern Hudson Bay (2011)	1.56 (0.06)	1.49 (0.08)	0.16	0.12	Obbard et al. 2015
Foxe Basin (2009-2010)	1.54 (0.04)	1.48 (0.05)	0.13	0.10	Stapleton et al. (2015)

Appendix 1

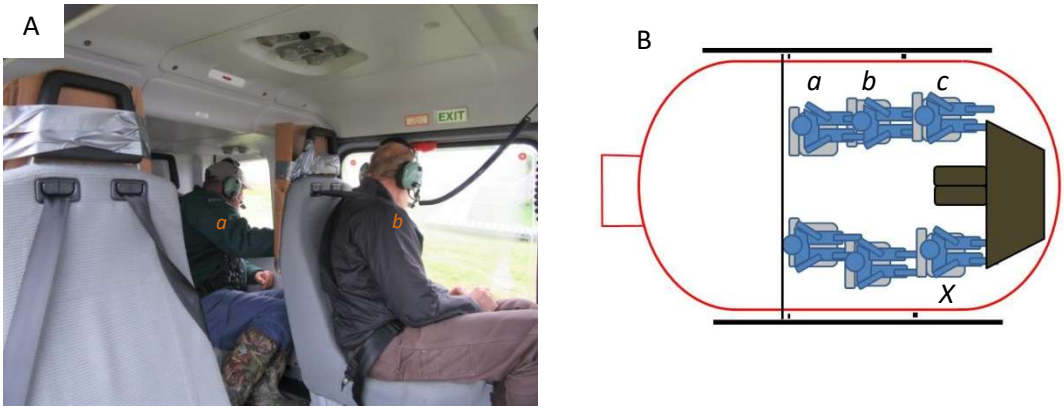


Figure A1: Overview of the EC135 rotary wing seat/observer configuration with separation wall set-up. Left photograph (A) depicts position *a* and *b* in the schematic diagram (right panel, B; *c* not shown in photograph A, *X* denotes pilot).

Appendix 2

Figure A2. Depicted are the front observers (local members of the Rankin Inlet and Arviat Hunters and Trappers Association) in a Twin Otter fixed-wing survey platform, separated by a cardboard barrier from the rear observers. Not shown are the recorders.

Appendix 3

Figure A3.1. Extended tidal flats in the western Hudson Bay study area. Red circle indicates 2 polar bears near boulders observed during the August 2016 aerial survey.

Figure A3.2 Boreal forest several kilometers inland interspersed with ponds and lakes. Red circle indicates a swimming polar bear seen during the August 2016 aerial survey.

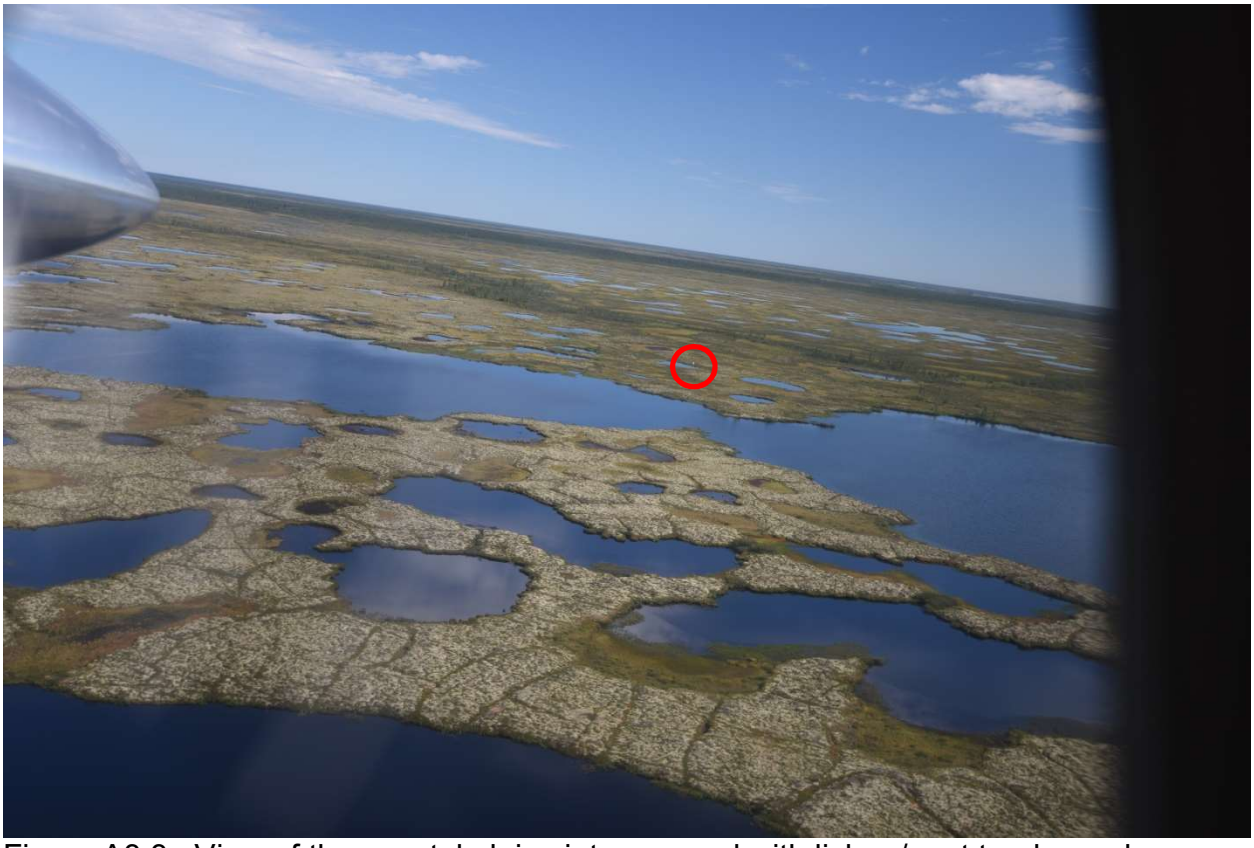


Figure A3.3 View of the coastal plains interspersed with lichen/peat tundra and pond/lakes. Red circle indicates a polar bear seen resting next to a pond during the August 2016 aerial survey.

Figure A3.4 Polar bear (red circle) seen near the shore in the water at high tide during the August 2016 aerial survey in western Hudson Bay.

Appendix 4

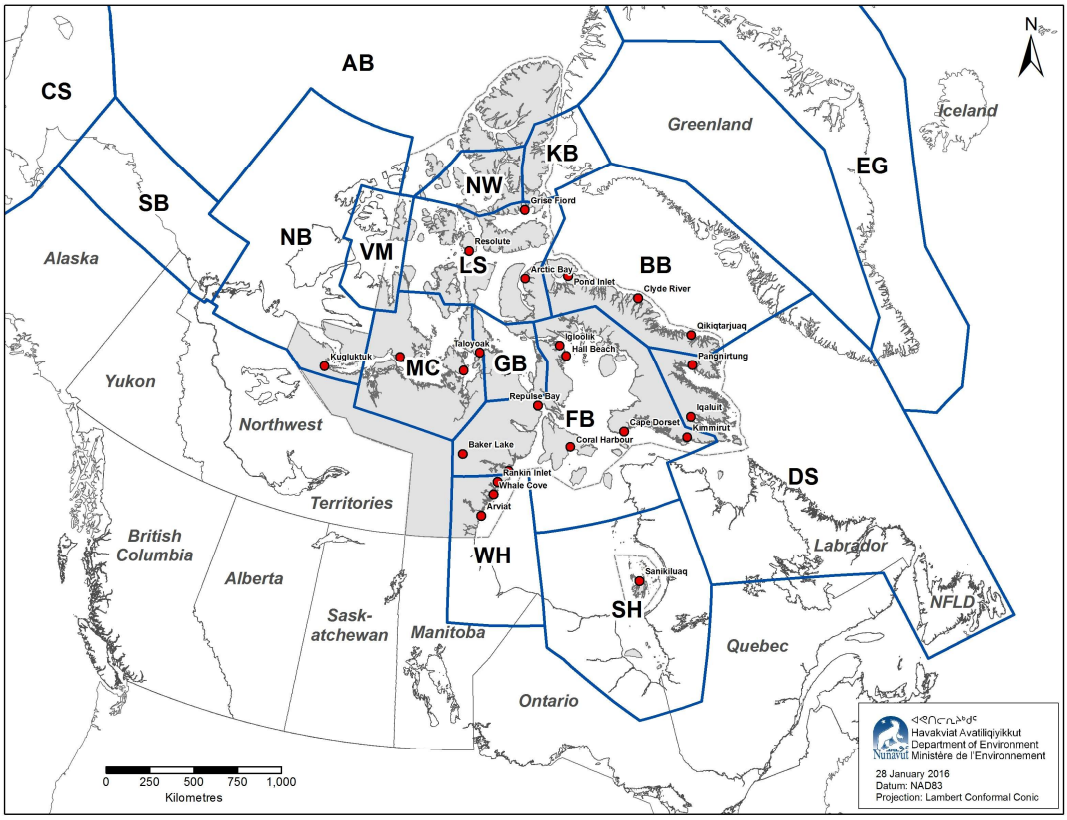


Figure A4.1. Canadian and Nunavut (dark grey) polar bear subpopulations [BB = Baffin Bay; DS = Davis Strait; SH = Southern Hudson Bay; WH = Western Hudson Bay; FB = Foxe Basin; GB = Gulf of Boothia; MC = M'Clintock Channel; LS = Lancaster Sound; KB = Kane Basin; NW = Norwegian Bay; VM = Viscount Melville Sound; NB = Northern Beaufort Sea; SB = Southern Beaufort Sea.

CONSULTATION SUMMARY NOTES FOR THE 2016 WESTERN HUDSON BAY POLAR BEAR AERIAL SURVEY COMPILED DURING MEETINGS CONDUCTED BETWEEN 4-7 JULY 2017

4 July, 2017: Rankin Inlet HTO, Rankin Inlet

5 July, 2017: Issatik HTO, Whale Cove

6 July, 2017: Arviat HTO, Arviat

7 July, 2017: Aqigiq HTO, Chesterfield Inlet

Department of Environment, Government of Nunavut

Igloolik, NU

Prepared: 11 July, 2017

Executive Summary

Government of Nunavut, Department of Environment representatives together with delegates from Nunavut Tunngavik Inc. and the Kivalliq Wildlife Board conducted consultations with the Hunters and Trappers Organizations of Rankin Inlet, Whale Cove, Arviat, and Chesterfield Inlet on July 4, 5, 6, and 7, 2017, respectively. Invited Baker Lake HTO representatives did not attend the meeting in Chesterfield Inlet on 7 July 2017.

The primary purpose of these consultations was to provide co-management partners with:
1) an overview of the most recent scientific study results on the western Hudson Bay (WH) polar bear sub-population (Appendix 1); and
2) the GN's management recommendation of no change to the current TAH despite a decline in abundance in the 2016 population estimate (842, 562-1121 95% CI) relative to the 2011 aerial survey estimate (1030, 754-1406 95% CI).

In addition, the GN representatives collected feedback on the results and any additional information or management concerns expressed by co-management partners. This included public safety concerns expressed by the Arviat HTO, to which the GN suggested it would recommend re-setting the current TAH of 28 bears to the NWMB, thus eliminating existing polar bear tag credit issues so as to allow each community full, restored access to its quota allocation.

Only communities that hunt from the WH polar bear sub-population were consulted.

The feedback and information collected during these consultations will be considered when forming Total Allowable Harvest (TAH) recommendations for the WH sub-population to be submitted for decision to the Nunavut Wildlife Management Board (NWMB) at its September, 2017 meeting.

This report attempts to summarize the comments made by HTO members/participants during these consultation meetings.

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In addition, the GN representatives collected feedback on the results and any additional information or management concerns expressed by co-management partners. This included public safety concerns expressed by the Arviat HTO, to which the GN suggested it would recommend re-setting the current TAH of 28 bears to the NWMB, thus eliminating existing polar bear tag credit issues so as to allow each community full, restored access to its quota allocation.

Only communities that hunt from the WH polar bear sub-population were consulted.

The feedback and information collected during these consultations will be considered when forming Total Allowable Harvest (TAH) recommendations for the WH sub-population to be submitted for decision to the Nunavut Wildlife Management Board (NWMB) at its September, 2017 meeting.

This report attempts to summarize the comments made by HTO members/participants during these consultation meetings.

Preface

This report represents the Department of Environment's best efforts to accurately capture all of the information that was shared during consultation meetings with the Hunters and Trappers Organizations of Rankin Inlet, Whale Cove, Arviat, and Chesterfield Inlet.

The views expressed herein do not necessarily reflect those of the Department of Environment, or the Government of Nunavut.

Table of Contents

1.0 Report Purpose and Structure

This report is intended to: 1) provide the details of the GN DOE presentation and resulting management recommendations for the WH polar bear subpopulation assessment, 2016 (Appendix 1), and 2) collate and summarize comments, questions, concerns and suggestions provided by the HTOs in response to the results from the recent western Hudson Bay (WH) scientific study. In addition, these consultations were conducted with community HTOs to collect feedback and TK prior to submitting formal recommendations for the WH sub-population to the NWMB that include no change to the current TAH. The following community HTOs were consulted from July 4-7, 2017:

- 4 July, 2017: Rankin Inlet HTO, Rankin Inlet
- 5 July, 2017: Issatik HTO, Whale Cove
- 6 July, 2017: Arviat HTO, Arviat
- 7 July, 2017: Aqigiq HTO, Chesterfield Inlet

After these consultations, the DOE will provide a submission to the NWMB for decision that includes no change in the existing TAH and management approach, but as per Arviat HTO's suggestion GN DOE will recommend to re-set and zero credits so that communities are able to harvest bears but are also in a position to deal with defense of life and property kills, should the situation arise.

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In addition to the HTO Board members, co-management representatives from Nunavut Tunngavik Inc. (NTI), and the Kivalliq Wildlife Board (KWB) also attended each of the consultations. The NWMB had no delegates present during these meetings.

2.0 Purpose of Consultations

The purpose of these consultations was to discuss the newest scientific information that was collected during the 2016 aerial survey regarding the WH polar bear sub-population, and as reported in the final GN report which was produced by several co-authors. After the consultations the GN DOE will submit TAH recommendations for the WH sub-population to the NWMB for decision which will include no change in the existing TAH and management approach, but as per Arviat HTO suggestion to re-set the credits to zero. This would allow communities to harvest bears while also being in a position to deal with defense of life and property kills, should the situation arise.

2.1 Format of Meetings

The meetings were held in the evenings, usually between 19:00 and 22:00, and ran approximately 2.5 hours depending on HTO engagement. Meetings were facilitated and led by the GN Polar Bear Biologist, M. Dyck, who was also the presenter. Each consultation session began with an overview of the study design, study execution, and results from the aerial survey study conducted on the WH polar bear sub-population (Appendix 1). It was also mentioned that the population has remained relatively stable and that no difference between the 2011 and 2016 aerial survey results existed. The GN's position, therefore, was to recommend no change in the current TAH for the WH sub-population. The participants were invited to ask any questions, raise concerns, or provide recommendations throughout the meetings. After the presentation, questions/discussions continued until no further questions were raised.

3.0 Summary by Community

The objectives of the consultations were made clear to the HTO members prior to and at the start of each meeting. There were many similar questions, concerns and suggestions raised by HTO Board members in all the communities consulted. A full report of the questions and comments from each community follows in Appendix 2.

3.1 Rankin Inlet Consultation Summary

Date: 4 July, 2017

Representatives:

- GN-DOE, Polar Bear Biologist: Markus Dyck
- GN-DOE, Regional Manager: Rob Harmer
- GN-DOE, Conservation Officer: Joanne Coutu-Autut
- NTI: Raymond Mercer
- NTI: Robert Karetak
- Rankin Inlet HTO, Secretary: Nigel Kubluitok
- Rankin Inlet HTO, Temporary Secretary: Clayton Tartak
- KWB Representative: Qovik Netser

Comments and questions:

There were no HTO board members present in Rankin Inlet, however, several questions regarding the presentation and results of the study were raised by representatives. The question whether there is current concern for this population was raised, and it was discussed that although there does not seem to be a significant decline in abundance, declines in body condition, survival rates, and reproduction have

been documented for years. In particular, there are some effects on cubs-of-the-year that only allow a small proportion to survive to the yearling stage.

There was also some support for a new IQ study, and a fall coastal survey to determine when and how many bears migrate through and are in the vicinity of the community.

3.2 Whale Cove Consultation Summary

Date: 5 July, 2017

Representatives:

- GN-DOE, Polar Bear Biologist: Markus Dyck
- GN-DOE, Regional Manager: Rob Harmer
- NTI: Raymond Mercer
- NTI: Cheryl Wray
- KWB Representative: Nick Arnalukjuaq
- Issatik HTO: Shirley Kabloona
- Issatik HTO: Eva Voisey
- Issatik HTO: Martha Arualak
- Issatik HTO: Chris Jones
- Issatik HTO: Robert Enuapik

Comments and questions:

In response to questions asked by M. Dyck regarding when many bears would show up near the community, HTO members responded usually in the fall between October and December, and that there may be a disproportionate migration of bears north from Manitoba. HTO members agreed that there were fewer polar bears during the 1960s and 1970s, and that during the 1980s more bears were seen on the land. It was also suggested whether biopsy sampling could be used in order to track problem bears near the community, or if a fall coastline survey could be used to determine some trends over time. There also seemed to be support for a renewed study in order to continue the monitoring of the WH polar bears.

3.3 Arviat Consultation Summary

Date: 6 July, 2017

Representatives:

- GN-DOE, Polar Bear Biologist: Markus Dyck
- GN-DOE, Regional Manager: Rob Harmer
- GN-DOE, Conservation Officer: Joe Savikataaq Jr.
- NTI: Raymond Mercer

- NTI: Cheryl Wray
- NTI: Bert Dean
- NTI: Robert Karetak
- KWB Representative: Nick Arnalukjuaq
- KWB Chairperson: Stanley Adjuk
- Arviat HTO: Thomas Alikaswa
- Arviat HTO: Ludovic Issumatarjuak
- Arviat HTO: Gordy Kidlupik
- Arviat HTO: Angelina Suluk
- Arviat HTO: Sam Garry Muckpa
- Arviat HTO: Jamie Kablutsiak
- Arviat HTO: Mary Issumatarjuak

Comments and questions:

In response to questions asked by M. Dyck regarding when many bears would show up near the community, HTO members responded usually in the fall between October and December. HTO members agreed that there were fewer polar bears during the 1960s and 1970s, and that during the 1980s more bears were seen on the land. It was also discussed if a fall coastline survey could be used to determine some trends over time. Concern over the TAH was expressed and that it is likely low to deal with problem bears. M. Dyck suggested to bring forward to DOE whether it is possible to re-set credits and TAH for the new harvest season. Some HTO members suggested that bears in the Arviat area move inland up to 120 miles – and that this was important local information that should be documented for the next aerial survey. Problem bears do also not seem to be scared anymore of people like they used to.

3.4 Chesterfield Inlet Consultation Summary

Date: 7 July, 2017

Representatives:

- GN-DOE, Polar Bear Biologist: Markus Dyck
- GN-DOE, Regional Manager: Rob Harmer
- GN-DOE, Conservation Officer: Peter Kattegatsiak Sr.
- NTI: Raymond Mercer
- NTI: Cheryl Wray
- NTI: Bert Dean
- NTI: Robert Karetak
- KWB Representative: Nick Arnalukjuaq
- Aqigiq HTO: Harry Aggark
- Aqigiq HTO: Leonie Mimialik
- Aqigiq HTO: Patrick Putulik

- Aqigiq HTO: Jerome Misheralak
- No Baker Lake HTO members attended the meeting after invitations and travel was arranged to Chesterfield Inlet

Comments and questions:

In response to questions asked by M. Dyck regarding when many bears would show up near the community, HTO members responded usually in the fall between October and December, but also in the spring time. HTO members agreed that there were fewer polar bears during the 1960s and 1970s, and that during the 1980s more bears were seen on the land, and that there are bears from 2 sub-populations near the community (e.g., Foxe Basin and WH). It was also discussed if a fall coastline survey could be used to determine some trends over time.

4.0 Summary

Some common themes that were apparent during several HTO discussions were that communities would likely support a fall coastal survey allowing to monitor bears near communities, and possibly means of genetic biopsy sampling so that bears near communities could be identified and their background examined if they had contact with communities and humans before. It also seemed that HTOs would be in support of a new traditional knowledge study that would examine whether freeze-up patterns near their communities have changed during the past 20-30 years, and how the fall distribution of bears near communities has changed from the 1970s to the present. The Arviat HTO commented that the current TAH likely is not sufficient to cover problem bears and it was suggested that a credit re-set could be considered so that the full TAH is available for all communities, given the public safety concern. M. Dyck and R. Harmer offered all communities to forward questions to the GN should they arise so that anything that was not discussed or unclear at the meetings could be explained.

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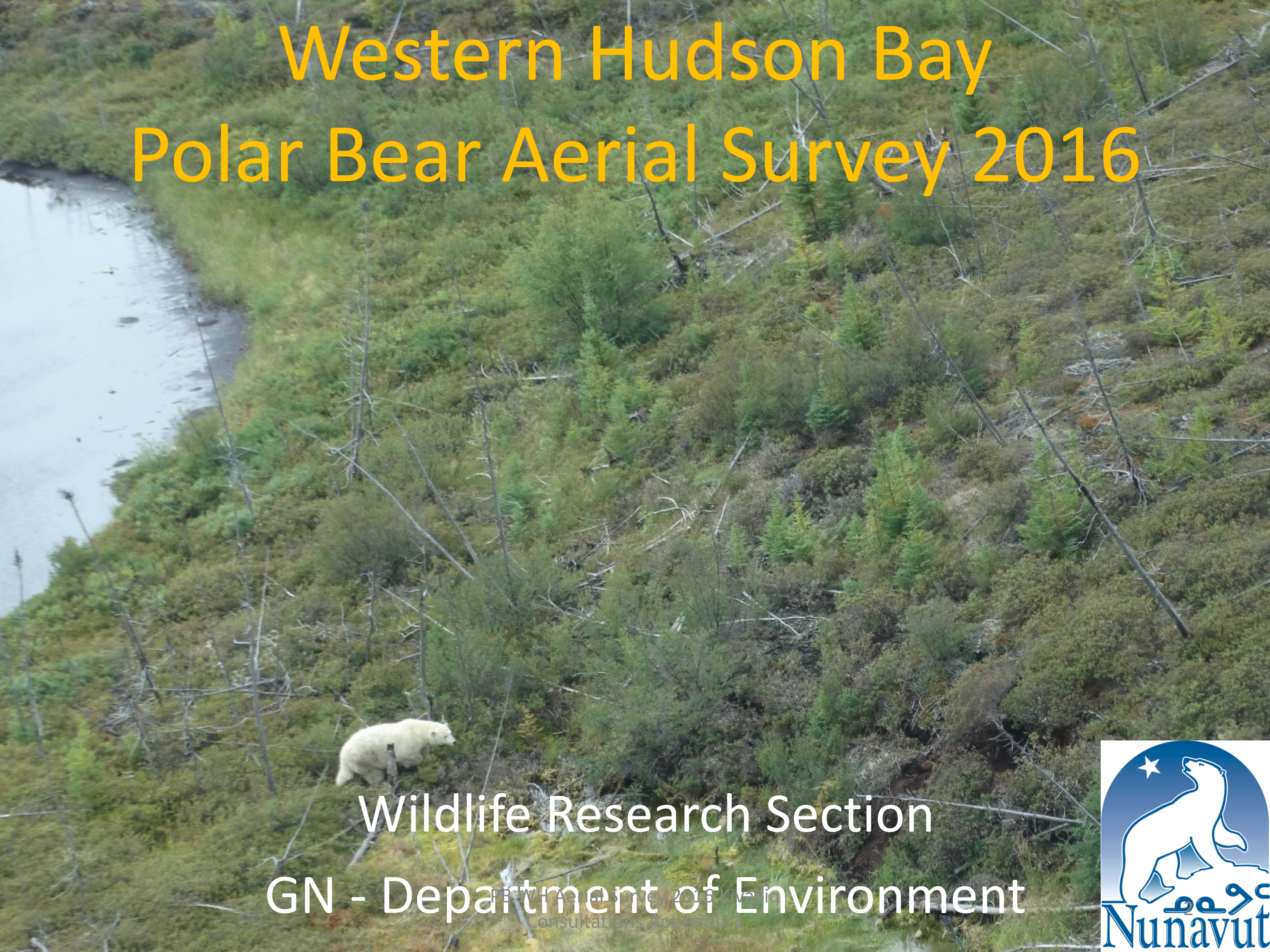
Department of Environment
Avatiliqiyikkut
Ministère de l'Environnement

CONSULTATION MEETING TO DISCUSS THE RESULTS OF THE 2016 AERIAL SURVEY FOR THE WESTERN HUDSON BAY POLAR BEAR SUBPOPULATION

POLAR BEAR RESEARCH GROUP

Government of Nunavut – Department of Environment

Western Hudson Bay
Polar Bear Aerial Survey 2016

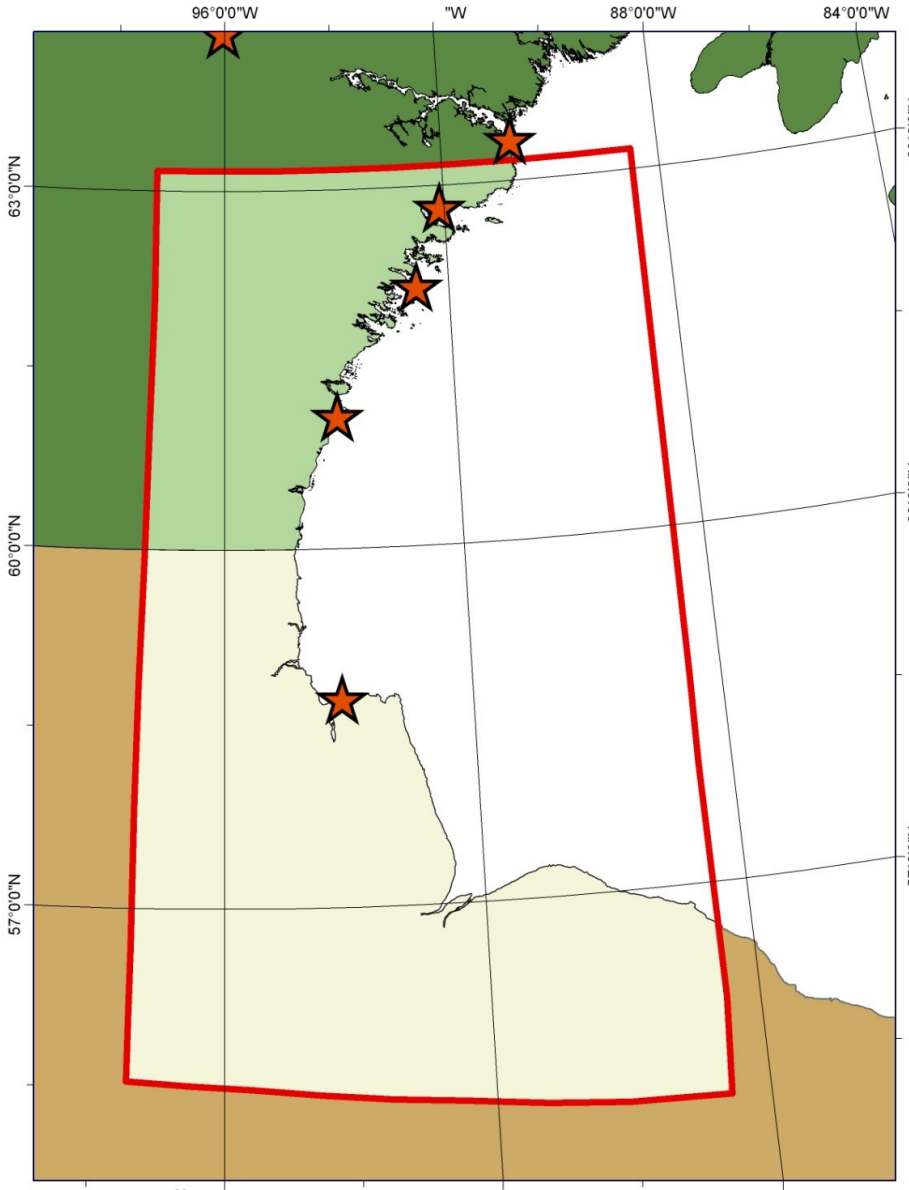


Wildlife Research Section

GN - Department of Environment

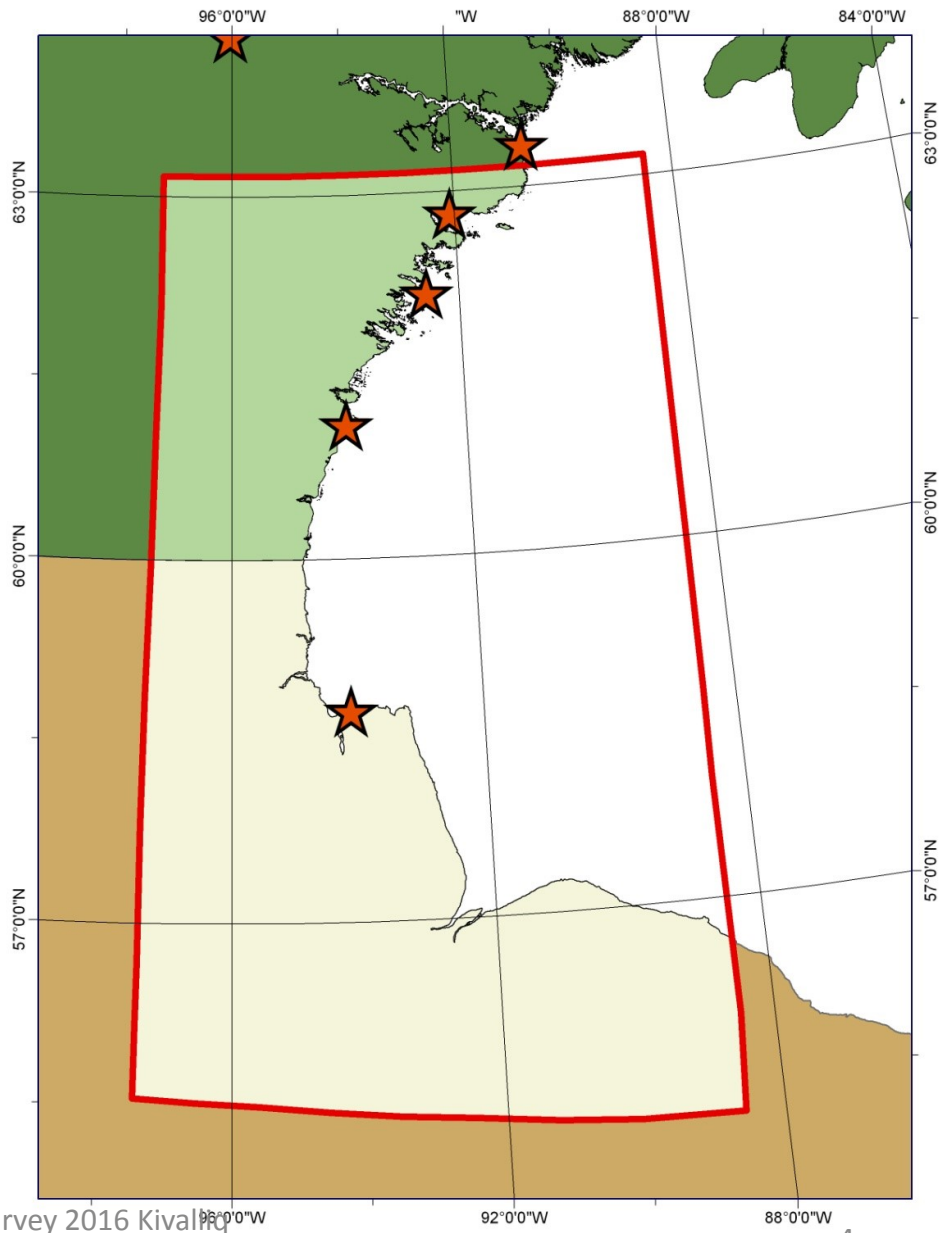
Background

- Concern about status of sub-population
- Science:
  - 1030 bears (last GN-led aerial survey [2011])
  - EC results agree that WH has been stable for last decade
- IQ and local observations:
  - More bears seen
  - Increasing numbers & range
  - Concern about accuracy & impacts of tagging studies



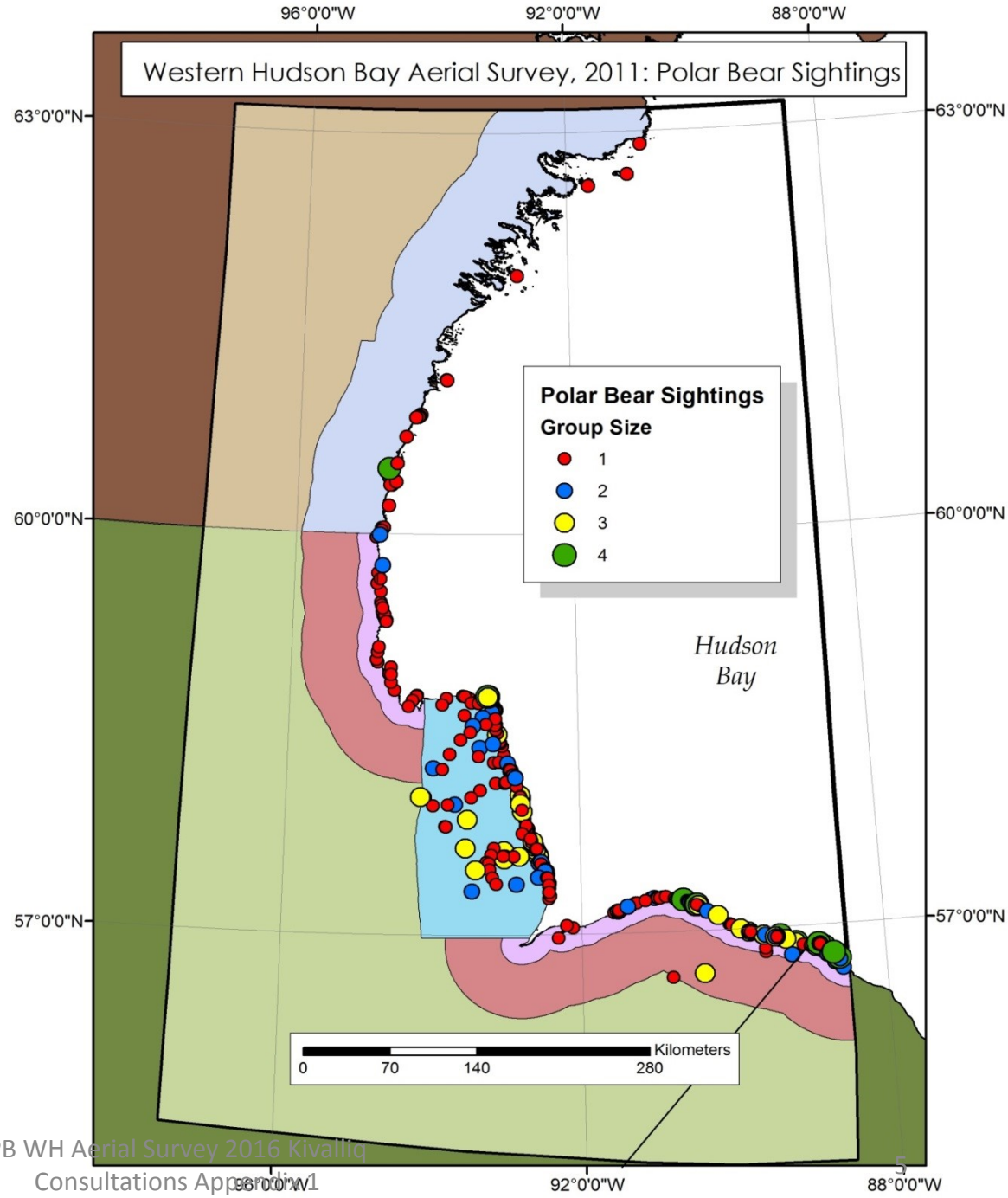
Background

- Disagreement between science and IQ
- Need for new study
  - Tried new non-invasive method = aerial survey
  - Resolve disagreement
  - Continue to monitor population to establish trend



Aerial Survey 2011: Results

- 1030 polar bears
- High densities in southeast WH
- Large portion of the population outside area where tagging studies occur
- Evidence of poor reproductive performance



Mark-recapture Studies and Sea-ice Monitoring

- Environment Canada long-term study
- Analysis of data for 1987 to 2011
- Key Results:
  - Survival linked to sea-ice conditions
  - Estimated 806 bears (in 2011)
  - Long-term declines in sea-ice and bears numbers but stability over the last decade
  - No recent trends in sea-ice or bear numbers
  - Predictions of future trend highly dependent on sea-ice conditions

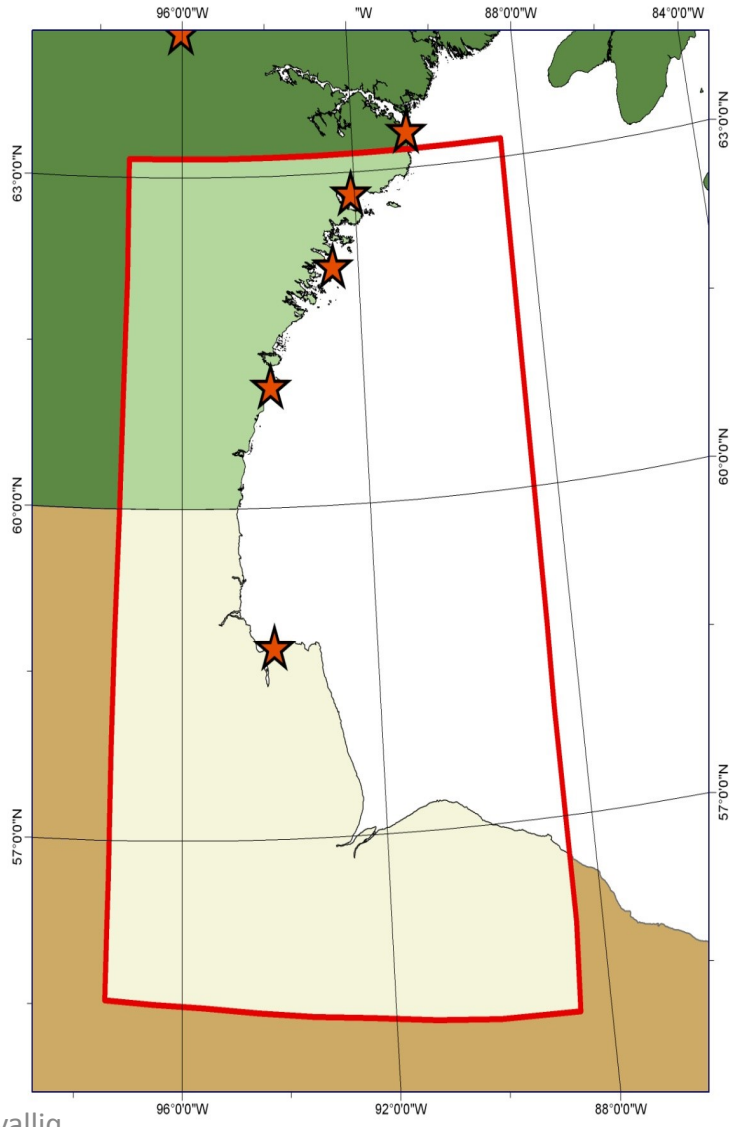
Using Aerial Surveys to Monitor WH

- Adaptive management requires more frequent monitoring
- Methods like aerial survey are well suited
- Fast, less invasive, cost effective, community involvement
- Can detect trends in populations and respond accordingly
- Scope of information limited: Trade-off

Aerial Survey 2016

Objectives:

- Estimate abundance of PB in WH
- Comparison with last aerial survey (2011)
- Evaluate as a monitoring method
- PB distribution in relation to habitat & environmental conditions where possible



Research Plans 2016

- Aerial survey
  - Alternative to tagging
  - used in 2011

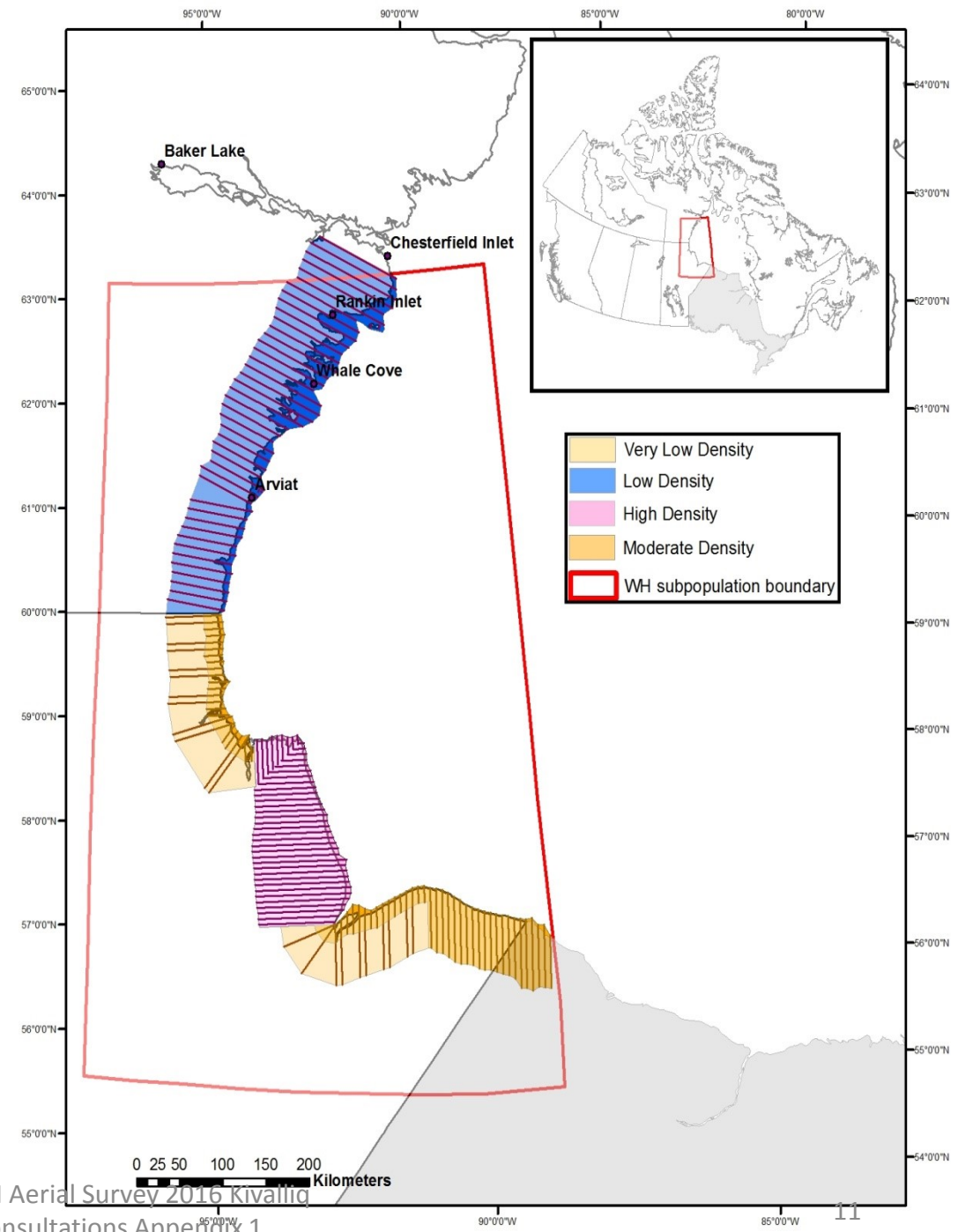
- On-going collection of IQ and hunter observations
  - HTO's, NTI, GN

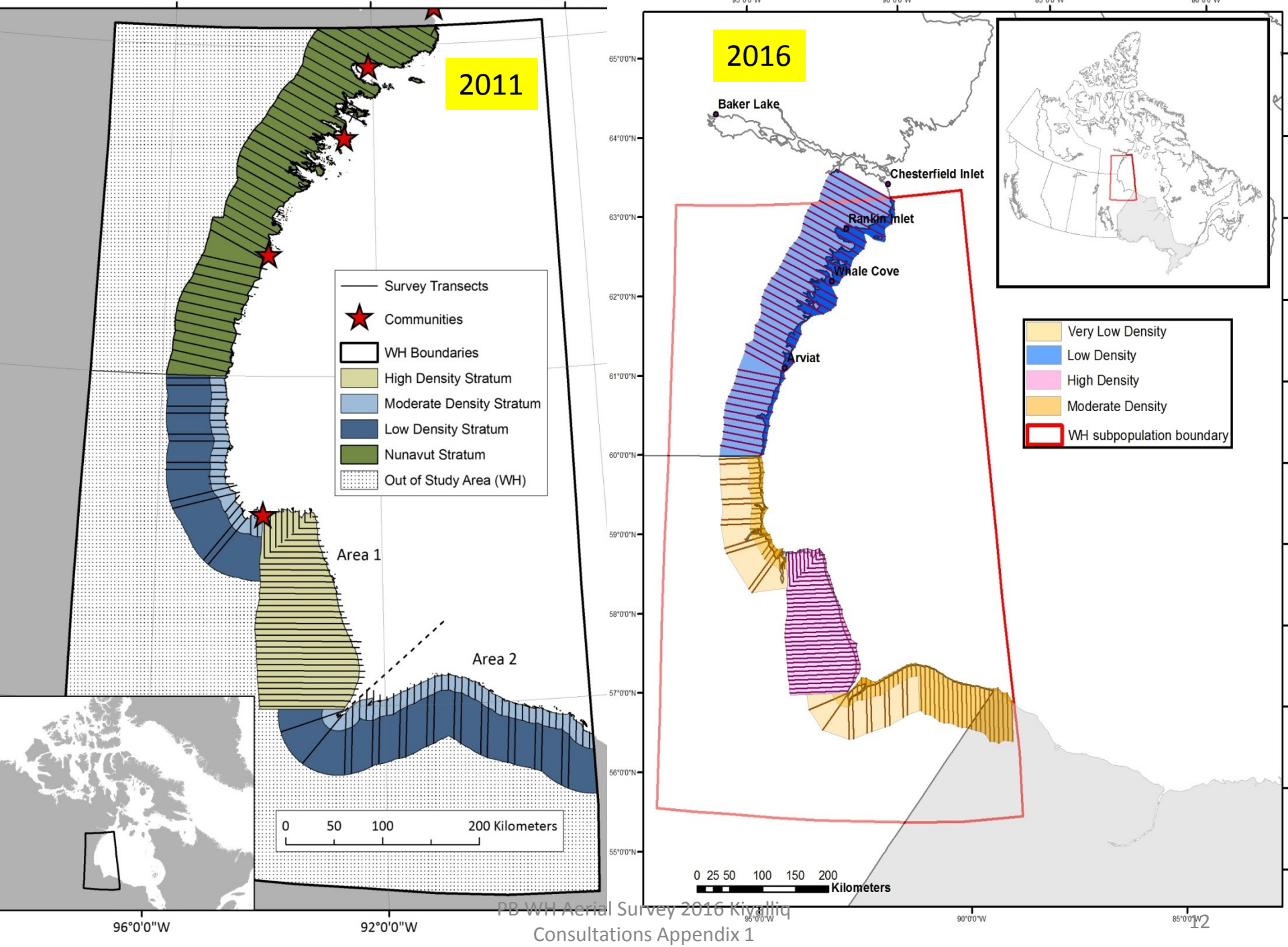
Design

Sources of Information:

- Tagging Studies in Manitoba (>40 years)
- Coastal surveys in Manitoba (>40 years)
- Movements on satellite collared bears
- Workshop with HTO members, 2010*
- Tested aerial survey in Nunavut, 2010 and 2011*

- All of this information was used to divide the study area into blocks (‘strata’) based on density of bears
- Transects extended 60-100 km inland in places and along coast




2011
Survey Transects
Communities
WH Boundaries
High Density Stratum
Moderate Density Stratum
Low Density Stratum
Nunavut Stratum
Out of Study Area (WH)
Area 1
Area 2
0 50 100 200 Kilometers
96°0'0"W
92°0'0"W
2016
Baker Lake
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
Very Low Density
Low Density
High Density
Moderate Density
WH subpopulation boundary
0 25 50 100 150 200
Kilometers
65°0'0"N
64°0'0"N
63°0'0"N
62°0'0"N
61°0'0"N
60°0'0"N
59°0'0"N
58°0'0"N
57°0'0"N
56°0'0"N
55°0'0"N
95°0'0"W
90°0'0"W
85°0'0"W

Timing of Survey: Late August

Why?

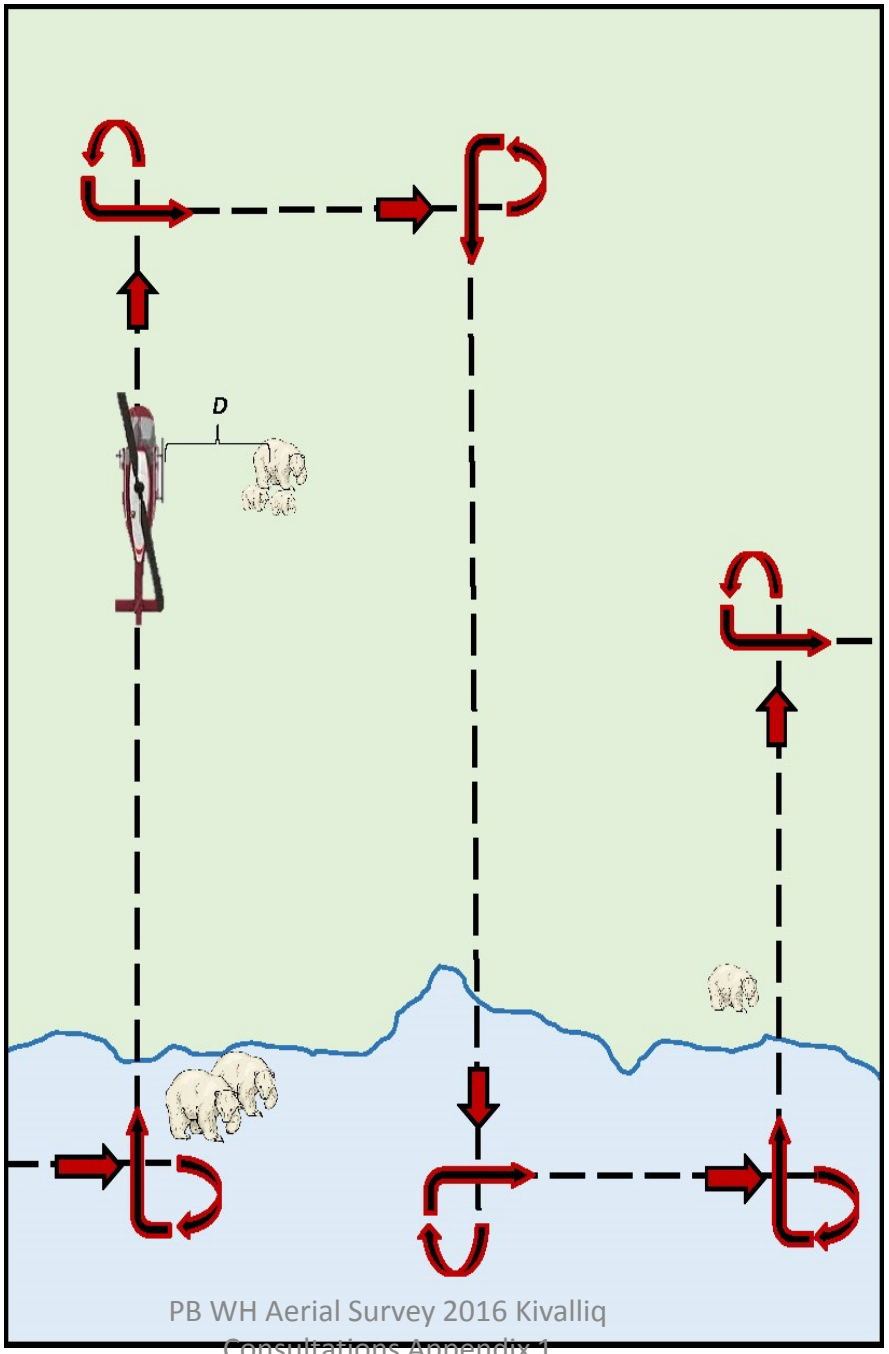
- All bears are off the sea-ice and it is before they return (e.g., concentrated on land)
- Minimize number of denned bears
- Good sighting conditions (i.e. lack of snow cover, longer days, weather, light conditions)
- Coincides usually with timing of tagging studies

How we flew the last survey

- Survey teams: Nunavut - Twin Otter (13-17 Aug 2016)
- 2 Helicopters (17-22 August 2016) in Manitoba
- 4 observers per team
- Front and back observers working independently
- Recording type and location of bears seen, habitat

flying transects

flying transects



Challenges

- Islands and offshore waters
- Tidal flats

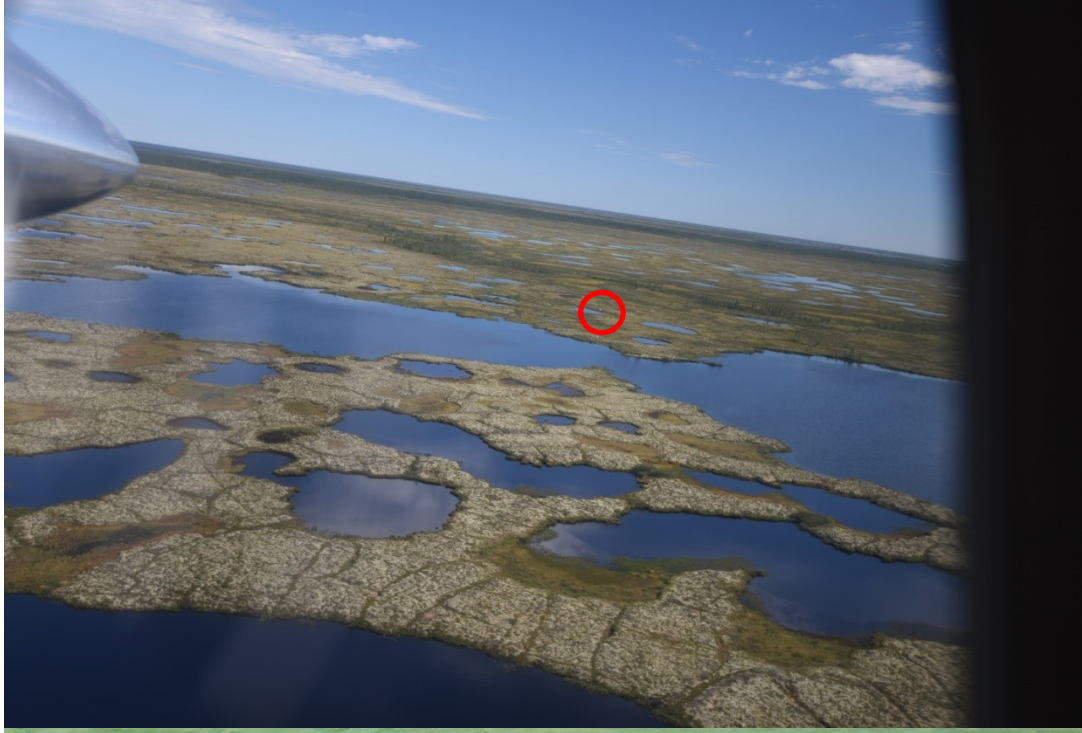
Challenges

- Vegetation

- Glare

Challenges

- Vegetation



Challenges

- Denning


Nunavut Wildlife Management Board


Nunavut


Environment
Canada


ONTARIO
Ministry of
Natural Resources


Manitoba
Conservation

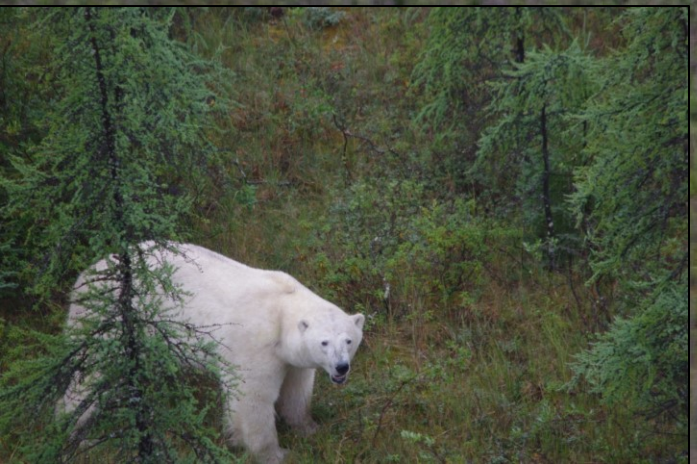

Parks
Canada
Parcs
Canada

Results

- Survey flown August 12 – 22nd
- More than 130 hours of flying
- Over 9500 km of inland transects flown plus extended over water

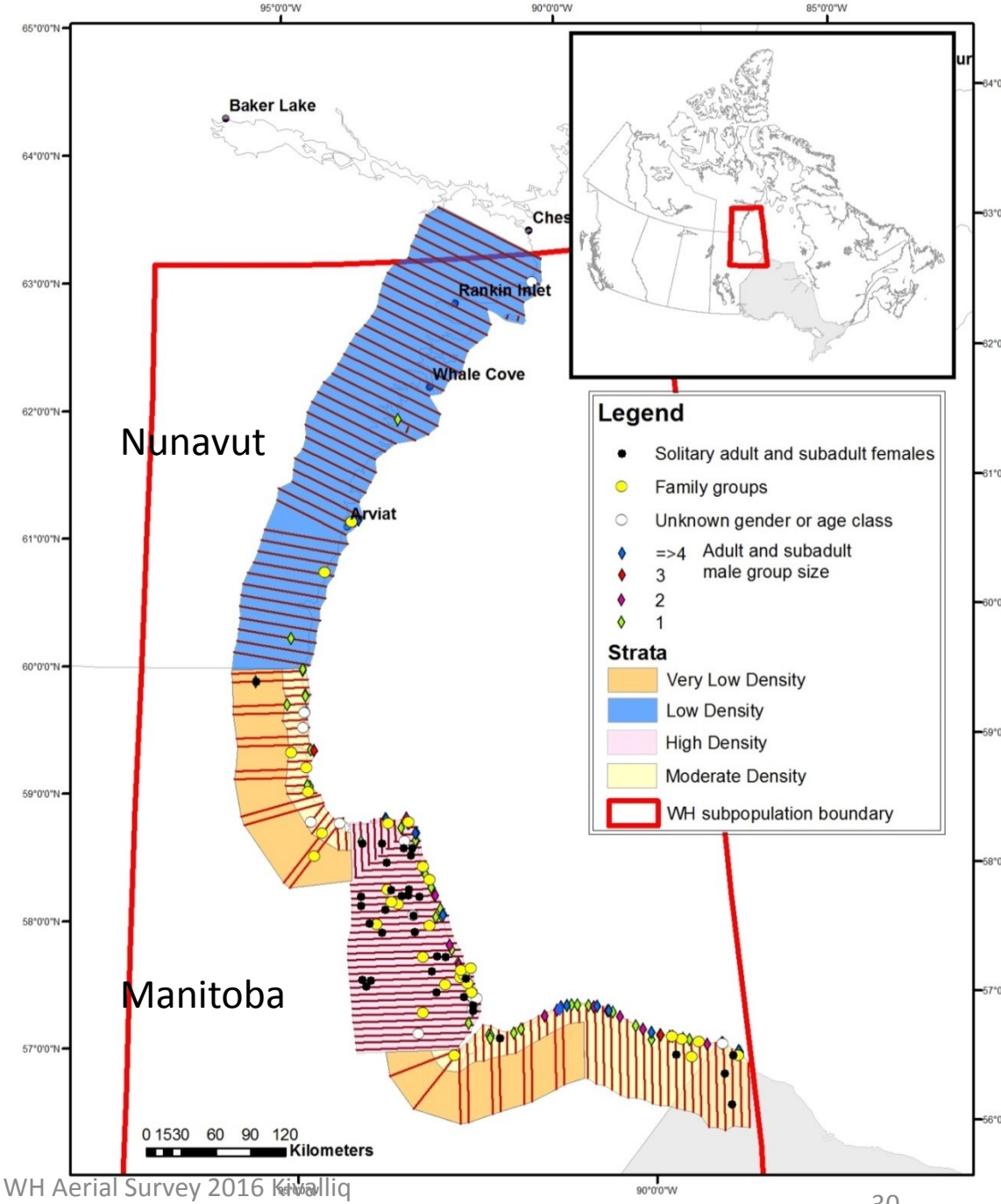
Participants

- Mitch Campbell, Kelly Owlijoot, M. Dyck (GN Dept. Of Environment)
- David Lee, Robert Karetak (NTI)
- Leo Ikakhik (Arviat HTO)
- Louis Tattuinee (Rankin HTO)
- Daryll Hedman, Vicki Trim (Manitoba Conservation)
- Kevin Burke, Chantal Ouimet (Parks Canada)



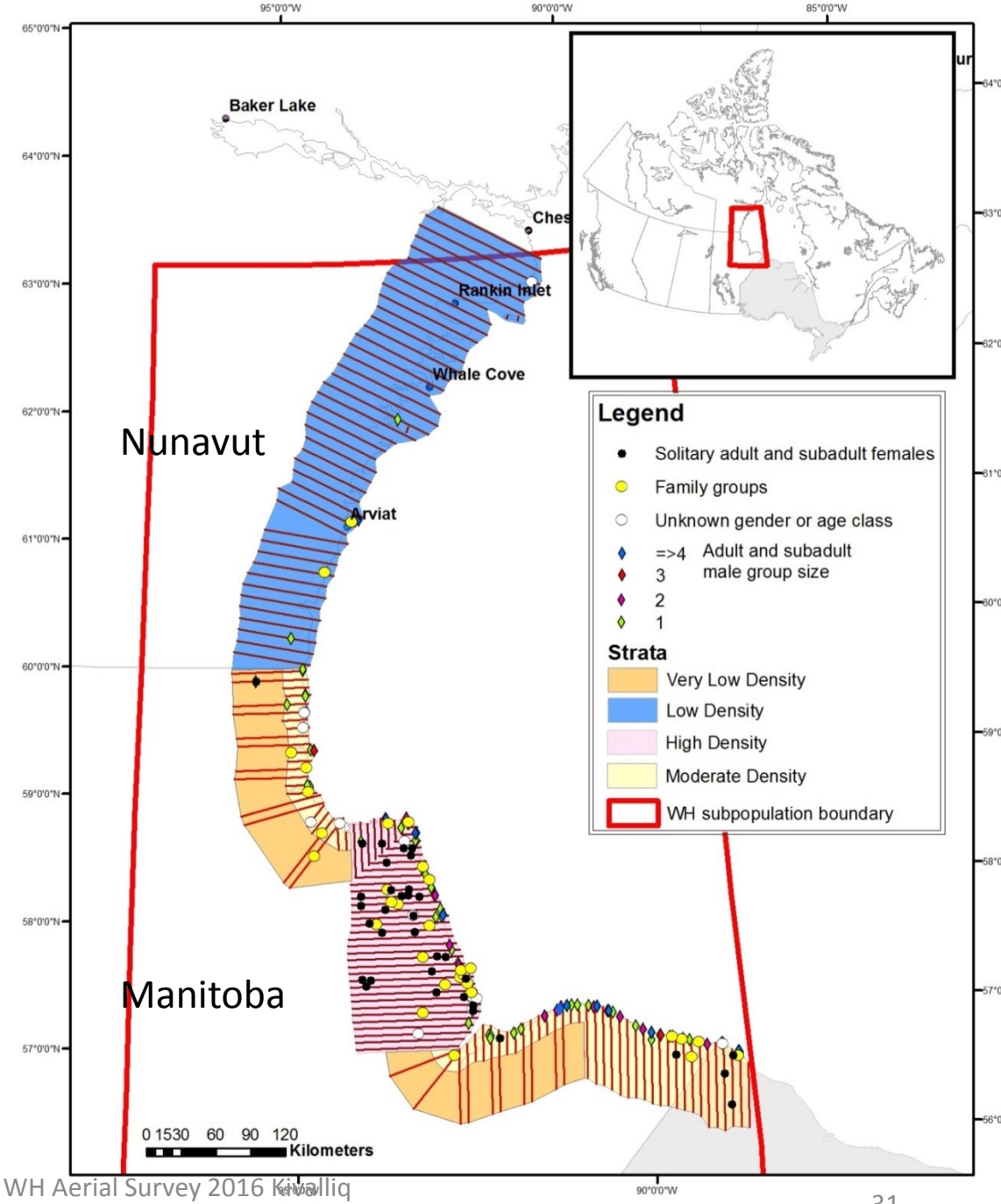
Results

- 339 polar bear sightings
  - 18 in Nunavut
  - 321 in Manitoba
- Groups of 1 to 11
- Includes swimming bears



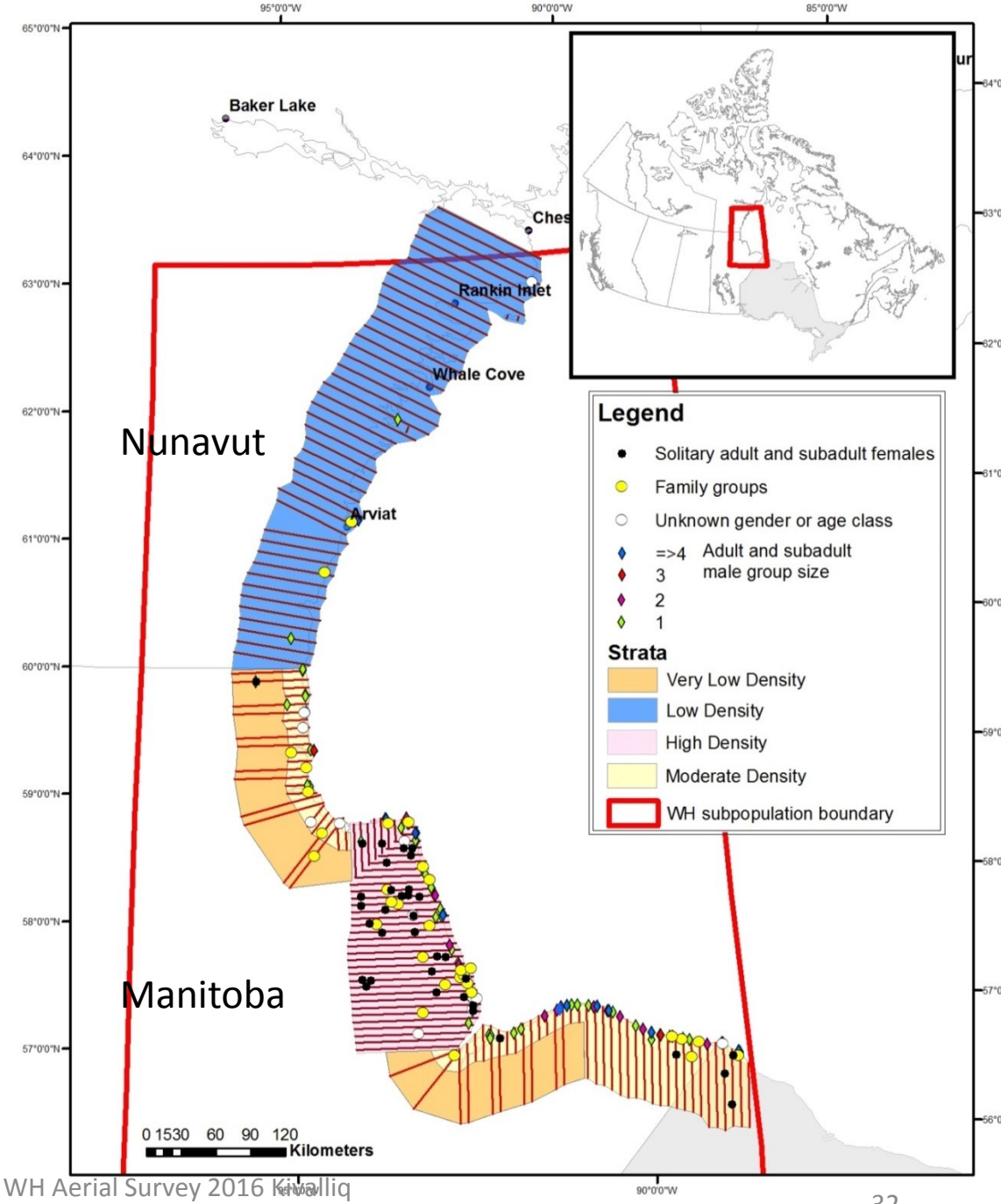
In Nunavut

- Distribution similar to 2007, 2010, 2011
- Low densities during August
- Most bears south of Arviat (coast, islands)



In Manitoba

- Distribution similar to previous studies
- Over 80km inland in Wapusk (family groups, pregnant females)
- High density in southeast WH (many adult males)



Subpopulation	Litter size		Proportion of total observations		Source
	COY	YRLG	COY	YRLG	
Western Hudson Bay (2016)	1.63 (0.10)	1.25 (0.16)	0.11	0.03	GN (unpublished data)
Western Hudson Bay (2011)	1.43 (0.08)	1.22 (0.10)	0.07	0.03	Stapleton et al. (2014)
Southern Hudson Bay (2011)	1.56 (0.06)	1.49 (0.08)	0.16	0.12	Obbard et al. 2015
Foxe Basin (2009-2010)	1.54 (0.04)	1.48 (0.05)	0.13	0.10	Stapleton et al. (2015)

Western Hudson Bay has some of the lowest yearling litter sizes recently recorded in Hudson Bay, and low proportions of offspring

Body Condition

- Variable across WH
- Best body condition in southeast WH

2016 Estimate of 842 bears (95% CI: 562-1121)

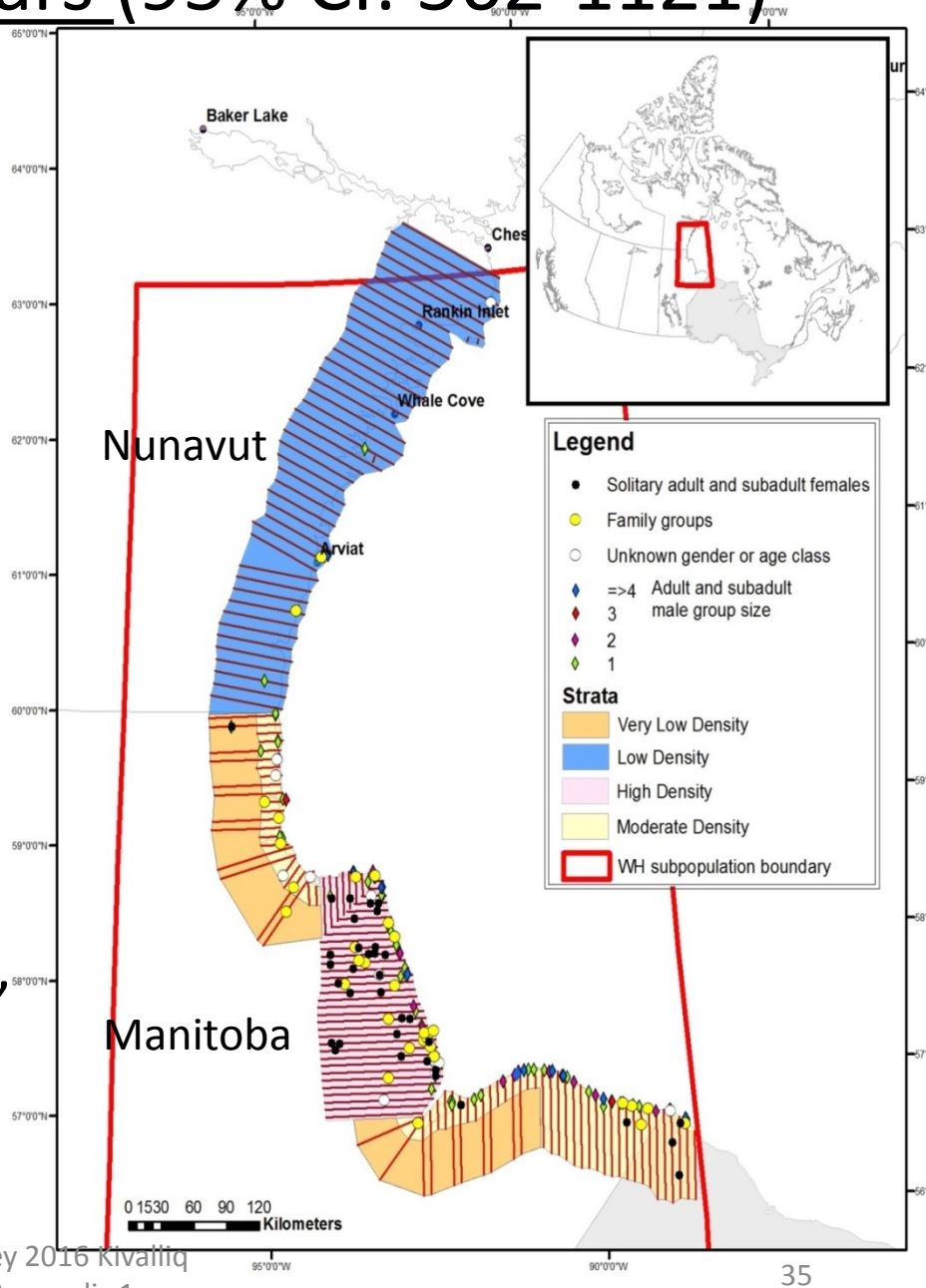
Precision

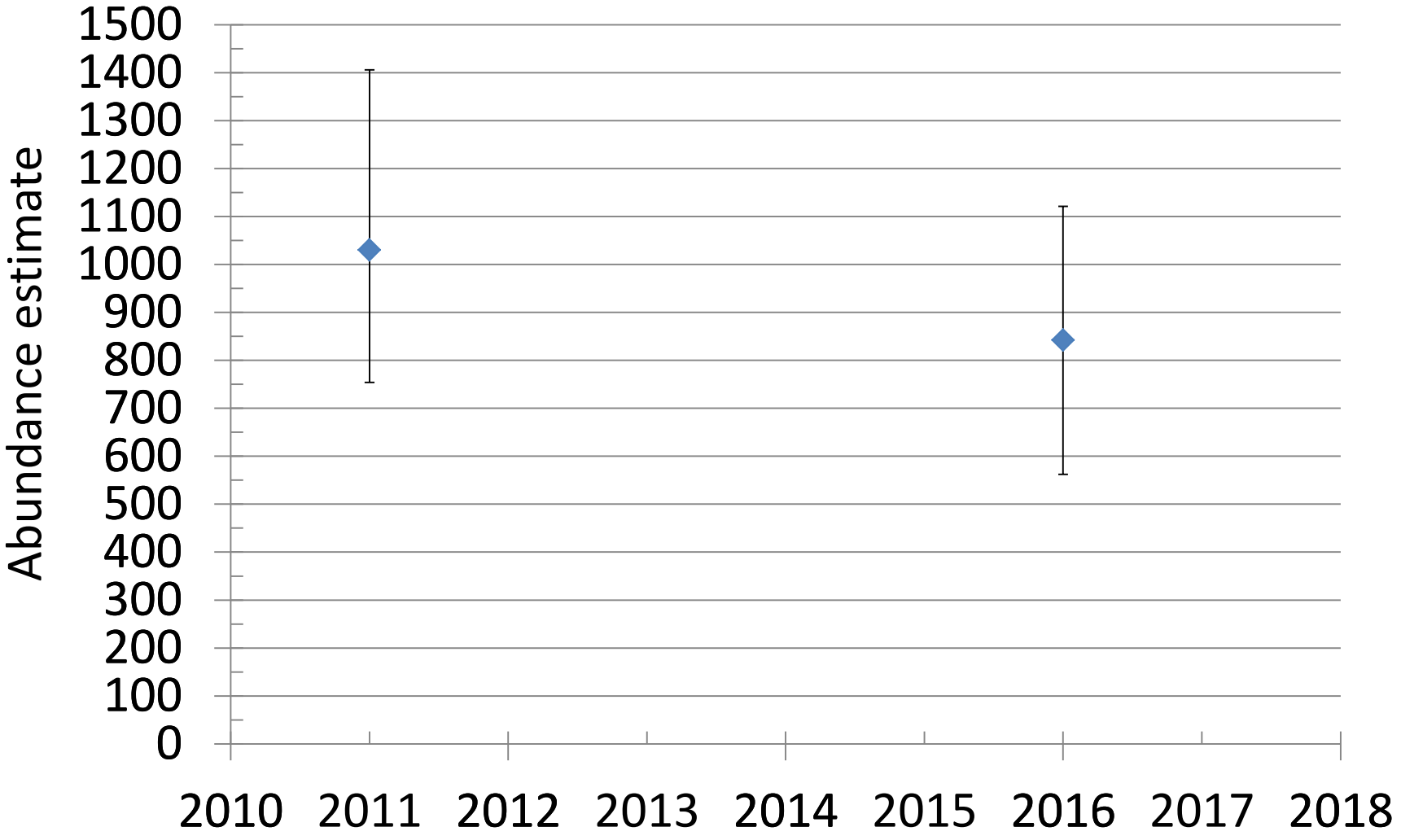
- Met expectations
- Coefficient of Variation = 16.9%

Accuracy

- Near 100% detection on transect
- Bears outside study area
  - Far inland bears (unlikely)
  - Swimming bears
- Other factors: Dens (checked all), habitat (trees)

- Tendency to underestimate abundance




Abundance estimate
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
Year of survey

Summary

- Estimated 842 bears in 2016 (August) (not sig. different than 2011 study)
- Low densities and distribution in Nunavut during August consistent with 2 previous studies
- Majority of bears are in Manitoba during August
- 2016 aerial survey estimate similar to 2011 estimate

Summary

- Evidence of low offspring production in 2016 as in previous aerial survey study

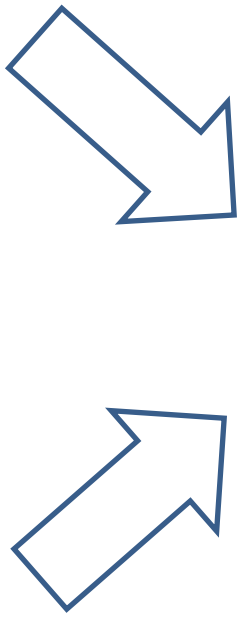
- Body condition variable across WH

Next Steps

Further analyses:

- Comparison between aerial survey & future mark-recapture?
- Comparison with 2016 aerial survey in SH

Collect more available IQ

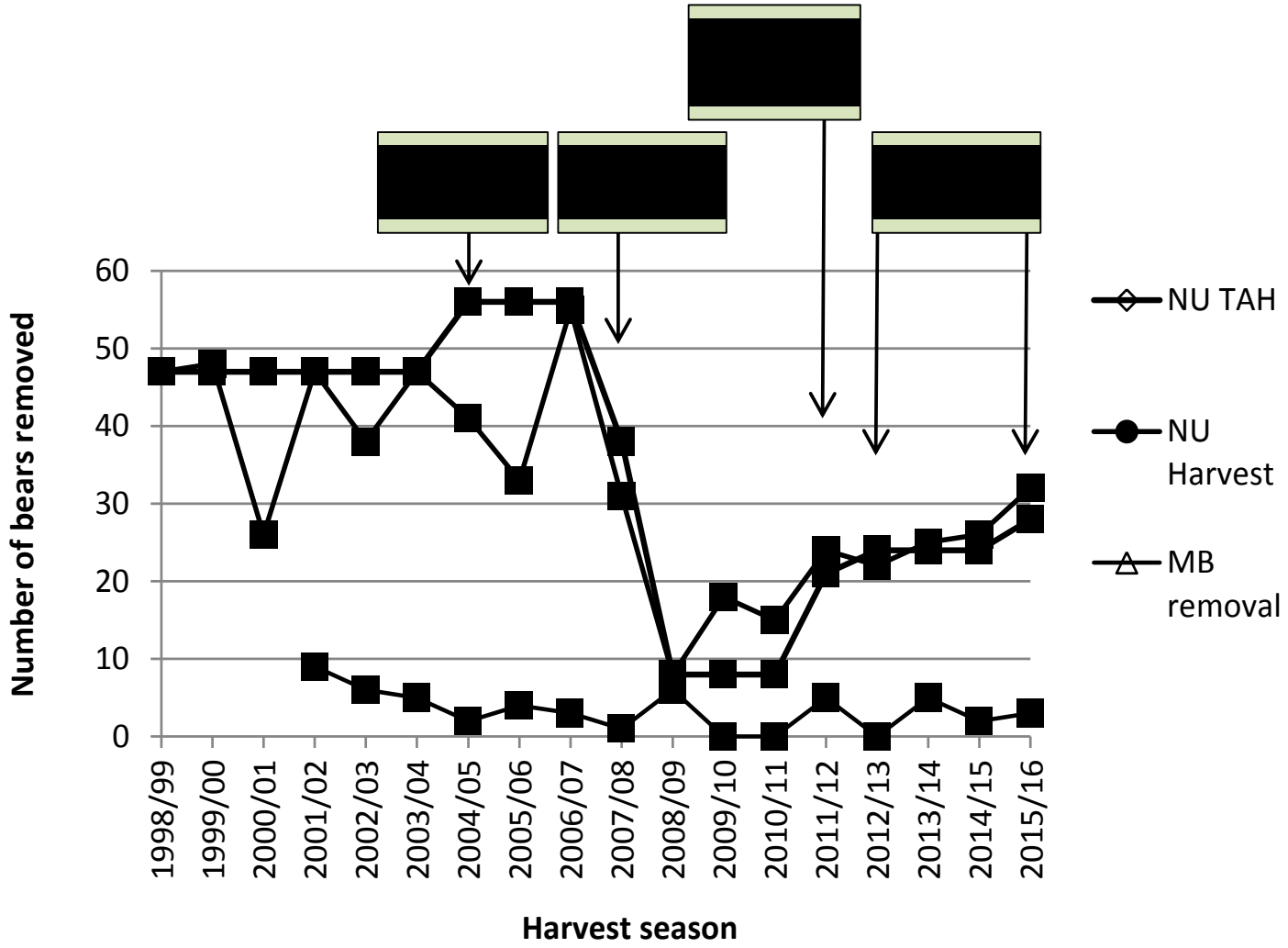


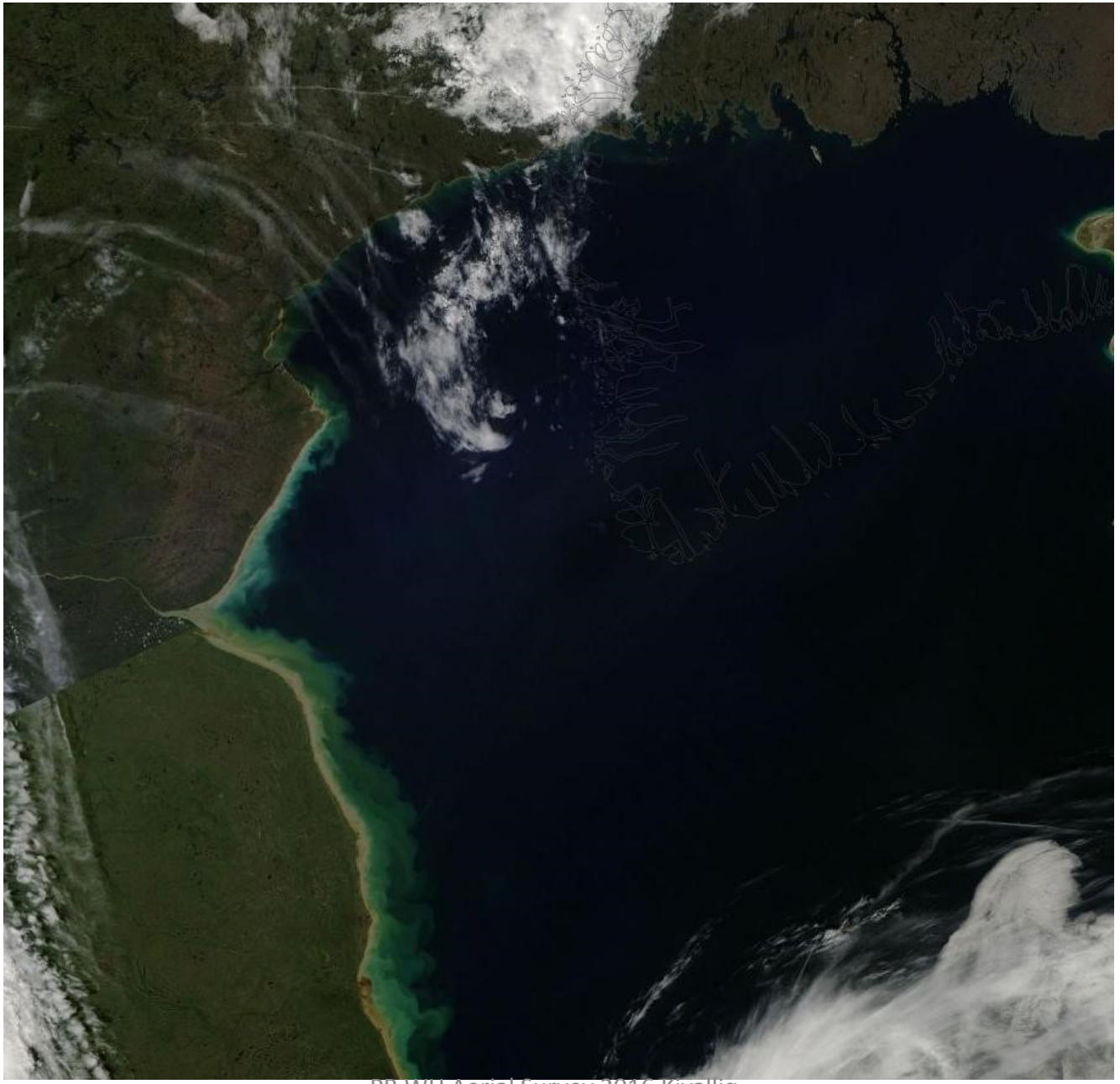
Sea ice monitoring

Assessment of status

Thank you – Questions?

Explanation of variation and estimate


Number of bears removed
60
50
40
30
20
10
0
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
2008/09
2009/10
2010/11
2011/12
2012/13
2013/14
2014/15
2015/16
Harvest season
NU TAH
NU Harvest
MB removal



CONSULTATION SUMMARY NOTES FOR THE 2016 WESTERN HUDSON BAY POLAR BEAR AERIAL SURVEY COMPILED DURING MEETINGS CONDUCTED BETWEEN 4-7 JULY 2017

1. **Rankin Inlet**
   Date: 4 July 2017
   Time: 19:00 – 21:00

   Present: R. Harmer, GN, Regional Manager Kivalliq
   J. Coutou, GN, Conservation Officer, Rankin Inlet
   M. Dyck, GN, Polar Bear Biologist II
   Nigel Kubluitok, Secretary, Rankin Inlet HTO
   Clayton Tartak, Secretary (temporary), Rankin Inlet HTO
   Raymond Mercer, NTI
   Robert Karetak, NTI
   Qovik Netser, KWB Representative
   - **No HTO Board members present –**

   a) M. Dyck welcomed everyone to the meeting, and also explained that the timing is likely not the best because many board members will be out on the land and a meeting during October would have been much better. However, the Minister thought this was a high priority to report back the results from the 2016 survey, and so we are here to do just that. M. Dyck presented the current status of the western Hudson Bay (WH) polar bear population, i.e., what is currently known from a scientific perspective. The presentation (attached in English and Inuktitut) included a background of the scientific findings up to 2015, why a new study is needed, what the basis was for the new aerial survey, how it was designed, what information was used to design it, how it was conducted, and what the results were of this study. The presentation also included the position of the GN on the current status of WH polar bears, i.e., that the population appears to be stable and the GN currently does not support an increase in the TAH.

   b) Questions that arose from the presentation:
      i) Q: R. Mercer: Do you think there is a concern with this population currently?
      A: M. Dyck: The population appears to be stable based on the new aerial survey results where we could not detect a significant difference between the last survey from 2011 and the current one from 2016. However, as in the previous aerial survey and

other previous ECCC studies, the reproductive performance of the population is poor compared to other Hudson Bay complex polar bear populations (see Table in ppt presentation). There are few coys surviving into the yearling stage. ECCC also documented that body condition, survival and reproduction has been decreasing for many years in this population. Abundance-wise the population appears to be stable, but something concerning is going on regarding the reproduction. Ongoing monitoring of this population is needed as well as sea-ice monitoring for the future.

ii) Q: Nigel: I heard there is some tagging going on?
A: R. Harmer/M.Dyck: There is a PITT tagging program going on for polar bear hides to monitor export and identity of the population where bears were harvested – that is a collaborative program between ECCC and the GN. In addition, ECCC and the University of Alberta is putting out satellite ear tags in Manitoba to monitor and examine male polar bear movements and how they are distributed during freeze up.

iii) Q: Nigel: When will the next survey be?
A: M. Dyck: Ideally we want to survey every 3-5 years. If intervals are too large between aerial surveys then all the investment in previous surveys was for nothing so we need to maintain a rigorous monitoring schedule. I will make sure that we can have the next survey in 2020 for WH.

iv) Q: R. Mercer: If we wanted to conduct a coastal survey in Nunavut like Manitoba does, how much would it cost?

A: M. Dyck: I think that with about 10-15K we could cover most of the coastal area, and it would be a great effort to collect this information over the next few years, in addition to traditional knowledge, to examine fall distribution of bears in Nunavut. We could get money from the GN, and likely NWMB, and maybe the RWO to apply together to secure funding.

Meeting adjourned around 21:30
Notes by M. Dyck

2. **Whale Cove**
   Date: 5 July 2017

Time: 19:00 – 21:00

Present: Rob Harmer, GN, Regional Manager Kivalliq
Markus Dyck, GN, Polar Bear Biologist II
Eva Voisey, Whale Cove HTO
Shirley Kabloona, Whale Cove HTO
Martha Arualak, Whale Cove HTO
Chris Jones, Whale Cove HTO
Robert Enuapik, Whale Cove, HTO
Raymond Mercer, NTI
Cheryl Wray, NTI
Nick Arnalukjuaq- KWB Representative

a) M. Dyck welcomed everyone to the meeting, and also explained that the timing is likely not the best because many board members will be out on the land and a meeting during October would have been much better. However, the Minister thought this was a high priority to report back the results from the 2016 survey, and so we are here to do just that. M. Dyck presented the current status of the western Hudson Bay (WH) polar bear population, i.e., what is currently known from a scientific perspective. The presentation (attached in English and Inuktitut) included a background of the scientific findings up to 2015, why a new study is needed, what the basis was for the new aerial survey, how it was designed, what information was used to design it, how it was conducted, and what the results were of this study. The presentation also included the position of the GN on the current status of WH polar bears, i.e., that the population appears to be stable.

b) Questions that arose from the presentation:
    i) Q: Eva Voisey: How can you tell if it is a male or female from the air?
    A: M. Dyck: We tested this in the Baffin Bay but it is difficult. The males are easy to spot as they have distinctive features like larger necks and scars on their faces. We are flying 300-400 feet up and we take the GPS location, then we go to about 100 feet, take a picture and can tell the differences. But there are times, when we don't know the sex of the bear and we do state that.

    ii) Q: Rob Harmer: how far inland is that photo taken (slide 18)?
    A: M.Dyck: I can't remember specifically but around 30-40 kilometers inland.

iii) Q: Nick Arnaklujuaq– I don't see any partners that include HTO's? Why don't we include that on our slides?
A: M. Dyck: This slide only includes organizations that provided financial assistance and fuel. We did include the HTO's during consultations and I can add a slide that shows the HTO's that were involved. I have to apply for funding from a lot of different organizations and that is what I am trying to convey here.
A: R. Harmer: I just want to add that we are in no way trying to be disrespectful and not listing the different individuals or HTO's. We do not in any way under value the contributions of individuals or HTO's and we realize the importance and that is conveyed to upper management.

iv) Q: Chris Jones: Did you mention that there was a concentration of family groups in Manitoba? In Coral Harbour the females with cubs would always stay away from the big males.

v) Q: Are the transects 7 km apart? Maybe the transects are too far apart to get an accurate count?
A: M. Dyck: We designed the study so that the transects were closer in areas where we knew the densities were higher. It wouldn't make any difference if we spaced the transects closer, as there just are not more bears. Having transects closer in some areas would not mean that we find more bears – the effort was already maximised considering density of bears and costs involved. We need to work closer together with communities and HTO's to determine when the best time of the year to survey.
Chris Jones: Our problems are in October to December when we see a lot more bears, and what we think is happening that a greater proportion of bears from Manitoba are moving into Nunavut.
Markus: See that is very interesting as this is the first time I have heard that there are proportionally more bears moving up and not just an increase in the population overall.

vi) Markus: Q: Have you seen a change in the sea ice freeze-up patterns here? Maybe ice freezers here sooner than in Churchill and that is why bears move into Nunavut faster in higher

numbers. We need to collect that information. When did you see a change in bear numbers occurring in your community?
Eva/Chris: In the 60s and 70s there were very few bears around and people were on the land in spring or summer and did not see bears. In the 80s that started to change and more bears were seen. Usually the number of bears in Whale Cove seems to be higher in October before freeze-up.
Markus explains also that between the 1800s and early 1900s about 55K polar bears were harvested by explorers and whalers, and not many bears were suspected to be left across the arctic, that is why the international agreement was put in place – to contribute towards conservation. But also the tourism industry in Churchill began and by the mid 1990s it was in up-swing – there are bears habituated to tourism, the Ladoon dog yard, and other activities, and maybe all these combinations lead to have more bears showing up in Nunavut during early fall. We need to collect the IQ that is out there, and try to get genetic samples of all bears that are frequenting the communities, and then compare that to the ECCC data base which will allow us to find out the history of each bear in communities where it is know. Then we can hopefully explain better why there are more bears in Nunavut, and how we can manage that situation. I have brought this issue up with Manitoba several times, and I think they are seeing this more now as a concern and are willing to collaborate on that topic.

vii) Chris Jones: Maybe we can use the biopsy darts as part of our deterrent and help collect the information.
Markus: we should discuss this and if the HTO is willing to do this, then I think that would be great.

viii) Eva Voisey: I think the climate change has a lot to do with impacting the bear populations. Also when we have the bear problems; they are used to people from being habituated in Churchill.
Markus: I did research this in Churchill and I think that the tourism has allowed habituation and conditioning and now Nunavut is paying for it.
Chris Jones: Deterring bears has changed dramatically in that they are not scared anymore.

Chris Jones: there is a trail that the bears use to move around Whale Cove.
Rob Harmer: Have the conditions of the bears changed?
Chris: we had an older male last year. We have a lot of bears in town. Female with 2 cubs under the houses.

ix) Eva Voisey: I don't understand this quota thing? Why does it come from America?
Markus/Rob: I think you are talking about CITES and the trade of the hides.
Eva: it's not only humans that kill the bears. It's also contamination from plastics etc.

x) Chris Jones: When is the next time you'll be in the communities?
Markus: My plan is to conduct the next survey in 2020. But that is also dependent on where the community concerns are. We are traveling to all the WHB communities to provide updates. We need to keep up a regular interval with the surveys as it makes the data set stronger. We can detect a change if we maintain a rigorous survey interval.

xi) Chris Jones: do you guys regularly count the bears in Arviat?
Rob: we have a couple of employment positions that are bear monitors and keep track of wildlife sightings.
Markus: We can work with the communities as we have darts that will take a sample but also colour it so you can keep track of what bears are moving through.

Meeting adjourned at 21:30

Notes by Cheryl Wray

3. Arviat HTO

Date: 6 July 2017
Time: 19:00 – 21:00

Present:
Rob Harmer, GN, Regional Manager Kivalliq
Markus Dyck, GN, Polar Bear Biologist II
Joe Savikataaq Jr., GN Conservation Officer
Thomas Alikaswa, Arviat Vice-Chairman HTO
Ludovic Issumatarjuak, Arviat HTO
Gordy Kidlupik, Arviat HTO
Angelina Suluk, Arviat HTO
Sam Garry Muckpa, Arviat HTO
Jamie Kablutsiak, Arviat HTO
Bert Dean, NTI
Robert Karetak, NTI
Raymond Mercer, NTI
Cheryl Wray, NTI
Nick Arnalukjuaq- KWB Secretary/Treasurer
Stanley Adjuk – KWB Chairperson
Mary Issumatarjuak, HTO Office
Bobby Suluk, Interpeter

a) M. Dyck welcomed everyone to the meeting and presented the current status of the western Hudson Bay (WH) polar bear population, i.e., what is currently known from a scientific perspective. The presentation (attached in English and Inuktitut) included a background of the scientific findings up to 2015, why a new study is needed, what the basis was for the new aerial survey, how it was designed, what information was used to design it, how it was conducted, and what the results were of this study. The presentation also included the position of the GN on the current status of WH polar bears, i.e., that the population appears to be stable and the GN would not recommend an increase in TAH.

b) Questions that arose from the presentation:
   i) Q: Markus: One of the questions I asked the other HTOs was when do you see these bears coming into the communities? Also is there a difference in when the bears would show up historically vs present day? I believe that if we work together and partner western science and IQ that we can get a better idea of when the bears pose problems to the communities to keep people safe.

   ii) Q: Gordy – Can we share this information with the public with people in our communities?

A: Markus: Yes this information is public to Nunavut right now, but when I get back to Igloolik next week I will share the information with Manitoba, Parks Canada. It has also been shared with NWMB.

iii) Q: Sam: For aerial surveys would it be possible during the migration to conduct surveys during that time of the year? We hear that sometimes 20-30 bears are moving by the community.
A: Markus: What I think we could is during the fall time is to conduct a coastal survey. Manitoba conducts a survey during the fall down to the Ontario border. What I think we should do in Nunavut is that we survey north of the border and see how many bears up during this time frame. I think we should think about this. In order to time this right, we can discuss with all the HTOs as to when a good time would be. The other option is that we can genetically biosample bears, I think we could do this throughout the community. Joe is already helping with this. But we can compare the genetics of the bears moving by the community to what ECCC has and learn the history of these bears then we will be able to determine if bears had past encounters with humans, the dump in Churchill and whether this contributes to bears near communities. If there are bears that have been captured before we can compare the genetics to what ECCC has and learn the history of this bear such as if it was captured in Manitoba. Myself and some other HTOs think is that some of these bears that have been conditioned in Churchill could possibly be bears that are coming into our communities here in Nunvaut. We don't know this, but the genetics could tell us a story. I also have darts that can mark a bear with colour as well as take a biopsy. This could actually help us monitor if it is a bear that is returning or different bears moving through. We have some options and we should discuss this further.

iv) Q: Gordy: We need to keep in mind that the bears we see here will be in another community in a couple of weeks. Maybe October is a good month to conduct the surveys. They will be here and then in Whale Cove in a couple of weeks.

v) Q: Markus – have you seen a change in the sea ice in the last 15-20 years in freeze up? By knowing all these different pieces of the puzzle, we can figure out how the bears are moving and whether they are coming from the Churchill area. Churchill now has a weir and perhaps that can play a factor in how the ice freezes now in that area and that could be a contributing factor.

vi) Q: Thomas: There is a difference between thin bears and large bears that spend more time on the ice and that thin bears have been walking for miles. It's not because they can't hunt, it's because they have been walking for a long time. The second point is that I don't believe that there is a decrease in the numbers but rather there are bears further out in the ocean.
A: Markus – thanks for your comments and observations.

vii) Q: Ludoric: The elders used to say that the populations were quite low in the past and have witnessed that there weren't many bears in the past as I am a hunter. I also support what my colleague Thomas is saying in that the bear population is not declining but rather is a lack of food and they are walking farther. It's not possible to stay in tents in the summers anymore as there are so many bears.

viii) Q: Markus – we heard in Whale Cove that in the 60's there were fewer bears and then in the 80's the numbers started to increase. Is this what you have seen as well?
A: Ludoric: Yes I agree with what Whale Cove has said that we are now seeing more.
Q: Robert – is that around the time that Churchill closed their dump?
A: Markus: the military was killing a lot of animals when they were in Churchill and the bears have had time to rebound and maybe that's why we are seeing more as there is now a quota system. Bert: the mid to late 80s hunters from Rankin would come down to Arviat and Churchill to harvest bears as there weren't many in the Rankin area. Even in the early 90s, Rankin wouldn't even fill their quota.
Ludoric – I remember this time well.
Rob Harmer/Markus – between 1890's and 1930's there were about 55K bears killed in Canada by whalers and explorers

were killing many bears. This is the time when Governments became concerned that the number of bears were declining. Ludoric – I can remember this lady from Rankin was speaking about the number of bears harvested and they were declining.

ix) Q: Jamie – When should we as people from communities expect to get our TAH's back? Can you take this back to the GN that we want to see our quota increase to where it was previously?
A: Markus: The population estimate that we have now is stable. The Government's position now is that there is no increase in TAH as the population is stable. I can take that request back to my Director and see if there is a way to even out the credits and overharvests to get back to the original TAH. Bert – The NWMB is going to be doing a public hearing in the fall on the Polar Bear Mgmt Plan and your HTO will send someone to this meeting. This meeting will allow a discussion as to how the populations can be managed. I think it is worthwhile to start thinking about a workshop to discuss the Mgmt Plan as we are hearing from a lot of communities that public safety is a huge issue.

x) Q: Gordy: During the 50/60s to the 90s, Tommy had noticed that the bear numbers were increasing and people were starting to get scared and wanted him to harvest it.

xi) Q: Thomas: When you conduct your surveys, how far inland do you go and how do you decide that? We have seen bears about 120 miles inland at a caribou outfitting camp.
A: Markus: That would have been good information to have so we could survey in those areas. When we discussed this initially during the consultation for the design this did not come up.

xii) Q: Thomas – we travel inland on quad and have seen bears and those bears aren't counted?
A: Markus – we have surveyed from between 80-120 km's inland. If there are any locations that you have during the summer months where you have seen bears that far inland. Can you please report those areas to the CO so we can search

that area for the next survey. That's important information to know as it would help us.

xiii) Q: Ludoric: I have heard guide/people talking about seeing bears in a sports camp at a caribou camp 120 miles inland.
A: Markus – We hope to have a lot of this information for our next survey so that we can search better if we need to go inland.

xiv) Q: Sam Garry – in 2007 my grandfather mentioned that almost every night there was a polar bear encounter at a sports camp near Dianne River.
Ludoric – I have also witnessed that as I have helped the sports hunters for bears. I have also heard from my ancestors that some bears could be spending their entire life cycles in the ocean. They have even stated that the bear's eyes are red because they are so large.

xv) Q: Raymond: In Whale Cove they said they are seeing a lot of seals. I am wondering if this is the same in Arviat?
A: Sam Garry – boating near Century Island we noticed a lot of seals. A lot more seals than we have seen.
Ludoric – there does seem to be a lot more seals.

xvi) Q: Rob – Can there be some sort of agreement that maybe bears are more comfortable around humans now. Do you guys feel that they might be too comfortable with us now due to them becoming conditioned and used too our deterrence efforts? Could that be a possibility as to why we are having more occurrences because they're becoming more bold and have lost their fear of humans?
A: Ludoric: Nodding head. Gordy: I believe that it is more about finding food. I think the bears know that they can access food near the communities. Andy Derocher showed me a graph as to when the bears started declining and it was around when we say more around the community and it occurred to me that they were looking for food near our communities.
Rob: What we think is that bears are coming up from Manitoba and they aren't scared of people anymore due to Manitoba's deterrence program; so when they get to Arviat or Whale Cove

they aren't affected by rubber bullets, or bangers, etc. and aren't deterred anymore. Manitoba had a serious problem bear last year and notified us that this bear would be a problem for us, but fortunately that bear moved onto the ice before it got here.

xvii) Q: Ludoric: I have heard that because the garbage is now managed at Churchill that they are going after our dumps because the food is available there.
Robert Karetak: There was a workshop conducted on wildlife deterrents in Churchill and we want to have another workshop like that. If there was funding they thought they might hold a workshop in Arviat or Rankin. There was a final report issued on the workshop and I can forward that to you.

Nick: closing remarks. Nick thanked the GN for the presentation about the results, but he does not agree with the survey results and we need to conduct new surveys in the future. When it comes to animals, it's like every single result was never positive and constantly lowered and that impacts Inuit. To the Inuit this is not justified. If we did not have defense kills, our quotas would be fine. In the long run, I would like to see effective communication and build on our relationship between RWO/HTO and the GN. With powers and authorities we need to be able to manage our wildlife populations with the government. We need to continue and maintain the surveys as we want accurate numbers as we know that populations will stabilize. So we want the IQ and western science to work together.

Meeting adjourned at 22:00

Notes by Cheryl Wray

4. **Chesterfield Inlet**
   Date: 7 July 2017
   Time: 17:00 – 19:00

   Present: Rob Harmer, GN, Regional Manager Kivalliq
   Markus Dyck, GN, Polar Bear Biologist II
   Harry Aggark, Chesterfield Inlet HTO
   Leonie Mimialik, Chesterfield Inlet HTO
   Patrick Putulik, Chesterfield Inlet HTO
   Jerome Misheralak, Chesterfield Inlet HTO
   Simon Aggark, Summer Student, Chesterfield Inlet GN
   Bert Dean, NTI
   Raymond Mercer, NTI
   Cheryl Wray, NTI
   Robert Karetak, NTI
   Nick Arnalukjuaq- KWB Representative
   Jennifer Sammurtok – Interpreter
   Peter Kattegatsiak Sr. – COII, GN-DOE
   NO BAKER LAKE HTO BOARD MEMBERS PRESENT (travel arrangements were made for 2 members which did not show up for the meeting)

a) M. Dyck welcomed everyone to the meeting, and also explained that the timing is likely not the best because many board members will be out on the land and a meeting during October would have been much better. However, the Minister thought this was a high priority to report back the results from the 2016 survey, and so we are here to do just that. M. Dyck presented the current status of the western Hudson Bay (WH) polar bear population, i.e., what is currently known from a scientific perspective. The presentation (attached in English and Inuktitut) included a background of the scientific findings up to 2015, why a new study is needed, what the basis was for the new aerial survey, how it was designed, what information was used to design it, how it was conducted, and what the results were of this study. The presentation also included the position of the GN on the current status of WH polar bears, i.e., that the population appears to be stable.

b) Questions that arose from the presentation:
   i) Q: Markus – I am posing the same question to you as I have with other communities. In Whale Cove, they told us that in the fall time they would have a lot of bears in their community. What time of the year do the bears show up in your community?
   A: No comments.

   ii) Q: Markus - The COY's are not surviving into the first year and maybe hunters can help us understand why that is. Maybe the

males are killing the cubs or the mothers are not in good condition and killing off the weaker COY, or there are other reasons that local knowledge could help us understand.
A: No comments.

iii) Q: Jennifer Sammurtok: July 1st long weekend we saw a mother with 2 cubs on the Inlet. Also the elders have stated that bears are being fed in Churchill so they are not afraid anymore.
A: Rob/Markus: We have heard this is in every community where all of a sudden all the bears show up at once and where that didn't happen 15-20 years. We would like to gather more information from the communities as to why all of a sudden these bears show up at once.
Leona: in the spring time when the ice breaks we see them near the community.
Rob: During the spring time are they problematic or are they just moving through? Leonie: it is scary for us as the kids are out of school and we have to tell them to go home. Also the bears are walking down the roads.
Leona: Because the community is on a point, the bears are coming from all directions.
Markus: Is there a time frame when the bears weren't problematic?
Leonie: Previously we were able to go camp.
Harry: In the mid 60's we would be able to camp on the islands without seeing bears.
Rob: do you find that there is a difference in the bears now – are they less fearful then they used to be?
Leonie: they are not scared anymore and approach the communities. Previously if a dog was barking, the bear would get scared and run, but that doesn't happen anymore. We have a camp not far from here and we can't even go there to eat anymore because of the bears. The bear was hiding and watching them so we had to leave and go back to town.

iv) Q: Harry Aggark: I know the reason why we have low populations in August is because they are south in Manitoba. We see them in the fall time when the ice starts to freeze. Also we have both the WHB and FB populations here so that is why we see more bears.

v) Q: Harry: so you stated that Ontario has done their studies but you don't know what those numbers are yet?
A: Markus: Yes I haven't seen that data yet.

vi) Q: Harry: It might be best to do WHB and FB surveys at the same time, as they move around at the same time.
A: Markus: Yes it makes sense. The issue is I have been the only biologist for the GN right now, and there at times competing resources and priorities.

vii) Q: Jerome Misheralak: It might be more effective if you have a team working from the south and another working from the north conducting the surveys.
A: Markus: explained how the work was done in WH and why.

viii) Q: Harry Aggark: Are you collaring bears still?
A: Markus: We haven't collared in 6 years.
Rob: people have expressed that they don't want bears collared anymore.
Markus: There is ECCC and Universities that are still collaring and tagging bears.
Harry: We know that there was a bear collared near Manitoba and then saw a bear at Ungava Bay that had a collar.
Harry: I don't support collaring as it causes a lot of damage to the bears neck.
Rob: We have pulled back on collaring on bears because of that reason.
Harry: We are not really concerned about where they move but rather if there numbers are increasing or decreasing.

ix) Q: Rob: Do you guys tell Peter whenever you see a bear even if it isn't problematic.
A: Jennifer: yes, he is always notified.

x) Q: Leonie: Why did you not survey between Rankin and Chester?
A: Markus: It's considered a different population (Foxe Basin).

xi) Q: Jennifer: Why are you not surveying bears north of the boundary line?

A: Rob – we know that bears move beyond each management zone. Different population/management zones are created through tracking and previous surveys that the bears occupy.
A: Leonie: I understand what you are saying but I know that bears are moving between zones.
Markus: I totally believe that bears are moving between areas.
Leonie/Jennifer: We don't understand why Foxe Basin/WHB aren't surveyed together?
Rob: With these surveys it's about time and money. Markus is the only biologist currently and we don't have time and money to do every management zone or population on a consistent schedule . Markus has to request funds from other interested partners which takes time. We also want to survey areas every so many years which makes sense. We don't want to survey an area every 15 years or every year; by doing that it wouldn't be productive to gather consistent data.

xii) Q: Jerome Misheralak: Do you survey the area into Baker Lake for bears, I know a bear was there last year? We know when we go to that area to hunt caribou that we see bears.
A: Rob: We know that Baker Lake isn't a natural habitat for bears so we don't include that area for bear surveys. Baker Lake has had two occurrences where polar bears were sighted and killed as a result of defence kills. One of these was last summer just east of Baker Lake in Cross Bay.
Markus: That might be important information for us to know if there are more bears going inland so that we can include this area on our next Foxe Basin survey.
Rob: Do you regularly report your sightings to the CO so that's he can let Markus know.

A: Peter Kattegatsiak: To elaborate for Leonie, the Foxe Basin inclues different communities like Coral Harbour, Repulse Bay, Kimmirut, etc. They are different subpopulations. And Markus cannot survey everywhere at once.

xiii) Q: Harry – would it possible to conduct surveys once in August and then again in September or October?
A: Markus: We have talked to other communities about this as well. I think what we could do is look at a coastal survey and get information from the communities as to when a good time to do survey. We could potentially do a survey in

September/October. Manitoba does coastal surveys in the spring and fall and I think that this would be a good idea for Nunavut. Coastal surveys would be good to tell us what bears are near the communities but we may miss females in dens or already on the ice.

xiv) Q: Jerome Misheralak: I think it's a good idea to do surveys in WHB and then FB at the same time.
A: Markus: We need a lot of money and manpower to do that. We don't want to confuse the populations. But if we just wanted to look at how many bears are near the communities, then that might be possible.

Bert Dean: NWMB is going to have a public hearing on the Management Plan in the fall, I think it's very important that these issues be brought up at those hearings. Even working in Parks Canada as they manage Wager Bay and could help with surveys.

xv) Q: Harry Aggark: My question is about the survival of the COYs.
A: It's something that we have observed on our surveys. We are noticing that cubs aren't surviving and maybe males are eating cubs.

Bert Dean: They are still handling bears in Wapusk and has anyone asked whether they are still drugging cubs?

A: Markus: I would have to look further into that, but the ECCC capture programme has been relatively small in recent years in Manitoba.

xvi) Q: Leonie – when is that Polar Bear Mgmt Plan meeting?
A: Bert – they haven't decided yet but as soon as NWMB does know, they will let the HTOs know.

xvii) Q: Leonie: When the public hearing happens is there the possibility to have an elder, youth and middle age?
A: Bert: The reason why the public hearings were delayed is that NWMB would only fund 6 representatives in each region. Baffin has 13 seats and they were upset that all communities weren't invited so Baffin boycotted and Kivalliq supported them.

End of meeting: 19:20

Notes taken by C. Wray

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Minister of Environment
Ministaat Avatiliqiyitkut
Ministre de l'Environnement

September 22, 2017

Mr. Daniel Shewchuk
Acting Chairperson
Nunavut Wildlife Management Board
P.O Box 1379
Iqaluit, NU X0A 0H0

Dear Mr. Shewchuk:

Re: ***Nunavut Wildlife Management Board decisions concerning the level of regional total allowable harvest for the Western Hudson Bay (WH) polar bear subpopulation***

Thank you very much for your decision concerning the new Total Allowable Harvest decision for the WHB sub-population.

To reiterate the decision of the NWMB:

> *RESOLVE that the NWMB approve, pursuant to Section 5.6.16, 5.6.17(b) , 5.3.3 (a) and 5.3.3(c) of the Nunavut Agreement and as an interim decision due to urgent circumstances, an increase of six (6) bears to the regional total allowable harvest in the Nunavut settlement area for the Western Hudson Bay subpopulation, resulting in an overall regional total allowable harvest of 34 bears for the 2017-2018 harvests season.*
>
> *FUTHER RESOLVE that the NWMB hold an in-person public hearing at the earliest possible opportunity concerning the future (2018-2019) and subsequent harvest seasons level of the regional total allowable harvesting in the Nunavut Settlement Area for the Western Hudson Bay subpopulation.*

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Minister of Environment
Ministaat Avatiliqiyitkut
Ministre de l'Environnement

I hereby accept your decision to increase the TAH for the regional total allowable harvest in the Nunavut settlement area of the Western Hudson Bay subpopulation with 6 bears, resulting in an overall regional total allowable harvest of 34 bears under the agreed sex selective harvest system outlined in the Nunavut Polar Bear MOU's.

I will implement this decision forthwith and the TAH will be put in regulation and be implemented as a final decision. If the board want to adjust or make a new decision after you conduct public hearings, based on new information acquired during the public hearing process, the board can submit this as a new TAH decision and will be considered at that time. This decision will thus be in place until I receive a new NWMB decision.

On-going communication, meetings, and the recent NWMB regular meeting have shown that we all share concerns regarding the WB polar bear subpopulation. I hope that our collaborative work will continue in implementing this TAH and other management actions needed to ensure sustainability of WH polar bear subpopulation.

Sincerely,

Joe Savikataaq,
Minister

Cc. David Akeeagok - Deputy Minister, Department of Environment, Government of Nunavut (GN)

November 24, 2017

Daniel Shewchuk
Acting Chairperson,
Nunavut Wildlife Management Board
P.O. Box 1379
Iqaluit, NU
X0A 0H0

Dear Mr. Shewchuk:

Re: Nunavut Wildlife Management Board (NWMB) in-person public hearing to consider potential modifications of the Western Hudson Bay (WH) polar bear total allowable harvest (TAH)

Nunavut Tunngavik Incorporated (NTI) appreciates the opportunity to provide comments on the NWMB's decision concerning the TAH for the Western Hudson Bay (WH) polar bear population.

A. General Comments

1) NTI supports the decision to increase the TAH for the WH population for the 2017-18 harvest season by 6 (resulting in an overall regional TAH of 34). This modification considered the knowledge, insight and perspectives of Inuit, who have been advocating for an increase on the grounds of both conservation and public safety.

2) NTI appreciates the NWMB's efforts to settle the increase of the regional TAH for the WH polar bear subpopulation in a timely manner that safeguards the 2017-18 harvesting season from dispute and uncertainty. While NTI acknowledges the timing, logistical and financial challenges associated with in-person hearings, it must nonetheless be pointed out that Inuit harvesters will only be provided an opportunity to discuss future modifications of the WH regional TAH in a public hearing setting; the initial scope of the public hearing was the consideration of a TAH modification proposal that included the upcoming harvest. NTI urges the NWMB not to forego public hearings in relation to decisions that it views as unlikely to be controversial—such an assumption might not hold true in all instances.

B. Specific Comments

Inuit Qaujimajatuqangit and Local Knowledge

One of the key objectives of Article 5 of the *Nunavut Agreement* prescribes the creation of a wildlife management system that promotes public confidence, particularly amongst Inuit. NTI strongly encourages inclusion of Inuit knowledge and principles (*Inuit Qaujimajatuqangit*) in wildlife management decision-making to avoid drastic decisions that deteriorate public confidence. For this to occur requires maintaining relationships and communication among different parties that result in improved understanding of the ways in which different sources of knowledge can contribute to decision-making affecting wildlife management.

In previous NWMB hearings, NTI, the KWB, and Arviat HTO have submitted IQ on Western Hudson Bay. In summary, Inuit hunters and elders observed very few polar bears in the earlier part of the 20th century. Beginning in the 1980s, Inuit started to notice an increase in numbers of polar bears in the area.

Initially, quotas imposed on Inuit and subsequently co-management with inclusion of Inuit have permitted the WH polar bear population to increase. Consequently, Inuit have repeatedly stated that the number of bears have increased and public safety is now a major concern. A GN analysis of coastal surveys conducted by the Government of Manitoba reveals that the numbers of adult male polar bears counted along the WH coast from 2011 – 2016 have increased, providing support to Inuit observations. The number of adult females with offspring counted along the coast has remained similar for the same period.

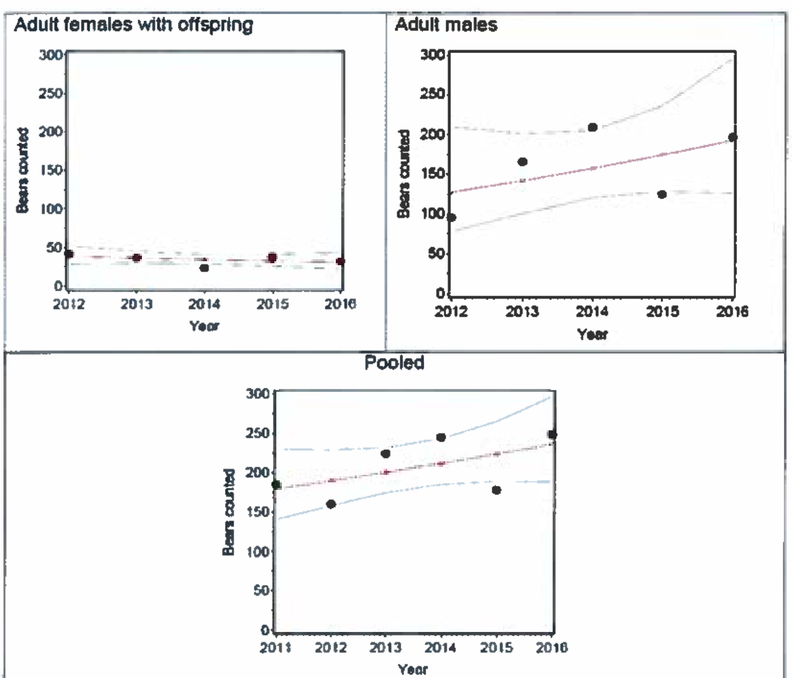

Figure SM2.2: Predicted trend from log-linear models of coastal survey. Counts are given as black dots with model predictions as red lines with associated confidence limits.

Management Objectives

Under Part 1 of Article 5, subsection 5.1.2 (e), the Nunavut Agreement specifies the need for an effective wildlife management system in Nunavut that "*complements Inuit harvesting rights and priorities, and recognizes Inuit systems of wildlife management*".

However, over the last decade, Inuit of the Kivalliq region have been subject to significant and at times very drastic fluctuations in the TAH of polar bears from the WH subpopulation. Since 2000-01, annual TAHs have averaged 34 but have ranged from a high of 56 (between 2004-05 and 2006-07) to a low of 8 (between 2008-09 and 2010-11), varying by as much as 30 from one year to the next (Figure 1). For example, the second step of a 2007 NWMB decision involved "a drastic 86% reduction from the current TAH of 56" (NWMB 2007). Scientific evidence generated from computer simulations that suggested the population would continue to decline because of low polar bear vital rates contributed to the NWMB decision (NWMB 2007).

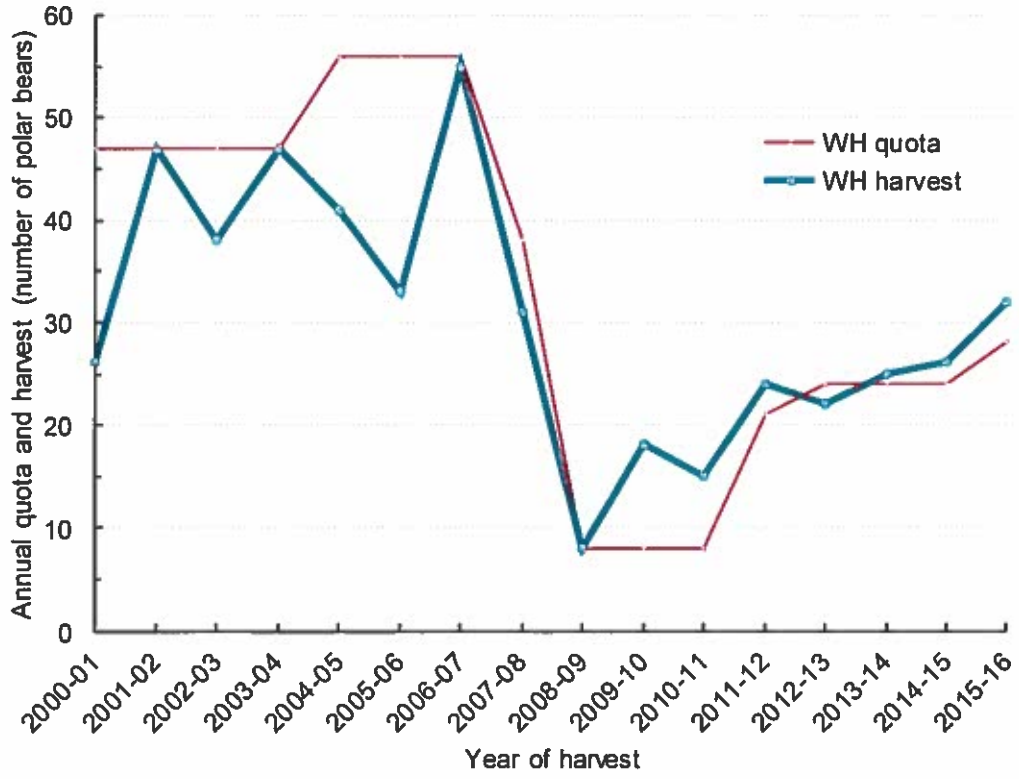

Figure 1. Total annual quotas for the Western Hudson Bay (WH) polar bear subpopulation and combined annual harvests of WH polar bears by Kivalliq communities, from 2000-2001 to 2015-2016. (Source: Adapted from annual Polar Bear Harvest Reports available at http://www.gov.nu.ca/environnement/information/wildlife-research-reports)

NTI submits that the NWMB may wish to ponder whether moving away from the flexible quota system and its associated credits and penalties to a multi-year fixed TAH could permit improved relations, communication and discussion amongst parties on developing shared management objectives. To reiterate NTI's May 24, 2017 comments to NWMB on the Nunavut Polar Bear Co-Management Plan revision, the management and application of the flexible quota system has been an ongoing concern to NTI and Inuit harvesters.

With respect to public safety, the TAH continues to exert a certain influence on the number of Defense of Life and Property Kills (DLPKs). Indeed, whereas the combined annual DLPKs of WH polar bears by Kivalliq communities averaged only 3 polar bears between 2000-01 and 2007-0 that average jumped to 8 from 2008-09 to 2015-16 (figure 2). Given the extent of the public safety concern, modification of the TAH represents a sensible course of action.

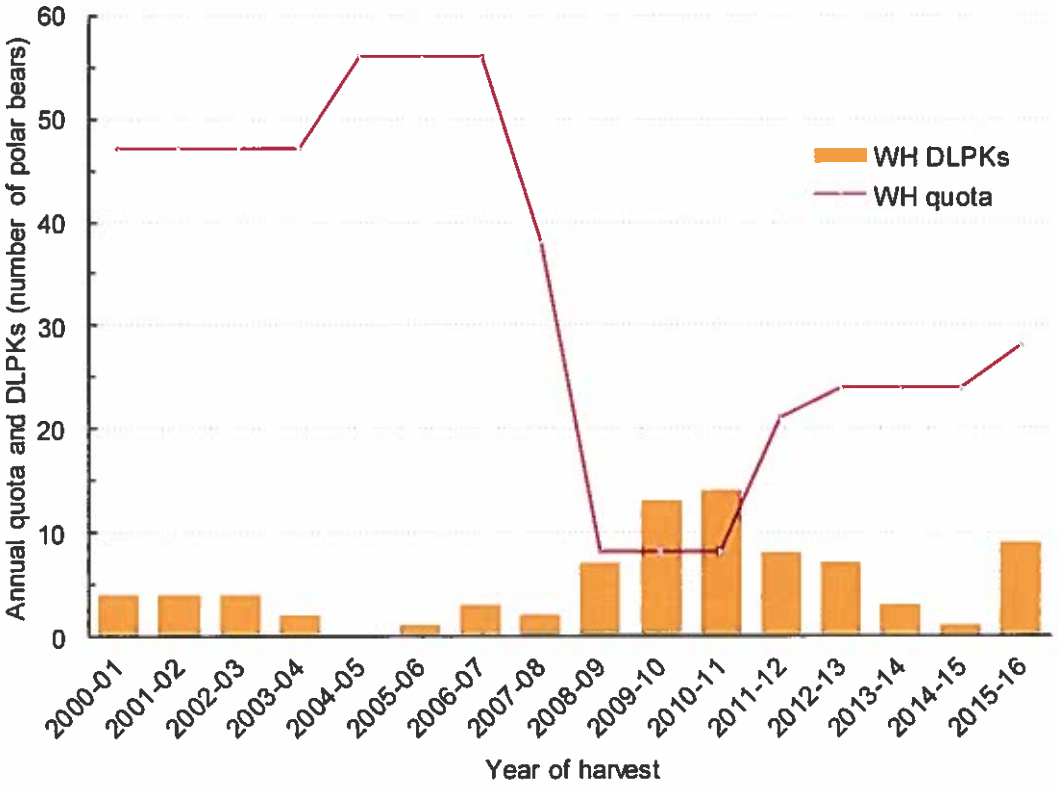

Figure 2. Total annual quotas for the Western Hudson Bay (WH) polar bear subpopulation and combined annual Defense of Life and Property Kills (DLPKs) of WH polar bears by Kivalliq communities, from 2000-2001 to 2015-2016. (Source: Adapted from annual Polar Bear Harvest Reports available at http://www.gov.nu.ca/environnement/information/wildlife-research-reports)

Under Part 3, subsections 5.3.3 (a) and (c) of the Nunavut Agreement identify conservation and public safety as acceptable grounds for the restriction of Inuit harvesting. Public safety and the protection of property, as well as the perpetuation of harvesting practices that facilitate the transmission and promotion of *Inuit Qaujimajatuqangit*, remain priorities that should be considered in the management of the population.

Sincerely,

Paul Irngaut
Director of Wildlife & Environment
Nunavut Tunngavik Inc.
Iqaluit, NU

References:

NWMB. 2007 Letter to GN re: Western Hudson Bay Polar Bear TAH Decision

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KIVALLIQ WILDLIFE BOARD

WRITTEN SUBMISSION

NUNAVUT WILDLIFE MANAGEMENT BOARD
PUBLIC HEARING ON THE TOTAL ALLOWABLE HARVEST FOR THE WESTERN HUDSON BAY POLAR BEAR SUB-POPULATION

Filed by:

Kivalliq Wildlife Board

Nov 24, 2017

Table of Contents

Written Submission for the NWMB Public Hearing on the Total Allowable Harvest for the Western Hudson Bay Polar Bear Sub-Population

1. Background and Objectives

The Kivalliq Wildlife Board (KWB) is the Regional Wildlife Organization (RWO) for the Kivalliq Region. The board consists of representatives from each community Hunters and Trappers Organization (HTOs) in the Kivalliq region.

The mandate of RWOs and HTOs is contained in Article 5.7 of the 1993 *Nunavut Agreement.*[1] The *Nunavut Agreement* gives HTOs and RWOs a broad mandate to oversee and manage Inuit wildlife harvesting in their respective communities and regions. The *Nunavut Agreement* also provides HTOs with a mandate to represent the interests of Inuit hunters and their hunting rights, including the right to sue on behalf of members for rights infringements (5.7.15).

KWB has been actively involved in the co-management of the Western Hudson Bay Polar Bear Sub-Population (WH PB) for several years. Before and after the signing of the *Nunavut Agreement* and the creation of the Nunavut territory, KWB has been a strong proponent of including Inuit Qaujimajatuqangit of Elders and expert hunters in management decisions about polar bears as well as other wildlife. KWB, along with five Kivalliq HTOs, worked with the Government of Nunavut (GN) Department of Environment (DoE) and the Nunavut Wildlife Management Board (NWMB) to create and sign the *Polar Bear Management Memorandum of Understanding for the Management of the "Western Hudson" Polar Bear Population*[2] that currently provides the framework for WH PB management. Every year the KWB works with the HTOs to allocate tags that correspond to the Total Allowable Harvest (TAH) and does its best to meet the management requirements for WH PB.

In recent years, a lot of challenges exist around the management of polar bears. The GN and NWMB's work with co-management partners towards creating a new Nunavut Polar Bear Management Plan (PBMP) to replace the existing Memoranda of Understanding has not been without its difficulties. Prior to the scheduled hearing in June 2017 on the PBMP draft plan, as expressed in a letter to NWMB, KWB had concerns about NWMB's commitment to allowing equal and fair opportunity for all HTOs in Nunavut to participate in the public hearing process and also had concerns about how seriously recommendations from RWOs and HTOs are taken. Providing funding for enough participants from all the Kivalliq communities that harvest WH PB to participate in this current WH PB TAH public hearing is a start. The KWB was also pleased with the recently recommended and accepted increase in WH PB TAH from 28 to 34. These tags were allocated to HTOs at the KWB AGM in October 2017. KWB remains committed to working with its co-management partners on polar bear management.

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[1] Nunavut Tunngavik Inc. and Minister of Indian Affairs and Northern Development and Federal Interlocutor for Métis and Non-Status Indians. (2010). *Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in right of Canada as amended*.

[2] Arviat HTO, Baker Lake HTO, Aqigiq HTO (Chesterfield Inlet), Aqiggiaq HTO (Rankin Inlet), Issatik HTO (Whale Cove), Kivalliq Wildlife Board, and GN Department of Environment. (2005). *Polar Bear Management Memorandum of Understanding for the Management of the "Western Hudson" Polar Bear Population*.

While pleased with the increase in TAH, KWB feels that a TAH of 34 is still not enough for the current situation in the Kivalliq. Polar bear encounters with humans have increased significantly, especially near Arviat, Chesterfield Inlet and Whale Cove. At the 2017 KWB AGM, Rob Harmer, Kivalliq Regional Manager, GN DoE reported 185 polar bear observances without deterrence and 205 polar bear observances with deterrence in Arviat alone in a single year (KWB AGM, October 18, 2017). Public safety and protection of property is a major concern for people in the Kivalliq. Furthermore, limited TAH levels and increased bear encounters have led to increased Defense of Life and Property Kills (DLPKs).[3] These kills further limit the ability for Inuit to participate in and learn traditional polar bear hunting practices and the Inuit Qaujimajatuqangit that is shared during these hunts. KWB supports a main goal of polar bear management being the continued practice of polar bear hunting by Inuit.

KWB wants the TAH for WH PB to be increased to 45 (with 40 tags being allocated to Kivalliq communities in Nunavut and 5 tags being allocated to Manitoba). As will be explained, KWB finds that this figure continues to meet the management goal of maintaining a stable polar bear population. At the same time, a higher TAH will decrease polar bear and human encounters and increase public safety as well as allow for the continued hunting of polar bears by Inuit. The following two sections provide the general and specific comments and recommendations that support this overarching objective.

2. General Comments and Recommendations

2.1 Maintaining Inuit Ways and Knowledge of Hunting Polar Bears

The 2016 *Draft of the Nunavut Polar Bear Co-Management Plan*[4] states that the goal of polar bear management in Nunavut is: "To maintain viable and healthy polar bear subpopulations for current and future generations and to ensure that polar bears remain an integrated and functioning part of the ecosystem while monitored and appropriate harvests are allowed" (p. 8).

KWB contends that a primary goal of polar bear management in Nunavut should be maintaining Inuit hunting practices and cultural learning that has existed since time immemorial and that this should be expressed more clearly in the goal of the polar bear management plan. Inuit do not want to change their ways for management plans; if they must exist, KWB wants management plans to accommodate Inuit hunting traditions and practices.

In order for this goal to be achieved, it is extremely important that Inuit Qaujimajatuqangit become even more integrated into polar bear management and that the deep historical understanding of bears in the Kivalliq is respected by wildlife managers.

2.2 Public Safety is a Top Concern

Public safety of people and property is a top priority of the KWB. Human and polar bear interactions have been increasing and many people are worried that human life could be lost if

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[3] See Table 1 and Table 2 in attached WH PB Tables and Figures document. Particularly in the years 2008-2013, there was a significant decrease in TAH (to as low as 8 bears for the entire WH sub-population) and a subsequent increase in DLPKs.

[4] Government of Nunavut Minister of Environment and Nunavut Wildlife Management Board. (2016). *Draft of the Nunavut Polar Bear Management Plan*.

something is not done to limit human and polar bear encounters. As already expressed, polar bear observances are very high in Arviat, Whale Cove and Chesterfield Inlet, and it is extremely important that something is done to reduce this.

Inuit Qaujimajatuqangit about polar bears reaches far into the past and many Inuit express that polar bear populations are currently higher than they ever were from the early 1900s to the 1970s. In an IQ study done by Nirlungayuk and Lee[5], hunters and Elders who frequently and extensively traveled the land and sea in the Kivalliq and Western Hudson Bay reported seeing very few polar bears during this time period and note that more recently, since the 1980s, polar bears have been seen with greater frequency.

KWB wants polar bear and human encounters to be reduced for the safety of both humans and bears. As expressed in the teachings of Elders who grew up and lived on the land and ice, one way to do this is to actively hunt polar bears.

2.3 Disagreement with Sub-Population Understanding of Polar Bears

It is important to note that the knowledge of Elders and hunters as expressed through Inuit Qaujimajatuqangit tells us that polar bears do not know the boundaries created by human wildlife managers. Polar bears move up and down the coast and travel on ice pans across the Hudson Bay. The same bears can be WH, Foxe Basin (FB) or Southern Hudson Bay (SH) polar bears during their lifetimes.

Sometimes the borders cause issues for humans in the Kivalliq as well. The WH sub-population and FB sub-population boundary is south of Chesterfield Inlet, which can cause disagreements within the Kivalliq about who should get tags from the TAH.

Issues are noted with the sub-population boundaries. However, there are also concerns about too many levels of government and bureaucracy existing in polar bear co-management, and if any sub-population boundaries are reconsidered, KWB would not want to open up management of polar bears in the Kivalliq to even more jurisdictions, which could create even more political-legal complications.

2.4 Concern with Manitoba Polar Bear Tourism

There are issues with how people in Nunavut and how people in Manitoba interact with bears. In Nunavut, bears are hunted by Inuit, while in Manitoba, they are a tourist attraction and part of the tourism industry. KWB is concerned with the Manitoba tourism industry because it is felt that increased human interactions with polar bears may be habituating polar bears to humans. This is a public safety concern because it means that bears may come around humans more often. KWB would like to see the GN DoE and NWMB work more with the appropriate agencies in Manitoba to research and address concerns about the effects of tourism on polar bears.

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[5] Nirlungayuk, G. & Lee, D. S. (2009). A Nunavut Inuit perspective on Western Hudson Bay polar bear management and the consequences for conservation hunting. In M. M. R. Milton & L. Foote (Eds.), *Inuit, polar bears, and sustainable use: Local, national, and international perspectives* (pp. 135-142). Edmonton, AB: CCI Press.

2.5 Concern with Invasive Wildlife Research

KWB has concerns with the impact of invasive research on polar bears overall health. The continued mark and recapture practices of researchers from Environment and Climate Change Canada's Canadian Wildlife Service in Manitoba that includes flying close to bears, tranquilizing bears, handling bears to take measurements, tagging and tattooing bears, taking samples from living bears and putting satellite radio collars on bears[6] are a concern to Inuit. Inuit ancestors stressed that animals are not to be played with and have feelings and that they are to be respected; hunting animals is a form of respect, and certain rules have to be followed after a successful hunt to respect animals in death.[7] KWB questions what impact invasive research has on bears and whether bears frequently getting tranquilized and examined contributes to deteriorating body conditions.

KWB supports less invasive research methods like aerial surveys, fur collection through snagging hair on scratch posts and sample and measurement collection after harvesting.

3. Specific Comments and Recommendations

3.1 Increase TAH from 34 to 45

KWB requests that the TAH of WH PB be further increased from 34 to 45. 40 of these tags should be made available to Kivalliq HTOs and 5 tags should be made available to Manitoba.

KWB maintains that this harvest level still meets the overall management goal of maintaining the stability of the WH PB population. A TAH of 45 is 4.5% of 1000, a population estimate supported by both the 2011[8] and 2016[9] aerial surveys when the confidence interval is considered. With the on-the-ground observations of active Inuit hunters and Elders expressing that polar bear populations are higher than they have been within living memory, KWB believes this higher population estimate is reasonable. Historically, a harvest rate of 4.5% of the total population has been used as a suitable rate to harvest from the WH PB while keeping the population stable.

During community consultations with Kivalliq HTOs and KWB about the results of the 2016 aerial survey of the WH PB, the GN DoE presented findings that the 2016 population estimate is not significantly different than the 2011 population estimate and that the population remains

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[6] McCue, D. (2017, November 1). Polar bears in Churchill face bleak future, researchers warn. *CBC News*, http://www.cbc.ca/news/multimedia/polar-bears-in-churchill-face-bleak-future-researchers-warn-1.4380568, accessed November 11, 2017.

[7] For just a few examples of the importance Inuit place on respecting animals, see chapters by Kalluak, M.; Angutinngurniq, J.; Ayalik, A.; Uluadluak, D. (2017) In J. Karetak, F. Tester & S. Tagalik (Eds.), *Inuit Qaujimajatuqangit: What Inuit have always known to be true.* Halifax & Winnipeg: Fernwood Publishing.

[8] Government of Nunavut, University of Manitoba, and Government of Manitoba. (2012). Western Hudson Bay polar bear aerial survey, 2011 – Final Report.

[9] Government of Nunavut, Department of Environment. (2017). 2016 Aerial survey of the Western Hudson Bay polar bear sub-population – Final report.

stable.[10, 11] KWB feels that the WH PB population can stay stable with a TAH of 45 as it did in the past when a TAH of between 47 and 56 was common (prior to 2006).

An increased TAH also increases the likelihood of hunter's compliance to polar management regulations. In the past, when the TAH was 38 or higher, harvesting levels were almost always under the TAH and never over it. It was only when the TAH was reduced to 8 and then stayed below 30 that overharvesting occurred.[12] Furthermore, when the TAH has been higher, DLPKs occur less often[13] and the 2M:1F ratio is achieved with regularity.

KWB strongly feels that a TAH of 45 can maintain a stable WH PB population as well as increase public safety and encourage Inuit hunting practices and the transfer of Inuit Qaujimajatuqangit.

3.2 Moratorium on Flexible Quota System Penalizations for Overharvesting Females

The 2M:1F sex-selective harvesting requirements in the flexible quota system creates too many penalizations and can be burdensome and difficult to maintain, particularly when the TAH is very low and DLPKs are very high. Too often, Inuit are severely penalized when a female bear is caught. When penalizations add up, it can lead to several years of a community not having the ability to hunt. Hunting is one of the main ways that ecological knowledge of bears develops, and if youth and other hunters are not hunting polar bears, they are likely not learning ways to distinguish living male bears from female bears, making sex-selective harvesting even more difficult to follow into the future.[14, 15]

KWB would like to see a moratorium on severe penalizations resulting from overharvesting females in the flexible quota system for five years. Instead, hunters should be encouraged by KWB, HTOs and other co-management partners to hunt bears at a 2M:1F ratio, but there should not be punishment if this ratio is not maintained perfectly. If overharvesting occurs beyond the TAH, a one to one reduction should occur in the next year's TAH.

After five years, a harvesting analysis and population survey can be done to determine what ratio of males and females were actually caught during the time period and evaluate the impact on the overall WH PB population to determine whether severe penalizations for overharvesting females need to be reinstated.

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[10] Government of Nunavut, Department of Environment. (2017). Consultation meeting to discuss the results of the 2016 aerial survey for the Western Hudson Bay polar bear sub-population.

[11] Government of Nunavut. (2017). Submission to the Nunavut Wildlife Management Board for polar bear total allowable harvest recommendations for the Western Hudson Bay sub-population.

[12] See Figure 2 in attached WH PB Tables and Figures document.

[13] See Figures 3-7 in attached WH PB Tables and Figures document.

[14] Wenzel, G. (2008). Inuit TEK and the sport-hunt. In G. Wenzel, *Sometimes hunting can seem like business: Polar bear sport hunting in Nunavut* (pp. 21-31). Edmonton, AB: CCI Press.

[15] Tyrrell, M. (2009). Guiding, opportunity, identity: The multiple roles of the Arviat polar bear conservation hunt. In M.M.R. Freeman and L. Foote (Eds.), *Inuit, polar bears, and sustainable use: Local, national, and international perspectives* (pp. 25-38). Edmonton, AB: CCI Press.

3.3 Provide Clarity on Tag Penalizations

Certain issues related to harvesting and tag allocation/penalizations need to be clarified. For example, recently, there was a DLPK by a hunter from Rankin Inlet who was close to Whale Cove when he had to kill a bear. Whale Cove lost a tag for the DLPK, despite the hunter being from Rankin Inlet. This caused quite a bit of disagreement and animosity between the HTOs and the communities. Clarity at the management level is needed to handle issues like these, and defining how scenarios like these will be handled should be in the management plan. These types of scenarios need to be considered ahead of time with clear procedures on how tags will be used up.

3.4 Increase Bear Deterrence Programs

Arviat has a strong bear deterrence program which involves a GN Conservation Officer (with the possibility of one more), two bear deterrers and one World Wildlife Fund officer (with the possibility of one more) using live trapping, bear bangers, rubber bullets and ATVs to deter bears from entering town.[16]

KWB would like to see this type of program setup in Whale Cove and Chesterfield Inlet to help deter bears from entering the communities and causing public safety concerns. This would include the training of bear deterrers, the provision of equipment and the funding to keep this program running and working. In Whale Cove, it is very important that a Conservation Officer is hired and trained to coordinates these types of duties in the town.

3.5 Increase Funding for Wildlife Damage Prevention and Compensation Programs

The Government of Nunavut currently has a small amount of funding dedicated to programs for Wildlife Damage Prevention and Compensation. These programs are underfunded and difficult to access for people of Nunavut. KWB wants these programs to receive more funding and for there to be an easy and transparent way for Inuit to access these programs to help prevent polar bears and other wildlife from damaging their properties as well as to receive compensation for damaged property.

3.6 Research and Actions on Improving Community Infrastructure

KWB wants there to be more research studies on how to build or retrofit community infrastructure (e.g. dumps, meat caches, cabins, etc.) to reduce the likelihood of polar bears entering a community. Beyond research, KWB wants actions to be taken by the GN and municipalities to create better infrastructure that helps prevent bears from coming close to communities. Looking into what Churchill, MB has done for their land fill and other infrastructure might offer guidance on what could be done in the Kivalliq.

[16] Rob Harmer, Kivalliq Regional Manager, GN DoE presentation at KWB AGM, October 18, 2017

Table 1. Annual and averaged polar bear harvests (**black bold**) of Kivalliq communities associated with the Western Hudson Bay polar bear subpopulation, from 2000-2001 to 2015-2016, broken down according to the source of the harvested polar bears: Western Hudson Bay (**bold blue**) or Foxe Basin (light blue) subpopulations. (Source: Adapted from annual *Polar Bear Harvest Reports* available at http://www.gov.nu.ca/environnement/information/wildlife-research-reports)

	2000-2001		2001-2002		2002-2003		2003-2004		2004-2005		2005-2006		2006-2007		2007-2008		2008-2009		2009-2010		2010-2011		2011-2012		2012-2013		2013-2014		2014-2015		2015-2016		Average	
Arviat	**17**	17	**23**	23	**19**	19	**20**	20	**19**	19	**21**	21	**22**	21	**11**	11	**7**	7	**9**	9	**10**	9	**10**	10	**9**	9	**11**	10	**9**	9	**10**	10	**14**	14
		0		0		0		0		0		0		1		0		0		0		1		0		0		1		0		0		0
Baker Lake	**2**	2	**2**	2	**0**	0	**2**	1	**2**	2	**0**	0	**2**	2	**1**	1	**0**	0	**1**	0	**0**	0	**0**	0	**1**	0	**0**	0	**1**	0	**0**	0	**1**	1
		0		0		0		1		0		0		0		0		0		1		0		0		1		0		1		1		0
Chesterfield Inlet	**9**	0	**8**	1	**11**	2	**3**	1	**2**	0	**6**	2	**9**	1	**11**	2	**4**	0	**10**	0	**9**	0	**10**	0	**6**	0	**3**	0	**7**	0	**12**	2	**8**	1
		9		7		9		2		2		4		8		9		4		10		9		10		6		3		7		10		7
Rankin Inlet	**3**	3	**9**	9	**11**	11	**14**	13	**10**	10	**7**	7	**15**	15	**8**	8	**0**	0	**2**	2	**3**	3	**7**	7	**6**	6	**7**	7	**8**	8	**10**	10	**8**	8
		0		0		0		1		0		0		0		0		0		0		0		0		0		0		0		0		0
Whale Cove	**4**	4	**12**	12	**6**	6	**12**	12	**10**	10	**3**	3	**16**	16	**9**	9	**1**	1	**7**	7	**4**	3	**7**	7	**7**	7	**8**	8	**9**	9	**10**	10	**8**	8
		0		0		0		0		0		0		0		0		0		0		1		0		0		0		0		0		0

Table 2. Annual and averaged polar bear harvests (**black bold**) of Kivalliq communities associated with the Western Hudson Bay polar bear subpopulation, from 2000-2001 to 2015-2016, broken down according to harvest type: Regular harvest (**bold green**), sport hunt (light blue) or defense kill (**bold orange**). Illegal kills and miscellaneous hunts annotated individually. (Source: Adapted from annual *Polar Bear Harvest Reports* available at http://www.gov.nu.ca/environnement/information/wildlife-research-reports)

	2000-2001		2001-2002		2002-2003		2003-2004		2004-2005		2005-2006		2006-2007		2007-2008		2008-2009		2009-2010		2010-2011		2011-2012		2012-2013		2013-2014		2014-2015		2015-2016		Average	
Arviat	**17**	14	**23**	15	**19**	14	**20**	13	**19**	15	**21**	15	**22**	16	**11**	10	**7**[1]	0	**9**	2	**10**[2]	1	**10**	6	**9**	9	**11**	11	**9**	8	**10**	6	**14**	10
		3		5		4		7		4		6		6		1		0		0		0		0		0		0		0		0		2
		0		3		1		0		0		0		0		0		5		7		8		4		0		0		1		4		2
Baker Lake	**2**	2	**2**	2	**0**	0	**2**	2	**2**	2	**0**	0	**2**	2	**1**[3]	0	**0**	0	**1**	1	**0**	0	**0**	0	**1**	1	**0**	0	**1**	1	**0**	0	**1**	1
		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0
		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0
Chesterfield Inlet	**9**	8	**8**	8	**11**[4]	6	**3**[5]	1	**2**	2	**6**	5	**9**	9	**11**	10	**4**	3	**10**	9	**9**	9	**10**	8	**6**	0	**3**	1	**7**	7	**12**	11	**8**	6
		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0
		1		0		2		1		0		1		0		1		1		1		0		2		6		2		0		1		2
Rankin Inlet	**3**	1	**9**	9	**11**	11	**14**	13	**10**	10	**7**	7	**15**[6]	13	**8**	5	**0**	0	**2**	2	**3**	0	**7**	7	**6**	5	**7**	7	**8**	8	**10**	8	**8**	7
		0		0		0		0		0		0		0		2		0		0		0		0		0		0		0		0		0
		2		0		0		1		0		0		1		1		0		0		3		0		1		0		0		2		1
Whale Cove	**4**	3	**12**	11	**6**	5	**12**	12	**10**	10	**3**	3	**16**	8	**9**	4	**1**	0	**7**	0	**4**	1	**7**	5	**7**	7	**8**	7	**9**	9	**10**	8	**8**	6
		0		0		0		0		0		0		6		5		0		2		0		0		0		0		0		0		1
		1		1		1		0		0		0		2		0		1		5		3		2		0		1		0		2		1

[1] 1 illegal kill and 1 miscellaneous hunt; [2] 1 illegal kill; [3] 1 illegal kill; [4] 3 illegal kills; [5] 1 illegal kill; [6] 1 illegal kill

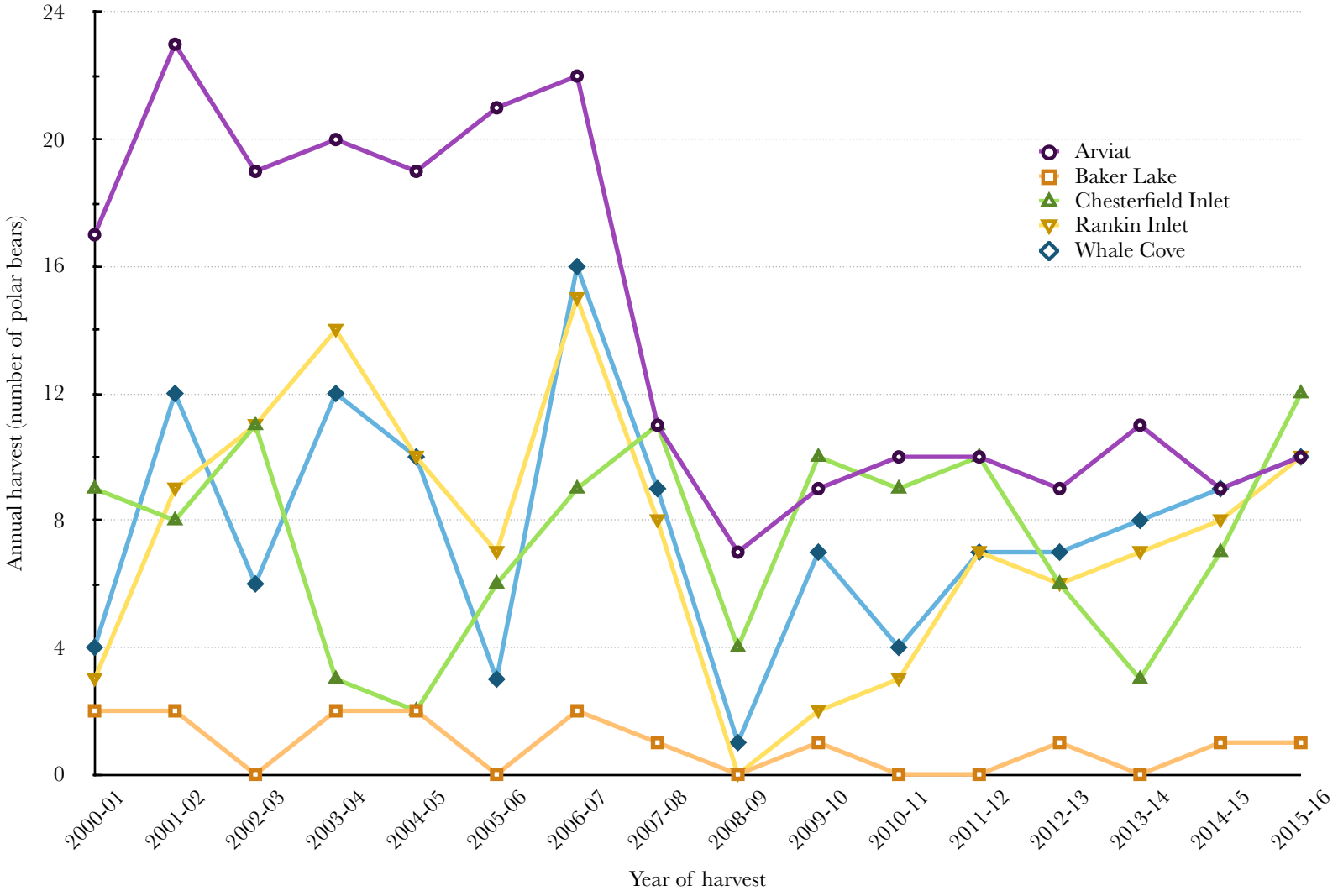

Figure 1. Annual polar bear harvests, from 2000-2001 to 2015-2016, of Kivalliq communities associated with the Western Hudson Bay polar bear subpopulation; polar bears harvested from the Foxe Basin subpopulation also included in totals. (Source: Adapted from annual *Polar Bear Harvest Reports* available at http://www.gov.nu.ca/environnement/information/wildlife-research-reports)

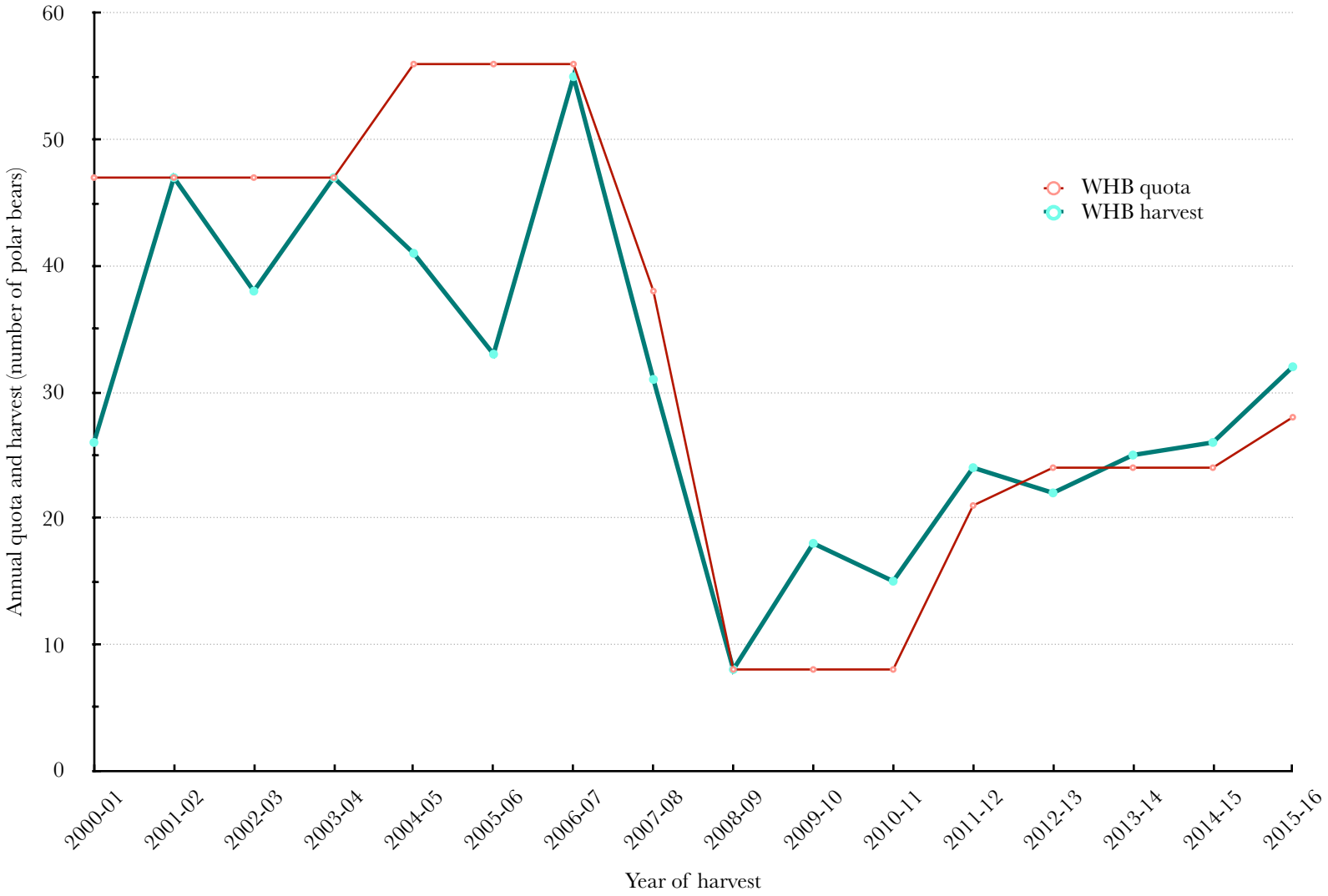

Figure 2. Comparison between the total annual quotas for the Western Hudson Bay (WHB) polar bear subpopulation and the combined annual harvests of WHB polar bears by Kivalliq communities, from 2000-2001 to 2015-2016. (Source: Adapted from annual *Polar Bear Harvest Reports* available at http://www.gov.nu.ca/environnement/information/wildlife-research-reports)

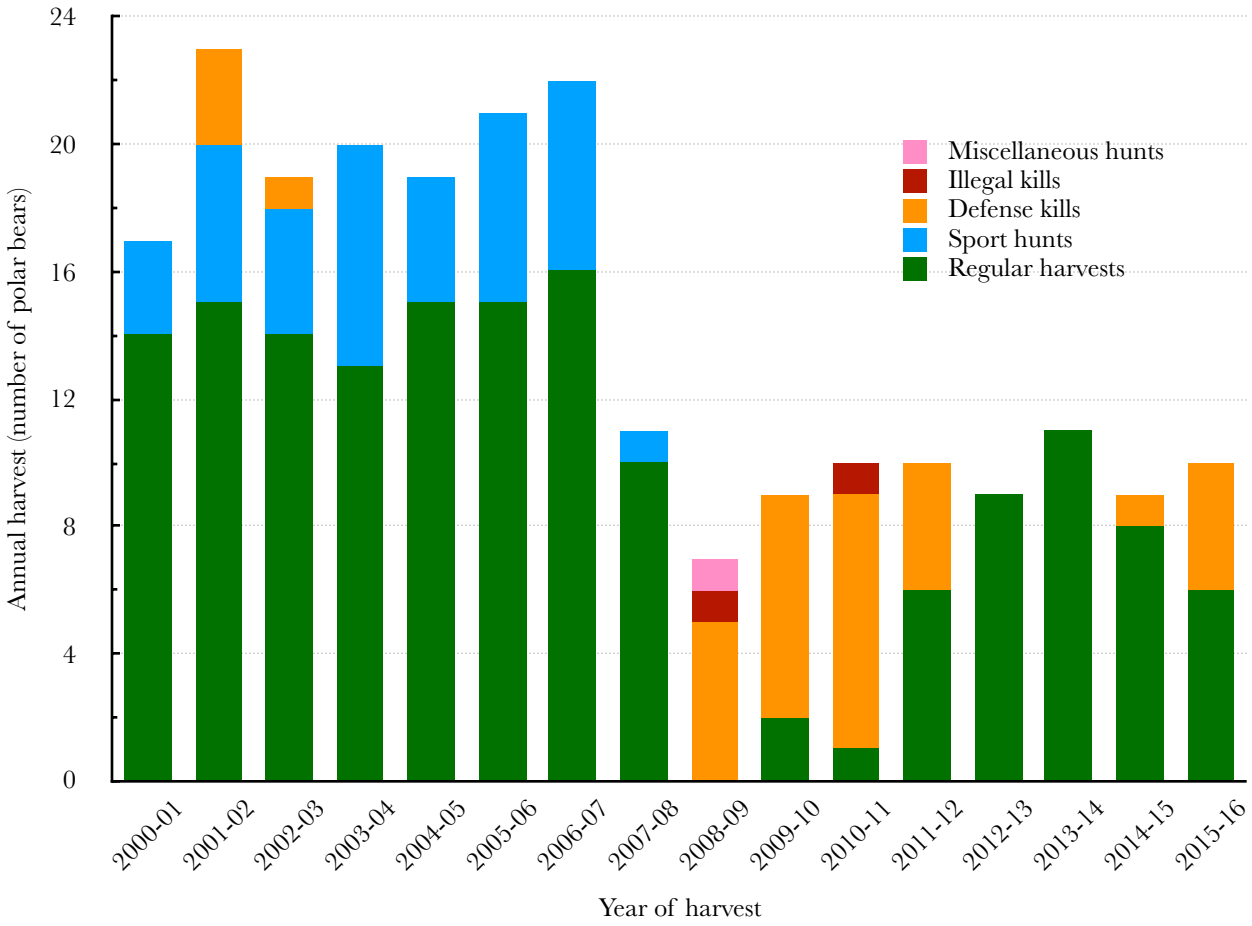

Figure 3. Polar bear harvests recorded in Arviat, from 2000-2001 to 2015-2016, subdivided according to harvest type. (Source: Adapted from annual *Polar Bear Harvest Reports* available at http://www.gov.nu.ca/environnement/information/wildlife-research-reports)

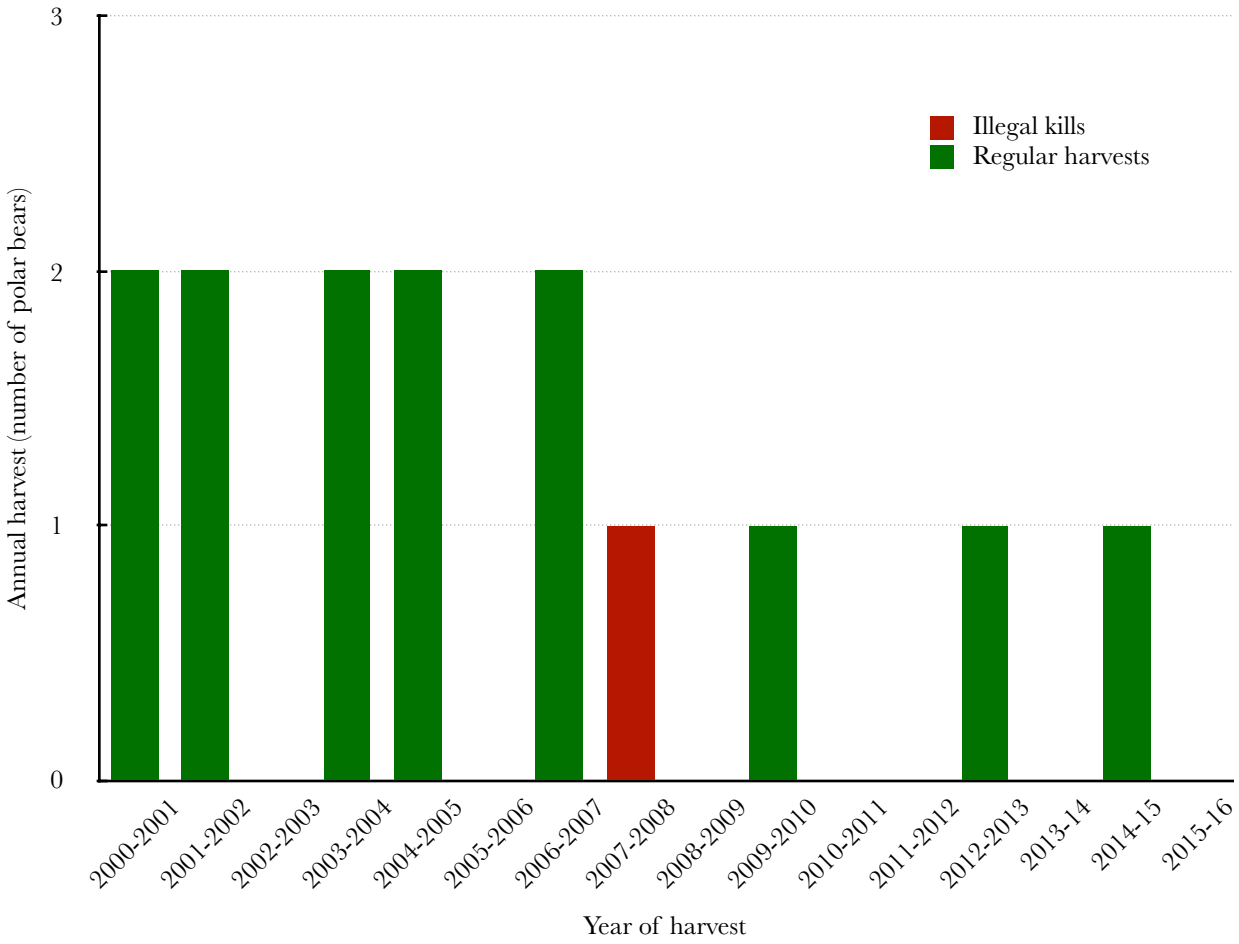

Figure 4. Polar bear harvests recorded in Baker Lake, from 2000-2001 to 2015-2016, subdivided according to harvest type. (Source: Adapted from annual *Polar Bear Harvest Reports* available at http://www.gov.nu.ca/environnement/information/wildlife-research-reports)

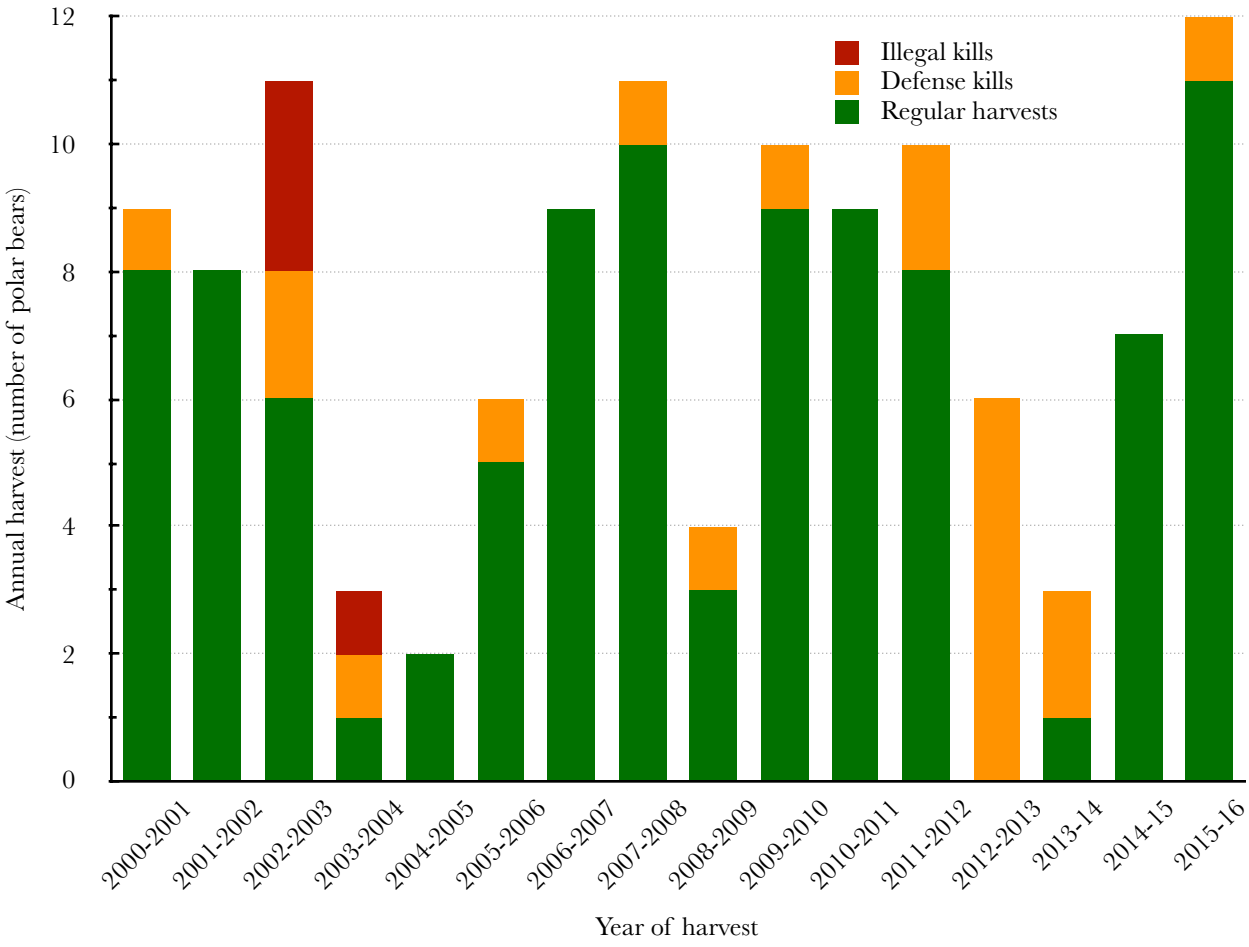

Figure 5. Polar bear harvests recorded in Chesterfield Inlet, from 2000-2001 to 2015-2016, subdivided according to harvest type. (Source: Adapted from annual *Polar Bear Harvest Reports* available at http://www.gov.nu.ca/environnement/information/wildlife-research-reports)

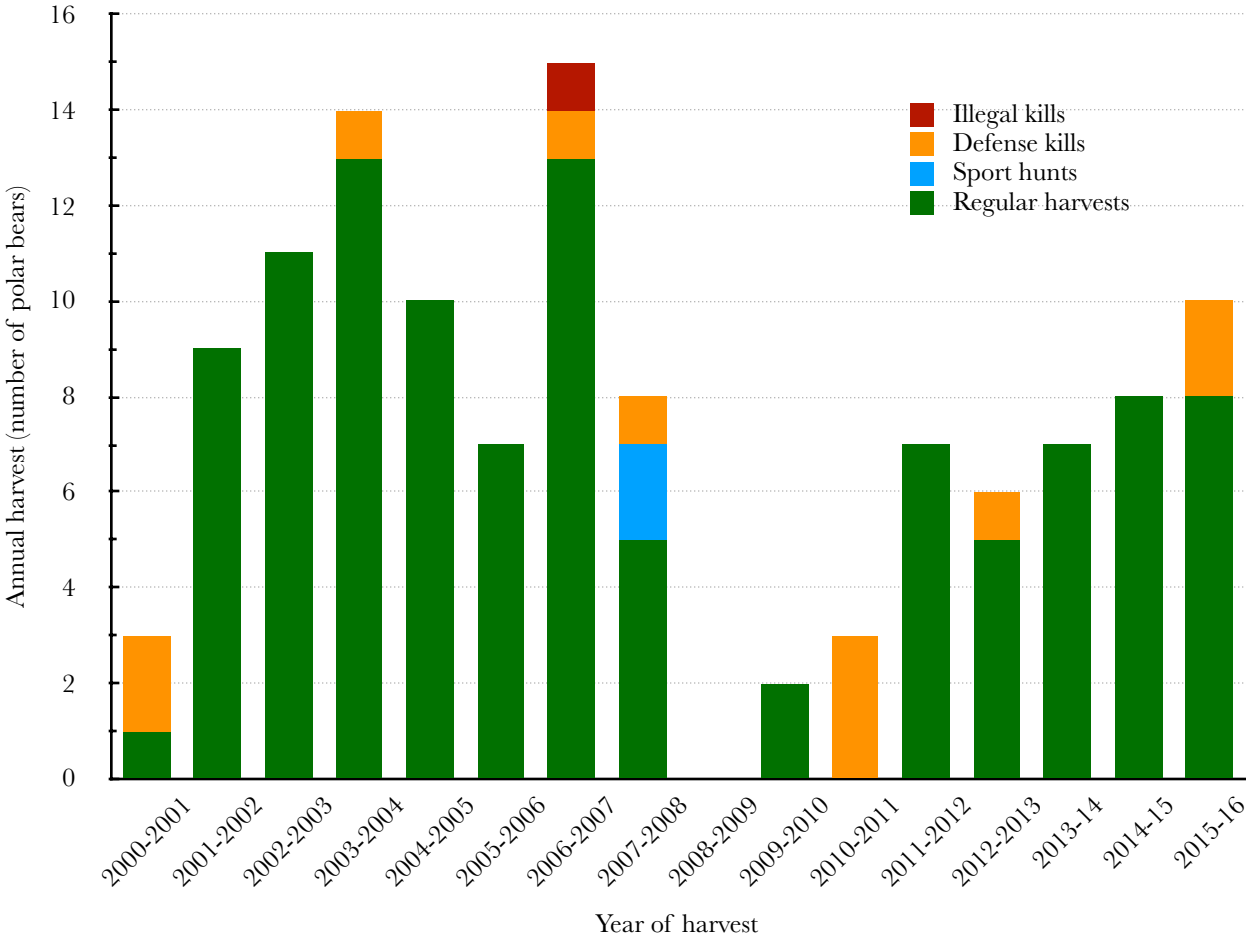

Figure 6. Polar bear harvests recorded in Rankin Inlet, from 2000-2001 to 2015-2016, subdivided according to harvest type. (Source: Adapted from annual *Polar Bear Harvest Reports* available at http://www.gov.nu.ca/environnement/information/wildlife-research-reports)

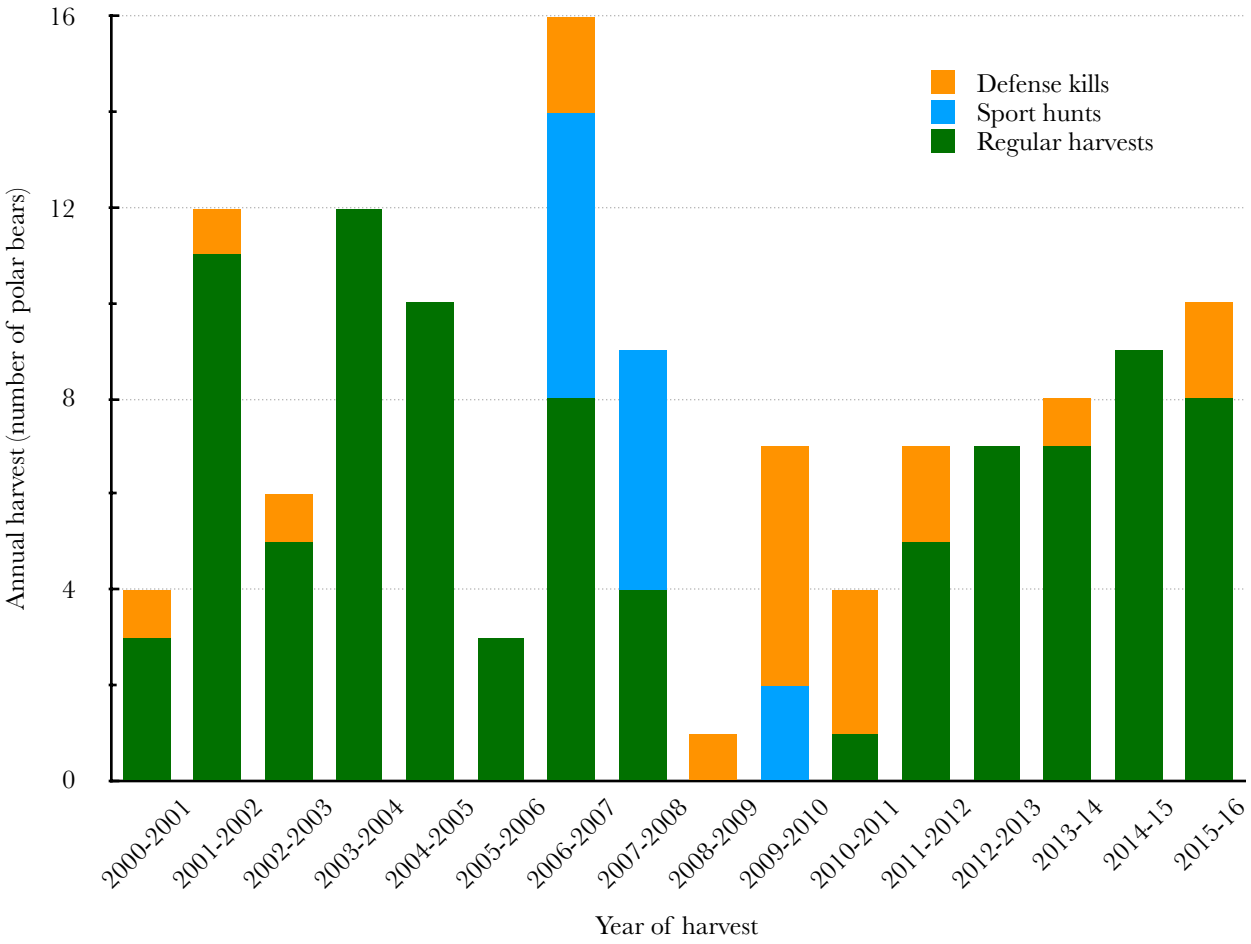

Figure 7. Polar bear harvests recorded in Whale Cove, from 2000-2001 to 2015-2016, subdivided according to harvest type. (Source: Adapted from annual *Polar Bear Harvest Reports* available at http://www.gov.nu.ca/environnement/information/wildlife-research-reports)

Société Makivik
Makivik Corporation

November 17, 2017

Daniel Shewchuk
Acting Chairperson
Nunavut Wildlife Management Board
Box 1379
Iqaluit, NU
X0A 0H0

Re: Makivik submission to the NWMB Western Hudson Bay Polar Bear public hearing

Dear Mr. Shewchuck;

I am writing to you on behalf of Makivik Corporation, the birthright organization representing the Inuit of Nunavik. As you are aware, Nunavimmiut are also polar bear hunters. Although Nunavik is not adjacent to the Western Hudson Bay (WH) polar subpopulation boundary, Inuit hunters know polar bears travel extensively throughout Hudson Bay, and that polar bears from the Western Hudson Bay subpopulation can sometimes be found along the coast of Nunavik. During the 2010-2011 polar bear harvest, two polar bears that had been tagged in Western Hudson Bay (tag numbers 33126 and 33232, captured and tagged south of Churchill, MB) were hunted near Inukjuak, Nunavik. Makivik would like to stress that, while the take of WH polar bears in Nunavik is limited, there is an incidental take of WH bears, primarily by our communities in Hudson Bay.

When making decisions, the Nunavut Wildlife Management Board (NWMB) must consider harvesting activities that take place outside of the Nunavut Settlement Area (Nunavut Land Claims Agreement s. 5.3.4). Makivik feels that it is important that the NWMB be made aware of information related to hunting of WH polar bears that takes place in outside of the NSA in order for the NWMB to arrive at the best decision possible.

For further information on the take of polar bears in Nunavik, including polar bears from the WH subpopulation, I invite you to contact my technical staff: Gregor Gilbert (ggilbert@makivik,.org) or Mark O'Connor (moconnor@makivik.org).

Sincerely,

Adamie Delisle-Alaku
Executive Vice-President
Resouce Development Department
Makivik Corporation

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Environment and Climate Change Canada
Environnement et Changement climatique Canada

NOV 2 3 2017

Daniel Shewchuk
Acting Chairperson
Nunavut Wildlife Management Board
P.O. Box 1379
Iqaluit, NU X0A 0H0

Dear Mr. Shewchuk:

Thank you for your letter of October 20, 2017, to Catherine McKenna, Minister of Environment and Climate Change, which extended an invitation to provide written submissions in response to the Government of Nunavut – Department of Environment's (Nunavut DOE's) proposal concerning a Total Allowable Harvest (TAH) for the Western Hudson Bay (WH) polar bear subpopulation.

It is my understanding that the key matter before the NWMB at its January 9-10, 2018 public hearing in Rankin Inlet will be to discuss what an appropriate and sustainable removal level should be in WH starting with the 2018-19 hunting season. The reason for the re-assessment is a new aerial survey conducted by the Nunavut DOE in August 2016, from which a new subpopulation abundance estimate was derived. The new estimate assessed the subpopulation at 842 bears (95% CI: 562-1121). This compares to a previous estimate of 1030 bears (95% CI: 754-1406) in 2011 using the same aerial survey methodology (a downward adjustment in population estimate of 18%). As the Nunavut DOE report notes that a population trend cannot be inferred from two data points, the 2016 WH aerial survey abundance estimate now constitutes the most recent and best available information upon which to make decisions on the TAH of the WH subpopulation.

I note that the NWMB refers to TEK that indicates greater numbers of bears have been observed in and near communities in recent years than in the past and that this increase in bear incursions constitutes a threat public safety. In light of the public safety concern, ECCC agrees with NWMB in its call for the Government of Nunavut to continue to work with communities to take measures to minimize human-bear conflict and protect people (e.g., bear patrol programs, providing steel bins for storing country food, use of electric deterrent fences around dog team pens).

With respect to total allowable harvest of the WH, as was noted by the PBTC as well as in the report prepared by Nunavut DOE, there is reason for concern about the near-term and long-

term prognosis of this subpopulation, including: (1) evidence that reproductive performance has been lower in WH than other polar bear subpopulations in Canada, and (2) research conducted by ECCC, Science and Technology Branch at field sites in Manitoba indicate declines have occurred in polar bear body condition, reproductive performance, and survival in association with sea ice decline. Supplementary information raises additional concern about the status of ice-adapted species in the Hudson Bay ecosystem. Declines in ringed seal density and blubber thickness have been documented in Hudson Bay by the Department of Fisheries and Oceans Canada scientists.

Preliminary results from a polar bear aerial survey conducted in the adjacent Southern Hudson Bay (SH) subpopulation indicate lower polar bear abundance than was previously measured. According to information provided by Ontario Ministry of Natural Resources and Forestry (OMNRF) to the Polar Bear Administrative Committee (PBAC) in July 2017, the SH abundance estimates were 943 (95% CI: 658-1350) in 2011/2012 and 784 (95% CI: 593-1037) in 2016 (a 17% downward adjustment in population estimate). Similar to the findings of ECCC scientists for WH, OMNRF scientists have documented declines in body condition and survival of SH polar bears.

Finally, with respect to sea ice, there are long-term trends toward earlier breakup and later freeze-up, which directly impact the amount of time that polar bears in Hudson Bay have access to seals, their main prey. Breakup of sea ice on western Hudson Bay has advanced by 22 days and freeze-up prolonged by 15 days since 1979. Thus, there is a growing body of independent scientific evidence of changes occurring in the Hudson Bay marine ecosystem as a whole that collectively suggest that the WH subpopulation is not healthy and that the ecosystem is not stable. It is this weight of evidence that warrants a precautionary approach be taken when setting harvest levels.

The most recent status assessment of the WH subpopulation by the Canadian Polar Bear Technical Committee (PBTC) was in Spring 2017, prior to the release of the 2016 aerial survey final report. At the time, the PBTC noted the population trend over the past 15 years as 'likely stable' and that the subpopulation was considered to be 'increased' from previous levels on the basis of TEK. However, it also noted that based on a variety of biological and environmental factors, such as changes in polar bear body condition, reduced reproductive productivity, as well as observed and expected declines in sea ice coverage, that the WH subpopulation will 'likely decline' over the next ten years.

When last invited by NWMB to provide a written submission concerning a TAH for WH, ECCC supported a TAH of 24 bears, which represented a 2.3% harvest rate of a subpopulation numbering 1030 polar bears. In ECCC's opinion, the underlying conditions that led us to support a precautionary harvest level have not changed. The most current information now indicates the point estimate of the size of the WH subpopulation to be 842 bears.

Also, as the NWMB is aware, products from species that are listed under Appendix II of the Convention on International Trade in Endangered Species (CITES), such as polar bear, require an export permit. A sustainable harvest rate for the WH subpopulation will support a finding that

the export will not be detrimental to the survival of the species. Such a finding is required prior to issuance of a CITES export permit.

In light of the aforementioned considerations, ECCC recommends that co-management partners consider undertaking a comprehensive harvest risk assessment to provide assurance to co-management partners, stakeholders, and the public that whatever TAH is adopted, it will not have an adverse effect on the WH polar bear subpopulation viability. Precedent for such an analysis can be taken from the Baffin Bay polar bear subpopulation. Until such time as a comprehensive risk assessment is completed, ECCC recommends that a precautionary approach be taken to setting a TAH for the WH polar bear subpopulation.

Sincerely,

Sue Milburn-Hopwood
Assistant Deputy Minister
Canadian Wildlife Service
Environment and Climate Change Canada

George Enei
Assistant Deputy Minister
Science and Technology Branch
Environment and Climate Change Canada

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Nunavut Wildlife Management Board

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Tammaqtailinahuarniriit anngutighat atuqhugit Inuit qaujimajatuqangillu ilihimaniillu ilitquhiannin
Conserving wildlife through the application of Inuit Qaujimajatuqangit and scientific knowledge

September 20th 2017

Honourable Joe Savikataaq
Minister of Environment
Government of Nunavut

Dear Minister Savikataaq:

Re: Nunavut Wildlife Management Board decisions concerning the level of regional total allowable harvest for the Western Hudson Bay polar bear subpopulation

1. THE NWMB DECISIONS

On September 12th 2017, during its In-Camera meeting (IC003-2017) in Iqaluit, the Nunavut Wildlife Management Board (NWMB or Board) considered the Government of Nunavut-Department of Environment's *Proposal for NWMB Decision* (Proposal) concerning the total allowable harvest of the Western Hudson Bay (WH) polar bear subpopulation. At this meeting, the NWMB passed the following resolutions:

***RESOLVED* that the NWMB approve, pursuant to Section 5.6.16, 5.6.17(b), 5.3.3(a), and 5.3.3(c) of the *Nunavut Agreement* and as an <u>interim measure</u> due to urgent circumstances, an increase of six (6) bears to the regional total allowable harvest in the Nunavut Settlement Area for the Western Hudson Bay subpopulation, resulting in an overall regional total allowable harvest of 34 bears for the 2017-2018 harvest season.**

***FURTHER RESOLVED* that the NWMB hold an in-person public hearing at the earliest possible opportunity concerning the future (2018-2019 and subsequent harvest seasons) level of the regional total allowable harvest in the Nunavut Settlement Area for the Western Hudson Bay subpopulation.**

2. RATIONALE FOR THE NWMB's DECISIONS

In arriving at this decision, the NWMB carefully considered the new information (*2016 Aerial Survey of the Western Hudson Bay Polar Bear Subpopulation, Final Report)* and recommendations from the Government of Nunavut – Department of Environment. The aerial survey estimated the abundance of the WH subpopulation to be 842 (95% CI: 562-1121) bears. The previous 2011 aerial survey estimate was 1030 (95% CI: 754-1406)

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and was based on similar methods. Although this 2016 abundance estimate indicates an 18% decline in abundance, the estimates from the two studies are not statistically different, which suggests that the subpopulation abundance may be stable. However, the Government of Nunavut – Department of Environment expressed the following concerns about the health of the WH polar bear subpopulation: 1) reproductive performance (the number of cubs and yearlings compared to adults) was lower than adjacent subpopulations of Southern Hudson Bay and Foxe Basin, and, 2) other studies have found that the reproductive performance and body condition of WH polar bears has declined.

The Board also considered information provided by the public during the Regular Meeting (RM003-2017) on September 11th 2017 and heard about polar bear-human conflicts in the communities on the western Hudson Bay coast. The main message was that the number of polar bears coming to the communities and garbage dumps has increased, causing serious concerns about public safety and property damage, especially during the late autumn when bears are on land waiting for the sea ice to form.

More specifically, the NWMB's decision:

1. Uses a precautionary approach, by setting the regional WH total allowable harvest (34) in the Nunavut Settlement Area using the Government of Nunavut recommended sustainable harvest rate of 4.5% (4.5% of 842 = 38) for a subpopulation considered to be stable.
2. Considers the removal rate for the entire WH subpopulation by considering the average number (4 bears/yr) of polar bear defence kills in the Manitoba.
3. By setting a new TAH, the polar bear credits for the communities that harvest from WH subpopulation (Arviat, Baker Lake, Chesterfield Inlet, Rankin Inlet and Whale Cove)[1] will be reset to zero as per the flexible quota system of the 2005 *Memorandum of Understanding (MOU) for the Management of Western Hudson Polar Bears Population* and each community can be allocated their full quota for the 2017-2018 harvest season.
4. Incorporates Inuit Qaujimajatuqangit (IQ) knowledge that there are greater numbers of bears in and near the communities, and that subpopulation size is stable or increasing.
5. Considers the western Hudson Bay communities' public safety concerns and the anticipated defence of life and property kills.

[1]The Government of Nunavut – Department of Environment confirmed that as per the flexible-quota system the available tags for the 2017/2018 harvest season are thirteen (13), reduced from overall regional TAH of twenty-eight (28). The reduction in tags is a direct result of defense kills over the past several years.

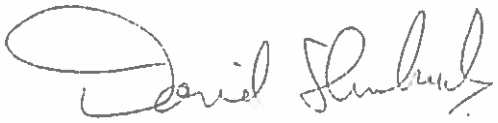
6. The in-person public hearing will provide an opportunity for all affected communities, co-management partners, and the public to present oral and written submissions on the future (2018-19) WH polar bear total allowable harvest.

To reduce ongoing human-polar bear conflicts in the Hudson Bay communities, keep communities safe, and provide information for future TAH decisions, the NWMB encourages the Government of Nunavut to work with the communities to minimize polar bear defense kills, and develop and implement an annual WH polar bear monitoring program (scientific and/or Inuit Qaujimajatuqangit) to provide indicators of abundance, distribution, reproduction, and health.

As the 2017-2018 harvest season is underway, the NWMB looks forward to your prompt reply and timely completion of the *Nunavut Agreement* Article 5 decision-making process.

Should you or your officials have any questions or concerns about the content of this letter, please contact the NWMB.

Yours sincerely,



Daniel Shewchuk
Acting Chairperson of the
Nunavut Wildlife Management Board

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Minister of Environment
Ministaat Avatiliqiyitkut
Ministre de l'Environnement

September 22, 2017

Mr. Daniel Shewchuk
Acting Chairperson
Nunavut Wildlife Management Board
P.O Box 1379
Iqaluit, NU X0A 0H0

Dear Mr. Shewchuk:

Re: ***Nunavut Wildlife Management Board decisions concerning the level of regional total allowable harvest for the Western Hudson Bay (WH) polar bear subpopulation***

Thank you very much for your decision concerning the new Total Allowable Harvest decision for the WHB sub-population.

To reiterate the decision of the NWMB:

> *RESOLVE that the NWMB approve, pursuant to Section 5.6.16, 5.6.17(b) , 5.3.3 (a) and 5.3.3(c) of the Nunavut Agreement and as an interim decision due to urgent circumstances, an increase of six (6) bears to the regional total allowable harvest in the Nunavut settlement area for the Western Hudson Bay subpopulation, resulting in an overall regional total allowable harvest of 34 bears for the 2017-2018 harvests season.*
>
> *FUTHER RESOLVE that the NWMB hold an in-person public hearing at the earliest possible opportunity concerning the future (2018-2019) and subsequent harvest seasons level of the regional total allowable harvesting in the Nunavut Settlement Area for the Western Hudson Bay subpopulation.*

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Minister of Environment
Ministaat Avatiliqiyitkut
Ministre de l'Environnement

I hereby accept your decision to increase the TAH for the regional total allowable harvest in the Nunavut settlement area of the Western Hudson Bay subpopulation with 6 bears, resulting in an overall regional total allowable harvest of 34 bears under the agreed sex selective harvest system outlined in the Nunavut Polar Bear MOU's.

I will implement this decision forthwith and the TAH will be put in regulation and be implemented as a final decision. If the board want to adjust or make a new decision after you conduct public hearings, based on new information acquired during the public hearing process, the board can submit this as a new TAH decision and will be considered at that time. This decision will thus be in place until I receive a new NWMB decision.

On-going communication, meetings, and the recent NWMB regular meeting have shown that we all share concerns regarding the WB polar bear subpopulation. I hope that our collaborative work will continue in implementing this TAH and other management actions needed to ensure sustainability of WH polar bear subpopulation.

Sincerely,

Joe Savikataaq,
Minister

Cc. David Akeeagok - Deputy Minister, Department of Environment, Government of Nunavut (GN)

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Nunavut Wildlife Management Board

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Tammaqtailinahuarniriit anngutighat atuqhugit Inuit qaujimajatuqangillu ilihimaniillu ilitquhiannin
Conserving wildlife through the application of Inuit Qaujimajatuqangit and scientific knowledge

September 25th 2017

Hon. Joe Savikataaq
Minister of Environment
Government of Nunavut

Hon. Catherine McKenna
Minister of Environment and Climate Change
Canada

Aluki Kotierk
President
Nunavut Tunngavik Incorporated

Stanley Adjuk
Chairperson of the Kivalliq Wildlife Board and Issatik Hunters and Trappers Organization

Nick Arnalukjuak
Chairperson of the Arviat Hunters and Trappers Organization

Richard Aksawnee
Chairperson of the Baker Lake Hunters and Trappers Organization

Harry Aggark
Chairperson of the Agigiq Hunters and Trappers Organization

Brian Sigardson
Vice-Chairperson of the Kangiqliniq Hunters and Trappers Organization

Robert Enuapik
Chairperson
Issatik Hunters and Trappers Organization

Christine Cleghorn and Stas Olpinski
Chairpersons of the Polar Bear Administrative Committee

Dag Vongraven and Nick Lunn
Co-Chairs of the IUCN Polar Bear Specialist Group

David Miller
President and CEO
World Wildlife Fund

Gregor Gilbert and Aaron Dale
Co-chairs of the Polar Bear Technical Committee

Dear Colleagues:

Re: Invitation to the Nunavut Wildlife Management Board pre-hearing teleconference concerning the total allowable harvest for the Western Hudson Bay polar bear subpopulation

On September 12th 2017, during a Nunavut Wildlife Management Board (NWMB or Board) in-camera meeting in Iqaluit, the Board considered a *Proposal for Decision* (Proposal) from the Nunavut Department of Environment concerning the total allowable harvest (TAH) for the Western Hudson Bay (WH) polar bear subpopulation in the Nunavut

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Settlement Area. A copy of that Proposal and accompanying Consultation Summary is attached to this correspondence.

During the meeting, the NWMB made two decisions. The first was an interim regional TAH decision for the sub-population. Pursuant to Section 5.3.8 of the *Nunavut Agreement*, that decision must remain confidential until either it is accepted by the Minister or it is disallowed and the NWMB – following relevant further directions in the *Nunavut Agreement* - issues a final decision.

The second Board decision was to hold an in-person public hearing at the earliest reasonable opportunity, concerning the future regional TAH (commencing 2018-2019) for the WH polar bear subpopulation. Before proceeding to schedule and provide public notice of that hearing, **the NWMB has decided to organize a pre-hearing teleconference on October 3rd 2017, at 2:30 pm eastern time (1:30 pm standard time), to discuss with you - or with your representatives – the following issues:**

1. **The proposed location and dates of the hearing:**

   The NWMB proposes to hold a two-day hearing in Rankin Inlet at the Siniktarvik Hotel, on January 9th and 10th 2018. Taking into account its airline schedules, meeting facilities and hotel and restaurant services, Rankin appears to be the most appropriate choice to host the significant number of participants expected to attend the hearing.

2. **The adequacy of consultations carried out by the Nunavut Department of Environment concerning its Proposal:**

   Please see the Department of Environment's "*Consultation Summary Notes for the 2016 Western Hudson Bay Polar Bear Aerial Survey Compiled During Meetings Conducted Between 4-7 July 2017*", including the "*Western Hudson Bay Polar Bear Scientific Study Consultation Report – Appendix 2*", attached to this correspondence.

3. **Participant funding to attend the hearing:**

   The NWMB is under no legal obligation to fund travel and accommodation costs for parties attending NWMB hearings. However, the Board recognizes that it can be difficult for Hunters and Trappers Organizations (HTOs) to find such funding within their limited budgets. Until such time as Government puts in place appropriate participant funding arrangements for NWMB hearings, the Board will continue to try to secure a limited amount of funding from its own annual operating budget to provide HTO financial assistance. For this hearing, the NWMB has been able to secure sufficient funding to pay travel, accommodation

and per diem costs (but no honoraria) for up to ten HTO representatives to attend the hearing. Selection of those representatives will be decided by the Kivalliq Wildlife Board in consultation with the five HTOs who harvest from the WH polar bear subpopulation.

4. **Any other relevant issue that a hearing party wishes to raise.**

For those participants in Iqaluit, the NWMB will be hosting the pre-hearing teleconference in its boardroom. Attached to this letter is a draft agenda for the teleconference, including all necessary dial-in information.

The NWMB requests that you provide confirmation of attendance at the pre-hearing teleconference (by letter, fax, email or phone) by no later than September 29th at 5:00 pm eastern time (4:00 pm standard time). Please also inform the Board at that time: (i) if you wish to raise an additional relevant issue at the teleconference, and (ii) if you require translation services for the call. For logistical reasons, the NWMB recommends participation in the call by no more than two representatives of each agency.

The NWMB is hopeful that the outcome of the pre-hearing teleconference will be a consensus among the parties concerning each of the issues to be discussed. The Board will promptly issue a pre-hearing teleconference summary to all agencies that participated in the call. Following careful consideration, final decisions as to the way forward will be made by a quorum of the NWMB members.

If you have questions or require further information, please do not hesitate to contact the NWMB's Executive Director.

Yours sincerely,

Dan Shewchuk,
A/Chairperson of the
Nunavut Wildlife Management Board

Attachments: 3

c.c. Drikus Gissing, Director of Wildlife, Nunavut Department of Environment;
Paul Irngaut, Director of Wildlife, Nunavut Tunngavik Inc.;
Qovik Netser, Regional Coordinator, Kivalliq Wildlife Board;
Lisa Jones, Secretary Manager of the Issatik HTO;
Mary Issumatardjuaq, Secretary Manager of the Arviat HTO;
Hugh Nateela, Secretary Manager of the Baker Lake HTO;

Janice Aggark, Secretary Manager of the Aqigik HTO;
Nigel Kubluitok, Secretary Manager of the Kangiqliniq HTO;
Lisa Pirie-Dominix, Acting Head of Eastern Arctic, Canadian Wildlife Service, Environment and Climate Change Canada;
Caroline Ladanowski, Director, Wildlife Management and Regulatory Affairs Division, Canadian Wildlife Service, Environment and Climate Change Canada; and
Paul Crowley, Vice-President Arctic, World Wildlife Fund Canada.

PRE-HEARING TELECONFERENCE
FOR A PUBLIC HEARING CONCERNING THE TOTAL ALLOWABLE HARVEST FOR THE WESTERN HUDSON BAY POLAR BEAR SUBPOPULATION

October 3rd 2017
2:30 pm to 4:30 pm (eastern time)[1]

Teleconference No: 1-877-733-5390
Conference ID: 423-158-2642#

PRE-HEARING TELECONFERENCE AGENDA

AGENDA ITEM	ESTIMATED TIME
1. Introductions and opening remarks	15 minutes
2. Review and approval of agenda	5 minutes
3. Location and dates of the hearing	15 minutes
4. Adequacy of consultations carried out by the Nunavut Department of Environment	30 minutes
5. Participant funding to attend the hearing	15 minutes
6. Other relevant issues	30 minutes
7. Next steps and closing remarks	10 minutes

[1] Note: standard time is one hour earlier – 1:30 pm to 3:30 pm.

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Nunavut Wildlife Management Board

Tammaqtailinahuarniriit anngutighat atuqhugit Inuit qaujimajatuqangillu ilihimaniillu ilitquhiannin
Conserving wildlife through the application of Inuit Qaujimajatuqangit and scientific knowledge

October 6th 2017

Hon. Joe Savikataaq Minister of Environment Government of Nunavut	Hon. Catherine McKenna Minister of Environment and Climate Change Canada	Aluki Kotierk President Nunavut Tunngavik Incorporated
Stanley Adjuk Chairperson of the Kivalliq Wildlife Board and Issatik Hunters and Trappers Organization	Nick Arnalukjuak Chairperson of the Arviat Hunters and Trappers Organization	Richard Aksawnee Chairperson of the Baker Lake Hunters and Trappers Organization
Harry Aggark Chairperson of the Agigiq Hunters and Trappers Organization	Brian Sigardson Vice-Chairperson of the Kangiqliniq Hunters and Trappers Organization	Robert Enuapik Chairperson Issatik Hunters and Trappers Organization
Christine Cleghorn and Stas Olpinski Chairpersons of the Polar Bear Administrative Committee	Dag Vongraven and Nick Lunn Co-Chairs of the IUCN Polar Bear Specialist Group	David Miller President and CEO World Wildlife Fund
Gregor Gilbert and Aaron Dale Co-chairs, Polar Bear Technical Committee		

Dear Colleagues:

Re: Summary Minutes of the Nunavut Wildlife Management Board pre-hearing teleconference concerning the total allowable harvest for the Western Hudson Bay polar bear subpopulation

On September 25th 2017, the Nunavut Wildlife Management Board (NWMB or Board) sent out a letter inviting you to attend a pre-hearing teleconference concerning the total allowable harvest for the Western Hudson Bay polar bear subpopulation on October 3rd 2017, at 2:30 pm Eastern Time.

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The conference call was held at the NWMB boardroom in Iqaluit, started at 2:34 pm and was led by Jason Akearok, the Nunavut Wildlife Management Board's (NWMB) Executive Director. The following is a summary of the discussions:

1. **The proposed location and dates of the in-person public hearing concerning the total allowable harvest for the Western Hudson Bay polar bear subpopulation**

The Executive Director stated that, considering the logistical challenges of holding an in-person public hearing, the NWMB has tentatively booked The Siniktarvik Hotel and Conference Centre located in Rankin Inlet on the 9th and 10th of January 2018, for the Western Hudson Bay Polar Bear In-Person Public Hearing. There was no disagreement expressed on the proposed dates and location of the hearing.

2. **The adequacy of consultations carried out by the Nunavut Department of Environment concerning its Proposal**

All parties acknowledged that the timing of, and community attendance at, the consultations were not ideal. Consultations for the Western Hudson Bay polar bear subpopulation took place in July and were poorly attended, most likely because this is a time when many community members are out on the land. However, the GN-DOE considered that due to community requests for an urgent decision to implement a new Total Allowable Harvest, that the GN-DOE considered it best to submit its Proposal to the Board in order to begin the decision-making process as soon as practicable. Notwithstanding the timing and attendance concerns – none of the participants on the teleconference were of the view that the consultations were inadequate.

3. **Participant funding to attend the hearing**

The NWMB Executive Director stated that the NWMB will be able to fund travel, accommodation and per diem costs but no honoraria for up to 10 community participants to the public hearing. It will be up to the Kivalliq Wildlife Board to choose those participants. No concerns were raised about this at the teleconference.

4. **Other issues**

The NWMB Executive Director informed the participants that the NWMB did make a decision on Western Hudson Bay Polar Bear Total Allowable Harvest levels, increasing the number to 34 bears. Drikus Gissing (GN-DOE) stated that the Minister has accepted and will implement the Board's decision. Mr. Gissing also stated that the decision is not an interim decision from the Minister's perspective as it is going to go into Regulations and can only be changed if the NWMB submits a

new decision to the Minister for consideration. The NWMB is in agreement with the position of the Government of Nunavut – Department of Environment in that once the new TAH is implemented, it will remain the legal harvesting limit for Western Hudson Bay Polar Bears until such time as the next *Nunavut Agreement* Article 5 decision-making process is completed.

The conference call ended at 3:25 pm.

If you have any concerns about the issues discussed at the meeting, the content of this letter, or if there is something that we failed to record in the attached pre-hearing teleconference minutes, please let us know by contacting the NWMB on or before **Friday October 13th 2017 at 5 pm Eastern Time**.

Yours sincerely,

Dan Shewchuk,
A/Chairperson of the
Nunavut Wildlife Management Board

Attachments 3:

1. Teleconference minutes
2. Government of Nunavut – Department of Environment Letter: NWMB Total allowable harvest for the WH Polar Bear subpopulation
3. Nunavut Wildlife Management Board Letter: NWMB decisions concerning the level of regional total allowable harvest for the Western Hudson Bay polar bear subpopulation

c.c. Drikus Gissing, Director of Wildlife, Nunavut Department of Environment;
Paul Irngaut, Director of Wildlife, Nunavut Tunngavik Inc.;
Qovik Netser, Regional Coordinator, Kivalliq Wildlife Board;
Lisa Jones, Secretary Manager of the Issatik HTO;
Mary Issumatardjuaq, Secretary Manager of the Arviat HTO;
Hugh Nateela, Secretary Manager of the Baker Lake HTO;
Janice Aggark, Secretary Manager of the Agigik HTO;
Nigel Kubluitok, Secretary Manager of the Kangiqliniq HTO;
Lisa Pirie-Dominix, Head of Eastern Arctic, Canadian Wildlife Service, Environment and Climate Change Canada; and
Paul Crowley, Vice-President Arctic, World Wildlife Fund Canada.

NWMB PRE-HEARING TELECONFERENCE

Nunavut Wildlife Management Board
Pre-Hearing Teleconference
Western Hudson Bay Polar Bears
Tuesday, October 3rd, 2017

NWMB Members and Staff

Staff

• Jason Akearok	Executive Director
• Patricia Pearson	Director, Finance and Administration
• Sarah Spencer	A/Director of Wildlife Management
• Denis Ndeloh	Wildlife Management Biologist
• Michael d'Eça	Legal Advisor

Other participants/ Observers

• Paul Irngaut	Nunavut Tunngavik Incorporated
• Cheryl Wray	Nunavut Tunngavik Incorporated
• Bert Dean	Nunavut Tunngavik Incorporated
• Raymond Mercer	Nunavut Tunngavik Incorporated
• Janice Aggark	Chesterfield Inlet HTO, Manager
• Harry Aggark	Chesterfield Inlet HTO, Chair
• Drikus Gissing	Government of Nunavut, Department of Environment
• Robert Enuapik	Whale Cove HTO, Chair
• Chris Jones	Whale Cove HTO, Board of Director
• Lisa Jones	Manager, Whale Cove HTO
• Stanley Adjuk	Kivalliq Wildlife Board, Chair
• Sam Iverson	Environment and Climate Change Canada
• Brian Sigardson	Rankin Inlet HTO, Vice Chair
• Clayton Tartak	Manager, Rankin Inlet HTO
• Ezra Greens	Consultant for Kivalliq Wildlife Board
• Mary Issumatardjuak	Arviat, A/Manager Arviat HTO

Introduction and Opening Remarks

Jason Akearok, the Nunavut Wildlife Management Board (NWMB) Executive Director welcomed participants to the call and introduced the Iqaluit NWMB participants.

The remaining participants, those in attendance in Iqaluit and those that called introduced themselves, stating who they were and who they were representing.
The Executive Director reminded those in attendance of the letter sent out by NWMB on September 25th outlining the items to be discussed on the conference call.

Location and Dates of Meeting

The Executive Director stated that, considering the logistical challenges of holding an in-person public hearing, the NWMB went ahead and tentatively booked The Siniktarvik Hotel and Conference Centre located in Rankin Inlet for the Western Hudson Bay Polar Bear Public Hearing. Dates of January 9 and 10 of 2018 have been selected as the optimal dates for the Public Hearing. The Conference Centre has been tentatively booked for these dates.
Paul Irngaut from Nunavut Tunngavik Incorporated (NTI) said that NTI was ok with the proposed dates and he will confirm with NTI's executive. The NWMB Executive Director informed the participants that the Government of Nunavut – Department of Environment (GN-DOE) did make a decision on Western Hudson Bay Polar Bear Total Allowable Harvest levels, increasing the number to 34 bears.
Drikus Gissing, Director of Wildlife Management, from the GN-DOE stated that the Minister has accepted and will implement the Board's decision.

Adequacy of consultations carried out by the Nunavut Department of Environment

Michael d'Eça, the NWMB Legal Advisor stated that the NWMB has the legal authority – and responsibility - to assess the adequacy of Government consultations carried out pursuant to the Crown's duty to consult Inuit when considering limitations on their harvesting rights. He underlined that the NWMB is not saying Government consultations regarding the Western Hudson Bay polar bear *Proposal for Decision* were inadequate. The NWMB acknowledges that the consultations were conducted in-person (Government travelled to almost all of the communities and made arrangements for Baker Lake HTO to participate) – which is very good. However, the NWMB noted during its September quarterly meeting that those consultations were sparsely attended, and the Consultation Report devoted little space to the discussions between Government and affected Inuit regarding the proposed level of regional total allowable harvest. The NWMB is raising this issue now to provide an opportunity for participants on the conference call to comment on those consultations. The NWMB wants to avoid potential complications later in the hearing process: If there are any concerns, it would be best to address them prior to the commencement of the hearing. However, if there are no concerns, the NWMB is satisfied to move on to the next agenda item.

Drikus Gissing (GN, DOE) asks for clarification as to where the NWMB legal authority comes from.

The NWMB Legal Advisor stated that the authority is grounded in case law - particularly at the Supreme Court of Canada (SCC) - developed over the last 10-15 years. The NWMB has formally maintained this position since 2012 (see NWMB *Governance Manual*). The 2 most recent examples are the *Clyde River* and *Chippewas of the Thames* cases, in which the SCC addressed questions concerning the role of regulatory agencies with respect to the Crown's duty to consult.
The NWMB was an intervenor in both SCC cases, and the resulting judgments have reinforced the NWMB's interpretation of the law.

Drikus Gissing (GN-DOE) reminded everyone that there is a need for the Board and management authorities in Nunavut to have a discussion on this specific issue. He said the government of Nunavut does take their responsibility to consult very seriously. He argued that NWMB criticism of government consultation often fail to take into account the difficulties in achieving "adequate" consultations especially in cases where people do not want to attend consultation meetings. He added the NWMB should provide the government with a consultation guideline that it will consider adequate. Referring to the 2017 Western Hudson Bay consultations, he said adequate notice was given. He agreed that the timing was not the best and GN-DOE could probably have done more. Generally, the GN-DOE tries not to have summer consultations. However, the problem GN-DOE ran into was that the pressure from the communities on the government to make a decision in time for the 2017-2018 harvest season was enormous. Communities did not want to lose out on the entire hunting season.

NWMB Legal Advisor stated that he agrees with Drikus, co-management partners should meet to discuss this matter. He said all parties have a stake in ensuring effective consultations, and we all want to keep in line with the developing law. NTI, the NWMB and GN were going to meet last spring, that was put off until the *Clyde River case* was settled. It was assumed that this winter or coming spring that that meeting will happen.

Paul Irngaut (NTI) supported Drikus's point that it can be very hard to conduct effective or adequate consultations when communities do not attend consultation meetings. He asked if adequate notice was provided? He further said it is probably time to think outside the box and consider new ways to reach more people in the communities. He said community radio-based consultations could be one of the ways by which the government could reach a more representative audience.

Stanley Adjuk from the Kivalliq Wildlife Board stated that when we talk about consultations, they are done at the wrong time. Summer is a busy season; no one is around. Best time would be winter months. More on radio, social media. People will see the social media items immediately.

The NWMB Executive Director stated that when a proposal comes in for the NWMB to make a decision, there are NWMB procedures that are to be followed, which can take time, as per the NWMB Governance Manual.

The NWMB Executive Director also reminded everyone that the Board made an interim decision in September which was accepted by the GN-DOE. In that decision, the Board also decided to hold the public hearing as soon as possible.

Towards the end of the discussion of this agenda item, the Executive Director asked the teleconference participants if anyone had concerns with the adequacy of the Department's 2017 consultations concerning Western Hudson polar bears. No party raised any concerns. As a result, the NWMB Legal Advisor suggested that – with everyone reasonably satisfied with the adequacy of the consultations - the participants could move on to the next agenda topic. No objections were raised to that suggestion.

Participant Funding to Attend the Hearing

The NWMB Executive Director spoke to the participants about funding to attend the Public Hearing. The NWMB position is that there is no legal obligation on the NWMB to fund travel and accommodation costs for parties attending NWMB hearings. However, for this hearing, due to the circumstances, the NWMB will cover travel and accommodation costs as well as per diems. No honoraria will be provided to the hearing delegates. The NWMB will cover expenses for ten (10) participants, chosen by the Kivalliq Wildlife Board.

Paul Irngaut (NTI) inquired if these participants would be Hunter and Trapper Organization members, or elders?

The NWMB Executive Director stated it would be up to Kivalliq Wildlife Board to make those decisions.

Harry Aggark, the Chair of the Chesterfield Inlet HTO asks whether they can send HTO representatives, HTO chairperson and HTO manager?

The NWMB Executive Director restated it would be up to you and the Kivalliq Wildlife Board to make that decision.

Harry Aggark asked for if the elder has to be an HTO member?

The NWMB Executive Director stated that in previous hearings each community sent one delegate (1) was the HTO Chair and the other one (1) was an elder but that the elder wasn't necessarily an HTO Board member. It is up to the Kivalliq Wildlife Board, in consultations with the Kivalliq HTOs, to make that decision.

Paul Irngaut (NTI) clarified that the HTO would have the option of inviting someone else at their own expense?

The NWMB Executive Director stated that the invitation is extended to anyone from the communities. Beyond the ten (10) delegates funded by the NWMB, the HTO's and RWO would be responsible for funding any additional participants.

Other Relevant Issues

Drikus Gissing (GN-DOE) said that the Minister's decision regarding the Western Hudson Bay polar bear Total Allowable Harvest can now be made public. He further stated that the Minister does not consider the current decision as an "interim" decision meaning that the decision is final and will stay in place until a new NWMB decision is made. It could be 2-3 years or it could be in 6-months time. It's not an interim decision from our perspective, it's going to go into Regulations.
We have run into this problem in the past with interim decision. When there is no new information coming forward. This decision is not viewed by GN-DOE as an interim decision. It creates difficulty and misunderstanding when you use the word interim. To avoid that, this decision will stay in place until the Board makes another decision.

NWMB Legal Advisor agreed with Drikus that this NWMB decision – duly accepted and implemented by the Minister - will remain the legal harvesting limit for Western Hudson Bay polar bears until such time as the next *Nunavut Agreement* Article 5 decision-making process for Western Hudson Bay polar bears is completed. He went on to suggest that – in order to avoid confusion - the term "*interim*" should, in future, only be used in connection with *Nunavut Agreement* S.5.3.24 "*Interim Decisions*".

Ezra Greens wanted to know if participant funding will be distributed equally among HTO.

The NWMB Executive Director stated that the Kivalliq Wildlife Board will be responsible for the selection of participants and will decide how many participants will be invited from each community. He said NWMB's rationale for the ten (10) delegates is that it would be two (2) participants from each of the communities that harvest from the Western Hudson Bay Polar Bear population.

Chris Jones asked why Chesterfield Inlet and Baker Lake are included in harvesting from the Western Hudson Bay Polar Bear subpopulation given that there are outside the Western Hudson Bay boundaries.

Drikus Gissing (GN-DOE) stated that the HTO should have an answer to his question and that the information could be forwarded to him.

Drikus Gissing (GN-DOE) also said that the RWO's are the ones that decide which communities harvest from which subpopulation and that the GN-DOE tries to stay out of those decisions. On the allocation, he said the RWOs will decide how the TAH is allocated between communities, probably during their next Board meeting.

The NWMB Executive Director states the GN has accepted the NWMB decision of 34. As part of the implementation process, the Kivalliq Wildlife Board decides on the allocation of the regional total allowable harvest among those communities that harvest Western Hudson Bay polar bears. It could be an opportunity for KWB and the HTOs to discuss how the allocation can be distributed amongst the five communities.

Next Steps and Closing Remarks

The NWMB Executive Director mentions that the NWMB will send out a letter summarizing the information discussed.

Conference call ended at 3:25 pm.

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Nunavunmi Anngutighatigut Aulapkaijitkut Katimajiat
Nunavut Wildlife Management Board

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Tammaqtailinahuarniriit anngutighat atuqhugit Inuit qaujimajatuqangillu ilihimaniillu ilitquhiannin
Conserving wildlife through the application of Inuit Qaujimajatuqangit and scientific knowledge

October 20th, 2017

Honourable Catherine McKenna
Minister of Environment and Climate Change
Government of Canada

Honourable Joe Savikataaq
Minister of the Environment
Government of Nunavut

Aluki Kotierk
President
Nunavut Tunngavik Inc.

Honourable Rochelle Squires
Minister of Sustainable Development, Government of Manitoba

Stanley Adjuk
Chairperson
Kivalliq Regional Wildlife Board

Gordy Kidlapik
Chairperson
Arviat Hunters and Trappers Organization

Jamie Seeteenak
Chairperson
Baker Lake Hunters and Trappers Organization

Robert Enuapik
Chairperson
Issatik Hunters and Trappers Organization

Brian Sigardson
Vice-Chairperson
Kangiqliniq Hunters and Trappers Organization

Barney Aggark
Chairperson
Aqigiq Hunters and Trappers Organization

David Miller
President and CEO
World Wildlife Fund

Stas Olpinski/Christine Cleghorn
Co-Chairpersons of the Polar Bear Administrative Committee

Nick Lunn/Dag Vongraven
Co-Chairpersons of the IUCN/SCC Polar Bear Specialist Group

Dear Colleagues:

Re: In-person public hearing of the Nunavut Wildlife Management Board concerning the regional total allowable harvest level for the Western Hudson Bay polar bear sub-population

The Nunavut Wildlife Management Board (NWMB or Board) has scheduled an in-person public hearing concerning the level of regional total allowable harvest for the Western Hudson Bay polar bear subpopulation.

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Background

On September 12th, 2017, during the NWMB's In-Camera Meeting (IC 003-2017), the Board considered the Government of Nunavut-Department of Environment's Proposal for Decision concerning the level of regional total allowable harvest for the Western Hudson Bay polar bear subpopulation. At this meeting, the Board passed the following resolution:

RESOLVED that the NWMB approve, pursuant to Section 5.6.16, 5.6.17(b), 5.3.3(a), and 5.3.3(c) of the Nunavut Agreement and as an interim measure due to urgent circumstances, an increase of six (6) bears to the regional total allowable harvest in the Nunavut Settlement Area for the Western Hudson Bay subpopulation, resulting in an overall regional total allowable harvest of 34 bears for the 2017-2018 harvest season.

FURTHER RESOLVED that the NWMB hold an in-person public hearing at the earliest possible opportunity concerning the future (2018-2019 and subsequent harvest seasons) level of the regional total allowable harvest in the Nunavut Settlement Area for the Western Hudson Bay subpopulation.

On October 3rd, 2017, the NWMB held a pre-hearing teleconference with hearing parties to discuss the date and location for the hearing, the adequacy of consultations conducted by the Government of Nunavut, the available funding for participants to attend the hearing and any other relevant issue that the parties wished to raise. No concerns were raised on the above-mentioned issues by participants on the teleconference (see attached minutes).

In-person public hearing details:

The hearing will take place on January 9th and 10th, 2017, in Rankin Inlet, Nunavut at the Siniktarvik Hotel and Conference Center. The Hearing will be conducted each day from 9 am to 5 pm. If necessary, the NWMB will also hold evening sessions from 7:00 pm to 9:00 pm.

The Board is able to pay travel, per-diems, and accommodation costs for up to ten (10) representatives from the Kivalliq Region of Nunavut to attend the hearing. The representatives will be selected by the Kivalliq Wildlife Board.

The hearing rules and additional documents comprising the best available information to date – are available for download from the NWMB's website (www.nwmb.com), or by contacting the Board at the following coordinates:

NUNAVUT WILDLIFE MANAGEMENT BOARD
P.O. Box 1379, Iqaluit, NU, X0A 0H0
Phone: (867) 975-7300
Fax: (888) 421-9832
Email: receptionist@nwmb.com

Through this letter, the NWMB is extending an invitation to your department or organization to provide written submissions and supporting documentation in response to the Government of Nunavut-Department of Environment's Proposal, Written submissions must be filed with the NWMB – in Inuktitut and English – by no later than 5:00 p.m. (Iqaluit Time) on November 24th, 2017. The requirement for translation at the time of filing is mandatory.

Subject to relevant confidentiality or privacy concerns, all submissions and supporting documentation will be placed on the NWMB's website, and will be available for download.

Please take careful note that, unless persuasive written and translated reasons are provided to the Board for late filing, the NWMB will not consider materials for this hearing that are not filed on time.

Submissions and their supporting documentation may be filed with the Board in person, by courier or by mail. They should be clearly marked as pertaining to the *NWMB Public Hearing for Western Hudson Bay Polar Bear.* Delivery of materials may also be made through fax or electronic transmission, but only if your department or organization confirms with the NWMB – prior to the filing deadline – that a complete and legible copy of the transmission has been received by the Board. Materials are deemed to have been filed on the actual day of receipt by the NWMB.

Please keep in mind that the more thorough, reliable and persuasive submissions and supporting documentation are, the more weight they will be given by the NWMB in the *Nunavut Agreement* decision-making process.

If you require further information, please do not hesitate to visit the NWMB website or to contact the Board directly.

Sincerely,

Daniel Shewchuk
Acting Chairperson of the
Nunavut Wildlife Management Board

Attachments (3)

c.c. Lisa Pirie-Dominix, Head of Eastern Arctic Section, Canadian Wildlife Service;
Caroline Ladanowski, Director Wildlife Management and Regulatory Affairs Division, Canadian Wildlife Service;
Daniel Watson, Chief Executive Officer, Parks Canada Agency
Marilyn Peckett, Superintendent, Manitoba Field Unit, Parks Canada Agency;

Drikus Gissing, Director of Wildlife, Government of Nunavut Department of Environment;
James Duncan, Director of Wildlife and Fisheries Branch, Manitoba Sustainable Development;
Daryll Hedman, Northeast Region Director, Manitoba Sustainable Development;
Paul Irngaut, Director of Wildlife and Environment, Nunavut Tunngavik Incorporated;
Qovik Nester, Regional Coordinator, Kivalliq Wildlife Board;
Jason Mikki, Acting Executive Director, Nunavut Inuit Wildlife Secretariat;
Brandon LaForest, Senior Specialist, Arctic Species and Ecosystems, World Wildlife Fund Canada.

NOTICE OF NUNAVUT WILDLIFE MANAGEMENT BOARD
IN-PERSON PUBLIC HEARING

Notice is provided on October 20th, 2017 that the Nunavut Wildlife Management Board (NWMB or Board) will be conducting an in-person public hearing to consider the Government of Nunavut-Department of Environment's *Proposal for NWMB Decision* (Proposal) concerning the total allowable harvest of the Western Hudson Bay polar bear subpopulation. The Proposal and documents relevant to the hearing are available for download from the NWMB's website (www.nwmb.com), or by contacting the NWMB at the coordinates set out at the end of this notice.

The Hearing is scheduled to take place in **Rankin Inlet, Nunavut** at the **Siniktarvik Hotel** from **January 9th and 10th** from 9am to 5pm each day. In addition, the NWMB may hold evening sessions from 7:00pm to 9:00pm.

The filing of submissions:

The NWMB is inviting interested organizations or persons, including any member of the public, to file written response submissions and supporting documentation concerning the Proposal by **5:00 p.m. Iqaluit time on November 24th, 2017**. The NWMB will not accept or consider materials filed after the deadline unless persuasive written reasons are provided. All submitted written materials will be publically available on the NWMB's website, subject to relevant confidentiality or privacy concerns.

How to obtain more information:

To receive more information about filing or obtaining submissions or the rules applying to the in-person public hearing, please contact the NWMB:

NUNAVUT WILDLIFE MANAGEMENT BOARD
P.O. Box 1379, Iqaluit, NU X0A 0H0
Phone: (867) 975-7300
Fax: (888) 421-9832
Email: receptionist@nwmb.com
Website: www.nwmb.com

POLAR BEAR MANAGEMENT
MEMORANDUM OF UNDERSTANDING

BETWEEN

Arviat
Arviat Hunters' and Trappers' Organization

Baker Lake
Baker Lake Hunters' and Trappers' Organization

Chesterfield Inlet
Aqigiq Hunters' and Trappers' Organization

Rankin Inlet
Aqiggiaq Hunters' and Trappers' Organization

Whale Cove
Issatik Hunters' and Trappers' Organization

Kivalliq Wildlife Board

and

The Department of Environment

FOR THE MANAGEMENT OF THE "WESTERN HUDSON" POLAR BEAR POPULATION

March 9, 2005

The following Polar bear Management Memorandum of Understanding (MOU) recognizes and respects both the Agreement between the Inuit of the Nunavut Settlement Area and her majesty the Queen in Right of Canada (The Nunavut Land Claims Agreement or NLCA), and the jurisdiction of the Nunavut Wildlife Management Board (NWMB) under the NLCA. Accordingly, this MOU shall, where appropriate, constitute recommendations for consideration by the NWMB.

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MEMORANDUM OF UNDERSTANDING FOR THE MANAGEMENT OF THE WESTERN HUDSON POLAR BEAR POPULATION

Section 1.0
Definitions/Assumptions

1.1 The species considered in this Memorandum of Understanding (MOU) is the polar bear (*Ursus maritimus*).

1.2 The polar bear population covered by this MOU is the Western Hudson Polar Bear Population, hereafter referred to as (WH) as shown in the map in Appendix 1. However, this MOU is for polar bear management practices within the (WH) population boundaries and the Nunavut Territorial borders only.

1.3 Outpost camps associated with a community, and not having organized their own Hunters' and Trappers' Organization (HTO), are considered part of the local HTO and party to this MOU.

1.4 "Conservative Harvest Rate" means the number of bears that can be taken per year with not more than 10% risk of a population decline that would require more than 5 years of harvest moratorium to recover to the current number over a 15-year period starting from the most recent population inventory. It is recognized that the population is expected to grow when harvested at the "Conservative Harvest Rate".

1.5 "Guided Harvest Rate" means the number of bears that can be taken without reducing the population below the target number. The "Guided Harvest Rate" is based on Inuit Qaujimajatuqangit (IQ), perception of trend, and probability of increase or decline. The "Guided Harvest Rate" must be consistent with the principles of conservation identified in the Nunavut Land Claim Agreement (NLCA).

1.6 "Total Allowable Harvest" (TAH) for the (WH) polar bear population means the number of polar bears that can be harvested annually at a sex ratio of 2 males per 1 female as established by the NWMB pursuant to Sections 5.6.16 to 5.6.18. For clarity (see also Section 1.10), the TAH identified in this MOU serves as a recommendation to the NWMB, and is understood to come into effect only after it is approved as a decision by the NWMB.

1.7 "Credit" is that part of an HTO's share of the TAH that is not harvested in the year it is allocated.

1.8 "Flexible Quota System" is protocol for ensuring that the kill of both males and females remains within the TAH for each sex.

1.9 "Target Number" is the management goal for the population size of the (WH) population.

1.10 This MOU supersedes any previous polar bear management agreement for the (WH) population, and will come into effect after it has been reviewed and accepted by the Nunavut Wildlife Management Board (NWMB).

1.11 The terms and conditions of this MOU will not be changed without the consent of all the signatories. This MOU may be reviewed anytime there is new information or a management issue. If one of the signatories wishes to revisit some aspect of the MOU, they shall provide notification to all other parties, and allow 90 days for a response. Once all the signatories have agreed to an amendment, it will come into effect after it has been reviewed and accepted by the NWMB.

1.12 For the purpose of this MOU, a Nunavut beneficiary shall be considered to include any person who has received an assignment of rights to hunt polar bears and any person who has been designated as an Inuk as per the NLCA. For greater certainty, a person assigned a share of the polar bear TAH under the NLCA section 5.7.34(b) is not to be considered an Inuk under the NLCA unless the person is an Inuk under the NLCA.

Section 2.0

Objectives

2.1 To manage polar bears to simultaneously maximize benefits to beneficiaries of the NLCA; safeguard the interests of future generations of hunters; and ensure good conservation of polar bears by keeping the risk of population decline due to over-harvest within the acceptable level in accordance with the best information available, including comprehensive harvest statistics.

2.2 To encourage the collection of Inuit Qaujimajatuqangit and scientific information on a timely basis to guide management decisions.

2.3 To ensure that the (WH) polar bear population remains abundant and productive. The target number for the polar bear population of the (WH) population is (1400).

2.4 To identify a management approach that meet the needs and preferences of the hunters that harvest polar bears from the (WH) population and is also consistent with the NLCA and the Wildlife Act.

2.5 To conserve female polar bears in order to mitigate the impact of harvesting on the (WH) population, and encourage the number of polar bears in the (WH) population to attain and retain the target number. This requires harvesting the TAH at 2 or

more males per female taken. It is recognized that it would be to the benefit of the (WH) population to keep the proportion of males harvested as high as possible.

2.6 To minimize detrimental effects of human activities, especially commercial activities, to the polar bears and polar bear habitat of the (WH) population.

2.7 To encourage the wise use of polar bears and all polar bear products of the (WH) population.

2.8 To identify research priorities and ensure participation of local people in research activities and the collection of harvest data for the (WH) population.

2.9 To hold management meetings with representatives of the parties to this MOU at least once every 7 years to review and update information and set direction for the continuing management of polar bears.

Section 3.0
Hunters' and Trappers' Organization (HTO) Determinations

3.1 As per the NLCA, the HTO may develop rules for non-quota limitations and manage harvesting among members.

3.2 Within one year of the signing of the MOU, the HTO will develop and record its rules for harvesting polar bears. Such HTO rules only require formal NWMB approval to be valid if they are inconsistent or in conflict with:

i) existing provisions of the MOU that constitute plans for the management or protection of polar bears or their habitat, or
ii) TAH, non quota limitations or TAH rules established by the NWMB.

Once these rules have been approved at a meeting of the members (e.g., an Annual General Meeting) and, if necessary by the NWMB. The rules will be considered to be part of this MOU and will be recorded in Appendix 4. ***Community HTO Polar Bear Hunting Rules***. As a courtesy, the HTO shall inform the Dept of Environment and the NWMB of any new rules or amendments to existing rules.

3.3 The HTO will interpret and enforce these rules as internal business, but the rules will not be part of the regulations.

3.4 The polar bear harvest year shall be from July 1 to June 30 of each year. The HTO shall open and close their polar bear hunting season as they choose to optimize polar bear hunting for their community.

Section 4.0

Regional Wildlife Organization (RWO) Determinations

4.1 The relevant RWO will have the authority to distribute any accumulated harvest credits as required to cover accidental, defence, or illegal kills. The RWO may also return credits annually to augment a community's harvest. Credits may not be transferred between communities that share a population without the written consent of the community that accumulated the credit.

4.2 The Dept of Environment shall support the RWO by maintaining an up to date record of the harvest credits. The Dept of Environment will provide the RWO a summary of the harvest credits as part of the annual harvest report by July 1st each year. For clarity, the available credits will be automatically allocated to retain the full TAH for each community. The RWO shall provide the Dept of Environment with their decisions on credit allocations and the Dept of Environment shall retain and archive all administrative records. The full administrative records for harvest credits shall be available for the RWO on request. The Dept of Environment shall advise the RWO as requested on the optimal allocation of credits to maximize harvest opportunities for Nunavut beneficiaries.

Section 5.0

Regulations

5.1 Definitions

5.1.1 "Cub" means a young polar bear that is less than one year of age.

5.1.2 "Yearling polar bear" means a polar bear that is older than one year of age, but less than two years of age and is still with its mother.

5.1.3 "Two-year old" means a polar bear that is two years of age or older, but less than 3 years of age, and is still with its mother.

5.1.4 "Family group" means a group of polar bears that consists of a mother with a cub/cubs, a mother with a yearling/yearlings, or a mother with a two-year old/olds.

5.2 Evidence Age/Sex

5.2.1 The parts that evidence the age, species, and sex of a polar bear are teeth for the age; the jaw or skull for the species; and the baculum of the male polar bear for

the sex. When the baculum has been lost or forgotten the DNA determination shall also constitute evidence of the sex. Where evidence is not provided, the kill will be counted as a female polar bear for TAH purposes.

5.2.2 It is recognized from traditional knowledge that polar bear cubs are born in November and December. The age of a cub will be determined by the degree of canine tooth eruption for cubs, and the annular rings for cubs, yearlings, and two-year olds when the skull, jaw or a tooth is present.

5.3 Prohibitions

5.3.1 No person shall hunt:

(a) Any member of a family group. If the female of a family group of cubs, yearlings, or two-year olds is killed, the cubs, yearlings, and two-year olds will be regarded as killed as well.

(b) A female polar bear that is using a den, or a female polar bear that is constructing a den.

5.4 Harvesting of Cubs and Yearlings

5.4.1 All polar bears that are not members of a family group (i.e., are by themselves) may be harvested. If a cub or yearling is found without its mother, it may be harvested, but it must be reported to the Wildlife Officer and the HTO as soon as possible.

5.4.2 The HTO may apply to the Minister for a Wildlife Management Permit to allow cubs or yearlings to be harvested for food and cultural purposes. The permit must be issued in advance with a copy to the Wildlife Officer, and the HTO must monitor the hunt to ensure that the female (mother) is not harmed.

5.5 Total Allowable Harvest (TAH)

5.5.1 (a) Determination of the TAH

For the first seven (7) years following an accurate population inventory, the TAH shall be set as the "Conservative Harvest Rate".

For the next seven (7) years, or until a new population inventory has been completed, the TAH shall be set as the "Guided Harvest Rate".

When there is no reliable population inventory information, the TAH shall be set as the "Guided Harvest Rate".

Table 1:
The numbers attributed to Nunavut communities and any jurisdictions that share the (WH) polar bear population indicate the respective share of the Total Allowable Harvest (TAH) that is allocated to each community or jurisdiction that harvests from the (WH) population. These values represent the basic annual allocation of the TAH to the community. The actual number of tags received in any given year to Nunavut communities will not exceed this number (unless the RWO allocates credits from previous years), but may be decreased as required for over-harvest of males or females in any given year as per the Nunavut Flexible Quota System described in Appendix 2.

Allocations of the TAH (64) from the (WH) population (N=1400)

NUNAVUT	TAH	TOTAL
Arviat	20 + 2	22
Chesterfield Inlet	1 + 2	3
Whale Cove	12 + 2	14
Rankin Inlet	12 + 2	14
Baker Lake	2 + 1	3
subtotal	**47 + 9**	**56**
OTHER JURISDICTION	**TAH**	**TOTAL**
Manitoba	8	8
subtotal	**8**	**8**
TOTAL (WH)	**64**	**64**

5.5.2 Tags issued for the (WH) population may be used within the geographical area defined for this population and up to 30 km (17 miles) outside of the boundary after agreement has been reached with HTOs that are signatory to the polar bear management MOU in the adjoining populations.

5.5.3 Tags issued for Polar Bear Populations that border the (WH) population may be used up to 30 km (17 miles) inside of the (WH) population.

5.5.4 The 30 km (17 miles) rule does not apply to inter-jurisdictional borders unless there is a cross-boundary overlap agreement; it only applies to populations within the Nunavut Territory.

5.5.5 Unused tags will not be carried over for use in a subsequent hunting season. After June 30th, all unused tags will be turned over to the Dept of Environment. These returned tags will be counted as credits to the community and administered by the appropriate RWO.

5.6 Specimens/Information

5.6.1 The following shall be collected from each polar bear killed:

(a) Lower jaw;
(b) Ear tags, if present;
(c) Lip tattoos, if present;
(d) Evidence of sex (baculum), or as per Section 5.2.1, from all male polar bears;
(e) Any other polar bear specimens as agreed by the HTO or individual hunter for any additional studies. For clarity, this stipulation means that this MOU constitutes HTO support for the use of the polar bear specimens referred to in subsection 5.6.1(a) to (e) for Dept. of Environment research studies.

NOTE: The specimens identified in 5.6.1 (a,b,c,and d) are mandatory, however they can be returned if requested by the hunter. Returned specimens will be sent within 6 months of being received by the laboratory. If a polar bear with a radio collar is taken, the radio collar will be turned in to the local HTO for return to the research project. Any damage to the meat or hide from polar bear research activities will be compensated for by the research project as per Section 5.6.4.

5.6.2 The Dept of Environment agrees to compensate hunters for their work to collect and label the required specimens at the following rates:

(a)	Lower jaw or skull:	$45.00
(b)	Ear tags:	$30.00
(c)	Lip tattoos:	$40.00
(d)	Baculum:	$100.00

5.6.3 The hunter is required to provide the following data, which are recorded for each polar bear killed:

(a) Hunters name and full address including country;
(b) Date of kill;
(c) Location of kill;
(d) Sex;
(e) Tag number; and
(f) Any other information that is required by the Wildlife Officer.

5.6.4 Any damage to the hide from research activities will be compensated for based on the reduced amount of the hide's market value. When the meat has been made unfit for human consumption by chemical immobilization within one year of the date of harvest, $300.00 compensation will be paid to the hunter who harvested the polar bear.

5.6.5 The Dept of Environment will provide an annual report of population and community harvest statistics, and recommendations for the next year's TAH, by July 1st of each year for the HTOs and RWOs to review and to assist the NWMB in setting TAH for the following year.

5.7 Response to Population Depletion

5.7.1 This agreement recognizes that the estimates of population numbers, birth and death rates, and acceptable harvest levels are uncertain. For that reason there is a small chance that the population will decline. The Dept of Environment intends to conduct a population inventory every 15 years. If the new research indicates that the population has declined below 90% of the target number for any reason, a moratorium on harvesting will be implemented until the population is projected to have recovered, or until a new population estimate shows that it has recovered to its target number. If the new research indicates that the population has declined by no more than 10% of the target number for any reason, a reduction in TAH will be implemented that is projected to be sufficient to allow the population to recover to the target number in 15 years or less.

5.8 Development of Regulations

5.8.1 The Dept of Environment will develop the wildlife regulations required to implement this MOU.

Section 6.0

Application of Tags to Total Allowable Harvest

(Administration of the Flexible Quota System)

6.1 All human caused polar bear kills will be taken from the TAH of the nearest community, or from a community within the (WH) population with unused tags, if that community agrees. In the event that the human caused mortality exceeds the TAH, additional tags will be issued and the number of additional tags issued will be deducted and counted as part of the next year's TAH. A naturally abandoned cub or yearling will be counted as a natural death. Polar bear cubs caught in traps and/or netting set for other species shall be recorded as part of the human kill. For TAH determination purposes, the cubs will be counted as males, and will require one half tag each.

6.2 When a Nunavut beneficiary residing in a WH population community kills a bear in the WH population, the tag will come from their home community. If his/her home community has utilized all of its tags, the tag may be used from any

available credits; or another (WH) population community with their consent. If the kill is accidental, illegal, or is carried out in defence and no tags or credits are available from the home community or provided by another WH population community, a tag must be taken from next year's TAH of the home community.

6.3 When a female with accompanying cubs, yearlings, or two-year olds is killed in the defence of life or property, the cubs, yearlings, and two year olds are also regarded as killed (removed from the population). For TAH determination purposes, the cubs and yearlings will be counted as males, and require only half tag for each cub. The two-year olds will receive a full tag and be counted as their actual sex if killed, or one-half male and one-half female if they are not killed.

6.4 The number of TAH tags allocated in a given year depends on the communities share of the (WH) population's acceptable annual harvest rate of both males and females, the actual number of males and females killed in the previous year, and the proportion of females in the total harvest in the previous year. The Nunavut Flexible Quota System determines the TAH for the current year as described in Appendix 2.

6.5 The implementation of the Nunavut Flexible Quota System will consider the current polar bear harvest credits (see Appendix 2). As per Appendix 2, no reductions in TAH will occur unless there are no polar bear harvest credits available to address the over-harvest. Unharvested males and females are considered as credits to address any problems resulting from over-harvest of males or females in a particular year, or can be allocated in future years. In the case of one-half tag reductions to the TAH (i.e., cubs and yearlings that were still with their mother or cubs caught in traps set for other species), no TAH reductions will be made until a whole tag (i.e., one full tag) reduction is required.

6.6 Community credits shall be used to cover defence, illegal, or accidental kills before the community TAH is reduced. The appropriate RWO will take the final decision after a review of the HTO request and a summary of the incident has been provided by the community Wildlife Officer.

6.7 The complete rules for administration of the Nunavut Flexible Quota System are contained in Appendix 2. The regulations will not be modified year by year, rather the polar bear TAH for a given year will be determined based on the Flexible Quota System described above and in Appendix 2.

6.8 Any person finding a dead polar bear should report the bear to the nearest HTO or Wildlife Officer, and if the hide or any parts have been taken, they shall be turned over to the Wildlife Officer for investigation. When the investigation is complete and it is concluded that the death was by natural causes, the hide and all parts of the bear will be returned to the nearest HTO, and it will not be counted against the

TAH. The existing certification of wildlife regulations will apply to all natural kills. If the specimens identified in Section 5.6.1 are collected, the person shall be compensated according to Section 5.6.2 by the Dept of Environment.

6.9 The TAH will not be reduced in future years just because the full TAH is not taken in any given year. Unused tags will be recorded as credits and can be reallocated in subsequent years at the discretion of the appropriate RWO.

Section 7.0

Research and Management

7.1 The intention of the Dept of Environment is to conduct population inventory studies every 15 years to determine the numbers, and rates of birth and death for the (WH) population. Harvest statistics will continue to be collected. The results of these studies will guide future management of this population. The intended date to begin the next (WH) population inventory is 2005 (open water season).

7.2 Community residents (priority to HTO members) shall have the opportunity to participate in polar bear research projects.

7.3 This MOU shall constitute consultation and support for the periodic polar bear population inventory studies identified in Section 7.1. These studies shall be done in partnership with the relevant HTOs and RWOs.

7.4 When a tooth referred to in Section 5.2.1 is not available for the purpose of determining the age, the age of a cub shall be determined by expert testimony (i.e., Qaujimanilik) if there is any question.

7.5 When tag is used for a defence or accidental kill by a non-Nunavut beneficiary, it reduces polar bear harvest opportunities for Nunavut beneficiaries who have been identified as requiring the TAH in Article 5.6.5 of the NLCA. Compensation for that loss is required from the party whose activities caused the destruction of the bear. The parties of this MOU call upon the NWMB as the primary instrument of wildlife management to identify the most appropriate administrative process to ensure that communities that lose tags to non-beneficiary polar bear kills are fairly compensated.

(a) All polar bears killed in or during polar bear research activities or the Dept of Environment approved activities (i.e., research permit issued) will receive a tag from the nearest community and the community will be compensated at $5,000.00.

(b) Currently the direction of the NWMB and the RWOs is that the hide, meat, and all parts from emergency kills (i.e., accidental, defence, or research kill) will be returned to the HTO. When there is an irregular kill, the investigating officer will seize the parts of the bear necessary to complete the investigation. The specimens identified in Section 5.6.1 shall be collected and the Dept of Environment shall provide compensation to the HTO as per Section 5.6.2. When it has been determined that the kill was an accidental, defence, or research kill, the Wildlife Officer shall ensure that all seized parts from that kill shall be turned over to the local HTO. The cleaning and drying of the hide will be arranged and paid by the HTO because the HTO shall retain the hide.

(c) If there is any dispute on the disposition of the hide, meat, or parts of the bear from an emergency kill, the decision on the disposition of all bear parts is deferred to the appropriate RWO.

(d) There shall be no payment to the HTO or the hunter for specimens, or for cleaning and drying the hide of a bear taken illegally. As per the Wildlife Act, all seized parts from bears taken illegally shall be disposed of as directed by the appropriate judicial authority.

7.6 HTOs and the Dept of Environment will:

(a) Research and develop better methods to:
i) Deter problem bears,
ii) Prevent polar bear damage to property,
iii) Prevent loss of meat caches to polar bears. and

(b) Work co-operatively with all jurisdictions that share this population to reduce human impacts from research, tourism, and problem bear control activities.

7.7 Within one year from the signing of this document, the Dept of Environment will ensure that a community based polar bear deterrent plan had been formulated and implemented.

7.8 The terms and conditions of this MOU will also apply on lands within National Parks, Federal Bird Sanctuaries, and National Wildlife Areas.

7.9 If a bear is found that is near death from natural causes, and will not recover, a hunter may take this bear as a humane action. The Wildlife Officer will require the carcass and the hide from the hunter for purposes of conducting an investigation to determine if it was a humane kill. A humane kill will be considered a natural death and will not be taken off the TAH, and the hide and all parts will go to the HTO after the Wildlife Officer has seized the hide and carcass and completed the investigation.

7.10 The HTO may, at their discretion, use a portion of the community TAH for sport hunting. The Dept of Environment will assist any HTO that wishes to develop polar bear sport hunts for their community.

7.11 A polar bear co-management agreement should be developed that includes all jurisdictions that harvest from the (WH) population.

7.12 Inuit Qaujimajatuqangit (IQ) will be incorporated in polar bear management.

(a) The rules established by the HTO to regulate local hunting practices will reflect the wisdom, spirit and information of IQ.

(b) It is recognized that information about denning areas, feeding areas, season concentration areas, behaviour, and the general ecology of polar bears is held collectively by the Inuit, but much of this information has not become a part of the scientific information. The Dept of Environment will support and endeavour to collect and archive the information relevant to conservation and public safety.

(c) Recognizing that information about polar bear population demography (i.e., analysis of the standing age distribution and mark-recapture data) and population boundaries (i.e., observations of the movements of marked bears and radio collared bears) is not a part of IQ, and recognizing that IQ is a living and evolving knowledge system. The scientific information on population dynamics and population boundaries will be transferred by improved communications, and by ensuring participation of local people in research projects and management decisions. The goal is that one day all the information about polar bears will be held in common as science, TEK, and IQ.

Section 8.0
Western Hudson Population Signature Block

x_____ date:_____
Peter Kritaqliluk
Chairman
Arviat Hunters' and Trappers' Organization

x_____ date:_____
David Aksawnee
Chairman
Baker Lake Hunters' and Trappers' Organization

x_____ date:_____
Jimmy Krako
Chairman
Aqigiq Hunters' and Trappers' Organization (Chesterfield Inlet)

x_____ date:_____
Jerome Tattuinee
Chairman
Aqiggiaq Hunters' and Trappers' Organization (Rankin Inlet)

x_____ date:_____
Jack Angoo
Chairman
Issatik Hunters' and Trappers' Organization (Whale Cove)

x_____ date:_____
David Alagalak
Chairman
Kivalliq Wildlife Board

x_____ date:_____
Olayuk Akesuk
Minister
Deptartment of Environment
Government of the Nunavut Territory

Appendix 1.
WESTERN HUDSON (WH) Polar Bear Population

Boundary was based on the movements of satellite radio-collared polar bears, mark-recapture movements, and guided by the hunting practices and information of local people.

Appendix 2.

Rationale and Administration of the Flexible Quota System

INTRODUCTION

The flexible quota system for polar bears assumes that the annual maximum sustainable yield of males and females for a given population has been divided between the communities that share that population. Each community receives its share of the maximum sustainable harvest of males and females as an annual baseline allocation. For polar bears, the maximum harvest that can be sustained is realized when the harvest is 2 males for every female. However, not every community can harvest exactly 2 males per female every year. In some years, the full allocation may not be taken. In other years the kill may exceed the annual base allocation of males or females. The flexible quota calculation takes into account:

1) Any "credits" from previous years when not all the bears were harvested,
2) The total number of males killed or removed from the population, and;
3) The total number of females killed or removed from the population.

ADMINISTRATION / ACCOUNTING

The flexible quota system is nothing more than system for administering the portion of the total population maximum sustainable yield that has been allocated to a given community. First the sustainable yield of males and females for a given population must be identified. Next the total sustainable yield must be divided among the communities that share a given population. Then the base annual allocation for each community is established and the flexible quota system is used to adjust the TAH as required to keep the kill within sustainable limits.

Simulation modelling has shown that, for polar bear populations about twice as many males as females can be harvested. The sustainable number of females is defined as the number that can be removed without causing a decline in the number of females in the population. However, it is different for the males. Because the males do not produce the cubs, twice as many can be taken. A 2M:1F harvest sex ratio does reduce the number of males in the population to about 70% of the number that would be present if the harvest was unselective. The mean age of the males in the population is also reduced by about 2 years. However, this has the effect of focusing the harvest on younger males in the more abundant age classes. We assume that the females can still find mates and that younger bears mate just as successfully as older bears. The available data support this. There is no evidence of diminished reproduction, even in populations where it is clear that over-harvesting has depleted the males. Males are reproductively mature by the time they are 4-5 years old, and on average females are only available to mate every two years because of extended parental care.

The annual base allocation value is an annual allotment that does not vary. However, if a community over-harvests either males or females in a given year, that over-harvest must be compensated for by reducing the annual actual allocation. The actual allocation is reduced two ways. The first was is a simple numerical reduction to "pay back" the over-harvested males or females. The second is that if the females are over-harvested, then the community has shown it cannot harvest at a 2M:1F sex ratio. The current allocation for females always gives the maximum number of females that can be taken. However, when an over-harvest of females has occurred in the previous year, the current allocation for males is based on both:

1) The current allocation of females, and
2) The actual proportion of females in the harvest (P_F).

The current allocation of males is determined by the equation for calculating the sex ratio:
P_F = # Females / # Males

Males = # Females / P_F

The value of P_F cannot be less than 0.33 or the take of males would be too large (unsustainable). For that reason, if the actual PF value is less than 0.33, we still use 0.33. If the actual value of P_F is greater than 0.33, the actual value is used.

The actual sex ratio is only taken into consideration when the kill of females has exceeded the sustainable number (i.e., the actual allocation for that year). This is to avoid penalizing a community that shuts down the harvest when the last female has been taken. It is the number of bears taken that really matters. The proportion of females in the harvest is only an indication of what the sex ratio for the next year will be. As long as a community has not exceeded the allowable kill of males or females, there is no reduction in TAH, regardless of the sex ratio of the kill.

Credit is given for any unused current allocation of males and females. The credits can be either male or female. Credits are specific for a given population and cannot be used for other populations. Credits belong to the community that did not fully utilize its actual allocation. A community can use its credits to compensate for over-harvest in a given year. Also, credits can be provided to other communities that share a given population if both communities agree. The community that has over-harvested must request the credit of the appropriate sex from a community that has such credits. If a female credit is requested, a male credit must be exchanged because there cannot be more negative male credits than positive female credits. It is sustainable to over-harvest the males as long as an equivalent number of females are also under-harvested. As long as there is at least one positive female credit for each negative male credit, there is no reduction to the TAH. This means that as long as the total TAH is not exceeded, and as long as the females are not over-harvested, the TAH for the following year will stay at the maximum base allocation.

Credits are a special case because they represent individuals that were not taken, so they are in addition to the estimated population. Credits are administered separately. There is an assumed loss rate of 4% per year for male credits because 4% is the natural mortality rate. There is an assumed increase of 3% per year for female credits because that is the zero-harvest natural population growth rate. Females produce both males and female offspring so the female increase of 3% per year also applies to the males. However, the male increment is 3% times the number of females since it is the females that produce the cubs. Credits accumulate until the next population inventory, and then they are zeroed because the total population is taken into effect when the new TAH is determined. When the credits are not used, the population will increase allowing larger quotas for future generations.

The rules for how the kill is counted are given in the polar bear MOU for each population are also listed above. They are repeated here using slightly different language:

1. All human caused mortality to polar bears will be taken from the TAH of the nearest community. In the event that the human caused mortality exceeds the TAH, extra tags will be issued, and the TAH for the following year will be correspondingly reduced as per the flexible quota system.

2. A naturally abandoned cub will be counted as a natural death and not counted against the TAH.

3. Any bear that is found near death can be killed as a humane action and, once the Wildlife Officer has certified that the bear was near death, the humane kill will not be counted against the TAH.

4. When a Nunavut beneficiary kills a bear, the tag will come from that person's home community if that community has a TAH in the population that the bear was harvested from. Otherwise, the nearest community must provide the tag.

5. When a female with cubs, yearlings, or juveniles is killed; the cubs, yearlings and juveniles are also regarded as killed (even if they run away). For TAH determination purposes, the cubs and yearlings are counted as all males and only ½ tag each. The juveniles are counted as whole tags of whatever sex they are. If the cubs run away after the female is killed, the cubs are counted as ½ tag and all male, however the yearlings and the juveniles are counted as whole tags for each, and the sex is counted as ½ male and ½ female.

6. The credits are available to address all types of kills, including accidental, illegal, and defence kills.

7. If a community shuts down it's harvest after exceeding the maximum allowable females, the unused tags are counted as harvested males **for calculating the proportion of females only** so as not to penalize the community for shutting down the harvest before filling all the tags. If a community does not exceed the current allocation for females, for TAH calculation purposes the harvest sex ratio is assumed to be 0.33 (i.e., 2M:1F).

8. The community credits accumulate until the next population inventory results are final. Then all credits are set back to zero because the new TAH is based on the new population information, and all of the sustainable take is allocated as the new TAH. Any credits will be realized as TAH increases if the population information was accurate and the credits are not used. The communities then resume collecting credits from the new start, as before.

9. Each year male credits are reduced by 4% per male because of natural mortality. Each year female credits are increased 3% per female and male credits are increased 3% per female because of the natural (no-harvest) population growth rate.

Here is an example to show how the calculations are made:

The flexible quota system has been in use since 1996, and is well tested. The lessons learned have been incorporated into the new computer program, and hopefully the more fully developed system will be sufficient for all cases.

The 1999/2000 Coral Harbor harvest is a good example of the general principles.

The base allocation is 26 males and 13 females.
The allocation for 1999/2000 was 26 males and 13 females.
The credits going into the harvest year were 8.67 males and 2.33 females.
The kill for 1999/2000 was 21.5 males and 16 females.

The first step was to deal with the over-harvest of the females.
There were 2.33 credits to cover the over-harvest of 3 females.
That left 0.67 female over harvest to be covered from the next year's allocation of 13 females.

13-0.67 = 12.33 as the 2000/2001 allocation of females.

Next the TAH for 2000/2001 has to be determined.

The females are known (12.33), so it is a matter of determining the total number of tags that can be allocated without exceeding the sustained yield of females (12.33) and males (26) for the 2000/2001 harvest season.

When the kill of females exceeds the sustained yield and the credits are not sufficient to cover the over-harvest, the TAH for the next year is calculated using the actual sex ratio of the harvest rather than the 0.33, which was exceeded. The reason for this is to avoid allocating too many tags causing an even larger over-harvest of females the next year.

The actual sex ratio was 13/37.5 = 0.34666.

However, we the community did not fill all of it's tags. If the full 39 had been killed, and the last 1.5 had been males ... the sex ratio would have been better. We do not want to penalize the community for stopping the harvest as a conservation measure, so we assume the unused tags were males for the purpose of calculating the sex ratio. This is not in the MOUs, but it gives communities that stop harvesting the benefit of the doubt as an incentive to STOP HARVESTING once the last female has been taken.

The effective sex ratio is 16/39 = 0.41025.

The TAH for next year is based on the following relationship:

Maximum Females Taken = TAH* Proportion Females

We know the Maximum Females Taken = 12.33
We know the sex ratio from last year was 0.41025
The TAH is given by:

TAH = Maximum Females Taken / Proportion Females
= 12.33/0.41025
= 30.05

By convention we round up the total to 31 with a recommendation that the kill not exceed 12 females and 19 males.

We keep track of all the fractions so the communities always get their full allocation and full credits. However, the recommended tags are always whole numbers that, if followed, will result in the full TAH for next year.

IMPORTANT: The sex ratio consideration is only implemented when the kill of females exceeds the available allocation and credits. That means that if Coral could obtain a transfer

of 0.67 females credit from some other Western Hudson Population community, they would receive their full TAH of 39. They are being reduced both by number of females allowed AND by the 0.41025 sex ratio. However, Coral should be warned that the larger TAH also increases the risk of over-harvesting females.

The credits for males and females are based on the base allocation and actual kill. In most cases a reduced TAH is because of an over-harvest problem with females, and that is why the male credits seem to accumulate more than female credits. When the total TAH is reduced because of over-harvest of females and failure to harvest at the 2M:1F sex ratio, the determination of male credits is based on the base allocation provided there was no over-harvest of males the previous year. Thus the full credits from the estimated maximum sustained yield are correctly accounted for.

Here is a final simple recommendation that will prevent any reductions in the TAH from the flexible quota system: **Stop hunting when the last female is taken.**

If there are any difficulties in using or understanding this program or the counting rules, please contact your local Wildlife Officer, or the Polar Bear Biologist.

Appendix 3.
Harvest Risk Management Protocol

Management decisions on polar bears are guided by the information available. One of the most important management decisions is the number of males and the number of females that can be harvested. Because the TAH is a number, the decision is based mainly on the quantitative data on polar bear population demography (population number and natural rates of birth and death). However, the demographic information is not always available for each population. Even when the demographic information is available it is not perfect, it is uncertain. Research programs that provide the demographic estimates also provide a measure of the uncertainty of the estimates produced by the study.

There are two ways that the demographic data can be "checked". The first is to see if the estimates make sense. If the natural rates of birth and death would not sustain a polar bear population even if there were no harvest, then they are probably not correct. If the population estimate suggests that the current harvest would be reducing the population, but the population is known to be extending its range and increasing its numbers, then the population estimate is probably not correct. These qualitative "reality checks" are useful to avoid serious management mistakes, but do not provide the necessary quantitative information for a sound decision on the TAH.

Even when the full demographic information has been collected, and the parameters seem to make sense; the variance of the estimates of birth and death and population numbers (i.e., variance) document that these estimates are not exact, but rather have varying degrees of uncertainty. A variance estimate is a measure of how much the parameter might be off. This kind of uncertainty is quantitative, and we can accommodate it.

Our population inventory programs provide good estimates of demographic parameters. We then use the computer to simulate the future under many, many scenarios. Each scenario is a "what if" run. Each run takes a different set of parameter values that are based on the variance estimates. This method of exploring different outcomes based on the uncertainty of the main factors is called the Monte Carlo method. When it is applied this way it is also sometimes called Population Viability Analysis or a Bayesian probability estimate.

Most times population viability analysis is concerned with avoiding reducing the population so much that it goes extinct. In our case, we want to avoid reducing the population below levels that would be "unacceptable". By "unacceptable", we mean reductions that would require a long time for the population to recover. The decision of what constitutes "unacceptable" is subjective, and would be identified through consultations with hunters and Nunavut's co-management process. Even after the unacceptable level of reduction has been agreed and accepted, there is always some risk that the population may decline to a value less than the agreed level. The co-management authorities must also agree on the acceptable level of risk that there is a reduction worse than the one judged to be acceptable.

Our recommendation for large and productive populations is that the harvest and total kill be limited to a number that gives 90% certainty that the population will not decline to a level that would take more than 5 years to recover. When independent information provides a strong reason to believe that the population can sustain a larger harvest, a minimum of 80% certainty can be tolerated. The certainty estimates require a population inventory cycle of not longer than 15 years. When the information on the population is very uncertain, fewer bears can be harvested. This means that there is value to the community (larger TAH) for good information. It also means that if the information is dated and suspect, as it is for many of Nunavut's polar bear populations, that the TAH will be reduced as a result. Both conservation polar bears and TAH are enhanced by good information, and compromised by poor information.

When there is no commitment for a population inventory cycle, or the population has such low numbers that it is not cost-effective to maintain a periodic inventory schedule, a more conservative harvest management is required. The criteria for these populations will be 95% certainty that the population will not decline to a level that would take more than 5 years to recover over a 75-year time interval. If monitoring of these small populations can occur more frequently, these criteria can be relaxed accordingly.

A final issue is that many of Nunavut's polar bear populations are shared with other jurisdictions. There is little value in reducing Nunavut TAHs if other jurisdictions that share polar bear populations with us continue to over-harvest polar bears and refuse to accept their financial obligations for the population inventory cycle. An essential component to risk management is that it must be accepted and implemented over the entire range of the population to be fair and effective.

This harvest policy commits the GN to a polar bear research program sufficient to conducting a population inventory of its large populations every 15 years. There must also be a comprehensive harvest collection program, and inter-jurisdictional agreements between Nunavut to participate in and cost-share the inventory and harvest monitoring programs for shared populations.

Appendix 4
Community Polar Bear Hunting Rules

Appendix 5
Summary of the Roles and Responsibilities of the Co-management Partners for Polar Bear Conservation as per this MOU

FILE

Western Hudson Bay Population

x _____ date: April 7, 2004
Jimmy Kako
Chairman
Aqiqiq Hunters' and Trappers' Organization (Chesterfield Inlet)

x _____
David Alagalak
Chairman
Kivalliq Wildlife Board

x _____ date: May 3, 2004
David Aksawnee
Chairman
Baker Lake Hunters' and Trappers' Organization

x _____ date: May 5, 2004
Jack Angoo
Chairman
Issatik Hunters' and Trappers' Organization (Whale Cove)

x _____ date: May 4, 2004
Peter Kritaqliluk
Chairman
Arviat Hunters' and Trappers' Organization

x _____ date: 7/5/04.
Jerome Tatturinee
Chairman
Aqiccjaq Hunters' and Trappers' Organization (Rankin Inlet)

x _____
Olayuk Akesuk
Minister
Department of Sustainable Development
Government of the Nunavut Territory

FILE

Western Hudson Bay Population

Section 8.0
Western Hudson Population Signature Block

x_____ date:_____
Peter Kritaqliluk
Chairman
Arviat Hunters' and Trappers' Organization

x_____ date:_____
David Aksawnee
Chairman
Baker Lake Hunters' and Trappers' Organization

x_____ date:_____
Jimmy Krako
Chairman
Aqigiq Hunters' and Trappers' Organization (Chesterfield Inlet)

x_____ date:_____
Jerome Tattuinee
Chairman
Aqiggiaq Hunters' and Trappers' Organization (Rankin Inlet)

x_____ date:_____
Jack Angoo
Chairman
Issatik Hunters' and Trappers' Organization (Whale Cove)

x_____ date:_____
David Alagalak
Chairman
Kivalliq Wildlife Board

x_____ date:_____
Olayuk Akesuk
Minister
Deptartment of Environment
Government of the Nunavut Territory

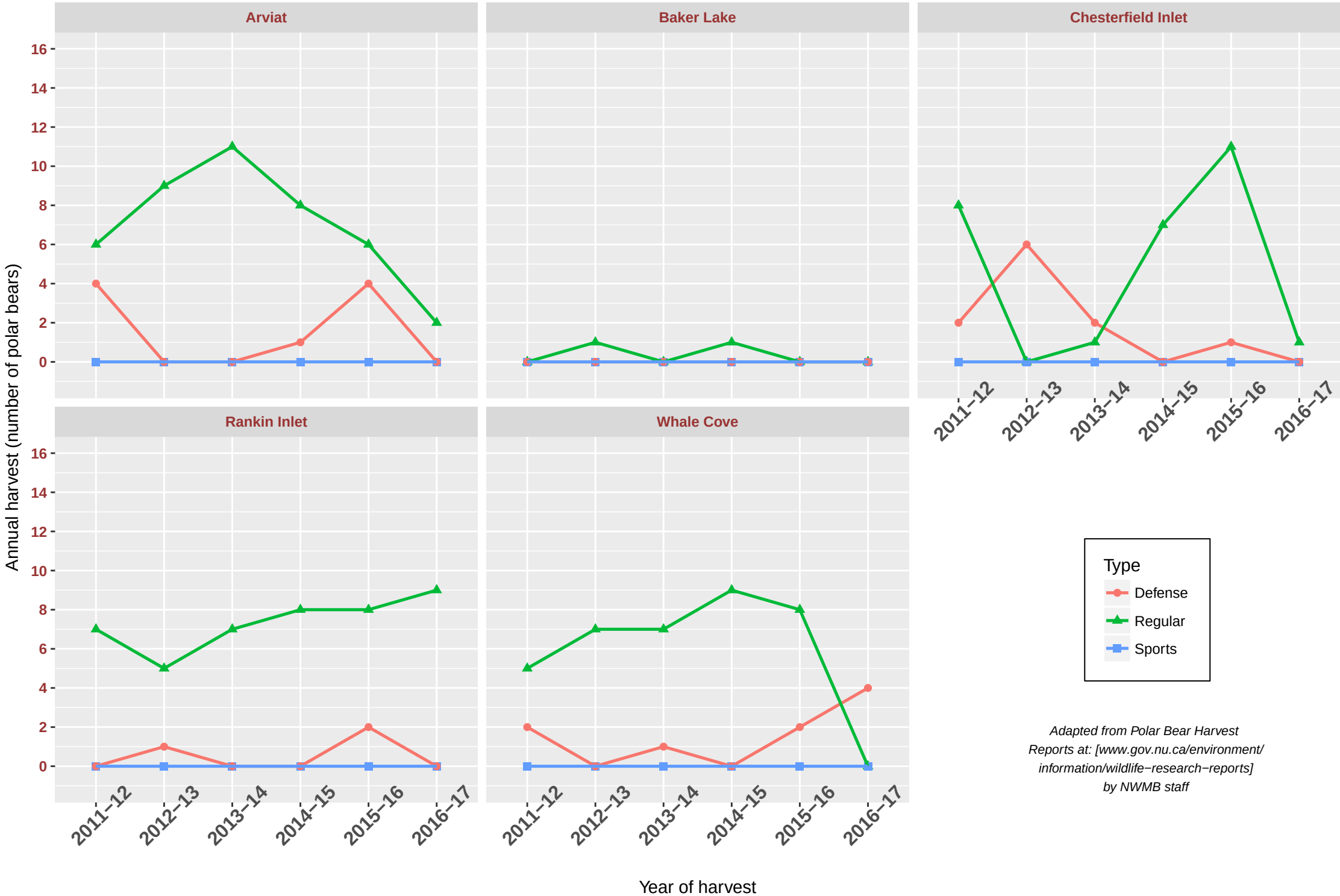
Community harvest records from the Western Hudson Bay Polar Bear sub−population

from 2000−2001 to 2016−2017

Adapted from Polar Bear Harvest Reports at: [www.gov.nu.ca/environment/information/wildlife−research−reports] by NWMB staff

Community harvest records from the Western Hudson Bay Polar Bear sub−population

from 2011−2012 to 2016−2017



Adapted from Polar Bear Harvest Reports at: [www.gov.nu.ca/environment/information/wildlife−research−reports] by NWMB staff