







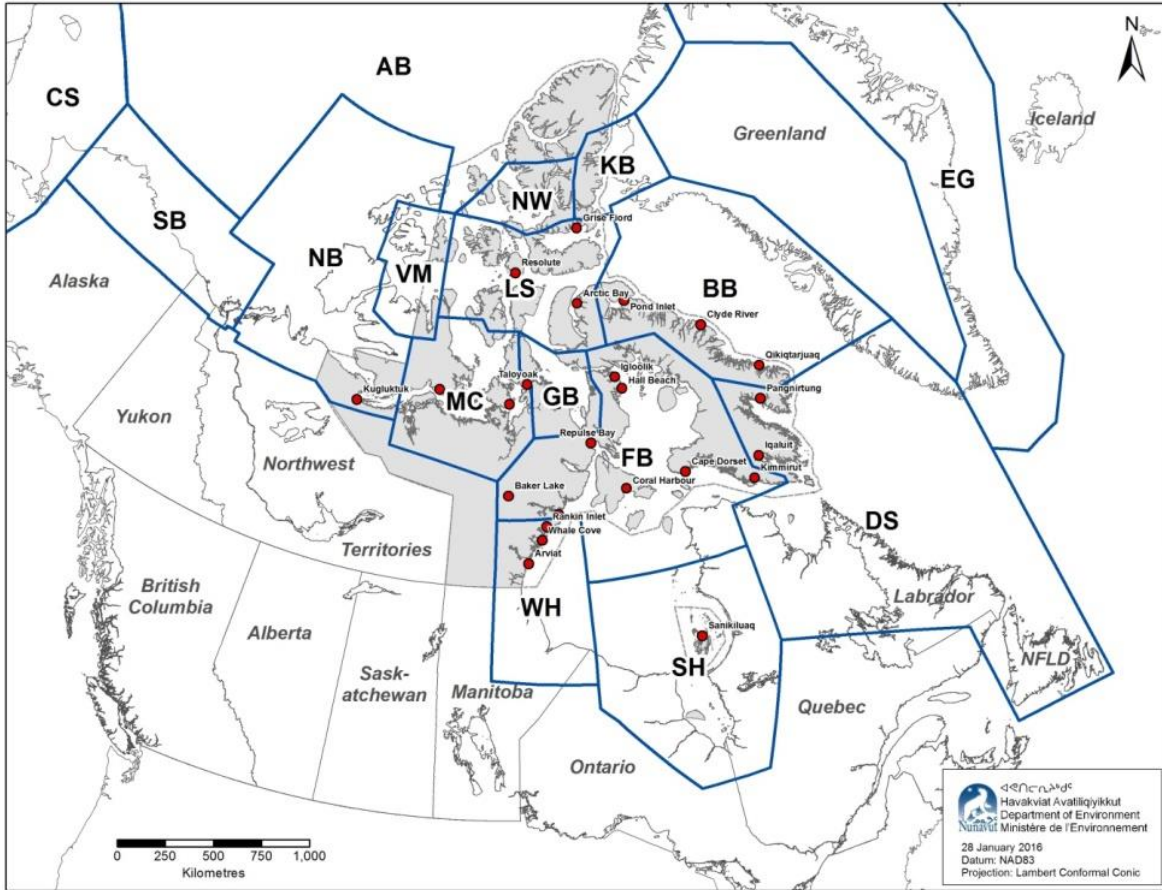








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Building *Nunavut* Together  
*Nunavut* iuuqatigiingniq  
Bâtir le *Nunavut* ensemble



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Department of Environment  
Avatiliqiyikkut  
Ministère de l'Environnement

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# Appendix 1: Complete Consultation Presentation of the M'Clintock Channel Polar Bear Study Results 2014-2016


Slide 1

**Department of Environment**  
Avatliqiykukut  
Ministère de l'Environnement

## M'Clintock Channel Genetic Biopsy Study 2014 – 2016 Results

Markus Dyck and Jasmine Ware  
Polar Bear Biologists

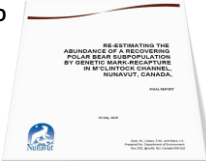
Department of Environment  
Wildlife Management Division  
- Research Section -



Slide 2

### Objectives Of Presentation

- Provide a summary of results from study
- Obtain feedback from your HTO




2

Slide 3

### Background

- First mark-recapture study between 1973-78
  - MC and GB treated as one unit, estimate of 1,081
- GB estimate increased to 900 in mid-90s based on local knowledge and uneven and incomplete sampling
- MC estimate decreased from 900 to 700 based on local knowledge in mid-90s
- Population boundaries in 1995 and 2001

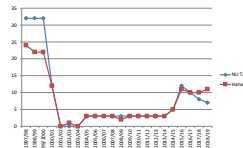


3

Slide 4

### Background – Harvest

- Concerns over low bear densities in MC lead to new mark-recapture study 1998-2000; GB also included in the work.
- Estimate for MC was 284
- Average harvest of 34 bears/year from 1979-1999 for MC
- MC harvest unsustainable:
  - a) hunting moratorium 2001-2003
  - b) TAH of 3 until 2015/16
- MC population likely growing
- TAH of 12 since 2016



4

Slide 5

### Background – Where does that bring us?

- Population status unknown (stable? increasing?)
- Population boundaries of MC/GB/LS?  
Inuit Qaujimagatuqangit/genetics suggest movement between both units

5

Slide 6

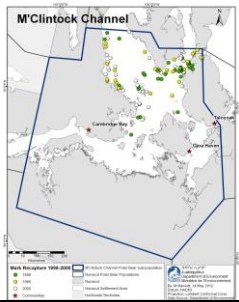
### Goals of study

- Need for new information – current data was deficient
  - Re-assess population abundance
  - Evaluate population boundaries/movements of bears
  - Provide information for review of Total Allowable Harvest (TAH)
  - Observe effects of changing sea-ice conditions

Slide 7

### Study method choices

- Co-management partners indicated concern about drugging & handling bears
  - Explore alternative population assessment methods
  - Better reflect Inuit societal values
- Balance with analysis needs –to properly monitor population




The map shows the M'Clintock Channel region with several green dots indicating sampling locations. A legend identifies symbols for 'Study Area', 'Population Boundary', 'Landmark', and 'Inlet'. A scale bar and north arrow are also present.

Slide 8

### Study method chosen

➤ Co-management partners and GN selected less invasive choice:

Genetic mark-recapture (biopsy sampling, no physical handling)



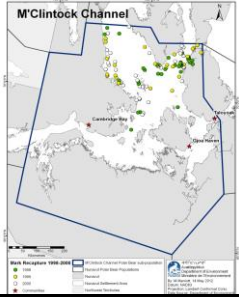
Dart after collecting sample. Immediately falls out. No handling.

The image shows a polar bear in a snowy environment. A red circle highlights a dart in the bear's back. An inset image shows a close-up of the dart and a coin for scale.

Slide 9

### Genetic capture mark-recapture study goals

- Estimate polar bear abundance in MC
- Compare with 1998-2000 estimate
- Compare information on reproduction, survival
- Cannot estimate movement or boundaries with this method



The map shows the M'Clintock Channel region in the Arctic, with several green dots indicating sampling locations. A legend in the bottom left corner identifies the symbols used on the map.

Slide 10

### Study funding and support




Logos for Nunavut, Environment and Climate Change Canada (Environment et Changement climatique Canada), Nunavut General Monitoring Plan, Wildlife Board, and WWF. Text below the logos reads: "HTOs from Gjoa Haven, Cambridge Bay, Taloyoak".

Slide 11

### Study Design

#### Community Participation


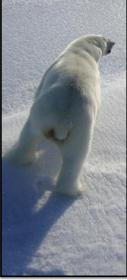
- Survey design and method choice - 2013
- Survey observers – participants from Ekaluktutiak HTO and Spence Bay HTO available in 2014 and in 2015; no participants available from Gjoa Haven
- Review & evaluation of results - 2020



Slide 12

### Study Design – Data collection

- Method choice: genetic capture mark recapture
- Timing of study: mid-April to early June
- HTO participation on searching and sampling flights
- Used helicopters to search

Willy Niekirk, from Cambridge Bay, searching for bears in MC 2023.

Slide 13

### Study Design – Data collection






- Recording age class, sex, body condition, litter size, location of bears




Slide 14

### Study Design – Data collection

1
2
3
4
5

**Skippy**

Spine extremely bony, ribs and shoulder blades protruding, ribs easily felt with the hand. A deep hollow will be noted between the spine and tail or, if empty, strongly so.

**Thin**

Bear obviously thin, ribs easily felt with the hand, the ribs will not touch, but having some muscle covering them. The hollow between the spine and tail is obvious, but softer.

**Average**


Body is well rounded, but obvious ribs to present over spine and shoulder, the hollow between the spine and tail is absent.

**Fat**

Bear has a rounded or blocky appearance, ribs well hidden, ribs of ribs are obvious, obvious fat over hump and shoulders.

**Very Fat**

Bear is extremely round, ribs appear too short for the body, ribs of fat on neck and lower shoulders.




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Slide 15

### Study Design – Data collection

- Collected small tissue samples for genetic analysis (to genetically identify and “mark” an individual)
- No cubs-of-the-year sampled
- No drugging, no collaring
- No specific ages or samples for other studies (e.g., contaminants)



Slide 16

### Study Design - Analysis

- Included all mark-recaptures and dead recoveries for analysis:
  - Genetic mark-recapture (biopsy) information 2014-2016
  - 1998-2000 capture mark-recapture information
  - Harvest recoveries (e.g., when an ear tag/lip tattoo is recovered by a hunter) 1998-2016

16

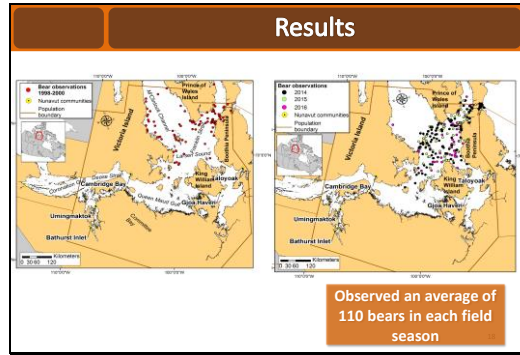
Slide 17

### Analysis Goals

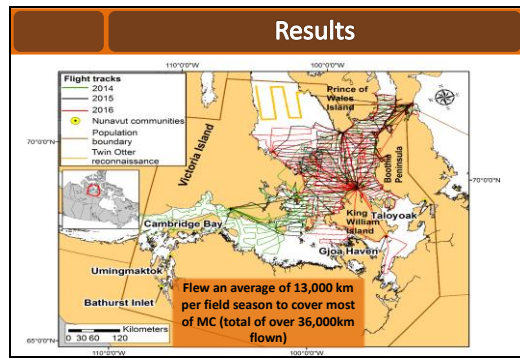
- Use all information to determine:
  1. Trends in abundance from 2000-2016
  2. Survival rates of different age classes and sexes over time
  3. Reproductive parameters such as size of litters, litter rate per adult female (how productive are the females/population)
  4. Population growth rate – determined using survival rates and litter production rates
  5. Evaluate body condition of bears across the searched MC area

17

Slide 18



Slide 19



Slide 20

### Results – mark-recapture samples

- 953 samples genetically analysed (319 biopsy, 532 harvest, 102 old capture)
- Live re-sampled 6 bears from old study, and 33 from new study
- Dead-recoveries through harvest:
  - 15 recovered inside MC
  - 7 recovered outside MC but not in GB
- 7 bears marked in M'Clintock study 2014-2016 sampled in GB 2015-2017

20



Slide 21

### Results – body condition

- All bears except adult males were in better condition (fatter) in 2014-2016 compared to 1998-2000

1998-2000      2014-2016

- No change in condition for adult males

- **Why? Your thoughts?**

21

Slide 22

### Results – Reproduction

- What does "reproduction" mean? What do scientists look at?
- Litter size
- data from:
 

	1998-2000	and	2014-2016
➤ Cubs of the year:	12 family groups		27 family groups
➤ COY litter size:	1.58 COYS in each litter		1.70 COYS in each litter
➤ Yearlings:	11 family groups		18 family groups
➤ Yearling litter size:	1.71		1.61

22

Slide 23

### Results – Reproduction cont.

- Number of offspring per adult female
 

1998-2000	2014-2016
COYS:	
➤ 0.38 COYS/adult female	➤ 0.43 COYS/adult female
Yearlings:	
➤ 0.39 yearlings/adult female	➤ 0.28 yearlings/adult female
- Sample size very small to suggest changes over time – only for information
- Number of yearlings per adult female is important because it shows how many cubs-of-the-year survive to be yearlings
  - it is a good measure of reproduction
- Appears MC subpopulation has healthy reproduction

23

Slide 24

### Results – Survival


- We had limited samples – MC is a small population, few recoveries through harvest, big time gap with no data – and could not explore all possible survival models
- Independent bears > 2 years
  - Apparent survival constant at 0.88
  - It is a lower estimate, and does not reflect true survival(We do not know what happens to bears once they leave MC: they can be dead = are not re-sampled; they also can be alive and are not re-sampled)

24

Slide 25

### Results – Population growth rate

- Population growth rate indicates males and females increased in abundance since 2000 (recovered from low numbers)  
(growth rate is simply the difference between what is added through births minus the deaths and takes into account how animals survive)
- Male growth rate was stronger than female growth rate which allowed them to recover from overharvest

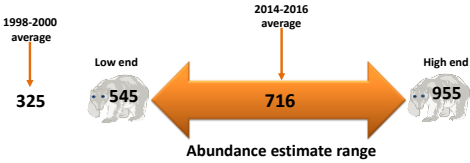


25

Slide 26

### Results – Abundance

➤ Assessment of number of bears in MC



1998-2000 average  
325

Low end  
545

2014-2016 average  
716

High end  
955

Abundance estimate range

➤ Increased over time

26

Slide 27

### Results – Interpretation

- MC is doing well, healthy subpopulation for now
- Because we don't have a quantifiable idea about movement, we are likely counting bears from other subpopulations like LS and MC as GB bears → increases the abundance assessment.

27

Slide 28

### Further Questions

- **Boundary between GB-MC-LS?**
  - Genetic mark-recapture method does not provide data to answer these questions
  - Movement data are necessary
  - How important is the boundary issue to you and other users?
    - IQ says there is movement. How much? Where? When? Which animals?
    - Are bears changing where they choose to spend their time? Is this related to sea ice changes? Seals?
- Options:
  - The Government of Nunavut is committed to surveying Lancaster Sound in the next few years
    - With your support, we could propose to put collars and satellite ear tags on a small number of bears in LS and MC/GB to gather info about bear movements between and among these areas.

28

Slide 29

### Further Questions

- Do you agree that the number of bears increased over time?
- What did you observe in the bears' body condition over time?
- Are there enough bears to harvest? Are there too few? Too many?
- Is there anything special that you observed and wanted to share with us?
- Where do you agree/disagree with our findings?

29

Slide 30

**Suggested Harvest Recommendation**

- MC is doing well, healthy subpopulation for now
- Because we don't have a quantifiable idea about movement, we are likely counting bears from other subpopulations like LS and MC as GB bears → increases the abundance assessment, and uncertainty.
- Recommend increase in TAH from 12 to 16 bears/year (8 male bears and 8 female bears).

30

Slide 31

**Further Questions? - Thank you**

31

## Appendix 2: Complete Consultation Summary of the M'Clintock Channel Community Consultations

### **Nunavut Community Consultations on the results from the 2014-2016 M'Clintock Channel Polar Bear Study**

**October 19-21, 2020**

**HTOs Consulted:  
Cambridge Bay  
Gjoa Haven  
Taloyoak**

## **Summary of Consultations:**

A: Cambridge Bay

October 19, 2020

**Start:** 18:15      **End:** 22:20

### **Participants:**

Beverly Magsagak - Manager  
Bobby Greenley – Chairperson  
George Angohiatok – Vice Chair  
Peter Evalik – Secretary/Treasurer  
Ipeelie Ootoova – Director  
Clarence Kaiyogana – director  
Mercy Panegyuk – director  
Alice Maghagak – director  
M. Dyck – GN-DOE  
J. Ware – GN-DOE  
K. Methuen – GN-DOE  
M. Angohiatok – GN-DOE  
S. Angulauk – GN DOE  
Bobby Klengenber – KRWB chair

### **Harvest table and credit discussion:**

- The meeting began with introduction of participants.
- GN representatives then discussed harvest table and Up to 1:1 Harvest Management system handout. During meeting/consultation planning, HTO expressed interest to obtain more information on those topics. – Jasmine
- HTO board asked questions about credits and the table. Board was well informed about how the credit exchange worked within the subpopulation.
- Markus explained fractional credits are from 2:1 system

### **Main presentation:**

#### **Background on MC slides:**

- GN representatives went over MC history and background to allow HTO representatives to become familiar about past research and management items

- GN representative passed around the biopsy dart to demonstrate how the biopsy method works, pros and cons and limitations of that method.
- **Question: Bobby G:** would you dart both mom and cub if you came across them?
- **Answer Markus** – we'll answer this in the methods very shortly (GN explained that depending on offspring age both mother and offspring would be sampled – no young small bears->COYs in spring, but older offspring-> yearlings).

### **Community participation slides:**

- discussed study design during 2013 consultations, talk with hunters in town – where do bears go, when should we go search. Observers from Cambridge Bay participated in field work.

### **Study design:** reviewed slides; no questions

- **Question Bobby G:** – were there any bears that were marked in 1998-2000 that were marked again in 2014-2016?
- **Answer Markus/Jasmine** – yes
- George: In the mid 1960's, was the first time I went in M'Clintock channel, there was no quota system and there were very very few bears. No signs either. Took a lot to get bears. As the years went on, started noticing more and more bear-- Lots of bearded seals around. Big bears are around the bearded seals and feed on them. In the last few years, I've seen many healthy bears, sow and cubs. This year was the very first time in March I saw open water---never seen that in my whole life. Birds were there too. Lots and lots of sign of bear. Pre-2000 started seeing more bear sign. Ten to twenty bearded seals around a single hole, big male bear can get those pretty easy when the seals try to go into a seal hole.
- Bobby K: end of October, near Kent Peninsula, south of Cambridge Bay, polar bears were spotted, which is very rare.
- Beverly – there was one in gravel pit area in June and then another one just a week ago.
- Bobby K – using the multi year ice to come in and near, large floes

### **Flight path slide:**

- Markus explained that weather prevented coverage of MC channel proper. Maybe local knowledge could fill this information in. Maybe with Pam (the

contractor for the on-going IQ study on MC and Gulf of Boothia) the IQ study can help answer that question of whether there are a lot of bears in that area in the spring. The flight with Twin Otter was early April, but don't know what's going on in early June.

- Bobby G: they didn't want to have collars which I agree with and when I first got on, they didn't have an ear tag.
- **Question Bobby G:** - Is there anything long term, short term effects of immobilization on the bear?
- **Answer Markus** – There are advances in the drugs—there are reversals now. Immobilize the animal but you can introduce agents that reverse the effects and so the bears recover way faster – within minutes.
- Bobby – so there is nothing left long term effects?
- Markus – Health Canada has looked at how fast the drugs are metabolized and found it's completely safe after 45 days---even before, but they are being conservative. Other studies, by USFish and Wildlife Service did studies examining movement rates, survival rates, reproduction – there were no negative impacts they could find on survival or reproduction. Movement rates were back to 95% of normal after 2 days and 100% after 5 days.
- Jasmine – reversals bind to the drugs and pull them off the receptors so the liver/kidney can process. Bear is awake very fast. Physically, no long term effects, but we have heard concerns about psychological trauma and can't really say about that being a long-term effect? We can't really say. Drugging over and over and over would probably have long term effects---like us if we drank and drank and drank alcohol. Even for the 2-minute darting the bear is not enjoying that event, but the idea is that in order to collect the data, these are the trade offs and what we (as co-managers) are all willing to accept is a personal, ethical question. We find that bears return quickly to where they were sampled and take that to mean that the experience wasn't so bad psychologically that they stay away from where they want to be –their preferred habitat/hunting ground.
- Markus – there are also new release mechanisms for collars so that bears do not have to be handled so often, and release is pre-programmed.
- George – The collars likely don't really affect hunting as much for bigger bears as they do for smaller bears ---trouble to break the ice with their heads
- **Question Peter** – could we not use the Google Earth satellite images and count bears that way?



- **Answer Markus** – very good points and questions: GN has partnered with universities and people are trying to examine just that. Using summer and spring satellite images, there are at times difficulties when there are white rocks – can't tell the difference; a computer program, or algorithm has to be developed, that takes time and patience.
- Jasmine – and this is where big donors comes in---that technology is a good potential, but need money to pay people to work on it and develop it. My understanding is that this is the current obstacle because it takes time and effort to work on developing it and program it properly.

**Body condition slides** – thoughts on why body condition improved?

- Bobby – did you guys look at weather and see if there were differences in warmth and seals—more seals out basking?
- Markus – We kinda did that with the model where we incorporated sea ice because there is a lot less multi-year ice in MC now....what I've seen was lots of rubble ice and the packed to old ice is gone. What we were thinking and what we proposed in the report, is that the changes in sea ice, not being packed, more leads, more open water was good for seals and therefore temporarily good for bears.
- George: another thing is that when the sea ice freezes and freezes flat, this is not good habitat for bearded seals ---go to rough ice to find the bears cause that's where seals make their lairs.

**Reproduction** --- explained the slides; no questions

**Survival** --- explained the slides; no questions

**Population growth** – explained slides; comment by George about the skinny bear picture from Baffin Bay by some people that made the rounds around the world.

- Markus – That brings up a good point and is maybe a good time to point out part of my job is to gather data and provide information that allows me, Nunavut, and Canada to stand up to those organizations to are showing misinformation about bears. We try to get the word out that bears in Nunavut generally are doing well, and that there are more bears now than there have been since the 1960s.

**Abundance** – explained slides; also the surrounding uncertainty of the estimate

- **Question Peter** – Where do we want this population to go? Do we let it keep increasing? How do we know? What does an ever-increasing population do to other parts of the ecosystem?

- **Answer Jasmine** – this is the real question and one that community and HTO have to decide.
- **Answer Markus** – had discussions with DFO to try and get some seal surveys so that some of those impacts on other parts of the ecosystem can be answered or at least some data provided. Want to see recent estimates of polar bear abundance coordinated with new seal studies.
- Peter – like ECCC saying polar bears are declining due to climate change ---but polar bears are increasing and increasing even though sea ice is declining—even what you show.
- Markus – These reports for MC and GB are used for SARA and new population assessments; and not all NU populations are doing poorly, but some are not doing well. I should point out that in the recent years ECCC has been supporting Nunavut with the new management plan, and the harvest system.
- **Question Bobby G** – after the tour, when does this end up at NWMB table?
- **Answer Markus** – we will probably put our recommendation to the NWMB for March because deadlines for December are likely already passed by the time we get through the consultations
- **Question Beverly** – have you looked at other species for the bear? Like the invasive species such as beaver, pelican, etc and how they might be affecting bears?
- **Answer Markus** – There are some projects going on like poop and intestine collections and collaborations with other universities that are designed to see how diet is changing with bears. The NWMB has priority meetings every few years---should be coming up next year – HTO or RWO should bring up these questions as priorities because that is how funding might get allocated.
- George – you were saying how difficult it was to count the bears due to weather. When my daughter got at a John Hackett Island (correct location name?) on a pressure ridge –never seen so many bears in one spot. Counted 13 bears--May 2<sup>nd</sup>. A good percentage were sows with cubs. All moving east on the ridge.
- **Question Peter** – have you thought using a ground survey –in the area that was hard to survey?
- **Answer Markus** – We are starting Lancaster Sound next spring hopefully, what I'm going to do is fly into M'Clintock Channel during the same time for a reconn. I

wanna know what is going on in the area and if bears are moving, we are going to sample bears that are moving in and out. there is some uncertainty

- **Answer Jasmine** -- specifically to your point about ground surveys...the issue is that for the survey to work, every bear in the area has to have an equal chance (theoretically) of being sampled. This detection probability is different between an aircraft and ground-based. Unfortunately, the math doesn't know how different those two types of methods are and so we can't combine them without introducing more bias into the model...which increases uncertainty about the estimates even further.
- Markus – a ground survey in some of these areas are also very difficult because you cannot travel easily by snowmachine; get stuck, break equipment and that limits the usefulness of ground survey.
- Monica – the area you talk about there is open water now and maybe there are animals moving in like killer whales ---they chase the seals away. That will change things for the polar bears.
- Markus – Local knowledge like this should drive the IQ research questions. That's what we have to consider in the abundance estimate---think about that ecosystem might change for the bears and how that might affect them—what happens in 5 to 10 years?
- **Question Bobby G:**– these studies were done in 2014-2016; how come these are just now being presented?
- **Answer Markus** – Thanks for this question and it needs to be asked. These biopsy studies that rely on DNA take much longer because the DNA takes 9-10 months to get back and then, for MC, the computer models were difficult with such small samples. Followed by ransomware and Covid. It's been a long road and we appreciate your patience.
- **Question Clarence**– What's your plan if you get MC bears in LS?
- **Answer Markus**—depends on how many we get. If we get many samples, we're gonna try to analyze the complex together MC/GB/LS ---this might give us more information about their movements and that might help improve survival estimate. We did leave it open for collars for the communities in Lancaster Sound. Whenever there is interest by communities if you want to investigate the LS/MC/GB, we can always investigate movement through collars.
- Bobby Klengenber – thanks for HTOs work and biologists' work. Saw hundreds of polar bear tracks. Maybe HTO could use locals to get information of

observations – feed to HTO and biologists. Signs of tracks and information to help feed the understanding of the whole picture; maybe take also photographs as record.

- **Question Ipeelie** – do you have any idea of what proportion of bears are in water versus land? Is there a way to compare the samples between ice and land bears? There are some bears that rarely leave the water, they are found all year in water.
- **Answer Markus** – We try to cover the entire study area, but when there is open water, there are safety concerns so we can't fly over tons of open water. We will dart in water, and can do it, but there is no way to know how long that bear has been in the water, and pilots do not want to fly lots over open water.
- Ipeelie – Reason I was asking is that bears that are in the water eat differently than bears that spend most of their time on land. Wondering if you ever thought of biopsy sampling those versus the land bears? Some bears might end bowhead whales.
- Markus – we use the fat from biopsy samples to see what they're eating but there isn't really a way to know which samples would be from bears that spend a lot of time in the water versus those that spend most time on land.
- **Question Peter** – going back to LS study, you said your biopsy might get MC bears --- if you find that there a lot of MC in LS...would that help increase the TAH?
- **Answer Markus** – I would not be comfortable saying that that would increase the TAH, but if there is more new information, then that could put more information to NWMB and let them decide. But, ultimately, we don't know and we don't know what we'll find.
- **Question Peter** – how do we know there are not lots of bears that were in LS that you missed?
- **Answer Markus/Jasmine** – Ultimately, we don't know that's the plus/minus we have on the abundance estimate here. It is unlikely that hundreds were missed because that is like an entire population. However, there is likely some movement between MC and LS, but we don't know how much.
- Jasmine --- we recommend to not get too hung up on the abundance number, but more focus on what the community is comfortable with ---you know what it's like on the land and what this amount feels like---this range that we've presented.

Does that feel like too many? Just right? Want more? This is big question --- we have an estimate that is useable, though it does have uncertainty.

- **Question Beverly** – we are seeing more grizzlies coming up to island. No idea what that is going to mean in the future. And there are hybrids -what do you even classify those animals as? Grizzly or polar bears?
- **Answer Markus** – we aren't sure because the hybrids are not in the Wildlife Act – they didn't think of these back then when it was written. Lol...what we see right now is evolution on how polar bears came about...but it all also depends on how we view the hybrids and their importance.

**Discuss TAH** – Markus – the reason we recommend an increase from 12-16 is we are cautious, and the recommendation is based on maintaining the population roughly on where it is right now, but also considering uncertainty. We saw what happened in the past, and we all do not want to go back where this population is overharvested, and a moratorium has to be put in place.

- **Question Clarence** – is it possible to have the IQ study included so that this TAH goes up? If Pam's data is super great, could this TAH come up then?
- **Answer Markus** – at this time, this recommendation is just based on the scientific survey and we can't speak to IQ study since Pam hasn't finished. All information, science and IQ, will go to the NWMB – they will consider all information for decision making.
- **Question Beverly** – have you talked to Wily Nakashook?
- **Answer Markus** – I wanted to but haven't been able to get him.
- **Question Beverly** --- are you coming back for consultations after you've finished this tour and heard from all the communities?
- **Answer Markus** – We were not planning on that, but we're willing to have video conference and answer questions
- Jasmine – we will circulate the notes to make sure that we captured the comments and concerns raised today. Will include all the communities' notes.
- Peter – I would really recommend if we accept this, then we should make it even for every community so each community has the same number of tags otherwise there will be conflict.

- Markus – there are options to work together through the KRWB with other communities that harvest from MC and see if the redistribution of tags can be changed. It is also worth thinking about what is the goal with a management objective – are there too many bears? What is tolerable as a number of bears around? There is uncertainty around the number of bears. If the TAH is increased by a few bears there is a risk we all must be willing to accept that the response of the population might be different from what we expect, and we want to avoid a potential reduction and depletion, like what happened in the 1990s.
- Jasmine – we can only base our recommendation on the survey. That doesn't mean that there can't be a joint submission among HTOS and the GN, but for this meeting right now, the recommendation is based on the science. There are a lot of good points relative to the fairness to communities regarding allocation, what the community wants to do relative to the management of this unit. It is ultimately what the community wants.
- Kevin – Grizzly bear TAH submission to KRWB could be done similarly for polar bears.
- Monica – they want the tags too – the other communities so it will be a hard fight. They want them as much as we do.
- Beverly -- Send the link for the harvest tables \*email link sent 10/30/2020\*

Meeting ended with parties being appreciative of the visit and the opportunity to discuss these topics and interesting questions.

B: Gjoa Haven

October 20, 2020

**Time Start:** 18:50

**Time End:** 21:15

**Participants:**

Eruk Pauloosie  
 William Aglukkaq  
 James Qitsualik via cell phone video chat  
 Simon Komangat  
 Jimmy Qirqqut  
 Roger Ekilik  
 Ben Putuguq  
 Jimmy Pauloosie  
 Ralph Porter Sr.

J. Skillings – GN-DOE  
K. Metheun – GN-DOE  
M. Dyck – GN-DOE  
J. Ware – GN-DOE  
Jacob Keanik - translator

- Markus introduced option to go over background of MC/GB or skip it? Question to the board---what would you prefer?
- Ralph: we don't need super detailed on the background so you can go through it quickly.

**Background slides:** review – our objective to provide new data for the co-management partners and the NWMB to make decisions on setting harvest levels. We are here to hear feedback.

**Study methodology:** review, no questions

**Community participation:** review; no questions

**Study design:** review; no questions

**Study design analysis:** explained why the amounts of data matter for getting the results; no questions

- Ben: Years ago, when the moratorium came I was one of the Board members back then and remember it. We used to go all the way to Prince of Wales Island before the quota system was put in place to harvest as much as we could.
- Markus: thank you, I'd like to hear about the ice back then.
- Ben: it's totally different. There isn't any ice really.

**MC Study Results: Body condition**

- Willy: From experience, males during the spring mating season, the males have empty bellies, just snow in there. They are so focused on females.
- Males are also mating that is likely why male body condition did not improve between studies

**MC Study Results:** Reproduction, Survival, Abundance; no questions

**MC Harvest Recommendation:** the increase is our GN recommendation from the scientific study. It doesn't mean that it has to be the TAH. It depends what the goal for this population is—what do the communities want? Raising harvest higher carries more

risk. This level represents what we think from a scientific study what would maintain this population.

### **GB Results:**

- Willy—the board isn't that interested in Gulf of Boothia because it is very rare that we go there to hunt. The ice conditions are too dangerous. Young hunters do not have any knowledge about that area. We are not that interested in this population.
- Ralph said if a bear doesn't want to show up, you can't see it. It is the knowledge of our ancestors.
- Ben: when our young hunters go to Gulf of Boothia, they don't have a clue about the ice conditions and it's very dangerous...the ice can just take them.
- Willy: that actually happened with a sport hunting group—the ice split and took the hunters out to sea.
- Ben: the hunters that were taken the sport hunters, I was there and I managed to get home before the ice split. The younger generation doesn't have a clue how the ice conditions.
- Markus: I can go over GB very quickly. It is my job; I have to tell you about it.

**GB Results/TAH recommendation:** Because it's stable and there are no changes that we can detect, we are recommending that there is no change to the TAH. If the communities feel differently—want more meat or public safety is an issue, then that is an opportunity to discuss how the TAH could change.

- Willy: It doesn't affect us.
- Markus: That's pretty much it for the presentation for the MC/GB. Are there any questions that the community here has with regards to GB/MC/LS boundaries and movements? We can hear these comments and try to see if they can be incorporated into our future work. We are doing LS and are going to be analyzing those samples in the next 4-6 years and we will let you know what we find—were there MC bears up there that we marked in 2014-2016.
- I know there is no desire from this community for collaring, but there are some communities that are interested in movements because they are wondering about climate change, increased development, increased shipping. For example, NTI approached me once about impact on bears from a development project, but I couldn't answer those questions because we don't have movement data. For now, maybe this is okay, but this may be important in the future.



- If there are specific questions from the communities or specific areas of interest, bring those forth to the regional wildlife board/NWMB priority—those priorities help the GN determine how they focus their resources and money along with our mandate to get updated information for the polar bear subpopulations.
- **Question Simon:** Peter DeGroot seems to be doing a lot of research in the last 20 years. What does he do with you guys?
- **Answer Markus:** He works for a university, not affiliated with GN. He is part of a big project, multiple universities, maybe 25 organizations supporting BearWatch – Peter is involved, but he is not the lead. It is looking at genetics, bacteria, developing a kit for fecal sampling. A lot of different projects but Peter is a tiny part of the bigger project. The GN supported Bearwatch because there are bits and pieces of this project that could help for management that we could not collect alone.
- **Question Willy:** Is this work they are doing helping us? It is helping the government...but what is it doing for us?
- **Answer Markus:** the samples are still being analyzed...from the many samples they are trying to determine if it's possible to see contaminants and genetics. As the GN, we could not do it. The idea was to be able to harness the resources of universities and their labs to gather information and develop potential new methods for non-invasive health monitoring of the bears.
- **Answer Jasmine:** also, we don't know if what BearWatch has proposed will work –it was an idea that had to be tested. The idea was to develop less invasive technologies and methods, but will it actually work? Don't know.
- **Question Ralph:** so whatever Peter does, it is not affiliated with the NWMB?
- **Answer Markus:** that is correct. Whatever Peter does is not counting bears and they are not primarily responsible to providing info to NWMB for management decisions.
- Willy: they are mostly doing contaminants, health, same as they are doing with the fish.
- Roger: Hunting bears in GB is too far—takes a lot of gas and people don't go there. Mostly MC.

- Markus: the GN is not responsible for allocation—the KRWB does that. For GB, all 3 regional wildlife boards are involved for GB—they all have to talk to each other. That requires a lot of discussion, I think. I think it requires involvement of all the RWOs.
- Ben: Bears in MC once it starts to freeze up, they start to come to town...that's because they are not being harvested due to the moratorium. Even during the summer, there are bear sightings now.
- Markus: Also probably not that much noise and traffic going out so they aren't afraid.
- Ben: it's because they aren't being harvested or disturbed by machines. They are even sighted far inland on King William Island. The population is healthy.
- Willy: Another thing is that between here and Taloyoak, there used to be a lot of traffic between the two communities even in the spring. Lately they have been seeing bears between here and Taloyoak. Seeing a lot of bears tracks, even wolf and wolverine around Clarence islands. Packs of wolves on the sea ice – Markus you've seen the wolves come into camp, two of them. Even going up to Boothia. But there are packs of wolves and they can also kill polar bears, from experience.
- Markus: the wolves could have an impact on the offspring of polar bears
- Willy: bottom line is that we saw a lot of bear sign and the 3 bears we got were very healthy and over 10 ft.
- Markus: that lines up with what we are seeing –that is really nice to hear.
- **Question Simon:** you were going to talk about sea ice Markus?
- **Answer Markus:** I think the way we looked at sea ice was that we included it our body condition analysis and how that might affect the body condition. We know from satellite imagery from last 30 years that ice has changed. We didn't do full analysis from satellite imagery or ice analysis on ice specifically. I don't know if that's answering your question.
- Simon/Willy nod it was sufficient answer
- Ben: Used to have icebergs that even have cracks and there used to be abundance of seals and there were ice packs and they were easy to spot. Nowadays the bears are moving more because there are less icebergs –we don't see the icebergs any more.

- Willy: we don't see much ice any more.
- Markus: agree with the satellite imagery—barely any ice in MC channel in fall
- Willy: people that used to go harvest belugas to Prince of Wales, but as soon as they get westerly winds the ice would get pushed in and they'd be stuck for weeks---they have a hard time getting through because of ice, but now no problem...20 years a big difference in sea ice.
- **Question Markus:** that's the other question I have---if this northern area is free of ice, what's going on with bears? Do they stay on the little ice? Do they go on land? What do you guys see when you travel in the summer?
- Ben: northwest king William island, bears would be swimming miles away from sea ice and can catch seal in open water. They're still hunting even if it's free of ice. They're always traveling even when it's full of ice.
- Willy: During the summer months, July/Aug prince of Wales, I stood and counted 33 bears in Cunningham bay—this happens when the beluga whales are coming in with their calves.
- Markus: to Willy---we tried to figure something out with you and watch bears there - remember?
- Willy: polar bears going after belugas staying in the mouth of the bay to catch them.
- **Question James** (via video on smartphone): Going to that old MOU, remember we had that issue with Taloyoak with them “stealing” our tags when the TAH went to 12. But maybe this is a RWO issue.
- **Answer Markus:** You are correct, this is definitely a point to bring up with the RWO.
- James: I'm trying to make the numbers more equal. I'm just trying to make the communities have a fair trade. If we want a higher TAH is that NTI?
- Jasmine: that would be the NWMB to raise the TAH. The RWO decides how to allocate the TAH.
- **Question Willy:** Why is Taloyoak involved in the TAH for MC when they were not involved when we signed the MOU. Taloyoak can harvest from MC but Gjoa can't get to GB. What are bears considered when they are harvested—MC/GB

- **Answer Markus:** The boundary goes right through Taloyoak
- Willy: so if Taloyoak has a defense kill is that considered MC
- Ben: there was a big male harvested as defense and counted as GB -- happened last year
- Markus: that is something that Kevin/Jack look into
- Kevin: okay
- **Question Jack:** isn't within 30km of the management unit a buffer zone?
- **Answer Markus:** yes, there is a 30 km zone that they can go on both sides.
- Willy: to board---do you have any concerns on bears?—time to ask
- **Question:**---is there going to be another polar bear survey again some time seen?
- **Answer Markus:** that is a very good question---we have seen with our experience that having these long empty data periods of many many years, it makes analysis very very challenging. Not just in MC, all the populations this is a struggle having these long gaps. That was the old system because it worked for money resources, bears are long-lived, and it was the management and monitoring plan initially but now we have realized that 15-20 year gaps are not good for analysis. Ideally, we'd like to be back in a few years for a one-year effort to sample bears in MC. That would help us get better data and get better estimates for survival. That is where the HTO comes in—if you make it a priority and identify it to the RWO and NWMB---say it's not okay to have long huge gaps for population assessments---that helps then us and the GN to make our case to allocate time/funding.
- **Question Kevin:** question regarding the 30 km buffer zone – where did that come from?
- **Answer Markus:** that was originally from the MOU—because bears don't respect boundary and hunters may not have always a precise location.
- Willy: like the Hadley Bay population and with NWT
- **Question Jack:** does that get carried forwarded from the MOU into the new polar bear management plan?

- **Answer Markus:** not sure, probably, don't have it memorized, can check. Just want to thank you for allowing us to come in person and giving us your time. Just because we talking here, doesn't mean that we have to end the conversation...we are open for contact and can help any way we can.
- **Question Simon:** how often could you come to Gjoa Haven?
- **Answer Markus:** 2013 and now 2020 – so maybe twice in 7 years? We rotate through the 12 subpopulations – we have a better chance to make it to the regional AGM and we are certainly open to joining via video conference on an HTO meeting if you have interest or questions for us.
- Jasmine: Unfortunately, you are looking at all the biologists for Nunavut. What we'd like to do personally isn't always what we can do realistically. We would ideally be able to make regular visits and updates for all communities.
- Simon: reason I'm asking is because we've been waiting to hear since 2017
- Markus: I'll tell you the same thing I told Cambridge Bay—it was a long time to wait for these results I admit, it is not ideal --- MC was challenging because the data was so sparse, analysts really struggled to analyze the little bit of data, ransomware, and COVID. I wanted to be able to stand behind these numbers and support them and so it took longer than we predicted. We apologize for that.
- **Question Willy:** another comment/concern I'd like to mention is did you do MC then to GB? --
- **Answer Markus:** we did them at the same time
- **Question Willy:** could you do a survey in the summer?
- **Answer Markus:** No---because there is still ice enough for bears, but not enough for pilots. The pilots don't want to fly over open water and bears would still be in the water and on ice pans during that time—we would not be able to do proper coverage of the area. You'd have to have really low ice and bears would have to be on shore.
- Willy: it is good to hear that we are having a recommended increase and the population is healthy. Of course, we'd like a bit more. A lot of activity and population is increasing.
- End of meeting

C: Taloyoak

October 21, 2020

**Start:** 17:45

**End:** 20:15

**Participants:**

Joe Ashevak, Chairperson HTO

Tommy Aiyout

Bruce Takolik

Jayko Neeveacheak

Kovalak Kootook

J. Ware – GN-DOE

M. Dyck – GN-DOE

K. Methuen – GN-DOE

D. Anavilok – GN-DOE

- Joe: Board wanted to know whether there was going to be a public meeting and were under the impression that there was going to be a public meeting. It appears that Jimmy the manager forgot to bring this up to the GN (Joe asked Jimmy if he let the GN know that the HTO wanted a public meeting and Jimmy indicated that he forgot). \*Note, the GN did not receive any notification or request for a public meeting prior to this meeting.\*
- This is very important to us and we can wait—sometime this winter would be good. We really want this and have been waiting a long time. M’Clintock is very important. Is this a possibility to do?
- Markus/Jasmine – This is possible to do, but we don’t know if it is likely and we cannot commit at this moment because we need to discuss with our supervisors and figure out a schedule.

**Background slides:** review; no questions

**Study design/methods slides:** passed around biopsy dart; answered a few questions regarding how the dart sampled the bear. No other questions.

**Community participation slides:** review; no questions

**MC study results:**

**Body condition results:** question to board – do you see the improvements in body condition between now and 20 years ago?

- Joe: well, we don't go to MC too much, but what we see are good. Up in Cunningham Bay, we see lots of bear there and they all seem to be in good shape. Did see a subadult that was frozen, dead, and had no fat on it. During darting, do you take a picture of every bear you see/dart? If not, you should. Take a picture of every bear you see and dart – from the top and side. That way you can easily see what kind of shape they're in.
- David A: two years ago, from Gjoa Haven, there were about 5 or 6 males around one female
- Joe: Cape Sydney---where they congregate when they are mating
- Markus: I found most of the breeding pairs in Larsen Sound and tip of King William Island—hanging out in the rough ice around the islands.

**TAH recommendation/discussion:**

- the GN recommendation is based on how certain we are with the estimate, it takes into account the uncertainty with the survival and abundance and it takes into account to maintain the population at our current estimate of ~700. This doesn't mean that the community has to decide to maintain the population at 700—there may be different management objectives. We've shared the same information with the other communities. The communities have to decide what the management objective will be for the population.
- One thing to keep in mind, every time that the harvest TAH gets higher, there is increased risk for population to down. Depending on what the management objective is, this may be a good thing or not. The objectives must be discussed among the communities. Also have to consider what effects the sea ice changes and environmental changes might have on the bears and their abundance. Any bear that the TAH is being increased is also increasing the risk for the population to decline in numbers. The communities should discuss really how they want to manage this population for the future for Nunavummiut thinking about harvest, and all the other factors such as ecosystem, sea ice, seals, contamination.
- You can bring your requests to the RWOs or you can contact us to help with these requests/questions. We are here to provide information and even after we are gone from here in person, we are still available to chat/help how we can.
- Joe/others: noted that there have been some observations of mothers with 3 cubs, even during the moratorium

- Markus: we didn't see any in MC or GB with 3 cubs
- **Question David:** did you see other animals during your survey –wolf and wolverine?
- **Answer Markus:** we saw 2 grizzly bears, but no wolves or wolverines during that time we were flying.
- Peter Aqqaq: regarding the lower yearling litter size---maybe you see less yearlings because there is a greater chance of running into an adult male now that there are more males in the population.
- Markus: good point. I've found 1 male coy over the years killed over the years. I thought if I saw more then it would be a big impact.
- **Question Joe:** So with MC, are we increasing the TAH?
- **Answer Markus:** the government is recommending an increase from 12 to 16
- **Question Joe:** we have 12 right now?—between Taloyoak, Gjoa Haven, Cambridge Bay? So only an increase of 4 –that's not very much.
- **Answer Markus:** yes, that is what the government is recommending.
- Kevin: to be consistent with other communities, you can make a submission at any time to the KRWB about allocation. That is the responsible body for allocating tags and the NWMB makes decisions on setting the TAHs.
- **Question Joe:** and if we get 16, how long would that be for—like how many years?
- **Answer Markus:** Speaking as a biologist, not only as the GN, you guys should chat with the other communities and decide on the management objective for the population. Decide what you want to do with this population. Is 700 just right? Want more? Fewer? These questions help decide what kind of harvest level you would want. So I can't say for how long the TAH would be set.
- **Question Joe:** what was the TAH before the moratorium?
- **Answer Markus:** it was 32 and it was too high---led to the situation where the population went down to 284-300 bears.
- Jasmine: we provide the scientific estimate based on the survey data but the hunters and communities know what that means practically on the land—what



does this 'number' we provide mean to hunters using the land? That is the question – do hunters/communities feel comfortable at this level of bears, is that something you would like to maintain.


- Markus: the GN will only have real issues if it conflicts with The Agreement in which it is the government's mandate to ensure sustainable harvests into the future.
- David: about the distribution of locations of sampling –found that during hunting there are differences in where seals are---seal distribution changing.
- Joe: global warming may be causing more open water and seals in the newer times—why the distribution of bears are changing. Shipping traffic increased.
- **Question Peter Aqqaq:** the GN has a fisheries and sealings department -- Do you compile the seal data with your polar bear data? Would that be a great idea to compile?
- **Answer Markus:** I've been wondering about that the last 10 years or so to see what they have. I do not know what they have --- they count the hides they buy and sell, but not sure if that would be able to tell how many seals there are just by counting the pelts that are sold.
- Joe: there was a cruise ship that ran aground a few years ago that could have an effect on the seal population. We didn't get a report about that---whether there was fuel or other things that leaked.
- **Question Jayko :** Do you do studies in the summer time?
- **Answer Markus:** It depends on the population....when there are areas with both ice and water it is hard to know if bears on land or on the ice and pilots don't like to fly over open water so those aren't good study designs...for example MC or GB. In other areas, where it goes completely ice free and almost all the bears are on the shore, we can do the summer time.

#### **GB results:**

- **Question Joe:** what is the TAH for GB?
- **Answer Markus:** 74
- **Question Jayko:** are you guys getting new equipment –like cameras and stuff to take pictures that have the built in ability to see how big the bear are?

- **Answer Markus:** I think I know what you're saying and it might be a bit more complicated to determine actual size from a picture -- we would need to know altitude, distance, focal length. It might be possible to calculate size and do that. We could look into that.
- **Question Tommy:** talking about quota –all those communities Gjoa, Igloodik, Sanirajak, What the quota like before MC was shut down?
- **Answer Markus:** it was 42 until 2003/2004. It was increased to 74 in 2004/2005 because the study in 1998-2000 showed ~1600 bears instead of 900. I was around at that time of the moratorium in MC that communities were given a few tags for GB to preserve traditions during that moratorium and low harvest in MC.
- Joe: that was a big jump from 42 to 74.
- Markus: yes, I don't know how the recommendation went, but it seems that the 74 has been okay because the population has remained stable, though there may be some environmental changes that have helped the population---like the sea ice thinning/reduction in multi-annual ice and becoming better habitat for fish/seals/algae/etc.
- **Question Jimmy:** no colons being collected anymore?
- **Answer Jasmine:** correct, that was a collaborator project and they had funding for only a set number of years. That funding has run out and now they are working on analyzing the data. I am not sure when reports/information will be ready, but reports will be sent to communities with what they find.
- **Question Jimmy:** about credits? If we want to have a sport hunt, can we use our credits for sport hunts?
- **Answer Kevin:** Yes, that is not a problem. However, keep in mind that we haven't approved any outfitter licenses due to Covid. But, we can help support you for that if you have questions. Not much going on with sport licensing this year still with covid.
- **Question David A.:** with the feces and Peter DeGroot study ---maybe ask the HTO to make sure there was approval – we're not sure there was approval.
- **Answer Markus:** I'm pretty sure that all Bearwatch research had permits—they would have gone through our department.
- **Question Kevin:** do you know when that permit expires?

- **Answer Markus:** I'm not sure—probably multi-year
- Kevin: during the research permit review period that is a good time to bring up any concerns or comments---that is the time to bring that forward and decide if you support. If you don't say anything, it is assumed to be approval from the HTO.
- **Question Bruce:** Is it mostly the GN that counts bears or do other people do it?
- **Answer Markus:** mostly it is GN, but sometimes we have to have help because it is only me and Jasmine. There are a few people that have lots of experience that we bring on to help out on big projects. I'm in charge of the program and I only get people with experience to do the work. And there are locals involved—it's not just the biologists.
- Following the meeting after Jasmine/Markus left, Kevin remained for other agenda items and it was mentioned again that there was a lot of disappointment that the public would not be hearing these results. Kevin reiterated that it appears this was not communicated to the GN and the biologists were not able to plan for this. Tonight was the first it was brought up about the desire for a public meeting.
- End of meeting



# **RE-ESTIMATING THE ABUNDANCE OF A RECOVERING POLAR BEAR SUBPOPULATION BY GENETIC MARK-RECAPTURE IN M'CLINTOCK CHANNEL, NUNAVUT, CANADA,**

**FINAL REPORT**

**29 July, 2020**



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## TABLE OF CONTENTS

1.	A) EXECUTIVE SUMMARY – ENGLISH .....	6
1.	B) EXECUTIVE SUMMARY – INUKTITUT AND INNUINAQTUN TO ADD .....	9
1.	C) EXECUTIVE SUMMARY – INNUINAQTUN .....	13
2.	INTRODUCTION .....	17
3.	STUDY AREA .....	20
4.	METHODS.....	21
	Sampling – field collections .....	21
	Sampling – recovering previously marked bears through harvest .....	25
	Sampling - recaptured bears from past population study .....	25
	Sample preparations .....	25
	Genetic analysis.....	26
	Abundance .....	27
	Survival .....	28
	Reproduction.....	29
	Population growth.....	30
	Body condition .....	30
	Seal observations .....	32
5.	RESULTS.....	33
	General overview .....	33
	Samples examined.....	34
	Population demographic information.....	34
	Abundance .....	34
	Survival.....	35
	Reproduction and Recruitment .....	35
	Population Growth.....	35
	Body condition .....	36
6.	DISCUSSION.....	37
	General .....	37
	Abundance .....	38
	Survival .....	41
	Reproduction.....	42

Population Growth .....	43
Body condition .....	45
7. MANAGEMENT IMPLICATIONS .....	46
The need for continued monitoring .....	46
The need for improved data .....	47
Harvest management and considerations .....	48
8. ACKNOWLEDGEMENTS .....	51
9. LITERATURE CITED .....	52
10. FIGURES AND TABLES.....	61
Figure 1. Overview and location of the M’Clintock Channel polar bear subpopulation with major geographical features and water bodies. ....	61
Figure 2. Capture and re-capture locations for the 1998 – 2000 M’Clintock Channel polar bear study. ....	62
Figure 3. Helicopter paths flown in search for polar bears in M’Clintock Channel, Nunavut, Canada, during April/May-June 2014 – 2016. The golden path represents the Twin Otter reconnaissance flight during April 2016. ....	63
Figure 4. Locations of polar bear encounters in the M’Clintock Channel polar bear subpopulation during April – June of 2014 – 2016. The red arrows pointing to the star and large filled circle are two brown bear observations. ....	64
Figure 5. Seal observations for May – June 2014 in M’Clintock Channel (n = 2,236) recorded during search for polar bears. ....	65
Figure 6. Estimated polar bear abundance in M’Clintock Channel during the early (1998 – 2000) and late (2014 – 2016) study periods. ....	66
Figure 7. Posterior distributions for abundance estimates of female (top) and male (bottom) M’Clintock Channel polar bears.....	67
Figure 8. Population growth rate ( $\lambda$ ) as a function of adult female survival. The observed growth rate is achieved when survival is approximately 0.92. ....	68
Figure 9. Predicted probabilities of bears being classified in Poor, Average, or Good condition in the early (1998 – 2000) and late (2014 – 2016) sampling periods. ADFI = adult, independent female, ADFWO = adult female with offspring, ADM= adult male, SUB = subadults of both sexes .....	69
Figure 10. Predicted probabilities of a bear being in Poor, Average, or Good body condition when sampled at different dates.....	70

Table 1.	Parameter estimates for best fit ordinal logistic regression model for body condition analysis of the M’Clintock Channel polar bear subpopulation.....	71
Table 2.	Overview of field statistics of the M’Clintock Channel polar bear study 2014 – 2016. ....	72
Table 3.	Model selection results for Cormack-Jolly-Seber models of polar bear capture-recapture data from 1998 – 2016 used to estimate apparent survival of independent bears > 2 years. K is the number of parameters in the model.....	73
Table 4.	Mean numbers for cubs-of-the-year (C0) and yearlings (C1) per adult female and litter size for the M’Clintock Channel polar bear subpopulation, 1998 – 2000 and 2014 – 2016. ....	74
Table 5.	Body condition scores (BCS) for polar bears (n = 380) in the M’Clintock Channel subpopulation 1998 – 2000 and 2014 – 2016. Poor BCS corresponds to a thin bear and Good BCS corresponds to a fat/obese bear. Age classes are adult (≥ 5 years) and subadult (2 – 4 years).....	75
Appendix A Study activities.....		76
Plate A1.	Image from the helicopter directly facing the sea ice. Rough ice, pressure ridges, and ice pans are visible (M. Dyck, Government of Nunavut).....	76
Plate A2.	A polar bear being genetically sampled from the air. The orange color at the left rump area is the flagging tape from the mid-air dart as it hits the bear and falls to the ground (M. Dyck, Government of Nunavut). ....	77
Plate A3.	View of the sea ice with pressure ridges and a wind-blown and snow-encrusted surface. A polar bear is visible in the red circle (M. Dyck, Government of Nunavut). ....	77
Plate A4.	Discoloured multi-year ice pushed together to form high pressure ridges and rubble ice fields (M. Dyck, Government of Nunavut).....	77
Plate A5.	Five adult male polar bears along a crack in the sea-ice. These bears were observed feeding together on a bearded seal carcass in May 2014. The sixth bear is not pictured (M. Dyck, Government of Nunavut).....	77
Plate A6.	Genetic biopsy sampling is very minimally invasive. A male polar bear is pictured lying down after being darted, with the dart in the background (M. Dyck, Government of Nunavut). ....	77
Plate A7.	View of flatter sea-ice areas with a polar bear circled on the flat portion of the sea ice (M. Dyck, Government of Nunavut).....	77



## 1. A) EXECUTIVE SUMMARY – ENGLISH

Polar bears (*Ursus maritimus*) are managed across Nunavut, Canada, under a harvest and monitoring system that seeks to ensure harvest is sustainable and identified management objectives are achieved. In recent decades, climatic changes across the Arctic have altered polar bear habitat at unprecedented rates. To retain viable polar bear subpopulations as part of the ecosystem and provide a subsistence resource for Inuit, scientific research and monitoring studies are conducted to evaluate subpopulation status and whether management objectives are being met. Here we report the results of a population study for polar bears inhabiting the M'Clintock Channel (MC) conducted 2014 – 2016. Current samples were collected using less-invasive genetic biopsy darting without immobilizing or physically handling bears. Our analyses included data from the 2014 – 2016 biopsy mark-recapture study, live-capture data collected under a mark-recapture study 1998 – 2000, and limited harvest recovery data over the entire period 1998 – 2016.

Results of a closed capture-recapture model, implemented in a Bayesian framework and fitted to data for independent animals (i.e., >2 years), suggest a mean abundance estimate of 716 (95% Credible Interval [CRI] = 545 – 955) for the period 2014 – 2016, indicating that the MC polar bear subpopulation increased from the mean abundance in 1998 – 2000 (325 [95% CRI = 220 – 484] in this study; 284 [SE: ± 59.3] in Taylor et al. [2006]). Both the male and female segment of the subpopulation increased between study periods (1998 – 2000 and 2014 – 2016), likely because of a combination of reduced harvest pressure and improved habitat quality. We used a closed population model because data were too sparse for models with more parameters. Estimates of abundance should be interpreted with caution because they reflect the “superpopulation” (e.g., it includes all bears that use the MC management area, some of which spend time in other subpopulations as well) and likely include positive bias due to violation of model assumptions in addition to the negative bias caused by variation in the capture probability. The overall mean litter sizes for the period 2014 – 2016 were 1.70 (SE = 0.09) and 1.61 (SE = 0.11) for cubs-of-the-year and yearlings, respectively. The calculated mean number of yearlings per adult female declined from 0.39 (SE =

0.10) to 0.28 (SE = 0.06) between both study periods, but MC remains a productive polar bear subpopulation despite that decline and observed sea-ice changes. However, given the sparse reproductive data, we are not able to make any substantive inferences. Polar bear body condition (i.e., relative fatness), assessed in the spring, generally increased between the periods 1998 – 2000 and 2014 – 2016. Estimated apparent survival for bears aged 2 and older was 0.88 (SE = 0.02), although this is likely biased downward due to temporary or permanent movement of individual bears with respect to the study area and limited data availability concerning immigration and emigration. This is corroborated by the increase in abundance estimates across periods indicating the survival rate had to be greater than 0.88 to achieve such substantial growth. When we calculated adult survival using the change in abundance estimates between 1998 – 2000 and 2014 – 2016, our estimated rate of 0.93 suggests that the population growth is positive, with a growth rate of 2%. Overall, our findings align with local knowledge that the MC subpopulation recovered from over-harvest that occurred 1979 – 1999 (average harvest 34 bears/yr). Ecologically, we hypothesize that the observed improvements in body condition and strong population growth over time may be related to spatial and temporal reductions in sea-ice type and quantity providing transient benefits to the MC subpopulation due to lighter ice conditions (i.e., a reduction in thick, multiyear ice) and increased biological productivity. However, climate change is the primary long-term threat to polar bears and the threshold beyond which the MC subpopulation could be negatively affected by continued ice loss, like some other polar bear subpopulations, is currently unknown.

Estimating demographic parameters for the MC subpopulation proved to be challenging because small sample sizes, low probability of recapturing the same bear, and lack of movement information constrained analyses in this study such that the estimates of abundance and survival are almost certainly biased. Our estimates represent only the second time the MC subpopulation has been inventoried under a replicable, structured study design and thus offer many opportunities to learn from these experiences in analysis and data collection methodology. For other wildlife populations or ecosystems that share similarities with MC, we recommend collecting additional reproductive data and genetic samples at approximately the midpoint between the

current study and the next comprehensive subpopulation assessment (in Nunavut's case, that would be 5 – 7 years post-field work completion) or increasing study length (e.g. 4 – 5 years), to increase confidence in the survival rates, possible emigration, and reproduction. Further, movement data (satellite telemetry) are recommended. In the absence of satellite telemetry data on polar bear movements, we recommend conducting a meta-analysis to investigate exchange between MC and nearby subpopulations (i.e., Lancaster Sound, and Gulf of Boothia).









## 1. C) KAVAMALIQINIRNUT NAINAAQHIMAJUQ –

Nanuit (*Ursus maritimus*) munariyauyut tamainni Nunavunmi, Kaanatami, angunahuarniqmut munariniqmulu qiniqtut naunairiami angunahuarniq munariyauyuq ilitariyauyuqlu munariniqmut piyangit. Taimaa 10nik ukiunik, hilaup aadlangurninnga tamainni Ukiuqtaqtumi aadlanguqtitait nanuit nayugangit aadlatqiiktumik nampanik. Pihimagiami nakuuyumik nanuit amihunik ilagiyanganik avatinganik tuniyuqlu inuujjutikhangit Inungnut, nalunaqtunik naunaiyainiq munarininnganiklu piyait naunaiyariami amihunik qanurittaakhaanik taimaalu munarininngit piliqtait. Hamani uqaqtavut qanurittaakhaanik amihuuninnginnik naunaiyainiq nanuqnut nayugangit Ittuaqtuuq (MC) havaktait 2014-2016. Nutaat uuktuutingit katitiqtauyut aturhutik mikitqiamik-pittailiniq ihariagiyainnik niqinginnik piiyaqtauniq kapuqtauyut nutqaqtihimaittumik akhuraalukluuniit pilugit nanuit. Ihivriurutivut ilaliutihimayug nampangit uumannga 2014-2016 niqinginnik piiqtauniq naunaiqtait piffaarhugit nanuit naunaiyainiq, tuqutihimaittumik piplugit nampangit katitiqtait uumani naunaiyainiq piffaarhugit naunaiyainiq 1998-2000, kikliqaqtumiklu angunahuarniq piffaarninnga nampangit tamainni uumani 1998-2016.

Qanurittaakhaanik umikhimayumik piyait piffaaqtait uuktuutigiplugu, iliuraqtuq uuminnga Nampanik ihivriuqniq tunngavinga ihuarhaqtauyuqlu nampangit inmikkuuqtunut huradjat (ukunatitut, >2 ukiunik), piyuq piqarninnganik itqurnarutauyuq uuminnga 716 (95pusantmik Itquumayuq Nutqarninnga [CRI] = 545 – 955) uumunnga 2014-2016, naunaiqtait tamna MC nanuit amihuuninngit angikliyuumiqtuq uumannga amihuuninnganik uumani 1998-2000 (325 [95pusantmik CRI = 220 – 484] uumani naunaiyaininngani; 284 [SE: ± 59.3] uumani Taylor aadlallu. [2006]). Tamarmik



anguhalluk arnallatlu ilagiyanga uuminnga amihuuninngit angikliyuumiqtuq naunaiyaqtillugit (1998-2000 uumanilu 2014-2016), aadlatqiiktumik ikikliyuumiqtuq angunahuarniqmut akhuurniq ihuaqhaqhimayuqlu nayugangit qanurittaakhaanik. Atuqtugut qaffit inuuyut angikliyuumiqtut tuqtut uuktuutigiplugu taimaa nampangit piqalluanguinmat uuktuutikhamut amihunik kikliqarninnga. Itqurnarninnga amihuuninnganik pipkaijjutauyukhaq qayagilugit taimaa naunaiqmata “amigaininnga” (ukunatitut, ilaliutikmata tamaita nanuit atuqtait MC munarininnga, ilangit nayuqpaktut aadlani amihuuninngit ukuatlu) ilaliutiniaruknaqhiuq nakuuyumik ihuittumik piyuq ulapiqutiyuq uuktuutimut maliktakhangit unalu nakuungittumik ihuittumik pipkaijjutauyuq aadlatqiininnganik pigaangamitkik. Tamainnit nanunnuangit aktikkulaangit uumunnga 2014-2016 ittuq 1.70 (SE = 0.09) unalu 1.61 (SE = 0.11) nanunnuangit-ukiungani unalu atauhiqmik ukiulik, inmikkut. Naunaiyarhimayuq qaffiuyut atauhiqmik ukiulik atauhiqmut arnallakmut mikhiyuq uumannga 0.39 (SE = 0.10) uumunnga 0.28 (SE = 0.06) tamarmiknit naunaiyaininnganik, kihimi MC nakuuyumik piyuq nanuit amihuuninngit humaangittuq mikhiyuq qun’ngiaqtauyuqlu tariup hikunga aadlangurniq. Kihimi, tuttumik nanunnuaqarninnganik nampangit, piliulimaittugut ihariagiyauyumik ihumagininngit. Nanuit timingit qanurittaakhaanik (ukunatitut, puvalaniq), naunaiyarhimayuq upin’ngakhami, angikliyuumiqtuq uumani 1998-2000 uumanilu 2014-2016. Itqurnarutauyut naunaittuq inuujjutingit nanuqnut ukiulgut 2mik avatqumayuqluunit 0.88 (SE = 0.02), taimaa pilimaittuq ihuittuq mikhiyuq tadjakaffukmut ingilrainnaqtullu nanuit naunaiyaininnganut kikliqaqtumiklu nampangit piqarninnga piyuq tikittunik nuutiqtirninngalu. Una naunaiqtauyuq angikliyuumiutinganik amihuuninnganit itqurnarninnga tamainni naunaiyaiyuq inuujjutingit nampangit angitqiyauyukhaq

uumannga 0.88 pigiami angiyumik angikliyuumirniq. Taimaa naunaiyarmatku angayukhiuyut inuujjutingit aturhugu aadlangurninnga amihuuninnganik itqurnarninnga uumani 1998-2000 uumanilu 2014-2016, itqurnarutauyut nampavut uuminnga 0.93 pitquyait amihuuninnga angikliyuumiutinga nakuuyuq, piqarhuni angikliyuuminnga nampanga 2pusantmik. Tamainnit, naunaiqtavut aadjikutariyaa nunallaani ilihimaniq tamna MC amihuuninngit piffaaqtait amihumik angunahuarniq piyuq uumani 1979-1999 (angunahuarninnga 34 nanuqnik/atauhiqmi ukiumik). Avatininnganut, ihumagiyaqqut qun'ngiaqtauniq ihuarhiyut timinginnik akhuraaluklu amihuuninnga angikliyuumiqtuq taimaa piyuq inikhanganik qangarnitamik ikikliyuumiqtuq tariup hikunga qanurittaakhaanik qanuraaluklu tuniyuq tadjakaffuk ikayuutauyuq uumunnga MC amihuuninngit pikmat uumannga tualihimayuq hikunga (ukunatatit, ikikliyuumiqtuq hilikninnga, amihunik ukiut hikunga) unalu angikliyuumiqtuq inuujjutinganik qanurittaakhaanik. Kihimi, hilaup aadlangurninnga hivulliutinga akuniraalukmik qayangnarutauyuq nanuqnut aullaqtirininnga uumannga MC amihuuninngit nakuungittumik ayurhautipkaiyuq hikuirninnganit, taimaatut ilangit aadlat nanuit amihuuninngit, tadjja naluyait.

Itqurnarutiyuq piyuq amihuuninnganik kiklikhangit uumunnga MC amihuuninngit naunaiqtuq akhuurutauyuq taimaa mikkait uuktuutingit aktikkulaangit, piqalluanguinmat piniaruknaqhiyuq piffaarumitkut tamna piyaraluangit nanuq, piqalluanguinmallu ingilrarninnga naunaitkutingit pitquyayuyuq naunaiyainiq uumani naunaiyaqtamiknik taimaa itqurnarninnga amihuuninnganik inuujjutingalu taimaa ihuittuq. Itqurnarutikput piyaa tuglianganik MC amihuuninngit naunaiqtauyyuq uumani aadjikutaliurhimayuq, ihuarhaqhimayuq naunaiyaininnga piliurninnga talvuuna tuniyuq amihunik

pivikhaqautikhaq ayuiriami tahapkunanit atuqtamiknik naunaiyaininngani nampangniklu katitiqtut piplugu. Aadlanut huradja amihuuninngit avatingaluuniit atuqtait aadjikutariikninnga uumunnga MC, katitiqyavut aadlanik nanuliurniqmut nampangit unalu auminganik uuktuqtut qitqani uumannga nutaamit naunaiyainiq aippaangalu iluittuq amihuuninngit naunaiyainiq (Nunavutimi, inniaqtuq 5-7 ukiunik maniqqamungaqtinnagu havaanga iniqtaukpat) angikliyuumirluguluuniit naunaiyaininnga qanuraaluktut piyakhaq (ukunatitut 4-5 ukiunik), angikliyuumiriami ilihimaninnga inuuyunik nampanginnik, unaluuniit ahinunngauyut, nanuliurniqlu. Unalu, ingilraninnga nampangit (saatalaitkut nipiliurniq tunigiamilu taiguqtanginnik) pitquyayuuq. Piqangitkumi saatalaitkut nipiliurniq tunigiamilu taiguqtanginnik nampangit nanuit ingilraninnginnik, pitquyavut pigumik ihivriurninnga nampangnik ihivriuriami himmautingit uumannga MC qanittullu amihuuninngit (ukunatitut, Aqqusiriaoq, uumanilu Kangirturulukmilu).

## 2. INTRODUCTION

Wildlife managers face complex decisions when seeking to balance conservation and human priorities. Decisions and outcomes must be evaluated periodically so that new information can be fed back into an adaptive management framework (Holling 1978, Lancia et al. 1996, Johnson 1999). Accurate and up-to-date estimates of population abundance are often a key component of informed management decisions (Nichols and Williams 2006). Typically, new estimates of abundance are acquired periodically according to a monitoring interval that is determined by management objectives, species' biology (Gibbs 2008), and available resources. As climatic changes affect many areas around the globe, shortened monitoring intervals may be required to understand the concurrent effects of management interventions and environmental change. Broadly, more frequent monitoring increases the probability of meeting management objectives and reduces the severity of potential negative outcomes (Taylor et al. 2007, Regehr et al. 2017).

One species that has received significant monitoring attention is the polar bear (*Ursus maritimus* Phipps 1774). Polar bears are characterized by having delayed maturation, small litter sizes, and high adult survival rates (Bunnell and Tait 1981). They are at the top of the Arctic food chain and depend on the sea ice for hunting, travel, mating, and in some instances denning (Amstrup 2003). Sea-ice loss resulting from climate change is predicted to impact polar bear subpopulations severely in the future (Derocher et al. 2004, Stirling and Parkinson 2006, Amstrup et al. 2008, Durner et al. 2009, Stirling and Derocher 2012, Atwood et al. 2016, Regehr et al. 2016). The global polar bear population, consisting of 19 subpopulation units, is estimated to be approximately 26,000 polar bears (Obbard et al. 2010, Wiig et al. 2015). There is not currently empirical evidence for declines in global abundance due to sea-ice loss (Regehr et al. 2016). However, accurate assessment of such changes is complicated by poor data for many polar bear subpopulations (Durner et al. 2018, Hamilton and Derocher 2018), spatial and temporal variation in the effects of sea-ice loss, and the fact that some subpopulations have likely recovered in recent decades from overexploitation

prior to the 1973 Agreement on the Conservation of Polar Bears (Honderich 1991, Larsen and Stirling 2009).

Despite on-going research and monitoring efforts on polar bears to date, reliable and updated abundance and demographic information about all subpopulations is still lacking (Obbard et al. 2010, Vongraven et al. 2012, Durner et al. 2018). Polar bear research is expensive and logistically challenging, especially for management jurisdictions that oversee more than one subpopulation. Nunavut, Canada, is home to 12 subpopulations (8 shared with other jurisdictions, 4 entirely within Nunavut; Obbard et al. 2010) and as such, carries the major responsibility of polar bear research and management in Canada. In order to maintain healthy and viable polar bear subpopulations, population studies in Nunavut are carried out on average within a 10 – 15-year rotational cycle, which can vary depending on research needs and priorities (Hamilton and Derocher 2018) along with available resources. Here we present findings from a 2014 – 2016 monitoring study to re-estimate abundance of the M'Clintock Channel (MC) polar bear subpopulation.

M'Clintock Channel is entirely managed by Nunavut, Canada (Figure 1) and an initial physical mark-recapture study was carried out from 1973 – 1978 (Furnell and Schweinsburg 1984) for both MC and the adjacent Gulf of Boothia (GB) subpopulation together as a single demographic unit. The total abundance estimate for both areas was 1081 bears. The estimate was known to be biased by non-representative sampling and was subsequently increased to 900 for GB and 900 for MC based on back-calculations to determine abundance levels that would be necessary to sustain the existing subsistence harvest levels (Aars et al. 2006, Taylor et al. 2006) along with local indigenous knowledge.

In the mid-1990s, the MC estimate was revised downwards to 700 based on hunter reports of reduced densities of polar bears (Aars et al. 2006, Taylor et al. 2006). M'Clintock Channel and GB were later delineated based on movements of satellite radio-collared adult female bears, recoveries of research tags in the harvest (Taylor and

Lee 1995, Taylor et al. 2001), and Inuit knowledge about how local conditions may influence the movements of polar bears (Keith et al. 2005). Genetic analyses based on microsatellite data also suggested some level of differentiation between the MC and GB subpopulations, although the magnitude of population structuring was higher among females than males (Campagna et al. 2013). Past harvests in MC of 34 bears/year from 1979 – 1999 were considered unsustainable (Taylor et al. 2006), resulting in a harvest moratorium from 2001/2002 – 2003/2004 and a reduced harvest of 3 bears annually until 2015. Prior to the current study, the most recent estimate of abundance for the MC subpopulation was 284 bears (SE:  $\pm 59.3$ ) from a physical mark-recapture study conducted 1998 – 2000 (Taylor et al. 2006). In recent decades the subpopulation has been managed to achieve recovery, and local knowledge indicates that more bears have been seen in the 2000s by Gjoa Haven and Taloyoak hunters during their travels across the sea ice (Dyck personal communications with hunters during consultation meetings 2013). This perceived increase in abundance resulted in an increase in the annual harvest from 3 to 12 bears at a 2:1 male to female harvest sex ratio, beginning with the 2015/2016 harvest season.

Nunavut's polar bear co-management system is based on memoranda of understanding (MOU)<sup>1</sup> developed between each community's Hunters and Trappers Association and the government. These MOUs lay out harvest, management and research aspects for each polar bear subpopulation. Under the existing MOU that was co-signed by all parties in 2005, the Government of Nunavut (GN) committed to a new population study for MC. The new study had the objective to estimate the current subpopulation size and composition, and to compare those results to the former study so that this information would be available to responsible management authorities for decision-making. In addition, we sought to obtain data that would provide estimates on survival and reproductive parameters in order to allow population viability analyses. Lastly, by implementing a research method that was minimally invasive but supported by local communities and stakeholders, we sought to evaluate whether genetic mark-recapture can be a useful alternative in population monitoring (Vongraven and Peacock

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<sup>1</sup> The MOUs were replaced by the Nunavut Polar Bear Co-Management Plan in September 2019

2011, Vongraven et al. 2012). To address these objectives, we conducted a genetic mark-recapture study from 2014 – 2016.

### 3. STUDY AREA

The current management boundary for the MC subpopulation (Figure 1) is mainly based on telemetry data for adult female bears that were fitted with radio-collars in adjacent subpopulations, and tag returns from harvested bears (Schweinsburg et al. 1982, Bethke et al. 1996, Taylor et al. 2001). This boundary has also been supported by recent genetic analyses (Campagna et al. 2013, Malenfant et al. 2016) although its validity has been questioned by Inuit (Keith et al. 2005). The MC study area (about 495 000 km<sup>2</sup> including land mass, or 140 000 km<sup>2</sup> of sea-ice; Barber and Iacozza 2004, Hamilton and Derocher 2018) is bound by Victoria Island to the west, Prince of Wales Island to the north, Boothia Peninsula to the east, and the Nunavut mainland to the south (Figure 1). These land barriers are believed to restrict bear movement in and out of the study area. A detailed description of the physiography, currents, and sea ice of the region can be found in Schweinsburg et al. (1981).

Over the past 20 – 30 years, there has been a change in sea-ice quantity and composition. Multi-year sea ice has declined and been replaced by annual ice (Schweinsburg et al. 1981, Rothrock et al. 1999, Comiso 2002, Barber and Iacozza 2004, Keith et al. 2005, Howell et al. 2008, 2009, Sou and Flato 2009, Perovich et al. 2018, Richter-Menge et al. 2018, Environment and Climate Change Canada 2019). This has resulted in a smoother sea-ice platform interspersed with long pressure ridges, with rougher multi-year ice generally limited to localized areas (i.e., M'Clintock Channel proper; Dyck pers. observations). For most of the year, the sea is completely ice covered except for a few small polynyas that attract seals, polar bears, and other species (Hannah et al. 2009, Stirling 1997). From approximately mid-June to July, wide cracks form and extend for miles, providing haul-out habitat for ringed (*Pusa hispida*) and bearded seals (*Erignathus barbatus*) and thus, good foraging habitat for polar bears. From August to early October, much of the sea ice disappears in the southern

and eastern portion of the study area, allowing shipping traffic along the Northwest Passage route (Stewart et al. 2007, Howell et al. 2008, 2009, 2013a, Analyse and Strategi 2011). Currently, some multi-year ice remains in M'Clintock Channel proper year-round – ice that originates and is pushed south from the Queen Elizabeth Islands and M'Clure Strait (Howell et al. 2008, 2013b). How important the contemporary remaining summer multi-year ice in M'Clintock Channel proper is to MC polar bears is currently unknown.

#### **4. METHODS**

##### *Sampling – field collections*

Our study design followed that of the previous physical mark-recapture study conducted in MC between 1998 – 2000 (Taylor et al. 2006; Figure 2); however, it did not involve the immobilization and physical handling of bears. Inuit co-management partners in Nunavut expressed their concern over wildlife capture and handling during a wildlife symposium in 2009 (Lunn et al. 2010, Department of Environment 2013). As a result, the responsible government management agency explored alternative research methods. Given the presumed low densities of bears (Hamilton and Derocher 2018) and the vast study area, genetic mark-recapture was chosen as the method since it is minimally invasive (Garshelis 2006) and has been successfully applied on various species, including bears (Brown et al. 1991 (right whales (*Eubalaena glacialis*)), Palsbøll et al. 1997 (humpback whales (*Megaptera novaeangliae*)), Boulanger et al. 2004, Olson 2009 (brown bear (*U. arctos*)), Pagano et al. 2014, SWG 2016 (polar bear)). We obtained genetic material for individual bears from a small sample of skin and hair collected via a remote biopsy dart (Pneudart Type C - Polar Bear) fired from a dart gun (Capchur Model 196) from inside a Bell 206 Long Ranger helicopter (Pagano et al. 2014). The extracted DNA was used to identify individual animals without the need for ear-tagging or lip-tattooing (see section “Genetic analysis”). Recaptures occurred when a previously sampled bear was biopsy-darted on a later occasion or when a genetic sample was recovered through the Nunavut polar bear harvest monitoring



program. Every hunter in Nunavut is required to submit samples to the polar bear harvest lab so that age, gender and various other variables can be used in any ecological or demographic assessment (Nunavut Wildlife Act, SNU 2003).

We initially intended to begin field work in early April, but poor spring weather forced us to wait until late April to early May each year between 2014 and 2016. Field work usually was completed by mid-June. Approximately 80% of the entire MC study area was searched every year though poor weather and unsafe flying conditions prevented us from searching the entire study area during each field season, and we were not able to sample M'Clintock Channel proper in any year. In mid-April 2016, we used a Twin Otter for a reconnaissance flight over M'Clintock Channel proper to assess bear presence and sign. This allowed us to infer whether this portion of the study area potentially contained animals that were unlikely to be exposed to sampling effort unless they moved into areas that were searched by field crews.

Searches for bears were conducted at approximately 100 – 120 m above sea level, and at average speeds between 120 – 150 km per hour. Search areas were initially discussed with hunters and local Hunters' and Trappers' Associations during pre-study consultation meetings to gain insight about sea-ice conditions and bear distribution. Also taking past capture locations (Taylor et al. 2006) into account, we searched the sea ice, adjacent coastal areas, and small islands of Coronation Gulf, Dease Strait, Victoria Strait, Franklin Strait, James Ross Strait, Larsen Sound, Rae Strait, and Queen Maud Gulf during 2014 and 2015 (Figure 1). We decided to forego the Coronation Gulf and Queen Maud Gulf areas in 2016 because we observed very low bear activity and presence during our survey flights, and local knowledgeable hunters also indicated and confirmed that bears are rarely seen in those areas.

In order to minimize potential sampling bias, and to allow replication of this study, we used a "semi-structured" sampling approach. Generally, we flew transect lines across the sea ice and small islands with search intensity proportional to apparent bear activity (or bear presence). When signs of bears (e.g., tracks, bears, seal kills) were rare

or plentiful, search transect lines were spaced further apart (i.e., 11 – 16 km), or closer to each other (i.e., 7 – 10 km), respectively. In that fashion, we were able to cover large sections of the study area efficiently (Figure 3). We decided to fly our survey transects from east to west and vice versa whenever possible (e.g., perpendicular to suspected density gradients based on past capture and harvest locations).

Once we located a bear, a small sample of tissue (<5 mm diameter), mostly skin with some adipose tissue attached to it (Pagano et al. 2014), was taken from the rump area at an approximate distance (or altitude) of 3 – 7 m using a biopsy dart (5CC Polar Bear Biopsy DNA Dart, Pneu-Dart Inc., Williamsport, PA). All bears except cubs-of-the-year (C0) were sampled. Cubs-of-the-year in early spring are still small and easily confused (Atkinson and Ramsay 1995, Robbins et al. 2012), so we decided not to dart C0s to avoid possible injury and the splitting-up of family groups. Every bear that was biopsied received a unique field identification number so that the genetic results and our field data could be cross-referenced and linked.

The biopsy darts are designed to fall to the ground after impact and are retrieved without physically handling a bear (see Appendix A for images). The effectiveness of these darts for sampling polar bears has been previously demonstrated (Pagano et al. 2014, SWG 2016, Dyck et al. 2020). The darts are quick and easy to use and require less pursuit time of bears than during capture operations. On average, it took less than 4 minutes from when a bear was initially spotted to the time when the dart was picked up after sampling a bear (GN, unpublished data). The design and relatively low velocity of the dart means that risk of injury to a bear is minimal. Typically, bears show no or very little response to the impact of the dart and are left with no obvious visible mark. In order to facilitate easy spotting of darts on the ice or in deeper snow, a 10 – 15 cm long and ~2 cm wide strip of brightly colored flagging tape (C.H. Hanson, Naperville, IL; or Johnson, Montreal, PQ) was tied and wrapped around the distal end of the dart.

We recorded the date, time, location of each observed bear (or group of bears), body condition based on aerial inspection using a subjective standard fat index (Stirling

et al. 2008; a scale from 1 – 5 with 1 being skinny, 3 average and 5 obese), specific markings or characteristics, group size or litter size, the estimated field age class (C0, yearling (C1), 2-year old, subadult, adult) and field sex both with a confidence qualifier (a = high confidence; b = low confidence). Field age class and sex were assessed remotely from the helicopter at altitudes between 3 – 7 m by the same observer. When we encountered mothers and their dependent offspring we distinguished C0s, C1s, and 2-year old bears based on their size and physical features (e.g., blood or fecal/urine stains, scars) or their behavior to a) assign them to a field age class, and b) avoid sampling the same individual more than once. Additional cues such as body size of the individual bear in relation to its surrounding or group members, body shape and proportions, presence of scars, secondary sexual characteristics, observation of urination, and gait were all used to determine sex and age class (SWG 2016, Laidre et al. 2020).

When field age class and sex of a bear were initially assessed with low confidence, additional field notes were taken. For example, young subadult male bears and younger adult females are at times difficult to discern from the air when they are solitary. If we thought that the encountered bear was a young adult female, but were uncertain (confidence classifier “b”) then we also noted what this bear could be as alternative – in this case “maybe a young subadult male”. We used genetic results to confirm the field-recorded sex and age classes. Lastly, we recorded factors that may have influenced detection probability during sightings, including weather conditions (e.g., cloudy, clear, sun glare), bear activity when first observed, and sea-ice characteristics in general and within the immediate vicinity (~ 30 m) of an individual bear that may impede detection (e.g., sea-ice type: flat, intermediate, rough multi-year ice).

Our work combined data collected during the genetic biopsy sampling sessions from 2014 – 2016, considered the *late period*, and data from the previous capture-mark-recapture study conducted 1998 – 2000, or the *early period*.

### *Sampling – recovering previously marked bears through harvest*

To detect the recovery of previously 'marked' bears (e.g., when bears were marked either during the initial mark-recapture study from 1998 – 2000, or from a previous biopsy-darting field season), we asked hunters to return any ear tags or lip tattoos from their harvested bears. To detect recoveries for bears in which a tattoo may be too faded to see or bears that had been marked through biopsy sampling (which leaves no physical marking), small muscle tissue samples were collected from all bears harvested in MC and surrounding subpopulations such as GB, Lancaster Sound (LS) and Viscount Melville Sound (VM) throughout the duration of the study (May 2014 – June 2016). These samples were stored in 2 ml cryovials (ThermoScientific, Nalgene long-term storage cryogenic tubes) at - 20°C until sample preparation and analyses.

### *Sampling - recaptured bears from past population study*

Because the initial subpopulation inventory for MC (1998-2000) was conducted using physical capture-mark-recapture methods in which a physical tag or tattoo was used for identification, we had no genetic database for these bears. In order to identify recaptures of bears during our 2014-2016 study that were originally marked during the 1998-2000 study, we examined captures and recaptures from the 1998 – 2000 population inventory, removed bears that we knew were dead (e.g., through a recovered ear tag or tattoo by harvest) and selected the remaining individuals that could be still alive ( $\leq 34$  years of age) in 2014 for genetic analyses. Samples (ear plugs from punching a hole through the pinna so that unique identification ear tags can be applied) of captured and re-captured bears from the initial study had been stored in cryovials at - 20°C until preparation for genetic analyses.

### *Sample preparations*

We used the same method to prepare all field and laboratory tissues or biopsy samples. A lentil-size piece of skin (~1 – 1.5 mm thick) or tissue was cut from either the biopsy

sample, the ear plug, or the muscle tissue with a new scalpel blade (# 20) and transferred onto a shipping card (Avery, 70 x 35 mm) and attached with scotch tape. Each sample card was labelled with the unique bear identification number and placed into a coin envelope (57 x 89 mm) and left to dry at room temperature for up to 3 days. The dried specimens were then sent to Wildlife Genetics International Inc. (Nelson, British Columbia) for individual genotyping and sex determination.

### *Genetic analysis*

DNA was extracted from tissue with QIAGEN DNeasy Blood and Tissue Kits (Qiagen, Inc.). The tissue samples were genotyped at eight previously published dinucleotide microsatellite loci (REN145P07, CXX20, MU50, G10B, G10P, G10X, MU59, G10H; Paetkau and Strobeck 1994, Paetkau et al. 1995, 1998; Taberlet et al. 1997, Breen et al., 2001, Ostrander et al. 1993). Analysis of individual identity followed a 3-phase protocol previously validated for bears and described elsewhere (Paetkau 2003; Kendall et al. 2009).

First, to select markers for the analysis of individual identity, we used allele frequency data from approximately 1700 polar bears for which complete 20-locus genotypes existed before the genetic mark-recapture study began (GN, unpublished data). We ranked the 20 microsatellite markers in the dataset by expected heterozygosity. The eight most variable markers that could be analyzed together in a single sequencer lane were selected for use. These surpassed the required standard for marker variability (Paetkau 2003). In addition to the eight microsatellite markers, we analyzed sex on every sample, using a *ZFX/ZFY* marker. We searched the dataset for genotype matches that seemed unlikely based on our field data. In each case, three extra markers were added to the genotypes to lower the probability of chance matches between individuals. The extra loci confirmed all of these matches. Once the genotyping and error-checking was complete, we defined an individual for each unique eight-locus genotype.

## *Abundance*

We estimated abundance using a closed-population mark-recapture model (Otis et al. 1978) in a Bayesian framework (Kéry and Schaub 2011) for independent animals (>2 years old) encountered during 2 primary sampling periods which occurred during the spring field seasons for the years 1998 – 2000 (early sampling period) and 2014 – 2016 (late sampling period). We used annual time-steps referenced to the springtime field seasons, resulting in three capture occasions within the early and late period (1998, 1999, 2000 and 2014, 2015, 2016, respectively). The model allowed for capture probability to vary by sex but was held constant across capture occasions within each primary sampling period. We fit separate models for the early and late periods. Abundance estimates for the two sampling periods were derived separately without any shared parameters. Furthermore, we split each abundance estimate by sex to obtain separate estimates of detection and abundance by sex. We make no assumptions about the change in population between the periods, nor do we assume equal capture probability. We fit a total of four separate closed-population models, one for each sex and time period.

The model assumed that the MC subpopulation was a geographically and demographically closed population within each three-year period of data collection. Therefore, the model assumes there is no movement in or out of the study area and no birth or death. Polar bear survival is generally higher for adults (Amstrup and Durner 1995), which should reduce bias associated with violation of the demographic closure assumption. However, lower survival rates for younger polar bears (Regehr et al. 2010) and recruitment of juvenile animals into the study population could be expected to cause positive bias in estimates of abundance (Pollock et al. 1990). Furthermore, potential violations of the geographic closure assumption due to movement of animals in and out of the study area mean that the estimate of abundance does not represent the number of animals within the study area at any given time, but rather represent the total number of bears available for capture across the three-year period (i.e., the “superpopulation”; Kendall et al. 1997). We estimated abundance using closed models,

despite potential biases, because the data were sparse and insufficient to parameterize an open population model. Moreover, because the survey area changed annually with changing weather and effort, common estimators such as the Horvitz-Thompson for  $N$  from each year's sampling were not appropriate because the estimator's results would conflate changing survey area with population size in unknown ways. We chose to estimate abundance using data from the 2 primary sampling periods rather than from all data from 1998 – 2016 because the 13-year gap between the 1998 – 2000 and the 2014 – 2016 surveys will overstate permanent emigration causing survival ( $\phi$ ) to go down and capture probability ( $p$ ) to go up. Therefore, the estimate of  $p$  will be too high underestimating population size. While not ideal, using the closed models provides the best estimate with the available data.

To fit the closed-population capture-recapture models, we performed Markov chain Monte Carlo (MCMC) analysis using JAGS (Plummer 2003) through the R package *R2jags*. Each model was run for 20,000 iterations with the initial 2,000 discarded for burn-in. We used diffuse normal prior distributions on a logit link for all parameters. We checked for model convergence using  $\hat{R}$  statistics and by examining MCMC chain plots (Gelman et al. 2013).

### *Survival*

We estimated annual, apparent survival for independent bears >2 years old using all encounters from 1998 – 2016 by grouping our data into the 2 capture-mark-recapture sampling periods (1998 – 2000 and 2014 – 2016) and using available dead-recoveries from 1998 – 2016. Data were sparse with respect to live-recaptures and dead-recoveries and there was a 13-year gap (i.e., 2001 – 2013) in sampling between the capture-mark recapture studies. The gap period was characterized by a very low harvest rate resulting in minimal dead-recovery opportunities (e.g., 3 bears per year as harvest). Additionally,  $p$  is essentially equal to zero because the closed population model does not allow any recaptures during the gap period between sampling efforts. Because we did not have radiotelemetry data, and very few or no data on recoveries of

previously marked animals, we could not estimate fidelity ( $F$ ; the probability that an animal does not permanently emigrate from the sampling area and remains available for live observation in the future) to our study area. Therefore, estimates are not true survival but rather apparent survival, which is the probability of a bear remaining alive and available for capture, given it was alive at the previous sampling time. Bears that permanently leave the study area and remain alive, but are unavailable for recapture cannot be separated from mortality when estimating apparent survival. Therefore, apparent survival will likely be lower than true survival due to emigration.

We used a Cormack-Jolly-Seber (CJS) model (Cormack 1964, Jolly 1965, Seber 1965) and considered apparent survival ( $\phi$ ) varying by sex (i.e., male or female) or remaining constant, and capture probability ( $p$ ) varying by sex, study period (i.e., early versus late period), or remaining constant. The commonly used Burnham model was not applicable for estimating MC survival rates because the harvest rate changed, yet there are insufficient data to estimate multiple recovery probabilities. Therefore, the survival from the Burnham model would be unreliable and would reduce to a CJS model in the absence of additional data. We fit six models representing all combinations of  $\phi$  and  $p$  in Program Mark (White and Burnham 1999) through the *Rmark* (Laake 2013) package in R. We used AIC to rank models with the lowest AIC value suggesting the strongest support (Burnham and Anderson 2002). All models differed by a single, nested parameter, therefore we evaluated whether that parameter resulted in a model improvement based on  $\Delta$ AIC and parameter estimates.

### *Reproduction*

We calculated reproductive indices for MC polar bears using data for the early and late study periods by using reproductive metrics that have been identified as important for monitoring (Vongraven et al. 2012). The annual observations of dependent young during the sampling periods were few and variable which limited our ability to estimate many reproductive indices. We calculated the mean number of C0 and C1 per adult female (AF) by year and study period ( $\pm$  SE) using the observed sampling data. Adult



females were a) bears identified genetically as females, and b) bears classified in the field with the age class “adult” with high confidence. We also calculated mean C0 and C1 litter size by study period, although the data were too sparse to evaluate patterns in litter size as function of biological, environmental and temporal factors.

### *Population growth*

We estimated population growth rate in two ways to understand differences between observed changes in abundance and demographic rates. First, we estimated the empirical growth rate as the ratio of the late period abundance over the early period abundance for males and females. We then computed an average annual growth rate ( $\lambda$ ) by taking the 17<sup>th</sup> root of the growth rate to account for the length of time between the two study periods. We estimated separate growth rates for males and females because the abundance estimates differed by sex. Second, we computed an asymptotic growth rate from a 4-stage matrix model based on the demographic rates estimated in this study (Mills 2012). For rates that were not available from our study, we used values from Taylor et al. (2006). The population matrix was defined as:

$$L = \begin{bmatrix} 0.00 & 0.00 & 0.00 & 0.17 \\ 0.62 & 0.00 & 0.00 & 0.00 \\ 0.00 & 0.88 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.88 & 0.88 \end{bmatrix},$$

where C0 survival probability = 0.62 (Taylor et al. 2006), 2+ year old survival probability = 0.88 (present study), and recruitment = 0.39 C0 per AF (present study). The value of 0.17 in the upper right of the matrix is the product of AF survival (0.88), recruitment (0.39), and sex ratio at birth (0.5). We solved for asymptotic growth rate by calculating the dominant eigenvalue of the matrix ( $L$ ) assuming a stable stage distribution.

### *Body condition*

We compiled body condition score (BCS) data for the early and late study periods. Bears were assigned a BCS on a scale of 1 – 5 with 1 being skinny and 5 being obese

(Stirling et al. 2008) through physical handling and capture (early period; 1998 – 2000) or aerial observation during biopsy sampling (late period; 2014 – 2016) from April to June. Sex, age, and reproductive classes were assigned during physical handling during the early period and ages were determined based on previous capture history, known birth year, or from tooth analysis (Calvert and Ramsay 1998). During the late sampling period, classification was done during biopsy sampling while flying approximately 3 – 7 m above the ground with sex verified by subsequent genetic analysis (SWG 2016, Laidre et al. 2020). Observers who participated in classifying age class and sex during biopsy sampling had either participated in both study periods, or were experienced in physical capture-mark-recapture studies.

The BCS raw scores were binned into 3 classes: ‘poor’ (1 – 2), ‘average’ (3), and ‘good’ (4 – 5) in order to follow recommended monitoring schemes (Stirling et al. 2008, Vongraven et al. 2012) and facilitate comparison between previous studies (SWG 2016, Laidre et al. 2020). Like previous studies, we did not include dependent offspring in the BCS analyses because their body condition is dependent on maternal condition (SWG 2016) and we excluded within-year observations of the same individual.

We modeled BCS using ordinal logistic regression and included *period* as an indicator of sampling period (early = 1998 – 2000 or late = 2014 – 2016). Reproductive status, age, and sex were combined into one 4-level categorical variable, *reproclass* (ADM = adult male, ADFI = independent adult female, ADFWO = adult female with offspring, and SUB = subadults of both genders) and Julian date of sampling (*jul\_cap\_day*) was included as a continuous covariate to reflect the amount of time a bear had on their preferred sea-ice hunting platform before being sampled in year *t*. The sampling seasons (April-June) in this study also coincided with the annual seal pupping period, which is known to be prime feeding period for bears (Pilfold et al. 2012, Reimer et al. 2019). Thus, we predicted that increased time on the ice prior to sampling would be associated with higher BCS. The number of days between sea-ice retreat and advance (*icetm1<sub>t-1</sub>*) was included to evaluate the hypothesis that interannual variation in BCS was related to sea-ice availability in the previous year. We selected a global model

that reflected biological and environmental variables we hypothesized, or that have been shown in other studies, to have effects on BCS (Rode et al. 2012, SWG 2016, Laidre et al. 2020). Finally, given our interest in evaluating whether different reproductive classes and age classes had varying BCS based on the amount of time they spent on the sea ice during the months immediately prior to observation (*jul\_cap\_day*) and whether this relationship was different between our two sampling periods (*period*), we included a 3-way interaction for *reproclass*, *jul\_cap\_day*, and *period*. Once the global model was selected, we performed a backwards and forwards model comparison (stepAIC; Package *MASS* with AICc criteria functionality added) to obtain the most supported model which included main effects for *epoch*, *reproclass*, *jul\_cap\_day*, *icetm*, and interactions for *epoch* and *icetm* and *epoch* and *reproclass* (Table 1). On the final model, we performed ordinal regression-specific goodness of fit test (Pulkstenis-Robinson test;  $p > 0.1$ ; Fagerland and Hosmer 2017). Covariates were considered significant at  $p < 0.05$  and predicted probabilities were calculated for significant covariates.

We hypothesized that BCS would be correlated with ice conditions based on previous studies suggesting decreased body condition with increased ice-free days and lower sea-ice concentrations (Rode et al. 2012, Laidre et al. 2020). Thus, we calculated the number of days between the summer sea-ice retreat and fall sea-ice advance in *sampling year t - 1* (Environment and Climate Change Canada 2018). Sea-ice retreat and advance in MC were defined as the point in which the sea-ice concentration for a given year fell below, or exceeded, respectively, the halfway point between the averaged 1979 – 2016 March sea-ice concentration (representative of annual sea-ice maximum) and the average September sea-ice concentration (annual minimum). For MC, that transition threshold sea-ice concentration was 59%.

### *Seal observations*

There is little recent information about seal abundance across the Canadian Arctic. We therefore recorded all seal locations encountered along our flight paths while searching

for polar bears. These data were collected only during the 2014 field operations due to logistical challenges and can potentially provide baseline information on relative abundance for help in assessing ecosystem productivity.

## **5. RESULTS**

### *General overview*

During research operations 2014 – 2016, we spent between 72.5 and 97.5 hours flying each season in search of polar bears across the sea ice, with an average distance flown per year of 12,300 km (Table 2, Figure 3). The highest bear encounter rate occurred during 2014. Each field season was conducted generally between May and early to mid-June. Due to poor weather conditions a large portion of M'Clintock Channel proper could not be surveyed (Figure 3) and a reconnaissance flight via plane into the Channel in 2016 found few signs of bears (e.g., only one bear was observed).

The MC study area is vast and bears occur at low densities (Hamilton and Derocher 2018). In addition, polar bears were not distributed evenly across the study area (Figure 4). Most bears across all study periods were encountered from Franklin Strait southward to Victoria Strait and Jenny Lind Island. The sea ice in Queen Maud Gulf, Dease Strait and Coronation Gulf did not exhibit many signs of polar bears, at least not during the time of the survey (i.e., April to early June). The low coverage of M'Clintock Channel proper by Twin Otter did not suggest high bear density, however, it remains uncertain if sea ice is used by bears with higher intensity north of Gateshead Island during early spring at times when we were not present.

Due to logistical constraints we were only able to record seal observations during 2014. During that field season, work continued into June when ambient temperatures were sufficiently high for seals to haul out on the sea ice and bask in the sun. On our search flights we observed 2,236 seals distributed across the area where most bears were encountered (Figure 5).

### *Samples examined*

For the entire study period 1998 – 2016 we analyzed a total of 953 (319 biopsy, 102 physical capture, and 532 harvest) tissue samples for genetic identification. We identified 244 individual bears through the biopsy sampling activities 2014 – 2016. All 102 tissue samples from physical captures during the early study period (1998 – 2000) were successfully analyzed and of the 532 harvest samples, 99% produced reliable genetic results. Overall, the success rate of extracting DNA material from all study samples (research and harvest) was 97.8%.

Dead recoveries of marked bears through the harvest resulted in 22 bears being identified, 7 of these were recovered in subpopulations outside MC (4 in LS, 1 in Northern Beaufort Sea, 1 in Foxe Basin, and 1 in Viscount Melville Sound). Sixty-eight percent of all recoveries occurred in MC, and no recoveries were made in GB. We live-recaptured 6 bears marked in 1998 – 2000 and 33 bears 2015-2016. As a note of interest, 7 bears that were originally marked via biopsy in MC 2014 – 2016 were live recaptured in Gulf of Boothia during the GB population study conducted 2015 – 2017 (Dyck et al. 2020).

### *Population demographic information*

Abundance – Estimated total (males and females combined) abundance was 325 (95% Credible Interval (CRI) = 220 – 484) for the period 1998 – 2000, and 716 (95% CRI = 545 – 955) for the period 2014 – 2016 (Figure 6). The CRIs around the total abundance do not overlap across the two study periods providing substantial evidence for an increase. Estimated recapture probability was 0.13 in both periods with higher precision in the later period (95% CRI = 0.03 – 0.19 (early), 95% CRI = 0.10 – 0.18 (late)).

We estimated sex-specific abundance to obtain additional insight into population dynamics. Between the two study periods, the female segment of the MC subpopulation increased from 219 (95% CRI = 124 – 405) to 327 bears (95% CRI = 230 – 487, Figure

7). The males showed a larger increase from 134 (95% CRI = 74 – 256) to 360 bears (95% CRI = 244 – 550, Figure 6).

Survival – We estimated apparent survival for independent bears aged 2 and older from 1998-2016. The best-supported model included constant survival and detection probabilities across time and sex (Table 3). All other models showed no support given that the AIC values increased when a single parameter was added. Apparent survival from the top model was 0.88 (SE = 0.02) and detection probability was 0.17 (SE = 0.02). Cub-of-the-year survival was not possible to estimate because they were not sampled due to their small physical size (see Methods above).

Reproduction and Recruitment – During the 1998 – 2000 mark-recapture sampling efforts, 23 family groups (5 with single C0, 7 with 2 C0, 3 with single C1, 8 with 2 C1) were sampled, representing a total of 38 (19 C0 and 19 C1) dependent offspring. Through the genetic biopsy sampling study 2014 – 2016, we sampled 27 family groups with 46 C0 (8 with single C0, 19 with 2 C0), and 18 family groups with 29 C1 (7 with single C1, and 11 with twins; Table 4). For the 1998 – 2000 period, C0 and C1 mean litter sizes were 1.58 (SE = 0.14) and 1.71 (SE = 0.14), respectively. Calculated mean C0 and C1 litter sizes for 2014 – 2016 were 1.70 (SE = 0.09) and 1.61 (SE = 0.11), respectively. We calculated the number of C0 and C1 per AF across the two study periods (Table 4). The mean C0 and C1 per AF from 1998 – 2000 was 0.38 (SE = 0.02) and 0.39 (SE = 0.10), respectively. The mean C0 and C1 per AF for 2014 – 2016 was 0.43 (SE = 0.10) and 0.28 (SE = 0.06), respectively. The overall mean C0 recruitment was 0.39 (SE = 0.11).

Population Growth – Based on the estimated increases for the female and male proportions of the subpopulation between the two time periods, the average annual growth rate ( $\lambda$ ) was 1.02 for females and 1.05 for males. We built a 4-stage matrix population model to describe the polar bear subpopulation with C0, C1, subadult, and adult as life stages. We included vital rates estimated above. For parameters not included in this analysis, we used estimates from Taylor et al. (2006). Specifically, adult

survival and C0 per AF were estimated in this analysis and therefore those estimates were used. Cub-of-the-year survival was taken from Taylor et al. (2006) because we were not able to estimate this value reliably using this study's methodology. Using our calculated recruitment value of 0.39 for C0 per AF, a survival rate of bears older than 2 of 0.88, and C0 survival of 0.62 the matrix model results suggest a declining subpopulation ( $\lambda = 0.97$ ). This represents a discrepancy between observed demographic rates and calculated abundance. Our estimate of apparent survival is biased low compared to true survival due to unknown emigration. Furthermore, unmodeled heterogeneity in recapture probability is a well-known source of bias in estimates of survival from CJS-type models (Devineau et al. 2006). To explore this, we calculated what level of adult survival would be needed to achieve the estimate of female  $\lambda = 1.02$  based on changes in abundance across study periods. The new adult survival probability of 0.93 provides a population growth of  $\lambda = 1.02$  (Figure 8). That survival value is consistent with survival in the absence of harvest from Taylor et al. (2006). Flat population growth ( $\lambda = 1.0$ ) occurs when survival is 0.91.

### *Body condition*

We analyzed a total of 380 BCSs from the two study periods (Table 5). The most supported model included *period*, *reproclass*, *jul\_cap\_day*, and *icetm<sub>t-1</sub>* and interactions *period:reproclass* and *period:icetm<sub>t-1</sub>* (Table 1). Body condition of bears improved for all reproductive classes from the early period to the late ( $P_{\text{Poor early adult females and subadults}} = 0.50$  vs  $P_{\text{Poor late adult females and subadults}} = 0.14$ ), except for adult males ( $X^2 = 10.81$ ,  $P = 0.01$ ;  $P_{\text{Poor early ADM}} = 0.15$  vs  $P_{\text{Poor late ADM}} = 0.17$ ; Figure 9). Later sampling in the year was associated with better body condition ( $X^2 = 9.38$ ,  $P < 0.01$ ; Figure 10). As the number of days between sea-ice retreat and advance increased (*icetm*), the predicted probability of a bear being in poorer condition increased but this was more pronounced in the early period ( $X^2 = 3.86$ ,  $P < 0.05$ ;  $P_{\text{Poor early icetm136}} = 0.58$  vs  $P_{\text{Poor late icetm136}} = 0.19$ ).

## 6. DISCUSSION

### *General*

This study reports population abundance, survival, population growth, reproductive indices and body condition using the data from surveys conducted in the MC polar bear subpopulation between 2014 – 2016 and 1998 – 2000 along with dead-recoveries of harvested bears from 1998 – 2016. After more than 15 years of a reduced harvest and a moratorium that were implemented because of overharvest (Taylor et al. 2006), the subpopulation has recovered to the determined mid-1990s level (Aars et al. 2006; Taylor et al. 2006). Without the support and participation of community co-management partners from Taloyoak, Cambridge Bay and Gjoa Haven, this subpopulation would not have recovered over the past 15 years, hence this report and results should be welcomed as good news.

The recovery of this subpopulation may have been aided not only by concerted conservation actions by communities and management authorities, but also, counterintuitively, by climate-induced sea ice changes occurring in this region. While some polar bear subpopulations are showing negative impacts from climate change, (Regehr et al. 2007, Regehr et al. 2010, Lunn et al. 2016, Obbard et al. 2016, 2018), the short-term narrative may be different in terms of MC. Historically, the study area, and in particular M'Clintock Channel proper, had an abundance of multi-year sea-ice that remained mostly throughout the year (Schweinsburg et al. 1981, Barber and Iacozza 2004; Howell et al. 2008, 2009; Environment and Climate Change Canada 2018, 2019; Sou and Flato 2009). However, recent evidence suggests that the open-water extent in the western Arctic (including the study area) has been increasing between 1968 and 2005 (Stewart et al. 2007) and sea-ice cover during the summer has declined (Stern and Laidre 2016, Rothrock et al. 1999, Comiso 2002). In addition, some heavy multi-year sea-ice has been already replaced by annual ice (Barber and Iacozza 2004, Environment and Climate Change Canada 2018, 2019, Marz 2010, Perovich et al. 2018, Richter-Menge et al. 2018) and an even greater shift is expected (Sou and Flato



2009; Hamilton et al. 2014). The observed changes from multi-year to annual sea ice result in declining sea-ice thickness. Younger and thinner sea ice is more mobile and susceptible to mechanical wind forcing and is also more vulnerable to complete melting in the summer which contributes to the observed decrease in summer sea-ice extent. (Richter-Menge 2018, Perovich et al. 2018). This reduction in sea ice results in the absorption of more heat by the upper ocean (Richter-Menge 2018). While sea-ice loss overall is considered very detrimental to the persistence of polar bears, in the short term, it may have beneficial effects since many of the observed sea-ice changes have been associated with greater Arctic marine productivity (Derocher et al. 2004, Häder et al. 2014, Frey et al. 2018). This increased productivity and dynamic ice may have played a role in the observed improvement in body condition of bears in MC between the late 90s and the recent study period (Derocher et al. 2004).

Currently, it is uncertain when continued reductions in sea-ice availability may cross a threshold such that limited time to hunt seals on the ice begins to have a negative effect on the MC subpopulation which have been documented for more southerly polar bear subpopulations (Bromaghin et al. 2015, Lunn et al. 2016). Over the long term, progressive loss of Arctic sea ice is a primary threat to the species (Atwood et al. 2016, Regehr et al. 2016).

### *Abundance*

Polar bear abundance has increased across the two study periods with the male segment of the subpopulation increasing more rapidly than females. This may reflect recovery of the male segment after depletion due to general harvest overexploitation, which, when coupled with a sex-selective harvest (2 males for each female in Nunavut) could have been further exacerbated (Taylor et al. 2005, McLoughlin et al. 2005, Taylor et al. 2008a). Male abundance was almost half of female abundance in the early period but grew to be equal to or slightly larger than female abundance during the late time period. Increases in male abundance over females reflect a higher growth rate for males

during the study period, potentially from reductions in harvest pressure and/or immigration of males into MC from other subpopulation units.

We estimated abundance of MC polar bears using closed-population mark-recapture models. Yet, our sampling occurred across 3-year periods suggesting that the assumptions of demographic and geographic closure are almost certainly violated. The limited numbers of bears detected and the sparse recaptures within a year precluded fitting models that can potentially reduce bias in parameter estimates, such as the 'robust design' or 'spatially-explicit' capture-recapture models. Moreover, 'open' population models that include an abundance estimate (e.g. forms of the Jolly-Seber model) require more years of data with more recaptures than our data allowed. Thus, despite evidence from the few harvest-recovered marked bears that the subpopulation is not, in fact, 'closed' to emigration, our limitations with available data prevented these more highly-parameterized models from being fitted. These more complex models better reflect biological and ecological systems. However, they are 'data-hungry' (Bromaghin et al. 2015, Lunn et al. 2016, Regehr et al. 2018) meaning if less data are available due to low densities or other constraints, then these approaches, such as multistate capture-recapture models and integrated population models, are generally not options to estimate abundance, despite the potential advantages of these models in estimating demographic parameters of interest and reducing bias.

The basis for capture-mark-recapture studies rely on the marks that are initially put out into the population during the study's first field season and the subsequent recovery of those marks (recaptures) through harvest recovery or re-sampling (Caughley et al. 1977, Amstrup et al. 2010). This approach has worked relatively well for larger, denser subpopulations that allow for relatively large sample sizes (Regehr et al. 2007, Peacock et al. 2013). However, when populations are small, occur at low densities, have low harvest levels, and/or are located in remote regions that are difficult to access, recapturing or recovering marked individuals from the population is difficult (e.g. M'Clintock Channel). This process is made more complicated when it is unknown if

the subpopulation is open or closed (Kendall 1999), which can only be determined through radiotelemetry to examine long-term movement patterns of individual bears.

The consequences of assumptions violations in closed-population models are well known (Otis et al. 1978) and affect both the actual abundance and what that abundance geographically represents. A lack of demographic closure results in underestimated detection probability (for example, bears that die are no longer available for detection). The underestimated detection probability leads to an overestimated abundance for any given year. Despite these caveats, for this study, the total number of bears in the study area available for detection across the three years appeared to have been unbiased (i.e., a similar number of bears frequented the study area while the study was conducted) and our estimated abundance for MC using a closed population model for the early period with 325 bears was similar to Taylor et al. (2006; 284 bears). A lack of geographic closure blurs the boundaries of the study area. If bears move in and out of the sampled area, then the estimated abundance refers to an area larger than the area sampled (e.g., estimating the “superpopulation”). A superpopulation is defined as all the animals with a chance (non-negligible probability) of occurring within the MC management boundary, regardless of where the animals were located at any given sampling occasion (Schwarz and Arnason 1996). Thus, estimates of superpopulation size in year  $t$  likely reflect some animals that were temporary emigrants in year  $t$ . We were not able to estimate temporary emigration directly from the sampling area (Cooch and White 2019) because our sample sizes were not sufficiently large to do so, and there are no recent radiotelemetry data to provide location and movement data. However, recoveries of previously marked bears in other subpopulations through the harvest sampling program indicate that movement into and out of MC is occurring.

Lastly, the fact that we were not able to survey the entire study area – namely the portions of M’Clintock Channel proper – contributes to the uncertainty surrounding our abundance estimate. Although we did not detect many signs of bear activity while conducting our reconnaissance flight, it is unknown how many bears (e.g., bears that may temporarily move into this area from the neighboring LS subpopulation, or resident

MC bears) may utilize this section of the study area throughout the timing of our surveys since we were able to conduct only one limited survey flight due to poor weather conditions. Because we have no information on how many bears could have been in this area, we are unable to determine whether or not our abundance estimate would be affected negatively or positively.

Taken together with the effects of demographic and geographic closure violation, the estimate of abundance is almost certainly larger than the actual number of animals within the MC subpopulation boundary at any given time. This should be taken into consideration when using these findings to inform management decisions. For example, if capture-recapture analyses are performed independently for multiple adjacent subpopulations that experience exchange of animals, the sum of the estimates of superpopulation size will be larger than the actual total number of bears in the subpopulations (i.e., there will be “double counting” of some bears). This could lead to cumulative TAH levels that result in removal of a larger proportion of polar bears each year than was intended based on the TAH levels for the individual subpopulations.

### *Survival*

We estimated apparent survival of polar bears from 1998 – 2016. The resulting survival probability (0.88) is lower than biological survival estimated from other studies (Taylor et al. 2006). This is likely due to a combination of factors such as emigration away from the study area, which will cause apparent survival to be lower than biological survival (Lebreton et al. 1992). Further, capture-recapture data were collected intensively for 3 years in 2 distinct study periods separated by 13 years. Therefore, few observations of bears exist between 2001 and 2013. The missing sampling years greatly reduce the power to estimate survival or estimate variation in survival across time, sex, or age classes.

Survival is known to differ among sex and age classes; however, none of the models including differences in survival by sex were supported by the data (Table 3). In addition we were not able to test for differences in survival by age class. It is very likely that by pooling age classes and sexes the overall mean natural survival rate was also biased low (SWG 2016). Furthermore, unmodeled heterogeneity in recapture probabilities can introduce substantial negative bias into estimates of survival (Regehr et al. 2009). Unfortunately, with live capture-recapture data, limited harvest data, and no contemporary information on animal movements (e.g., from satellite radiocollars), there are few options to estimate biological survival. Our data were too sparse for joint live/dead models and capture probability was too low for known fate models. These challenges were also recognized by Taylor et al. (2006).

### *Reproduction*

Our field observations of C0 and C1 litter sizes revealed inter-annual variation with mean values similar to other subpopulations within the Canadian Arctic Archipelago (Table 4; Durner et al. 2009; dated estimates – Lancaster Sound and Norwegian Bay: Taylor et al. (2008b); Gulf of Boothia: Dyck et al. (2020); Kane Basin: SWG (2016)), although our sample sizes were small. We estimated reproduction based on counts of C0 and C1 observed with adult females. Reproduction rates were very similar across our study periods and were within the ranges estimated by Taylor et al. (2006).

It is difficult to draw definite conclusions about whether all reproductive parameters differ between the two studied periods because of limited data. Estimating the number of C1 per AF is considered a key reproductive parameter (Vongraven et al. 2012, Regehr et al. 2015) because it integrates cub production and cub survival. The C1 per AF of the recent period of 0.28 was lower than during the earlier period (0.39 in this study). Whether this decline is real or represents an artifact of sample size is unknown. Nevertheless, our observed number of C1 per AF appears to be sufficient to maintain a viable subpopulation, provided that survival is within the normal range for healthy subpopulations (Regehr et al. 2015). Continued monitoring of MC to obtain

improved estimates of survival and reproductive rates is prudent to determine whether this subpopulation remains healthy.

### *Population Growth*

We estimated population growth rate both empirically based on changes in abundance and using a matrix population model to compare observed changes in abundance to theoretical population growth rates arising from the vital rates. For the purpose of estimating an asymptotic population growth rate based on the vital rates, we used a simplified matrix projection model that does not accurately represent the multiyear reproductive cycle of polar bears (Regehr et al. 2017). Although such a simplified model would not be suitable for stochastic projections (Taylor et al. 1987), we believe it was sufficient for a general assessment of consistency between empirical and matrix-based estimates of population growth rate. The changes in abundance suggest that growth was approximately 2% per year for females and 5% per year for males for the period 1998 – 2016. Conversely, the estimated vital rates suggested a population growth rate of -3% per year (i.e., that a subpopulation with these vital rates would decline by 3% per year). Therefore, the demographic rates and abundance estimates are not internally consistent. The most likely explanation is negative bias in estimates of true survival for adult females. We estimated apparent survival rather than biological survival. In addition, we pooled independent bears (subadults and adults) in order to obtain survival rates during this study. Adult polar bear survival rates are higher than subadults (Regehr et al. 2007, 2010), and pooling them would bias the result negatively. Finally, there was likely unmodeled heterogeneity in recapture probabilities that introduced additional negative bias into survival estimates (Regehr et al. 2009). If we replace estimated survival from Taylor et al. (2006), the model shows growth similar to our observed female population growth.

The discrepancies in abundance and survival provide insight into the utility of each data type. Abundance data appear to be providing stronger inference into population dynamics of this polar bear population. The survival information contains too

much bias relative to biological survival to be meaningful for polar bear management. If capture-recapture data were collected over a longer time period, then survival may become a more useful parameter. Other data-based and simulation studies for polar bears have documented that, although mean percent relative bias can be higher for estimates of abundance than survival, the resulting challenges to demographic inference are actually larger for bias in adult female survival because it is a primary driver of population growth for long-lived species like polar bears (Eberhardt 1990).

One question that remains is the amount of potential bias in estimates of abundance and survival for the two study periods. The abundance estimates use data across 3-year periods, therefore some bears included in the estimate died before the end of the period. Our estimated apparent survival rate (0.88) would suggest a declining subpopulation, however, to achieve abundance estimates derived for this study, survival rates would need to be 0.92, which is reasonable for polar bears. Therefore, the total mortality during a 3-year abundance estimate is expected to be about  $0.15 = (1 - 0.92^2)$ . An increase in abundance is also supported by other lines of evidence. First, the MC subpopulation was managed for recovery and had a restricted harvest for 15 years that was designed to nurture population increase (Taylor et al. 2006) and likely led to a recovery of the depleted male proportion. Second, body condition of bears improved between the two studies, which could be an indication that the habitat improved as multi-year ice decreased over the past 15 years resulting in increased productivity, enhancing seal habitat which may be reflected in a larger carrying capacity.

Similar to estimates of abundance and survival, potentially high and variable levels of immigration and emigration across subpopulation boundaries can directly affect estimation and interpretation of population growth rate (Peñaloza et al. 2014). In some other subpopulation studies, radiotelemetry data have been critical to resolving these issues (Regehr et al. 2018). For regions where radiotelemetry is not available, we recommend that the best way to reconcile these interpretation challenges and provide accurate information to inform management is to perform a meta-analysis of the

capture-recapture and harvest recovery data for all subpopulations within the region that are known to exhibit substantial levels of exchange (e.g., GB, MC, and LS).

### *Body condition*

Polar bears observed during the recent study period were in better body condition compared to the late 1990s with the exception of adult males, which is not unexpected given that during April – June, males are often intent on searching for mates and breeding rather than only feeding (Stirling et al. 2016). Further, rapid changes in sea-ice characteristics in the last 15 years from multi-year to more annual ice, which is less thick and prone to experiencing leads and cracks, may facilitate increased opportunities for hunting during the annual seal pupping period that occurs in mid-April. These conditions potentially account for our finding that body condition improves later in the year (Stirling and Archibald 1977, Pilfold et al. 2014, Reimer et al. 2019).

It is less likely that sampling method is responsible for changes in the observed BCS between time periods. Raw BCS scores were binned into 3 general categories to account for any potential small biases in observer classifications (Laidre et al. 2020). Furthermore, there have been varied results in other studies in which earlier time period BCS classification was done by physical handling and compared to later time period BCS classifications based on aerial observations, suggesting that there is not an inherent bias in aerial observation versus physical handling body condition classification (Kane Basin: no change in BCS, Baffin Bay: decrease in BCS, Gulf of Boothia: increase in BCS; SWG 2016, Dyck et al. 2020, Laidre et al. 2020). Many of the same observers and biologists that participated in the early physical capture and handling studies also participated in the aerial observation studies which supports reliability and consistency between study methods for BCS. The general application of our index during physical handling has been shown to be a reliable indicator in the assessment of body condition (Stirling et al. 2008). Moreover, there is the potential to assess the lipid content of the extracted adipose tissue from the biopsy darts (Pagano et al. 2014, McKinney et al. 2014) which could be used to verify the aerial condition assessments.



The replacement of multi-year with annual ice in our study area may have also provided improved seal habitat and contributed to an increase in the polar bear prey base. To our knowledge, there are no quantitative data about seal abundance from our study area available; however, during our investigations and observations, it became apparent that ringed and bearded seals appear relatively abundant and demonstrated a preference for annual sea ice (GN, unpublished data reports). These longer-term changes in habitat may be in part responsible for the fact that we found BCS of bears sampled in the late period to be relatively unaffected by the number of days between sea-ice retreat and advance, which wasn't the case in the early period, suggesting that over time, the ecosystem has become more productive. It is important to note that our study periods encompass a relatively short period of time, with 3 years in the early period and 3 years for the late period. Inter-annual variation could significantly affect BCS for such a limited temporal window. Thus, we caution over-interpretation beyond general trends for BCS. It is likely that the potential enhanced productivity brought on by changes in sea-ice dynamics may be a short-lived advantage to polar bears if access to their prey is reduced by a declining sea-ice hunting platform, though the time scale of these events remains unknown.

## **7. MANAGEMENT IMPLICATIONS**

### *The need for continued monitoring*

In the past 20 years, polar bear population studies in Nunavut were generally conducted over a 3-year period, which is a relatively short time considering polar bear life spans. In many studies, survival rates tend to be biased low because of limited study length, low recapture probabilities, unmodeled heterogeneity in recapture probability due in part by prohibitive weather to cover the entire study area, and movements of animals with respect to the sampling area (Taylor et al. 2008b, Regehr et al. 2009, SWG 2016, Dyck et al. 2020). In the case of MC, several of these factors are true, including unknown emigration rates, low density of bears (fewer bears receive marks), and potential heterogeneity in recapture probability resulting in a likely low-biased survival rate.

What we have learned from this process of studying and analyzing MC data is that continued monitoring, in the form of increasing study length or adding an intermittent marking session, would reduce the type of bias we encountered in estimating population parameters like survival and abundance (Peacock et al. 2012).

Further, the MC subpopulation area has experienced drastic sea-ice changes since the 1990s with multi-year sea-ice diminishing and being replaced by annual ice (Stern and Laidre 2016, Environment Canada 2018, 2019). It is currently unknown what importance the little remaining multi-year ice plays for MC polar bears, especially during the summer months (e.g., as feeding platform or summer retreat areas).

### *The need for improved data*

Concomitant to adding intermittent marks or increasing study length, is the need to obtain an understanding of the movement into, and out of, the MC subpopulation boundaries, especially in light of continuing sea-ice changes. The results of this study were affected by the lack of available data to inform even the simplest population models, leading to abundance, survival, and population growth estimates that are known to be biased. Emigration rates are vital to accurately estimating survival.

The delineation of this subpopulation is inferred based on movement of collared bears in adjacent subpopulations from the 1990s, prior to the large-scale ice changes in the region (Taylor et al. 2001). Tag recoveries of captured and harvested bears, and some genetic analyses, indicate that MC likely is a distinct unit, but that has been disputed by local hunters and community members (Taylor et al., 2001; Bethke et al. 1996; Schweinsburg et al. 1982; Campagna et al. 2013; Malenfant et al. 2016; Keith et al. 2005, Dyck and Bohling, in prep.) and the current study provided evidence that bears tagged in the MC region were harvested in adjacent subpopulations (see Results Section – samples examined). With continued reduction in multi-year sea-ice, and sea-ice in general predicted to decline, (Sou and Flato 2009; Hamilton et al. 2014), understanding the behavior of bears and their ecology in MC is critical to maintaining a

healthy population (Vongraven et al. 2012). Very little about the movement patterns and habitat use of MC polar bears is known under the current environmental conditions since there has not been a satellite telemetry study to monitor movements and habitat use. At the direction of community co-partners representing Inuit societal values and concerns over physically handling wildlife, the GN Department of Environment, did not carry out any collaring for telemetry data in MC, despite efforts to garner support. In the future, the GN will have to make decisions on how to continue monitoring polar bears in this subpopulation in order to provide adequate information to decision makers.

### *Harvest management and considerations*

The MC subpopulation represents a unique polar bear management unit in that bears are sparsely distributed (low density) over a large geographic area. This requires adaptive harvest management and considerations. The MC polar bear subpopulation saw a harvest of approximately  $32 \pm 10$  bears (range: 12 – 55) between 1970 and 2001 (roughly 19.5 males and 12.0 females; GN, unpublished data) which was not sustainable over the long-term (Taylor et al. 2006) and led to a moratorium and harvest reduction. Harvest levels in the past were based on vague abundance data with high uncertainty and expert opinion (Aars et al. 2006, Taylor et al. 2006). Our study suggests that MC abundance increased since 2000, although with significant caveats and high uncertainty (e.g., biased survival rates and biased abundance; unknown emigration). Future research and monitoring should seek to understand the role emigration plays in this subpopulation so that estimates of survival can be re-assessed.

Here we provide several considerations to aid in harvest management decisions:

- The mean abundance estimate of 716 bears (95% CRI = 545 – 955) for the period 2014 – 2016 is for independent bears 2 years and older and includes substantial caveats and uncertainty, including the knowledge that this estimate is positively biased. Furthermore, this estimate applies to a group of bears that use

the MC region but may also use other management units (e.g., superpopulation; see Discussion Section).

- Data for this subpopulation are sparse and a quantitative harvest risk assessment using subpopulation-specific estimates of vital rates (Regehr et al. 2018) is not possible with the available data.
- A conservative approach to harvest will reduce the probability of subpopulation declines, especially in light of uncertainty in the available information and the documented changes in the sea ice regime.
  - Attempts to reduce subpopulation abundance without effective monitoring and a coupled research-management system increase the probability of negative biological effects on the subpopulation (e.g., reduction to a small size).
- Although recovery of this subpopulation from previous overexploitation appears successful, it came at a high cost to communities during the recovery period from reduced hunting opportunities and knowledge transfer to new hunters of polar bear hunting practices. To prevent this from recurring, we recommend focusing on the considerations above and additional recommendations below to achieve long-term sustainability and subsistence use of this subpopulation.

### **Additional specific recommendations for MC**

1. Seek support from co-management partners to implement a radiotelemetry study to collect movement data in MC to obtain emigration estimates, resolve boundary issues, collect missing demographic data, and evaluate changes in habitat use and denning in light of the ongoing sea ice changes. Before starting such a study, it would be possible to identify the sample size and

duration required to address information needs so that no more bears are physically captured than necessary;

2. a) Increase monitoring activities by sampling bears (i.e., introduce more marks into the MC subpopulation) 5 – 7 years post-completion of the field portion of the last study (e.g., in 2023 or 2024) for a 1 year injection of marks until the next comprehensive population study will be conducted (~10 – 15 post-completion of last inventory; 2027 – 2032) to increase the number of marked individuals, recaptures and recapture probability of marked individuals. These factors will assist in determining more realistic survival rates when the next comprehensive study is undertaken (note that a power analysis will likely aid in determining whether additional marks really provide more data, and if this endeavor is cost-effective);  
  
b) Monitor reproductive metrics at the time of mark introduction to assess reproductive performance of MC, and if there are significant changes in reproduction consider whether the timing of the next comprehensive subpopulation assessment should be changed;
3. Increase population study length to 4 – 5 years to ensure that it covers a full reproductive cycle and reduces potential biases and assumptions that are required during the modeling process;
4. Consider any TAH recommendation above the current TAH allocation with caution and as an interim harvest level until a) the meta-analysis is performed and/or b) the boundary issue has been resolved which can assist in resolving the caveats of whether MC is a closed or open subpopulation, and to what degree emigration (either temporary or permanent) is affecting vital rates.

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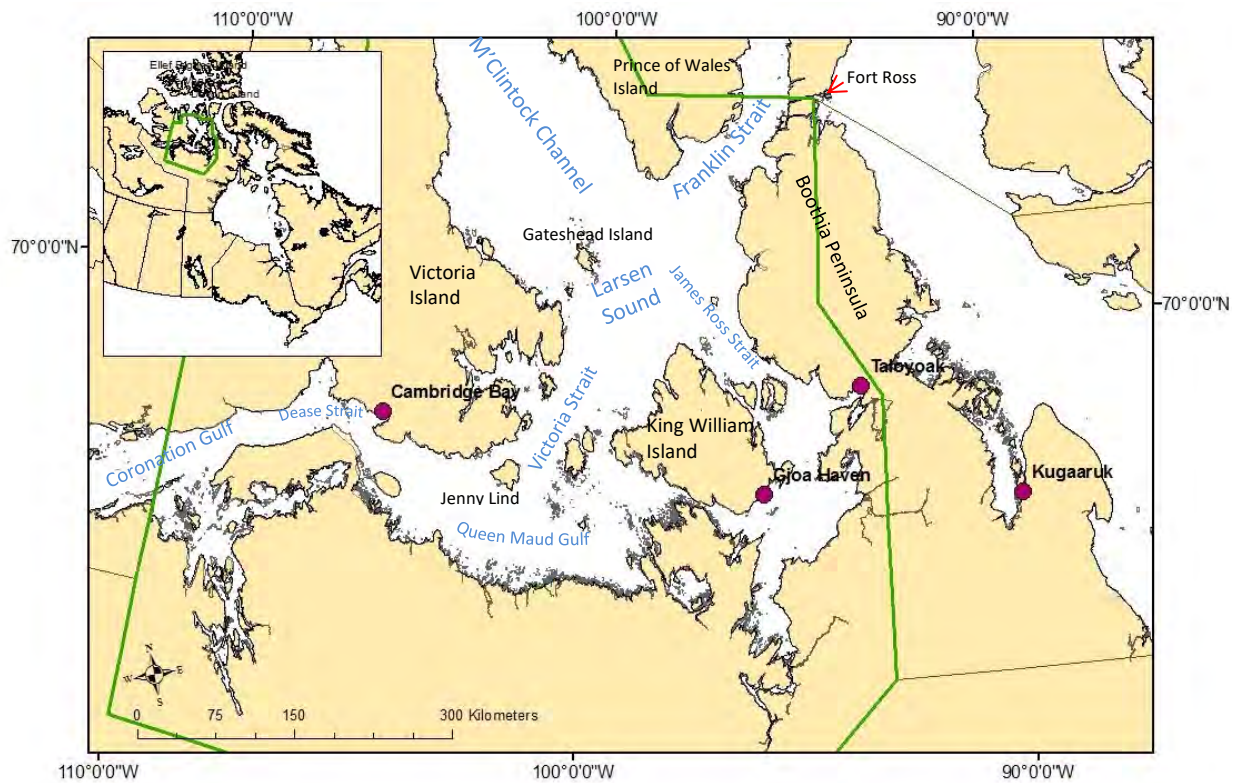
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## 10. FIGURES AND TABLES



*Figure 1. Overview and location of the M'Clintock Channel polar bear subpopulation with major geographical features and water bodies.*



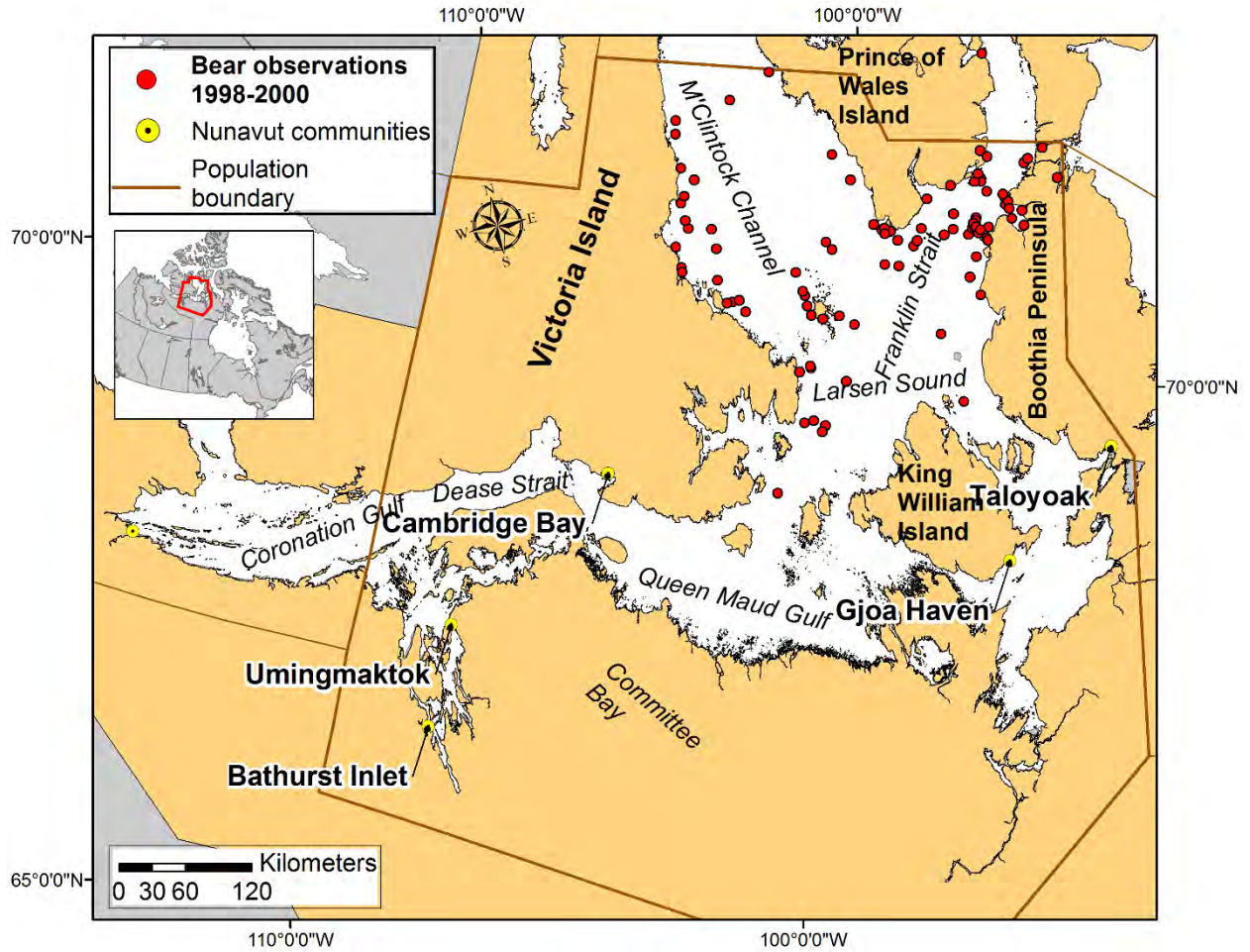


Figure 2. Capture and re-capture locations for the 1998 – 2000 M'Clintock Channel polar bear study.

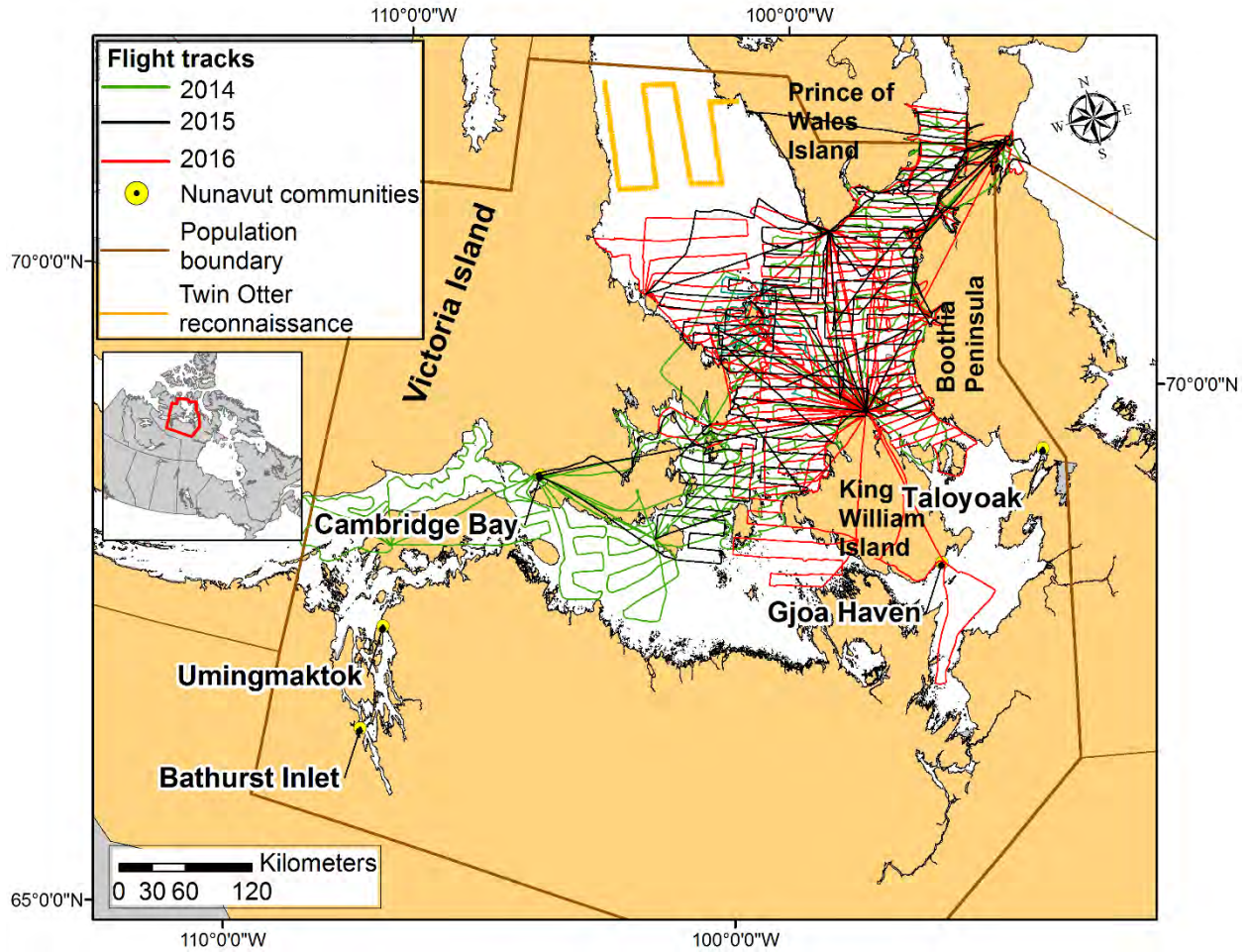


Figure 3. Helicopter paths flown in search for polar bears in M'Clintock Channel, Nunavut, Canada, during April/May-June 2014 – 2016. The golden path represents the Twin Otter reconnaissance flight during April 2016.

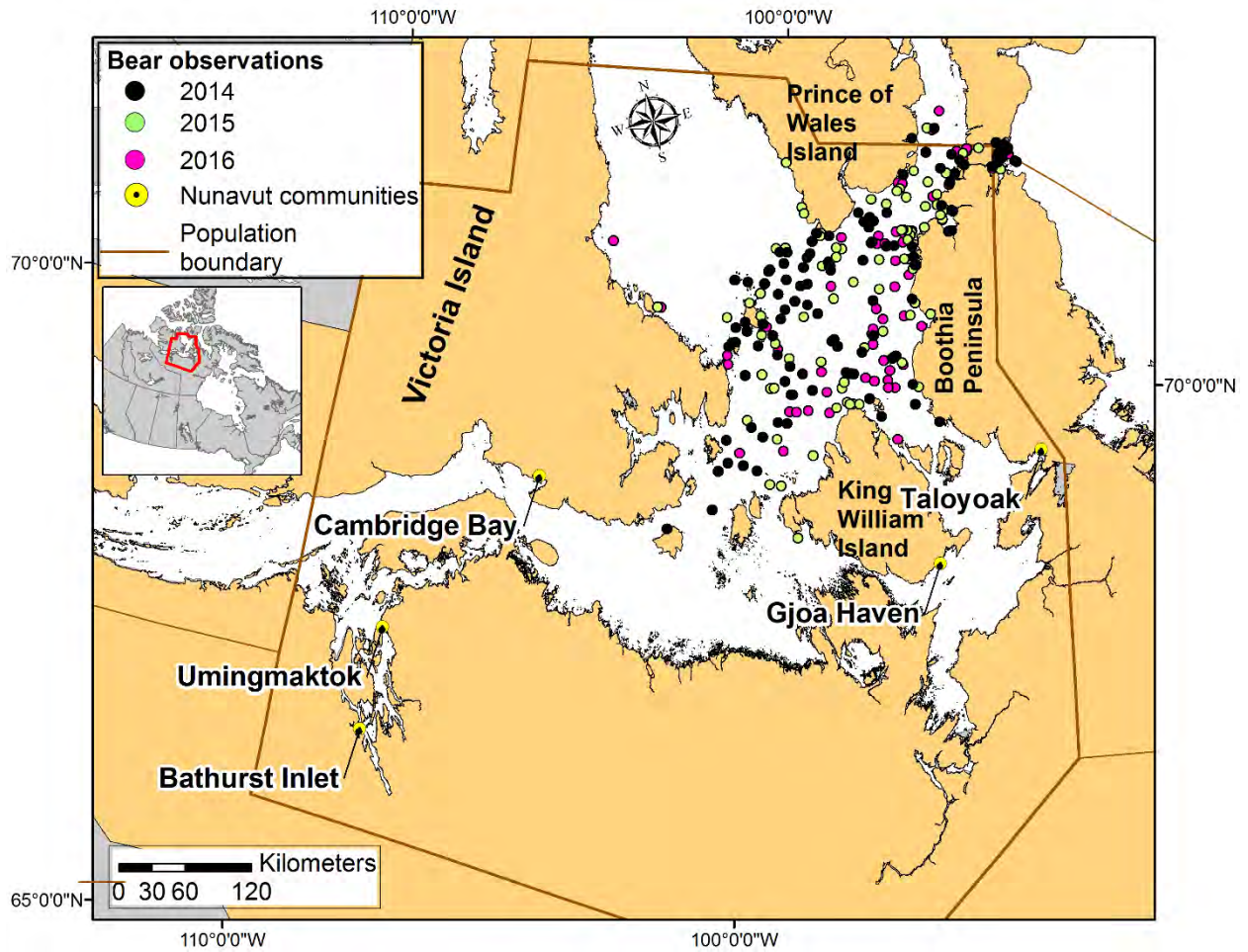
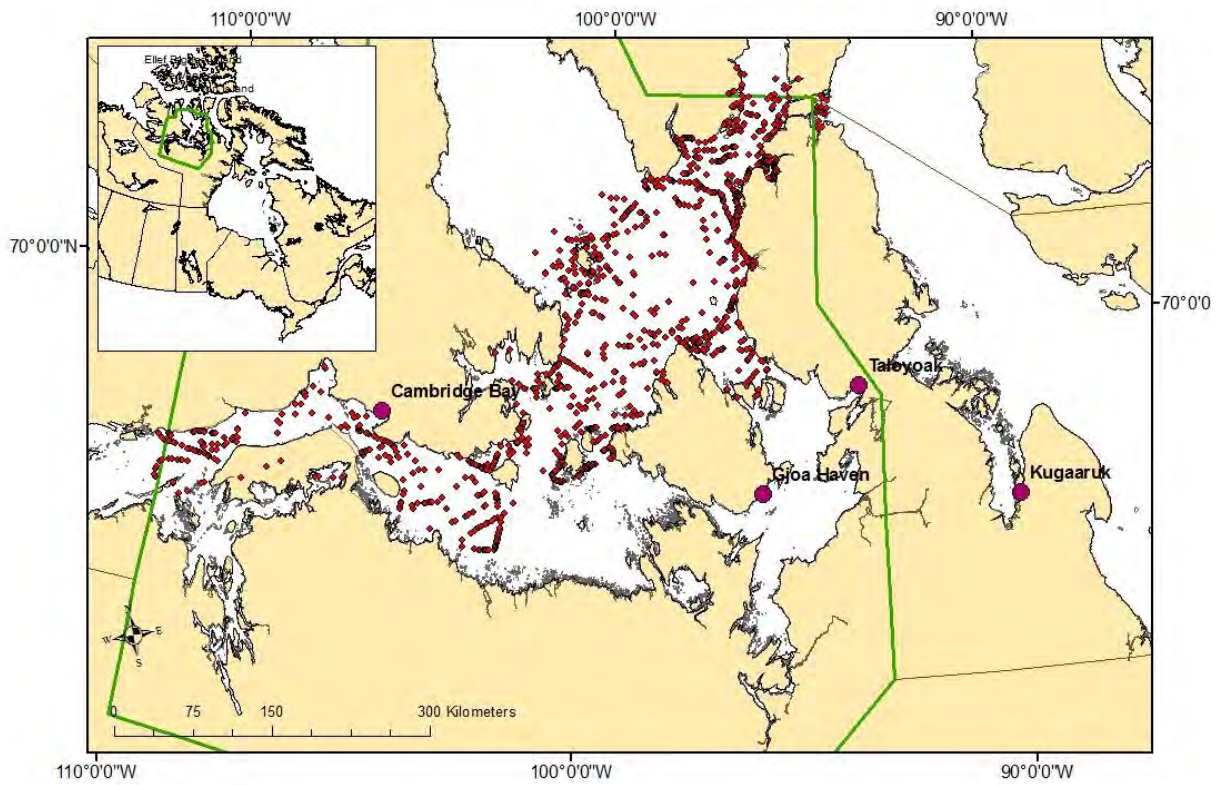
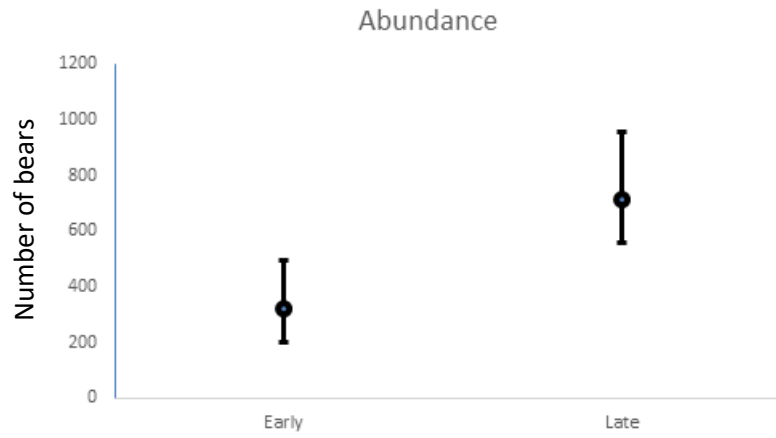


Figure 4. Locations of polar bear encounters in the M'Clintock Channel polar bear subpopulation during April – June of 2014 – 2016.



*Figure 5. Seal observations for May – June 2014 in M'Clintock Channel (n = 2,236) recorded during search for polar bears.*



*Figure 6. Estimated polar bear abundance in M'Clintock Channel during the early (1998 – 2000) and late (2014 – 2016) study periods.*

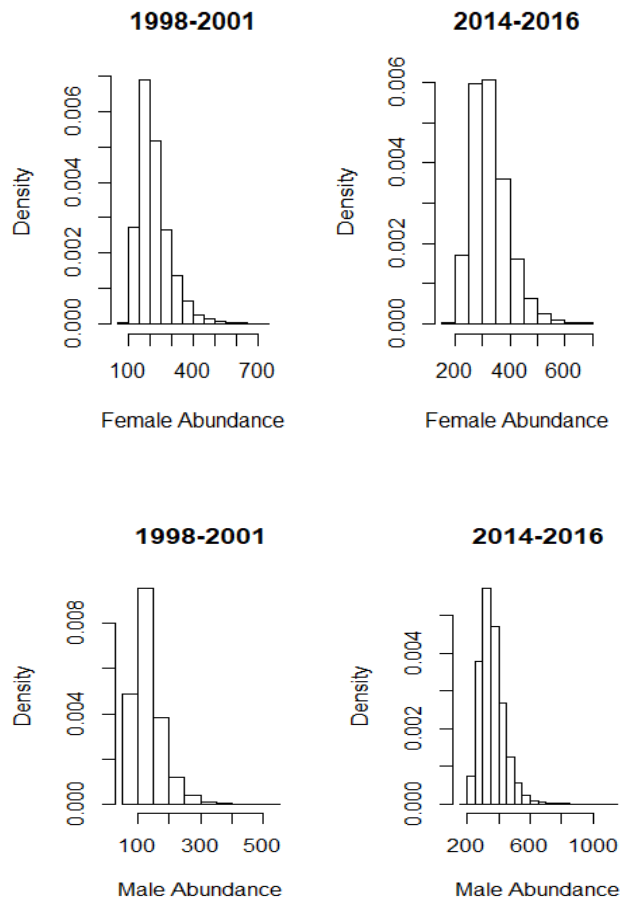
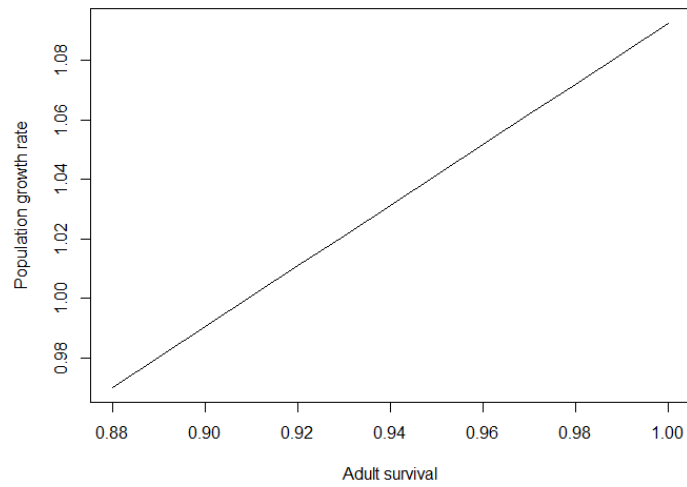
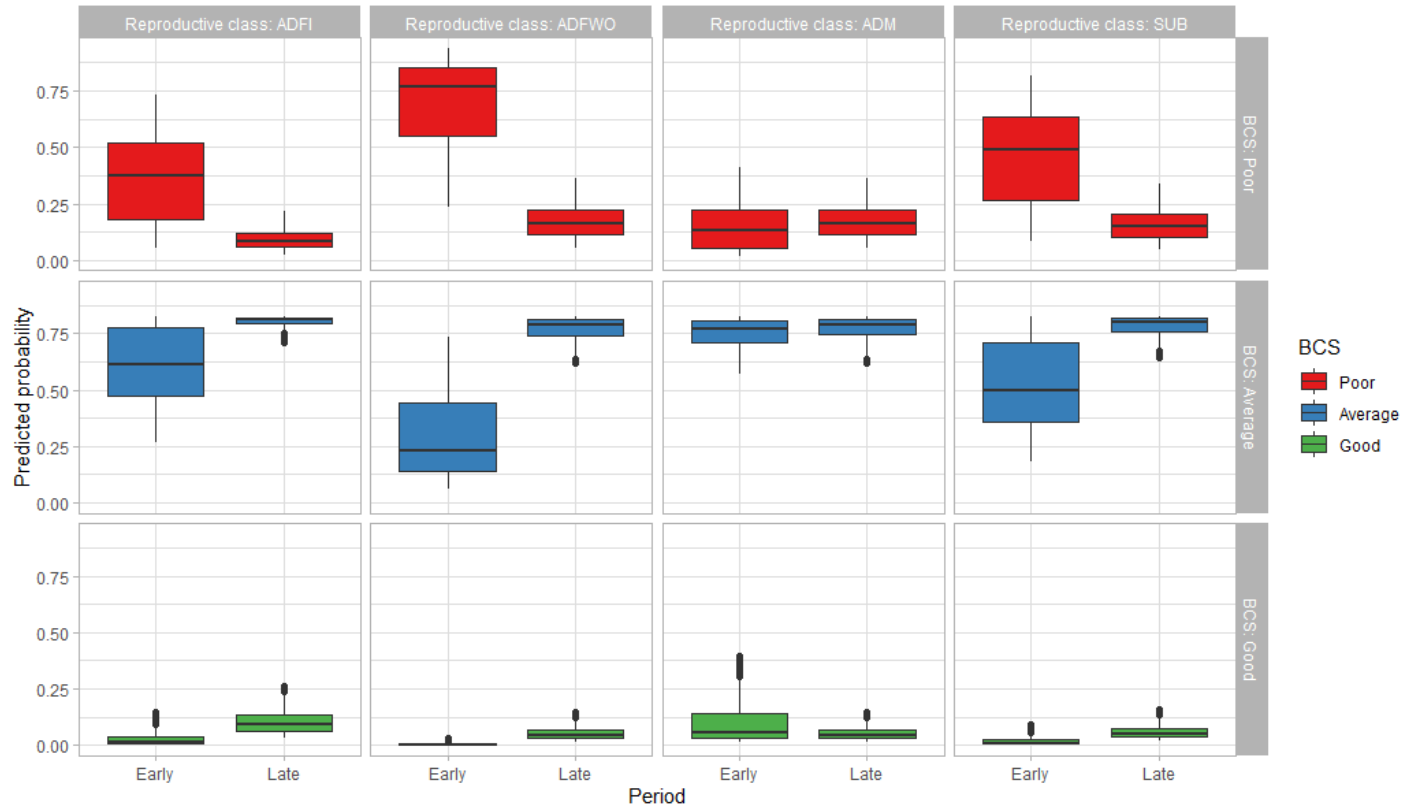


Figure 7. Posterior distributions for abundance estimates of female (top) and male (bottom) M'Clintock Channel polar bears.



*Figure 8. Population growth rate ( $\lambda$ ) as a function of adult female survival. The observed growth rate is achieved when survival is approximately 0.92.*



**Figure 9.** Predicted probabilities of bears being classified in Poor, Average, or Good condition in the early (1998 – 2000) and late (2014 – 2016) sampling periods. ADFI = adult, independent female, ADFWO = adult female with offspring, ADM= adult male, SUB = subadults of both sexes



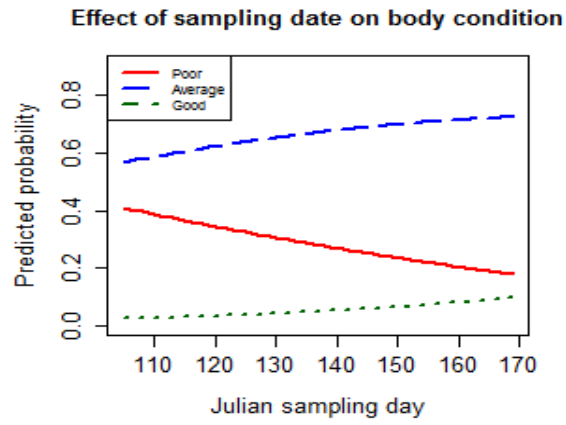


Figure 10. Predicted probabilities of a bear being in Poor, Average, or Good body condition when sampled at different dates.

Table 1. Parameter estimates for best fit ordinal logistic regression model for body condition analysis of the M'Clintock Channel polar bear subpopulation

Parameter	Estimate	SE	$p$
periodEarly	1.27	1.54	0.41
reproclassADFOW	-0.74	0.47	0.12
reproclassADM	-0.73	0.40	0.07
reproclassSUB	-0.62	0.50	0.21
jul_cap_day	0.02	0.01	<0.01
icetm <sub>t-1</sub>	-0.01	0.01	0.11
periodearly: icetm <sub>t-1</sub>	-0.03	0.01	0.05
periodearly:reproclassADFOW	-0.97	0.82	0.24
periodearly:reproclassADM	2.07	0.96	0.03
periodearly:reproclassSUB	0.14	0.77	0.86

Table 2. Overview of field statistics of the M'Clintock Channel polar bear study 2014 – 2016.

Field Year	Search time (hrs)	Number of bears/hr	Bears encountered <sup>a</sup>	Flown distance (km)	Duration
2014	97.5	1.90	155	12,600	4 May – 18 June
2015	72.5	1.68	122	10,100	5 May – 8 June
2016	94.0	1.00	95	14,200	19 April – 7 June

<sup>a</sup> The number of bears encountered does not represent the number of unique individuals (e.g., some bears have been resampled within same sampling period)

Table 3. Model selection results for Cormack-Jolly-Seber models of polar bear capture-recapture data from 1998 – 2016 used to estimate apparent survival of independent bears > 2 years. K is the number of parameters in the model.

Model	<i>K</i>	AICc	$\Delta$ AICc	Weight	Deviance
Phi(constant)					
p(constant)	2	425.53	0.00	0.28	26.46
Phi(sex)p(constant)	3	426.22	0.69	0.19	420.15
Phi(constant)p(period)	3	426.40	0.87	0.18	25.30
Phi(sex)p(period)	4	427.02	1.49	0.13	418.90
Phi(sex)p(sex)	4	427.25	1.72	0.12	419.13
Phi(constant)p(sex)	3	427.46	1.94	0.10	421.39

Table 4. Mean numbers for cubs-of-the-year (C0) and yearlings (C1) per adult female and litter size for the M'Clintock Channel polar bear subpopulation, 1998 – 2000 and 2014 – 2016.

Year	Offspring per adult female		Litter size*			
	C0	C1	C0	n	C1	n
1998	0.40	0.25	2.00	4	1.67	3
1999	0.40	0.33	1.20	5	1.67	3
2000	0.33	0.60	1.67	3	1.80	5
2014	0.41	0.15	2.00	8	1.50	4
2015	0.61	0.35	1.50	14	1.71	7
2016	0.26	0.32	1.80	5	1.57	7

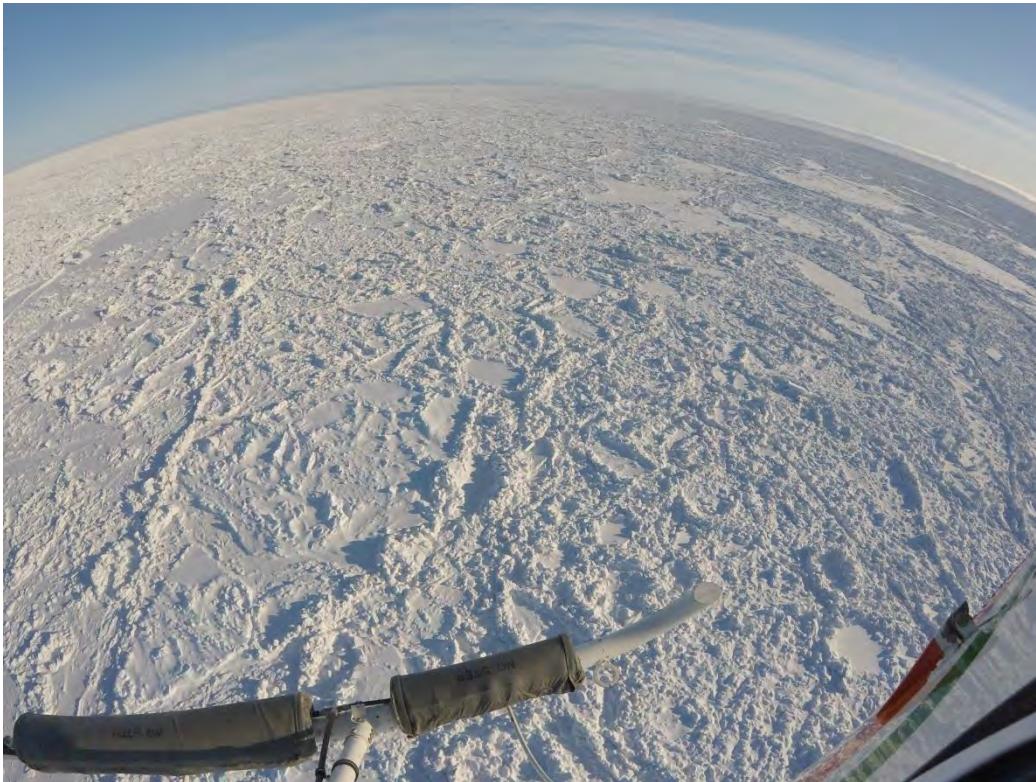
\*Litter sizes of zero (whole litter loss) are not listed; all litters depend on at least one offspring being present.

Table 5. Body condition scores (BCS) for polar bears (n = 380) in the M'Clintock Channel subpopulation 1998 – 2000 and 2014 – 2016. Poor BCS corresponds to a thin bear and Good BCS corresponds to a fat/obese bear. Age classes are adult ( $\geq 5$  years) and subadult (2 – 4 years).

	Body condition scores					
	1998 – 2000			2014 – 2016		
	Poor	Average	Good	Poor	Average	Good
Adult female without offspring	6	12	1	4	52	8
Adult female with offspring	22	8	1	4	44	1
Adult male	2	9	1	18	78	11
Subadult	24	31	2	2	38	1

## Appendix A Study activities

Ice habitat images from the field work, in addition to some images of the genetic biopsy darting activities are presented in this appendix to demonstrate the harsh environment, field activities and the non-invasiveness of the technique.



*Plate A1. Image from the helicopter directly facing the sea ice. Rough ice, pressure ridges, and ice pans are visible (M. Dyck, Government of Nunavut).*



*Plate A2. A polar bear being genetically sampled from the air. The **orange color at the left rump area is the flagging tape from the mid-air dart as it hits the bear and falls to the ground** (M. Dyck, Government of Nunavut).*



*Plate A3. View of the sea ice with pressure ridges and a wind-blown and snow-encrusted surface. A polar bear is visible in the red circle (M. Dyck, Government of Nunavut).*





*Plate A4. Discoloured multi-year ice pushed together to form high pressure ridges and rubble ice fields (M. Dyck, Government of Nunavut).*



*Plate A5. Five adult male polar bears along a crack in the sea-ice. These bears were observed feeding together on a bearded seal carcass in May 2014. The sixth bear is not pictured (M. Dyck, Government of Nunavut).*



*Plate A6. Genetic biopsy sampling is very minimally invasive. A male polar bear is pictured lying down after being darted, with the dart in the background (M. Dyck, Government of Nunavut).*



*Plate A7. View of flatter sea-ice areas with a polar bear circled on the flat portion of the sea ice (M. Dyck, Government of Nunavut).*



















Δᓗᑦᑦᑦ

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3.5 ᓗᓂᑦᑦᑦᑦᑦ ᓗᓂᑦᑦᑦᑦᑦᑦᑦᑦᑦᑦ ᓇᓃᓂᑦ ᑦᑲᓗᓂᑦᑦᑦ ..... 8

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Appendix 1: Complete Consultation Presentation of the Gulf of Boothia Polar Bear Study Results 2015-2017 ..... 11

Appendix 2: Complete Consultation Summary of the Gulf of Boothia Community Consultations ..... 22

A: Gjoa Haven..... 23

B: Taloyoak ..... 30

C: Kugaaruk ..... 32

D: Naujaat ..... 37

E: Sanirajak ..... 48

E: Igloodik ..... 50









- መጋቢት ፲፩ ቀን ፊርማው በብሔራዊ ጽሑፍ ላይ ማህተም
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**ጥያቄውን ተግባር ለማድረግ፡**

ጥያቄውን በጽሑፍ ላይ ወይንም በግንኙነት ላይ ማድረግ ለማድረግ የሚችሉ ጥራት ለማረጋገጥና ጥያቄውን ለማረጋገጥ የሚያስፈልጉ ጥያቄዎችን ለማድረግ ማስታወሻ ላይ ጥንቃቄ ማድረግ ይገባል። ማህተም ለማድረግ የሚያስፈልጉ ጥያቄዎችን ለማድረግ ማስታወሻ ላይ ጥንቃቄ ማድረግ ይገባል።

**3.6 ለጥያቄው ጥንቃቄ ለማድረግ የሚያስፈልጉ ጥያቄዎችን ለማድረግ ወይንም በግንኙነት ላይ ማድረግ**

**ጥያቄው፡** ጥንቃቄ 28, 2020  
**ገደብ፡** 18:40 - 21:42

**ጥያቄውን ለማድረግ፡**

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**ጥያቄውን ተግባር ለማድረግ፡**

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**4.0 ለጥያቄው ጥንቃቄ ለማድረግ የሚያስፈልጉ ጥያቄዎችን ለማድረግ ወይንም በግንኙነት ላይ ማድረግ**

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# Appendix 1: Complete Consultation Presentation of the Gulf of Boothia Polar Bear Study Results 2015-2017

Slide 1

**Gulf of Boothia Polar Bear  
Genetic Biopsy Study 2015 – 2017 Results**

Markus Dyck and Jasmine Ware  
Polar Bear Biologists

Department of Environment  
Wildlife Management Division  
- Research Section -

Department of Environment  
Avatitigiikkut  
Ministère de l'Environnement

Slide 2

## Objectives Of Presentation

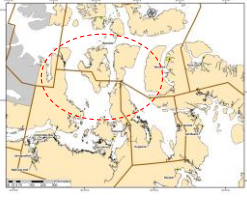
- Provide a summary of results from study
- Obtain feedback from your HTO

2

Slide 3

### Background

- First mark-recapture study between 1973-78
  - MC and GB treated as one unit, estimate of 1,081
- GB estimate increased to 900 in mid-90s based on local knowledge and biased sampling
- MC estimate decreased from 900 to 700 based on local knowledge in mid-90s
- Population boundaries in 1995 and 2001

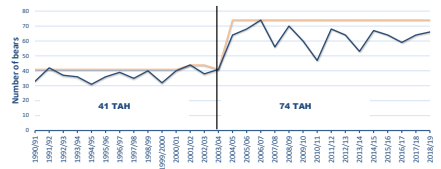


3

Slide 4

### Background

- 1998-2000--Mark-recapture estimate for GB was 1592 bears
- TAH of 41 for GB until 2003/2004
- Increased TAH to 74 bears in 2004/2005
- Average harvest per year: **63 bears since 2005**



4

Slide 5

### Background

- Population status unknown (stable? increasing?)
- Population boundaries of MC/GB/LS?
  - Inuit Qaujimagatuqangit/genetics suggest movement between both units

5

Slide 6

### Goals of study

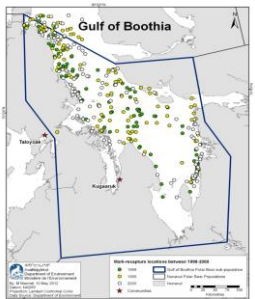
- Need for new information – current data was deficient
  - Re-assess population abundance
  - Evaluate population boundaries/movements of bears
  - Provide information for review of Total Allowable Harvest (TAH)
  - Observe effects of changing sea-ice conditions
  - Assess potential impacts of industrial activity

6

Slide 7

### Study method choices

- Co-management partners indicated concern about drugging & handling bears
  - Explore alternative population assessment methods
  - Better reflect Inuit societal values
- Balance with analysis needs –to properly monitor population




The map shows the Gulf of Boothia region with various sampling locations marked by colored dots. It also delineates management boundaries and includes a legend for different types of locations and boundaries.

Slide 8

### Study method chosen

➤ Co-management partners chose, and GN supported, less invasive choice:

Genetic mark-recapture (biopsy sampling, no physical handling)



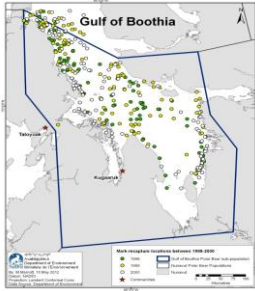
Dart after collecting sample. Immediately falls out. No handling

The image shows a polar bear in a snowy environment. A red circle highlights the darting site on its back. An inset image shows a dart and a coin for scale.

Slide 9

### Genetic capture mark-recapture study goals

- Estimate polar bear abundance in GB
- Compare with 1998-2000 estimate
- Compare information on reproduction, survival
- Cannot estimate movement or boundaries with this method



Slide 10

### Study funding and support



HTOs from Gjoa Haven, Igloodik, Kugaaruk, Naujaat, Taloyoak, Sanirajak


10

Slide 11

### Study Design

#### Community Participation



- Survey design and method choice - 2013
- Survey observers – 2015 through 2017
- Review & evaluation of results - 2020



Slide 12

### Study Design

- Method choice: genetic capture mark recapture
- Timing of study: mid-April to early June
- HTO participation on searching and sampling flights where available



➤ Used helicopters to search

Slide 13

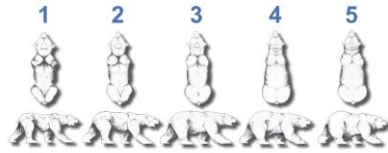
### Study Design

- Recording age class, sex, body condition, litter size, location of bears



Slide 14

### Study Design




**1 Skinny**  
Appears extremely skinny, ribs are visible, neck is very thin, belly protruding, legs are thin, and the tail is long. A thin yellow line is visible between the neck and the rest of the body.

**2 Thin**  
Barely ribs visible, neck is thin, belly is slightly protruding, legs are thin, and the tail is long. A thin yellow line is visible between the neck and the rest of the body.

**3 Average**  
Ribs are barely visible, neck is thin, belly is slightly protruding, legs are thin, and the tail is long. A thin yellow line is visible between the neck and the rest of the body.

**4 Fat**  
Ribs are not visible, neck is thick, belly is protruding, legs are thick, and the tail is long. A thick yellow line is visible between the neck and the rest of the body.

**5 Very Fat**  
Ribs are not visible, neck is very thick, belly is very protruding, legs are very thick, and the tail is long. A very thick yellow line is visible between the neck and the rest of the body.

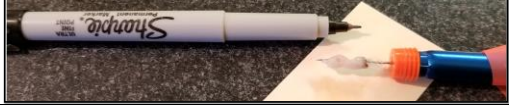


14

Slide 15

### Study Design

- Collected small tissue samples for genetic analysis (to genetically identify and “mark” an individual)
- No cubs-of-the-year sampled
- No drugging, no collaring
- No specific ages or samples for other studies (e.g., contaminants)



Slide 16

### Study Design - Analysis

- Included all available information for analysis:
  - Genetic mark-recapture (biopsy) information 2015-2017
  - 1998-2000 capture mark-recapture information
  - Harvest recoveries (e.g., when an ear tag/lip tattoo is recovered by a hunter) 1976-2017
  - 1976-1997 capture mark-recapture information

16

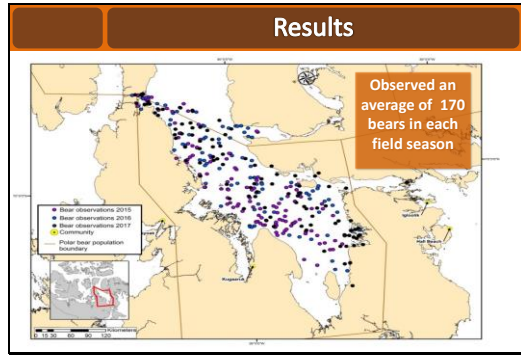
Slide 17

### Analysis Goals

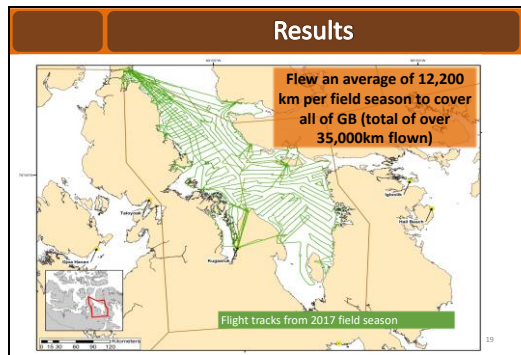
- Use all information to determine:
  1. Trends in abundance from 2000-2017
  2. Survival rates of different age classes and sexes over time
  3. Reproductive parameters such as size of litters, litter rate per adult female (how productive are the females/population)
  4. Population growth rate – determined using survival rates and litter production rates
  5. Evaluate body condition of bears across the entire GB area

17

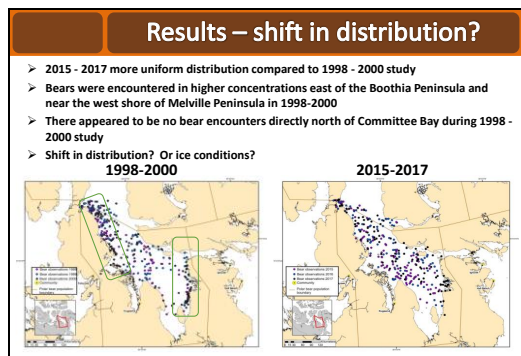
Slide 18



Slide 19

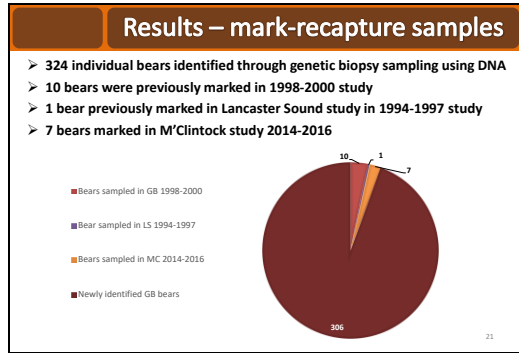


Slide 20

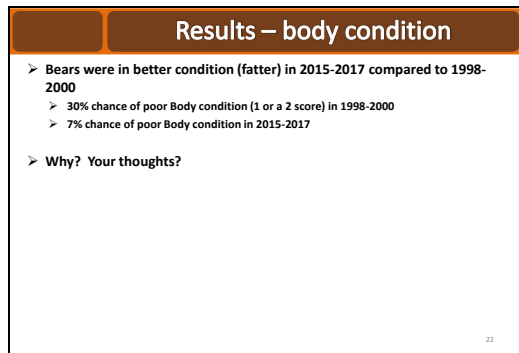




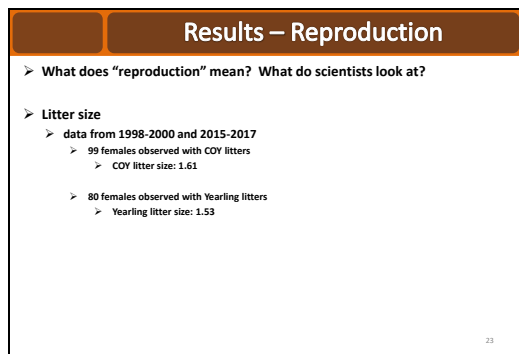
Slide 21



Slide 22



Slide 23



Slide 24

### Results – Reproduction cont.

- Number of offspring per adult female
  - 1998-2000
    - 0.51 COYs/adult female
    - 0.37 yearlings/adult female
  - 2015-2017
    - 0.43 COYs/adult female
    - 0.36 yearlings/adult female
- 85% chance that COYs per adult female was less in 2015-2017 compared to 1998-2000
- Number of yearlings per adult female is important because it shows how many cubs-of-the-year survive to be yearlings
  - good measure of reproduction
- The GB subpopulation has healthy reproduction

24

Slide 25

### Results – Survival


- Females and males separated
- Adults and subadults separated
- Data support similar survival across time
- Unsurprisingly, subadults have the lowest survival of these groups with subadult males lower than subadult females.
- There were fewer adult males than expected, but that is likely due to the past harvest with a 2 males for 1 female harvest system

25

Slide 26

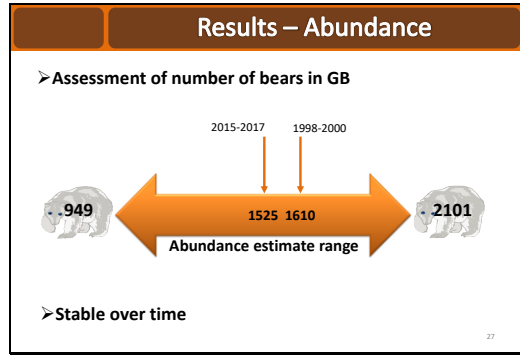
### Results – Population growth rate

- Population growth rate similar to assessments from the last study  
(growth rate is simply the difference between what is added through births minus the deaths and takes into account how animals survive)
- Growth rate indicates strong potential for growth



26

Slide 27



Slide 28

### Results – Interpretation

➤ GB is doing well, healthy subpopulation for now

➤ Because we don't have a quantifiable idea about movement, we are likely counting bears from other subpopulations like LS and MC as GB bears → increases the abundance assessment.

28

Slide 29

### Further Questions

➤ **Boundary between GB-MC-LS?**

- Genetic mark-recapture method does not provide data to answer these questions
- Movement data are necessary
- How important is the boundary issue to you and other users?
  - IQ says there is movement. How much? Where? When? Who?
  - Are bears changing where they choose to spend their time? Is this related to sea ice changes? Seals?

➤ Options:

- The Government of Nunavut is committed to surveying Lancaster Sound in the next few years
  - With your support, we could propose to put collars and satellite ear tags on a small number of bears in LS and MC/GB to gather info about bear movements between and among these areas.

29

Slide 30

**Further Questions**

- > Do you agree that the number of bears stayed relatively the same over time?
- > What did you observe in the bears' body condition over time?
- > Are there enough bears to harvest? Are there too few? Too many?
- > Is there anything special that you observed and wanted to share with us?
- > Where do you agree/disagree with our findings?

30

Slide 31

**GN Recommendation**

- > The GB subpopulation has remained stable – we recommend no change in TAH
- > What are your thoughts about the recommendation?

31

Slide 32

**Further Questions? - Thank you**

32

Appendix 2: Complete Consultation Summary of the Gulf of Boothia  
Community Consultations

**Nunavut Community Consultations on the results from the 2015-2017 Gulf of  
Boothia Polar Bear Study**

**October 20-28, 2020**

**HTOs Consulted:**

**Gjoa Haven  
Taloyoak  
Nauyas  
Kugaaruk  
Igloodik  
Sanirajak**

## **Summary of Consultations:**

A: Gjoa Haven

October 20, 2020

**Time Start:** 18:50

**Time End:** 21:15

### **Participants:**

Eruk Pauloosie  
William Aglukkaq  
James Qitsualik via cell phone video chat  
Simon Komangat  
Jimmy Qirqqut  
Roger Ekilik  
Ben Putuguq  
Jimmy Pauloosie  
Ralph Porter Sr.  
J. Skillings – GN-DOE  
K. Metheun – GN-DOE  
M. Dyck – GN-DOE  
J. Ware – GN-DOE  
Jacob Keanik - translator

- Markus introduced option to go over background of MC/GB or skip it? Question to the board---what would you prefer?
- Ralph: we don't need super detailed on the background so you can go through it quickly.

**Background slides:** review – our objective to provide new data for the co-management partners and the NWMB to make decisions on setting harvest levels. We are here to hear feedback.

**Study methodology:** review, no questions

**Community participation:** review; no questions

**Study design:** review; no questions

**Study design analysis:** explained why the amounts of data matter for getting the results; no questions

- Ben: Years ago, when the moratorium came I was one of the Board members back then and remember it. We used to go all the way to Prince of Wales Island before the quota system was put in place to harvest as much as we could.

- Markus: thank you, I'd like to hear about the ice back then.
- Ben: it's totally different. There isn't any ice really.

### **GB Results:**

- Willy—the board isn't that interested in Gulf of Boothia because it is very rare that we go there to hunt. The ice conditions are too dangerous. Young hunters do not have any knowledge about that area. We are not that interested in this population.
- Ralph said if a bear doesn't want to show up, you can't see it. It is the knowledge of our ancestors.
- Ben: when our young hunters go to Gulf of Boothia, they don't have a clue about the ice conditions and it's very dangerous...the ice can just take them.
- Willy: that actually happened with a sport hunting group—the ice split and took the hunters out to sea.
- Ben: the hunters that were taken the sport hunters, I was there and I managed to get home before the ice split. The younger generation doesn't have a clue how the ice conditions.
- Markus: I can go over GB very quickly. It is my job; I have to tell you about it.

**GB Results/TAH recommendation:** Because its stable and there are no changes that we can detect, we are recommending that there is no change to the TAH. If the communities feel differently—want more meat or public safety is an issue, then that is an opportunity to discuss how the TAH could change.

- Willy: It doesn't affect us.
- Markus: That's pretty much it for the presentation for the MC/GB. Are there any questions that the community here has with regards to GB/MC/LS boundaries and movements? We can hear these comments and try to see if they can be incorporated into our future work. We are doing LS and are going to be analyzing those samples in the next 4-6 years and we will let you know what we find—were there MC bears up there that we marked in 2014-2016.
- I know there is no desire from this community for collaring, but there are some communities that are interested in movements because they are wondering about climate change, increased development, increased shipping. For example, NTI approached me once about impact on bears from a development project, but

I couldn't answer those questions because we don't have movement data. For now, maybe this is okay, but this may be important in the future.

- If there are specific questions from the communities or specific areas of interest, bring those forth to the regional wildlife board/NWMB priority—those priorities help the GN determine how they focus their resources and money along with our mandate to get updated information for the polar bear subpopulations.
  
- **Question Simon:** Peter DeGroot seems to be doing a lot of research in the last 20 years. What does he do with you guys?
  
- **Answer Markus:** He works for a university, not affiliated with GN. He is part of a big project, multiple universities, maybe 25 organizations supporting BearWatch – Peter is involved, but he is not the lead. It is looking at genetics, bacteria, developing a kit for fecal sampling. A lot of different projects but Peter is a tiny part of the bigger project. The GN supported Bearwatch because there are bits and pieces of this project that could help for management that we could not collect alone.
  
- **Question Willy:** Is this work they are doing helping us? It is helping the government...but what is it doing for us?
  
- **Answer Markus:** the samples are still being analyzed...from the many samples they are trying to determine if it's possible to see contaminants and genetics. As the GN, we could not do it. The idea was to be able to harness the resources of universities and their labs to gather information and develop potential new methods for non-invasive health monitoring of the bears.
  
- **Answer Jasmine:** also, we don't know if what BearWatch has proposed will work –it was an idea that had to be tested. The idea was to develop less invasive technologies and methods, but will it actually work? Don't know.
  
- **Question Ralph:** so whatever Peter does, it is not affiliated with the NWMB?
  
- **Answer Markus:** that is correct. Whatever Peter does is not counting bears and they are not primarily responsible to providing info to NWMB for management decisions.
  
- Willy: they are mostly doing contaminants, health, same as they are doing with the fish.



- Roger: Hunting bears in GB is too far—takes a lot of gas and people don't go there. Mostly MC.
- Markus: the GN is not responsible for allocation—the KRWB does that. For GB, all 3 regional wildlife boards are involved for GB—they all have to talk to each other. That requires a lot of discussion, I think. I think it requires involvement of all the RWOs.
- Ben: Bears in MC once it starts to freeze up, they start to come to town...that's because they are not being harvested due to the moratorium. Even during the summer, there are bear sightings now.
- Markus: Also probably not that much noise and traffic going out so they aren't afraid.
- Ben: it's because they aren't being harvested or disturbed by machines. They are even sighted far inland on King William Island. The population is healthy.
- Willy: Another thing is that between here and Taloyoak, there used to be a lot of traffic between the two communities even in the spring. Lately they have been seeing bears between here and Taloyoak. Seeing a lot of bears tracks, even wolf and wolverine around Clarence islands. Packs of wolves on the sea ice – Markus you've seen the wolves come into camp, two of them. Even going up to Boothia. But there are packs of wolves and they can also kill polar bears, from experience.
- Markus: the wolves could have an impact on the offspring of polar bears
- Willy: bottom line is that we saw a lot of bear sign and the 3 bears we got were very healthy and over 10 ft.
- Markus: that lines up with what we are seeing –that is really nice to hear.
- **Question Simon:** you were going to talk about sea ice Markus?
- **Answer Markus:** I think the way we looked at sea ice was that we included it our body condition analysis and how that might affect the body condition. We know from satellite imagery from last 30 years that ice has changed. We didn't do full analysis from satellite imagery or ice analysis on ice specifically. I don't know if that's answering your question.
- Simon/Willy nod it was sufficient answer

- Ben: Used to have icebergs that even have cracks and there used to be abundance of seals and there were ice packs and they were easy to spot. Nowadays the bears are moving more because there are less icebergs –we don't see the icebergs anymore.
- Willy: we don't see much ice anymore.
- Markus: agree with the satellite imagery—barely any ice in MC channel in fall
- Willy: people that used to go harvest belugas to Prince of Wales, but as soon as they get westerly winds the ice would get pushed in and they'd be stuck for weeks---they have a hard time getting through because of ice, but now no problem...20 years a big difference in sea ice.
- **Question Markus:** that's the other question I have---if this northern area is free of ice, what's going on with bears? Do they stay on the little ice? Do they go on land? What do you guys see when you travel int eh summer?
- **Answer Ben:** northwest king William island, bears would be swimming miles away from sea ice and can catch seal in open water. They're still hunting even if it's free of ice. They're always traveling even when it's full of ice.
- Willy: During the summer months, July/Aug prince of Wales, I stood and counted 33 bears in Cunningham bay—this happens when the beluga whales are coming in with their calves.
- Markus: to Willy---we tried to figure something out with you remember?
- Willy: polar bears going after belugas staying in the mouth of the bay to catch them.
- **Question James** (via video on smartphone): Going to that old MOU, remember we had that issue with Taloyoak with them “stealing” our tags when the TAH went to 12. But maybe this is a RWO issue.
- **Answer Markus:** You are correct, this is definitely a point to bring up with the RWO.
- **Question James:** I'm trying to make the numbers more equal. I'm just trying to make the communities have a fair trade. If we want a higher TAH is that NTI?
- **Answer Jasmine:** that would be the NWMB to raise the TAH. The RWO decides how to allocate the TAH.

- **Question Willy:** Why is Taloyoak involved in the TAH for MC when they were not involved when we signed the MOU. Taloyoak can harvest from MC but Gjoa can't get to GB. What are bears considered when they are harvested—MC/GB
- **Answer Markus:** The boundary goes right through Taloyoak
- Willy: so if Taloyoak has a defense kill is that considered MC
- Ben: there was a big male harvested as defense and counted as GB -- happened last year
- Markus: that is something that Kevin/Jack look into
- Kevin: okay
- **Question Jack:** isn't within 30km of the management unit a buffer zone?
- **Answer Markus:** yes, there is a 30 km zone that they can go on both sides.
- Willy: to board---do you have any concerns on bears?—time to ask
- **Question:** ---is there going to be another polar bear survey again some time soon?
- **Answer Markus:** that is a very good question---we have seen with our experience that having these long empty data periods of many many years, it makes analysis very very challenging. Not just in MC, all the populations this is a struggle having these long gaps. That was the old system because it worked for money resources, bears are long-lived, and it was the management and monitoring plan initially, but now we have realized that 15–20-year gaps are not good for analysis. Ideally, we'd like to be back in a few years for a one-year effort to sample bears in MC. That would help us get better data and get better estimates for survival. That is where the HTO comes in—if you make it a priority and identify it to the RWO and NWMB---say it's not okay to have long huge gaps for population assessments---that helps then us and the GN to make our case to allocate time/funding.
- **Question Kevin:** question regarding the 30 km buffer zone – where did that come from?
- **Answer Markus:** that was originally from the MOU—because bears don't respect boundary and hunters may not have always a precise location.

- Willy: like the Hadley Bay population and with NWT
- **Question Jack:** does that get carried forward from the MOU into the new polar bear management plan?
- **Answer Markus:** not sure, probably, don't have it memorized, can check. Just want to thank you for allowing us to come in person and giving us your time. Just because we talking here, doesn't mean that we have to end the conversation...we are open for contact and can help any way we can.
- **Question Simon:** how often could you come to Gjoa Haven?
- **Answer Markus:** 2013 and now 2020 – so maybe twice in 7 years? We rotate through the 12 subpopulations – we have a better chance to make it to the regional AGM and we are certainly open to joining via video conference on an HTO meeting if you have interest or questions for us.
- Jasmine: Unfortunately, you are looking at all the biologists for Nunavut. What we'd like to do personally isn't always what we can do realistically. We would ideally be able to make regular visits and updates for all communities.
- Simon: reason I'm asking is because we've been waiting to hear since 2017
- Markus: I'll tell you the same thing I told Cambridge Bay—it was a long time to wait for these results I admit, it is not ideal --- MC was challenging because the data was so sparse, analysts really struggled to analyze the little bit of data, ransomware, and COVID. I wanted to be able to stand behind these numbers and support them and so it took longer than we predicted. We apologize for that.
- **Question Wally:** another comment/concern I'd like to mention is did you do MC then to GB? --
- **Answer Markus:** we did them at the same time
- **Question Wally:** could you do a survey in the summer?
- **Answer Markus:** No---because there is still ice enough for bears, but not enough for pilots. The pilots don't want to fly over open water and bears would still be in the water and on ice pans during that time—we would not be able to do proper coverage of the area. You'd have to have really low ice and bears would have to be on shore.

- Wally: it is good to hear that we are having a recommended increase and the population is healthy. Of course, we'd like a bit more. A lot of activity and population is increasing.
- End of meeting

B: Taloyoak

October 21, 2020

**Start:** 17:45

**End:** 20:15

**Participants:**

Joe Ashevak, Chairperson HTO

Tommy Aiyout

Bruce Takolik

Jayko Neeveacheak

Kovalak Kootook

J. Ware – GN-DOE

M. Dyck – GN-DOE

K. Methuen – GN-DOE

D. Anavilok – GN-DOE

- Joe: Board wanted to know whether there was going to be a public meeting and were under the impression that there was going to be a public meeting. It appears that Jimmy the manager forgot to bring this up to the GN (Joe asked Jimmy if he let the GN know that the HTO wanted a public meeting and Jimmy indicated that he forgot). \*Note, the GN did not receive any notification or request for a public meeting prior to this meeting.
- This is very important to us and we can wait—sometime this winter would be good. We really want this and have been waiting a long time. M'Clintock is very important. Is this a possibility to do?
- Markus/Jasmine – This is possible to do, but we don't know if it is likely and we cannot commit at this moment because we need to discuss with our supervisors and figure out a schedule.

**Background slides:** review; no questions

**Study design/methods slides:** passed around biopsy dart; answered a few questions regarding how the dart sampled the bear. No other questions.

**Community participation slides:** review; no questions

**GB results:**

- **Question Joe:** what is the TAH for GB?
- **Answer Markus:** 74
- **Question Jayko:** are you guys getting new equipment –like cameras and stuff to take pictures that have the built in ability to see how big the bear are?
- **Answer Markus:** I think I know what you're saying and it might be a bit more complicated to determine actual size from a picture -- we would need to know altitude, distance, focal length. It might be possible to calculate size and do that. We could look into that.
- **Question Tommy:** talking about quota –all those communities Gjoa, Igloodik, Sanirajak, What the quota like before MC was shut down?
- **Answer Markus:** it was 42 until 2003/2004. It was increased to 74 in 2004/2005 because the study in 1998-2000 showed ~1600 bears instead of 900. I was around at that time of the moratorium in MC that communities were given a few tags for GB to preserve traditions during that moratorium and low harvest in MC.
- Joe: that was a big jump from 42 to 74.
- Markus: yes, I don't know how the recommendation went, but it seems that the 74 has been okay because the population has remained stable, though there may be some environmental changes that have helped the population---like the sea ice thinning/reduction in multi-annual ice and becoming better habitat for fish/seals/algae/etc.
- **Question Jimmy:** no colons being collected anymore?
- **Answer Jasmine:** correct, that was a collaborator project and they had funding for only a set number of years. That funding has run out and now they are working on analyzing the data. I am not sure when reports/information will be ready, but reports will be sent to communities with what they find.

- **Question Jimmy:** about credits? If we want to have a sport hunt, can we use our credits for sport hunts?
- **Answer Kevin:** Yes, that is not a problem. However, keep in mind that we haven't approved any outfitter licenses due to Covid. But, we can help support you for that if you have questions. Not much going on with sport licensing this year still with covid.
- **Question David A.:** with the feces and Peter DeGroot study ---maybe ask the HTO to make sure there was approval – we're not sure there was approval.
- **Answer Markus:** I'm pretty sure that all Bearwatch research had permits—they would have gone through our department.
- **Question Kevin:** do you know when that permit expires?
- **Answer Markus:** I'm not sure—probably multi-year
- Kevin: during the research permit review period that is a good time to bring up any concerns or comments---that is the time to bring that forward and decide if you support. If you don't say anything, it is assumed to be approval from the HTO.
- **Question Bruce:** Is it mostly the GN that counts bears or do other people do it?
- **Answer Markus:** mostly it is GN, but sometimes we have to have help because it is only me and Jasmine. There are a few people that have lots of experience that we bring on to help out on big projects. I'm in charge of the program and I only get people with experience to do the work. And there are locals involved—it's not just the biologists.
- Following the meeting after Jasmine/Markus left, Kevin remained for other agenda items and it was mentioned again that there was **a lot of disappointment that the public would not be hearing these results.** Kevin reiterated that it appears this was not communicated to the GN and the biologists were not able to plan for this. Tonight was the first it was brought up about the desire for a public meeting.
- End of meeting

October 22, 2020

**Start:** 18:50

**End:** 21:20

**Participants:**

Athol Ihakkaq  
Jesse Apsaktaun  
Mariano Uqqaraluk  
Columban Pujuarajok  
Mark Kutsiutikku  
James Nasalik  
Ema Qaqqutaq from KRWB  
J. Ware – GN-DOE  
M. Dyck – GN-DOE

**Introduction and Objectives:**

- mandate is to provide this information to co-management partners. Ideally, I would have liked to have both the science and IQ studies come out at the same time---unfortunately Covid impacted the IQ study researcher's ability to finalize the study at the same time.

**Background:**

- background of studies from 1970s to 2000. Heard from communities from last 3-4 days is that there have been a lot of changes in the environment and sea ice. Our obligation is to get new information to not just the GN, but also hunters, HTOs, RWOs, and to NWMB because they need the information to set the TAH; no questions
- The question that was important at the time—number of bears can be answered by the biopsy darting. However, with this method, we cannot answer questions about movement or industrial activity.

**Community participation:**

- incorporate the input from HTO/hunters to help us know where to look for bears--  
-where were good places to search; no questions

**Study Design/Methods:** review; no questions

**Study Design/Analysis:** review; no questions

**Results:** shift in distribution? Why are there changes in the bear observations?

- Ema: that area in committee Bay was usually open water in 1998-2000



- Athol: Yeah, that is often open water near the floe edge

**Results:** body condition? Any thoughts or similar observations of you guys as to bear fatness? Are you seeing any skinny bears? No real comments---board seemed to agree

**Results: reproduction** – key measures we look at to help compare from old study to new study or to other populations

- **Question Jesse:** have the number of Coys per adult female gone down because there are more females in the population now than 1998-2000?
- **Answer Markus:** can't remember off the top of my head---will have to consult the report, but my memory is that the number of males has gone down slightly---likely because of the 2:1 harvest ratio. Females may have increased slightly.
- **Answer Jasmine** – cited report for female proportion – 57% in 98-00 and 61% in 15-17. That is in line with the 2:1 male to female sex ratio—that's why it's not 50:50.

**Results: survival;** no questions

**Results: growth rate;** no questions

**Results: abundance;** population is stable, even with changes in environmental changes. This is good news. This is a collective accomplishment among the hunters and government in managing this population.

GN Recommendation: we are not recommended a change in TAH.

- **Question Ema:** would you recommend to SARA to downlist?
- **Answer Markus:** there isn't anything to downlist because they look at polar bears as a whole. SARA and COSWIC looks at these data for the next assessment. The next assessment will be likely in 2025—I provide this information to them. Plus this information not only goes into Canadian assessment, but also internationally. I am defending the Nunavut polar bear numbers internationally. This is good information for the outside world. However, it is important to remember to that we, me and you, we cannot know for certain what the future holds---what do the environmental changes impact for bears do in 5, 10, 20 years. What do the communities want and feel? There are different communities in Nunavut that note public safety, levels of social tolerance, I hear the communities say those things. It is important for the community to come up with what you want to do with this population---having a management objective. The decision you make now, always keep in mind to keep the future in mind.

**Shows video of biopsy darting**

- One more thing to mention to be fair since I've mentioned to the other communities. This is about movement....I respect that communities and HTOs do not want collaring or handling. I have had, in the past, organizations have asked about impacts of development on polar bears, but I could not provide that information because we do not have it. There is no pressure from me or the GN for collaring, but it's important to think about what questions you have and the information you need---describes benefits of collaring.
- I know that we have not been able to visit communities and I regret that. You are looking at the 2 people, sometimes 1 person, and we can't be there or everywhere.
- Jasmine: also, as the future unfolds, if there are priorities from the communities, bring those forth to the RWO and NWMB priority meetings because the GN uses those to help determine how they allocate funding. We have a mandate for abundance, but for other priorities, knowing what communities wants is very helpful.
- Markus: addresses why it has taken so long for us to get here with results. DNA analysis, finding old samples, ransomware, covid
- Another thing we learned is that having long gaps of 15 years makes it very difficult to get survival. Doing one more year of marks/biopsy sampling would be helpful, maybe 5 years.

### Questions:

- **Question Mariano:** did you see any bears that were wounded or sick?
- **Answer Markus:** in 3 years, I haven't seen any sick bears and no dead bears. I didn't see any dead cubs.
- Mariano: We had 4 bowhead whales die and was wondering if the bears were sick from that---not sure why the whales died.
- Jesse: going back to the topic of collars, I like the ideas of perhaps of collaring some bears because I do like seeing scientific data because it can tell a story. I'm not pushing back against IQ. But, I like to see the procedure – what are the pros and cons --- how many bears would you collar. I would want to see the positive and negative impact. Because it would be good to see where the bears are traveling. In the past 3 years, we are having bowhead whale issues since the cruise ships. Is the Northwest Passage gonna affect the bears?

- Jasmine: I feel like the IQ tells a story and the collars tell a story too –they together, tell a bigger story.
- Jesse: We need to get our residents to understand the positive and negative of bears. For example, if we have 10,000 bears and we collar 10 bears, what are the negative effects on those? I would recommend you providing a pros and cons. pamphlet
- Markus: Would it be helpful just to have a document, but that probably leads to more questions....it might be helpful to have a chat after you
- Athol: the Baffin area with the mine---they're going to put a shipping route in--- that is going to affect the bears—we know that.
- Jesse: It's like we need the scientific data because we don't live out on the land like our grandparents did...I live in settlements 99% of the time. We have to educate ourselves and the future---like the shipping lanes.
- Markus: what you're exactly saying is similar to Baffin Bay and Kane Basin--- communities saw climate change and wanted to know where the bears were going and what denning was doing. We worked with them and put out about 10 collars every year, a total of 30-35. And the data are huge
- Athol: the IQ and putting the collars together. I agree with the collars for the future.
- Markus: we are doing the LS starting next spring. We can maybe have communications to see what could work with the HTO. We have 3 years – maybe we could put a few collars out depending on your questions.
- Jasmine: to Jesse – maybe you could write your specific questions/concerns and that would help us design a study and collars.
- Mariano: I don't see any huge bears anymore 14-15ft bear.
- Markus: These are good observations to provide to Pam---that's the type of IQ that we need. When another study done in a few years, maybe there are different sizes and you document them.
- After board members left, GN representatives gave KRWB representative the MC presentation so that he also was informed about the study results.

D: Naujaat

October 26, 2020

**Start:** 18:10

**End:** 21:50

**Participants:**

NTI: Paul Irngaut

QWB Chairperson: James Qillaq

NWMB: Denis Ndeloh, KJ England, Steve Mapsalak

GN: Markus Dyck, Jasmine Ware, Jon Neely, Peterloosie Papatsie

HTO: Hugh Haqpi – acting manager

Paul Angotituar

David Ammaaq

John Ell Tinashlu

Peter Manniq

Dino Mablik

Mark Tigumiar – vice chairman

- Meeting started with introductions around the room
- Presentation
- GN representatives stressed that the IQ study is ongoing and has been delayed due to COVID because its results depend on ability of researcher, Pam Wong, being able to verify interviews and speak with interviewees. Ultimately, together the science and IQ will all go together to the NWMB for decisions for a bigger picture. Looking for a good discussion among everyone – we want to get feedback on what we present this evening.
- Paul Irngaut: Informing the group that NTI wasn't on the first leg of the consultations and explaining that he and James (QWB) are here as observers.
- Markus: asks board if they want to do background on GB and they agreed.
- **Background slide review:** no questions
- **Goals of Study/need for new info:** no questions
- **Question Hugh:** the boundary that you first showed is the boundary? What are the new boundaries that you show?
- **Answer Markus:** \*reversed to previous slide showing 1970s boundary\* Biologists back in the 1970s/Govt of NWT/local communities outlined as where there are a lot of bears and because they didn't know much about numbers of

bears for any areas, they decided to survey this area. So, this circle (\*shows red circle) was in a way arbitrary.

- Paul I.: can I explain a little bit? Explains the role of the Range States, Polar Bear committees like the PBAC/PBTC.
- Markus: Further explains the management unit boundaries---The brown lines show boundaries based on movements of female bears with collars that were put on bears in the 1980s-1990s.
- **Question David:** Question about the boundaries -- that NWT boundary (\*red circle) that is pretty big --- do the tags depend on the boundaries?
- **Answer Markus:** For each of the areas, we know how many bears there are in each of these areas and the NWMB has set a TAH based on that. Based on how many bears there are in total and based on what the management objective is --- some communities want a population to stay stable, so you can't harvest as many if you want to keep population stable. From the total # that is determined the TAH. For Gulf of Boothia, NWMB decided 74 total allowable harvest and then the RWO decides how the tags get distributed.
- Denis: I think what he was asking: Is there a relationship to the size of the management unit to the number of tags?
- **Answer Jasmine:** No, the size doesn't tell you how many bears there are. Some areas are quite big but don't have many bears. MC/GB for example. Tags are based only on how many bears there are in an area.
- **Study method choices slides:** Discusses how alternative options to traditional capture mark recapture were presented during initial consultations in 2013 (aerial survey, DNA biopsy). Reviews biopsy darting and how it works. Shows biopsy dart, passes it around. Explains how the method differs from traditional mark recapture and why we don't get as much data.
- **Question Hugh:** does the genetic DNA biopsy indicate age and health of the bear? Has there been any disease since the start of the mine?
- **Answer Markus:** Lots of good questions in there. We cannot get the exact age because we do not have a tooth. We cannot see anything for contaminants--our sample is too small. And no disease can be seen other than a big injury on the bear because we are not handling or touching the bear. The hunters can report back if they notice something weird or sick with the bears, disease -- fills in gaps that we have with the science study.

- **Community participation slides:** no questions
- **Study design slides:** no question
- **Question:** From the 70s study to now --- how do you see the health from then to now?
- **Answer Markus:** good question---we are going to get to that in a minute---not really from the 70s cause we don't have tissue and samples from back then, but we were able to compare to the 1998-2000 study and we will get to that shortly.
- **Results:**
- **Question Hugh:** was there any changes in the biopsy based on climate change? Were bears getting fat, getting skinny, any disease
- **Answer Markus** – We can't see disease from this type of study. We rely on hunters to bring in anything that looks diseased. Body condition we do know and we will talk about that in a couple of slides.
- **Review of shifts in distribution slide:** Based on where we observed and sampled bears in 2015-17 compared to 1998/2000, appears to be a distributional change---maybe because of sea ice and seals? Bears have likely adjusted to these changes
- **Comment:** maybe more narwhal carcasses?
- **Peterloosie:** Those 2 high concentration areas in 2015-2017 – are two polynyas. Usually a polynya with open water around these areas that were empty of bear observations in 1998-2000.
- **Question Markus:** Do hunters notice changes in ice? How does ice look compared to 20 years ago?
- David: The ice is very thin and more drifting snow---it's not compacting and not making ice. Not forming properly.
- Markus: how is that for seals?
- John: When it is very thick, it is good for the seals. When it is very thin, it is not good for seals.
- **Results: Body condition**

- Comment: Bears back then were skinnier so this fits with what you're showing us.
- **Question Hugh:** Have you noticed difference in temperature and its effects on body condition? As in warmer temperatures make bears skinnier and the cooler temps get them fatter and ready for hibernation?
- **Answer Jasmine:** we haven't looked at that, but we could easily see what the average temps were during the field work for each of the study years and compare.
- Peterloosie: I think that the seal pups are getting bigger – saw one that was 3 ft long –huge. Maybe they are bigger and feeding bears.
- Jasmine: Describes thinning ice and changing productivity of ecosystems with decreasing ice thickness and more dynamic ice being potentially helpful for bears because the ecosystem is boosted in productivity (algae, fish, seals, bears). Theory because we do not have data on seals or fish for these areas. Markus is working with DFO to try and get information for seals.
- Markus: describes efforts to get seal info with DFO. The Lancaster Sound is where we are going to try to get seal info as a start.
- Hugh: I'm from Baker Lake where there are no polar bears. Back in the 60s and 70s, there were 4 or 5 bears caught super inland --- the bears were migrating to the west. Cause looking at LS and GB and comparing the distance from Gjoa Haven and Hudson Bay is about the same distance.
- Markus: There are some bears that move a long distance. Gives a couple of examples.
- **Question John:** I have a question about scientists---do you keep in contact with other provinces, territories? Or do you not talk to the other scientists?
- **Answer Markus:** There are 8 populations in Nunavut that are shared between jurisdictions/provinces/territories that I work with when there are studies – mentioned Baffin Bay and James Qillaq working with Greenland. Also Western Hudson with Manitoba. All the jurisdictions meet once per year, more frequently on the phone, so definitely in contact with other scientists and jurisdictions.
- I also present information gathered in Nunavut to international community and defend the Nunavut harvesters and Nunavummiut. We exchange this information with different countries.

- Paul I.: talked in Inuktitut for a while and explained he reviewed the PBTC and polar bear advisory committee and status table. That you guys meet once per year and review the polar bear populations.
- John: conversation in Inuktitut with Paul I.
- Paul I: John was asking about the ECCC ongoing mark-recapture study in Western Hudson and the effects of being handled/lack of hearing. At the Advisory Meeting where ECCC is a member, we voiced our concerns with handling bears, but also mentioned that that handling occurs in Manitoba which Nunavut has no control or jurisdiction over.
- Inuit have been opposed to handling of wildlife of any kind, especially polar bears. We have pushed for biopsy darting. We have made this known to our counterparts in Manitoba and ECCC. They know our concerns and to date we haven't seen any changes on their part.
- Peterloosie: I think John that was saying is that the bears are going partly deaf after so many helicopters getting close and then landing next to them. Then the partially deaf bears are moving north into Nunavut and causing issues.
- Steven: you came here to do a presentation to do Gulf of Boothia; I think that maybe we stick on topic.
- Markus: We are happy to answer to any questions and it's not like we are here that often so we are more than happy to entertain any questions on any topics for as long as you all want.
- Break --- 10 minutes ---
- **Reproduction slides:** coys/yrlgs – offspring per ad. Female
- **Question Hugh** - Are there more cubs with females in old study?
- **Answer Jasmine** – there are a few that have 2 cubs more than just 1; some hunters see 3 coys, none were seen during the study period, but maybe recently this is happening more?
- **Question Peterloosie** – reproduction is low with 1.6?
- **Answer Markus:** I know it looks low, but in context, it is not a low number. That is actually very good reproduction numbers in Gulf of Boothia \*explains values that would be concerning. The observation you see represent localized observations; our number is averaged across the entire study area at the same time so \*all the moms with single cubs and twins get counted and averaged.



- **Question Hugh** – pb numbers are low with low seal numbers?
- **Answer Jasmine** – we do not have seal numbers in Nunavut, likely it is the case when seals are poor, bears likely do not reproduce.
- **Survival slides:** -- no questions
- **Pop growth slide** – no questions
- **Abundance slide** – no questions; describe the range of the number and why there is a range – uncertainty in science because no one thing can know all. It reflects that there are likely biases and errors in places, that is why the result produces a range of numbers rather than an exact number.
- **Further questions slide:** other questions that the hunters/communities have regarding boundaries, denning, development (mines, shipping) --- if these become concerns, methods such as collaring would likely have to be employed. IQ and DNA biopsy can inform parts of the puzzle, but each method provides its own information.
- Markus: further questions – do you see bears staying the same?
- Comment: feels like they are increasing around.
- Markus: That's definitely true – between 1850-1935 that's when a lot of whalers came to Canada/Nunavut and bears were shot. Not many bears in the 1950s and 1960s –but definitely more bears now.
- John: even berry picking, we have to bring our gun and be a safety guide
- Paul: Can't even go camping anymore.
- Markus: that's good information – need to talk to Pam and see if that's helpful to include and help us to understand the bigger picture – have bear distribution changed? ---could ask that for Pam to include
- Hugh: population going up, bears come more to community. IQ says there is bear movement and that is true – larger bears move farther out. Now and then, there is sometimes a 12 footer but average is 8 ft.
- Markus: do you see you big bears?
- Peterloosie: They are talking more Foxe Basin, not so much Gulf of Boothia for those big bears

- **GN Recommendation TAH slide:** with the info the government collected, and with the objective to maintain the subpopulation, we are not recommending a change in TAH.
- **Discussion with group about TAH Increase and Tag Allocations – originated organically from group and created lots of discussion with NTI, NWMB, QWB, and GN offering information on processes, options, and clarifications for how TAH increases or reallocation among communities may occur.**
- **Question:** about harvesting, can we have more than 5 tags?
- **Answer Markus:** There are a few options. The government is not recommending a change. However, depending what is presented to the NWMB, there are options for the Regional Wildlife Organizations and communities to talk ---have to be on the same page – the communities have to have the same objective –keep pop same, higher, lower. Then, the RWO, supported by HTO’s needs, makes their submission to NWMB – may or may not be the same as the Governments.
- We have to understand that this is not black and white, we know that the population has stayed the same, but I don’t have a crystal ball to know what the future holds. When the decision makers (RWO, NWMB, etc) increase the TAH, there is a risk that the system that you could screw up the system --- it is a question of how much risk are you willing to take. Are you willing to take a risk that is very high --- say TAH of 90-100? – but that is very very risky. We want to make sure we provide for future generations – that is our mandate in the Government. But, it is not for us to say what the management objective for a population should be. This is a decision for the communities to think about. It is not an easy decision.
- Another option is to bring forth a request for reallocation to the Regional Wildlife Organizations– based on concern or need. The RWOs can redistribute the tags at any time—does not need to be a new study or anything like that.
- Anything that is not clear, contact us, we give you information. Our door is open.
- Hugh: Looking at TAH by Minister, maybe redistribute the tags ---like Coral Harbour. Difficult to talk to Arviat, Coral Harbour
- Markus: You can only discuss reallocation of tags with the communities that harvest from the same subpopulation. So Gulf of Boothia communities. And Foxe Basin communities (Coral, Cape, etc)

- Comments: Naujaat suffering defense kills and impacts on their quota from hunters coming from Rankin and Arviat.
- Markus: we have to take a look at that and see. But harvests come off the hunter's home community – part of the Polar Bear Management Plan. MOUs are no longer in force
- \*surprise comments from group indicating they are not aware of the Polar Bear Management Plan and have not seen it.
- Markus: \*Explains the process the Polar Bear Management Plan went through before being ratified by the NWMB and Minister\* --- The Polar Bear Management Plan was accepted after going through a multi-year process in which all HTOs across the territory were consulted. \*NTI nods agreement\* RWOs were consulted and part of it too. All partners were involved and – drafts sent back and forth and back and forth. Public hearing in fall 2018 and all HTOs invited.
- Denis: wanted to provide clarification for what Markus is talking about for the Polar Bear Management Plan – the wording about hunter's home community is part of an appendix that is approved on an interim basis right now.
- KJ: it is on the NWMB website.
- **Video of darting:** clapping from John – \*not sure if sarcasm or true support of method/video\*
- **Question Peterloosie:** what do you think of the 1:1 harvest ratio? I think that it will increase polar bear populations in the future.
- **Answer Markus:** This is something the communities wanted, maybe not every community, but the majority. Also, in the Polar Bear Management Plan hearings. There is a concern because the TAH was not adjusted when Nunavut went to 1:1. The TAHs were set to protect females and maximize sustainable harvest. But, when 1:1 went into effect, there is a chance that more females would be harvested and could be riskier. If there is a concern, the GN will bring those concerns to the NWMB. Just because it's 1:1 doesn't mean it has to stay that way if there is a conservation concern with consultation with community.
- Hugh: there was a concern we would like to know the male/female ratio, we want to have balance and not drive the population down and what happens with climate change in the future is not really known.

- Markus: When there are concerns, hunters raise the flag – like MC not being able to find males – that was a trigger to lower harvest in MC and to do study. We rely on hunters to provide information because it's not possible to do studies/surveys frequently – costly.
- **Question Paul I.:** Asking how much harvesting done from here.
- John: Yes 5
- **Question:** That's why I ask if we can get more than 5. More people are hunting up there. Would like more tags. And more people go camping to hunt in March. – mostly people go to the island in Committee Bay (Peterloosie – about half the hunters go to the big island in Committee Bay).
- Markus: You don't have to wait for a new study, you can raise this with the NWMB with information or bring up with RWO to reallocate.
- John/Paul: conversation in Inuktitut -- summarizes that HTOs can allocate half a tag for a cub – request has to come from HTO, then approved by someone, Superintendent maybe. Also, they have made requests to increase TAH to the KWB, but haven't heard anything. We have a committee, under NTI, Nunavut Inuit Wildlife Secretariat, the chairs sit on the committee and we can bring it up at the next meeting.
- James Qillaq – adds comments in Inuktitut
- Comments – Rob Harmer explained procedure in spring and we are just starting to put it on paper and we can't just have ask – we have to go through process.
- Paul I.: Six communities harvest from GB so it seems that the allocation isn't exactly fair. But if want an increase in TAH, will have to bring to RWO which brings it to NWMB. If you want a re-distribution, then RWO has to do that – KWB, QWB, KRWB – they all are responsible for allocating GB.
- Steve M.: I used to be the Chair for the HTO when the MOU, there was a decrease in the TAH, Mitch Taylor was the pb biologist. There was a quota of 3 for GB for Naujaat. When the quota went to 74, Naujaat went to 5. The way the tags are allocated is done by the Regional Wildlife Organizations – it's up to them. But they have to follow the TAH. \*note – not clear what this reduction is referring to. MD is not aware that there was TAH reduction for GB while Mitch Taylor was working.
- **Question:** Do you know when this will be going to the NWMB?

- **Answer Markus:** We have to finish consultations first and we maybe are done by Wednesday, and we could get back to the office and be told to get something ready for the NWMB. I don't know though.
- Jasmine: And just to reiterate, even if nothing ever goes to the NWMB and this study never happened, the concerns and requests for redistribution of tags can go to the Regional Wildlife Organizations at any time. Technically, they can reallocate each year the tags. They usually don't but it is within their rights/responsibilities.
- Steve/John Ell/James: conversation in Inuktitut
- Denis: assuming the request comes from the GN to the NWMB at some point, what is going to happen very likely, because it is 3 regions and NWMB cannot set a TAH Nunavut-wide --- the Board will determine what the TAH is for Gulf of Boothia. The NWMB will then send a letter to the 3 RWOs and ask to know how the RWOs are going to share it. The RWOs will meet and decide and then provide that info to the NWMB and this will be sent to the Minister. This is also when the communities can have their voice heard.
- Paul I.: that is why I mentioned the committee at NTI that we will bring forth this issue. If communities want to increase the TAH within the already set TAH, then that is the RWO jurisdiction.
- John Ell: conversation in Inuktitut – about Foxe Basin – \*not sure what was said. Left abruptly\*
- Paul I.: I was explaining that communities get together to discuss and agree on what they want—if they bring that forth, it is much more powerful than a single request.
- KJ: because there are so many communities and regions are covered, the easiest option would be to request for a transfer of credits for a short term increase in quota. Another option would be going to the RWO, to advocate with the other RWOs, for a change in allocation. Thirdly, work with all the RWOs and advocate for a change in TAH.
- **Question:** when do you plan to study Gulf of Boothia again?
- **Answer Markus:** With the previous study plans, studies were done every 10-15 years. With this analysis, we realized that this long timeframe is too long. Makes the analysis really difficult to have that long period with nothing. We ideally would like to come back in 4 or 5 years after study completion to sample bears in

the entire area, but only for a single year. This would put more 'marks' as we call them into the population and give us better understanding of survival, reproduction. Four to five years after the single year sampling effort, we'd do another full study—where we survey the entire area 3-4 years in a row. But that depends on what information is coming in --- from communities, or the environment. NWMB sets regional priority and makes list --- get what you think is important on the priority list. Helps the GN allocate funding and know what is pressing priorities.

- **Question Hugh:** would 4 or 5 years be enough for you?
- **Answer Markus:** we would do a single year, cover the whole area between April/June. We'd do this in 4-5 years. In 5 years, we need to put more marks out because the bears marked in 2015-2017 are dying.
- We cannot get a full population abundance by putting 1 year of marks out. There is maybe a chance if we do genetic samples in 1 year, there is maybe a way to update the abundance – but there is no guarantee because it will be the first time. We are learning as we go.
- Jasmine: noted the increase in time for DNA biopsy analysis. DNA analysis takes significantly longer than traditional mark-recapture – by at least 9-10 months.
- Markus: we are open to communication and work for you.
- Jon Neely: I didn't realize that defense kills from residents from other communities might be counted on your quota so we can look at that. We also have money in the deterrence budget – HTOs can apply for up to 10k for bear deterrence equipment – bear bins, fence. If a bear does damage your cabin, we have another program that can pay up to a few k for repairs and such. Talk to Peterloosie a bit tomorrow.
- Peterloosie: We applied for scare cartridges in early June – but we haven't heard.
- Jon: We can look into that – I wasn't aware of this application. I do apologize – I did not see that program application this year. That is something we will fix on our side. We will make sure that program works better for you.
- KJ: thanked the biologists and their work, difficult to get around – only 2 of them. Thanks to the HTO for community sampling program.

End of meeting

E: Sanirajak

October 27, 2020

**Start:** 19:15

**End:** 21:15

**Participants:**

NTI: Paul Irngaut

QWB Chairperson: James Qillaq

NWMB: Denis Ndeloh, KJ England

GN: Markus Dyck, Jasmine Ware, Jon Neely, B. Grosset

HTO: Lizzie Phillip-Qanatsiaq – secretary manager

Jopie Kaernerker – Chairperson

Danny Arvaluk

Jaypeetee Audlakiak

Sam Arnardjuak

Zillah Piiallaq

Cain Pikuyak

George Innuksuk

Introductions around the room

Question to the Board re: background – Markus asks Board how much detail on background

Question: how much time with all the background?

Markus—material about 2-2.5 hrs but depends on interaction and how many questions the members have. I think it's beneficial to have the background so we can go over it.

**Objectives of Presentation:** reminds Members that the IQ study is ongoing for Gulf of Boothia. We are hoping that the information you have is provided to Pamela. Ideally, the science and IQ would be together, but COVID has prevented the IQ and the fact that Sanirajak has not had a Manager for quite some time.

**Background review slides:** no questions

**Goals of study slides:** Refreshed commitment of MOUs that new research had to be conducted for GB in 2015. Review goals including how sea ice changes incorporated – see how bears are doing as sea ice changes. No questions.

**Study method choices slides:** Refresh that DNA biopsy method was supported by communities back in 2013. The DNA biopsy method gives us information about the abundance. Reminded about drawbacks of biopsy darting. No questions.

**Community participation slides:** review, no questions

**Study design/analysis slides:** review, remind that hunters bring muscle and fat that can be used to address contaminants questions; no questions

**Results slides**...map with dots, flight lines....map comparison old vs new distribution – no questions

**Question Jasmine** – are you seeing bears evenly distributed like in the 2015-17 study? Didn't catch answer...something with Naujaat

**Who was sampled slide** – tells us some bears are moving between areas – no questions

**Jasmine question -- Body condition slides** – have you noticed less skinny bears than 20 years ago?

Comment: Maybe more carcasses on shore than other areas?

Hunters are only over in GB in spring only – bears are skinnier due to mating, Sanirajak only goes there in spring

Some people do not hunt bears anymore because the hides are not worth a lot of money

**Reproduction slides** – review; no questions

**Survival slides**, review;– no questions

**Growth rates slides** – no question

**Abundance slide – interpretation slide – no questions**

**Questions slide – questions:** walrus on top of ice in September – did bears get counted in spring down there?

**Answer Jasmine** – we sample them when there is ice in spring, when there is open water we can't sample really – too dangerous for flying

**Question was more about FB** – when we do FB we actually do it in fall, Aug and Sep.

**Review of slides and questions...are there too many bears in GB, too few?**

**Comment:** not too many bears hunted in GB, not too many sport hunts; COVID-19 likely not much sport hunts



**Question** – seal populations is having an impact on pb population? Under water sonar...might have an impact on bear populations

**Answer Markus** – explained NWMB priority list, work with RWO to have seal abundance and impacts on priority list; I can also ask DFO biologists to see if there is a desire for research

**TAH slide** – question-in the winter when the quota is not completed; traditional hunting and bears taste better in summer – can we hunt in summer;

**Jasmine Answer** – when you hunt is an HTO decision; The GN does not care when hunts occur; season is July 1 – June 30...all year.

**Question:** when there are more bears in summer, and there are sport hunters, how can we harvest more?

**Answer JNeely** – we normally distribute tags in fall, but tags can be sent sooner in the season to assist with sport hunts if you want to have summer hunts

**Movie – darting.....**

**Question:** When you are doing your research – have you seen the bigger bears? 12-14 feet or more?

**Question Markus** - In FB? Or GB?

**Question:** they move in March, Sanirajak hunts in spring in GB...where are they moving to?

We asked hunters to show but they could not tell because of the ice conditions, changing too much

**Question:** is that the same in Hudson Bay bears from Churchill?...assumed the question relates to abundance(?).

**Markus Answer** – there are different numbers of bears in the populations, and not every area that is large does not necessarily have a large number of bears.

**No more questions - End of meeting**

E: Igloodik

October 28, 2020

**Start:** 18:40

**End:** 21:42

**Participants:**

NTI: Paul Irngaut  
QWB Chairperson: James Qillaq  
NWMB: Denis Ndeloh, KJ England  
GN: Markus Dyck, Jasmine Ware, Jon Neely  
HTO: Jacob Malliki  
David Irngaut – Chairperson  
Gideon Taqaugak  
Daniel Akittirq  
Michelline Ammaaq  
Joannie Alaralak  
Salomon Mikki  
Natalino Piugattuk  
Loyd Idlout  
Janet Airut - translator

Introductions around the room

**Background slides:** review; no questions

**Goals of Study:** review and reasoning for new research study – MOUs obligations for updated information and Total Allowable Harvest information to decision-makers – RWO/NWMB; no questions

**Study method choices:** review when initial consultations occurred in 2013. Balance between methods and the trade-offs between different method choices. Review that all HTOs supported the less invasive method. Describe DNA biopsy and passed around dart. Explained how skin sample and genetics works to ‘mark’ or identify a bear so that we can track it through time. No questions.

**Community participation slides:** Review; no questions

**Study design/goals slides:** review; no questions

**Results:** maps – questions – shift in distribution?

Salomon: answer – count up to 47 family groups in summer – count bears in summer would be better;

Jasmine – is it new to see more than 2 cubs; usually 2 offspring, but recently seen 3 cubs, a bit rare but seen

**Question Salomon** – Could you monitor in summer time? Is that possible?

**Answer Markus:** The area you pointed on the map is Foxe Basin and we do our monitoring in the summer there. But for GB the ice doesn’t go away completely so we do it in the spring when most bears will be on the ice hunting and breeding.

Natalino – ice comes from aqqu, ice transports animals, no more ice up there and around Moag Bay there are polar bear tracks, some come up to community (this past summer); not so much ice through Hecla and Fury strait

Salomon – are bears afraid of ships? Is it because there was a ship? Ship in Hecla Strait, ice breaker.....this summer there were lots of bears near the cabins

Comment: this summer saw lots of bears in that area , more than usual...during September

**Question Jasmine** – do hunters go in springtime to GB or mostly summer? Do hunters see GB much in the spring?.....

Michelline – recently less ice in that area, lots of tracks;

Paul I....shifting ice is likely;

Jasmine...if more ice is shifting, ice breakers are coming through, maybe this is a time to find out how bears are moving, maybe if it's important to the community?

Gideon – if there is less ice, less polar bears, but we do not see a negative effect yet

Salomon – bears are usually where there is food; ships were dumping in that area and the seal moved; the seals went further up, maybe bears are moving up there; same in Lancaster sound across Arctic Bay

Natalino – if area is researched the funding is always a problem; excuse is always there is no funding available.....

Markus/Jasmine – nod in agreement that funding is always a challenge for big projects

**Question Salomon** – why are you not searching up there – points to BB and KB...bears are likely moving up there and are coming down into our areas?

**Answer Markus** – we did sampling and research in Baffin and KB, and we had collars, but we are doing LS in 2021 for several years; maybe some bears move between MC/GB and we pick them up –

Jasmine – we are doing LS work in spring—same as MC and GB so that also might help to find out how/where they move/are at that time of year. Sampling at the same time of year gives us information that is more comparable compared to spring vs. fall sampling.

**Question:** why does our quota never get an increase when we feel bears are increasing? \*Interpreter struggling to translate conversation – following meeting, Inuktitut-fluent GN staff member indicated that the conversation also included that Igloodik area igunaq caches were being raided by bears in FB and that's one of the reasons the HTO wants to harvest more bears in the FB area.

**Answer Jasmine:** gave Baffin Bay example and how process went for increase there.

**Answer Markus:** Describes RWO allocation responsibility and NWMB responsibility of increasing TAH. The reason there has not been an increase for GB is that there has not been new scientific information since 1998-2000.

Paul – you can approach NWMB with requests, this information goes to the govt, you have to clarify why you want quota increased; because of the studies and the results they give to NWMB; there are 3 RWOs for GB; the quota is 74 for all the communities; for FB you would need to talk to that RWO and communities.

Gideon – there are NWMB reps here; concerned about seals, there are no caribou, they would deny us quota increase for bears because they've done it before.

Natalino – took sport hunter to hunt bear, caught collared when I was 7 years old; collar came off and they lost it; head was “separated from neck”??....\*maybe no fur on neck?\*...a bear was caught and hide was no good and he is asking for replacement of hide from GN

**Question Daniel** – in FB they wanted a cub, or a family group?

**Answer Paul I**...it comes out of the quota,

Requested a mother and a cub last year but we did not hear about it...anyone catches a cub it counts 0.5 of a tag; \*HTO comments and discussion about what ‘half a tag’ means. In order to stay on topic of presentation, GN indicated that these questions they could answer at an HTO meeting since they live in Igloolik and would be happy to answer harvest-related questions during a regular meeting\*

James...to NWMB send your request about cubs....to them;

**Results slide** – describe how many individual bears and recaptures there were for GB

**Question Jacob** - Where is MC?

**Answer Markus** – explained where it is on a map

**Results body condition** –

**Question Jasmine:** Why are bears in better condition?

**David:** When Paul was kid almost no bears around; whenever a bear came near community, it made the news; because if there are more bears, they get skinnier – not enough food and they fight; haven't seen skinnier ones; I think and what I see is we used to wait until quota is increased, there are less bears and they are not attacking each other; the numbers will decline; not so much on the ice, more time on land; they tend to be fatter now; when people went caribou hunting hunters saw no caribou but polar bear tracks; they sometimes tend to stay in one place-someone cried about what is going to happen about to polar bears, it was a biologist, GB area always had polar bears – there are hardly any bears because they are on the land – we think if funding is

available they should research sooner to get increase in quota; when they do research bears are not scared of machinery and people; the bears are not scared of people anymore; some hunters are aware of changes on bears; I would like to see more IQ being used;

**Salomon** – GB is being researched, I have been to Churchill and saw somebody attacked from bear; bears come into the community, up to 200 bears \*unclear the time frame that the 200 observations came from\*,

**Natalino** – went over quota, we were not penalized, we are grateful and there are lots of bears around

**Paul I...** talked about that the MOU is replaced by new plan; quotas were increased in BB; when a female is caught the quota is decreased, now it is 1 male or 1 female for any overharvest; the federal govt is not always in agreement with increase in quota but we have the reports from the government.

**Reproduction slides – no questions**

**Survival slides – no questions**

**Growth – no slides**

**Abundance slides – no comments**

**Did not go over slides with boundary issues**

**Recommendations – slides**

**Denis** – explains the process of how it works with TAH decisions and the role of NWMB; different ways of decisions and what info is used for decision making; says the GN position is to keep TAH same; Denis also explain or asks what is the risk the GN is willing to take with a new TAH decision

**Paul I:** the last TAH was changed in 2003 – no change in TAH since then, what is it what the communities want, The GN position is only a recommendation; send a request to NWMB, no problem if you do not agree with the recommendation right now

**Natalino:** chose a little increase in TAH because we have to kill bears or family group for different reasons; or the yearling is left behind when she is having another cub

**Daniel-**the other communities have not been communicating of what they want, and we can negotiate about the 74 bears; meet with other communities to increase quota, or talk to them

**Jasmine** – we are taking notes, we send them around to the communities so you can see what was discussed among the communities

**Paul** – we visited different communities, in Naujaat they hunt in GB, but Hall Beach does not really harvest there; have not heard from other communities

**Salomon**-if we make a request about GB we need to ask QWB for support, and what government are they talking about? The Federal government, American government...?; would they say no about request immediately?

**Paul** explains process about how the RWOs need to discuss and decide how to split up the TAH and allocate among the communities. With NTI their is the NIWS that can assist; with NWMB you go take the request and then to RWO;

Film sampling

End of meeting



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# TABLE OF CONTENTS

<b>1.A) EXECUTIVE SUMMARY – ENGLISH</b>	<b>7</b>
<b>1.B) EXECUTIVE SUMMARY INUKTITUT</b>	<b>9</b>
<b>1.C) EXECUTIVE SUMMARY INNUINAQTUN</b>	<b>12</b>
<b>2. INTRODUCTION</b>	<b>15</b>
<b>3. STUDY AREA</b>	<b>18</b>
<b>4. METHODS</b>	<b>19</b>
Sampling – field collections	19
Sampling – recovering previously marked bears through harvest	22
Sampling - recovered bears from past population study	23
Sample preparations	23
Genetic analysis	23
Sea-ice metrics	24
Body Condition Score	25
Reproduction	26
Survival	28
Abundance	31
Population growth	31
<b>5. RESULTS</b>	<b>32</b>
General overview	32
Samples examined	32
Field sampling activities	33
Body condition score	34
Reproduction	34
Demographic analyses	36
Survival	36
Abundance	36
Population Growth	37
<b>6. DISCUSSION</b>	<b>37</b>
General	37
Abundance	38
Population Growth	40

Reproduction.....	41
Survival.....	42
Body condition .....	43
<b>7. MANAGEMENT IMPLICATIONS.....</b>	<b>45</b>
The need for continued monitoring.....	45
Harvest management and considerations .....	47
<b>8. ACKNOWLEDGEMENTS .....</b>	<b>49</b>
<b>9. LITERATURE CITED .....</b>	<b>50</b>

## List of Figures

Figure 1.	Basic overview and location of the Gulf of Boothia polar bear subpopulation delineated by red dashed line. ....	59
Figure 2.	Locations of observed polar bears within the Gulf of Boothia study area during the 1998 - 2000 (a) and 2015 - 2017 (b) studies. Different colored dots indicate different years. Inset shows subpopulation boundary in red. ....	60
Figure 3.	Flight tracks (green lines) of helicopter flown in search for polar bears in Gulf of Boothia, Nunavut, Canada, during April/May 2017. Inset shows subpopulation boundary in red. ...	61
Figure 4.	Sea-ice metric of ‘low-ice days’ calculated as the number of days between the sea ice retreat and sea ice advance in calendar year t using the transition dates when ice concentration dropped below, and exceeded, respectively, the midway point of sea ice concentration between the March and September mean (Environment and Climate Change Canada 2018). Shaded boxes indicate sampling periods used in this study and intervening years are shown for context. Gray dotted line indicates the linear trend of low-ice days from 1997-2016. ....	62
Figure 5.	Predicted probability based on best-fit model parameter estimates of a bear being classified as poor, average, or good body condition for each time period (Early = 1998 - 2000; Late = 2015 - 2017). ....	63
Figure 6.	Predicted probability based on best-fit model parameter estimates of a bear being classified in poor body condition for each reproductive age class across both time periods. Adult females with offspring and subadults were more likely than other reproductive age classes to be classified in poor body condition at the time of sampling (ADFI = independent adult female, ADFWO = adult female with offspring, ADM = adult male, SUB = subadults of both genders). ....	64
Figure 7.	Number of polar bear tags that were initially deployed within the Gulf of Boothia subpopulation boundary and subsequently recovered through the harvest between 1972 and 2017. Percentages indicate the proportion of total recoveries that occurred in a given subpopulation (GB=Gulf of Boothia; LS = Lancaster Sound; MC=M’Clintock Channel; FB=Foxe Basin; BB=Baffin Bay; DS=Davis Strait). ....	65

## List of Tables

Table 1.	Parameter estimates for best-fit ordinal logistic regression model (reference level = “poor”/BCS = 1) for body condition score analysis of the Gulf of Boothia subpopulation. 66
Table 2.	Parameter-specific submodels used to analyze live-recapture dead-recovery data for the Gulf of Boothia polar bear subpopulation. .... 67
Table 3.	Overview of descriptive field statistics of the Gulf of Boothia polar bear study 2015 - 2017. .... 68
Table 4.	Body condition scores (BCS) for polar bears in the Gulf of Boothia subpopulation 1998 - 2000 and 2015 - 2017. Poor BCS corresponds to a thin bear and Good BCS corresponds to a fat/obese bear. Age classes are adult ( $\geq 5$ years) and subadult (2 - 4 years). .... 69
Table 5.	Numbers and mean sizes of cub-of-the-year (C0) and yearling (C1) litters observed during capture-recapture studies on the Gulf of Boothia polar bear subpopulation..... 70
Table 6.	Model-averaged parameter estimates for a binomial logistic regression on cub-of-the-year (C0) litter size for the Gulf of Boothia polar bear subpopulation. .... 71
Table 7.	Model-averaged parameter estimates for a binomial logistic regression on yearling (C1) litter size for the Gulf of Boothia polar bear subpopulation. .... 72
Table 8.	Numbers of live-observations and dead-recoveries (in parentheses) of individually identified polar bears in the Gulf of Boothia subpopulation used in survival estimation... 73
Table 9.	Importance scores for the various factors and covariates within the parameter-specific survival submodels. Importance scores for interaction terms (e.g., year:sex) should be interpreted with caution because interactions can only appear in models with the corresponding main effects. .... 74
Table 10.	Model-averaged parameter estimates for the Burnham model for survival and abundance. .... 75

## 1.A) EXECUTIVE SUMMARY – ENGLISH -

Polar bears (*Ursus maritimus*) are managed across Nunavut, Canada, under a quota system that seeks to ensure harvest is sustainable. In recent decades, climatic changes across the Arctic have altered polar bear habitat at unprecedented rates. To retain viable polar bear subpopulations as part of the ecosystem ensure continued availability of a subsistence resource for Inuit, scientific research and monitoring studies are conducted to evaluate subpopulation status and whether management objectives are being met. Here we report the results of a population study for polar bears inhabiting the Gulf of Boothia (GB) conducted 2015 – 2017. Current samples were collected using less-invasive genetic biopsy darting without immobilizing or physically handling bears. Our analyses included 2015 – 2017 biopsy sampling data, live-capture data collected under a designed study 1998 – 2000, live-capture data collected opportunistically 1976 – 1997, and harvest recovery data over the entire period 1976 – 2017. Results of live-capture dead-recovery models fitted in Program MARK suggest that a mean abundance estimate of 1525 (standard error [SE] = 294) for the period 2015 – 2017 was similar to mean abundance in 1998 – 2000 (1610 [SE = 266] in this study; 1592 [SE = 361] in Taylor et al. [2009]). Mean cub-of-the-year and yearling litter sizes for the period 2015 – 2017 were 1.61 (95% confidence interval [CI] = 1.51 – 1.70) and 1.53 (95% CI = 1.41 – 1.64), respectively, with no apparent trend compared to 1998 – 2000. The mean number of yearlings per adult female for the period 2015 – 2017 was 0.36 (95% CI = 0.26 – 0.47) which suggests that GB is currently a productive polar bear subpopulation, despite sea ice change. This is consistent with our finding that polar bear body condition (i.e., fatness) in the spring increased between the periods 1998 – 2000 and 2015 – 2017. We detected sex- and age-specific variation in total survival rate (i.e., including harvest mortality) with higher estimates for adult females (0.95; 95% CI = 0.81 – 0.99) than adult males (0.85; 95% CI = 0.74 – 0.92) for the period 2005 – 2017. A potentially related effect was detected as an increase in the proportional abundance of females from 0.57 in 1998 – 2000 to 0.61 in 2015 – 2017. The asymptotic, intrinsic population growth rate calculated using a matrix projection model with estimates of total survival was 0.06 (95% CI = -0.06 – 0.12) for the period 2005 – 2017, suggesting strong

potential for growth. However, our results for subpopulation size and trend should be interpreted with caution because our estimate of abundance reflects the “superpopulation” (e.g., it includes all bears that use the GB management area, some of which spend time in other subpopulations as well) and our estimate of population growth rate does not account for permanent emigration from the GB management area. Overall, our findings suggest that the demographic status of the GB subpopulation is currently healthy, although we recommend that lower estimates of total and un-harvested survival for male bears warrant further investigation. We hypothesize that spatial and temporal reductions in sea ice may have provided transient benefits to the GB subpopulation due to increased biological productivity. Climate change is the primary long-term threat to polar bears and the threshold beyond which the GB subpopulation could be negatively affected by continued ice loss, like some other polar bear subpopulations, is currently unknown. This study represents the second structured population assessment in 22 years for the GB subpopulation. Based on experience garnered through this study and analysis, we submit several recommendations for consideration when planning future polar bear population studies. We suggest collecting additional data at approximately the midpoint between planned subpopulation assessments. In this case, that equals approximately 5 – 7 years from the 2017 completion of field work. Additionally, while the recommendation for movement data is not new, it continues to be highly recommended for subpopulations with known exchanges of bears between areas. In the absence of satellite telemetry data on polar bear movements, conducting a meta-analysis to investigate exchange between GB and nearby subpopulations (i.e., Lancaster Sound, GB, and M’Clintock Channel) may help alleviate some of the uncertainty around individual subpopulation estimates for these areas. Finally, when time, resources, and management objectives warrant it, we recommend conducting a quantitative harvest risk assessment to inform sustainable harvest levels.









## 1.C) EXECUTIVE SUMMARY INNUINAQTUN

### **Naunaiyaqni Amigaitpiaqni tapkuat Tariunga Boothia Nannut amigaitni ilangi Atuqtauyut Aqnallut Anguhallut Titiqni-Angutqiktauyut**

#### **Aulapkaiyini Naittuq**

Nannut (*Ursus maritimus*) aulatauyut humiliqak Nunavut, Kanata, atuqhugit haviktakhat havagutai pinahuat atuqpiaqni angutauyut ihuaqhihimanit. Taimaa 10nik ukiunik, hilaup aadlangurninnga tamainni Ukiuqtaqtumi aadlanguqtitait nanuit nayugangit aadlatqiktumik nampanik. Pitariangi naamaktumik nannut amigaitni ilangi ilaunit tapkununga uumatyutit atuqpiaqni piyaunginnalaqnit niqikhanut piqaqnit tahapkununga Inuit, naunaiyainiq naunaiyaut munarinilu naunaiyautit havariyauyut naunairiangi amigaitni ilangi qanuritni aulatauninutlu ihumagini piyakhai. Hamani tuhaqhitaivit tapkuat qanuritni amigaitni naunaiyaut tapkununga nannut nayuqpektat Tariunga Boothia (GB) havariyauyuq 2015-2017. Nutaat uuktuutingit katitiqtauyut aturhutik mikitqiamik-pittailiniq ihariagiyaikkik niqinginnik piiyaqtauniq kapuqtauyut nutqaqtihimaittumik akhuraalukluuniit pilugit nanuit. Qauyihainivut ilalik 2015-2017 uumatyutit naunaiyautit tuhagakhat, uumatitlugit-tiguyauni tuhagakhat katitiqni atuqhugit hanatyuhikhat naunaiyaqni 1998-2000, uumatitlugit-tiguyauni tuhagakhat katitauni pilalirangata 1976-1997, angutauyutlu utiqtitni tuhagakhat tamaitnut pivigiyaini 1976-2017. Qanuritni uumatitlugit-tiguyaunituqungayut-utiqtitni pityuhit ihuaqhihimayut tapkunani Havagut MARK piniraqtai anginiqhamik amigaitni mikhautni tapkuat 1525 (atuqpakni ulamniqni [SE] = 294) pivigiyanut 2015-2017 ayyikcutapyagiya anginiqpaq amigaitni talvani 1998-2000 (1610 [SE = 266] uumani naunaiyaut; 1592 [SE = 361] talvani Taylor et al. [2009]). Anginiqpaq piarait-ukiumun tapkuatlu ukiulgit piarait aktilangi pivigiyanut 2015-2017 tapkuanguyut 1.61 (95% nalungitninit akunit [CI] = 1.51-1.70) tamnalul.53 (95% CI = 1.41-1.64), tuklirinut, pitquhiqaqungitnit hutqikni tapkuat 1998-2000. Tamna anginiqpaq qaphiuni ukiulgit atuni iniqnit aqnallut pivigiyanut 2015-2017 tamnauyuq 0.36 (95% CI = 0.26-0.47) tapkuat piniraqtai tamna Tariunga

Boothia tatty piruttiaqtut nannut amigaitni ilangi, pigaluaqtitlugu tariup hikua allanguqnia. Una malikhaqmiya naunaiqtavut tapkuat nannut timingi qanuritni (naunaipkutariplugu, uqhuqaqnit) upingami ilagiaqtut akungani pivigiyai 1998-2000 tamnalu 2015-2017. Naunaiqtavut aqnallut anguhallut- ukiungilu-tainit allatqit katitlugit annaamani aktilat (naunaipkutariplugu, ilautitlugit angutat tuqutaunit) puqtutqiyautitlugit mikhautni iniqnit aqnallut (0.95; 95% CI = 0.81-0.99) tapkunangaunganit iniqnit anguhallut (0.85; 95% CI = 0.74-0.92) pivigiyanut 2005-2017. Atulaq turangayuq aktuania naunaiqtauyuuq ilagiaqni avikhimaninut amigaitni qnallut talvanga 0.57 talvani 1998-2000 tikitlugu 0.61 talvani 2015-2017. Tamna ayyikkiquqni, taittiaqni amigaitni aglivaliani aktilat kititni atuqhugit kitityutit pinahuginut uuktut mikhauttaqnit katitlugit annaktut tamnauyuq 0.06 (95% CI = -0.06-0.12) pivigiyanut 2005-2017, piniraqhugit akhut aglivalialaani. Kihimik, qanuritnivut amigaitni ilangi aktilat pitquhitlu tukiliuqtakhat munarilugit pipplugu mikhautnivut amigaitninut pihimani tapkuat “amigaitniqpanguni” (naunaipkutariplugu, ilalgit tamaita nannut atuqtat Tariunga Boothia aulatauvia inaa, ilangi nayuqtat ahii amigaitni ilangiluttauq) mikhautavutlu amigaitni aglivaliani aktilat piyaungittut ahiningartaqnit taphumanga Tariunga Boothia aulatauvia inaa. Tamaitnut, nalvaqtavut piniraiyut tapkuat amigaitni qanuritnit taphuma Tariunga Boothia amigaitni ilangi tatty nakuuyut, pinahuaquigaluaqhuta pukkitqiyat mikhautnit katitninut angutaungittutlu annaamani anguhalluit nannut naunaiyatqikhariqit. Pinahugiyavut tapkuat akuttuni mikhivallilaknilu tariup hikua piqarutaulat nuktiraqninut ikayuqtat tamna Tariunga Boothia amihuni ilangi pipplugu ilagiaqni uumatyutit piaraniktaqni. Hilap allanguqnia tamna pityutauniqhaq hivituyumun hivuranauta nannut nayuqpaknitlu avataanut Tariunga Boothia amigaitni ilangi ihuittumik aktualaqni hikuiqpalianginnaqat, taimattauq ilai nannut amigaitni ilangi, tatty naunaqmata. Una naunaiyaut kivgaqtuta aipanik hanatyuhit amigaitni naunaiyaqni tapkunani 22 ukiut tahamunga Tariunga Boothia amigaitni ilangi. Pipplugit atuqhimani piyauyut atuqhugu una naunaiyaut qauyihaqnitlu, tuniyavut qaphit aturahuaquni ihumagiyauyukhat parnaiyautitlugit hivunikhami nannut amigaitni naunaiyautit. Aturahuaqyavut katitqini ilagiarutit tuhagakhat mikhaani qitqani akungani parnakhimayat amigaitni ilangi naunaiyaqni. Uumani pipplugu, tamna piya mikhaani 5-7 ukiut talvanga 2017 iniqtauni maniqami havat. Ilagiaqhugu, pigaluaqtitlugit aturahuaquni nuktiraqnit tuhagakhat nutaungittut, huli

pinahuaquyauqpiatuq tapkununga amigaitni ilangi ilihimayqnut himmiqtautai nannut akungani inait. Piqangititlugu qangattaqhimayunik takukhautitni tuhagakhat nannut nuktiraqnit, havarinia angiyumik-qauyihaqni naunaiyautit himmiqtautai akungani Tariunga Boothia hanianilu amigaitni ilangi (naunaipkutariplugu, Lancaster Hanikgakhik, Tariunga Boothia, tamnalu M'Clintock Kangikhuakyuk) ikayulat naunairutai ilai naunaqtut piplugu ilikkut amigaitni ilangi tahapkuat inait. Kingulliqpamik, pikpat pivikhait, piqaqni, aulataunilu ihumagiyayut piyaqaliqturini, aturahuaquyavut havarini amigaitninut angutat hivuranaqni naunaiyaqni tuhaqhittangi ihuaqhihimani angutat puqtunit.

## 2. INTRODUCTION

Wildlife managers face complex decisions when seeking to balance conservation and human priorities. Decisions and outcomes must be evaluated periodically so that new information can be fed back into an adaptive management framework (Holling 1978, Lancia et al. 1996, Johnson 1999). Accurate and up-to-date estimates of population abundance are often a key component of informed management decisions (Nichols and Williams 2006). Typically, new estimates of abundance are acquired periodically according to a monitoring interval that is determined by management objectives, resource availability, and species' biology (Gibbs 2008). As climatic changes affect many areas around the globe, shortened monitoring intervals may be required to understand the concurrent effects of management interventions and environmental change. Broadly, more frequent monitoring can increase the probability of meeting management objectives and reduce the severity of potential negative outcomes resulting from mis-specified management interventions (Taylor et al. 2007, Regehr et al. 2017).

One species that has received significant monitoring attention is the polar bear (*Ursus maritimus* Phipps 1774). Polar bears are characterized by having delayed maturation, small litter sizes, and high adult survival rates (Bunnell and Tait 1981). They are apex predators and as such bioaccumulate environmental contaminants (e.g., Derocher et al. 2003, Fisk et al. 2009, McKinney et al. 2009, 2011, Letcher et al. 2010, Routti et al. 2019). As a circumpolar species that depends on the sea ice for hunting, travel, mating, and in some instances denning (Amstrup 2003), sea ice loss resulting from climate change is predicted to impact polar bear subpopulations severely (Derocher et al. 2004, Stirling and Parkinson 2006, Amstrup et al. 2008, Durner et al. 2009, Stirling and Derocher 2012, Atwood et al. 2016, Regehr et al. 2016). The global polar bear population, consisting of 19 subpopulation units, is estimated to be approximately 26,000 polar bears (Obbard et al. 2010, Wiig et al. 2015). Currently there is no empirical evidence for declines in global abundance due to sea-ice loss (Regehr et al. 2016). However, some subpopulations have exhibited negative effects resulting from

climate change (e.g., Bromaghin et al. 2015, Lunn et al. 2016) and accurate assessment of global changes is complicated by poor data for many polar bear subpopulations (Durner et al. 2018, Hamilton and Derocher 2018), spatial and temporal variation in the effects of sea-ice loss (Rode et al. 2014), and the fact that some subpopulations have likely recovered in recent decades from overexploitation prior to the 1973 Agreement on the Conservation of Polar Bears (Honderich 1991, Larsen and Stirling 2009).

Despite the on-going research and monitoring efforts, reliable and updated abundance and demographic information about all subpopulations is still lacking (Obbard et al. 2010, Vongraven et al. 2012). Polar bear research is expensive and logistically challenging, especially for management jurisdictions that oversee multiple subpopulations. Nunavut, Canada, is home to 12 subpopulations (8 shared with other jurisdictions, 4 entirely within Nunavut; Obbard et al. 2010) and as such carries the major responsibility of polar bear research in Canada. In order to maintain healthy and viable polar bear subpopulations, population studies in Nunavut are carried out on average within a 10 - 15-year rotational cycle, which can vary depending on research needs, priorities, and available resource (Hamilton and Derocher 2018). Here we present findings from a 2015 - 2017 study to estimate abundance and evaluate the demographic status of the Gulf of Boothia (GB) polar bear subpopulation.

Gulf of Boothia (GB) is a relatively small polar bear subpopulation area that is entirely managed by Nunavut (Fig. 1). An initial physical mark-recapture study was carried out from 1973 - 78 for the M'Clintock Channel (MC) and the adjacent GB subpopulations, although at the time it did not identify these as separate management units. The total abundance estimate for both areas was 1081 bears (Furnell and Schweinsburg 1984, Urquhart and Schweinsburg 1984). The estimate was known to be biased by non-representative sampling and was subsequently increased to 900 for GB and 900 for MC (Furnell and Schweinsburg 1984, Aars et al. 2006) based on the fact that the entire area was sampled, and the knowledge of Inuit local hunters about polar bear abundance in the broader study area (Derocher et al. 1998, Aars et al. 2006).

The GB and MC subpopulations were later delineated based on movements of satellite radio-collared adult female bears, recoveries of research tags in the harvest (Taylor and Lee 1995, Taylor et al. 2001), Inuit knowledge about how local conditions may influence the movements of polar bears (Keith et al. 2005), and genetic analyses (Paetkau et al. 1999, Campagna et al. 2013, Malenfant et al. 2016).

Prior to this study, the most recent population inventory work for GB was completed in 2000, where abundance (mean  $\pm$  SE) was estimated to be  $1592 \pm 361$  polar bears (Taylor et al., 2009). Based on those results, the population was considered stable or very likely increasing during the early 2000s due to a high intrinsic growth rate and relative low harvest levels (Taylor et al. 1987, 2009, Durner et al. 2018). However, harvest rates for GB increased from an average of 40 bears per year (with a Total Allowable Harvest [TAH] of 41) as reported by Taylor et al. (2009), to 62 bears per year (22 females and 40 males on average annually with a TAH of 74 starting in 2004/2005; Government of Nunavut (GN), unpublished data), between 2005 and 2017 (GN, unpublished data). How this change in harvest may have affected the GB subpopulation abundance and status is unclear.

Polar bears in Nunavut are managed through a co-management system and memoranda of understanding (MOU) between each community's Hunters and Trappers Association and the territorial government<sup>1</sup>. These MOUs lay out harvest, management and research aspects for each polar bear subpopulation. Under the existing 2005 MOU, the GN committed to begin a new population study for GB in 2015. The new study had the objective to estimate the current subpopulation size and composition, and to compare these results to the former study. In addition, we sought to obtain data that would provide estimates on survival and reproductive parameters that can be used in population viability analyses and a quantitative harvest risk assessment. Lastly, by implementing a research method that was minimally-invasive and supported by local communities and stakeholders, we sought to evaluate whether genetic mark-recapture

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<sup>1</sup> As of September 2019 the Nunavut Polar Bear Co-Management Plan is replacing the Memoranda of Understanding.

can be compared with traditional capture mark recapture studies previously done in GB in order to establish longer term trends for population monitoring (Vongraven and Peacock 2011, Vongraven et al. 2012).

### **3. STUDY AREA**

The GB polar bear subpopulation lies entirely within Nunavut and encompasses an area of approximately 67 000 km<sup>2</sup> (excluding land; Taylor et al. 2001, 2009, Barber and Iacozza 2004, Hamilton and Derocher 2018; Fig. 1). The management unit is bound by the Boothia Peninsula to the west, and Brodeur Peninsula to the east. The geography of the study area is described in Schweinsburg et al. (1981). The current management boundary is mainly based on telemetry data for adult female bears that were fitted with radio-collars, tag returns from harvested bears (Schweinsburg et al. 1982, Bethke et al. 1996, Taylor et al. 2001), and genetic analyses (Campagna et al. 2013, Malenfant et al. 2016). Validity of the current boundary has been questioned by Inuit local knowledge (Keith et al. 2005).

Sea ice generally begins to form in early October and persists until July or August in most areas of GB (Schweinsburg et al. 1981). The most southerly area of GB, namely Committee Bay, remains mostly ice-covered throughout the year (Barber and Iacozza 2004). The presence of various ice types such as mobile, multi-year rubble, and first-year ice creates diverse seal habitat across GB (Barber and Iacozza 2004). Recent sea ice and climate data analyses indicate that the Arctic sea ice quality and abundance has changed during the past 30 years and that in most polar bear subpopulations, the sea ice melts sooner and forms later than in the 1980s (Stroeve et al. 2012, Stern and Laidre 2016, Regehr et al. 2016, Environment and Climate Change Canada 2019). Currently, sea ice persists across GB to various degrees throughout the year, but it is predicted that GB may be ice-free for 5 months each year by the late 21<sup>st</sup> century (Hamilton et al. 2014).



## 4. METHODS

### *Sampling – field collections*

Our 2015 - 2017 study design was informed by the previous physical mark-recapture study conducted in GB 1998 - 2000 (Taylor et al. 2009; Fig. 2), although our study did not involve the immobilization and physical handling of bears. Inuit co-management partners in Nunavut expressed concern over wildlife capture and handling during a wildlife symposium in 2009 (Lunn et al. 2010, Department of Environment 2013). As a result, the responsible government management agency explored alternative research methods. Given the generally low densities of bears on the sea ice and the vast study area, genetic mark-recapture was selected since it is minimally invasive (Garshelis 2006) and has been successfully applied on various species, including bears (Brown et al. 1991 (right whales [*Eubalaena glacialis*]), Palsbøll et al. 1997 (humpback whales (*Megaptera novaeangliae*)), Boulanger et al. 2004, Olson 2009 (brown bear (*U. arctos*)), Pagano et al. 2014, SWG 2016 (polar bear)). From 2015 - 2017, our biopsy darting sampling sessions occurred between April to late-May each year where we searched the sea ice and near-shore areas for bears across the entire study area. We allocated approximately 100 hours of helicopter time for each field season to search for bears. We obtained genetic material for individual bears from a small sample of skin and hair collected via a remote biopsy dart (Pneudart Type C - Polar Bear) fired from a dart gun (Capchur Model 196) from inside a Bell 206 Long Ranger helicopter (Pagano et al. 2014). The extracted DNA was used to identify individual animals without the need for ear-tagging or lip-tattooing, which are typical methods for individual identification during live-capture studies (see section “Genetic analyses”). Recaptures occurred when a previously sampled bear was biopsy-darted on a later occasion or when a genetic sample was recovered through the Nunavut polar bear harvest-monitoring program. Every hunter in Nunavut is required to submit samples from each polar bear harvest so that age, gender and various other variables can be used in ecological and demographic assessments (Nunavut Wildlife Act, SNu 2003).

Search areas were initially discussed with hunters and local Hunters' and Trappers' Associations during pre-study consultations to gain insight about sea-ice conditions and bear distribution. We also took past capture locations (Taylor et al. 2009) into account when searching the sea ice, adjacent coastal areas, and small islands of our study area (Figs. 2b and 3).

Searches for bears were conducted at approximately 100 - 120 m above sea level, and at average speeds between 120 - 150 km per hour. To minimize potential sampling bias, and to allow replication of this study, we used a semi-structured sampling approach. Generally, we flew transect lines across the sea ice and small islands with search intensity proportional to apparent bear activity (or bear presence). When signs of bears (e.g., tracks, bears, seal kills) were rare or plentiful, search transect lines reflected that with further (i.e., 11 - 16 km) or nearer spacing (i.e., 7 - 10 km), respectively. In that fashion, we were able to cover large sections of the study area efficiently (Fig. 3). We decided to fly our survey transects from east to west and vice versa whenever possible, and to be perpendicular to suspected density gradients based on local knowledge, past capture and hunter-provided harvest locations.

Once we located a bear, a small sample of tissue (<5 mm diameter), mostly skin with some adipose tissue attached to it (Pagano et al. 2014), was taken using a biopsy dart. All bears except cubs-of-the-year (C0s) were darted in the rump area from an approximate distance (or altitude) of 3 - 7 m. C0s in early spring are still small and easily confused (Atkinson and Ramsay 1995, Robbins et al. 2012), and therefore were not darted to avoid possible injury and the splitting-up of family groups. Every bear that was biopsied received a unique field identification number so that the genetic results and our field data could be cross-referenced and linked.

The biopsy darts are designed to fall to the ground after impact and can be retrieved without handling a bear. The effectiveness of these darts for sampling polar bears has been previously demonstrated (Pagano et al. 2014, GN, unpublished data and reports, SWG 2016). The darts are quick and easy to use and require less pursuit

of bears than live-capture operations. On average, it took less than 4 minutes from when a bear was initially spotted to the time when the dart was picked up after darting a bear (GN, unpublished data). The design and relatively low velocity of the dart means that risk of injury to a bear is minimal. Typically, bears show no or very little response to the impact of the dart and are left with no obvious visible mark. In order to facilitate easy spotting of darts on the ice or in deeper snow, a 10 - 15 cm long and ~2 cm wide strip of brightly colored flagging tape (C.H. Hanson, Naperville, IL; or Johnson, Montreal, PQ) was tied and wrapped around the distal end of the dart.

In addition to collecting the biopsy sample, we recorded the date, time and location of each observed bear (or group of bears), body condition based on visual assessment using a standardized fat index (e.g., Stirling et al. 2008; a scale from 1 - 5 with 1 being skinny, 3 average and 5 obese), specific markings or characteristics, group size or litter size, the estimated field age class (e.g., C0, yearling (C1), 2-year old, subadult [approx. 2 - 4 years], adult [approx.  $\geq$  5 years]) and estimated gender. Both field age-class and gender estimated included a confidence qualifier (i.e., a = high confidence; b = low confidence). Field age-class and gender throughout this project were assessed remotely from the helicopter at altitudes between 3 - 7 m by four experienced observers. When we encountered mothers and their dependent young, we distinguished C0s, C1s, and 2-year old offspring based on their size relative to their mother and physical features (e.g., blood or fecal/urine stains, scars) to a) assign them to a field age class, and b) avoid sampling the same individual more than once. Additional cues such as body size of the individual bear in relation to its surrounding or group members, body shape and proportions, presence of scars, secondary sexual characteristics, observation of urination, and gait were all used to estimate gender and age-class. Genetic microsatellite analysis was used later to confirm the gender of each sampled bear (see section Genetic analysis).

When field age class and gender of a bear were initially assessed with low confidence, additional field notes were taken. For example, young subadult male bears and younger adult females are at times difficult to discern from the air when they are

solitary. If we thought that the encountered bear was a young adult female, but were uncertain (e.g., confidence classifier “b”) then we also noted what this bear could be as alternative – in this case “maybe a young subadult male”. When genetics confirmed the field estimate of sex, we assessed the identity of the bear as recorded initially. If the genetics returned a different sex, we reviewed our notes and concluded that the bear, in this example, must have been a young subadult male. Lastly, we recorded factors that may have influenced detection probability during sightings, including weather conditions (e.g., cloudy, clear, sun glare), bear activity when first observed, and sea-ice characteristics in general and within the immediate vicinity (~ 30 m) of an individual bear that may affect detection (e.g., sea ice type: flat, intermediate, rough multi-year ice).

Our work combined data collected during the genetic biopsy sampling sessions from 2015 - 2017, data from the previous capture-mark-recapture study conducted between 1998 - 2000, sporadic live-captures conducted from 1976 - 1997, and harvest recovery data for the entire period 1976 - 2017 (Peacock et al. 2012).

#### *Sampling – recovering previously marked bears through harvest*

To detect the recovery of previously individually identified bears (e.g., when bears were marked either during the initial mark-recapture study from 1998 - 2000, or from a previous biopsy-darting field season) by hunters, small muscle tissue samples were collected from all bears harvested in GB and surrounding subpopulations such as MC, Lancaster Sound (LS) and Foxe Basin (FB) throughout the duration of the current biopsy darting study (i.e., April 2015 - May 2017). Polar bear harvesting occurs throughout the year and these samples were stored in 2 ml cryovials (ThermoScientific, Nalgene long-term storage cryogenic tubes) at - 20°C after submission to our laboratory until sample preparation and analyses.

### *Sampling - recovered bears from past population study*

We examined captures and recaptures from the 1998 - 2000 population inventory, removed bears that we knew were dead (e.g., through a recovered ear tag or tattoo by harvest) and selected the remaining individuals that could be still alive (e.g.,  $\leq 34$  years of age) in 2015 for genetic analyses. Samples (e.g., ear plugs from punching a hole through the pinna so that unique identification ear tags can be applied) of captured and re-captured bears from the initial study had been stored in cryovials at  $- 20^{\circ}\text{C}$  until preparation for genetic analyses.

### *Sample preparations*

We used the same method to prepare all field and laboratory tissues or biopsy samples. Briefly, a lentil-size piece of skin ( $\sim 1 - 1.5$  mm thick) or tissue was obtained from either the biopsy sample, the ear plug, or the muscle tissue using a scalpel blade (# 20) then transferred onto a shipping card (Avery, 70 x 35 mm) and attached with scotch tape. Each sample card was labelled with the unique bear identification number, placed into a coin envelope (57 x 89 mm), and left to dry at room temperature for up to 3 days. The dried specimens were then sent to Wildlife Genetics International Inc. (Nelson, British Columbia) for individual genotyping and sex determination.

### *Genetic analysis*

DNA was extracted from tissue with QIAGEN DNeasy Blood and Tissue Kits (Qiagen, Inc.). The tissue samples were genotyped at eight previously published dinucleotide microsatellite loci (REN145P07, CXX20, MU50, G10B, G10P, G10X, MU59, G10H; Paetkau and Strobeck 1994, Paetkau et al. 1995, 1998, Taberlet et al. 1997, Breen et al. 2001, Ostrander et al. 1993). Analysis of individual identity followed a 3-phase protocol previously validated for bears and described elsewhere (Paetkau 2003, Kendall et al. 2009).

To select markers for the analysis of individual identity, we used allele frequency data from approximately 1700 polar bears for which complete 20-locus genotypes existed before the genetic mark-recapture study began (GN, unpublished data). We ranked the 20 microsatellite markers in the dataset by expected heterozygosity. The eight most variable markers that could be analyzed together in a single sequencer lane were selected for use. These surpassed the required standard for marker variability (Paetkau 2003). In addition to the eight microsatellite markers, we analyzed sex, using a *ZFX/ZFY* marker. We searched the dataset for genotype matches that seemed unlikely based on our field data. In each case, three extra markers were added to the genotypes to lower the probability of chance matches between individuals. The extra loci confirmed these matches. Once the genotyping and error-checking was complete, we defined an individual for each unique eight locus genotype.

### *Sea-ice metrics*

Other population studies have identified relationships between the spatial and temporal availability of sea ice and demographic parameters for polar bears (Regehr et al. 2007, Rode et al. 2012, Laidre et al. 2020). March and September mean ice concentrations were calculated for the entire GB area for each day sea-ice data were available and then averaged across 1979 - 2016 (Environment and Climate Change Canada 2018). We calculated the number of days between the sea ice retreat and sea ice advance in calendar year  $t$  using the transition dates when ice concentration dropped below, and exceeded, respectively, the midway point of sea ice concentration between the March and September mean (Environment and Climate Change Canada 2018). For the GB area, this transition sea-ice concentration was 63% (Environment and Climate Change Canada 2018). We describe the annual interval that sea-ice concentration was below the transition threshold as the “low-ice days” (Fig. 4). To evaluate the potential relationships between sea ice and the status of GB polar bears, we analyzed several metrics (e.g., body condition, recruitment, and survival) of bears in year  $t$  as a function of the duration of low-ice days in year  $t-1$ .

## *Body Condition Score*

We compiled body condition score (BCS) data from two distinct time periods of mark-recapture population sampling in GB. Bears were assigned a BCS on a scale of 1 - 5 with 1 being skinny and 5 being obese (Stirling et al. 2008) through physical handling and capture (1998 - 2000) or aerial observation during biopsy sampling (2015 - 2017). All BCS observations occurred in April and May. Sex, age, and reproductive classes were assigned during physical handling during 1998 - 2000 and ages were determined based on previous capture history, known birth year, or from tooth analysis (Calvert and Ramsay 1998). During the biopsy sampling period, classification was done at approximately 3 - 7 m above the ground with sex verified by subsequent genetic analysis (SWG 2016). Observers who participated in classifying age class and sex during biopsy sampling had either participated in both sampling periods or were experienced in physical capture-mark-recapture studies.

The BCS raw scores were binned into 3 classes: 'poor' (1 - 2), 'average' (3), and 'good' (4 - 5) to follow recommended monitoring schemes (Stirling et al. 2008, Vongraven et al. 2012) and facilitate comparison with other studies (SWG 2016, Laidre et al. 2020). Like previous studies, we did not include dependent offspring in the BCS analyses because their body condition is dependent on maternal condition (SWG 2016). We excluded within-year observations of the same individual but retained observations of the same individual in different years.

We modeled BCS using ordinal logistic regression (Venables and Ripley 2002) and included *period* as an indicator of sampling period (early = 1998 - 2000 or late = 2015 - 2017). Reproductive status, age, and sex were combined into the four-level categorical variable *reproclass* (ADM = adult male, ADFI = independent adult female, ADFWO = adult female with offspring, and SUB = subadults of both sexes), and sampling day of year (*jul\_cap\_day*) were included as a continuous covariate to reflect the amount of time bears had on their preferred sea ice hunting platform before being sampled in year *t*. The sampling periods in this study also coincided with the annual

seal pupping period, which is known to be prime feeding period for bears (Pilfold et al. 2012, Reimer et al. 2019). Thus, we predicted that increased time on the ice prior to sampling would be associated with higher BCS. The number of low-ice days ( $icetm1_{t-1}$ ) was included to evaluate the hypothesis that interannual variation in BCS was related to sea-ice availability in the previous year. We selected a global model that reflected biological and environmental variables we hypothesized, or that have been shown in other studies, to be related to BCS (Rode et al. 2012, SWG 2016, Laidre et al. 2020). Finally, given our interest in evaluating whether different reproductive classes and genders had varying BCS based on the amount of time they spent on the sea-ice during the months immediately prior to observation ( $jul\_cap\_day$ ), and whether this relationship was different between our two sampling periods ( $period$ ), we included a three-way interaction between  $reproclass$ ,  $jul\_cap\_day$ , and  $period$ . Once the global model was selected, we performed a backwards and forwards model comparison (stepAIC; Package MASS in the R programming language [R Core Team 2019]) to obtain the best-supported final model ( $\Delta AIC < 2$ ) (Table 1). We performed Lipsitz and Hosmer-Lemeshow tests to evaluate fit of the global ordinal regression model ( $p > 0.1$ ; Fagerland and Hosmer 2017). Best-supported model covariates were considered significant at  $p < 0.05$  (Wald  $X^2$  tests) and predicted probabilities for each BCS class were calculated based on the suite of final-model covariates.

### *Reproduction*

We evaluated reproductive indices for polar bears in GB using data from physical captures 1998 - 2000 and biopsy sampling 2015 - 2017. We used reproductive metrics that have been identified as important for monitoring polar bears (Vongraven et al. 2012). First, we C0 and C1 litter size as a function of biological, environmental, and temporal factors using logistic regression. We considered litter size ( $ls$ ) for adult female  $i$  in year  $t$  to be a binary response variable (i.e.,  $ls_{it} = 1$  or  $2$ ). Analyses for C0 and C1 litters were performed separately using a three-step modeling approach, although we note that the C0 and C1 litter size data were not independent due to potential repeated measures and correlations (i.e., C1 litter size in year  $t$  is likely a function of C0 litter size



in year  $t-1$ ). We created a general model that included the main hypothesized sources of variation in the data. General models were simple due to small sample size. To ensure the general model was a suitable starting point for model selection, we evaluated goodness-of-fit (GOF) using Hosmer and Lemeshow tests (Hosmer et al. 2013). Second, we developed a candidate model set representing all combinations of main effects and interaction terms in the general model, with a marginality constraint to ensure that interactions were only included if the corresponding main effects were included. Third, we performed model selection using Akaike's Information Criterion adjusted for small sample size ( $AIC_c$ ) and then estimated model-averaged parameters for all models with  $\Delta AIC_c < 4$  (Burnham and Anderson 2002). Modeling was performed in the R programming language version 3.5.2 (R Development Core Team 2016) using package *MuMIn* (Bartón 2018) for multi-model inference.

The general model for C0 litter size was  $ls_{it} = \beta_0 + \beta_1 period_{it} + \beta_2 icetm1_{it} + \beta_3 BCS_{it} + \beta_4 month_{it} + \beta_5 period_{it} \times month_{it}$ , where  $period_{it}$  is a two-level factor indicating whether the observation of adult female  $i$  in year  $t$  was in the early or late period (1998 - 2000 and 2015 - 2017, respectively);  $icetm1_{it}$  is the duration of the low-ice days in calendar year  $t-1$  (see section Sea-ice Metric) for a polar bear observed in calendar year  $t$ ;  $BCS_{it}$  is a three-level factor representing the body condition score of the adult female at the time of observation (see section Body Condition Score);  $month_{it}$  is a two-level factor indicating whether a bear was observed in April or May; and  $period_{it} \times month_{it}$  is an interaction term allowing the month effect to potentially differ between the early and late periods (e.g., because within-year temporal variation in litter size could change due to changes in sea-ice conditions, den emergence date, etc.). We hypothesized that litter size would be negatively correlated with  $icetm1$  (Laidre et al. 2020), positively correlated with  $BCS$  (Derocher and Stirling 1998), and negatively correlated with  $month$  because observations later in the spring reflected additional time in which cubs could die.

The general model for C1 litter size was  $ls_{it} = \beta_0 + \beta_1 period_{it} + \beta_2 icetm1_{it} + \beta_3 BCS_{it}$ , where definitions of the predictor variables are the same as in the model for C0s.

We did not include the predictor  $month_{it}$  because individual C1 survival is generally high (e.g., Regehr et al. 2017) and we did not expect litter size to change between April and May.

After evaluating patterns in litter size, we calculated the mean number of dependent young (C0 or C1) per adult female and evaluated differences between time periods. We also evaluated litter production rate, defined as the proportion of adult females that are available to breed in year  $t$  that produce a litter of C0 in year  $t+1$  (Taylor et al. 1987). These metrics have been used as indices of productivity for other polar bear subpopulations (e.g., Peacock et al. 2013, Regehr et al. 2015). We quantified uncertainty using a nonparametric bootstrap procedure with 1,000 iterations during which observations of individual polar bears were resampled with replacement and the three reproductive metrics were calculated from the resampled data.

### *Survival*

We used the Burnham capture-recapture model (Burnham 1993) in Program MARK (Cooch and White 2019) to analyze live-observation and dead-recovery data for the GB subpopulation. Live observations consisted of physical captures during which bears were assigned an individual identification number, or the identity of a previously captured bear was recorded; and biopsy sampling during which individual identification was determined from genetic analysis of a tissue sample (see sections above about recovering samples of bears through harvest and from the previous study). Live observations were conducted under random sampling protocols that attempted to search the entire area within the GB subpopulation boundary in 1998 - 2000 (physical captures) and 2015 - 2017 (biopsy sampling). Additionally, bears were physically captured and released each year 1976 - 1978, and sporadically during the period 1979 - 1997. Because research conducted from 1976 - 1997 did not follow a sampling protocol designed to evaluate demography, we included initial captures from this period but did not include recaptures of previously marked bears. This approach has been used in other analyses (e.g., Taylor et al. 2009) to increase the number of marked bears without

introducing heterogeneity into recapture probabilities, which can result in biased parameter estimates (Peñaloza et al. 2014). Because recaptures were excluded or did not occur in some years, within the Burnham model we fixed recapture probability to 0 in 1976 - 1997 and 2001 - 2014. Throughout the entire study period 1976 - 2017, dead-recovery data were obtained from hunter reports of research-marked bears and genetic analysis of tissue samples from bears that were harvested.

The Burnham model is a common choice for estimating survival and abundance of polar bears (SWG 2016). Parameters in the model are survival ( $S$ ; the probability of surviving interval  $t$  to  $t+1$ ), recapture probability ( $p$ ; the probability of re-observing a live marked animal), dead reporting probability ( $r$ ; the probability that an animal which dies is killed by humans and reported to authorities), and fidelity ( $F$ ; the probability that an animal does not permanently emigrate from the sampling area and remains available for live observation in future years). We limited our analyses to bears age  $\geq 1$  year (i.e., C1s and older) because in the 2010s most C0s were not biopsy darted or individually identified.

We developed a candidate model set based on combinations of parameter-specific submodels, with the structure of each submodel informed by hypotheses about polar bear biology and study design. We considered 16 submodels for  $S$  (Table 2). The temporal factor *year* allowed survival to differ between 1976 - 2004 and 2005 - 2017. We chose these year blocks to evaluate the potential influence of habitat changes in the past decade (Environment and Climate Change Canada 2018) and because total allowable harvest (TAH) for the GB subpopulation was increased in 2004 (see section Introduction). The two-level factors *sex* (female vs. male) and *sub* (C1s and subadults [2 - 4 year] vs. adults [age  $\geq 5$  year]) were included to allow sex- and age-specific variation in survival (e.g., Regehr et al. 2007). The covariate *icetm1*, calculated the same as for reproductive analyses, was included to evaluate the hypothesis that interannual variation in survival was related to sea-ice availability in the previous year. We considered five submodels for  $r$  that included *sex* and *year* to reflect sex-specific harvest and potential changes in harvest mortality associated with changes in harvest

level. The four submodels for  $p$  included *sex* to allow potential variation in recapture probability resulting from sex-specific habitat selection or movement patterns (Laidre et al. 2013), and *year* to accommodate different levels of sampling effort in the 1990s and 2010s. We did not include a submodel with annual variation in  $p$  because sample sizes were similar within each three-year block of intensive capture-recapture research. The four submodels for  $F$  included *sex* and *year*. Unlike Taylor et al. (2009), we estimated  $F$  rather than fixing it to 1 because bears captured in the GB management unit have been harvested in adjacent subpopulations, suggesting some degree of permanent emigration (see section Discussion - Abundance). Each submodel was constructed as a linear function, on the logit scale, of the various factors, covariates, and interaction terms discussed above. We fitted all possible combinations of the parameter-specific submodels in Program MARK (Cooch and White 2019) accessed through the R programming environment (R Core Team 2019) using the package RMark (Laake 2013).

We performed model selection and multimodel inference using QAIC<sub>c</sub> (Burnham and Anderson 2002). We used the overdispersion factor  $\hat{c} = 1.2$ , calculated as the ratio of live observations of dependent cubs (i.e., C1s and two-year-old cubs still accompanying their mothers) to total live observations (Taylor et al. 2009). For validation, we derived a separate estimate of  $\hat{c}$  using the parametric bootstrap procedure in Program MARK (Cooch and White 2019) with the general model  $S(\text{year}+\text{sex}+\text{year}:\text{sex})r(\text{year}+\text{sex}+\text{year}:\text{sex})p(\text{year}+\text{sex})F(\text{sex})$ , where “+” represents an additive effect and “:” represents an interaction. The bootstrap estimate of  $\hat{c}$  was 1.2, suggesting that our empirical estimate adequately reflected extrabinomial variation in the data. Model-averaged parameter estimates were derived from all candidate models with  $\Delta\text{QAIC}_c < 4$ . Our estimates of  $S$  reflected harvest mortality, so we derived estimates of un-harvested survival as  $S^* = S + r \times (1 - S)$  (Peacock et al. 2013) and estimated variance via the delta method (Taylor et al. 2008). This equation assumes that harvest of all marked bears is reported, and that harvest mortality is additive (i.e., that no harvested bears would otherwise have died during a given interval).

## *Abundance*

We used Horvitz-Thompson type estimators (McDonald and Amstrup 2001) to derive abundances in year  $t$  as  $\hat{N}_t = n_t / \hat{p}_t$ , where  $n_t$  is the number of individually identified animals observed alive in year  $t$ , and  $\hat{p}_t$  is a model-averaged estimate of recapture probability in year  $t$ . To estimate abundance of bears age  $\geq 1$  year we stratified the subpopulation by sex and summed the female and male estimates, which was necessary to accommodate sex effects in recapture probability. Finally, we adjusted annual abundances to include approximate numbers of C0s by adding the product  $(\hat{N}_t^{AFCO} \times \bar{l}_S^{C0})$ , where  $\hat{N}_t^{AFCO}$  is the estimated number of adult females with C0 litters in year  $t$ , and  $\bar{l}_S^{C0}$  is overall mean C0 litter size. We used the delta method to construct variance estimates for annual estimates of total  $N$  and for average estimates of total  $N$  over several years. In doing so, we assumed that estimates of recapture probability and C0 litter size were independent. Note that abundance estimates from a capture-recapture framework that allows permanent emigration, but not temporary emigration, may not represent the number of animals within the sampling area at a given point in time. Specifically, abundance estimates from the current study represent the “superpopulation”, defined as the group of animals that are alive and have a non-negligible probability of occurring within the sampling area, regardless of their actual location at a particular time. In other words, the superpopulation estimate in year  $t$  reflects temporary emigrants (i.e., animals that are outside of the GB management unit in year  $t$  but may return in future years).

## *Population growth*

We used estimates of  $S$  and  $S^*$  from live-recapture dead-recovery modeling, together with estimates of litter production rate and C0 litter size, to estimate intrinsic population growth rate ( $gr$ ) using a 10-stage matrix-projection model based on the life history of polar bears (Regehr et al. 2017). Because we did not estimate C0 survival in the current study, we used the mean estimate of 0.889 (SE = 0.179) for the period 1976 - 2000 from Taylor et al. (2009) for all matrix calculations. We estimated  $var(gr)$  by generating

10,000 correlated samples of the input vital rates using the model-averaged variance-covariance matrix for sex- and age-specific estimates of survival. We assumed that the correlation structure for C0 survival was the same as for subadults, that litter production rate and C0 litter size had a correlation coefficient of 1, and that there was no correlation between survival and reproductive parameters. Estimates of *gr* represent asymptotic intrinsic growth rate at a stable stage distribution.

## 5. RESULTS

### *General overview*

During research operations in 2015 - 2017, we spent an average of 103 hours of flying in April and May each year in search of polar bears across the sea ice, with an average distance flown per year of about 12,200 km (Table 3, Figs. 2 and 3). The number of bears encountered during each survey season was similar, with a mean of 170 observed bears per field season.

The GB study area is vast and consists of differing ice types (Barber and Iacozza 2004). The distribution of bears during the 2015 - 2017 study appeared to be more uniform across the study area as compared to 1998 - 2000 when bears were encountered in higher concentrations east of the Boothia Peninsula and near the west shore of Melville Peninsula (Figs. 1 - 3). Moreover, there appeared to be no bear encounters directly north of Committee Bay during the 1998 - 2000 study, in contrast to our recent observations. During both studies no bears were encountered in the lower section of Committee Bay (Fig. 2).

### *Samples examined*

We collected a total of 406 biopsy samples during research operations in 2015 - 2017. Of these, 397 (97.8%) contained sufficient material for genetic analysis. We

identified 10 GB bears that were previously captured during the 1998 - 2000 study (Taylor et al. 2009), and 1 LS bear that was 22 years old in 2017 when it was sampled. We also identified 7 individuals that were previously sampled during the MC study between 2014 - 2016. Overall, 324 individual bears were identified from these field samples. Some bears were resampled within the same season: 18 bears were sampled twice, 2 bears were sampled three times, and 1 bear was sampled four times (representing 5% of all successful samples). Re-sampling of the same individual within the same field season was low and likely occurred because weather prevented coverage of a large area within a short time frame, allowing bears to move over longer distances. Biopsy sampling leaves no visible marks on the individual animal as is the case with traditional mark-recapture studies (e.g., Peacock et al. 2013) thus it is impossible to avoid some re-sampling.

Through the harvest sampling program, we submitted 1704 samples between 2005 - 2017 from GB and neighboring subpopulations (338 GB, 701 FB, 402 LS, 47 MC, and 216 with unknown subpopulation) for genetic analyses. Twenty-five bears from the biopsy sampling sessions were harvested and recovered, as well as 8 previously marked bears from the 1998 - 2000 study. Those 8 bears were recovered in GB (6), MC (1) and LS (1). The 6 recovered bears in GB were identified through genetic testing because no ear tags and tattoos were reported.

### *Field sampling activities*

Biopsy sampling activities on the sea ice went very well. The darts do not leave a mark when bears are darted in the rump, and most bears do not react to the impact of the dart. Many of the adult males move very slowly away once darted, if at all. The colored flagging tape attached to the end of the dart makes dart retrieval easy and quick.

During our survey flights, additional observers besides the pilot and biologist were on board the helicopter. In order to safely maneuver during darting, some observers had to be safely dropped off once a bear was seen to reduce weight, but

before the darting activities began. It took the crew, on average, 4.3 min ( $\pm$  SE; 0.19; range: 2 - 8 min; n = 62) from the time a bear was observed for the first time (e.g., at times > 1 km from the helicopter) and when the additional observer was picked up again. The direct darting activities involving the safe approach of the bear, darting the bear, and dart retrieval took an average of 2.0 min ( $\pm$  SE; 0.11; range: 1 - 5 min; n = 62; GN, unpublished data).

### *Body condition score*

Body condition scores were higher between 2015 - 2017 compared to 1998 - 2000 (n = 626;  $\chi^2 = 5.5$ ,  $p = 0.02$ ; Fig. 5, Table 4). This was reflected in a decrease in the proportion of bears in poor condition ( $P_{poor}$ ) and an increase in the proportions of bears in average and good condition (i.e.,  $P_{poor} = 0.31$  for early period vs  $P_{poor} = 0.07$  for the late period; Fig. 5; Table 4). Adult females with offspring ( $P_{poor} = 0.28$ ) and subadults ( $P_{poor} = 0.26$ ) were more likely to be in poor body condition compared to other age and reproductive classes (mean  $P_{poor}$  for ADFI and ADM = 0.11;  $\chi^2 = 11.4$ ,  $p < 0.01$ , Fig. 6). For females with dependent offspring, increasing amounts of time on the ice before being sampled (*jul\_cap\_day*) was associated with higher BCS ( $\chi^2 = 9.0$ ,  $p < 0.05$ ).

In the early period, bears were more likely to be in poor condition as *icetm*<sub>*t-1*</sub> increased (*icetm* = 70 d:  $P_{poor\ early\ period} = 0.24$  and *icetm* = 104 d:  $P_{poor\ early\ period} = 0.39$ ;  $\chi^2 = 13.5$ ,  $P < 0.001$ ). The opposite was true in the late period; the probability of being in poor condition decreased as *icetm*<sub>*t-1*</sub> increased (*icetm* = 70 d:  $P_{poor\ late\ period} = 0.12$  and *icetm* = 104 d:  $P_{poor\ late\ period} = 0.03$ ).

### *Reproduction*

We observed 99 adult females with C0 litters during intensive capture-recapture studies conducted in 1998 - 2000 and 2015 - 2017 (Table 5). The general model for C0 litter size provided an adequate fit to the data (Hosmer and Lemeshow test:  $\chi^2 = 6.91$ ,  $df = 8$ ,  $P = 0.55$ ). The candidate model set included eight models with  $\Delta AIC_c < 4$ , from which



model-averaged parameter estimates were derived (Table 6). Low importance scores (i.e., sums of normalized  $AIC_c$  weights for models that included a variable) indicated a lack of support for variation in C0 litter size as a function of our proposed predictor variables (Table 6). The low- $AIC_c$  model included one parameter (i.e., intercept only;  $\beta = 0.43$ ,  $SE = 0.21$ ,  $P = 0.04$ ). Overall mean C0 litter size was 1.61 (95% CI = 1.51 - 1.70).

We observed 80 adult females with C1 litters during intensive capture-recapture studies conducted 1998 - 2000 and 2015 - 2017 (Table 5). The general model for C1 litter size provided an adequate fit to the data (Hosmer and Lemeshow test:  $\chi^2 = 5.96$ ,  $df = 7$ ,  $P = 0.54$ ). The candidate model set included five models with  $\Delta AIC_c < 4$ , from which model-averaged parameter estimates were derived (Table 7). Low importance scores indicated a lack of support for variation in C1 litter size as a function of our proposed predictor variables (Table 7). The low- $AIC_c$  model included one parameter (i.e., intercept only;  $\beta = 0.10$ ,  $SE = 0.23$ ,  $P = 0.65$ ). Overall mean C1 litter size was 1.53 (95% CI = 1.41 - 1.64).

The other reproductive metrics for GB polar bears were similar, or slightly lower, in 2015 - 2017 compared to 1998 - 2000. Mean number of C0s per adult female was 0.51 (95% CI = 0.39 - 0.64) for the 1990s and 0.43 (95% CI = 0.32 - 0.44) for the 2010s, which corresponds to a probability of 0.85 that values were smaller in the 2010s. Mean number of C1s per adult female was 0.37 (95% CI = 0.27 - 0.48) for the 1990s and 0.36 (95% CI = 0.26 - 0.47) for the 2010s, which corresponds to a probability of 0.54 that values were smaller in the 2010s. Mean litter production rate was 0.76 (95% CI = 0.48 - 1.0) for the 1990s and 0.64 (95% CI = 0.41 - 0.98) for the 2010s, which corresponds to a probability of 0.71 that values were smaller in the 2010s. Note that the ratio estimator we used to calculate litter production rate was different from the estimator used by Taylor et al. (2009), which required assumptions about litter loss and population growth rate.

## *Demographic analyses*

Survival - The capture-recapture data contained 987 live observations of individually identified polar bears and 139 dead recoveries of research-marked bears during the period 1976 - 2017 (Table 8). The candidate model set included 1280 live-recapture and dead-recovery models representing combinations of the parameter-specific submodels. Of these, 104 models had  $\Delta\text{QAIC}_c < 4$ , indicating relatively high model-selection uncertainty. To evaluate the explanatory power of the various factors, covariates, and interaction terms in each parameter-specific submodel, we calculated importance scores defined as the sum of  $\text{QAIC}_c$  weights for all submodels containing a given term (Table 9). Importance scores for survival ( $S$ ) suggested strong support for a sex effect and for a step change between the year blocks 1976 - 2004 and 2005 - 2017, relatively weak support for an age effect, and little or no support for interannual variation in survival in relation to our sea-ice metric. Importance scores for recovery probability ( $r$ ) provided weak to moderate support for a sex effect and a step change between year blocks. Finally, importance scores for recapture probability ( $p$ ) and site fidelity ( $F$ ) provided little or no support for sex or temporal effects.

Our model-averaged parameter estimates were consistent with patterns that would be expected based on the importance scores for the various terms (Table 10). Point estimates of un-harvested survival ( $S^*$ ) increased for females, and decreased for males, between the year blocks 1976 - 2004 and 2005 - 2017. Point estimates for  $r$  decreased slightly for females and increased slightly for males. Point estimates of  $F$  ranged between 0.93 - 0.99, suggesting relatively high fidelity to the GB management unit. Due to sampling uncertainty and potential process variation, no temporal changes in parameter estimates were statistically significant at an alpha level of 0.05.

Abundance - Mean model-averaged estimates of total subpopulation abundance, including numbers of C0s, were 1610 (SE = 266) for 1998 - 2000 and 1525 (SE = 294, 95% CI = 949 - 2101) for 2015 - 2017. Based on a randomization procedure, this corresponds to a probability of 0.57 that abundance of the GB subpopulation was

approximately stable or increasing (subjectively defined as  $N_{2015-2017} \geq 0.9 \times N_{1998-2000}$ ), and a probability of 0.43 that abundance was declining (defined as  $N_{2015-2017} < 0.9 \times N_{1998-2000}$ ). Our estimate of mean abundance for 1998 - 2000 was very close to the estimate of 1592 (SE = 361) for the same period from Taylor et al. (2009).

Population Growth – The time-constant estimate of asymptotic intrinsic population growth rate ( $gr$ ) for the period 2005 - 2017, calculated using estimates of total survival ( $S$ ), was 0.06 (95% CI = -0.06 - 0.12). The estimate of un-harvested growth rate for the period 2005 - 2017 was  $gr = 0.07$  (95% CI = -0.05 - 0.13). This suggests a strong potential for growth in the absence of harvest, although precision was low. For the period 1976 - 2004, estimates of harvested and un-harvested  $gr$  were 0.03 (95% CI = -0.07 - 0.09) and 0.05 (95% CI = -0.04 - 0.10), respectively. Although comparison is complicated by different model structures and datasets, these values are similar to the corresponding point estimates of  $gr = 0.02$  and 0.06 for the period 1976 - 2000 reported in Taylor et al. (2009).

## 6. DISCUSSION

### *General*

The GB study area experienced drastic sea ice changes over the past decades (Barber and Iacozza 2004, Stern and Laidre 2016, Environment and Climate Change Canada 2018). The quantity of multi-year sea ice has declined across the Canadian Archipelago (Mudryk et al. 2018, Perovich et al. 2018, Richter-Menge et al. 2018) and the fall freeze and spring thaw cycles in GB changed significantly, extending the period between sea-ice retreat and sea-ice advance by 16 days per decade (Stern and Laidre 2016). Moreover, the mean summer sea-ice concentration (June to October) has been decreasing by 9% per decade (Stern and Laidre 2016). As recently as the 1980's, the GB region was characterized by 40 - 50% multi-year ice during the summer, but this amount has declined to less than 10% between 2011 and now (Environment and

Climate Change Canada 2018) and the shift is predicted to continue (Sou and Flato 2009, Hamilton et al. 2014). The observed changes from multi-year to annual sea ice result in declining sea ice thickness. Younger and thinner sea ice is more mobile and susceptible to mechanical wind forcing. Annual sea ice is also more vulnerable to complete melting in the summer which contributes to the observed decrease in summer sea ice extent. (Richter-Menge 2018, Perovich et al. 2018). This reduction in sea ice results in the absorption of more heat by the upper ocean (Richter-Menge 2018). While sea ice loss overall is considered detrimental to the persistence of polar bears, in the short term, it may have beneficial effects in some parts of the high Arctic since many of the observed sea ice changes have been associated with greater marine productivity (Derocher et al. 2004, Häder et al. 2014, Frey et al. 2018).

### *Abundance*

Our estimate of mean abundance for the period 1998 - 2000 was 1610 (SE = 266), which is very similar to the estimate of 1592 (SE = 361) for the same period from Taylor et al. (2009). The new mean abundance estimate of 1525 (SE = 294) for the period 2015 - 2017 corresponds to a probability of approximately 0.57 that the GB subpopulation has remained approximately stable or increased despite observed sea-ice changes. We suggest that abundance estimates from 1998 - 2000 and 2015 - 2017 are likely an accurate portrayal of trends in abundance given the consistent methodology between the intensive capture-recapture efforts. Taylor et al. (2009) suggested that the subpopulation could sustain a quota increase from 40 to 74 bears per year which was instituted in 2004/2005. The 74-bear quota was rarely filled over the past 14 years with an average of 62 bears per year (22 females and 40 males) removed from the subpopulation. The sex ratio of removed bears was 64.3% male in keeping with the 2:1 sex selective harvest management system in place in Nunavut during that time (range: 56.7 - 72.1% male for the 2004/2005 – 2016/2017 harvest seasons; GN, unpublished data).

The mean point estimate of the proportion of females among independent polar bears (i.e., age  $\geq 2$  years) increased from 0.57 for the period 1998 - 2000 to 0.61 for the period 2015 - 2017. This appears consistent with the estimates of harvest recovery probability and the estimated differences in total, and un-harvested, survival between females and males. This finding may suggest that the selective harvest of polar bears at a 2:1 male-to-female ratio has resulted in a gradual depletion of adult males in the subpopulation, which is consistent with model-based predictions of declining male numbers under a sex-selective harvest (McLoughlin et al. 2005, Taylor et al. 2008, Regehr et al. 2015). We suggest that this effect could be mitigated by lowering the TAH while maintaining a sex-selective harvest. Alternatively, maintaining the current TAH, but switching to a 1:1 sex ratio for several years could also mitigate the gradual depletion of males but would increase the risks of overharvest given that adult female bears are the most important contributors to population growth (Eberhardt 2002, Hunter et al. 2010). We recommend that a more thorough harvest risk assessment be conducted to further investigate this and other issues related to the sustainability of current removal levels from the GB subpopulation (e.g., change in carrying capacity and environment over time; Regehr et al. 2017).

The GB study area has an estimated density of 8.9 bears per 1000 km<sup>2</sup> based on the current abundance estimate, which is the highest, currently known, density of polar bears within the subpopulation boundaries recognized by the IUCN Polar Bear Specialist Group (Durner et al. 2018). It is more than 5 times the median density of 14 subpopulations for which abundance estimates exist (Hamilton and Derocher 2018). It is also important to note that our estimates of abundance from the current study, as well as from the past study (Taylor et al. 2009), represent the “superpopulation”. A superpopulation is defined as all the animals with a chance (non-negligible probability) of occurring within the GB management boundary, regardless of where the animals were located at any given sampling occasion (e.g., Schwarz and Anarson 1996). Thus, estimates of superpopulation size in year  $t$  likely reflect some animals that were temporary emigrants in year  $t$ . We were not able to directly estimate temporary emigration from the sampling area (Cooch and White 2019) because our sample sizes

were not sufficiently large to do so, and there are no recent radio-telemetry data to provide location and movement data. However, recoveries of previously marked bears in other subpopulations through the harvest sampling program indicate that movement into and out of GB is likely occurring (Fig. 7). Therefore, our estimates of abundance are likely larger than the actual number of animals within the GB subpopulation boundary at any given time. This should be taken into consideration when using these findings to inform management decisions. For example, if capture-recapture analyses are performed independently for multiple adjacent subpopulations that experience exchange of animals, the sum of the estimates of superpopulation size will be larger than the actual total number of bears in the subpopulations (i.e., there will be “double counting” of some bears). This could lead to cumulative TAH levels that result in removal of a larger proportion of polar bears each year than was intended based on the TAH levels for the individual subpopulations.

### *Population Growth*

Our estimates of the population growth rate ( $gr$ ) for the period 2005 - 2017 based on total survival ( $gr = 0.06$ ) and un-harvested survival ( $gr = 0.07$ ) for the 2010s are high for polar bears, suggesting strong capacity for growth. Our estimates of  $gr$  for the 1990s were similar to estimates from Taylor et al. (2009), although a direct comparison is complicated by statistical uncertainty and different modeling structures and datasets. Note that our estimates of  $gr$  for the 1990s had more statistical uncertainty than that of Taylor et al. (2009) because we accounted for covariance among demographic parameters, whereas it appears that Taylor et al. (2009) considered variation in the different demographic parameters to be independent.

The high estimates of  $gr$  from this study should be interpreted with caution because they are based on estimates of total survival. Therefore, they reflect the potential for biological population growth but not necessarily the trend in the numbers of polar bears that remain within the GB subpopulation boundary. Indeed, when the harvested population growth rate for the period 2005 - 2017 is recalculated using

estimates of apparent survival (i.e., the probability of remaining alive and not permanently emigrating from the GB management unit) the point estimate is negative ( $gr = -0.024$ ; i.e., suggesting that the number of bears within the GB subpopulation boundary may be decreasing). Direct interpretation is complicated by statistical uncertainty (e.g., the coefficient of variation for the estimate of  $gr$  based on total survival was 0.79). However, this may suggest that emigration from the GB region is one explanation for the apparently contradictory findings of (1) a lower point estimate of abundance for 2015 - 2017 compared to 1998 - 2000 and (2) high point estimates of  $gr$  for 2005 - 2017 that suggest the GB subpopulation was growing during this period. In other words, it is possible that high estimates of  $gr$  based on total survival do indeed reflect increasing numbers of bears (i.e., there are more births than deaths), but that a substantial proportion of these bears are permanently emigrating from the GB management area. As the ice becomes more dynamic in GB and the surrounding areas, bears may be more dynamic in their movements. Potentially high and variable levels of immigration and emigration across subpopulation boundaries can directly affect estimation and interpretation of population growth rate (Peñaloza et al. 2014). In some other subpopulation studies, radio-telemetry data have been critical to resolving these issues (e.g., Regehr et al. 2018). For regions where radio-telemetry is not available, we recommend that the best way to reconcile these interpretation challenges and provide accurate information to inform management is to perform a meta-analysis of the capture-recapture and harvest recovery data for all subpopulations within the region that are known to exhibit substantial levels of exchange (e.g., GB, MC, and LS).

### *Reproduction*

Our estimates of reproductive indices (e.g., litter size, offspring per female) are on the higher end of the range of expected values for polar bears (Baffin Bay: SWG 2016, Foxe Basin: Stapleton et al. 2016, Western Hudson Bay: Dyck et al. 2017, Southern Hudson Bay: Obbard et al. 2018, Chukchi Sea: Regehr et al. 2018), suggesting that the GB subpopulation is currently capable of healthy reproduction. During our genetic biopsy sampling we were not able to collect data on the numeric age of most bears (i.e.,

through counting cementum annuli in teeth; Calvert and Ramsay 1998), hence we cannot comment on age of first litter for females or inter-birth intervals. However, our estimated number of C1 per adult female of 0.36 in 2015 - 2017 appears to be sufficient to maintain a viable subpopulation, provided that survival is within the normal range for healthy subpopulations (Regehr et al. 2015). The number of C1 per adult female (0.36 in this study) is considered a key reproductive parameter (Vongraven et al. 2012, Regehr et al. 2015) because it integrates cub production and cub survival. This is especially important when C0s cannot be sampled or handled, as in this study (see Method section above). Our estimates for 1998 - 2000 and 2015 - 2017 suggest that no significant change in recruitment occurred over time. Declines in reproductive performance in association with sea ice deterioration have been documented for some polar bear subpopulations (Derocher and Stirling 1995, Derocher 2005, Rode et al. 2010, Peacock et al. 2013, Rode et al. 2014). As spring sea ice break-up occurs earlier (which is also associated with later fall freeze-up; Stern and Laidre 2016, Regehr et al. 2016) feeding opportunities for polar bears presumably decrease, leading to poorer maternal body condition and reduced investment in reproduction. Despite changes in sea ice conditions over the past decades we did not detect any significant changes in reproductive output for GB polar bears, although if climate change continues as predicted (IPCC 2014) there will likely be a threshold beyond which reproduction declines (Laidre et al. 2020).

### *Survival*

Opposite to what Taylor et al. (2009) found in their study, our estimated survival rates (total and un-harvested) demonstrated lower survival rates for males than females (Table 10). Estimates of total (i.e., including harvest mortality) survival for adult females of 0.95 for the period 2005 - 2017 were high relative to other subpopulations for which survival estimates are available (Regehr et al. 2018, their Table S3). However, direct comparison is complicated because most other estimates are of apparent survival which includes permanent emigration. Similar to our findings for the GB subpopulation, a recent study documented male survival rates to be reduced for the Baffin Bay



subpopulation (SWG 2016). We are unaware of why un-harvested male survival may be declining for GB bears and we recommend this as an important area for research and monitoring. There also was moderate support for a time-period effect on survival, with total survival increasing for females and decreasing for males. This should be interpreted with caution because confidence intervals had substantial overlap. There was relatively low support for an age class effect in survival, with point estimates of survival lower for subadults than for adults, although again the CIs overlapped. No support for variation in survival as a function of the sea-ice covariates we explored was detected.

Estimates of un-harvested survival for adult females for the period 2005 - 2017 (0.97) were also high. When considered along with the reproductive indices, these findings suggest that the GB subpopulation remains capable of strong growth. As a note, estimates of total survival ( $S$ ) reflect the probability of remaining alive. Estimates of  $S$  directly from the Burnham models are not estimates of apparent survival (i.e., the probability of remaining alive and not permanently emigrating) because the Burnham model directly estimates the fidelity parameter  $F$ . Unlike Taylor et al. (2009), we did not fix the fidelity parameter ( $F$ ) to 1 (i.e., no assumed permanent emigration) based on the evidence of some movement from GB garnered from harvest recoveries. These factors suggest that there is some permanent emigration, which should be estimated to reduce potential bias in estimates of survival and abundance. Estimates of the parameter  $F$  ranged between 0.93 and 0.99 depending on sex and time period, with very large confidence intervals. Collecting movement data through radiotelemetry would provide better understanding of the movement into and out of the GB boundaries allowing more precise estimation of survival and abundance.

### *Body condition*

Bears in GB were in better body condition in the most recent survey from 2015 - 2017 compared to the previous survey in 1998 - 2000. This is in direct contrast to some other

subpopulation studies that have found decreasing body condition of bears in recent years (Rode et al. 2012, Stirling and Derocher 2012, SWG 2016, Laidre et al. 2020). However, polar bear subpopulation ecosystems vary widely. Within GB, multi-year sea ice predominated until recently (e.g., mid-1990s) when a shift to thinner, annual ice has occurred (Schweinsburg et al. 1981, Barber and Iacozza 2004, Howell et al. 2008, 2009, Sou and Flato 2009, Environment and Climate Change Canada 2018). This shift to annual ice may facilitate a short-term boost in hunting opportunities for bears as the ice is thinner and more prone to leads and cracks allowing access to bears' preferred prey, ringed seals (*Pusa hispida*). Indeed, we saw that in the recent time period, as the duration of low-ice days increased, bears were more likely to be in better condition. This is counterintuitive when thinking about polar bears' reliance on sea ice as a hunting platform. However, the GB ecosystem does not currently experience 100% ice-free periods and the low-ice days represented concentrations that were 63% or lower (see Methods: Sea-ice metrics) which are still within the range of preferred polar bear ice concentrations (Durner et al. 2009). It is worth noting that during the period 2009 - 2014 (Stern and Laidre 2016), the sea-ice area dipped to ~10%. Polar bears come onshore at concentrations of around 10-15% ice (Cherry et al. 2013) and thus, if sea ice coverage declines further, we may see a similar negative relationship of body condition and low sea ice concentration or extent as has been reported for other subpopulations (Regehr et al. 2007, Rode et al. 2012, SWG 2016, Laidre et al. 2020).

More favorable ice conditions relative to seal hunting, coupled with the seal pupping period that occurs roughly around mid-April, may account for our finding that body condition improved for bears sampled later in the field season (Stirling and Archibald 1977, Pilfold et al. 2014, Reimer et al. 2019). Females with offspring were much more likely to be in poor body condition compared to the other reproductive groups. When they were sampled earlier in the year, their probability of being in poor condition was highest which is unsurprising given the increased nutritional stress this reproductive class faces due to lactation and parturition. As time progressed, the likelihood of being in poor condition declined and they were more likely to be rated as

'average' suggesting that access to prey during the prime feeding period in the spring was beneficial for accumulating nutritional stores.

Similar to previous studies (SWG 2016, Laidre et al. 2020, GN unpublished data report MC 2020), the differences in body condition we observed are not likely related to the sampling method. Raw BCS scores were binned into 3 general categories to account for any potential small biases in observer classifications. Furthermore, in other similar studies in which comparisons in BCS were made for an earlier time period that used physical capture to determine BCS and a later time period in which aerial classifications were done, there were no trends of either method for BCS, suggesting that there is not an inherent bias in either method for BCS classification (e.g. Kane Basin: no change in BCS over time, Baffin Bay: decrease in BCS over time, M'Clintock: increase in BCS over time; SWG 2016, Laidre et al. 2020, GN unpublished data). In this study, the observer with the most sampling observations participated in both the early sampling period and recent one. The other observers were experienced and had participated both in physical capture studies and in aerial observation studies. The general application of our body condition index during physical handling has been shown to be a reliable indicator (Stirling et al. 2008). Moreover, there is the potential to assess the lipid content of the extracted adipose tissue from the biopsy darts (Pagano et al. 2014, McKinney et al. 2014) which could be used to verify the aerial condition assessments.

## **7. MANAGEMENT IMPLICATIONS**

### *The need for continued monitoring*

Climate change has affected the sea ice in every polar bear management unit (subpopulation) (Stern and Laidre 2016; Regehr et al. 2016), including GB. Over time, ice concentrations and thickness have declined, and the break-up and freeze-up dates have advanced and delayed, respectively (Stern and Laidre 2016). These changes in sea ice dynamics can elicit behavioural, nutritional, and demographic changes in bears. For example, studies in Baffin Bay documented that bears have reduced their home

range size and are spending more time on shore during the ice-free period with reduced denning periods (SWG 2016). In other subpopulations, the effects of climate change on polar bears have been exhibited through reduced body condition, survival rates, and litter sizes (Regehr et al. 2007, Stapleton et al. 2014, Lunn et al. 2016, Dyck et al. 2017, Obbard et al. 2016, 2018). These sea ice changes and their impact on bears have only become apparent because of concerted monitoring efforts of both sea ice and bear movements over long periods of time.

Body condition, reproduction, and survival may reflect changes on a finer temporal scale than abundance and can help understand the mechanisms through which environmental change affects polar bears. The GB subpopulation currently has several knowledge gaps that present challenges for informed decision making. It is currently unknown how bears in GB spend their time during the sea-ice minimum (e.g., July to October) due to the lack of movement data. Also, the delineation of this subpopulation is inferred based on movement of collared female bears during the 1990s (Bethke et al. 1996, Taylor et al. 2001), prior to the large-scale changes in sea-ice habitat. Recoveries of previously captured, and subsequently harvested, bears indicate that there is emigration into LS, MC, and FB (Fig. 7), although whether this is permanent or temporary is difficult to determine without movement data. Note also that our abundance estimate is for the superpopulation (see Discussion section) which likely reflects more animals than occur within the GB management boundary.

In respecting Inuit societal values and concerns over physically handling wildlife, the GN, Department of Environment, did not carry out any collaring to collect radio-telemetry data in GB, despite efforts to garner support for a collaring program and the associated valuable data. The GN, together with other co-management partners, will have to decide on how monitoring polar bears in this subpopulation will continue in order to provide adequate information to decision-makers.

### *Harvest management and considerations*

The GB polar bear subpopulation experienced a mean annual harvest of approximately 62 bears between the harvest years 2004/2005 and 2016/2017 (roughly 40 males and 22 females; GN, unpublished data) with a TAH of 74 bears per year. Our current abundance estimate for the superpopulation, together with other demographic data, suggest that the subpopulation has likely remained stable or only declined slightly given the removal rates and observed climatic sea ice changes. We suggest that taken together this study provides evidence that the GB subpopulation is currently healthy and productive. We documented a potential decline in the male proportion of the subpopulation, which may reflect the harvest system in place (i.e., 2 males for every female). However, similar to the Baffin Bay subpopulation (SWG 2016), we also found evidence for a decline in un-harvested survival for males, which we cannot currently explain. Future research and monitoring should seek to understand the causes and potential ramifications of male survival rates.

Here we provide several considerations to aid in harvest management decisions:

- Conduct a meta-population analysis that includes all possible subpopulations where some exchange of bears occurs (e.g., with LS and MC). This is important because the current abundance estimate for the GB subpopulation of 1525 bears (SE = 294) likely includes bears that also spend time in other management units. Assessing each subpopulation individually could lead to overestimating the total number of bears available and increases the risk of overharvest.
- Determine harvest management objectives (e.g., to maintain, reduce, or increase the subpopulation), taking into account possible changes in environmental carrying capacity in the future and the observed reduction in male proportion and survival rates. Perform a quantitative harvest risk assessment so that scientific information is available to help inform and justify management decisions.

## Research recommendations for GB

These recommendations reflect both newly gained insight from the experience of conducting and analyzing the GB data as well as continued awareness of the importance of certain research methods.

1. Seek support from co-management partners to implement a radio-telemetry study to collect movement data in GB to obtain emigration estimates, resolve boundary issues, collect missing demographic data, improve precision and accuracy of demographic estimates, and evaluate changes in habitat use and denning in light of the sea ice changes. Before starting such a study, it would be possible to identify the sample size and duration required to address information needs so that no more bears are physically captured than necessary;
  
2.
  - a) Sample bears (i.e., introduce more marks into the GB subpopulation) 5 - 7 years post-completion of field portion of last study (e.g., in 2023 or 2024) until the next comprehensive population study will be conducted (~10 – 15 yrs post-completion of last inventory; 2027 - 2032) to increase the number of marked individuals, recaptures and recapture probability of marked individuals. These factors will assist in determining more realistic survival rates when the next comprehensive study is undertaken (note that a power analysis will likely aid in determining whether additional marks really provide more data, and if this endeavor is cost-effective);
  
  - b) Monitor reproductive metrics at the time of mark introduction to assess reproductive performance of GB, and if there are significant changes in reproduction consider whether the timing of the next comprehensive subpopulation assessment should be changed;

3. Or, increase population study length to 4 - 5 years to ensure that it covers a full reproductive cycle and reduces potential biases and assumptions that are required during the modeling process;

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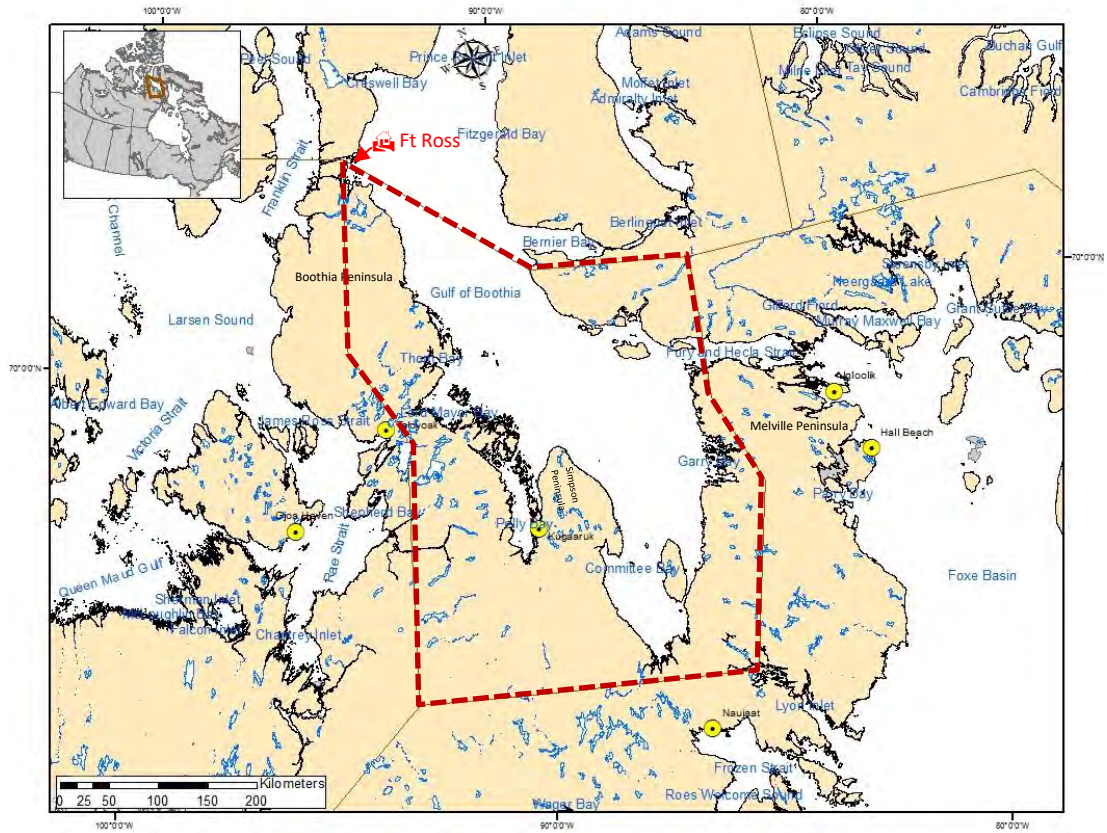
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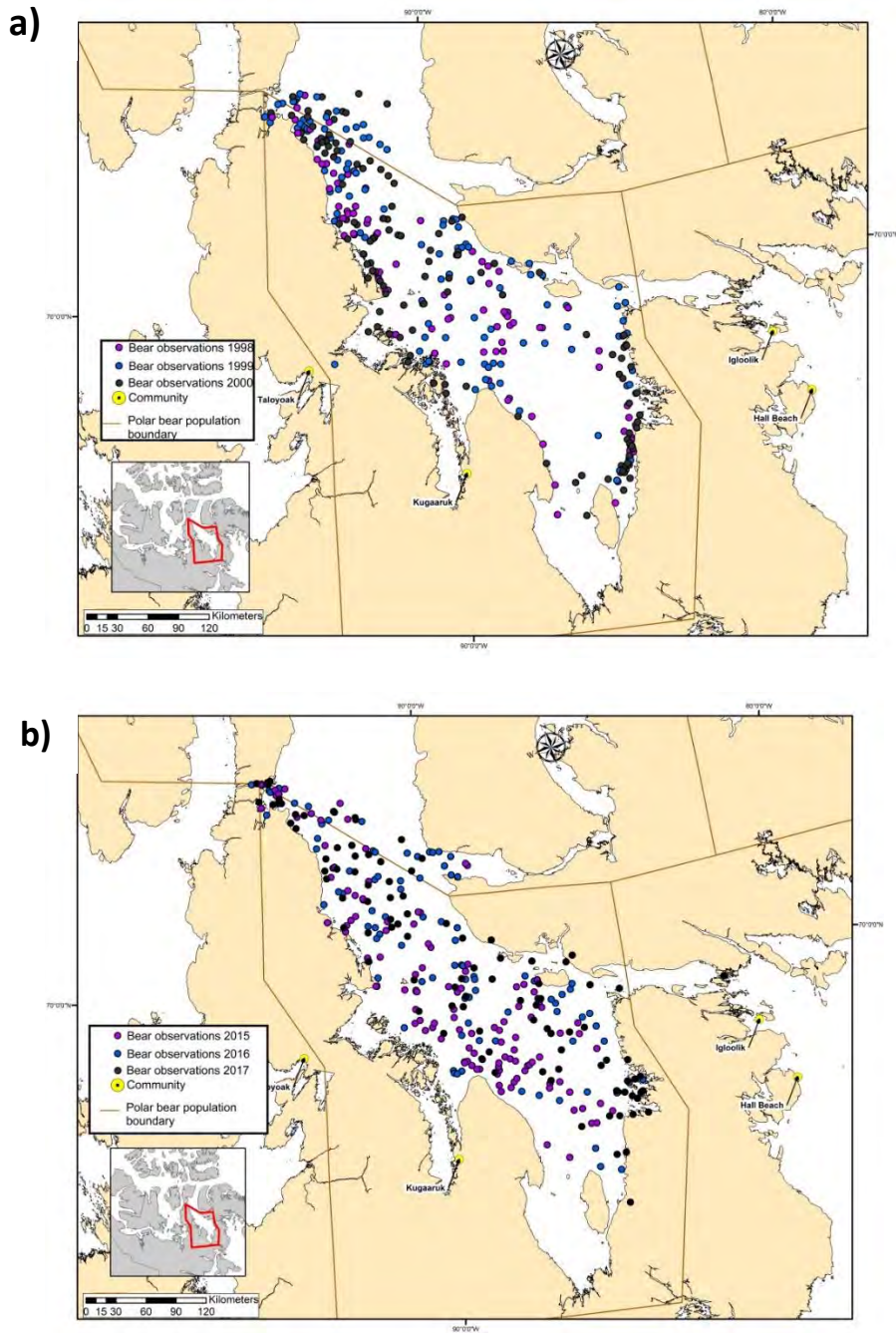
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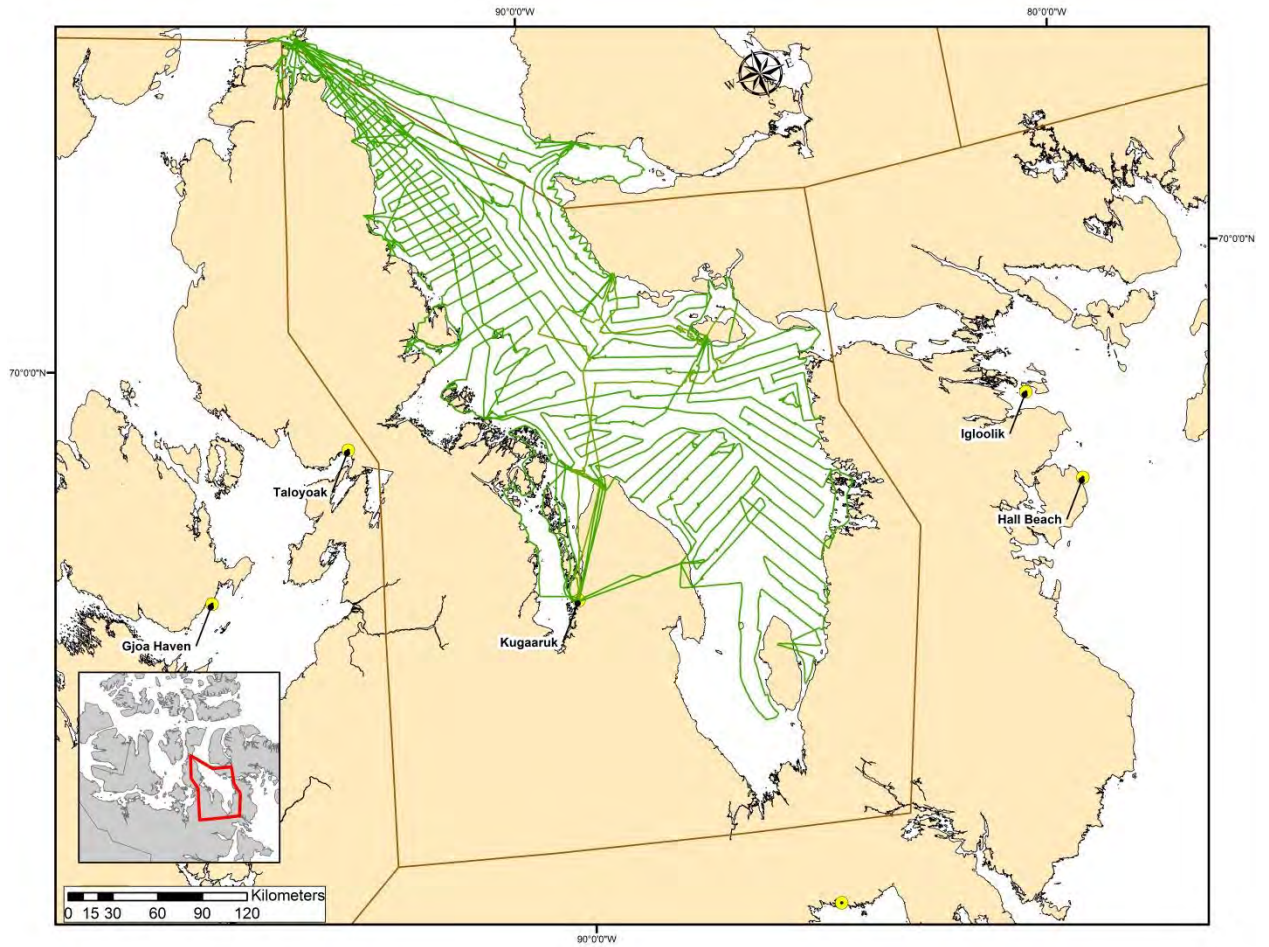




**Figure 1.** *Basic overview and location of the Gulf of Boothia polar bear subpopulation delineated by red dashed line.*



**Figure 2.** *Locations of observed polar bears within the Gulf of Boothia study area during the 1998 - 2000 (a) and 2015 - 2017 (b) studies. Different colored dots indicate different years. Inset shows subpopulation boundary in red.*



*Figure 3. Flight tracks (green lines) of helicopter flown in search for polar bears in Gulf of Boothia, Nunavut, Canada, during April/May 2017. Inset shows subpopulation boundary in red.*

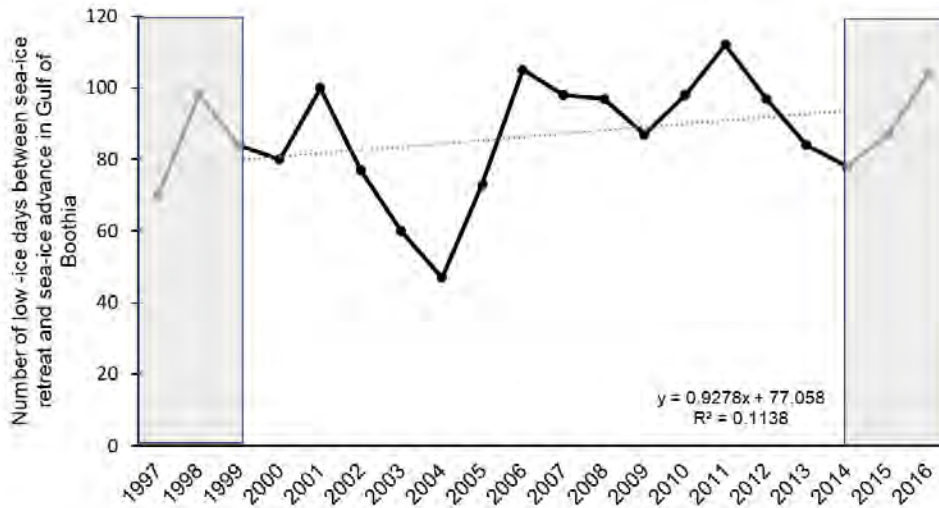


Figure 4. Sea-ice metric of 'low-ice days' calculated as the number of days between the sea ice retreat and sea ice advance in calendar year  $t$  using the transition dates when ice concentration dropped below, and exceeded, respectively, the midway point of sea ice concentration between the March and September mean (Environment and Climate Change Canada 2018). Shaded boxes indicate sampling periods used in this study and intervening years are shown for context. Gray dotted line indicates the linear trend of low-ice days from 1997-2016.

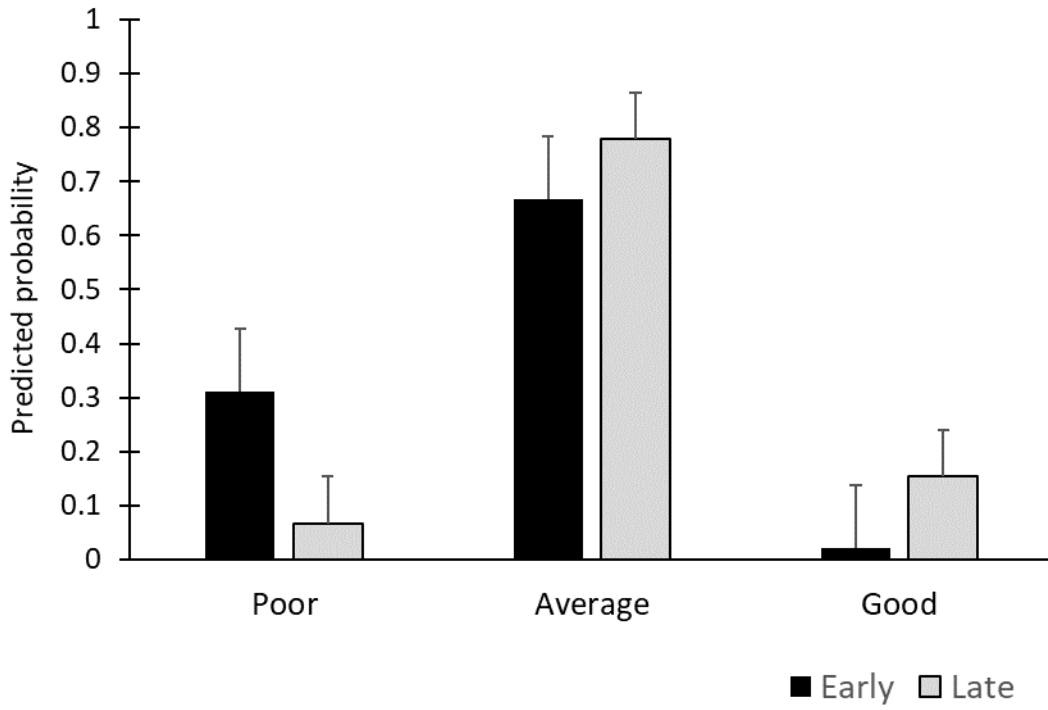


Figure 5. Predicted probability based on best-fit model parameter estimates of a bear being classified as poor, average, or good body condition for each time period (Early = 1998 - 2000; Late = 2015 - 2017).

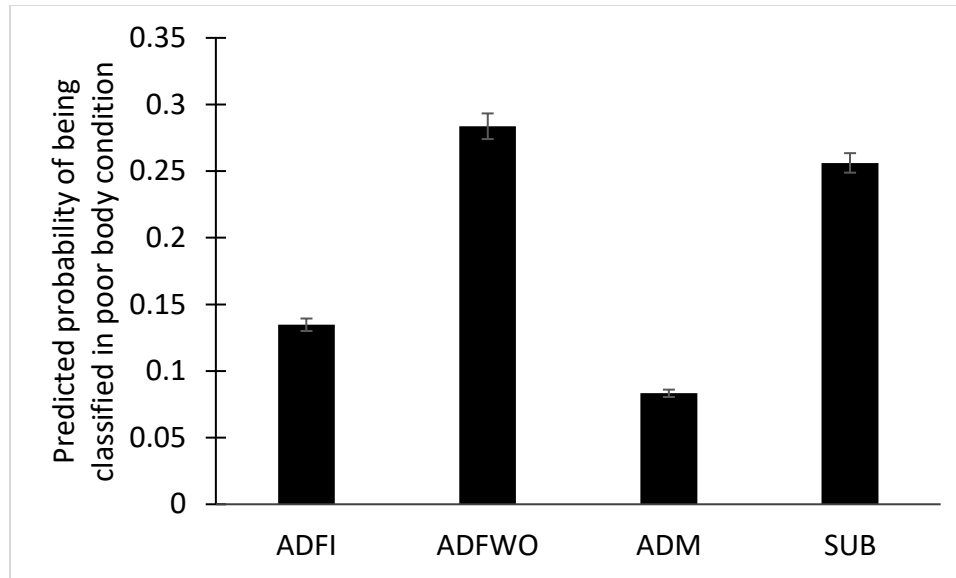
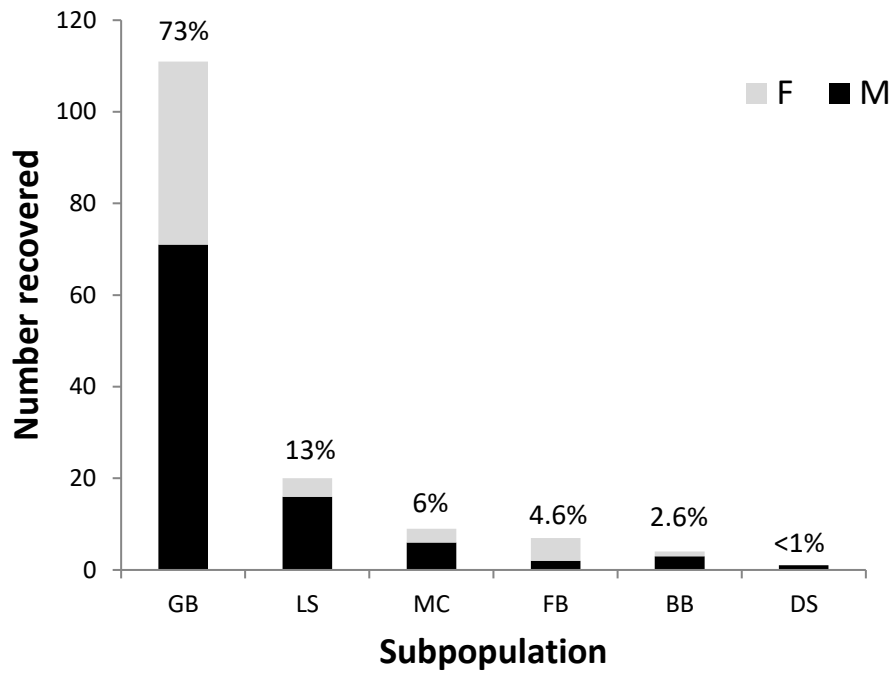


Figure 6. Predicted probability based on best-fit model parameter estimates of a bear being classified in poor body condition for each reproductive age class across both time periods. Adult females with offspring and subadults were more likely than other reproductive age classes to be classified in poor body condition at the time of sampling (ADFI = independent adult female, ADFWO = adult female with offspring, ADM = adult male, SUB = subadults of both genders).



*Figure 7. Number of polar bear tags that were initially deployed within the Gulf of Boothia subpopulation boundary and subsequently recovered through the harvest between 1972 and 2017. Percentages indicate the proportion of total recoveries that occurred in a given subpopulation (GB=Gulf of Boothia; LS = Lancaster Sound; MC=M'Clintock Channel; FB=Foxe Basin; BB=Baffin Bay; DS=Davis Strait).*

Table 1. Parameter estimates for best-fit ordinal logistic regression model (reference level = “poor”/BCS = 1) for body condition score analysis of the Gulf of Boothia subpopulation.

Parameter	Estimate	SE	<i>p</i>
periodlate	3.77	1.61	0.02
reproclassADFWO	-5.70	3.12	0.07
reproclassADM	3.74	3.03	0.22
reproclassSUB	2.07	3.22	0.52
jul_cap_day	0.03	0.02	0.14
periodearly:icetm	0.04	0.01	0.001
periodlate:icetm	-0.02	0.01	0.08
reproclassADFWO:jul_cap_day	0.04	0.03	0.14
reproclassADM:jul_cap_day	-0.03	0.02	0.29
reproclassSUM:jul_cap_day	-0.02	0.03	0.35



Table 2. Parameter-specific submodels used to analyze live-recapture dead-recovery data for the Gulf of Boothia polar bear subpopulation.

Submodel name	Submodel structure
<i>S1</i>	.
<i>S2</i>	year
<i>S3</i>	icetm1
<i>S4</i>	sex
<i>S5</i>	sub
<i>S6</i>	year + sex
<i>S7</i>	year + sex + year:sex
<i>S8</i>	year + sub
<i>S9</i>	year + sub + year:sub
<i>S10</i>	icetm1 + sub
<i>S11</i>	icetm1 + sub + icetm1:sub
<i>S12</i>	sex + sub
<i>S13</i>	year + sex + sub
<i>S14</i>	year + sex + sub + year:sex + year:sub
<i>S15</i>	icetm1 + sex + sub
<i>S16</i>	icetm1 + sex + sub + icetm1:sex + icetm1:sub
<i>r1</i>	.
<i>r2</i>	year
<i>r3</i>	sex
<i>r4</i>	year + sex
<i>r5</i>	year + sex + year:sex
<i>p1</i>	.
<i>p2</i>	year
<i>p3</i>	sex
<i>p4</i>	year + sex
<i>F1</i>	.
<i>F2</i>	year
<i>F3</i>	sex
<i>F4</i>	year + sex

(*S* = survival; *r* = dead reporting probability; *p* = recapture probability; *F* = fidelity)

Table 3. Overview of descriptive field statistics of the Gulf of Boothia polar bear study 2015 - 2017.

Field Year	Search time (hr)	Number of bears/hr	Bears encountered <sup>a</sup>	Flown distance (km)	Duration
2015	96.0	1.90	185	11,737	29 April - 26 May
2016	99.3	1.62	161	12,867	20 April - 14 May
2017	115.0	1.40	162	12,200	26 April - 15 May

<sup>a</sup> The number of bears encountered does not represent the genetically corrected number of bears (e.g., some bears have been re-sampled within same sampling period)

Table 4. Body condition scores (BCS) for polar bears in the Gulf of Boothia subpopulation 1998 - 2000 and 2015 - 2017. Poor BCS corresponds to a thin bear and Good BCS corresponds to a fat/obese bear. Age classes are adult ( $\geq$  5 years) and subadult (2 - 4 years).

	Body condition scores					
	1998 - 2000			2015 - 2017		
	Poor	Average	Good	Poor	Average	Good
Adult female without offspring	17	28	3	2	60	19
Adult female with offspring	30	40	2	5	86	4
Adult male	19	104	4	1	64	28
Subadult	25	34	2	4	43	2
Total	91	206	11	12	253	53

Table 5. Numbers and mean sizes of cub-of-the-year (C0) and yearling (C1) litters observed during capture-recapture studies on the Gulf of Boothia polar bear subpopulation.

	1998	1999	2000	2015	2016	2017
Number of C0 litters	20	13	20	12	22	12
Mean C0 litter size	1.60	1.54	1.70	1.75	1.50	1.58
Number of C1 litters	13	17	10	18	9	13
Mean C1 litter size	1.31	1.53	1.80	1.56	1.44	1.62

Table 6. Model-averaged parameter estimates for a binomial logistic regression on cub-of-the-year (C0) litter size for the Gulf of Boothia polar bear subpopulation.

Parameter	Estimate	SE	P	Importance
(Intercept)	0.78	1.12	0.49	NA
icefree.tm1	0.00	0.01	0.75	0.31
periodearly	0.02	0.19	0.90	0.18
month05	-0.01	0.18	0.98	0.17
BCS (level 1)	-0.07	0.27	0.79	0.15
BCS (level 3)	0.11	0.43	0.80	0.15

Table 7. Model-averaged parameter estimates for a binomial logistic regression on yearling (C1) litter size for the Gulf of Boothia polar bear subpopulation.

Parameter	Estimate	SE	P	Importance
(Intercept)	-0.74	1.53	0.63	NA
icefree.tm1	0.01	0.02	0.57	0.41
periodearly	-0.05	0.24	0.86	0.26
BCS (level 1)	0.02	0.13	0.91	0.06
BCS (level 3)	0.00	0.25	1.00	0.06

Table 8. Numbers of live-observations and dead-recoveries (in parentheses) of individually identified polar bears in the Gulf of Boothia subpopulation used in survival estimation.

Years	AFNC <sup>a</sup>	AFC0 <sup>b</sup>	AFC1 <sup>c</sup>	AM <sup>d</sup>	C1 <sup>e</sup>	SF <sup>f</sup>	SM <sup>g</sup>
1976 - 1997	21 (18)	17 (0)	10 (0)	49 (23)	15 (0)	13 (4)	21 (0)
1998 - 2000	75 (3)	53 (0)	40 (0)	128 (6)	68 (0)	49 (3)	44 (5)
2001 - 2017	88 (5)	46 (0)	40 (0)	94 (19)	61 (0)	21 (1)	34 (5)

(<sup>a</sup>AFNC = adult female no cubs; <sup>b</sup>AFC0 = adult females with cubs-of-the-year; <sup>c</sup>AFC1 = adult females with yearlings; <sup>d</sup>AM = adult male; <sup>e</sup>C1 = yearlings; <sup>f</sup>SF = subadult females; <sup>g</sup>SM = subadult males)

Table 9. Importance scores for the various factors and covariates within the parameter-specific survival submodels. Importance scores for interaction terms (e.g., year:sex) should be interpreted with caution because interactions can only appear in models with the corresponding main effects.

Factor or covariate	S	r	p	F
sex	0.82	0.33	0	0
year	0.71	0.35	0.06	0.16
year:sex	0.67	0.33	NA	NA
sub	0.23	NA	NA	NA
year:sub	0.23	NA	NA	NA
icetm1	0.05	NA	NA	NA
icetm1:sex	0	NA	NA	NA
icetm1:sub	0	NA	NA	NA



Table 10. Model-averaged parameter estimates for the Burnham model for survival and abundance.

Parameter	Class	Year block	Estimate	lci	uci
<i>S*</i>	Adult female	1976-2004	0.94	0.90	0.98
<i>S*</i>	Adult male	1976-2004	0.93	0.90	0.95
<i>S*</i>	Subadult female	1976-2004	0.93	0.86	0.99
<i>S*</i>	Subadult male	1976-2004	0.91	0.85	0.96
<i>S*</i>	Adult female	2005-2017	0.97	0.91	1.00
<i>S*</i>	Adult male	2005-2017	0.90	0.83	0.96
<i>S*</i>	Subadult female	2005-2017	0.95	0.86	1.00
<i>S*</i>	Subadult male	2005-2017	0.87	0.75	0.99
<i>S</i>	Adult female	1976-2004	0.92	0.86	0.96
<i>S</i>	Adult male	1976-2004	0.89	0.85	0.93
<i>S</i>	Subadult female	1976-2004	0.90	0.80	0.95
<i>S</i>	Subadult male	1976-2004	0.87	0.77	0.92
<i>S</i>	Adult female	2005-2017	0.95	0.81	0.99
<i>S</i>	Adult male	2005-2017	0.85	0.74	0.92
<i>S</i>	Subadult female	2005-2017	0.94	0.69	0.99
<i>S</i>	Subadult male	2005-2017	0.81	0.59	0.92
<i>r</i>	All female	1976-2004	0.26	0.17	0.38
<i>r</i>	All male	1976-2004	0.29	0.22	0.37
<i>r</i>	All female	2005-2017	0.22	0.08	0.46
<i>r</i>	All male	2005-2017	0.33	0.21	0.47
<i>p</i>	All female	1976-2004	0.11	0.08	0.15
<i>p</i>	All male	1976-2004	0.12	0.08	0.16
<i>p</i>	All female	2005-2017	0.10	0.07	0.14
<i>p</i>	All male	2005-2017	0.10	0.07	0.15
<i>F</i>	All female	1976-2004	0.95	0.71	0.99
<i>F</i>	All male	1976-2004	0.99	0.38	1.00
<i>F</i>	All female	2005-2017	0.93	0.79	0.98
<i>F</i>	All male	2005-2017	0.95	0.59	1.00

(*S\** = unharvested survival; *S* = total survival; *r* = dead reporting probability; *p* = recapture probability; *F* = fidelity)



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 Building *Nunavut* Together  
*Nunavut* liuqatigiingniq  
 Bâtir le *Nunavut* ensemble

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 Department of Economic Development and Transportation  
 Pivalliyuliqiyikkut Ingilrayuliqiyitkullu  
 Ministère du Développement économique et des Transports

## Information Item for the Nunavut Wildlife Management Board

Iqaluit, Nunavut

February 8, 2021

On April 1, 2021, the Fisheries and Sealing Division moved from the Department of Environment to the Department of Economic Development and Transportation by Cabinet decision. This transition started with the addition of Zoya Martin as the Director for Fisheries and Sealing for an interim period of 3 years on November 4, 2019. Following this the Division has moved over, hired new staff, reviewed its mandate and operations on how to best integrate with Economic Development and Transportation. We wish to provide the Nunavut Wildlife Management Board with an update on our Division's priorities and goals for the next few years as well as an introduction of our staff.

As Fisheries and Sealing is the Government of Nunavut's lead on fisheries and sealing files, we share many files with your organization. We look forward to working closely and collaborative with your staff to advance Nunavut's and Nunavummiut's interests in both fisheries and sealing.

We thank you for taking the time to listen and we look forward to our continued working together!

Kindly,

Zoya Martin

Fisheries and Sealing, Director  
 Economic Development and Transportation  
 Government of Nunavut

# Δῆμοῦ ἑνὸς ἁπλοῦς,

Ἀρμόδια ἑνὸς ἁπλοῦς (EDT)

Ἄρμόδια ἑνὸς ἁπλοῦς, ἁπλοῦς ἁπλοῦς























## ᑦᑲᑭᑦᑲᑦᑲᑦᑲᑦᑲᑦ

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- ᑲᑦᑲᑦᑲᑦᑲᑦᑲᑦᑲᑦᑲᑦᑲᑦ (mkilabuk3@gov.nu.ca) 867-473-2642
- ᑲᑦᑲᑦᑲᑦᑲᑦᑲᑦᑲᑦᑲᑦᑲᑦᑲᑦ (cfaulkner@gov.nu.ca) 867-645-8461



ბიჭვინტაძე













የኢትዮጵያ የብሔራዊ ትምህርት ማኅበር (TAC) ለደብዳቤ ማረጋገጫ ለመፍፀም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል። ለደብዳቤ ማረጋገጫ ማኅበር ለጥናት ማረጋገጫ ለማቆም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል።

የደብዳቤ ማኅበር የብሔራዊ ትምህርት ማኅበር (TAC) ለጥናት ማረጋገጫ ለማቆም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል። ለደብዳቤ ማረጋገጫ ማኅበር ለጥናት ማረጋገጫ ለማቆም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል።

**የጥናት ማረጋገጫ ስልጠናዎች**

የጥናት ማረጋገጫ ስልጠናዎች ለጥናት ማረጋገጫ ለማቆም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል። ለደብዳቤ ማረጋገጫ ማኅበር ለጥናት ማረጋገጫ ለማቆም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል።

የጥናት ማረጋገጫ ስልጠናዎች ለጥናት ማረጋገጫ ለማቆም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል። ለደብዳቤ ማረጋገጫ ማኅበር ለጥናት ማረጋገጫ ለማቆም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል።

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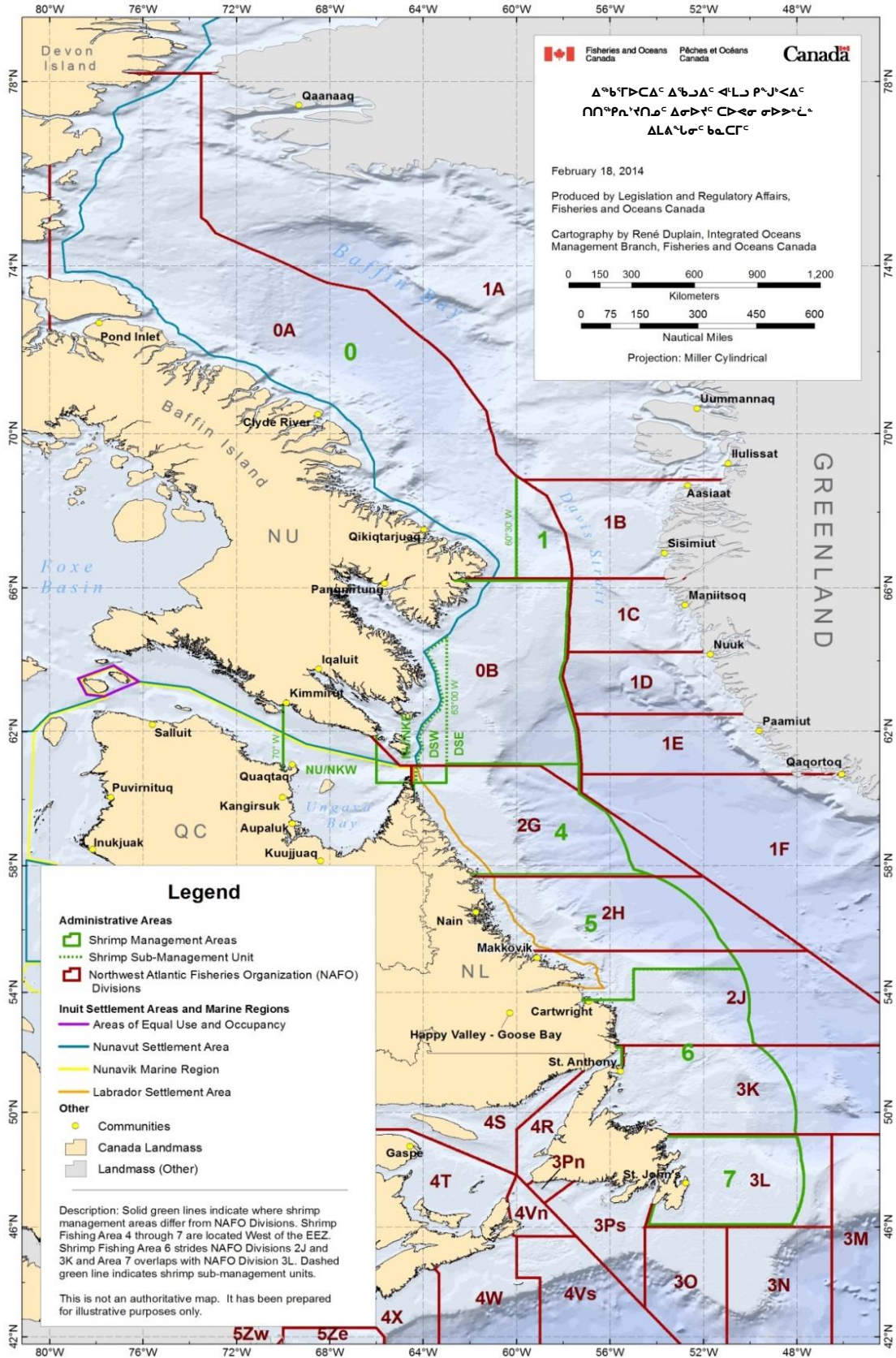
**ድንገተኛ ስልጠናዎች**

የጥናት ማረጋገጫ ስልጠናዎች ለጥናት ማረጋገጫ ለማቆም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል። ለደብዳቤ ማረጋገጫ ማኅበር ለጥናት ማረጋገጫ ለማቆም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል።

የጥናት ማረጋገጫ ስልጠናዎች ለጥናት ማረጋገጫ ለማቆም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል። ለደብዳቤ ማረጋገጫ ማኅበር ለጥናት ማረጋገጫ ለማቆም ለተዘጋጁ ስልጠናዎች ላይ ተገኝተዋል።



ርዕሰ ጉዳይ ስርዓት ለማረጋገጥ ለሚያስፈልግ ስርዓት (SFA) 2, 3, ለኃይል 4 ለሚያስፈልግ 63° W (የሥራ ስርዓት ለማረጋገጥ ስርዓት ለማረጋገጥ ስርዓት 2010/024).















ጎርብ ለጎረቤት





Fisheries and Oceans  
Canada

Pêches et Océans  
Canada

Fisheries  
Management

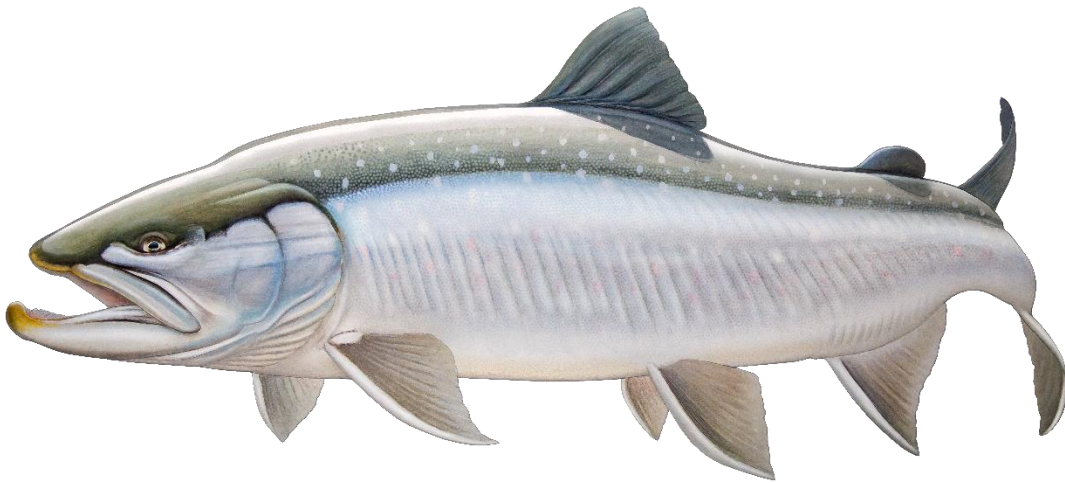
Gestion  
des pêches

Δεκαετησιας Διαχειρισης  
Παραγωγικης Μεσης  
Εδαφικης

Δεκαετησιας Διαχειρισης, *Salvelinus alpinus*, Δεκαετησιας  
Παραγωγικης Διαχειρισης,  
Μεση

Δεκαετησιας 2021

Δεκαετησιας  
(*Salvelinus alpinus*)



Canada





**ፍልጋትና ልማት ድጋፍ ለኢትዮጵያ ልማት ባንክ (IFMP) ድጋፍ ለማሰብ**

የኢትዮጵያ ልማት ባንክ ድጋፍ ለማሰብ ለማግኘት ማስገባት ይቻላል። የኢትዮጵያ ልማት ባንክ ድጋፍ ለማሰብ ለማግኘት ማስገባት ይቻላል።

**1. የኢትዮጵያ ልማት ባንክ**

የኢትዮጵያ ልማት ባንክ ድጋፍ ለማሰብ ለማግኘት ማስገባት ይቻላል። የኢትዮጵያ ልማት ባንክ ድጋፍ ለማሰብ ለማግኘት ማስገባት ይቻላል።

የኢትዮጵያ ልማት ባንክ ድጋፍ ለማሰብ ለማግኘት ማስገባት ይቻላል። የኢትዮጵያ ልማት ባንክ ድጋፍ ለማሰብ ለማግኘት ማስገባት ይቻላል።

የኢትዮጵያ ልማት ባንክ ድጋፍ ለማሰብ ለማግኘት ማስገባት ይቻላል። የኢትዮጵያ ልማት ባንክ ድጋፍ ለማሰብ ለማግኘት ማስገባት ይቻላል።

**የኢትዮጵያ ልማት ባንክ ድጋፍ ለማሰብ**

የኢትዮጵያ ልማት ባንክ ድጋፍ ለማሰብ ለማግኘት ማስገባት ይቻላል። የኢትዮጵያ ልማት ባንክ ድጋፍ ለማሰብ ለማግኘት ማስገባት ይቻላል።





















Figure 2: Map of Victoria Island showing current commercial fishing sites. The map includes an inset of the Northwest Territories (N.W.T.) and Nunavut (Nvt.) regions, a scale bar (0-200 km), and a north arrow. Fishing sites are marked with red dots at Paliryuak (Surrey) River, Ekalluktok (Ekalluk) River, Halokvik (Halovik) River, Paalliq (Lauchlan) River, and Jayko (Jayco) River. Cambridge Bay is marked with a star.



**Ilagijaujut Iqalut Munarijaujunut Upalungaijautingit  
Ukiuqtaqtuq Nunangani**

**Iqaluktuuttiaq Iqalukpik, *Salvelinus alpinus*,  
Iqalukhiuqtunut Maniliurahuaqtut,  
Nunavut**

**Aturnaqtut 2021**

**Iqalukpik**  
(*Salvelinus alpinus*)



## Hivunikhaq

Hivunikhangit haffumani Ilagijaujut Iqalungnut Munaqhijaujut Upalungaijautit (IFMP) nalunaiqtaugiami hivunikhautikhait kiuvikhangillu Iqaluktuuttiaq Iqalukpit (*Salvelinus alpinus*) maniliurahuagtut iqalukhiurnit, uuminngalu munaqhiiijaujut maliktakhait parnautikhainit tikinnahuarlugillu tahapkuat hivunikhautikhait. Una titiqqat kivgautigijakhaat ilaliutilugulu kangiqhijaujukhaq ajurnaittumik qaujimajangit iqalungnut, imaup kangiqhidjuhingit maniliurahuagtunut anngutikhaliuqtut Iqalukpit unalu tukiliutingit aturaaqtakhait munaqhiiijaujut Iqalungnit Tarjurmiutailu Kanatami (DFO), maligautilik munaqtiuatigiiktunut timiujut, ilagijaujut Iqaluktuuttiaq Anguniaqtit Timingat, uuminngalu avatikhanut atuqpagait aahiittauq ilauhijajunut.

Una IFMP maligautigut ilagijaunngittut ingilrutikhangit ilijaulaaqtut ajurnaittumik maligautaanit akihautigijaat. Una IFMP ihuaqhijaulaaqtut humilikiaq ajuqhautilimaittaat Minista'p maligautaat hakugingningit turaaqtauhimajuq iluani *Iqalungnut Maligaaq*. Una Minista pilaaqhuni, qanurilingajauuningit hapummivikhanut, huuplikiaq qanurilinganniqqat, ihuaqhihimalaaqtangit ilagijaujut haffumani IFMP malikhimajangit hakugingningit tunijauhijajut malikhugu uvunga *Iqalungnut Maligaaq*.

Himiliqaak DFO munarijakhaat pillimmakharlugillu munarijauullaqtaakhaat malikhugit nuna nunataarviup angirutaat, una IFMP pilimmakhautauniaqtuq ilitquhiqarluni atuinnaarluniuk munarijaujukhat. Huliniarumik hamna IFMP malikhimanngitkumiuk munarijaujukhat maligumiuk nuna nunataarviup angirutaat, ilagijaujut haffumani nuna nunataarviup angirutaat atuqhimaniaqtangit kigliutigijangit aturnanngitpat.

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Gabriel Nirlungnayuq, Aviktuqhimajumi Tukimuaqtittiji, Ukiuqtaqtuq Aviktuqhimajumi Iqalungnit Tarjungillu Kanata

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Ublua

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Daniel Shewchuk, Ikhivautalik, Nunavut Uumajuliqijit Katimajit

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Ublua

## Iluaniittut

<b>Hivunikhamut .....</b>	<b>3</b>
<b>Tautuktakhat .....</b>	<b>6</b>
<b>Ilitturningit .....</b>	<b>6</b>
<b>Ilagijaujut .....</b>	<b>Error! Bookmark not defined.</b>
<b>Nainaaqtauhimajut Titiiqqangit .....</b>	<b>7</b>
<b>1 Tamatkiumaningit .....</b>	<b>8</b>
<b>1.1 Iqaluktuuttiaq Iqalukpit maniliurahuqaqtut iqalukhiurniq IFMP .....</b>	<b>8</b>
1.2 Pitquhituqangit.....	<b>Error! Bookmark not defined.</b>
1.3 Aallatqii Iqalukhiurniq Ilauhimajullu .....	11
1.4 Najugaat Iqalukhiurniq .....	12
1.5 Iqalut Ilitquhingit .....	14
1.6 Aulattittiningit .....	<b>Error! Bookmark not defined.</b>
1.6.1 Iqalungnut Maligaaq, maliguarutit unalu atuagat .....	17
1.6.2 Aturaaqtakhat Iqalungnut Havaarijaujukhaq .....	17
1.6.3 Atuagaq Munarijakhaat Aallamik Iqaluktunut .....	17
<b>1.6.4 Ikhinnainnarningit Iqalukhiurnirnut Inikhautaat .....</b>	<b>Error! Bookmark not defined.</b>
1.6.5 Nunavut Angirutaat .....	18
1.7 Angiriiqtauhimajuj Piliriakhaq .....	20
<b>2 Iqalut Ihivriuqtauningit, Qaujiharniq unalu Ilitquhirnut Qaujimajangit (Qaujiharniq hivullingit).....</b>	<b>20</b>
2.1 Uumajuliqiniq Tautukhimajangit .....	20
2.2 Uumajuit Avataitalu Ilagijauniq .....	23
2.3 Pitquhituqangit Qaujimajait unalu <b>Inuit Qaujimajatuqangit</b> .....	21
2.4 Amihuuningit Ihivriurniq.....	25
2.5 Qajagijaunirnut Inikhautikhangit .....	<b>Error! Bookmark not defined.</b>
2.6 Qaujiharniq.....	<b>Error! Bookmark not defined.</b>
<b>3 Inungnit, Pitquhingit unalu Maniliurahuarniq Atuuqtakhat haffumani Iqalukhiurniq .....</b>	<b>30</b>
3.1 Inungnit unalu Pitquhingit .....	30
3.2 Maniliurahuarniq Atuuqtakhangit .....	31
<b>4 Munaqtiunirnut Akihautingit .....</b>	<b>32</b>
4.1 Amigainningit Amihut Kangiqhijaujut unalu Ihuittumik Atuuqpaqaat uuktuutigijangit .....	33
4.2 Angunahuarniq Unipkaaqtangit.....	34
4.3 Maniliurahuarniq Uuktuutigijangit haffumani Iqalukhiurniq.....	35

5	<b>Hivunikhautikhangit</b> .....	Error! Bookmark not defined.
6	<b>Apquhikhanut unalu Avvautingit</b> .....	37
7	<b>Munarijangit Uuktuutigijangit Ikaarnirnut haffumani Upalungaijautingit</b> .....	39
7.1	<i>Laisikhanut Maniliurahuarniq Iqalukhiuqtut Hulidjuhiit</i> .....	39
7.2	<i>Avvautingit</i> .....	<b>Error! Bookmark not defined.</b>
7.3	<i>Munarivlugit unalu Unipkaaqtangit</i> .....	40
7.4	<b>Ilagijaujut Laisingit Qanurilinganingit</b> .....	41
8	<b>Avvautijangit Munaqtilluarningit Ihuaqhiriqhimagajaut</b> .....	42
8.1	<i>Nakuuqpiqaqtumik Munaqtiunirnut Uuktuutigijangit – Huvaliuqtit</i> .....	42
8.2	<b>Nakuuqpiqaqtumik Munaqtiunirnut Uuktuutigijangit – Qajagijaujukhaq Inikhautikhangit</b> .....	43
8.3	<b>Nakuuqpiqaqtumik Munaqtiunirnut Uuktuutigijangit – Haputit Aturnaqtumik</b> .....	43
9	<b>Tamatkiumajangit Upalungaijautit</b> .....	43
9.1	<i>Tamatkiumajangit Piliriakhaq Turaarvigijangit</i> .....	43
9.2	<i>Katimadjutigijangit</i> .....	<b>Error! Bookmark not defined.</b>
9.3	<i>Tamatkiumajangit Ilitturvikharniq</i> .....	44
10	<b>IFMP Ilitturvikhangit Qimilurningit</b> .....	44
	<b>Turaarviujangit</b> .....	Error! Bookmark not defined.
	<b>Tukiliutingit</b> .....	51
	<b>Iluliutingit A Pitquhitsuqangit Maniliurahuagtut Iqalukhiurniq Najugait</b> .....	54
	<b>Iluliutingit B Maniliurahuagtut qaffiuningit nunamiunganillu unipkaagaq</b> .....	46
	<b>Iluliutingit C Atuqtangit munarijaujut uuktuutingit</b> .....	49
	<b>Iluliutingit D Maniliuqtangit qaujihaqtut Iqaluktuuttiaq Iqalukpit Maniliurahuagtut Iqalukpit Ilagijaujut Iqalungnut Munaqhijut Upalungaijaut</b> .....	47
	<i>Nunamiujut Nunamiittut Pitquhingit</i> .....	51
	<i>Nanminiliugait Aturnaqtut</i> .....	52
	<i>Havaktittinirnut</i> .....	53
	<i>Tunihiningit unalu Akikhait</i> .....	54
	<i>Inirutingit</i> .....	53
	<i>Turaarviujangit</i> .....	<b>Error! Bookmark not defined.</b>
	<b>Iluliutingit E Qajagijaujukhaq tarjurmi</b> .....	59

## Nalunaitkut

Nalunaitkutaq 1. Maniliurahuagtut Imarmit ilanganit Atingit Iqaluktuuttiaq nunangani iluani. ....	9
Nalunaitkutaq 2. Aturaaqtakhat –hivitunia unalu naittut-hivitunia hivunikhautit haffumani Iqaluktuuttiaq Iqalukpit maniliurahuagtut iqalukhiuqtut .....	35
Nalunaitkutaq 3. Malikhugit qaffiuningit haffumani Iqaluktuuttiaq Iqalukpit maniliurahuagtunut iqalukhiuqtut. ....	38
Nalunaitkutaq 4. Maniliurahuagtut Iqalukpit qaffiuningit unalu nunagijaujut iluani Iqaluktuuttiaq nunangani, 2009-2020 .....	46
Nalunaitkutaq 5. Atauttimuugtut nunamiujunit avatqumajut 5 ukiunganit 2014/15-2018/19 .....	52
Nalunaitkutaq 6. KFL Aulattittinirnut Akikhangit 2014/15 – 2017/18 .....	53
Nalunaitkutaq 7. Nunamiujunit, nunamiujut unalu havaakhanut akikhangit unalu akikhangit uvannat imarmijut ilangani, 2015 - 2019 .....	56
Nalunaitkutaq 8. Aulattittinirnut akikhangit maniliuqhimajangit uvannat Kitikmeot Foods Ltd., 2008-2012 .....	58

## Naahautit

Naahautit 1. Nunaujaq haffumani Nunavut Nunataarviup Iluani ukunannat Qitirmiut Nunangani unalu nunalingni Iqaluktuuttiaq.....	13
Naahautit 2. Nunaujaq Iqaluktuuttiaq nunangani takukhaujut atuqtangit maniliurahuagtunut iqalukhiuqtut najugaat. ....	14
Naahautit 3. Nunaujaq Iqaluktuuttiaq nunangani takukhaujuq pitquhiquangit maniliurahuagtut iqalukhiuqtut najugaat. ....	54
Naahautit 4. Ilitturningit haffumani qaffiuningit munaqhiujut unalu ihuaqhiujut unipkaangit (2020) .....	47
Naahautit 5. Ilitturningit haffumani ubluq tamaat atiliuqhimajangit havaatigut titiqqangit 2019.....	48
Naahautit 6. Ilitturningit haffumani ubluq tamaat utiqattaqtut unipkaangit iniquhimajangit ukunannat Kitikmeot Foods Ltd (2019).....	49

## Iluliutingit

Iluliutingit A Pitquhiquangit Maniliurahuagtut Iqalukhiuqtut Najugaat .....	54
Iluliutingit B Maniliurahuagtut qaffiuningit unalu nunamiujut unipkaarijangit.....	46
Iluliutingit C Tadjat atuqtangit munaqhiijangit uuktuutiniit .....	49
Iluliutingit D Maniliuqtangit qaujiharningit Iqaluktuuttiaq Iqalukpit haffumani Iqaluktuuttiaq Maniliurahuagtut Iqalukpit Ilagijaujut Iqalukhiuqtut Munaqhiijangit Upalungaijaut	47
Iluliutingit E Qajagijauniq tarjurmi .....	59



## **Nainaaqtauhimajut Titiqqangit**

<b>C&amp;A</b>	Qitirmiumni unalu Ukiuqtaqtuq Aviktuqhimajuq, Iqalungnit Tarjurmiunillu Kanata
<b>C&amp;P</b>	Munarijangit Hapummijangillu, Iqalungnit Tarjurmiunillu Kanata
<b>CPUE</b>	Qaffiuningit Aadjigiinngittut Iqalukhiurnigut
<b>DFO</b>	Iqalungnit Tarjurmiunillu Kanata
<b>EHTO</b>	Ekaluktutiak Anguniaqtit Timinganit
<b>HTO</b>	Anguniaqtit Timinganit
<b>IFMP</b>	Ilagijajut Iqalukhiurniq Munaqhiijangit Upalungaijaut
<b>IQ</b>	Inuit Qaujimajatuqangit
<b>KRWB</b>	Kitikmeot Nunangani Uumajuliqijit Katimajit
<b>NA</b>	<i>Nunavut Angirutaat</i>
<b>NSA</b>	Nunavut Nunataarviup Iluani
<b>NWMB</b>	Nunavut Uumajuliqijiunit Katimajit
<b>NWT</b>	Nunatsiaq
<b>RWO</b>	Aviktuqhimajumi Uumajuliqiniq Timiujuq
<b>TC</b>	Agjaqtuiniq Kanata
<b>TEK</b>	Ilitquhiqiniq Avatiliqinirnut Qaujimajangit
<b>PA</b>	Hapummijajukhaq Inikhaq

## 1 Nainaaqhimajuq

Hamna ilagijaujut Iqalukhiurniq Munaqhiijakhanut Upalungaijaut (IFMP) atuqtauvakhutik amirinahuaqhugit hapummivikhangit aturaaqtakhangillu atuqtakhanut haffumani imarmiutaujut avatikhangit, ikajuqhugillu munaqtiunirnut aturaaqtakhat iqalukhiurnirnut, ilagijauvlugulu angmaumajut qaujiharniq unalu Nunaqaqaaqhimajut ilitquhiqiniq qaujimajangit unalu avvautigivluniuk Inuit Qaujimajatuqangit (IQ) iqalungnu uumajuit nanminiliurahaqtut nalunaijainiq ihumaliurlutik nakuuqpiqatumik malikhimajakhaat anguniaqtakhat munarilugillu. IFMPt pivalliahimajut unalu iniqhimajaujut ukunangit hivitujumik havaktaunginnaqhutik inikhautikhaat ukunangit munaqtiuqatigiiktunut parnautigijait, nunamiunillu avatingnut atuqtittijut unalu aahiit ilahuahimajunut.

Iqalungnut unalu Tarjurmiunit Kanata (DFO) ilagiinnaqtangit iqalungnut pijunnautingit tigumiaqtit, Nunaqaqaaqhimajut timiujut, ilagiiktut unalu nunaliit, avatingnut atuqtittijut unalu ilauhimajunut qanuq ihumaliurahuariangani qanuq nakuuqpiqatumik munariniaqtangit iqalungnit pivallialutiglu IFMPt ikajuqhugit iqalungnit. Havaarijakhaat katimadjutigilugulu uvani IFMP ilitarijauhimajuq ilagijaulunilu hulijakhainit hivulliqaangujut ablurvikhaanit upalungaijaijunit pivalliavlutiglu piliriakhat pivikhangit IFMP. Qaffiujut hulijakhait atuqtauvaktut ilagijauvlugillu iqalungnut pijunnautingit tigumiaqtit, Nunaqaqaaqhimajut timiujut, ilagijaujut nunaliillu, avatingnut atuqtittijut unalu ilauhimajunut, ilagijaat hammajut: katimainnaqhutik IFMP WG katimajunut; ilagijaujut katimadjutigivlugillu; avvautigijangit nalunaijaijut; hailijakhaat qimilruriami kiuhiimalugillu iniqhimaittut nutaannguqtiqattaqtut upalungaijaut; ukiungani iqalungnut ilitturvikhangit qimilurningit.

Tamaat IFMPt kiugiaqaqtangit nutaannguqtiqattarlugit turaarvigilugit atuqtangit hulijakhainit akihautingillu, nutaamik nalunaitkutaq (uumajunit unalu iqalungnit-ilagijaujut), aallatqiingijullu akhuuqpiqatangit iqalungnut avatingit.

### 1.1 Iqaluktuuttiaq Iqalukpit iqalukhiuqtunut maniliurahaqtut IFMP

Una IFMP haffumani maniliurahaqtunut angunahuaqhimajaujut Iqalukpit (*Salvelinus alpinus*) uvannat Iqaluktuuttiaq nunangani Nunavunmi pilimmakhailihaaqtumik uvani 2014 mi, hivulliuvluni IFMP uumajuit Kanata iluani. Una Iqaluktuuttiaq maniliurahaqtunut Iqalukpit IFMP pinahuaqhutik qimilruqtaugialik nutaanngiqtirialik 5 ukiunganit, uuminngaluuniit kiugiaqaqhuni, ukunangit Iqaluktuuttiaq IFMP Havaqatigiiktut ilagijaujut (WG).

Una IFMP WG katimaqatigiiktut aippaagunnguraangat qimilruivlugillu kinguani-hilaqutitigut ilitturningit haffumani iqalungnit unalu nakuuqpiarningit haffumani munaqtiunirnut upalungaijaut. Una IFMP WG katimaqatigiikhutik aippaagunnguraangat uvannat IFMP uvani 2014. Ilagiikhugu, DFO aulapkaihimajut aippaagunnguraangat iqalukhiuqtinnagit unalu kinguani iqalukhiuqtunut ilagijaujut ukunangit maniliurahaqtut iqalukhiuqtit unalu aallat ilauhimajujut, uuminngalu aulapkaihimajut kitunuliqaak ilagijaujut niplautigivluniuk ilaliutigivluniuk nutaannguqtiqhimajut

haffumani maniliurahuagtunut iqalukhiuqtut unalu ilagijaujut qaujiharnirnut qaujihainingit hulijakhaillu, aippaagunnguraangat kigligutainnit. DFO unalu IFMP WG parnautigivagaat niplautigijait nalunaiqhiivakhugit akihautigijainnit hivulliutikhangillu turaarvigijaangani uvani iqalukhiurnirnut. Tamaat kiuhimajaujut tunijaujut qajagijaujut ihumaliuqtangit iniqtiqhimagiangani hamna nutaannguqtiqtauhimajut IFMP.

Una IFMP iniqpiaqhimajut uvani: **Tatqiqhiutigut, Ublua, Ukiunga.**

## 1.2 Pitquhituqangit

Iqalukpit, *Salvelinus alpinus*, nalvaaqtauvaktut tamainnut Kanatamiunit Ukiuqtaqtuq takunnaqhutik tamarmik tajurmiunngittut (tahirmiiliqpaktut uuminngaluuniit nunamiunirmut iqauk) unalu tarjurmiujut (tarjurmit majuraangat) ilitquhiit. Una tarjurmiuttat ilitquhingit nanijauvaktut kuukkanmi tattiillu uvani Kiilliniq Qikitarmi, haniani Nunalingni Iqaluktuuttiaq, ilitarijauvlunilu Iqaluktuuttiaq, tahamannat anguniajuktangit niqikhainit, iqalukhiurumajunut unalu maniliurahuagtunut iqalukhiuqtut.

Amihuujujut maniliurahuagtunut imarmiujujut iqalukhiuqtunut Iqaluktuuttiaq nunangani iluani. Tahapkuat imarmiujujut ilihimajauvlutik amihuit atiqagtut, ilagijauvlutik nunamiunut Inuinnaqtun Qablunaatullu atilgit, uuminngattauq maligautaatigut atiqaqhutik atuqtauvaktut Nunatsiarmi (NWT) Iqalungnut Maliguarutit (Nalunaitkut 1 mi). Tamainnut uvannat IFMP tamarmik nunamiunit Inuinnaqtun unalu Qablunaatitut atingit ilitarijaugamik nunamiunit atuqtunut.

### Nalunaitkut 1. Maniliurahuagtunut Imarmiunit Atiita Iqaluktuuttiaq Nunangani iluani.

Inuinnaqtun Nunamiujut Atiit	Qablunaatut Nunamiujut Atiit	Qablunaatut Maligautigut Atiit
Iqaluktuuq	Ekalluk (Wellington) River	Ekalluk River
Halugvik	Thirty-Mile River	Halovik River
Paalliryuak	Surrey River	Paliryuak River
Jayko	Jayco River	Jayco River, Albert Edward Bay
Paalliq	Lauchlan River	Lauchlan River (Byron Bay)

Nalunaitkut: Maligautigut Atiit turaarviujuq uvunga maniliurahuagtunut imarmiujujut atiit iluani Ilitturvik I haffumani Ilitturvikhaq V, NWT Iqalukhiurniq Maliguarutit.

Hivuani pitquhituqangit haffumani iqalukhiurnirnut tukiqaqhuni uvani Abrahamson (1964) unalu Barlishen & Webber (1973). Pilihaaliqhutik haffumani aullaqtilihaaqtumi maniliurahuagtut iqalukhiurniq, ilittuqhimajungnaqhijuuq tamaita kuukkat Iqaluktuuttiaq nunangani iluani iqalukhiuqpagaat niqikhaqhiuqhutik Inuinnainut (Friesen, 2002 unalu Ilulingni A nunaujaqtuq pitquhituqangit iqalukhiurviuvaktuuq najugaat). Maniliurahuarniq iqalukhiuqtut najugaanit hivulliippaaq aullaqtilihaaqqhimajuq uvani 1960 mi, ukunannat mahikkut kuvjiliqvaktut qanilruani Imatqiktumik Kuugaq (Day & Harris, 2013). Pivallaaqqhimaittumik akhuuriami akihautinahuuriami akhuurnirnut haffumani qanilruani iqalukhiurnirnut nuuhimaffaqtut uvani 1962 mi unghiktumik nunalingni hivuani Iqaluktuuq (Iqaluk) Kuugaa, hamna kuugaq imaiqtiqpaktuuq Iqaluktuuq Kangiqhuani (Day & Harris, 2013).

Nanminirijaanit, kuugap-nalaumattiarninga atuqtauvakhuni uvani Iqaluktuuq (Iqaluk) Kuugaa havaarijaukhaaqtut uvannat 1967 mut. Kinguani hamna “iningit” avguiningit aulapkaihimajuq haffumannat Iqaluktuuq ihumagivluniuk tunivlugit iqalukhiuqtunut akhuuqtangit tamainnit ilagijaat kuukkat nunangani (haffuminngatut Paallirjuaq (Surrey), Halugvik (Thirty-Mile) unalu Paalik (Lauchlan) kuukkait). Kihiani, katakpalliajut iqalukhiurnirnut (ilittuqtauhimajuq ikivalliajuq tukiqaqhuni uqumaidjuhigut) uvani Iqaluktuuq (Iqaluk) Kuugaq, humiliqaak iqalukhiuqpagaat unghahingniagut Iqaluktuuttiarmut, akhuurluaqtangit aulapkainirnut haffumani “kuugaq-nalaumattiarningit” avguiningit tunihimajangit iqalukhiuqtunut tamainnut pivikhangit. Uvani 1970 mi, maniliurahaqtut iqalukhiuqtut angiklijuummiqhuni uvani Jayko (Jayco) Kuugaq tununnangani kivataani Iqaluktuuttiarmut unalu Kuunajuk unalu Kuugjuat kuugait, qanilruanit ahiarmit.

Uvannat 2010 mit 2017 mut Paalliq (Lauchlan Kuugaq) maniliurahuarnirnut anguniarviunngittuugaluqaqtut maniliurahuangitkaluarmata ilagivluniuk pitquhituqarnit atiliuqhimajajuq maniliurahaqtut avguiningit unalu hivitujumik agjaqtuinirnut akituvallaaramik unghahikpallaaramilu iqalukhiuqtunut najugaanit Iqaluktuuttiarmut. Nutaannguqtumik pijumajainnit iluani iqalukhiuqtunut, una Iqaluktuuttiaq Anguniaqtiit Timinganit (EHTO) unalu Kitikmeot Niqiqarvinga Timingat, ikajuqtauvaktut ukunannat DFO-tkunnt, tukhiutijaujut hivumuurutigijangit avguiningit angiklijuummiqtauvlutik uvannat 5,000uqumaidjuhianit (uvannat pitquhituqarnit hivumuurutigijangit 2,400uqumaidjutingit). Una Nunavut Uumajuliqijit Katimajit (NWMB) ihumaliuqhimajangit tadja atuqhimmaaqtangit maniliurahaqtut avguiningit (atauttimuurutijangit ukunannat *Nunatsiaq Iqalukhiuqtunut Maliguarutit*) haffumani 9,100 uqumaidjutingit maligautijaujut unalu aturnaqhunilu. Ihumaliuqhimajangit, una NWMB ilitarijaujut ikajuqtauvlutiglu hapummiraaqhutik-kigligutaat munarijaujut inikhautikhangit haffumani iqalukhiuqtunut ukunannat EHTO unalu DFO aulapkaivlutik ikajuqtauvlutiglu ukunannat Kitikmeot Niqiqarvik Timinganit munariraaqhutik aturaaqtakhat maniliurahaqtunut iqalukpik iqalukhiuqtunut (Nunavut Uumajuliqijit Katimajit, 2017 mi). Aullaqtilihaaqhimajut uvani 2018 mi, Paalliq (Lauchlan Kuugaq) anguniarviuvlutik hivumuuhugit avguiningit haffumani 5,000uqumaidjutingit, ilittuqtauhimajut ukunannat iqalukhiuqtunut-munarijaujut unalu nanminirijaujut munaqhiijangit, unalu anguniaraaqpakhutik uvani hivumuurutaujut avguiningit hamna amigaiqhijut ihivriurnikhanut iniqpiaqhimalutik aturaaqtakhaillu anngutikhait aulapkaqhiilutik.

Iqalukhiuqhimaittut uvani Kuunajuk nutqaqhutik 1999 mi unalu Kuugjuat 1991 mi amihuujut huligamik, ilagijajuq agjaqtuinirnut akikhangit, nalunaiqhutik qakuqhivlutik niqaa, hilarluinnaqhunilu ukiakhami. Akihautit haffumani maniliurahaqtut najugait ilaliutijangit inuuhirnut pitquhirijangillu malikhimajangit (haffuminngatut, hivunnangani nirivagaat iqalungnit), angmaumagumik maniliurahaqtut avguiningit, unalu nunap ilitquhiita ilagijaujut maniliurahuarnirnut atuqattaqtangit (haffuminngatut, unghahingnia nunalingnut, agjaqtuinirnut akikhangit), iqalut qanurinningit unalu niuviqtittinahuarniq (haffuminngatut, niqaa qakuqhivallaarninga) hilaup qanurilinganingillu.

Tadja maniliurahuarniq iqalukhiuqtut iqalukhiuqpaktut uvani Iqaluktuuq (Iqaluk), Paallirjuaq (Surrey), Halugvik (Thirty-Mile), Paalliq (Lauchlan) unalu Jayko (Jayco) kuugait (

Naahaut 2). Angunialihaaqtut unalu amigainningit ilitqulia haffumani iqalukhiuqtut ilaliutauhimajut uvannat (Day & Harris, 2013) unalu angmaumajut ikiaqqivikkut uvani: [http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2013/2013\\_068-eng.html](http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2013/2013_068-eng.html).

Hamna hivunikhautikhangit haffumani IFMP, tamaat ublumimut Iqalukpik maniliurahuagtunut imarmiujut (Nalunaitkut 1) iluani Iqaluktuuttiaq nunangani kitiqhutik turaaqtauhimajut uvannat “Iqalukttuuiq Iqalukpik maniliurahuagtunut iqalukhiuqtut”. Munarijaujut hivunikhaat, tamaita maniliurahuagtut imarmiittut ihumagijaujut avaliqanngittut munarijaujut ilangani ilagijaujut ukunannat kuugaq-nalaumattiarningit avguiningit.

### 1.3 Aallatqiik Iqalungniq unalu Ilaqatauhimajut

Iqalukpik ihumagijaulluaqpagaat inikhaanut inungnit pitquhinga, niqinnariaujut unalu maniliurahuarnirnut angiklijuummiaqpaqtuq nunalingni – ikajulluaqpakhutik aturaaqtakhaat pitquhirnirnut unalu inuudjuhiit, ilaliutauvaktut himmautilimaitpiaqtut pitquhirnut niqingit, unalu maniliurahuarnirnut ikajuutikhangit ajurnanngitpiaqtut maniliurahuarniq hulijakhainillu iqalukhiurningit. Iqalukpit anguniarluaqpagaat nirijuktangit unalu maniliurahuaghutik iqalukhiuqtunut ikittumik hulijaujut (tahuqtaujut) iqalukhiuqtut iluani Iqaluktuuttiaq nunangani.

Una maniliurahuagtut iqalukhiurniq, hivunigijaujuq haffumani IFMP, aulapkaqhimajut ukunannat nunaqatigiingmiut Inuit iqalukhiuqtit ilagivlugillu aulattittinirnut ikajuqtangit Kitikmeot Foods Ltd., maniliurahuagtut niqiliqiviujut Iqaluktuuttiarmi. Kitikmeot Foods Ltd. Nauhimajut uvani 1990 mi maningnit ikajuqtauhimajut uvannat Nunavut Pivallianikhanut Timiujut, kivgaqtuijullu angiklivalliajut nunamiujut unalu hilarjuaqtigut iqalut niuviqtittijuktut malikhugu nunallaangit hanaugaa Iulumuqpiaqtuq Iqalukpingujuq taidjutilik *Truly Wild Arctic Char*<sup>TM</sup>. Una iqalukhiuqtut ilittuqhimajaujut aturaaqtakhait atauttimuqhugit aallatqiingujut nanminirijangit maliktangit, tadja ilitarijauvluunilu ukunannat Tarjurmi Ilittuqtit taidjutilik Ocean Wise aturaaqtaujut munarijauvluutik iqalukhiurnirnut. Najugautaa Iqaluktuuttiarmi, Qitirmiut Niqiqarvia Timigutaat, taidjutilik Kitikmeot Foods Ltd. Havaktiqaghutik amihuujut 28 nit nunamiuqatigiktut unalu nunataarviujut, ilagijaujut munaqhiijangit, hilaqutitigut pivalliajut unalu maniliurahuagtunut iqalukhiuqtit.

Una Iqaluktuuq (Ekalluk Kuugaa) unalu Paalliq (Lauchlan Kuugaa) najugaat ikajuqtauvaktut nunamiuqatigiiktunut anguniaqtit hamna tahuqtit iqalukhiuqtit

aulattittijut uvani Iqaluit majuliraangata ingilravingit. Tahapkuat iqalukhiuqtit, kihiani aulattitihimaittuq qanilruanit ukiunganit. Hamna iqalukhiuqtut akhuyuqpiagtangit uvannat tahuqtit iqalukhiuqtut aulattittijut ihumagijaulluannngittut uuktuqhimmaaqpakkamik iqalugaangat utiqittivagaat; kihiani, huli huli vakhutiktauq naittuqaluarmik iqalukhiuqtut iqalugaangat amigaiqtittigaangat ihivriuhimajaat kuukkait. Una iqalukhiurniq akhuyuqpiarningit iqalliqigaangamik qaffiuningit aallannguqtaulaaqhuni aippaagunnguraangat..

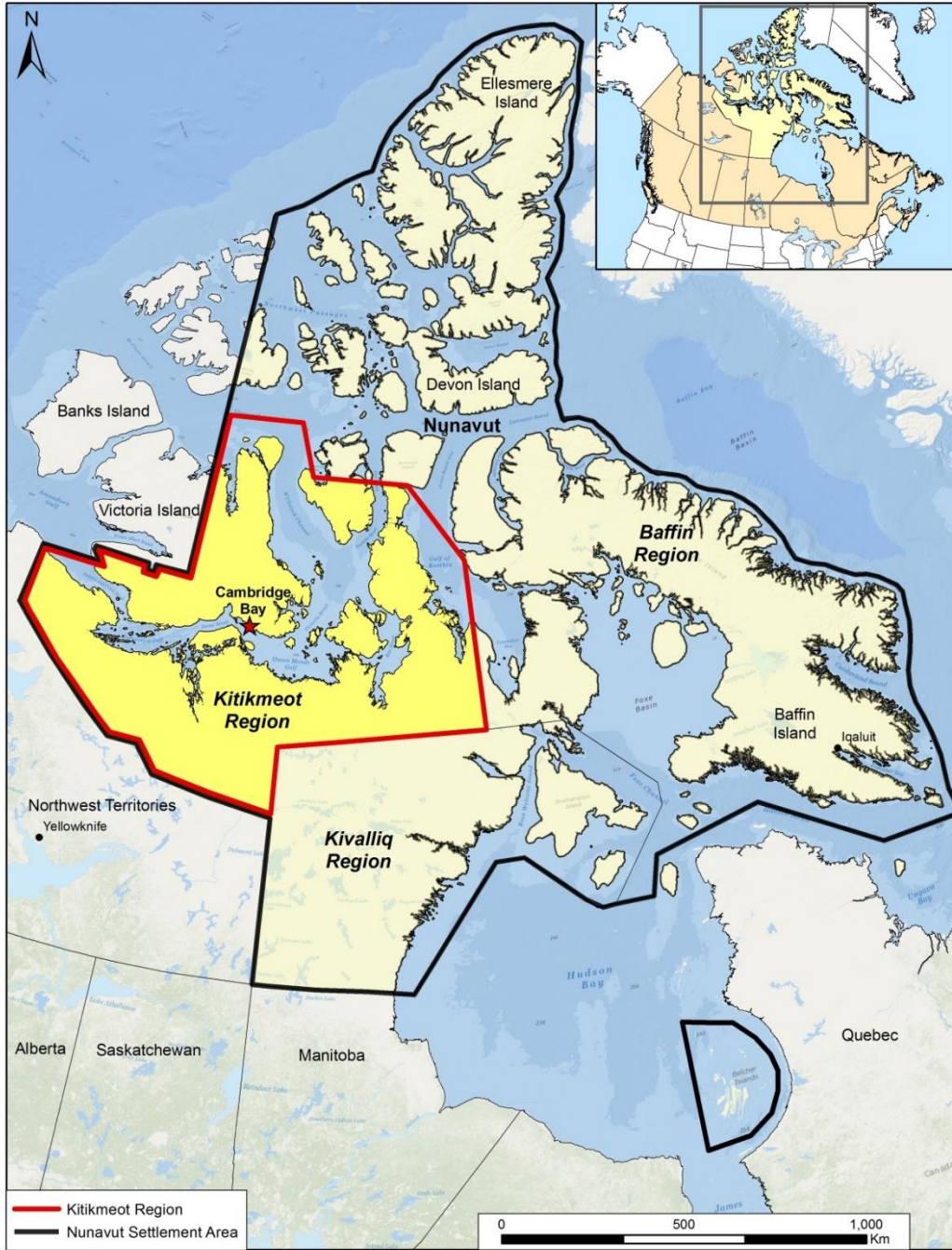
Amihut aallat iqalukhiuqtut najugaat qanilruani nunalingni atuqtauvaktut tamarmik hulilukaaqhutik (tahuqtaujut) unalu niqikhaqhiuqtut iqalukhiurningit (haffumannat (haffuminngatut, Niaqurnarjuaq, Tikirarjuaq, Iqaluktuuttiaq, Kuugaq) nunamiuqatigiiktunut. Qangaraalungmi, tamait maniliurahuqtunut iqalukhiuqtut najuqpaqtangit, atauttimuunngittumi, anguniarviuvakhuni niqikhaqhiuqtunut. Tadjanguniarviujut qanilruani hulilukaaqtumik iqalukhiuqpagaat najugait qanilrukkut nunanganit Iqaluktuuttiaq.

#### **1.4 Najugaat Iqalliqinirnut**

Una Nunalingni Iqaluktuuttiaq najugaat hivuraanit hinaanit Kiillinirmi iluani Kanatamiunut Ukiuqtaqtuq Qikiqtalingnit, Tattiit iluani. Iqaluktuuttiaq anginiqhaujuq nunanganit Qitirmiut Aviktuqhimajumi (Naahaut 1). Iqalukhiuqpagaat nunami hanianiluuniit hivua Iqaluktuuq (Ekalluk), Paalliryuak (Surrey), Halugvik (Thirty-Mile), Paalik (Lauchlan) unalu Jayko (Jayco) kuukkait (

Naahaut 2) hivumuurutigijangit uvannat hiugaangat (upinngaami) uuminngaluuniit majuraangat (ukiakhami) ingilrajut.

**Naahaut 1. Nunaujaq Nunavut Nunataarviup Iluani ukunangat Qitirmiut Aviktuqhimajumi nunalingni Iqaluktuuttiaq.**



Naahaut 2. Nunaujaq Iqaluktuuttiaq nunangani takukhaujut tadja maniliurahuagtut iqalukhiuqtut najugait.



### 1.5 Iqalukhiuqtut Iitquhiita

Angriiqtauliramik haffumani Nunavut Angirutaanit uvani 1993 mi, tamaita aturaaqtakhait iniqhimaittut uuminngaluuniit avguiningit qaffiujut uumajuit anguniarviulaaqtut iluani Nunavut Nunataarviup Iluani atiliuffaarmijangit ukpirijauvlutiglu aulpkaivlunilu ukunanngat NWMB. Tahapkuat maliguarutit ilaliutijangit huli ilittuqhimainnaqtut kigligutaanit maliguarutit unalu munaqtiunirnut Iqaluktuuttiaq Iqalukpiq maniliurahuagtunut iqalukhiuqtut, kiugiaqaqtangillu aallat pivikhait:

- Laisikhaq maniliurahuagtut iqalukpiq imaup iluani nalunaiqtauhimajut uvani Parnajaut V haffumani *NWT Iqalukhiuqtunut Maliguarutit* ([https://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,\\_c.\\_847/index.html](https://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._847/index.html))
- Munaqhiijangit malikhimajangit, ilaliutijangit ingilrutikhait iniqhimaittut, pidjarikhilugillu aturaaqtakhangit anguniaqtangit
- Kiugiaqaqhutik titiqqat pihimainnarlugit unipkaarinahuarlugillu anguniaqtangit nalunaitkutat



Atauttimuuqhimalugillu Ilangani 17(1) haffumani *NWT iqalukhiurnirnut Maliguarutit*, tamaat tarjumiujut maniliurahuagtut iqalukhiuqtut Iqaluktuuttiaq nunangani titiraqhimajuq uvani Parnajaut V malikhugu Aviktuqhimaninga IV Qitirmiut Ukiuqtaqtumi (Takulugu Ilulinga 3 (Ilainnaa 6) iluani IFMP tadsa avguiningit). Aallatqiingujut Malikhimajakhaat titiraqtauhimajut aippaagunnguraangat ukunangat DFO angmaqhimalugit tamainnit maniliurahuarnirnut tarjut ilittuqhimalugillu iqalukhiuqtangit ininganit, avguiningit, unalu ingilrutikhait kiuvikhangit. Uvani atulihaaqhimi aippaagunnguraangat, DFO tuhaqtittivagaat nainaaqhimajuq tamainnut titirariiqhimajut Aallatqiingujut Pitquijukhat (<https://www.dfo-mpo.gc.ca/fisheries-peches/commercial-commerciale/atl-arc/variation-orders-ordonnances/nunavut-2018-19-v001-eng.html>) tamainnut nunalingnit HTO havagviat Nunavunmi. Ilagijangillu, nunalingni pijumajainnit angmaqtirlugillu maniliurahuagtunut tarjuq anguniaqhimaittut qanilruani ukiunganit, hamna HTO tukhiutigilaaqtangit tarjuq angmaumahimalutik maniliurahuagtunut iqalukhiuqtut.

Iqalukhiuqtit inmi tukhiutijakhaat laisikhainit maniliurahuarumagumik tarjumi. Laisiit ilittuutijangit tarjumiunit, avguiningit unalu aahiit qanurilingavikhat (ilagijaujut Amiakkukhait Laisikhat Maliktakhait) tadsa atiliulaaqtut uvannat nunamiuqatigiingnut Annguhiqijit Havaktit (Avatiliqijitkut Havagviat – Nunavut Kavamangit) ilagijaujut DFO nit. Tamait maniliurahuagtut tarjumi iqalukhiuqhimajut uvannat iqalukhiuqti hivuliqtinga havaqatigiqaqtut malruk uvvaluuniit tallimat aallat iqalukhiuqtit. Ungahingningit uvannat Iqaluktuuttiarmut, ukiivit najuganiillutik tarjup hinaanit, iqalukhiuqtit ukiivingmiinniaqhutik iqalukhiuqhutik, iniqhimalugillu 3 nit Santiqhiiglutik avataagulluuniit.

Iqalukpiit anguniaqtaujuktut mahikkut kuvjiliqijut uvani hanianiluuniit hivuraanit kuukkait iqalut ingilraliraangat hituliraangamik tarjumut Taaqhivalirvingnuliraangat, qaujimajauvlutik upinngaami iqalliqigaangat (Lauchlan unalu Surrey kuukkait), uuminngaluuniit uvannat mahikkut kuvjiliqijut uvanngaluuniit haputit utirnaliraangamik halumajumik imaq uvani Niqiliqivik-qitqanit uvuuna Apitilirvik-qitqanit qaujimajaujuq ukiakhami iqalliqijut (Halugvik, Iqaluktuuq, unalu Jayko kuukkait). Iqaluktuumi (Ekalluk) Kuugaq iqalut anguniajuktangit ikaaruhianut kuukkami qanirluanit uvannat Kitigaq Tahiq, iniliurahuariami tahiuqtut-iqalukhiurumajunut nunami tahamani.

Maniliurahuagtunut anguniaqtut aulapkaihimajut uvannagalluuniit mahikkut kuvjiliqijit haputimiluuniit, qanuritkumi kihiani kuukkap ilitquhia. Humiliqaak qanurilingajaujut naammagijaujut (ikkattuuvluni nakitqijaujut kuugaq iluani), haputit ilitqijauvakhuni angunialiraangat. Haputit nakuutqijauvaktut mikitqijaujut iqalungnaittumik huvaqaliqtuniglu Iqalukpik utirialaqahutik aanniqtaililugillu, tahapkuallu Iqalukpiit anginiqhaujut utiqtigiami ajurnaittut, taimaa ajuqhautihimaittumik naammagijauvluni iqaluk. Humiliqaak mahikkut kuvjiliqijut taimaa tautungaqhutik ajuqhautijut iqalungnut, haputimi anguniaqtut niuvirnaqpiiaqtut tamainnut niqaita niqidjarikhivlutik, taimaa iqalukhiuqtit akiliqtauvaktut iqaludjarikhinirnut. **Haputit ilingatqijaujut taimaa anguniarumiuk ihumaliuqpagaat, taimaa hivuurannagittuuvluni ingilrutikhait tammarnaittumiglu, aallat imarmiuttat illitturnainnamiglu.**

Iqalukpiit pilaktauvaktut maniqqami (haffumani hungaijaqtauvaktut mahiillu ahivaqtauvaktut) halummaqhuqgillu hikuqaqtumik qijuqutiqtautinnatik. Tamaat qijuqutit tigumialaaqtangit tukingit, 45 uqumaidjuhingit (100 lbs.) pilakhimataaqtut iqalut unalu amigaitpaktut 13 nit qijuqutit agjaqtaulaaqtut uvani tingmiannuanut puqtalaaqtumik. Puqtalaaqtut tingmiat akiliqtauvagaat uvannat Qitirmiut Niqiqarvit Timiqutingit agjaqhivaktut iqalut iqalukhiurvingmit najugaat Iqaluktuuttiarmut, uhiijaivagaat tulagvingmit agjaqhivlugillu niqiqarvingmut havaarivlugit atauttimut. Iqalut niqiqarvingnunngaugaangat, qijuqutit uqumaidjuhiuqpagaat ahikkut qanurittuuvlutik qaffiuningillu atiliuqtauvaktut.

Hamna niqiqarvik titiraqhimavlugit anguniaqtangit tukiliugait ilagijauvaktut ubluq tamaat uqaqhimavaktut uvunga DFO nut, taimaa anguniarvingit unipkaarjangit unalu avguiningit munaqhiijangit uvannat maniliurahuqaqtunut iqalukhiuqtut hilaqutikhanut. Ihuahijauhijaujut onversion ilagijangit aturnaqtut anguniarviujut atauttimuurahuqaqhuqit avataanut uqumaidjuhinga (uvannat hungaijaqhimajut uqumaidjuhia) uvunga kilukulaanut, atiliuqhimajuq maniliurahuqaqtunut avguiniq. **Hamna avguiniq** akturaangamiuk, Nalunaitkutaq Umikhimajaujuq titirariiqtauvaktut uvannat DFO nit unalu atiliuqtaaqhuni nunalingni, ilittuqhiivluniuk umikhimajaat tarjumi hinaa kinguagut maniliurahuqaqtunut iqalukhiuqtut.

Tamaat ukiunganit DFO havaqatigivagaat maniliurahuqaqtunut iqalukhiuqtut, Qitirmiut Niqiqarvik Timiqutait, tajjauvagaat, Kitikmeot Foods Ltd., unalu anguniaqtit timiqutait EHTO nalunaiqhiivakhutik hivulliutikhangit munaqtiuningit akihautingit, uvani iqalukhiurnaqhigaangat hilaqutitigut DFO Iqalukhiurniq Havaktit munarivlugit maniliurahuqaqtunut anguniaqtit hulijakhait malikhimavlugillu ukunannat *Iqalungnit Maligaq* unalu aturnaqtumik maliguarutit. Munaqtiunirnut akihautingit malikhugillu ihumaaluutigijait turaaqtaujut uvani iqalukhiurnaqhigaangat hilaqutitigut uvani iqalukhiuqtinnagut unalu iqalikhiuqtaaqhutik katimavlutik, humiliqaak pijumagaangat. Ilagijaujut, Qitirmiut Niqiqarvik Timiqutingit taidjutilik, Kitikmeot Foods Ltd. Kamigivagaat iqalukhiuqtinnatik katimajut hivunnani tamainnut iqalukhiurnaqhigaangat katimadjutigivlugillu ilagijaujut akihautingit hivulliutikhangillu.

## **1.6 Aulattittiningit**

Hamna Iqaluktuuttiaq Iqalukpiit maniliurahuqaqtunut iqalliqijunit munaqtiuatigiiktut ukunannat Nunavut Uumajulijit Katimajit (NWMB), Ekaluktutiak Anguniaqtit Timiqutit (EHTO), unalu Iqalungnut Tarjungillu Kanata (DFO), atauttimuqhutik malikhutik ukunannat **una Nunavut Angirutaat (NA)**, una *Iqalungnut Maligaq* unalu maliguarutingillu. Una NWMB ingilrutilluanguuvluni haffumani anngutikhanut munaqhaijut Nunavut Nunataarviup Iluani (NSA), kihiani hamna Minista huli aulapkailluarijaat munarivlugillu anngutikhanut munaqhaijut hapummivikhangillu iqalungnut.

### 1.6.1 Iqalungnut Maligaaq, maliguarutit unalu atuagait

Una Iqaluktuuttiaq Iqalukpik maniliurahuagtunut iqalungnut maliguarutaujut ukunanngat *Iqalungnut Maligaaq* (R.S., 1985, c. F-14) unalu maliguarutit maligautaataat malikhugit, ilagijaujut *Iqalungnut (Tamaat) Maliguarutit* unalu *Nunatsiaq Iqalungnut Maliguarutit*. Humiliqaak aallannguqtiqattaqtut illitturnaqtut uvanngat tahapkuat titirariiqhimajut maligautit unalu Nunavut Nunataaqtunut Angirutaataat, una Angirut tikilluaqtaakhaat kigluanut aallannguqtiqattaqtumik.

Tahapkuat titiqqait angmaumajut uvani Ikiqqivikkut uvani: <http://www.dfo-mpo.gc.ca/acts-lois/index-eng.htm>

### 1.6.2 Atuqattainnarniq Iqalungnut Havaarijaujukhaq

DFO malikhimainnaqtangit hamna Atuqattainnarniq Iqalungnut Havaarijaujukhaq (SFF) tamainnut Kanatamiunut iqalungnut malikhimainnarlugillu hivunikhautikhangit hiliktumik aturaaqtakhainit, maniliurahuagtut nakuuqpiqatqumik, unalu ihuaqtumik aulattittinirnut Kanatamiunut iqalungnut tikinnahuarlugit. Una SFF ilaliutijangit atuagait malikhimainnarlugit nunap avatiqatautijut inikhaliuqtangit iqalungnut munaqhiijangit, ilaliutijangit hamna *Iqalungnut Ihumaliuqtangit Havaarijaujukhaq Ilaliutijangit hamna Qajagijaujuq Inikhaq, Munarivluniuk Ihuiluutaujut Iqalukhiurniq haffumani Imarmiujuunit Najuqpaktangit, Nunaliit unalu Uumajuit unalu Atuagaaq Munarijaat Iqalugaangata*.

Tahapkuat titiqqait angmaumajut uvani Ikiqqivikkut uvani: <http://www.dfo-mpo.gc.ca/reports-rapports/regs/sff-cpd/overview-cadre-eng.htm>

### 1.6.3 Atuagaaq Munarijaat Iqalukhiurnirnut

Iqalukhiurnirnut iluani Iqaluktuuttiaq iqalukhiurniq titiraqtauhimajut ukunanngat Atiliuqpagaat makpiraanmi uvani maniliurahuarnirnut laisilingnit qanurilingajaujut (takulugu ilangani 4.2 unalu 7.1). Una iqalukhiurniq atuinnaqhugillu haputit anguniaqpagaat illitturnvikhanut uvani malruk najugaanit, ahivaqtauvaktut unghiktumit tamaat tuqutiqpagaat iqalukhiuraangata. Qimilruqtaaraangata uvani Atiliuqpagaat makpiraanmi nalunaitkutaanit, iqalungnit munaqhiivagaat nalunaijajut tuhaqtittivakhugillu avatikhanut atuqtittijut unalu munaqtiuqatigiiktut parnautingit, ihumaliuqhimavagaat una iqalukhiurnirnut mikijumik ihuiluutauvaktut ihumaaluutiginnangit angilluuniit aallanut iqalut, imarmiuutaujut tingmiat unaluuniit imarmiuutaujut huraat amihuuningit. Unipkaaqtauhimaittut imarmiuutaujut huraat ilagijaujut Tuqutiqpagaat Aanniqpiaqhimaaittunigluuniit (IMSI) kinguani 5 nit iqalukhiuqtunut Iqaluktuuttiaq nunangani. Maniliurahuagtut mahikkut kuvjiqijut ihivriuqtauvaktut pingahuaqtaata hitamaaqtalluuniit 3-4 ubluq tamaat, unalu imarmiuutaujut huraat nalvaqtaugaangat uumajuit utiqittivakhutik, kihianiluuniit anguniajuktangit niqikhamaat malikpiaqhugillu nunataarviup pijunnautingit.

Una Iqaluktuuttiaq maniliurahuagtunut iqalukhiuqtut ilagijaujuq uvani Amialikaup Kanatamiunit Tarjurmiuttat unalu Avaliqanngittumik Aulattittinirniup (NOAA) Titiraqhimajut Haffumani Ahivaqtittihimajangit Iqalungnit (LOFF) malikhimainnarilugit hilarjuatigut maliguarutit pilimmakhaqhimajut haffumani Imarmiuttat Huraat Hapummijakhaat Maligaq unalu hivuniquhilugit ilaliutaujut. Hamna LOFF ilitturnaqtut humiliqaak “ ahivaqtittihimajangit” uuminngaluuniit “ahinirmunngarahuaqtut” iqalut kigligutaujut qajagijauhimajut imarmiutaujut huraat iqalukhiuqhimajangit. Nutqaqtittihimajut haffumani hilarjuarmiujut tuqutiqhimajangit uuminngaluuniit aanniqtittijut haffumani imarmiutaujut huraat (ilagijaat nattiit) maniliurahuaghutik iqalukhiuqtut aulattitivilutik malikhijakhaat tamarmik ahivaqtittijimajangit unalu ahinirmunngarahuaqtut iqalungnut. Tukhiutihimajangit haffumani Iqaluktuuttiaq maniliurahuagtunut iqalukhiuqtut uvunga LOFF huli qimilruqtauhimajut ukunannat NOAA, kihiani niriugijaujut ahivaquijaat naittuuvlutik ihuiluutaunianut unalu mikijuuvlutik ilagihimajaujut ukunannat imarmiutaujut huraat ilittuvlutik iluani iqalukhiurnirnut.

#### 1.6.4 Ikhinnainnarningit Iqalukhiurnirnut Inikhautaataat

Aullaqtihaaqhutik uvani 2019 mi, Iqalulijitkut taidjuhia DFO pivalliaiqhutik Ikhinnainnarningit Iqalukhiurnirnut Inikhautaataat. Hamna hivunikhaat haffumani Inikhautaataat naiglinahuaqtangit ihuiluutigijaujut palaastiit halumairningit unalu ikhinnainnarningit iqalukhiuqtunut ilagijaujut taimmaivagaat iqalukhiuqtingit parnautingit uvannat Kanatamiunut iqalukhiuqtunut, ikajuqhugillu angikliuummiqtangit atuqtattaqtakhangillu iqalukhiurnirnut, imarmiuttat uumajuit qajagijaujut, unalu aanniaqtailinirnut haffumani Kanata’p tarjungit aahiillu imarmiuttait avatiqatigiiktut najugait ikajuqhugillu haffumani Iqalulijitkut taidjutilik DFO’t munarilluaqhimajakhait. Haffumani Iqaluktuuttiaq Iqalukpik maniliurahuagtunut iqalukhiuqtut, laisiata qanurilinganingit pilimmakhaqhimajut munarivlugillu uuktuutigijangit hanajauliqhutik aadjigiikhimagiama tadsa atuqtangit uuktuutigijangit unalu hivuani ikajurlugillu unipkaarijaujukhat tammaqhimajut unalu/nalvaaqhimajaallu iqalukhiuqtunut parnautingit. Tadsa, tammaqhimajut parnautingit ihumaaluutaunngittuq iqalukhiurnirnut.

#### 1.6.5 Nunavut Angirutaataat

Uvani 1993, Kanata iniqhimajaat iniqpiaqhimajumik nunanut nunataarviujut angirutaataat ukunannat Inuit haffumani Nunavut Nunataarviujut Iluani. Una Nunavut Angirutaataat (NA) nautkalihaaqhimajut inikhautivikhangit unalu uumajuit anguniaqtakhat pijunnautingit haffumani Inuit unalu aallat Nunaqaqaqhimajut ilagijaujut ilitquhiquaghutik anguniaqpagaat iluani Nunavut Nunataarviup Iluani NSA.

Una Angirutaataat nautkaivlutiglu Nanminirijaanit Inungnut Kavakhait, una NWMO, avvautigivagaat ihumaliuqpaktunut aulattittinirnut ukunannat Kavamarjuangit Kavamangit. Una NWMB unalu DFO Ministangit ihumaliuqhutik qanurilinganingit ilagijaanit nalaumattiaqtumik munaqtiunirnut unalu munarivagaat iqalukhiurnirnut unalu hapummijangit iqalut Nunavut Nunataarviup Iluani. Malikhugillu munaqtiuqatigiiktunut

timiqutingit, hamna NWMB ingilrutilluanguuvluni uumajunut munaqtiunirnut, kihimi Minista tigumiaqpagaat munarilluaqtangit uumajuit munaqtiunirnut angiqhimalaaqtullu, qinnqihimalaaqhutik uuminngaluuniit aallannguqtilaaqtangit ihumaliuqtangit nauhimajaat ukunanngat NWMB ihumagijaanit anguniarnirnut aahiillu ihumaliuqtangit ilagijaanit munaqtiunirnut unalu hapummijakhaat uumajuit unalu uumajuit najuqpaktangit.

Una NA aulattittivagaat uumajuit munaqtiuvaktangit aulattittinirnut uvunga Aviktuqhimajumik Uumajuit Timiqutingit (RWO) unalu Anguniaqtiujut Timiqutingit (HTO). Una RWO iluani Iqaluktuuttiaq nunangani hamnaujuq Qitirmiut Aviktuqhimajumi Uumajuliqijit Katimajit (KRWB). Hamna nauhimajait unalu havaangit haffumani RWOt (NA 5.7.6) ilagijaujut:

- Maliguarutit anguniaqtunut maligautingit unalu ingilrutingillu ilagijaujut haffumani HTOtkut aviktuqhimajumi, ilagijangillu atuqpagaat avvautigiinnittunit iniqhimaittut.
- Avguiningit akhuuqujaujullu aviktuqhimajumi ajurnaittumik ihariahungningit maligautait unalu ihuaqhijauhijaujut ajurnaittumik maligautaat tamainnut HTOtkut nunangani.
- Atiliuqhimajangit kitunuliqaak uuminngaluuniit timinganit ahikkuuqtangit hamnaunngittut HTO, piqaqtumik piqaanngittuuvlutigliuuniit aturnaqtumik ihumaliuqtangit qanurilinganingilluuniit, ilainnaatigut haffumani nunangani ajurnaittumik ihariagijainnit ihuaqhimalugillu pijumajainnit maliktangit.
- Tamainnut, una munarijangit anguniaqtangit tamainnut ilagijaujut HTOtkut nunangani.

Una HTO Iqaluktuuttiaq nunangani hamnaujuq Ekaluktutiak Anguniaqtangit Timiqutingit (EHTO). Aulattittiningit hulijakhangillu haffumani HTOtkut (NA 5.7.3) ilagijaujut:

- Maliguarutit anguniaqtangit maligautingit ingilrutikhangillu tamainnut ilagijaujut, ilagijaattaq atuqtakhainit munaqtiuvikhangit uuktuutigijait.
- Avguiningit unalu aulattittijakhait nunalangit ajurnaittumik ihariagijainnit unalu ihuaqhihimajangit ajurnaittumik maliktangit tamainnut ilagijaujut.
- Atiliuqtakhait ilagijaunngittunut, uuminngat uuminngaunngittunilluuniit aturluaqtakhainit ihumaliuqtakhait qanurilingajaujunillu, hunalikiaq ilanganit nunalangit ajurnaittumik ihariagijamingnit maliktakhait unalu ihuaqhijaujut ajurnaittumik ihariagijaanit maligautit.
- Tamainnut, una munarijangit anguniaqtangit, munarijaanit anguniaqtunut tamainnut ilagijaujut.

Una Nunavut Angirutaat nauhimajaujut aulattittinirnut uvunga Nunavut Tunngavik Timigutaat hivulliuvluni Tikkuqaqtauhimajujut Inuit Timinganit maligautilik Angirutaat (Nakataq 39). Kamagijakhaat pidjarikhilugillu hamna Inuit pijunnautingit unalu munarilluaqtakhaat maliktangit Nunavut nunataariup pilimmakhaqtauhimajut, ilagilugillu uumajuit munaqtauhimajut ilaliutijait (Nakataq 5) haffumani Nunavut Angirutaanit.

Malikhugu Angirutaa, uumajuliqijit munaqhaijangit unalu Inuit anguniaqtangit munarijaujut uvannat hivunikhaliurutikhanut hapummivikhaq (NA s.5.1.5).

Una Nunavut Angirutaa angmaumajuq ikiaqqivikkut uvani:  
<http://laws-lois.justice.gc.ca/eng/acts/N-28.7/>

## **1.7 Angiriiqtauhimajuq Piliriakhaq**

Una IFMP tunijauniaqtuq uvunga Iqalulijit DFO Minista unalu NWMB qaangiqtugialik. Una IFMP pivalliahimajuq ihuaqhiqattaqtajukhaq titiraq, tukiqaqtuq titiraqtauhimajuq nalaumattiarangani aturaaqtaujukhaq, ihuaqhihimaittumik nunguavikhaq. Uvuuna qimilruqattaqtakhaat (takulugu Ilanga 9 haffumani IFMP) ukunannat IFMP Havaqatigiiktunut Ilagijaujut unalu ilauhimajunut, nutaannguqhimajut ihuaqhaqtauhimajullu tunijaulunilu NWMB unalu Minista Iqalulijit Tarjurmiunillu qaangiqtugialik, kiugiaraangat.

Hamna qaangiqtuhimajuq IFMP numiktaulunilu Inuinnaqtun, makpiraaliuqtaujukhaq tunijaulunilu uvunga munaqtuqatigiiktunut parnautinut, unalu inungnut tautuktakhaat angmaumaluni ikiaqqivikkut ukunannat DFO.

## **2 Iqalut Ihivriuqtauningit, Qaujiharniq unalu Iitquhirnut Qaujimajangit (Qaujiharniq hivullingit)**

### **2.1 Uumajuliqinirnut Tautukhimajangit**

Harris, aahiittauq., (2020a) ilaliutihimajangit iniqpiaqhimajumik nainaaqhimajut titiqqat haffumani uumajuit Iqaluktuuttiaq Iqalukpik, ihivriurningillu tikkuqahimajaat iluanittut. Iqalukpik, *Salvelinus alpinus* (L.) ilitturnaqtut tamainnit Kanatamiunit Ukiuqtaqtuq ilaliutijangillu qikiqtat haffumani Ukiuqtaqtumik Qikiqtalingnit (McPhail & Lindsey, 1970; Scott & Crossman, 1973), ilitturnaqhunilu tamarmiuujuk tahirmiujut (tahirmiujut unalu nunamiujunilluuniit) unalu (haffuminngatut, tajurmut hituvaktut) ilitturningit (Johnson, 1980; Jonsson & Jonsson, 2001; Loewen aahiittauq, 2009). Ikalukpit tarjulingmiulaqtut angiklikhimajuktullu 150 uvunga 200 mm (Johnson, 1980; Gilbert aahiittauq, 2016), angikligaangat utiqpakhutik kuugarnut imarmiunirnut najuqpaktangit niqikhaqhiuraangat (Moore, 1975; Harris, aahiittauq, 2020). Nirivakhutik hinaani, ikkattumik uvani kuukkap nuvuani 30-45 ublunganit haniraagutqaak, kihimi arvinilik ublunganit titiraqhimainnaqhimajuq (Dutil, 1986; Gyselman 1994; Moore, aahiittauq, 2016). Nirijunit qaanganit pivakhutik kihiani niqikhaqhiujuktut agluqhutik avataanit 30 m titiraqtauhimajut (Harris, aahiittauq, 2020). Kihiani kuukkat nuvua aturluarnaqtut aujami niqikhaqhiuqtunut tarjurmit (Harris, aahiittauq, 2020), ilangit unguhiktumit imarmiuttat ingilrajut titiraqhimajajut (haffuminngatut,  $\geq 100$ -400 km, Gyselman 1994; Dempson & Kristofferson, 1987; Moore, aahiittauq, 2016). Una Iqaluktuuttiaq maniliurahaqtut iqalukhiuqtunut makaqhiivaktut hituaraqtut, uuminngaluuniit upinngaami, ingilrajut (Taaqhivalirvia) ilagijaujut nirivlutik majuraraangatalu, ukiakhami, ingilrajut (qitqani uvunga kinguani Niqiliqivik atulihaaqtumi Apitilirvik) ilagijaujut utirniraangat huvangniliraangat uuminngaluuniit ukiiliraangat najuqpaktangit.

Huvangniliraangata halumajumik imarmiunit ukiakhami, uvaniqaat kinguani-Apitiirvik uvaniiluuniit hivunngani-Tattiarnaqtumi, hiuralingnit uvani tahirminngaaraangat najuqpaktangit. Iqaluktuuttiaq nunangani iluani, unalu qitqanit Kanatamiunit Ukiuqtaqtuq uvani, huvangniliraangat tahirmit, amihut kuukkat qiqivakkamik ukiumi (Johnson, 1980). Huvat ahivaraangat, iqalugait halumajumi imarmiunginnaqhutik (Johnson, 1980). Iqalugait nirijuktut halumajumik imarmik kinguit (amphipods) kumaruillu, inirniit nirijuktut iqalunnuanut unalu tarjurmiuttat kumait, uviluit, kinguillu. Ilitquhingit, iqalugait aktigiliqtaat 150-200 mm hitamat tallimanit ukiunit, ingilraliqhulik tarjurmuk (Gilbert aahiittauq, 2016) taimaa niqikhaqhiuriami uqhulingnit imarmiuttat niqikhainit. Ukiakhami, tamaat Iqalukpiit utiqpakhutik halumajumi imarmut ukiivakhutik qaajurnailrumik ukiaq imarmiut imat (Johnson, 1980).

Tarjurmiunngittut Iqalukpiit nalvaaqtauvaktut najuqpaktullu uvani tarjurmiunit ilitquhiit. Kihiani Iqalukpiit tarjurmunngalaaqtut, ingilrajuittu. Hungmallikiaq huli ilittuqhiigialik iluani Iqaluktuuttiaq nunaani, kihiani, aahiit ingilranirnut parnaijautingit ilitturnaqtuq inuuhirnut ilitquhirnut inikhaanit qanurilinganingit ilangani atulihaaqtangit aktilaangit angiklilaangilluuniit (Hendry, aahiittauq, 2004; Moore aahiittauq, 2014).

Angutaugumi arnaugumiluuniit ilitquhiita haffumani ingilrajuktut kuugarmut huvaniliraangat Iqalukpik angiklilaaqtut aktukkuhianit 450 mm aktilaangit (Johnson, 1980; Harris aahiittauq, 2020a). Qanilruani, Harris aahiittauq. (tuhagakhaujuq) kangiqhidjuhia aktilaangit ( $L_{50}$ ) ukiungillu ( $A_{50}$ ) uvannat 50% inirninnguqtut tukiliutaat haffumani nautqiktaqtut ilitquhia malruk pivikhangit nunangani iluani. Tamatkiqtangit kangiqhijaujuq  $L_{50}$  uvani Jayko Kuugaq hamnauvlutik 553.7 mm uvani Halugvik Kuugaq hamnauvlutik 539.7 mm. Tamainniqhaanit ihivriutauningit ilagijaujut, Harris aahiittauq. (tuhagakhaujuq) nalvaaqtangit tamainnut  $A_{50}$  uvani Jayko hamnauvaluaqtuq 12.5 ukiunganit humiliqaak tamainnut  $A_{50}$  uvannat Halugvik hamnauvaluaqtuq 10.4 ukiunganit. Tahapkuat kangiqhidjutingit nauqattaqhutik ihumagijaujut, kihiani, aallatqiiqattaqhutik ukiut aallat. Arnat tigumiaqpaktangit 3000 uvunga 5000 huvait (Scott & Crossman, 1973). Iqalukpik huvanikpaktut atauhiunngittumik inuuhirnut. Iqaluktuuttiaq nunangani, kihiani, takukhaujuittut huvaniliraangat aippaagunnguqtumik ukiunganit, arnait angutilluuniit ilitquhiita tikittaraangat kihiani. Huvaniktittijuitpakatut ukiakhami iqalut majuliraangata ihumagijaujut pijuittut, ilagijaanit, tarjurmunngauvakhutik aujami huvaniktinnatik (Johnson, 1980, Moore aahiittauq, 2017). Huvaijaraangat, Iqalut halumajumi imarmiujuktut ukiivlutik niqikhaqhiuqhutik ingilraliraangat tarjurmuk upinngaliraangat. Una ilitquhia qapaktipakhutik 30-40% timingat uqumaidjuhianut, qapakpakhutik taimaa uvani (Dutil, 1986).

Inuudjuhia ilitquhia unalu ingilravingat pitquhingit Iqaluktuuttiaq Iqalukpik unalu malikhimajangit ilagijaujut nauhimaningit amihuuningit ilitquhiat nainaaqhimajut naittumik ukunannat Harris aahiittauq. (2020a). Ilitturluangit uqariiqhimajut ataani. Ilaita munarijainnit kititiqtauhimajut unghiktumik amihuuningit (haffuminngatut "Iqauktuuq", "Paalliarjuk" ahiarmiuttat amihuuningit ilagijaujut) tukhiutigijaugaluqaqtut uvannat Kristofferson aahiittauq. (1984, takulugulu Dempson & Kristofferson, 1987) aallaugamik nanminiringani ilitquhiita uvannat amihuuningit ilittuqtauhimajut hivitujuraalungnit nalunaitkutaliuqtangit naunaijaujut. Ihivriuqhiijangit timinganit

ilitquhingit aallatqiingujut Kristofferson (2002) ilittuqhimajaat huvaniktut iqalukpik nunangani puqtuhijumik nanminirijaanit malittiaqhimainnaqtangit unalu ilittuqhimajaat aallat amihuuningit takukhauaaqtut uvannat akunnganit iluanilu kuukkait pivikhangit. Qanilruanit mikijunnuamik ilittuqhaijutt takukhauvlutik DNA ihivriurningit (Harris aahiittauq. 2016) nalvaaqhimajuq aviktuqhimajumik nauhimaningit ihuaqhijahimajut tamainnut ilittuqhimajut nunangat aadjigiiktumi tukhiutauhimajuq ukunannat Kristofferson aahiittauq. (1984), kihiani, iqalukhiurnirnut ihivriuhijaut najugaita Iqaluktuuttiaq nunangani hakuittuuvlutik aallatqiingujut. Harris aahiittauq. (2016) kiuhimajaallu hamna avaliqanngittut amihuuningit ilihimajaujut aadjigiinngittutik hivitujut tarjumiittutik ilagiinnaqtangit tuharnaqtut nipiliuqhugit itquumaningit (Moore, aahiittauq, 2016, 2017). Una kinguani illitturningit, akhuuqpiiaqtangit aallannguqhutik munaqtiunirnut iqalukhiurnigut. Qanilruanit Moore aahiittauq. (2017) ilaqatigijaat ilaruit uumajuit ilitquhiit nipiliuqhimajangillu nalunaijainingit ilittuqhimagiami hakuiqhimajut, nauhimajut amihuuningit aallaujut unalu aadjigiinngittut hiamihimajut. Ilagijaujut nalunaijainingit uqaqhimajut hamna Iqalukpik Iqaluktuuttiaq nunangani iluani utiqpaktut angilarvingnut nanminirijaat kuukkangit huvanigiami, kihimi ukiivakhutik kuukkanit naitpiaqtut ingilravingit naigliigiami akikhangit ingilrajunut huvanijuittumik ukiungani. Una tukiqaqhuni avaliqanngittut amihuuningit avivaktut tarjumiigaangata, avivakhutik hivitujumik halumajumi imarmi ukiivakhutik najuqpaqtangit. Hivunngani aallangujut amihuujut iqalungnut qaujihajut hivunigijaat hup amihuujut anguniaqtauvaktut humiqaak aktikkutaanit tamarmik tarjumiuttat halumajumik imarmiujut najugaat qulaaniittukhaujut hivulliulutik.

Uvani tukiliuqtauhimajuq ukunannat Harris aahiittauq. (2020a), hamnaujut hivituraaluit tikkuarningit kangiqhigiangani nauvikhangit amihuuningit ilitquhiita ilagivluniuk munaqtiunirnut iqalukpik amihuuningit nunangani iluani:

1. Ahiakkut amihuuningit ilihimajaujut avvautivaktut unghahiktumik tarjumiigaangat,
2. Avvautigaangat ahiakkut amihuuningit amigaitpaktut ukiiigaangamik najuqpaqtangit,
3. Avaliittut Iqalukpik utiriaaqtut halumajumut imat ukiunnguraangat ukiiivlutik nauhimaitkaluaqhutik ilitquhiat taimailiupaktut ilitquhinganit malruk aallatqiingujut huvaniliraangat (haffuminngatut, huvaniktumik ukiiivakhutik taimaa),
4. Iqaluktuuttiaq nunangani iluani unghahiktumik tamaita majuliqpaqtut ingilravlutik avaliittumik taimaa ilitturnaqtuq-ukiungani huvanijuittullu unalu ilitquhiittut hunaugumik ingilravaktut tadjat atuqtumi ukiungani unalu,
5. Amigaittut huvaniktut hulijut taimaa ukiiivaktut huvniktumik unalu
6. Tamainnit malittiqhimajaat tautungnaqtut ikittuuvlutik hamna uumajuit.

Munarijakaat hivunikaat, tamaita Iqalukpik takunnaqtut iluani uvannat imaup timing munarijauvlutik ahiqanngittumik munarijaujut ilagijaat, avaliqanngittut uvannat Iqalukpik amihuuningit iluani aallat imarmiujut. Hamnaujuq ilitquhirjangit munaqtiunirnut inikhautaa haffumani Iqaluktuuttiaq Iqalukpik maniliurahuqtaunut iqalukhiurnirnut, ublunganit ilittuqpiiaqhimajut aturaaqattaqtut. Nutaannguqtiqtut



nalunaitkutaq ilitquhirnut unalu tautungnaqtut avvautijut-amihuuningit anguniaqtut pilaaqtut ihuaqhalaqtut atuqtangit kuukkait-ihumagijaujut munaqtunirnut aulattitirnut munaqtunirnut nunangani iluani.

## 2.2 Nunat avatiqatigiiktunut najuqpaktangit ilagijaujut

DFOt Hapummivikhaq Iqalukhiurnirnut Havaarijaujukhaq (SFF) hivunigiijaat ikajuqtut amihuuningit hapummivikhaq aturaaqtakhangillu atuqtangit imarmiuttat avatikhait Kanata iluani (DFO 2016). Una havaarijaujukhaq tahuqtangit ilagijaujut iqalukhiurnirnut munaqtunirnut upalungaijautingit kihimi ihumagijaujut imarmiuttat avataita najuqpaktangit qanuq uumajuit ilagijaujut iluani avataita najuqpaktangit, ikajuqtangit malikhugillu avatiqatigiiktunut-kigligutaat inikhautikhangit munaqtunikhangit hivunigijangit hapummigiami imarmi iluaniittut nauhimajut iqaluillu najuqpaktangit.

Najuqpaktangit aallanguqhimajut unalu/uuminngaluuniit halumainningit huvangnikhangit unalu ukiivakhutik najugait takunnaittut ihumaaluutigivagaat. Kristofferson (2002), ikajuqtauvluni nunalingi inirniit iqalukhiuqtillu, nalunaiqtauhimajut 12 huvaniktumik maniraa Iqaluktuuttiaq nunangani iluani. Aktilaangit unalu ajurnautingit tamainnut maniliurahuqtunut halumajumik imarmiujujut, kihiani, tutqittiarnaqhuni aallaujuttauq huvaniktunut maniraanit iluani tamainnut kuukkait. Tahapkuay nalunaiqtauhimajut ukunangat ilitquhirnut qaujimajangit qaniluni maniraanit haffumani maniliurahuqtunut iqalukhiurvingit najugait. Ilahimajangit, huvaniktut tattiit nalunaiqtauhimajut uvani 2013 (L.N. Harris, makpiraaqtauhimaittuq naunaijainiq) ilagijangit haffumani aturaaqtakhait-hivitunia nipiqaqtut ihivriuqtangit piliriakhaq aturaaqtangit nunangani iluani uvani (takulugu Moore aahiittauq. 2016, 2017, Harris aahiittauq, tuhagakhanmit).

Tarjurmiitkaluaqtut kuukkamiujut Iqalukpik niqikhaqhiuqpaktut imarmiunit imarmiujujut qupilruit (kinguit haffuminngatut *Parathemisto libellula* unalu kingukpaluktut qupilruit (Mysidacea)) imarmiujujullu iqalut (amigaittut Uugait (*Boreogadus saida*), iqalugait (*Mallotus villosus*) unalu qupilruktut ittut (*Ammodytes dubius*) tarjurmiigaangat aujami (Dempson & Kristofferson, 1987, Gyselman 1994, Dempson aahiittauq. 2002, Spares aahiittauq. 2012) . Iqalukpinnuit nirijauvaktut Tahirmiuttat Ihuuq (*Salvelinus namaycush*) halumajumik imat; naujaiillu, aallat iqalungnit nirijuktut tingmidjat ilaaniittauq nattiit tarjurmiigaangamik. Ihuiluutaunngittut taimaa kihimi ihumaaluutaulluaqtut Iqalukpik amihuuningit inuuhirnut. Angijaaqtut Iqalukpik takunnaqtut unghiktumik munarijaujut niqikhaqhiuqtunut ihumagijaujut ulurianaqtumik niqikhaqhiuqtunut (Johnson, 1980), kihiani nattiit tautuktauvaktut iqiittumik malingnivaktut iqalungnut nunangani (L.N. Harris, nanminirijamingnit tautukhimajaa).

Naittuuvlutik aallanit iqalukhiuqhimajut iluani Iqaluktuuttiaq Iqalukpik maniliurahuqtunut iqalukhiuqtut makahimajaaq iqalukhiurnirnut akunningit unalu ingilrutikhait ilihimajangit. Qanilruanit maniliurahuqtunut tautukhimajangit nalunaiqhimajaaq hamna halumajumik imaq mahikkut kuvjiliqijut (haffuminngatut, Tahiryuaq humili Iqaluktuuq amihuuningit iqalukhiuqhimajangit) ikittuuvlutik aallanit iqalukhiuqhimajait ilitturnaqtuq, kihiani tautungnaraangat, Tahirmiuttat Kapihilik (*Coregonus clupeaformis*) unalu Ihuuq iqalukhiujuktangit uumajuit iqalukhimajangit.

Iluani imarmiujuut avatingit, iqalukhiuqhimajut uumajuit ilagijaujut tarjurmiuttat kanajuq (*Myoxocephalus spp.*) unalu Uugaq. Ilangit iqalukhiuqhimajangit iqalukhiuqtangit maniliurahuqtunut iqalukhiuqtut atuliqpagaat nanminikhait iqalukhiuqtunut aujiivingnit. Iluani haputit iqalukhiuqtut, tamaita iqalukhimajangit utiqittivagaat aanniqhimaittumik. Qanilruani, ihuaqhimajumik qanilruani ihuaqhihimajangit uuktuutijangit, tuulliit nalunaiqtauvaktut ilagijauvaktut. Tamainnut, iqalukhiuqhimajangit ihumagijaujut mikijumik ihuuluutauvaktut uvunga nunat avatiqatigiikhimajunut.

### 2.3 Ilitquhingit Qaujimajait unalu Inuit Qaujimajatuqangit

Iqaluktuuttiaq nunangani unipkaalluarijauvaktuq qangaraaluk iqalukhiuqtunut taimaa. Inuit Iqaluktuuttiarmiut amigaittunik kititiqhimavaktuq pitquhitsuqainnut nunaup avataita avatiqattautigiingnillu ilihimarjuaqtangit anguniarjuaqtut niqikhaqhiuqhutik ilitturijauvakhuni ikivalliavlutigli humiliqaak nunangani (Riedlinger & Berkes, 2001). Nalauttiaqhugit Iqaluktuuq (Ekalluk Kuugaq) unipkaarijaulluaqhuni titiraqhimavlunilu pitquhitsuqangit avatiqatigiiktunut nunami qaujimajainnit (TEK) hamnaujut Iqaluktuurmiut, Inuit ilaqatigiikhitik najuliqpagaat ilavlutik. Niplautigijaujuq uvani takunnaqtumi makpiraannuami nipiliuqhimajaat Qitirmiut Ingilraatigut Katimajit (2007), hakugikpiarami kuukkani Iqalukpik takukhauvaktut tamarmi upinngaami ukiakhamilu Iqaluktuuq (Ekalluk Kuugaq) najuqtaulluaqpagaat nunaa amigaittuuvlutik ittarningit ilitturnaqtuq nunangani najurjuaqpagaat qangaraalungmi hitamat tausiatigut ukiunganit (Takuluguttauq Friesen, 2002).

2000ngutillugu, Qitirmiut Ingilraatigut Katimajit havaqatigihimagaluaqtut Ilinniarvigjuangat Torontomi unipkaaliuqhutik/ittarnitaliqijit qaujihaqtit havaarivlugit titiraqhutik ilitquhirmigut inuuhiangit hivunigilluaqhugit iqalukhiurnirnut hulidjuhiit, ilagivluniuk qaujimajatuqangit, maligautingit ukpiruhuutailu (Friesen, 2002, 2004). Takunnaqtut makpiraannuami nalvaqaqtamingnit angmaumajut uvani ikiaqqivikkut: <https://www.kitikmeotheritage.ca/>.

Inuit unipkaangit unalu Inuit Qaujimajatuqangit (IQ) huli tukiqarjuaqhuni munarivlugit iqalukhiurnirnut, atuqhugillu qaujimajainnit ilihimajangit ihuaqtumik iqalukhiurnirnut ihumaliugait unalu pivallianikhanut qaujiharnirnut unalu iqalukhiurnirnut munarijaanit upalungaijautingit (Thorpe unalu Moore 2019). Inuit unipkaangit unalu Inuit Qaujimajatuqangit ilagijaujuq qanilruanit Iqalukpik huvanigaangamik najugainit kititiqhimajaat ikajuqtauvlutik nunalingnit inirniit iqalukhiuqtiillu (Kristofferson, 2002) unalu unipkaaqhimajaujut qauhimajangit tunihimajaat nalunaitkutaq pijumajaanit ikajuutaavluni nutaanguqtiqtauvlutik amihuuningit ilitquhiita maniliurahuqtunut anguniahimajangit Iqalukpik Iqaluktuuttiaq nunangani iluani (Day & Harris, 2013, Harris aahittauq 2020a). Inuit unipkaarianganit, ilagijaujut TEK unalu IQ huli kititiqhimamaqpaktut nunalingnit katimaliraangatcontinue. DFO Qaujihainingit qaujihaqtut upalungaijautingit qimilruinnaqtangit ukiunnguraangat ukunangit avatingnut atuqtunut, unalu havaanut tukiliutainit ihuaqhihimajangit ilaliutijangit qanilruanit qaujimajangit kiujaujukhallu. Una IFMP, ilagijaujut munaqtiunirnut maligautingit nakuuqpiyaqtumik maligautingit ilagijaujullu atuqtaujut iqalukhiuqtunut ingilrutingit ahivaijaqtakhaat huvaniktunut iqalukpik, pivalliahimajut ukunangit

Iqaluktuuttiaq Iqalukpik Havaqatigiiktut Ilagijaujut katimadjautigijangillu nunalungni. Kinguani, uvani 2016 mi katimaqatigijangit aullaqtittijangit ukunannat Ekaluktutiak Anguniaqtit Timinganit (EHTO) unipkaaliuqhugit hamna Inuit Qaujimajatuqangit Ukiuqtaqtuq iluani Iqaluktuuttiaq nunanganito (Thorpe unalu Moore 2019). Una havaaq, maningnit tunijauvlutik ukunannat Ukiuqtaqtumi Qaujimaningit Kanatamit, ilagijaallu ilihautikhangit nunamiunut inulrammiit aullapkailugillu ikajuqtauvlutik havaangit nunami nalunaijavlutik ilittuqhajut unipkaaliuqhimajut titiraqhimagi Inuit Qaujimajatuqangit uvunga arvinilik hitamat inuit nunalingnit (Thorpe unalu Moore 2019). Unipkaaliuqhimajut nalvaarijangit parnautigivlugu Inuit Qaujimajatuqangit qaritaujamut iliuravikhangit munarijaat ukunannat EHTO parnautingillu iniqhugulu uvannat inirniit-inulrammiillu qaujimajainnit himmauqatigiikhutik aujiivik Santiqhiikhutik uvani Niqiliqivik 2016 mi. Una parnaijautingit aulapkaqhutik kivgautigivlutiglu aadjikkutaanit hulijakhainit atuqattaqtakhait aippaagukhamut taimaa nunamiuqatigiit atauttimut katimaqataugiami unipkaaqtigilutik iqalukpik qaujiharningit munarilugillu mikhaagut nunangani iluani.

#### 2.4 Amihuuningit Ihivriurniq

Iniqpiaqhimajuuq amihuuningit ilitquhinga ihivriurningit haffumani Iqaluktuuttiaq Iqalukpik iniqhimajaujuq ukunannat Day & Harris (2013) angmaumajurlu ikiaqqivikkut uvani: [http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2013/2013\\_068-eng.html](http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2013/2013_068-eng.html). Una ihivriurnikhanut qaujihaqtauhimajuuq iqalukhiurnirnut-malikpagaat nalunaijainit hivunigijaat pivalliajavluni nanminirijangit ilitquhiit tamarmit maniliurahaqtunut anguniaqhimajangit imaup mikhaagut. Una ihivriurningit ihumaliuqtauuq tamaat hivulliuunit amihuuningit aallatqiiktut, hamnaunngittuuq Kuunajuk, ilittuqtauhimajut naittuuvluni qajagijauvluni iqalukhiurluarumi hamna anguniaqtangit parnautingit talvani. Qaffiuningit amihuuningit ihivriurnikhanut tautukhutik apquhiutikhangit qaujihaqtauhimavlni (Zhu aahiittauq. 2014 a,b) kihiani kiujaujut haffumani nalunaijaijut huli kiuttiaqhimaittut ilitturvikhangit atuqtaaqhimajut munaqtiunikhanut parnautingit.

Hamna Qajagilraaningit Apquhiurningit (PA) uvunga iqalukhiurnirnut munarijaat iluani hapummijaujukhat iqalukhiurnirnut havaarijaujukhaq ilagijaujut tukhiutijakhaat anguniaqtunut parnautikhat hamna (1) nalunaiqhiijut pingahut amihuuningit ilitquhingit kigligutaat (aanniarnangittut, qajagijaujut, unalu ihumaalungningit) malikhugit qulvahingningit amihuuningit unalu naigliligullu kiuvikhangit tiliugait (2) turaaviuhijangit anguniaqtunut uuktuutigijangit tamainnut kigligutat unalu (3) ihuaqhihimalugit ahivaqtirlugit uuktuutingit iqalungnut amihuuningit ilitquhiita (DFO 2006). Qanilruani, hamna ihivriurningit haffumani Halugvikost (Thirty-Mile Kuugaq) unalu Jayko (Jayco Kuugaq) ilagijaujuq ingilrahimajut nalunaijainingit (Harris aahiittauq. 2020a) haffumani qaffiuningit takukhaujut (Zhu aahiittauq. Tuhagakhaujuq) ihivriuriangani amihuuningit unalu nanminirijaat kiujangit tiliugait ukunannat **PA uvunga** iqaluliqinirnut munaqhainiq. Una ihivriurningit iniqhuni tamarmik iqaluliqinirnut ihumaliuqhutik haniraanit kigligutaatigut aanniarnangittumik unalu qajagijaujukhaq kigligutaa unalu ilittuqhimajaujuq naittumik ingattarnaittuq uvunga amihuuningit anguniaqtaugumik aulanngitpat.

Ikajuqhimavlutik amihuuningit ihivriurnirnut, kinguani pinahuaqhutik ihumagivlugit amigainningit aallatqiitigut pivikhait (McGowan, 1990; McGowan unalu Low 1992, Harris aahiittauq. Makpiraaliuqhimaittuq nalunaijainiq), hivunngani uvuuna atuqhugit haputit majuliraangamik ingilrajut. Tahapkuat kititirningit aallatqiinguvaktut kuukkap qanurilinganingit, ilaani, tamainnut ukiunganit iluani aadjikkutaanit pivikhait. Nalaumajuq kititirningit qaffiujut ukiunganit ilitturnaqhutik aturnaqtut kangiqhigiami ulurianaqtumik malikhimajangit hapummijaulaaqtut tahapkuat uumajuit. Uvani, tahapkuat nalunaijajut angmaumanngittut.

Hamna Iqaluktuuttiaq maniliurahaqtut iqalukhiurnirnut haffumani Iqalukpik ihumagijaujut nalunaijajut-naammagijaunngittut iqalukhiurnirnut ilitturnaqhunilu amihuujut akihautiqaqhutik unalu nalunaqpiqhunilu haffumani ilitarijaujut amihuuningit ihivriurnit (Tallman aahiittauq. 2013). Amihuujut-ukiunganit amihuujut ihivriurningit pivalliahimajut ukunangat DFO, katimaqatigivlugillu avatingnut atujuktangit unalu munaqtiuatigiiiktunut timiujut, uvannat Iqaluktuuttiaq Iqalukpik maniliurahaqtunut iqalukhiurnigut turaaqhimagiami una nalunaijajangit-naammagijaunngittuq ihumaaluut. Una hulijakhautikhat haffumani upalungaijautit ihivriuriami amihuuningit inuuhingit hapumminnaqtumik anguniarniq maligautingit tamainnut nunaliit anguniaqpagaat imarmi. Tamarmik iqalukhiurnirnut maliinnaqtangit (tahapkuat nalunaijainiq kititiqhimajaujut uvannat maniliurahaqtunut iqalukhiurnirnut) unalu nanmirijaujut nalunaijainiq (tahapkuat kitititqauhimagit nanminirijangit haffumani maniliurahuarnirnut iqalukhiurningit) kiujaujukhaq ilagijaujut hamna upalungaijautingit kititiqhimajukhaq aippaagunnguraangat.

Iqalukhiurniq-maliinnaqtangit nalunaijainingit huli kititiqhimainnaqtangit uvuuna DFO-maningnut ikajuqtauvaktut iqalliqarvingmi qaujijaijut havaangit, nautkaihimakhaaqhuni hivitujumik-atullaktangit ilagijaujut haffumani nanminirijaat nalunaijainingit (aktingnia, uqumaidjuhia unalu ukiunga) unalu ihivriurluaqtaujut ingilrutinga Iqaluktuuttiarmi. Ihivriurningit ihivriuqtauvaktut nalunaijaivlutik aallanguqhimagiakhaat aktingnia, uqumaidjuhia ukiunganilu hulidjuhianit tunihimajangit taimaa nalunaiqhimajaulaaqtuq kiuviniit amihuuningit uvunga ublumi atuqtangit maligautaanit anguniarnigut.

2012 mi atulihaaqtumi, EHTO, ikajuqtauvlutik ukunangat Qitirmiut Niqiqarvik Timinganit unalu DFO, aulapkaihimajut aturaaqtakhangit-hivitunia, kuukkap kigligutaanit munarijaujut havaangit kititiqhutik anguniaqtangit ilangani mikhaagut (CPUE) unalu anguniarnirnut nalunaitkutaq. Una havaangit ikajuutaavluni uvunga iqalukhiurnirnut maliinnaqtangit nalunaijainingit kititirningit havainnaqtut anguniaqhimajait maniliurahaqtunut iqalukhiurnirnut. Una havaaq munarijavluni haffumani tallimanit nutqaqhimaittumik ukiunganit uvuuna manngit ikajuqtauvlutik uvannat Nunavut Tamatkiumajangit Munaqtiujut Upalungaijaut qaangiqtautinnatik uvunga maniliurahaqtunut iqalukhiuqti-hivullitijangit havaaq. Una munaqtiunirnut havaat tukiliutilik kangiqhiinnaqhugit ukiunganit CPUE haffumani maniliurahaqtunut anguniaqtut uvuuna atuqhutik nalunaijajut titiraqhutik makpiraarmi. Ilagijaujut, unipkaaqhugit anguniaqtangit unalu iqqaqhimajaat iluani iqalukhiurnirnut huli parnautiginaqtangit ihuaqhijahimajumik kangiqhidjuhia haffumani uumajuit ilagijaujut. Illirivlugillu nalunaijajut titiraqtakhat makpiraanmi iniqhimajut nalaumattiaqtut tadja

ilagijauvlutik laisianut qanurilinganingit haffumani Iqaluktuuttiaq Iqalukpik maniliurahuagtunut iqalukhiurnitut.

Iqalukhiurniq-nanminirijaujut nalunaijainingit kititiqhimajaujut uvani Jayko (Jayco Kuugaq) uvannat 2010-2015, unalu uvani Halugvik (Thirty-Mile Kuugaq) uvannat 2011-2015. Tahapkuat nalunaijainingit tunngaviliuqhimajut haffumani 2017 ihivriurningit tamainnut iqalukhiurvingmi (Takulugu Harris aahiittauq. Tuhagakhaujuq, Zhu aahiittauq. Tuhagakhaujuq). Iqalukhurvingit-nanminirijamingnit ihivriuhiijut tadsa havaktauliqtuq uvani Paalliq (Lauchlan Kuugaq) niriugijaujut havaktauniaqtuq inirlutik 2022 mi, ihivriuqtaarumik amihuuningit havaktauluni. Ilgajaujurlu, hivitujumik nipiliugait atiliuqhimajakhaat havaaq (havaqatigihimajangit ukunanngat Ilinniarvigjuangit Windsor unalu Universite Laval), havakhimajaat uvani 2013 mi, ihivriuhiivlutik ingilrajuktut unalu ahinunngauvaktut pivikhangit, ikaaqttaqtut tarjumi ingilrajut ilitquhiat imarmiujut unalu halumajumit imat najuqpaktangit atuqtut (Harris aahiittauq. 2014, Moore aahiittauq. 2016, 2017, Harris aahiittauq. 2020). Kinguani, kumaruit ihivriuhimajangit haffumani Iqalukpik uvannat tamaat kuukkamiujut tadsa iniqhimaliqtangit (havaqatigivlugit ukunanngat Lakehead Ilinniarvigjuaq), tarjuq iluani ilitquhingit ihivriuqtauliqhutik (havaqatigijangit ukunanngat McGill Ilinniarvigjuaq), inuuhig pitquhutuqangit aallatqiingujut ihivriuqtauliqtut ukunanngat uumajunit ilaurutiqaqtut iijingnut takukhualittut kumaruit (havaqatigijangit ukunanngat Ilinniarvigjuangat Waterloo), uunarningit iniqhimaittut unalu anirnigut ilitturningit tadsa qanilrukkut ihivriuqtauliqhutik (havaqatigivlugit Ilinniarvigjuangat British Columbia) hamnaluu ihuuluutiniit haffumani imarmiuttat iijingnut takukhualittut kumaruit haffumani Iqalukpik nalunaijaiqtut (havaqatigijangit Ilinniarvigjuangat Toronto).

Tadsa avguiningit kigligijaujut uvani “Tallman”ip maligautaa” ilitquhirijaujut ulurianaqtumik pingujaujuq uuktuutigijangit haffumani 5% avvautingit qaffiujut Iqalukpik ingilravaktut ajuqhaqhutik iqalukhiuqtunut (Tallman aahiittauq 2015). Uqaqtauhimagaluaqtuq qaangani, hivuani qaujijarningit nutaannguqhimajut ulurianaqtumik pingujaujut uuktuutigijangit haffumani maniliurahuagtunut anguniaqtangit Iqalukpik nunangani pijumajaujut. Ihuaqtumik kangiqhidjutingit haffumani amihuuningit, utuqqaujut qaujijarningit, unalu amihuuningit inuuhingit ihumagijaulluaqtangit ihivriuriami tahapkuat ulurianaqtumik pingukluktut uuktuutigijangit aulakpaihimajangit hapummijakhaat anguniaqtut maligautaat tamainnut imarmi.

## **2.5 Qajagijaunirnut Inikhaq**

Uvani tukiliuqtauhimajuq qulaanit, una SFF ilagijaujurlu maliktakhaat haffumani PA havaarijaujukhaq uvunga iqalukhiurnirnut munarijaujukhaq. Una havaarijaujuq (1) nalunaiqhimajut pingahut amihuuningit ilitquhiita kigligutaat (inuuhingit, qajagijauniq, ihumaalungniq) malikhugit qaanganiittut amihuuningit unalu naiglihimalugit kiuviniit tiliugait (2) turaarviujut anguniaqtunut maligautait tamainnut kigligutaat unalu (3) ihuaqhihimajut ahivaqtaunirnut maligaut malikhugillu iqaluk amihuuningit ilitquhia. Kihimi qanilruani kiuvikhangit tilihimajut nalunaiqtauhimajut malruk kuukkat pivikhait (Halugvik unalu Jayco Kuugak) Iqaluktuuttiaq nunangani iluani (Zhu aahiittauq. Tuhagakhaujut). Haffumani ihivriurningit naiglihimajaujut-kigligutaanit amihuuningit

qaujiihaujut (DB-SRA) unalu nalunaijainigut- iniqhimannigittut ingilrutaat (DLM) havaktitijaujut ihivriuriami amihuuningit ilitquhiita hapummijaujuq iqalukhiurnirnut munarijaat haffumani iqalukhiurnirnut. Malikhugit qajagijaunirnut inikhaq iluani iqalukhiurnirnut munaqhiijakhangit, tamarmik iqalukhiurnirnut ihumagijaujukhat qanilruani kigligutaanit haffumani inuuttiarnirnut unalu qajagijaujukhaq kiglingat kihimi inikhangit ataaniittumik haffumani Qulaaniittumik Amihuuningit Kiuviniit 0.8 B<sub>MSY</sub>. Kihiani, nalunaqpiaghuni tadjja, unalu naittuuvluni kigligutaat ukpirijaujut nutqaqattaqtut qaliriiqhimajut haffumani naittumik-iniqhimaittuq kiuvikhaat tiliujaunigut haffumani iqalukhiurnirnut. Kiuvikhangit tiliugait pivalliahimaittuq qujaginnaq aallait iqalukhiurnirnut iluani Iqaluktuuttiaq nunangani.

Iqalukhiurniq-nanminirijaujut nalunaijainigut kititiiqhimajaujut uvani Jayko (Jayco Kuugaq) uvannat 2010-2015, unalu uvani Halugvik (Thirty-Mile Kuugaq) uvannat 2011-2015. Tahapkuat nalunaijainigut tunngaviliuqhimajut haffumani 2017 ihivriurningit tamainnut iqalukhiurvingmi (Takulugu Harris aahiittauq. Tuhagakhaujuq, Zhu aahiittauq. Tuhagakhaujuq). Iqalukhurvingit-nanminirijamingnit ihivriiuhiijut tadjja havaktauliqtuq uvani Paalliq (Lauchlan Kuugaq) niriugijaujut havaktauniaqtuq inirlutik 2022 mi, ihivriuqtaarumik amihuuningit havaktauluni. Ilgajaujurlu, hivitujumik nipiliugait atiliuqhimajakhaat havaaq (havaqatigihimajangit ukunannat Ilinniarvigjuangit Windsor unalu Universite Laval), havakhimajaat uvani 2013 mi, ihivriiuhiivlutik ingilrajuktut unalu ahinunngauvaktut pivikhangit, ikaaqtuqtut tarjurmi ingilrajut ilitquhiat imarmijut unalu halumajumit imat najuqpaktangit atuqtut (Harris aahiittauq. 2014, Moore aahiittauq. 2016, 2017, Harris aahiittauq. 2020). Kinguani, kumaruit ihivriiuhimajangit haffumani Iqalukpik uvannat tamaat kuukkamiujut tadjja iniqhimaliqtangit (havaqatigivlugit ukunannat Lakehead Ilinniarvigjuaq), tarjuq iluani ilitquhingit ihivriuqtauliqhutik (havaqatigijangit ukunannat McGill Ilinniarvigjuaq), inuuhig pitquhituqangit aallatqiingujut ihivriuqtauliqtut ukunannat uumajunit ilaurutiqaqtut iijingnut takukhaulaittut kumaruit (havaqatigijangit ukunannat Ilinniarvigjuangat Waterloo), uunarningit iniqhimaittut unalu anirningit ilitturningit tadjja qanilrukkut ihivriuqtauliqhutik (havaqatigivlugit Ilinniarvigjuangat British Columbia) hamnaluni ihuuluutiniit haffumani imarmiuttat iijingnut takukhaulaittut kumaruit haffumani Iqalukpik nalunaijailiqtut (havaqatigijangit Ilinniarvigjuangat Toronto).

Tadjja avguiningit kigligijaujut uvani “Tallman’ip maligautaa” ilitquhirijaujut ulurianaqtumik pingujaujuq uuktuutigijangit haffumani 5% avvautingit qaffiujut Iqalukpik ingilravaktut ajuqhaqhutik iqalukhiuqtunut (Tallman aahiittauq 2015). Uqaqtauhimagaluaqtuq qaangani, hivuani qaujiiharningit nutaannguqhimajut ulurianaqtumik pingujaujut uuktuutigijangit haffumani maniliurahuqtunut anguniaqtangit Iqalukpik nunangani pijumajaujut. Ihuaqtumik kangiqhidjutingit haffumani amihuuningit, utuqqaujut qaujiiharningit, unalu amihuuningit inuuhingit ihumagijauulluaqtangit ihivriuriami tahapkuat ulurianaqtumik pingukluktut uuktuutigijangit aulakpaihimajangit hapummijakhaat anguniaqtut maligautaat tamainnut imarmi.

## 2.6 Qajagijaunirnut Inikhaq

Uvani tukiliuqtauhimajuq qulaanit, una SFF ilagijaujurlu maliktakhaat haffumani PA havaarijaujukhaq uvunga iqalukhiurnirnut munarijaujukhaq. Una havaarijaujuq (1) nalunaiqhimajut pingahut amihuuningit ilitquhiita kigligutaat (inuuhingit, qajagijaunig,

ihumaalungniq) malikhugit qaanganiittut amihuuningit unalu naiglihimalugit kiuviniit tiliugait (2) turaarviujut anguniaqtunut maligautait tamainnut kigligutaat unalu (3) ihuaqhihimajut ahivaqtaunirnut maligaut malikhugillu iqaluk amihuuningit ilitqulia. Kihimi qanilruani kiuvikhangit tilihimajut nalunaiqtauhimajut malruk kuukkat pivikhait (Halugvik unalu Jayko Kuugak) Iqaluktuuttiaq nunangani iluani (Zhu aahiittauq. Tuhagakhajut). Haffumani ihivriurningit naiglihimajaujut-kigligutaanit amihuuningit qaujihajut (DB-SRA) unalu nalunaijainingit- iniqhimangittut ingilrutaat (DLM) havaktitijaujut ihivriuriami amihuuningit ilitquhiita hapummijaujuq iqalukhiurnirnut munarijaat haffumani iqalukhiurnirnut. Malikhugit qajagijaunirnut inikhaq iluani iqalukhiurnirnut munaqhijakhangit, tamarmik iqalukhiurnirnut ihumagijaujukhat qanilruani kigligutaanit haffumani inuuttiarnirnut unalu qajagijaujukhaq kiglingat kihimi inikhangit ataaniittumik haffumani Qulaaniittumik Amihuuningit Kiuviniit 0.8 B<sub>MSY</sub>. Kihiani, nalunaqpiqhuni tadj, unalu naittuuvluni kigligutaat ukpirijaujut nutqaqattaqtut qaliriiqhimajut haffumani naittumik-iniqhimaittuq kiuvikhaat tiliujaunigit haffumani iqalukhiurnirnut. Kiuvikhangit tiliugait pivalliahimaittuq qujaginnaq aallait iqalukhiurnirnut iluani Iqaluktuuttiaq nunangani.

## 2.7 Qaujiharniq

Qaujiharniq ihumagijauulluqtakhaat haffumani nalunaijainingit haffumani hapummijakhaat munaqtiunirnut haffumani Iqalukpik Iqaluktuuttiaq nunangani iluani. Uvani tukiliuriiqhimajut uvani naittumik-hivituniq hulijakhainit haffumani titiraqhimajut pijumajaujuq nutaanguqtiqhimalugit amihuuningit ihivriurningit nalunaitkutaq unalu tuhaqtittilugillu hapummijaujukhat anguniaqtangit maligautaanit tamainnut maniliurahuatunut imap unalu ihuaqhihimalugillu kangiqhimajaqqut haffumani uumajuit ilittuqhainingit haffumani Iqalukpik nuna iluani. Iqalukhiurnirnut-maliinnaqtangit nalunaijaijut kititiiqhimajangit ihumagijauulluqtangit ilagijangit nunangani ilittuqhimajangit (akingningit, uqumaidjutingit unalu ukiungit) tamainnit anguniaqhimajangit amihuuningit aippaagunnguraangat. Taimailuqpakhutik aippaagunnguraangat maniliurahuatunut iqaluliqivik ihivriuqtaujut havaangit (havaqatigivlugit ukunangit Qitirmiut Niqiqarvik Timigutaa) taimaa kititiiqhimavaktut uumajuit ilittuqhijut nalunaijainingit havakhimakhaaqtangit uvannat 1970 ngutillugu. Iqalukhiurnirnut nanminirijangit qaujihajut iniqhimajangit aippaagunnguraangat kititiiqtauhimajut uvuuna qaujiharvingmi havaangit unalu unghahingnia kangiqhidjutigit haffumani iqalukpik uumajuit ilitturningit. Uvani 2013, havaqatigihimajangit ukunangit DFO, unalu Tarjungit Nalunaijaijut Havaqatigiiktut (OTN), Ilinniarvigjuangit Laval unalu Ilinniarvigjuangit Windsor ilittuqtaulihaaqhimajut atuqhugit nipiqaqtumik nipiliuqtangit ingilrutilingnit naunaijaivlugit ingilrajunit Iqalukpik tamarmik tarjurmiuttat unalu halumajumik imait nunangani.

Una hivuniqhuutikhangit haffumani qaujiharningit havaangit huli havaarijauniaqtuq uvani 2022 mut. Una kiuviniit titiqqangit havaavut ilaliutauhimajuq ilulingit iluani tarjurmiuttat najuqpaktangit atuqpagaat unalu havaangit ingilrajunit ukunangit halumajumik unalu tarjurmiuttat najuqpaktangit tamarmik Iqalukpik (Moore aahiittauq. 2016, 2017, Harris aahiittauq 2020b) unalu Tahirmiut Ihuuq (Harris aahiittauq. 2014, 2020c). Una iningit haffumani halumajumik imaq ingilrajut unalu halumajumik imarmik najuqpaktangit atuqtangit (huvanijuktut unalu ukiivaktut) tadj, ilihautigijangit tamarmik Iqalukpik unalu Ihuuq ilagijaujut havaangillu, hamna kiuviniit hapkuat

makpiraaliuqhimannngittut. Ilagijaujut qaujiharniq qanilruani ukiungani hivunigijauvluni amihuuningit naammagijaunngittut kangiqhihimajangillu ingilrainnaqtut ahinunngaujuktut tamainnut amihuuningit iqalukpik nunangani (Harris aahiittauq. 2016, Moore aahiittauq. 2017). Una kiuviniit haffumani ilittuqhimajangit kiujakhaat hivitujumik kihimi hakuiqtut nauviniit aallatqiingujut tamainnut iqalukpik amihuuningit nunangani iluani unalu ingilrajuktut ulurianaqpiiaqtumik ihumagijaulluaqtangit aquhimajut ukiiraaqpaktut hiamihimajut. Aallat qanilruani havaaq hivunigijaat ihivriurnikhanut niklaumaningit ilagijaujut ilaurutingit uumajuit kumaruit unalu anginiqhautingit uummatigut tigigutaat tahapkuat majuqtunut ingilrajut Iqalukpik Qitirmiut nunangani iluani nalvaaqtauhimajut iqalukpik qaujimajangit niklaumanninga qaanganit ilitturvikhangit iniqhimannngittut (Gilbert aahiittauq. 2020). Amihijut aallaujut ilitarijaunngittut makpiraaliuqhimajut avatiqatigiingnigut nunami-kigligutaat ilihautigijangit tadja havaarijaujuq qimilruqtauhimajut haffumani tarjurmiutaujut niqit nikhikhimaningit nunangani ilagijaujut niriujuktangit inikhautaata haffumani Iqalukpik nalunaijaijut kumaruit ilitturnaqtut maniliurahuagtunut anguniaqhimajut iqalukpik.

### **3 Inungnut, Pitquhirnigut unalu Havaakhanut Ihumagijaulluaqtangit haffumani Iqalukhiurnigut**

#### **3.1 Inungnut unalu Pitquhirnigut**

Iqalukpik aturlluaqpagaat inungnut katilviuningit, pitquhirnigut tukiliutingit unalu niqinut kiuvikhaanit Inuit tamainnut Kanatami (Myers aahiittauq 2005; Balikci 1980). Iqaluktuuttiaq ilihimajaujuqtuq Ekaluktutiak, Inuinnaqtun tukiaqtuq "Nakuujumik Iqalugviutaulluaqtuq" tautungnaqhunilu hakugiktumik pitquhituqangit unalu ilitquhirnut katilviujuq inungnut avvautivagaat Iqalukpik (Thorpe aahiittauq. 2019). Ublumi nunangit huli hivitujumik niqimik iqalukhiurutaujuq uuminngalu inungnut havaakhanullu tunihivaktut uvuuna hulilukaaqtunut unalu maniliurahuagtunut iqalukhiurnirnut.

Iqalukpik inikhautauvluni aturluarivagaat niqitqiktumik (Evans aahiittauq. 2016) unalu inungnut pitquhirnut nunalingni – malittiaqhugulu pitquhituqarnut unalu inuuhittiarnigut maligaaqhugit ilagivagaat pitquhirnigut niqinut, unalu nunamiunullu inmikkut-ihuaqpiarijamingnit (Thorpe aahiittauq. 2019). Una niqigiktuq naammagluarijaat manirarmiunit niqit haffuminngatut Iqalukpik nalaummajumik himmautaulaittuq ukunanngat hivuraanirmiunit niqit, akitturluaqhutik agjaqtaugiami unalu iharianaqtumik aadjikkutaanit niqinit ihuaqtumik (Myers aahiittauq. 2005). Haffuminngatut, ublumimut Nunavut Iqalukhiurnigut Parnaujautinga, 2016-20 kangiqhijavuniguuq niqikhanut himmauhirijaat akingit iqalukpik avatquumajaujuq \$7 milian taala (Una Nunallaami Nunavunmi, Nunavut Kavamangit, Avatilqijit Havagviat, 2016). Ilagijaujuq, Iqalukpik ihumagijauvaktuq niqitqigluaqtuq maligahuaqhutik naahurivlugulu pitquhirnirnut niriujamingnit naiglinahuaqhugu Hg (mercury) niriijaangat ilagijauvaktangit aallat pitquhirnirnut niqingit (haffuminngatit, Tahirmiuttat ihuuq unalu imarmiuttat huraat, Evans aahiittauq. 2016). Una maniliurahuagtut anguniaqtangit Iqalukpik ikajuutaavlutik aturluarijangit inungnut pitquhirnirnullu ukpiruhuutait ilagiiktunut, avvautigijangillu nunalingni qangaraaluk malikhimainnaqtangit akuniraalungmi iqalukhiuqtunut. Ilangit iqalukhiuqtit uvani maniliurahuagtunut iqalukhiurnirnut anguniaqtut aadjigiiktumik



najugait humi inuuhimajut, humi ilaitalu najuqpagaat iqalukhiuqtut anguniaqtullu. Ajuinningit unalu pitquhirnirnut ilittuqtangit taimaa maliinnaqhugu ilihaqhutik tunihivakhutik ilagiiktunut avvautigiiktut aahiittauq iqalukhiuqtit.

Malikhugit uvannat Nunavut Uumajuliqijit Anngutikhanut Iihautikhaq (NWMB 2004), Iqalukpik anguniarluarviujuq avatikhanut Nunavunmi. Ukunannangi 1996 unalu 2001 ukiunnnguraalungmi qaffit niqikhaqhiuqtut anguniaqtit Iqaluktuuttiaq nunangani aallatqiingujut ukunannat 23 unalu 55, anguniaqtunut hamnavluni 6,461 Iqalukpik ukiungani uvannat amihuujut qanilruani imarmit. Iqaluk niuviqtittijut iqaluliqivik ahivaqtauhimajuq uvannat ilitturvikhangit. Kangiqhijaujuq aktilaangit haffumani Iqalukpik uvannat niqikhaqhiuqtunut anguniaqtut aadjigiiktut haffumani maniliurahuqtunut anguniaqhimajut aktilaangit, una Iihautikhangit kiujuujuq imaatut niqikhaqhiuqtut anguniaqtut avvautainnaatigut pivlutik maniliurahuqtunut anguniaqtangit.

### **3.2 Havaakhanut Aturluarningit**

Hamna maniliurahuqtut ikajuqhimajut haffumani Iqaluktuuttiaq Iqalukpik maniliurahuqtunut iqalukhiurnirnut tamainnut aturluarijuujuq tamarmik havaakhanut unalu Nunallaanmi. Uvani 2015, una qaffiuningit Iqalukpik maniliurahuqtunut anguniaqtut Nunavut iluani kangiqhijaujut uvani 72,574 kilukulaatigut kangiqhijaujut nunamunngaujut akikhangit akingit hamnavuq \$1,800,000 (2016 GN Iqaluliqinirnut Parnautingit). Iqaluktuuttiaq tunihimajaat haffumani 37,765 kilukulaatigut uqumaidjuhingit (52%) atautimuuqtumik anguniaqtangit, kangiqhijauhimajuq niuviqtakhaujut akingit maniliuqhimajut haffumani \$855,363.<sup>1</sup> Qanilruani, uvani 2019 mi Iqaluktuuttiaq maniliurahuqtunut iqalukhiurnirnut anguniaqhimajangit 99% haffumani makaqhimajaujuq avguiningit (48,493 Kilukulaatigut uqumaidjuhingit), atautimuuqhimajut 48,097 Kulukulaatigut uqumaidjuhia.

Hamna qanilruani 5-ukiungani ikaarningit angmaumajuq Iqaluktuuttiaq Iqalukpik maniliurahuqtunut anguniaqtangit (2015-2019), una ukiungani ilitquhirnut nunamunngaqtauhimajut avvautingit makaqhimajaat avguiningit nalvaaqtauvaktut puqtuhijullu haffumani Iqaluktuuq (Ekalluk Kuugaq) (96%), malikhugit ukunannat Halugvik (Thirty-Mile Kuugaq) (93%), Jayko (Jayco Kuugaq) (89%), Paallirjuuq (Surrey Kuugaq) (86%), unalu Paalliq (Lauchlan Kuugaq) (90% avatquumajut 2 ukiungit). Nunamihimajut akingit aulavikhangit ukunannat nunamihimajut avatquumajunit uvani 5-ukiunganit akunngani kangiqhijaujunaqhiangit \$942,883, ukunannat ukiunguraangat atuqtakhangit haffumani \$188,577.

Uvannat una 2015-2019, ikaangit, niuviqtakhaat akingit aulapkaihimajangit ukunannat nunamunngautihimajangit Iqaluktuuttiaq kangiqhijaujunaqhiujuq \$4,073,397, ukuninngat ukiunnngani tukiqaqhuni haffumani \$814,679. Una tallimmat-ukiuq tukungit maniliurahuqtut akingit tamainnut ilitturnikkut Iqaluktuuttiaq Iqalukpik nauhimajuq ukunannat Qitirmiut Niqiqarvingat Timigutaa hamnavluni \$22.65/kilukulaatigut uqumaidjuhia<sup>2</sup>.

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<sup>1</sup> See Appendix D: Economic Analysis for details.

Uvannat qanilruani, havaakhanut tunihimajaat haffumani Iqalukpik aadjigiinngittut aallannguqattaqtut aippaagut amihut qanurilingagamik. Hamna avguiningit huli aulajuittut, ukiungani aulattittijangit akikhaat, niuviqtakhaujut akhuuqtut unalu akikhangit, unalu hailihakhaujut anguniariami malikhimannngittangit aippaagunnguraangat aallauvakkamik. Haffuminngatut, akituvallaqaqkami agjaqtuinirnut akikhait, niqiliuqtangillu iqaluliqinirnut, unalu hilatqiijukkhamilu ihuuluutauvaktuq niuvirumajunut, pijumalluaqtangit Iqalukpik. Tukiliuqhimajuq nalunajainingit nunamunngaqtaujut, akikhangit, havaangit ihuaqutingit unalu ihumagijauvaktut havaatigut ihumagijaujut ilaliutauhimajuq uvani Ilulingni D: Havaakhanut Qaujiharngit.

Una Nunavut Pivallianikhanut Timiqutingit inungnut ikajuutaujuq haffumani Nunavut Kavamanut, munarijakhaattauq ikajurahuqtangit havaakhanut hailijakhaat, aadjigiinngittut, unalu aturaaqtakhangit angikliningit unalu ajuqhanngittut Nunavunmi. Hamnaluk angikliktiqhutik Iqalukpik niuviqtakhaat tamarmik iluani hilataanilu. Ihuaqhittiaqhutik havaqatigiiktunut ukunannat NDC, Nunavut Kavamangit, DFO, unalu nunalingni ikajuinnaqtut ihuaqhinahuarlugit kangiqhijunit ihumagijaujunut Iqalukpik ikajurahuqhugit havaakhanut ikajuutikhait nunamiunit nunallaamilu ihumagijauulluaqtangit nalaumattiaqtumik munarijakhaat iqalukhiurnirnut.

***Ocean Wise*** tarjukkut qaujimaningit taidjuhia tarjurmiuttat niqit nanminirijaujuq hapummiviujuq havaanut ajurnaittuni niuvirumajunut qanuq pukukhimagiami manirarmijut tarjurmiuttat niqit kivgaqtuijut unalu nirringmiunit qangaraaluk hivitunianut aanniaqtailinirnut unalu aturaaqhimajakhaat haffumani Kanata'p iqaluliqinirnut. Hitamaujut malikhimajangit ilitturvikhangit Tarjukkut Qaujimaningit ilitarijaujukhaq hamnaujut: (1) Iqalukhiurnirnut amihuuningit unalu aturaaqhimajaujukhat iqalukhiuqtunut akhuuqtangit, (2) nakuuqpiactumik munarijaujuq ukunannat iniqpiaqhimajumik munaqtiunirnut upalungaijautingit kigligutigijaat tadjat atuatangit qaujiharngit, (3) anguniaqhimajangit ukpiruhuutait pidjarikhihimajangit iniqhimaittut anguniaqhimajangit makautihimannngittangit unalu nungutpallialiqtut uumajuit, unalu (4) anguniaqhimajangit inilingnit iniqhimaittut ahiruqhimajaujut uvunga tarjurmiuttat uuminngaluuniit imarmiuttat najuqpaktangit unalu ihuittumik ilagijaujut ukuninngat aahiit uumajuit.

Uplumimut, Qitirmiut Niqiqarvit Timiqutit havaktittijut qaffiujungnaqhijut 28 nit nunamiuqatigiiktut unalu nunataarviujut ikajuqhutik haffumani Iqalukpik maniliurahuqtunut iqalukhiurnirnut ukiunnguraangat kigligutaa. Maniliurahuqtut iqaluliqinirnut anginiqhautaanit nunamiuqatigiiktunut havaktittijunut hailijakhainit, taimaa iqalukhiuqtut nunaqaqtut havakhutiktauq Iqaluktuuttiami ikajuqhugillu nunamiuqatigiiktunut havaangit taimaa amiriinnaqhugulu hivunikhautikhangit ajuinningit uvannat pitquhirijamingnit inuuhingit.

Iqalukpik atauttimuqtut niuviqtaujut unalu niuvirumajunut hailijakhainit angiklijuummiqhuni, aulavikhangit akikhagit taimaa angiklivakhunilu. Qitirmiut Niqiqarvik Timigutaat taimaa maliinnaqtangit atuinnaqhutik tingmiakkut agjaqhijut

akingit akikihimaningit uvannat Nunavut Pivallianikhanut Timiqutaat aturaaqhimainnaqtangit kigligutaanit taimaa ikajurahuaqhutik akitturjuummiqtumik tingmiakkuuqtut agjaqtuinit akikhangit ajuqhautivagaat agjaqhiinahuaqtangit Iqalukpik iqalukhiurvingni najugaanit niqiqarvingnut uvungalu aallatqiingujut nunamiunit iluani ahinunullu hilarjuarmit niuvirumajunut. Avatquttumik 5-ukiunganit ikaarningit haffumani 2014-2018, Qitirmiut Niqiqarvik Timigutaat ilittuqhimakhaaqtangit angiklijuummiqhimajut agjaqtuiniirnut ilagijaat akikhangit ukiunganit, uvannat 20% avvautingat tamainnut aulattittinirnut akiliakhait uvani 2014 mit uvunga 27% avvautaanit uvani 2018 mi.

#### **4 Munaqtiunirnut Akihautingit**

Amihuujut akihautiqaqtut hamna munaqtiuqatigiiktunut timiujut turaaqhimajaat iluani munaqtiunirnut haffumani Iqaluktuuttiaq Iqalukpik maniliurahuqaqtunut iqalukhiurnirnut. Una hivulliujuq munaqtiunikhanut akihautingit ilagijaujut pijumajainnit haffumani nutaannguqtiqattaqtumik amihuuningit amigainningit kangiqhutaat ikajuqhugit munaqtiunirnut ihumaliugainit, tuulliqhimaittumik anguniarnikkut uqariiqhimajut unalu titirainnaqhimalgillu unipkaarijangit anguniaqhimajangit unalu angujangit hakugikpiaqtumik nalunaijaijut ikajuqhutik aturaaqtakhangit anguniaqtangit maliktaat, pidjarikhihimalugillu aturaaqtakhaanit-hivitunia uuktuqattaqtangit nautkailuqaqtangillu haffumani maniliurahuarnirnut iqalukhiurnigut.

##### **4.1 Amihuuningit Amigainningit Kangiqhijaujuq unalu Ihuiluutaujut uuktuutingit**

Iniqpiaqhimajujut nutaannguqhimajut amihuuningit (uuminngaluuniit uumajuit anngutikhangillu nauliqpagaat) kangiqhidjutingit unalu amihuuningit ihivriurnikhat huli kiugiaqaqtangit amihuujut haffumani amihuuningit haffumani maniliurahuqaqtunut anguniaqhimajangit Iqalukpik (takulugu Ilangani 3.2.5). Pitquhirijangit qaujiharirnut inikhaat haffumani amihuuningit ihivriurnikhanut amihuuningillu kangiqhijaujut iniliurlugit aturaaqtakhangit anguniarnirnut malikhimajangit havangnainniaqhuni uumannat akikhangit, tikihimalaaqtangit unalu aturnaqtut tamainnut kuukkait ilitturvingit. Angiqhimagiama inikhautingit, amihuuningit atuqtangit ukpiruhuutait kangiqhijauhijaujut hakugingningit tadjja kiujauliqtut amihuujut hulijakhait humiliqaak nalunaijaijut angmaumajut. Ukuninngat nutaannguqtiqhimajut amihuuningit kangiqhuutingit unalu amihuuningit ihivriurningit, nutaannguqtaujut aanniqtittijunit malikhimajangit haffumani maniliurahuqaqtunut Iqalukpik iluani Iqaluktuuttiaq nunangani ilaliutaulaaqtut. Nalunaiqhimajukhaq, kihiani, hamna aanniqtittiniagut maligautaat hapummijaulaaqtut Iqalukpik mikhaagut huli kangiqhijaunngittut qaujijaqtauvlutik hivunigijangit iniqhimagiama maligautaat naammagijaujut uumajuit aulapkaikukhaq. Kiujauhijaujuq ilangani aviktuqhimajumi haffumani Kanatamiunit Ukiuqtaqtumi, hamna aanniqtittijunit maliktangit hammaujut 11% hapummihimanngittut (Johnson 1980), hamna uvani aahiit inikhaanit ahivaqtittivaktut maligautaanit haffumani 15% - 41% uqaqtauhijaujut (Dempson 1995).

Tadja, anginiqhautaata aanniqtittiniagut huli hapummijauvlutik Iqalukpingnut Nunavut iluani nalunaqtuq ajurnaahunilu atanngujait munarigiami amihuuningit. Kiujauhimajut qulaani, humiliqaak amihuuningit (uumingaluuniit uumajuit amihuuningit) ilihimajaujut qajagijaujukhat maligautaa haffumani 5% (“Tallman’ip Maligaut”) tukhiutauhimajut hapummigiangani nalunajainingit ahuigijaujut ihivriurningit. Talvanngaanit, tutqittiarnaqtuq havaaq hivumuurutijangit kangiqhittiariami anguniarnirnut akhuuqtaujuq(t) uvani uumajunit hapummijaulaahutik anguniariami hivulliutijangit. Tamaat unniqtaujut, qaujiharniq qaujihaijut pijumajangit huli ikajuqhimmaarlutik munaqtiunirnut ihumaliuqtangit avatikhangillu hapummivikhaq.

Angiqhimajaat una iqalukhiurnirnut huli ihumajaujut nalunajainingit-nakuunngittuq, malikhimajangit maligautingit ihivriurnikhanut, tamarmik iqalukhiurnirnut-munaqtaujut (tahapkuat nalunajainingit kititiqtauhimajut uvannngat maniliurahuagtunut iqalukhiurninut) unalu iqalukhiurnirnut-munaqtaunngittut nanminirijaat(tahapkuat kititiqhimajaat inmikkut haffumani maniliurahuarnirnut iqalukhiurnigut) maligiaqaqtangit. Aturaaqtakhaat-hivituningit munarijaat, tiliuqhimajut kangiqhinahuarlugit ukiungani CPUE haffumani anguniaqtangit unalu titiraqhimajaat anguhimajangit unalu iqqaqhimajaat iqalukhiurnirnut iluani, taimaa ikajuutauniaramik ihuaqtumik kangiqhidjuhianit amihuuningit unalu uumajuit ilagijaujut, pijumajaujut aturaaqtakhangit unalu nunat avatiqatigiiktunut-kigligutaa munarijaat haffumani Iqalukpik Iqaluktuuttiaq iluani.

#### **4.2 Anguniarniq Unipkaaqtakhat**

Ikaarvikhaq, nalaumajumik unipkaarjaujukhat tamainnut anguhimajainnit unalu havaktauhimajut atuqhimajangit anguniarutaanit tahapkuat angujangit uvannngat maniliurahuagtunut iqalukhiurvingnit imat unipkaaqtangialik. Iniqhimaitkumik unalu nalaumattiaqtumik munaqtauniq tamainnut anguniaqtunut hulijakhangit, atauttimuqtut anguniaqtangit ahivaqtauhimajut uvannngat iqalukhiurvingnit nalunaramik, unalu munaqtiuqatigiiktut uuktuqattaqtakhaat qajagijauluni aullaqtilihaarumik anguniarnirnut iniqhimaittut taimaa inuuttiarnaqtumik Iqalukpik amihuuningit aturaaqtatariangani anguniaqtut unalu niqikhainit pijumajainnit Inuit munarijaangani.

Anguniaqpallaarumik maniliurahuagtunut avguiningit tautungnaqpakhuni ilaani. Maniliurahuagtunut anguniaqtangit ihariajuktumik huli ittukhaujuq iluani maliguarutigut anguniaqtangit maligautaanit. Una ikaarvingit akunikhaat unipkaarjaanit pitquijangit atanngujat ihivriurluniuk anguniarnirnut iniqhimaittumik iniliuqhimajangit. Qanilruani inikhautikhangit kiuhiujaujut ubluq tamaat unipkaarjajangit haffumani maniliurahuarnirnut nunamunngautihimajangit uvuuna iqalukhiurvingnut ihivriuqtauhimajut (takulugu Munaqtiunirnut Maligautaa, Ilangani 7.4). **Ilagijaujut, avvautijangit munarilluarnikkut munaqtiunirnut pilirikaqhaq ilagijaujut EHTO, Qitirmiut Niqiqarvik Timigutaat unalu DFO talvannngat manngit ikajuqtauhimajut ukunannngat Nunavut Tamatkiumanirnut Munaqtiunirnut Upalungaijaut havaarijaujuk uvannngat 2011-2017. Tamaat maniliurahuagtunut iqalukhiurnirnut tadja munarijaujut atauttimut ahivaqtauhimajut, ilagijaujut maniliurahuagtut nunamunngautijangit unalu iqqaqtauhimajut, unalu nanminirijangit niqikhainit kiugiaqaqtuq qanilruani maniliurahuagtunut laisikhaanit qanurilinganingit.**

### 4.3 Havaanut Uuktuutikhangit haffumani Iqalukhiurnirnut

Puqtuhimajuq agjaqtuinirnut akikhat ihuiluutiliqhugit havaakhanut iniqtirumajangit haffumani maniliurahuaqtunut iqalukhiuqtut humiliqaak unгахiktut kuukkanut mikhaagut, iniqhimaittuullu ihumaliuqtangit aulapkaigiame nutaamik maniliurahuaqtunut iqaluliqinirnut aallat unгахiktumi iqalukhiuqtunut najugait. Niuviqhimajangit Iqalukpik uvannat qanilruani nunaliit, atuqhugit umiat, aahiillu parnaijautingit ihivriuqtaujut ikajuqtunut ilauhimajunut tunihivlutik maniliurahuaqtut nunamunngaqtittijut anguniaqtangit Iqaluktuuttiarmut, pidjarikhijaami hivitujumik pivallianikhangit havaktittijunullu inikhautaata haffumani Qitirmiut Niqiqarvik Timigutaat. Aviktuqhimaajumi unalu nunallaamilu munariqattariiqut timiujut huli ikajuqhimmajaqtut havaakhanut uuktuutijangit pidjarikhivlugillu amihuuningit humaangittut amihuuningillu.

## 5 Hivunigijakhaat

Hivunigijakhaat haffumani Iqaluktuuttiaq Iqalukpik maniliurahuaqtunut iqalukhiurningit hivunigilluarijaat haffumani IFMP. Aturaaqtakhangit hivitunia hivunigijakhaat tahuqtaata munaqhiijangit haffumani iqalukhiuqtunut taimaa ilanngailaaqhugit amihuuningit hapummivikhangit, nunat avatiqatigiit, avvautihimalugillu munarjuarnikhat, inuuhirnut, pitquhirnut unalu havaakhanut hivunigijakhaanut. Tamaita aturaaqtakhaat hivitunia hivunigijakhaat ikajuqtauhimajut atauhimit amihuujunilluuniit naittumik hivituningit hivunigijakhaanit turaaqhutik atuqtaaqhimajangit munaqhiinirnut akihautingit iqalukhiurnirnut. Una hivunigijakhaat titirariiqhimajut uvani Nalunaitkutaq 2 hannajariiqhimajaujut uvanna IFMP Havaqatigiiktunut Ilagijaujut unalu aallat ikajuqhimaajut ilauhimajut.

**Nalunaitkutaq 2. Aturaaqtakhangit-hivitunia unalu naittumik-hivitunia hivunigijakhaat Iqaluktuuttiaq Iqalukpik maniliurahuaqtunut iqalukhiuqtunut.**

Aturaaqtakhat-hivitunia Hivunigijakhaat	Naittumik-hivitunia Hivunigijakhaat
<i>Amihuuningit Hapummijangit</i>	
<p>Hapummilugit Iqalukpik amihuuningit uvuuna aturaaqattaqtakhainit atuqtangit unalu ihuaqtumik iqalukhiurnirnut munaqhainingit</p>	<ul style="list-style-type: none"> <li>• Nutaannguqtirlugit amihuuningit ihivriurnikhanut nalunaitkutaq unalu kiujakhaat aturaaqtakhainit anguniaqtangit maligautait taminnut maniliurahuaqtunut imat</li> <li>• Ihuaqhimalugit ilihimajainnit haffumani Iqalukpik nauviniit, avataita unalu amihuuningit ajuqhautingit</li> <li>• Ihuaqhimalugit ikaarvingit nalaumadjuhia anguniaqtumut unalu CPUE uqaqtauhimajut uvani maniliurahuaqtunut, hulilukaaqtunut</li> </ul>

Aturaaqtakhat-hivitunia Hivunigijakhaat	Naittumik-hivitunia Hivunigijakhaat
	<p>unalu niqikhaqhiuqtut iqalunirnut qanilrukkut munarilugit atauttimuqtut ahivaqhiijut iqalukpik angujangillu.</p> <ul style="list-style-type: none"> <li>• Ikajuinnarlugit hapummijakhaat unalu aulapkaijut iqalukhiuqtut maligautait Iqalukpinut.</li> <li>• Ilitturnaqtuq nalunaqtumik ilagijaat amigainningit Iqalukpik amihuuningit Iqaluktuuttiaq nunangani iluani, anguniaraaqhimalutik hapummiqattaqhimalutik maligautaanit atuqhimainnarlugit PA havaarijaujuq.</li> </ul>
<b><i>Avatiqaqatigiingniq</i></b>	
<p>Hapummilugit angujangit uumajuit uvuuna ihuaqpiagtumik iqalukhiuqtunut munaqhainingit.</p>	<ul style="list-style-type: none"> <li>• Ihuaqhimalugit nalaumajangit iniqpiaqhimajut uqaqtauhimajut angujait ihuaqtumik kangiqhittiariami uumajuit ilagijaujut unalu munaqhainingit.</li> </ul>
<b><i>Avvautihimalugit Munarjuarningit</i></b>	
<p>Ikajuinnaqhimalugit havaqatigiingnirnut, ilauqatigiingnirnut ihumaliuraangat, avvautihimalugillu auladjutingit ukunangat avatingnit atuqattaqtut, munaqtiuatigiiktunut timingat unalu aallat ikajuqhimajut ilauhimajullu.</p>	<ul style="list-style-type: none"> <li>• Aulapkailugit kinguani-hilaqutitigut iqalukhiuqtunut katimajut unalu IFMP Havaqatigiiktunut Ilagijaujut katimajut ukiumi atuqtangit.</li> <li>• Ilagiinnaqhimmaarlugit nunamiuatigiikunut ilauqatauhimajut uvani munariqatauhimajunut hulijakhait tamainnut hailijaugaangat.</li> <li>• <b>Ikajuinnarlugit auladjutikhangit haffumani maniliurahuagtunut iqalukhiuqtit munarigiame qanilrukkut unalu uqaqhimalugit, laisikhaitigut maliktangit.</b></li> <li>• Hukahimalugit manngit ikajuutikhangit munarigiame qanilrukkur ilihautikhangit haffumani maniliurahuagtunut, hulilukaarvikhanut unalu niqikhaqhiuqtunut iqalukhiurningit.</li> </ul>
<b><i>Inungnut, Pitquhirnigut unalu Havaakhanut</i></b>	
<p>Ikajuqhimalugit havaktittinahuarniq</p>	<ul style="list-style-type: none"> <li>• Ikajurlugit inikhautikhangit ihuaqhinahuarlugillu nunalimiunut</li> </ul>

<b>Aturaaqtakhat-hivitunia Hivunigijakhaat</b>	<b>Naittumik-hivitunia Hivunigijakhaat</b>
<p>aulattinnaqtumik unalu inmikkut-nakuuqpiarijamingit iqalukhiurniq kigligutaa puqtuhijumik nakuuqpiaqtumik angiklijuumminnaqtumik inungnut unalu havaakhanut ikajuqpiaqtangit, pidjarikhinahuarlugillu amihuuningit aanniaqtailinahuarlugit amihuuningillu hivunikhanut aturaaqtakhangit.</p>	<p>piliriakhaat unalu havaktittinirnut inikhautikhangit.</p> <ul style="list-style-type: none"> <li>• Ikajurahuarlugit parnaijautikhangit angiklinahuariami tikinnaqtumik maniliurahuagtunut auladjutikhangit amihunut ungahitqijajut kuukkait aahiillu iqalukhiurvingit najugait.</li> <li>• Munarilgut hapummilugillu nunamiujut pitquhingillu iqalukhiuqtunut hulijakhait nunaiillu.</li> <li>• Ikajuinnarlugit havaqatigiiktunut tamainnut munariqatigiiktunut timiujut ilagiinnaqtangit ukunangat havaakhaliurniq pivallianikhaq tamainnut Nunauvnm.</li> </ul>
<b>Malittiarniq</b>	
<p>Ikajuinnarlugu malittiarlugit maligautingit, maliguarutit, unalu munarijajut maligautaa tikinnahuarlugit hapummijakhat aturaaqtakhangillu atuqtut.</p>	<ul style="list-style-type: none"> <li>• Pidjarikhilugit maniliurahuagtunut laisikhaat maligautaa nutaanguqhimajut qautamaat, tautukhimalugillu atuqattaqtakhanut munaqhainingit haffumani iqalukhiurnirnut.</li> <li>• Ikajuinnarlugit malittiarniq uvuuna ilihautiniq unalu avvautigiinnarlugu munarjuaqatigiiktut. Havaqatigittiarlugillu nunamiunit nunallaamilu uumajulijit havaktit.</li> <li>• Ikajuinnarlugit malittiarniq qanilrukkut munariqattarlugit unalu qunnianginnarlugit piksaliurnigut hulidjuhit, angiklijuummirlugillu tautukhimainnaqtangit nunalingni.</li> </ul>

## 6 Atuqtittinuq unalu Avguiningit

Maniliurahuagtut avguiningit auladjutajut tamainnut imat, turaaqhimajut uvani Parnaijaut V haffumani *NWT Iqalukhiurnirnut Maliguarutit*. Tamaat imait akihautiqaqtut avguiniq; imaattutauq, tamaat iqalukhiuqtit laisikhautigut maniliurahuagtut iqalukhiulaaqtut

Angiqtauhimajunmi imarmi iqalukhiurnaqtuq kihimi atauttimuunganut avguinikhanut imarmi. Avaliqanngittut avguiningit qaffiuningit ilagijajut ukunangat maniliurahuagtunut iqalukhiuqtunut. Una maniliurahuagtunut iqalukhiurnirnut

angmaumajuktuq ukiunnguraangat uvuuna Aallatqiingujunut Maliktangit, unalu umikpakhunilu Nalunaitkusalik Umikhimajuq avguiningit tikittaraangat. Maniliurahuagtunut iqalukhiuqtut laisikhat titiraqtajut iqalukhiuqtit malikhaugit Ilangani 7 haffumani *Iqalukhiurnirnut Maligaq*.

Kinguani ilagijaungmat haffumani Paalliq (Lauchlan Kuugaq) uvani 2018, hivumuurutigijaat naiglivlugit qaffiuningit turaaqtaujuq qaffiuningit uvunga Iqaluktuuq unalu Jayko Kuukkat havaarivlugit angiklijuummiqhugu nunamunngaqtittijut anguhimajainnit niriugijaujuq uvannat Paalliq (Lauchlan Kuugaq). Tahapkuat hivunigijaat naiglijauvlutik qaffiuningit aadjigiinngittut ukiungani maliinnaqhugit havaatigut uvani iqalukhiurvingnit aulattittijut tamatkiumangit inikhautiningit ublumimut atauttimuqtumik qaffiuningit tutquumavikhangit inikhaqannginnamik angiqtaujumik amigaattumik Iqalukpingnut. Naiglijauhimajut hivumuurutingit qaffiuningit atuinnaqhugu uvunga ukiakhami iqalukhiuqtunut, ihuaqhinarluugit nakiruutikhangit haffumani upinnaami-ukiakhamilu anguniaqtangit kivgautijangit, ilagilugulu pivigilaaqtangit iqalukhiuqtit unalu puptalaaqtumik tingmiat aullarumik Jaykomit qilamik, hikutinnagu hilarluktinnagulu taimaa qajagijauvakkamik kinguani Apitilirvingmi.

Nalunaitkutaq 3 takunnaqtuq tadjja maligautigut qaffiuningit haffumani maniliurahuagtunut iqalukhiuqtunut tamarmik avatainnaagut uqumaidjuhigut kilukulaatigut (una nalaumaqpiangit naujangit ilitturningit qaffiuningillu malikhimajangit qaffiuningit avguiniagut, turaaqhimajaujuq uvani Parnaijaunmi V) unalu iliuttuq uqumaidjuhianut uqumaidjuhingit (ilitturningit iluittumiglu aktilaanganit atuqtauvaktut titiraqhugit angujangit). Uuktuutiniagut kititiqhimajangit tukiliuqhimajuq uvani Ilangani 7.3. Qaffiuningit unalu angujangit haffumani maniliurahuagtunut iqalukhiurnirnut qanilruani aippaanganit takukhaujut uvani Iuani B mi. Uvani qanilruanit aippaanganit Qitirmiut Niqiqarvik Timingat ilagijaat hivunikhaanut qaffiuningit tautungnaqtut niqiqarvingat inikhaat.

**Nalunaitkutaq 3. Maligautigut qaffiuningit Iqaluktuuttiaq Iqalukpik iqalukhiuqtunut.**

<b>Najugaat</b>	<b>Maligautigut Qaffiuningit</b> <i>(Kg, Iliuttut Uqumaidjuhia)</i>	<b>Ihuaqhiriqhimajut Maligautigut Qaffiuningit</b> <i>(Lbs, Tiataaqhimajut Uqumaidjuhia)</i>
Iqaluktuuq (Ekalluk) Kuugaq	20,000	36,744
Halugvik (Thirty-Mile) Kuugaq	5,000	9,186
Jayko (Jayco) Kuugaq	17,000	31,232
Paallirjuaq (Surrey) Kuugaq	9,100	16,718
Paalliq (Lauchlan) Kuugaq	9,100	16,718
<b>Tamatkiqtaat</b>	<b>60,200 Kgs.</b>	<b>110,598 Lbs.</b>



## 7 Auladjutingit Maligaat haffumani Havaktauvlutik Upalungaijautingit

Auladjutingit maligaat tukiqaqtuq munarilluaqtangit uuminngaluuniit malikhimajangit maliktaat iqalukhiurnirnut, ilagijaujut amihuuningit hapummijaujut aturaaqtakhangillu auladjutiningit maliktangit. Auladjutingit maliktangit haffumani Iqaluktuuttiaq Iqalukpik maniliurahuagtunut iqalukhiurnignit ilagijaujut munarijaat ilagivlugit qaffiuningit, angmaumaningit unalu nalunaitkutingit nutqaqhimajut haffumani iqalukhiuqtunut; laisikhaanit unalu malikhimajakhaat laisikhaat, ilagijangit uqaqtakhanut kiuvikhangit angujangit, iqqaqhimajangit, imarmiuttat anngutikhangit ilagijaujut nalvaaqtangillu/tammaijangit ingilrutingit uvuuna atuqhugit maniliurahuagtunut uqaqtakhaat titiraqhimajut makpiraanmi. Tahapkuat malikhimajangit kigliutijangit uvannat *Iqalukhiurnirnut Maligaq* unalu maliguarutit, una Nunavut Angirutaat NA, Iqalulijirjuat DFO atuagait, unalu malikhimajangit angiriiqhimajaat uvannat IFMP Havaqatigiikhimajut Ilagijaat, ikajuqtauvlutik haffumani aturaaqtakhangit auladjutigijangit. Ilagijaujurlu, tahapkuat malikhimajangit munarijauvlutik avvautihimajangit munarirjuarningit ihuaqhiriiqhimajut nakuuqpiaqtumiglu malittiaqtangit inikhalik haffumani Iqaluktuuttiaq Iqalukpik maniliurahuagtunut iqalukhiuqtunut (takulugu Ilainnaa 8). Iluaniittumi C takunnaqtuq tamatkiumajangit haffumani auladjutiningit malikhimajangit tadsa inikhautaujuq.

### 7.1 Laikhaatigut haffumani Maniliurahuagtunut Iqalukhiuqtut Hulidjuhiit

Maniliurahuagtunut iqalukhiuqtunut laisikhaat titirariiqhimajut ukiunnguraangat malikhugit ukunangat Ilainnaa 7 haffumani *Iqalukhiurnirnut Maligaq*. Ilainnaa 5(1) haffumani *NWT Iqalukhiurnirnut Maliguarutit* kinguani illittuqhimajaat tamaita iqalukhiuqtut hulidjuhiit pijukhautaujut aulattittinirnut laisikhaanit. Ilagilugulu ilaliutauhimajut turaaqtahimajuq iluani *Iqalukhiurnirnut (Tamainnut) Maliguarutit* unalu *NWT Iqalukhiurnirnut Maliguarutit*, naunaitiaqhimajut auladjutiningit maliktangit tukittaaqhimajuq iluani maniliurahuagtunut laisikhaanut.

### 7.2 Qaffiuningit

Tamaat imat akiharnaqtumik avguiniqaqtut. Hamna akihautigijangit avguiniq tikitkumiuk imarmi, anguniaraaqtakhaunngittut haffumani Iqalukpik pijakhaunngittut maniliurahuagtut hulidjutikhait piffaaqtakhaunngittut iqalukhiurvinut ikaarutingit (Qiqailruq 31). Imat umikhimajut maniliurahuagtumik iqalukhiuqtakhaunngittut uvuuna kitunuliqaak kivgautinirnut pinahuarniq haffumani Nalunaitkutaq Umiktauhimajuq ukunangat Iqalukhiurnirnut Havakti maliinnarlugu Ilainnaa 19(2) haffumani *NWT Iqalukhiurnirnut Maliguarutit*. Una ilagijaat titiraqtauhimajut tamarmik uvunga EHTO unalu Qitimriut Niqiqarvik Timigutaa nalunaiqhijakhaat nanminingillu najurvingit.

### 7.3 Munaqtiuningit unalu Unipkaaqtakhaat

Maniliurahuagtunut iqalukhiuqtit munarijakhaat unipkaaqtakhaat nunamunngaqtaugumik, una ilagijaujuq ukunanngat *Iqalukhiurnirnut (Tamainnut) Maliguarutit* unalu *NWT Iqalukhiurnirnut Maliguarutit* una tiliuqhimajuq iluani munaqhiijangit maligautaat haffumani upalungaijaut. Ikajuqtauvlutik maligautaa, titiraqhimajakhaat nalunaijaijut makpiraanmi angmaumajut uvannat EHTO, GN Annguhiqijit Havagvia, uuminngaluuniit Qitirmiut Niqiqarvik Timigutaa. Iniqpiaqhimalugit naunaijaijut titiraqhimajaat makpiraanmi hamna nutaannguqtiqtajut malikhugit laisikhaanit, unalu aulapkaijakhaat haffumani maniliurahuagtunut iqalukhiuqtit. Maniliurahuagtunut iqalukhiuqtit kiuqattaqtakhaat atuinnarlugit nalunaijaijut makpiraanmi nipiliurlugit tamaat maniliurahuagtangit angujangit, iqalukhiuqtunut hulidjuhingit, Iqalukpik iqqaqtauhimajangillu pihimajangit niqikhamaat, ikhinnaqtauhimajut ingilrutingit uqaqtaujukhat, tarjurmiut tingmiat unalu imarmiujut huraat hulivangniagut, unalu tamaita iqaluk anghimajangit havakhutik maniliurahuagtunut iqalukhiurnirnut. Nalunaijaijut titiraqhimajangit makpiraanmi tunijaujukhat uvunga una nunamiuqatigiiktunut uumajuliqiji havagviat uvungaluuniit iqaluqarvik utittillugulu uvunga Iqaluliqijirjuakkut DFO inirutaanit iqalukhiuqtunut.

Ikajuqhimagiama anguniarluagtut uqaqtauhimajut unalu qaffiuningit avguiniq munarijangit, ubluq tamaat nipiliuqtakhaat anghimajangit tamainnut maniliurahuagtunut imarmi pihimajaat ukunanngat Qitirmiut Niqiqarvik Timigutaa unalu uqaqtauvaktut ubluq tamaat uvunga DFO. Unipkaangit anqitauvaktut qautamaat iqalukhiuliraangat hilaqutitigut, kititiqtauvakhutik anghimajainnit tamainnut imarmi nalunaijaivakhutik naunaijariangani maniliurahuagtunut avguiningit. Havakhimajangit titiraqtauvakhutik naunairiaqaqtut atuqhugit nalunaijaijut makpiraanmi nalunaitkutaq nunguani hilaqutitigut. Ihuigijauningit turaaqtauhimajut uvani nunguani-hilaqutitigut qimilurningit.

Aturnaqtumi avguiningit munaqtaujut kiugiaqaqtangit tukhiutijangit uuktuutigijaangani mikhaagut. Anghimajangit nipiliuqtaujut titiraqhugit uqumaidjutitigut (lbs nut) tiahimajut uqumaidjuhia, humiliqaak avguiningit titiraqtauhimajut imaatut kilukulaatigut (Kg) iluittut uqumaidjuhia. Uqumaidjuhiatigut atuqtangit hamanujuq 1.2 titiraqhimajaujuq avvautigivlugit hapkuat tiahimajunit uqumaidjuhigut iluittumiglu uqumaidjuhitut. Titirariiqhimajut avvautiniagut hamnaujuq 0.45359237 atiliuqhimajut avvautaugumi uqumaidjutitigut uvunga kilukulaatigut. Iluittut uqumaidjuhia kilukulaatigut kangiqhidjuhia kititiqtautinnagu atuqhugit avigiirningit:

$$\text{Avataatigut Uqumaidjuhia Kg} = (\text{Tiahimajut Uqumaidjuhia lbs.} \times 1.2) \times (0.45359237)$$

Haffuminngatut munarijaujut qanilrukkut unalu titiraqtaujut piliriangit takukhaujut uvani Ilulingit B. Avguiningit qanilrukkut munarijaat avvautigijangillu unipkaanga (Naahaut 4) havaktaujut kigligutaanit ubluq tamaat unipkaagutaat titirariiqhimaningit nainaaqhimajut (Naahaut 5) unalu ubluq tamaat agjaqtaugaangat unipkaagutaanit (Naahaut 6).

## 7.4 Ilagijaujut Laisikhangit Qanurilinganingit

Uvani ilagijaujut tadsa laisikhanut qanurilinganingit, maligautingit, unalu munaqtiunikhanut unalu unipkaaqtakhaat kiuvikhangit, ilagijaujut qanurilinganingit aulattitihimajangit iluani iqalukhiurnirnut ihuaqhihimagiangani iqalukhiuqtit, nalunaijainingit kititiqhimajangit akhuurningit, unalu ihuaqtumik aturaaqtakhangit munaqtiunikhanut haffumani iqalukhiurnirnut tamainnut.

7.4.1 Una avvautingit nalunaiqtauhimajut uvani laisikhanut atauttimuqtut avguiningit haffumani akiharnaqtumik maniliurahuagtunut avguiningit illittuqtauhimajut imanganit. Iqalukhiuqtunut hulijakhangit nutqaqtukhaq kinguani avvautingit naahimagumiuk. DFO nalunaiqhimaniaqtangit avatikhanut atuqtittijut hamna umigumik haffumani iqalukhiurnirnut ukunannat ilitarijaujunut nalunaitkutaq.

1.1 Iqalukhiuqtunut hulijakhangit nutqariaqaqtut qilamik naahimagumiuk avguiningit.

7.4.2. Maniliurahuagtut titiraqhimajaat nalunaijaijut titiraqhimajakhaat ihuaqppiaqtumik, iniqpiaqhimalugillu, unalu taigurnaqtut qautamaat kuvjat ihivriuqtaugaangat uuminngaluuniit haputit imairaangata. Tamaat uumajuit angujaujut, munarihimajangit iqqaqhimajangillu titiraqtauhimajukhat, ilagijaujurlu anguhimajangit uumajuit, unalu qujaginnaq tarjurmiuttat tingmiat unalu tarjurmiuttat huraat ilagijauvaktut.

7.4.3. Ikajuqtauhimajut haffumani Ikhinnaqtauhimajut Ingilrutit Iqalukhiurnigut Inikhautikhangit (takulugu ilangani 1.6.4), laisikhangit tigumiaqtit kiugiaqaqtangit unipkaaqhimajakhaat tammaqtauhimajut kukiktauhimajulluuniit kuvjat uvunga DFO qaritaujakuurvigilugit uvunga:

[DFO.CALostandRetrievedGear-EnginsPerdusRecupCA.MPO@dfo-mpo.gc.ca](mailto:DFO.CALostandRetrievedGear-EnginsPerdusRecupCA.MPO@dfo-mpo.gc.ca).

Kinguani Ikhinnaqtauhimajut Iqalukhiuqtunut Ingilrutingit Inikhautikhangit, ingilrutikhat nalunaitkutait pilimmakhaqtaujut uvani maniliurahuagtunut iqalukhiurnirnut, ikajuqtauhimajut ukunannat uuktukkaffuktut havaaq hivuliqtigijangit ukunannat DFO ikajuqtauvlutik ukunannat Anguniaqtit HTO unalu nunamiuqatigiiktunut Hapummijunut Havaktit.

Nalaumattiaqtumik ingilrutikhat nalunaitkutait ilahimajaat uvunga maniliurahuagtunut mahikkut kuvjangit ukunannat Iqaluliqijjinut Havakti uuminngaluuniit tikkuaqtunut nunamijunut Annguhiqijit Havakti iqalukhiurnahuagtinnatik atuqhimalugillu alilaittumik qiliirutikhaq. Ingilrutit nalunaitkutait munarittiaqhimajakhaat iliuraqtakhaat uvunga mahikkut kuvjat qautamaat hamna kuvjaq atuqtauhimakpat maniliurahuagtunut iqalukhiurnirnut hivunikhaat. Tammaqhimagumik nalunaitkutait unqaqtaujuqhaujut uvunga [Lostgear-enginsperdus@dfo-mpo.gc.ca](mailto:Lostgear-enginsperdus@dfo-mpo.gc.ca) hivajarlugilluuniit akiittukkut uvunga 1-800-465-4336 unalu titirariaqaqtut (iluani illittuqhaujut makpiraaq).

## **8 Avvautijangit Munarilluaqtangit Ihuaqhihimajangit**

Una IFMP haffumani Iqaluktuuttiaq Iqalukpik maniliurahuagtunut iqalukhiurnirnut aulapkaihimajangit pivalliahimajangillu ukunannat Iqaluktuuttiaq Iqalukpik Havaqatigiiktunut Ilagijaujut uvani 2010 mi. Ilaugatauhimajut haffumani Havaqatigiiktunut Ilagijaujut ilagijaat kivgaqtuihimajangit uvannat EHTO (Ikhivautaqatigiiktunut), Qitirmiut Niqiqarvinga Timiqutingit, maniliurahuagtunut iqalukhiuqtit, nunalingni inutuqait, Avatiliqijit Havagviat – Iqalukhiurnirnut unalu Nattirnut Avvautingit, unalu DFO. Inulrammiit uvannat nunamiuqatigiiktunut angajukhiit iliharvik akhuuquijut upainnaqhimalutik ilaugataulutiglu ikhivajunut ilaugatigiiktunut haffumani Havaqatigiiktunut Ilagijaujut.

Una titiraqhimajut ikajuutigijangit uvannat NWMB tunijauhimajut ukunannat Havaqatigiiktunut Ilagijaujut uvani 2011 mi pijumajauulluaqtangit ikajuutikhangit inikhautikhangit haffumani Havaqatigiiktunut Ilagijaujut unalu pivallianikhanut haffumani munaqtiunirnut upalungaijaut. Katimajukhat katimahimajut Iqaluktuuttiami atauhiiqhutik ukiungani uvani 2010 mi. Tamaita katimajut ilaqatauvakhutik nunalingni katimadjutikhangit nalvaarahuaqhutik nunalingnit tautukhimajangit malikhugit Iqalukpik munaqhiijangit akihautingit, hivunikhautikhangit, munaqhiijangit maligautaat unalu qaujiharnirnut qaujiharniq.

Una tallimanit five (5) ukiunganit qimilurningit haffumani IFMP havaktauhimajut uvani 2019/2020 unalu titiqqangit kigligutaanit nutaannguqtiqtuniglu numigutaat haffumani IFMP.

Amihuujut aallatqiingujut inikhautikhangit hamna hivunigijakhaat haffumani iqalukhiurnirnut tikihimalaaqtangit. Tadja munarijaat maligautingit nalunaiqtaujut uvani Ilaliutaanit C. Aallat maligautingit aulapkaihimalaaqtut ukunannat munaqtiuqatigiiktunut timinganit, ukunannat IFMP Havaqatigiiktunut Ilagijaujut, unalu ilaliutijangit iluani ilanganit haffumani IFMP.

### **8.1 Nakuuqpiaqtumik Munarijakhaanit Maliktangit – Huvaniktittijut**

Ikajuqhugu haffumani aturaaqtakhangit-hivitunia aanniaqtailinirnut haffumani hapummijakhaat iqaluliqinirnut mikhaagut, aturluarnaqhunilu naiglinahuariami hup ihumagijauulluaqtangit ihuuluutauhimajut uvunga huvaniktittijut amihuuningit. Taimaa iniqpiaqhimajuq tammaqpalliajut huvaktittijunut ukiakhami majuqtunut ingilrajut kiutquijangit tahapkuat huvaniktittijut ilagijangit haffumani amihuuningit ihuittumik ihuuluutaunngittut ukunannat maniliurahuagtunut iqaluliqinikkut. Hamna huvaniktittijut angujaangaat kuvjanut iqalukhiurniq, unalu uumagaangamik, tamaat huvanikhimajut Iqalukpik utiqittijakhaat humiliqaak anghimajaat, taimaa aanniqtailinahuarlugit. Haputimi iqalukhiuraangamik, tamaat huvanikhimajut iqalukpik utiqittijakhaat aanniqtailihimalutik. Tahapkuat nakuuqpiaqtumik munaqhiiningit tadja malikhimajakhaat uvani maniliurahuagtunut iqaluliqijunut.

## **8.2 Nakuupiaqtumik Munaqhiijangit Uuktuutingit- Hapummijaujukhaq Inikhautikhaq**

Paalliq (Lauchlan Kuugaq) maniliuqtauhimaittut ananguniaqtakhat uvannat 2010 uvunga 2017 havaakhaqannginnamik uuktuutikhangit ilagijaujut angmaumajunut maniliurahuatunut avguiningit unalu hivitujumik agjaqtuinirnut akikhangit. Atulihaaqhimajut uvani 2018 mi, makaktaujukhaq maniliurahuatut avguiningit haffumani Paalliq (Lauchlan Kuugaq) turaaqtauhimajut uvannat 5,000 kilukulaatigut uqumainningit, ikajuriami ihuaqtumik amihuuningit ihivriurningit unalu havaakhanut uuktuutigijangit. Una maligautingit avguiningit haffumani iqalukhiurningit hamnaujuq 9,100 kilukulaatigut uqumainningit, kihimi nalunaqtuq amihuuningit qaffiuningit kumaruit uumajuit uvani.

## **8.3 Nakuupiaqtumik Munaqhiijangit Uuktuutigijangit – Haputit Aturnaqtut**

Una haputit pitquhirijaujut ukpiruhuut Inuit aturaaqhimajaat iqalukhiuqtut nuvuani kuukkait. Haputit pitquhirijangit aktigilluaqhugut tamaat kuukkait taimaa ingilragaangat iqalut katitiqtauvlutik hanaqivlugillu. Haputit atuqtauvagaat niqikhaqhiuliraangata unalu maniliurahuatunut kititiqpagaat Iqalukpik uvani Jayko Kuugaq. Atuqhugit haputit taimaa ajuqharnaittut iqalungnut avguiningit qilamik tatatpaktuq, naiglivlugillu pijumangittangit anguhimajangit, anngutikhanullu nirijumajangit unalu tammarnaittut ingilrutingit. Haputit taimaa iqalukhiuqtinut pijumajainnit pukungnaqhuni kititiqhimajangit iqalut, ajurnaittumik utiqittilaaqtangit huvaniktunut arnat kuugarnut aanniqtailivlutik; taimaa atuqhimaittut kuvjanik.

## **9 Angiqatigiikhimajujq Upalungaijaut**

Una DFO Hapummijangit unalu Hiamittailiniarniq havaaq ikajuqhimajut angiqatigiiklutik maligautaat, maliguarutit unamu munaqhiinirnut maliktangit pilimmakhaqhutik inirahuahutik hapummijakhaat aturaaqattarlutigli atuqtakhaat Kanata’p imarmiuttat avatingit..

Una piliriakhaq turaaqhimajaujuq ukunannat DFO Iqaluliqinirnut Havaktit Qitirmiummi unalu Ukiuqtaqtuq Nunangani ukunannat nalruujuq maliguarutit munaqhiijangit akhuuqhimajangillu apqutikhangit ilagijaujut hamnaujut:

- Ikajuinnarlugit angiqatigiikhimajut uvuuna ilihautiniq avvautijangillu munaqhaijangit;
- Munarinahuarlugit, maniqhiilugit unalu tautukhimajangit hulijakhangit; unalu
- Munaqhiijangit qimilruutijangit ilagijaujut ajurnaqtumik angiqatigiikhimajut akihautingit.

### **9.1 Angiqatigiiktut Piliriakhaq Agjaqtuiniq**

DFO Iqaluliqiniq Havaktit munarijakhaat angiqatigiikhimajut hulijakhait ilagijaat uvunga Iqaluktuuttiaq Iqalukpik maniliurahuatunut iqaluliqiniq. Iqaluliqiniq Havaktit nautkaihimajut qunniaqtaujukhaq hulajhkangit, ikajuqtauhimajut ukunannat

Aviktuqhimajumi DFO havaktiit ikajuinnaqtangit uvuuna munaqhiijangit, unipkaarijangit, ilihautiniq unalu avvautijangit munqhiiqattaqtangit.

Iqaluliqiniq Havaktit tikkuqaqtakhaat maligautigut Ilangani 5 haffumani *Iqalukhiurnirnut Maligaq* akhuuqhutik hakugingningit munarijakhangillu ilaliutijaat ukunanngat *Iqalukhiurnirnut Maligaq* unalu aahiit Maligaq Maligarjuarnigut, ilagijaattaq Ihuinaarnirgut Maliktakhaq unalu *Hivulliqaangit Kavamarjuangani Maligaq*. Iqaluliqiniq Havaktit qimilrulaaqtangit ihivriurlugillu havaarijaujumi aulattittijut, iqalukhiurvingit najugaat unalu umiangit angiqatihimajaujut uvannat *Iqalukhiurnirnut Maligaq* unalu ilagijaujuq maliguarutit, ilagivluniuk Aallatqiingujut Maliktakhat qanurilinganingillu laisingit.

## **9.2 Katimadjutigijangit**

DFO Iqaluliqiniq Havaktit ilauqatauvaktut qimilruutivlugit katimajunit atauttimuqtunit akihautaat tautungnaqtut kiugiaqaqtangillu iniqhimajakhaanit. Uuminngalu, ilitarijaunngittumik katimajunit huli uvani ihariahugaangata ihuaqhinahuariami iluani – hilaqutitigut hulijakhait. Iqaluliqiniq Havaktit niplautigijangit iqaluliqinirnut hapummivikhangit avvautigijangillu munarittiaquvlugit pulaaraangata Iqaluktuuttiaq ilaqatigiikhugillu nunalingni avatingnut atuqtunut, iqalukhiuqtit havaarijaujullu.

## **9.3 Angiqatigiingningit Aulapkainiq**

Kinguani hilaqutitigut qaujiharningit katimajut nauhimajut qimilruriangani akihautingit katittugit hivuani havaarijaanit kiutquijangillu ihuaqhiangani munaqhiijangit malikhimajangit.

## **10 IFMP Aulapkainingit Qimilurningit**

Una IFMP pivalliahimajuq uvuuna katimadjutaavluni piliriakhaq ilagijaujuq avatikhanut atuqtunut, munaqtiuatigiiktunut timiujut unalu ikajuqtiujut ilauhimajut. Maniliurahuagtunut iqalukhimajaat Iqalukpik amihuuningit Iqaluktuuttiaq nunangani iluani unalu amihuujunit ukiukhami ihivriurningit huli ihivriuqtauhimmaaqtukhat mamakhimajaat ikajuqtangit qaujiharnirnut kiuvikhangit. Munarijangit iqalukhiurnirnut iniqtukhaq atuqhugit amihunit ingilrutikhangit ilagijaujut ubluq tamaat unipkaariluniuk nunamunngautihijangit iqalut, avguiningit munarijaat, iqalungnut-maliinnaqatangit (iqalugarvik) ihivriurningit, titiraqattarlugit naunaijaijut makpiraanmi, unalu tautukhimainnarlugit piksaliutimi.

Kinguani hilaqutitigut qimilurningit havaariniqatigut qautamaat ukunanngat ikajqutuijut ilauhimajut unalu IFMO Havaqatigiiktut Ilagii. Havaadjaringningit tikihimajainnit naittumik hivitunia havaarijakhait ihuarutingillu pilimmakhainirnut munarijangillu malikhimajaat nalunaiqtaulunilu iluani Munaqhiijangit Upalungaijautingit qimilruqtaulunilu. Kiujakhaujut ihuaqtumik munaqtiuningit haffumani Iqaluktuuttiaq

Iqalukpik maniliurahaqtunut iqaluliqiniq pivallianahaqtuangit tikinnahuarlugulu aturaqtakhait hulijakhaat hapummijaujukhaq iqaluliqiniq.

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## **Tukiliutingit**

**Amihuuningit:** Naahautingit avaliqanngittut iluani amihuujut uuminngaluuniit amihuuningit.

**Ukiuq Havaangit:** Qaffiuningit avaliqanngittut aallatqiingujut ukiungit amihuujut uuminngaluuniit angujangit.

**Tarjurmiuttat Kuukkanunngaujuktut Iqalut:** Tarjurmiuttat kuukkanunngaujuktut uumajuit, iqaluktut, inuuhingit tarjurmiunginnaqtut utiqpakhutik halumajumut imat huvaniliraangat kuugarmiuujunit.

**Aallatqiit Iqalukhimajut:** Ihumagijaunngittut iqalukhimajangit makakhimaittangit uumajuit iqalukhiuraangata aallamik uumajukhiuqtut. Haffuminngatut, iluani IFMP iqalukhiurumajangit Iqalukpik, iqalukhimajut tamaat aallaujut uumajuit.

**Nauhimajut uumajunit:** atauttimuqtut uqumaidjuhia tamainnut avaliqanngittut amihuujut amihuuningit.

**Iqalukhiurniq:** Tukiqaqtuq ukunannat *Iqaluliqinirnut Maligaq*, iqaluliqinirnut ilagijaujut nunagani, huqpaniittumi, najugaat iqalukhiurvingat iluani qaangani uqumaidjuhia, iqalukhiurut, kuvjaq, haputi, uumingaluuniit aallat iqalukhiurvikhamik atuqpaktut, hannaijaqhimajuq, atuqtangit, humunngaqhimajangit, uuminngaluuniit najurvingit, nunangani, ilangani, tahnia imaup iluani uvannat iqaluk unguvaqtauhimajuq. Hivunikhautikhangit haffumani IFMP, tamaita ublungani Iqalukpik maniliurahuqtunut imangit iluani Iqaluktuuttiaq nungani kititiqhimajut kiujuavaktuq “Iqaluktuuttiaq Iqalukpik maniliurahuqtunut iqalukhiurniq”.

**Mahingnut kuvjaq:** Iqalukhiuqtut ingilrutik: kuvjaliqijut uqumaidjutiqaqtut ataani puptalaaqtut qulaanit atuqhutik iqalungnigiangat. Mahikkut kuvjat aallatqiinit hitijumik kihaqalingnit tarjumi nunangat. Hivunigijangit haffumani IFMP, tamaat maniliurnirnut atuqtauvaktut kuvjat naihimajukhat imaatut aktilaangit 139mm (5-½ inch), malikhimajangit ukunannat *NWT Iqalukhiurnirnut Maliguarutit*.

**Anguniaqtut:** Angujangit angunahuqtangit iqalut humik atuqhugit.

**Nunamiuhimajut:** Qaffiuningit uumajuit anguhimajangit pihimajangillu. Hivunikhautigijangit titiqqaitigut, nunamiuhimajangit turaarviujuq qaffiuningit Iqalukpik pihimajangit maniliurahuqtunut niuviqtakhaq.

**Nalunaitkut Umikhimajuq:** Hamna tukiliutiqaqtuq Ilangani 19 haffumani *NWT Iqalukhiurnirnut Maliguarutit*, naunaiqtauhimajuq titirariiqtaujuq uvannat Iqalukhiurnirnut Havaktinga uuminngaluuniit Aviktuqhimajumi Tukimuaqtittiji-

Atanngujaq uqaqhimajuq hamna naahautingit turaaqhimajajuq iluani Aallatqiingujut Maliktakhat pivluni, pinahuaqhuniluuniit, tikihimajangit. Naunaitkuta tunihimajakhaat ilihimajakhait inungnit ihuiluutauhimajut ukunannat (haffuminngatut, nalunaitkutaq tunijauhijajuq uvunga Ekaluktutiak Anguniaqtit HTO unalu Qitirmiut Niqiqarvik Timinganit kitunuliqaak tautuktakhat).

**Nunavut Angirutaat (NA):** Una 1993 angirutaat ukunannat Inuit haffumani Nunavut Nunataarviujuq Nunangani, kivgautijangit uvannat Tunngavik Timiqutaat Nunavunmi unalu Kuin Pijunnautinga Kanatami.

**Nunavut Uumajuliqijit Katimajit (NWMB):** Aullaqtilihaaqhimajuq ukunannat Nunavut Angirutaat NA, timiujut inungnit kavamangit avvautijangit ihumaliuqatigiiktut aulattittijut ukunannat Kavamarjuangit.

**Amihuuningit:** Ilagijajut inungnit aadjigiiktut uumajuit, nauhimajut ilagijajut, unalu avvautigijangit uumajuit najuqpaktangit.

**Avguiningit:** Hivunigijajut haffumani IFMP, qaffiujut atauttimuqtut (uvani Kilukulaatigut Avatingnut Uqumaidjuhia) haffumani Iqalukpik maniliurahuqtut anguniaqtakhaat, turaaqhimajajut uvani Nakataq V, Havaakhanut V haffumani *NWT Iqalukhiurnirnut Maliguarutit* uuminngaluuniit ilagijajut ukunannat Aallatqiingujut Maligautaat.

**Huvanilaqtut:** Arnaujut inirmiujut avaliqanngittut.

**Amihuuningit:** Tukiaqtut amihuuningit avaliqanngittut atajuijuq uumajuit nalvaqtauhimajut humiliqaak nunangani. Haffuminngatut, ilagijajut Iqalukpik avvautigijangit aadjikkutaanit ilagiinnaqtut. Imaq hivitujuq amihuuningit atuqtauvaktut ilangani iqalukhiurnirnut munarijaat hivunikhautikhangit Iqaluktuuttiaq maniliurahuqtunut iqalukhiurnirnut. Munarijakaanit hivunikhautikhangit, tamaita maniliurahuqtut imanganit ihumagijajut avaliqanngittumik munarijaat ilanganit.

**Ilitquhingit Avatiqatigiikhimajut Qaujimajangat (TEK):** Amigaitpaktut timingat qaujimajangit tunihimajaat ukunannat akuniraalut pitquhirnirnut turaaqhimajajut ilaqatigiiktunut uumajuit (ilagijaattaq inut) atahiuqatigiiktut nunap avatingillu.

**Aallatqiingujut Malikhimajanit:** Tukiliuqhimajut uvani Ilangani 6(1) haffumani *Iqalukhiurnirnut (Tamainnut) Maliguarutit*, humiliqaak umikhimajajut ikaarvikhanut, iqalukhiuqtut avguiningit uuminngaluuniit iniqhimaittut aktilaangit uuminngaluuniit uqumaidjuhiat iqaluk ihuaqhihimajajut ihumavlugit iningani (hamnaujuq imap ilangani) malikhugit Maliguarutit, Aviktuqhimajumi Tukimuaqtittiji-Hivulliujuq imailiulaaqtut, aallatqiingulaqtut iniqhimaittumik.

**Haputit:** Iqalukhiuqtut ingilrutingit: imarmiujuq ataaniittut talua ihuaqhiriqhimajut uvani V-tut ilitquhiqatut, tukiliuqhimajut kajumiiqtittilaqtut ikaaqhimajut iqalut. Itiqhimalaaqtut haniraagut ikaaqhimajut, taimaa iqalut angulaaqtangit haputi iluanut.

Iluani Iqaluktuuttiaq nunangani haputit ilitquhiutauvluni iqalukhiuqtunut qangaraaluk  
ujararnut hanavlugit. Tadjja ublumimut haputit hanaujajut tuqhualingnit.

DRAFT

# Iluliutaa A Pitquhitsuqangit Iqalukhiuqtut Najugait

# Maniliurahuagtunut

Naahaut 3. Nunaujaq Iqaluktuuttiaq nunangani takukhaujuq ilitquhimingnit maniliurahuagtunut iqalukhiuqtut najugait.





## Iluliutaa A Maniliurahuaqtunut avvautingit unalu nunamunngaqtut unipkaaqtaujut

Nalunaitkut 4. Maniliurahuaqtunut Iqalukpit avvautingit unalu nunamunngaqtut iluani Iqaluktuuttiaq nunangani, 2009-2020

Ukiug	Ekalluktok/ Ekalluk Kuugaq		Paliryuak/ Surrey Kuugaq		Halokvik/ Thirty-Mile Kuugaq		Paalik/ Lauchlan Kuugaq		Jayko/ Jayco Kuugaq	
	Avvautingit	Nunamunngaqtut	Avvautingit	Nunamunngaqtut	Avvautingit	Nunamunngaqtut	Avvautingit	Nunamunngaqtut	Avvautingit	Nunamunngaqtut
2009	20,000	12,666	9,100	8,657	5,000	5,219	2,400	NF	17,000	
2010	20,000	20,434	9,100	9,074	5,000	3,317	2,400	2,534	17,000	
2011	20,000	13,636	9,100	11,475	5,000	1,124	2,400	NF	17,000	
2012	20,000	19,038	9,100	8,945	5,000	4,920	2,400	NF	17,000	
2013	20,000	18,548.48	9,100	9,078.01	5,000	4,768.16	2,400	NF	17,000	1
2014	20,000	18,279.37	9,100	9,082.10	5,000	5,010.08	2,400	NF	17,000	1
2015	20,000	16,929.78	9,100	6,823.75	5,000	4,159.62	2,400	NF	17,000	
2016	20,000	20,011.32	9,100	5,739.49	5,000	4,212.42	2,400	NF	17,000	
2017	20,000	20,000.97	9,100	8,990.11	5,000	4,888.46	2,400	NF	17,000	1
2018	20,000	16,569.64	9,100	8,791.71	5,000	4,997.05	9,100	3,917.13	17,000	1
2019	20,000	16,698.91	9,100	8,883.97	5,000	4,971.74	9,100	5,061.27	17,000	1
2020	20,000	14,496.63	9,100	7,826.65	5,000	4,917.58	9,100	NF	17,000	1

Avvautingit nunamunngaqtullu akikhangit unipkaaqtaujut Kilukulaatigut uqumaidjutaanut, Tamatkiqtangit Uqumaidjuhiq.  
NF = Iqalukhiuqhimaittuq.

Iniqhimajuq ilitquhiita (1960 – 2009) avvautingit anguniaqtangit Iqaluktuuttiaq Iqalukpit maniliurahuaqtunut iqalukhiurniq ilagijaujut uvanngat Day unalu Harris (2013).

**Naahautaa 4. Iitqubiqut haffumani avguiningit munaqhiijangit unalu ihuaqhaihimaajangit unipkaangit (2020)**

Site	2020 Commercial Quota - Round		2020 Targeted Harvest		2020 Commercial Quota - Dressed Weight (conversion)		2020 Targeted Harvest - Dressed Weight		Kitikmeot Foods Reported Harvest (original reporting in)		Kitikmeot Foods Harvest (converted to Round Weight)		Quota (Round Weight) Remaining		Percentage
	KG	LB	KG	LB	KG	LB	KG	LB	KG	LB	KG	LB	KG	LB	
Lauchlan (Byron Ba	9,100	20,062	0	0	7,583	16,718	0	-	0.00	-	0.00	0.00	0.00	20,062.04	#DIV/0!
Ekalluk	20,000	44,092	17,418	38,400	16,667	36,744	14,515	32,000	12,080.53	26,633.00	14,496.63	31,959.60	2,921.37	12,132.80	83.2%
Halovik (30 Mile)	5,000	11,023	4,899	10,800	4,167	9,186	4,083	9,000	4,097.98	9,034.50	4,917.58	10,841.40	-18.58	181.70	100.4%
Jayco	17,000	37,479	13,063	28,799	14,167	31,232	10,886	23,999	9,278.01	20,454.50	11,133.61	24,545.40	1,929.39	12,933.14	85.2%
Paliryuak (Surrey)	9,100	20,062	8,709	19,200	7,583	16,718	7,258	16,000	6,522.20	14,379.00	7,826.65	17,254.80	882.35	2,807.24	89.9%
<b>TOTAL</b>	<b>60,200</b>	<b>132,718</b>	<b>44,089</b>	<b>97,199</b>	<b>50,167</b>	<b>110,598</b>	<b>36,741</b>	<b>81,000</b>	<b>31,978.72</b>	<b>70,501.00</b>	<b>38,374.46</b>	<b>84,601.20</b>	<b>5,714.54</b>	<b>28,054.88</b>	<b>87.0%</b>
					Reflects a round weight to dressed weight (gutted, head on) conversion in kilograms - Standard conversion for Cambridge Bay	Reflects a round weight to dressed weight (gutted, head on) conversion in pounds - Standard conversion for			Harvest converted to kilograms, Dressed Weight (gutted, head on) - this column can be compared	Original harvests from Kitikmeot Foods are reported in Lbs, Dressed Weight (gutted, head on) - this column can be compared to Column E (quota)	Harvest converted to kilograms, Round Weight (gutted, head on) - this column is compared to Column B to	Original harvests from Kitikmeot Foods in Lbs, converted to Round Weight - this column is compared to Column C to determine	A negative (-) value (displayed in red) indicates an over-harvest of the quota	A negative (-) value (displayed in red) indicates an over-harvest of the quota	
										THIS IS THE ONLY COLUMN YOU NEED TO ENTER DATA IN - all other data is automatically calculated from this.					
	This column reflects what is actually issued on a Variation Order		Kitikmeot Foods has advised that Ekalluk and Jayco targeted harvest is reduced by 5000 and 8000 lbs respectively to offset the increased landings expected from harvesting at Lauchlan. The fish plant operates at			This column can be used by Kitikmeot Foods for tracking of the annual quota (since it reports harvests in dressed				This column reflects what is actually reported by Kitikmeot Foods		This column reflects the dressed to round weight conversion of what is actually reported by Kitikmeot Foods (Column H)			

Nanminirijangit titiqqat uvaniittut qaritaujami Excel spreadsheet, nutaannguqtigattahutik qautamaat Ubluq Nalunaijaigaangat nainaaqhimaajuq Titiiqqanmi (takulugu Naahautaa 5 ataani)

**Naahautaa 5. Iitquhiatigut ubluq tamaat titiraqhimainnaqtangit havaangit uvani 2019**

Date	Time	Lot#	Tub#	Dressed Weight (lbs)	Round Weight (Kg)	Trip Total	per Tub per Trip (Lbs)	Culls (#)	Comments		
10-Jul-19	18:35	1	1	102.5	55.79					Site:	Surrey River
10-Jul-19	18:35	1	2	110.5	60.15					Fishing Period:	7/10/2019 - 7/21/2019
10-Jul-19	18:35	1	3	99.0	53.89					Average Weight per Tub:	102.60
10-Jul-19	18:35	1	4	102.0	55.52					Average Weight per Trip:	1,088.10
10-Jul-19	18:35	1	5	97.5	53.07					Total Trips:	15
10-Jul-19	18:35	1	6	98.5	53.61					Total Culls:	159
10-Jul-19	18:35	1	7	97.0	52.80					Quota (Dressed Wt LB):	16,718
10-Jul-19	18:35	1	8	81.0	44.09					Targeted Quota (Dressed Wt LB):	16,718
10-Jul-19	18:35	1	9	98.5	53.61					Total Harvest (Dr Wt LB):	16,321.50
10-Jul-19	18:35	1	10	96	52.25	982.50	98.25	10	Fish Condition: firm and uniform, no smell, good texture, no lesions, fish temp @ 3C.	Remaining Quota (Dr Wt LB):	396.89
11-Jul-19	10:15	2	1	100.0	54.43					Remaining Trips (estimate):	0.364753438
11-Jul-19	10:15	2	2	95.5	51.98						
11-Jul-19	10:15	2	3	89.0	48.44						
11-Jul-19	10:15	2	4	120.0	65.32					Quota (Rd Wt KG):	9,100
11-Jul-19	10:15	2	5	107.0	58.24					Targeted Harvest (Rd Wt KG):	9,100
11-Jul-19	10:15	2	6	120.0	65.32					Harvest to date (Rd Wt KG):	8,883.97
11-Jul-19	10:15	2	7	96.5	52.53					Remaining Quota (Rd Wt KG):	216.03
11-Jul-19	10:15	2	8	106.5	57.97	834.50	104.31	8	Fish Condition: firm and uniform, no smell, good texture, no lesions, fish temp @ 3C.	Percent Landed to date:	97.6%
12-Jul-19	13:45	5	1	108.5	59.06						
12-Jul-19	13:45	5	2	103.5	56.34						
12-Jul-19	13:45	5	3	100	54.43						
12-Jul-19	13:45	5	4	100.5	54.70						
12-Jul-19	13:45	5	5	98.5	53.61						
12-Jul-19	13:45	5	6	94.5	51.44						
12-Jul-19	13:45	5	7	98.5	53.61						
12-Jul-19	13:45	5	8	102.0	55.52						
12-Jul-19	13:45	5	9	110.5	60.15						

Nanminirijangit titiqqat uvaniittut qaritaujami Excel spreadsheet, nutaannguqtiqattaqhutik qautamaat Ubluq Nalunaijaangat nainaaqhimajuq Titiqqanmi (takulugu Naahaut 6 ataani)

**Naahaut 6. Iitquhiatut ubluq tamaat agjaqattaqtunut titiqqangit iniqhimajaat ukunangat Kitikmeot Foods Ltd (2019).**

Kitikmeot Foods Ltd.  
Fish Plant

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Raw Product Inspection Report

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ARCTIC CHAR

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Date: July 13-2019  
 Time: 12:00  
 Area: SURRY RIVER Lot# 06  
 Tubs: 13

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Tub #	Weight lbs.	Culls
1	116	
2	96	
3	104.5	
4	105.5	
5	99	
6	112	
7	101.5	
8	99	
9	102	
10	97	
11	99.5	
12	104.5	
13	108	
= 1254.5 lbs.		

Lot: Pass   
 Fail

#Culls: 13

Comments: Fish Condition  
Firm and Uniform  
No Smell  
Good texture  
No lesions  
Fish Temp @ 4°C

QMP Manager: [Signature]  
 Date: 07/13/19

\* ALL FISH ARE INSPECTED PRIOR TO PROCESSING \*

C:\Documents and Settings\SANDRA\My Documents\Fishing - inspection report.doc

Nalunaitkutaq: nunamunngaqhimajut unipkaaahimajangit uvannat Uqumaidjuhiatigut, Iuittukkut Uqumaidjuhia. Uqumaidjuhiat ihuaqhiyajut atiliuqhimajut uvani Naahautaanit 4 unalu 5.

**Tadja atuqhimajangit munaqtiunirnut uuktuutingit**

Munaqtiunirnut Uuktuut	Tukiliutaa
Najugait	<ul style="list-style-type: none"> <li>• Maniliurahuaqtunut imarmiujuq turaaqhimajaujut uvani NWT Maliguarutaanit.</li> <li>• Imarmiuttat angmaumajut ukiunnguraanit Aallatqiingujut Maliktangit</li> </ul>

<b>Munaqtiunirnut Uuktuut</b>	<b>Tukiliutaa</b>
Avguiningit	<ul style="list-style-type: none"> <li>• Turaaqhimajut uvani NWT Maliguarutimi tamainnut maniliurahuagtunut imarmiujut.</li> <li>• Tamaat imarmiujut akiharnaqtumik avguinilgit. Avaliqanngittuq avguinikhanut ilagijaujut ukunanngat maniliurahuagtunut iqalukhiurnirnut.</li> </ul>
Laisiata	<ul style="list-style-type: none"> <li>• Kiugiagaqtut maniliurahuagtut iqalukhiuraangat.</li> </ul>
Uumajuit, nunaanit iqalukhimajangit iniqhimaittut	<ul style="list-style-type: none"> <li>• Uumajuit unalu imarmiujut atiliuqtukhat iqalungnut ilittuqtaugaangat.</li> <li>• Qaffiuningit ilittuqtauhimajut Kilukulaatigut, Avataanit Uqumaidjuhia.</li> <li>• Aallannurningit pihimajut ilittuqhimajut, aturnaraangat.</li> <li>• Qaffiuningit ilittuqhimajaujut atauttimut akihautingit maniliurahuagtut qaffiuningit angmaumajut.</li> </ul>
Iqalukhiuqtut Hilaqutitigut	<ul style="list-style-type: none"> <li>• Qitiqqautijuq1 – Qiqailruq 31, ukiunnguraangat.</li> </ul>
Naunairutaanut umikhimajuq	<ul style="list-style-type: none"> <li>• Akiharnaliraangat avguiningit tikihimagaangat, imarmiujut umikhimajut maniliurahuagtunut iqalukhiuqtut.</li> <li>• Uvuuna inungnut nalunaitkutaq, titiraqhimajut ukunanngat Iqalliqinirnut Havakti.</li> </ul>
Iqalukhiuqtut Ingilruta	<ul style="list-style-type: none"> <li>• Mikiniqhautaanit mahiutigut kuvjijijut aktikkutaa 139mm (5-½ takinia).</li> <li>• Hapunmi aturaangamik, 1/3 hivitunia kuugarmi kuugannuamiluuniit angmaumainnaqtukhaq.</li> </ul>
Ikhinnainnarningit	<ul style="list-style-type: none"> <li>• Laisiqaqtunut unipkaaqhimajukhat tammai jaut kukiktauhimajut kuvjait nalvaaqhimagumigluuniit iqalukhiuqtunut ingilrutikhaq, uvani 24 ikaarnikkut ilittuqhimajunut DFO qaritaujami titiraqhimajut uvani Ilagijaujukhanut Laisinut Qanurilinganingit haffumani maniliurahuagtunut iqalukhiuqtut laisinut.</li> </ul>
Iqqaqhimajangit	<ul style="list-style-type: none"> <li>• Iqaluk igittukhaujut uvani tarjurminut marluanit. Tahapkuat tikkuarii qhimajut ukunanngat Iqalungnut Havaktit maligautaanit ilangani 56 haffumani Iqalungnut Maligaq.</li> </ul>
Ahivaqtauhimajut unala hulugijait	<ul style="list-style-type: none"> <li>• Tamaat igijauhimajut Iqalukpik, ilagijangillu nanminirijaanit nirihimajangit, titiraqhimajukhat nalunaitkutaq makpiraanmi.</li> <li>• Igijauhimajut iqaluk titiraqhimajukhat nalunaitkutaq makpiraanmi, nalunaiqhimajangit pihimaniaqtangit nanminirijakhait nirijakhait kititiffaaqhimajangillu.</li> </ul>
Unipkaaqhimajangit Kiuviniit	<ul style="list-style-type: none"> <li>• Unipkaaqhimajut nunamunngaqhimajut kiugiagaqtangit haffumani maniliurahuagtut iqalukhiuqtut.</li> <li>• Unipkaaqhimajut tamaita igijauhimajut unalu iqaqtaujut nalunaitkutaq makpiraanmi.</li> <li>• Unipkaaqhimajut tamainnut imarmiujut uumajuit ilagijaujut kiuhimajaujut haffuminngatut annauvikhanut anguniaqtut uuminngaluuniit utiqittijut uumagaluahutik; unipkaariaqahutik</li> </ul>

Munaqtiunirnut Uuktuut	Tukiliutaa
	<p>nalunaitkutaq makpiraanmi.</p> <ul style="list-style-type: none"> <li>• Maniliurahuagtunut iqalukhiuqtit nalaumajumik iniqpiaqhimajumiglu titiraqhimajakhaat iqalukhiuqtunut hulijakhainit, ilagilugillu iqaluktut qanurilinganingillu tamainnut mahingnut kuvjiliqijut uuminngaluuniit haputinut nunamunngautijut, titiraqtakhait uvani nalunaitkutaq makpiraanmi. Nalunaijajut makpiraanmi pivigiinnarialik uvannat EHTO uvanngaluuniit Kitikmeot Foods Ltd.</li> <li>• Kitikmeot Foods Ltd. Ilaliutijakhaat unipkaaqtut tamainnut aullaqhimajut, ilaliutijangit ublunganit, ikaarningit, najugaat, humiittut qijuqutingit naahautingit, unalu nunamunngaqhimajut qaffiuningit. Auhimajut Ililikhanut Ihivriuqhimajangit Unipkaarutikhat angiqtauhimajuq ilitturvikhaq. Tamainnut aullaqhimajut unipkaangit kajumiktukkuuqhimajut uuminngaluuniit qaritaujakkuuqhimajut uvunga DFO ublungani aullaqhimajut taimaa.</li> </ul>

**Iluliutaa A Havaakhaliurniq qaujiharniq Iqaluktuuttiaq Iqalukpik haffumani Iqaluktuuttiaq Maniliurahuagtunut Iqalukpik Ilagijaujut Iqaluliqinirnut Munaqhiijangit Upalungaijaut**

Iqalukhiuqtit Iqaluktuuttiarmi taimaaraaluk ilitarihimaliqtangit aturluaqtauvaktuq Iqalukpik avatikhangit nunangani. Maniliurahuagtut iqalukhiurnirnut havaktauhimajut ukunannat nunamiuqatigiiktunut Inuit iqalukhiuqtit ilagivluniuk ukunannat aulattittinirnut ikajuqtaujuq ukunannat niqiqarvik Kitikmeot Foods Ltd. (KFL), maniliuqhimajut niqiqarviujuq tamarmik Iqalukpik umingmainillu. Qitirmiut niqiqarvik taidjuhia Kitikmeot Foods Ltd., niqiqarviutuangujuq Iqaluktuuttiami, nauhimajuq uvani 1990 mi himmauhiutaujuq uvannat Nunavut Pivallianikhanut Timiqutait. KFL kivgaqtuijut angiklijuummiqhuni aimavingnit unalu hilarjuarnut iqalungnit niuviqtittijut malikhugit nunallaam atituangit hamna *Truly Wild Arctic Char*<sup>TM</sup>.

Hivitujuq maniliurahuarniq iqalukhiuqtunut najugait Iqaluktuuttiami tadja ilagijaat kuukkait Iqaluktuuq (Ekalluk), Paalliryuaq (Surrey), Halugvik (Thirty-Mile), Paalliq (Lauchlan) unalu Jayko kuugait.

**Nunamunngauliqut unalu Nunamiittut Akikhangit**

Uvani 2014/15-2018/19, ilagijaujut atauttimuqtut haffumani 227,915 kg uqumaidjuhia haffumani Iqalukpik nunamunngaqhimajut Iqaluktuuttiarmi maniliurahuagtunut iqalukhiurnirnut (Tukiliutaa 5 unalu 7).<sup>2</sup> Kititiffaarnirnut ajuqhautingit, ukiunganit

naahautingit atuqhimajut uvani havaatigut qaujijaijut hamnaunngittuq Paalliq (Lauchlan Kuugaq) iqalukhiunnginnamik uvannat 2010 unalu 2018. Atulihaaqtumi uvani 2018, Paalliq (Lauchlan Kuugaq) iqalukhiurviutaujuq malikhugit naiglihimajunit avguiningit, hamna qaujijaqtauhimainnami naunairvikhainit, ihumaliuqhugit ukunanngat IFMP havaqatihimajangit ilagijaujut ikajuqhugit hapumminahuarlugit inikhautikhangit aturaaqattaqtakhait munarijangit iqalukhiurnirnut. Una nunamunngaqhimaqut akikhangit aulapkaihimajuq ukunanngat iqalukhiurnirnut hamnaujuq \$1.2 milian taala atauttimut akuniujumi, ukiunganit atuqpagaat haffumani \$298,000.<sup>3</sup>

**Tukiliutaa 5. Atauttimuqtut nunamunngaujut avatqumajut 5 ukiukhamut 2014/15-2018/19**

	Nunamunngaqtut iqaluktangit (kg) <sup>1</sup> avataanit 5 ukiukhamut akuningit	Ukiukhamut nunamunngaqpagaat (%) <sup>2</sup>
Iqaluktuuq (Ekalluk Kuugaq)	91,791	95
Jayko (Jayco Kuugaq)	69,528	86
Paalliryuaq (Surrey Kuugaq)	39,427	87
Halugvik(Thirty-Mile Kuugaq)	23,268	93
Paalliq (Lauchlan Kuugaq)	3,902	7890 (2 ukiungani avatquttut iqalukhiuqhimaqut)
<b>Atauttimuqtut</b>	<b>227,915</b>	<b>90</b>

### Nanminiat Havaarijaujut

Uvani 2014/15 - 2018/19, una 5-ukiukhamut ilagijaujut niuviqtittijut akingit nauhimajut nunamunngautihimajut hamnaujungnaqhijut \$5.9 milian taalaujuq, ukiunganit havaarijauvagaat \$1.5 milian taalaujuq. Niuviqpaktangit akingit Iqaluktuuttiaq Iqalukpik hamnauvlutik \$25.9/kg (takulugu Tukiliutaa 7 tukungit)<sup>4</sup> ilitturnaqhunilu maniliuqhimaqut akingit angiklivalliavluni haffumani 22% uvani 5 ukiungani akunngani havaanut.<sup>5</sup> Una puqtuhitqijaujut angiklivallianinga titiraqhimaqut niaqua/papirua ahivaqtauhimajuq havaanut uvannat (35%) malikhugit iluittuq (28%), tiahimajut (19%) ihihungnittut haniraat (10%) mikpiliuqhimaqullu (4%). Angiklihimajut niuviqtukhat akikhangit ilainaa tukiaqhuni angiklijuummiqtumik niuvirumalluaqtut; angiklivallianingit kangiqhijaujuq

<sup>4</sup>Uqumaidjulia niuviqtunut akikhangit kititiqhimaqut kigligutaanit avvautainnaatigut niuviqhimaqut ilainnaatigut hamnaujut: (i) Tamatkiujut Ilulia: 55% havaarijaujut; (ii) Niaqua, papirua ahivaqtauhimajut: 23%; (iii) Tiahimajut: 10%; (iv) Ihihungnittut haniraat: 8%; unalu (v) Mipkuliuqhimaqut: 4%. Tukittiaqhimagiami avvautainnaatigut niuviqhimaqut ilainnaatigut, takulugu hamna RT & Associates (2001).

niuvigtunut akikhangit angiklijuummiqhuni akikhangit aulattittinirnut (hamnaujut tingmiakkut agjaqhijut aallat akikhangillu) haffumani iqalukhiurnirnut.

**Tukiliutaa 6 KFL Aulattittinirnut Akingit 2014/15 – 2017/18**

<b>Akingit Pivikhait osts Items</b>	<b>2014/15</b>	<b>2015/16</b>	<b>2016/17</b>	<b>2017/18</b>	<b>Average</b>
Tingmiakkut Agjaqtuijut Ilagijangit Akiliakhat					
Akiliakhat	20%	21%	22%	27%	22%
Qulliliqinirnut	25%	25%	25%	24%	25%
Havagviat Aulattittiningit	38%	40%	36%	33%	37%
Iqalut Niuvigtittijut unalu Iqalliqijut	17%	15%	17%	16%	16%
<b>Atauttimuuqtut</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>
Akingit kilukulaatigut Kg Iqalliqinirnut	\$16.6	\$22.4	\$18.3	\$16.1	<b>\$18.3</b>

*Tunngavia: Atuagaq Maniliurahuarnit, DFO Ukiuqtaqtuq Nunangani kititihimajut kiglianut nalunaijainirnut ukunangat Kitikmeot Foods Ltd.*

*Naunaitkut: KFL aulattittiningit akingit nalunaijainigut haffumani 2018/19 angmaumangittuq uvani kititihutik.*

Uvannga 4 ukiunganit akunnganit haffumani 2014/15 – 2017/18 akunnganit, qaffiujut ukiunganit aulattittihimajut akikhangit maniliuqhimajut ukunangat KFL hamnaujungnaqhijut \$800,000. Hamnauvluni, havagviata aulattittinirnut tukihiaqhuniuk akikhangit (37%) malikhugit, qulliliqiniagut (25%), tingmiakkuuqtut akikhangit (20%) unalu akiliakhangit iqalukhiuqtunut iqalliqijunullu (16%).

Qaujiharningit nanihimajangit akikhangit anguniarnirnut Iqalukpik aadjigiinnginnamik uvannat \$2.9 - \$3.6 uqumaidjuhanut haffumani maniliurahaqtunut iqalukhiurvingnit uvannat 2014/15 – 2017/18 akunnganit. Ilitturnaqhunilu ilangit kuukkait, kihimi atauttimuuqtut akikhait iqalukhiuqtunut puqtuhivallaahuni, ilainnaa akikhangit ikitpiaqhuni anginiqhautaanit iqalukhiuqtunut avguiningit puqtuhigamik (haffumani Iqaluktuq kuugaa). Taimaattaq, puqtuhijumik uuktuutigijangit anguniarnirnut uvaniittuni iqalukhiurvingnit, ikittumik akikhangit agjaqtuinirnut akikhangit unalu KFL Niqiqarvingit ilanganit ikivalliangmat. Qaujiharningit takukhauvluni iqalukhiuqtut Iqalukpik uvannat maniliurahaqtunut iqalukhiurvingnit kinguani niqiliuqhimajut niqiqarvingmi tunihigiami hivulliuqut niuvirumajunut, ukiunnguraangat aulattittinirnut akikhangit uvannat \$18.0 kilukulaatigut uqumaidjuhia Iqalukpik hanajauhimajut.

**Havaktittinirnut**

Hamna maniliurahaqtunut iqalukhiurniq unalu niqiqarvingit havakhaitigut aturluarnaqtuq nunalingni Iqaluktuuttarmiunut. Iqalukpik iqalukhiurniq ikajuinnaqpagaat nunamiunut havaakhanut nautkaqhugit nanminiqutigullu angiklijuummiqpaktut, ikajuqpakhutik aturaaqtakhat havaktittinirnut ilihautikhangillu hailijaujut nunamiuqatigiiktunut, ikajuqhutik havaakhanut aallatqiinut.



Qitirmiut Niqiqarvik havainnaqhutik ukiuraalungmi unalu havaktittivakhutik nunamiujunut iqalukhiuqtit iqalukhiurnaqhigaangat upinngaami ukiakhamilu iqalukhiurnaqtumi. Iqaluqarvik havaktiqaqhutik 6 havainnaqtunut havaktit, 14 niglu hilaqutitigut havaktiqaqhutik, unalu naahimavaktut 20 nit hilaqutitigut iqalukhiuqtit.

Iluani Iqaluktuuttiaq Iqalukpit iqalukhiurnigut, tamainnit maniliurahuagtunut iqalukhiurvingit najugait aulapkaihimajut ukunanggat hivuliqti iqalukhiuqti, munarivagaat havaktit aahiittauq ajuitpiaqtunut iqalukhiuqtit. Aktigijaat havaktit aallatqiingujut aallat hulijakhainut, ilagijaujuttauq havagviata najugaat ingilrutingillu atuqpagainit, niriugijaujut aullarutaat (haffuminngatut avguiningit, hilaup, havaup ikaarvingit), angmaumagumiglu qaujimajaujut iqalukhiuqtit. Ilangit iqalukhiuqtit havaaqajuktut amihut iqalukhiurvingnit najugaat. Havaarijangit uvani 2014-18, tukungit aippaagutaanit naahautingit anguniaqtit hamnaujut 10.<sup>6</sup> Amihunit iqaluk anguniaqtit hulijakhaqahutik uvani Iqaluktuuq (Ekalluk) Kuugaq, Paalliryuaq (Surrey) unalu Jayco (Jayco) Kuugait, tautukhugit anginiqhaujut avguiningit nunamunngautijangit kiujangillu uuktuutigijangit aulattittinirnut uvani najugainit.<sup>7</sup>

### **Tunihimajangit unalu Akigutaat**

KFL maliinnaqhugit aturaaqattaqtakhat anguniaqtunut haffumani Iqalukpik niqikhait uvani Qitirmiut nunangani Nunavunmi. KFL pivalliavlutik aturluaqtumik ikajuqtaujumajunut parnautikhangit maniliurahuagtunut niuvirumajut tamainnut Nunavunmi Nunatsiarmilu, hivuraanit Kanata iluaniittullu Amialikan. Qanilruani ilitarijaujut ukunanggat Ocean Wise<sup>TM</sup>, avaliqanngittut ihivriuqhiivlutik una iqalukhiurnirnut kinugani maliinnaqtangit aturaaqattaqtakhat haffumani Iqaluktuuttiaq Iqalukpik iqalukhiurningit.

Una hivulliujut niuviqattaqtunut haffumani Iqaluktuuttiaq maniliurahuagtunut Iqalukpik ilagijaujut Nunavut unalu NWT mi, tikkuqaqhimajaujut niuviqtittijut tamainnut Kanatami unalu Amialikanmilu. Aujami ukiakhamilu anguniaqtunut hilaqutigut, nutaangujut Iqalukpik agjaqtauvaktut uvannat Edmonton-mit agjaqtaugiama aallanut nunalirjuanut tamainnut Kanatami unalu San Francisco, taikanngat agjaqtauvakhutik puqtuhijumut nirriiit tamainnut Amialikanmi US (haffumanit San Francisco, Boston). Toronto, Ottawa, unalu Montreal tadsa hivulliuvtut Kanatamiunut najurvingnit Iqaluktuuttiaq Iqalukpik hilataanit nunallaanmit.

Ungahikpallaaramik iqalukhiurnirnut, iqalukhiuqtit najuinnaqtut qulvahiktumik tatqiqhiutigut iqalukhiuraagtut, talvannat agjaqtauvaktut puqtalaagtumut tingmiannuakkut uvunga KFL niqiliuriami. Niqiqarvik KFL havaktiita iqaluliqivakhutik tiavlugit niqiliuqhugittauq aallatqiitigut iqalugiagaangata pivlutik ukiunganit. Havaarivlugit imaatut hungaijaqhimajut iqalut (nutaangujut/qiqumajut), niaqua/papirua

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<sup>6</sup> Naahautaa ihuaqhihimajujut pittailinahuaramik maniliqinirnut amihuujut havaktittijut aallaunngittunut iqalukhiuqti aallatqiinut iqalukhiurvingnit.

<sup>7</sup> Una havaktittijut ilitquhiita niplautigijangit ilanganit hivunigijaanit havaktittijunut nautkaihimajut iqalukhiuqtunut hulijakhainit. Taimaa, kihiani, nalunaiqhijamajakhaat hamna maniliurahuagtut iqalukhiuqtut hulijakhat nautkaqhutik ilanganit nalruunngittut naiklivakhutik havaktittijut iluani aallat Nunaqaqaaqhimajunut nanminiqutilingnit maniliuqtunut.

ahivaqtaujuq, tiahimajut (mamaqhittiqhugit/aulayuittullu), ihiqhunngittumik tiahimajuq/avguqhimajut, hiirnaqtumik iqalukpik, mikpuliuqhimajangillu (KFL Akingit Titiraqhimajut, 2017/18), titiraqtauhimajut hiniktarvingnut, nirriviit, niqitqittiaqtut niuvirumajunut, niqimik niuvirvingnut, aittuuhikhanut niuvirvingnut, nunamiunullu nirijumavagait niuviqtittivaktut (Consilium Nunavut Inc., 2002). Pitquijangit uvanngat 2011/12 aallatqiingujut maniliuqtut kiuviniit haffumani KFL, atauttimuuqtangit maniliuqhimajut uvanngat Iqalukpik niuviqtittijut hamnaujuq \$466,916, haffumani iliuttut (nutaangujuq unalu qiqumajut) maniliuqhimajut haffumani 31%; pidjariktumik tiahimajunillu (30%), mikpiliuqtangit (12%), niaqua/papirua ahivaqtaujuq (11%), ihiqhunngittut (7%), aahiittauq niqiliuqhimajangit (10%).

Iqalukpik ihumagijaujuq puqtuhilluaqhimajuq-nakuuqpiiaqtumik, kihimi akituvallaaqtut, himmautauvlutik uvanngat Iqaluliqijunut amigaiqtittijut Iqaluk (FishChoice, 2018). Iceland aulattittivagaat iqaluliqijit Iqalukpik uvunga Amialikan U.S., nauhimavagaat 3,260t uvani 2012, humiliqaak Kanata unalu Amialikan US atauttimut nautkaihimajut haniraanit 500t. Nautkaihimavaktut pivakhutik uvani Norway unalu Sweden, kihiani, ahinut niuviqtittijut US nut naittuuvlutik (Eithier, 2014). Tautungnaqhunilu ihariahugluaqtut Iqalukpik uvani US mi avatqulluaqhutik nautkainirnut Iqalukpingnit. Kihiani, ilitturnaqhuni hamna maliinnaqhugu KFL Iqalukpik niuviqtittijut ahiqanngittuq inmikkut iluani niuvirumajunut akihautihimalaaqhugit iqaluliqihimajut Iqalukpik Iqaluillu amigaitpaktut uvani nunangani. Niuvirluarumajut Iqalukpingmi uvani Europe, kihimi nunamiungani nautkaihimajut, iqaluliqivlutik taamna kahakhimalruuqtut taimaa.

Taimaa kiutqujauhimajut uvani ilagijanganit hivunigivlutik haffumani US unalu Kanatamiunut niuvirumajunut, hakugitqijaujut niuvirumajunut pivallialaaqtut Iqalukpik Nunavunmi Nunatsiarmilu (Consilium Nunavut Inc., 2002). Angiklijuummiqhutik akikhangit ilagijaujut haffumani aulattittinirnut, agjaqtuinirnut, unalu himmauhiqattaqtut niqit tamainnut Nunavut nunaliit naiklilaaqhutik havaatigut iniliurutikhait angiklijuummiqtumik niuvirumajut, unalu kiujaulaaqhutik nunamiuttanut unalu pitquhirijainnit niqit hakugitqijaujut niuviqtunut Nunavut iluani.

## **Nunguani**

Tahapkuat ihumaaluutigijangit ihuuluutaujut maniliurahuarnirnut aulattittinirnut unalu ilitturnahuaqtavut haffumani iqalukhiurnirnut. Hivulliqpaangmi, aallannguqtiqattaqhimajut haffumani Kanatamiunit taalangit uvanngat Amialikan US taalangit. Aippaanganianit, qaffiuningit akikhangit haffumani Kanatamiut taalangit ikivallaaqhimajuq avataanit 33% uvanngat Amialikan US taalangit. Aadjigiinnnginnamik haffumani naiglihimagamik haffumani Kanatamiunit taalangit uvanngat Amialikan US taalangit angiklijuummiqhunilu ilagijaujut maniliuqhimajainnit uvangga Iqalukpik iqalukhiuqtunut hulidjuhianit ilainnaanit iqalut ahinut agjaqtauhimajut akingillu atuqhugit Amialikan US taalainnut. Tuglirijaangillu, angiklijuummiqhuni akikhat nauhimagiame (haffuminngatut, tingmiakkut agjaqtuijut akingit hanaliugait tunihiniit akikhangillu); unalu kinguani, pijumajaujut ihuaqhinahuaqtangit avguiningit hailijakhangillu iqalut himmauhiqattaqtut iqalukhiuqtunut najugaat angikligiangani uuktuutingit unalu aturnaqtut haffumani iqalukhiurnigut. Maniliurahuuqtut anguniaqtut

uvanngat Paalliq (Lauchlan Kuugaq) titiraqtauhimajuq 2010 mi talvanngat iqalukhiuruiqhutik tahamannat maniliuttiaqhimaittut iqaluqqukitpakkami avguiningit akituvaalliqpakhunilu tingmiakkut agjaqhiliraangat. Uvani 2018 mi, maniliurahuagtut anguniaqtut uvani Paalliq (Lauchlan Kuugaq) iqalukhiuffaarmijut ihuaqhihimavlunilu avvauningit haffumani 5,000 kg (iluittuq uqumaidjuhia) malikhimainnaqtangillu aturaaqtakhangit iqalukhiurnirnut.

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Imamiutaujut huminngaqtut Atinga	2015	2016	2017	2018	2019	5-Ukiuq Atauttimuqtut	5-Ukiunga Iitqubia
Iqaluktuuq Kuugaa (Ekalluk)							

<i>Nunamunngaqtut (kg)</i>	16,930	20,011	20,001	16,570	16,699	<b>90,211</b>	<b>15,344</b>
<i>Nunamiittut Akingit<sup>8</sup></i>	\$88,712	\$104,859	\$104,805	\$86,825	\$87,502	<b>\$282,684</b>	<b>\$56,537</b>
<i>Niuviktakhat Akingit<sup>9</sup></i>	\$383,460	\$453,256	\$453,022	\$375,302	\$379,230	<b>\$1,774,002</b>	<b>\$354,800</b>
<b>Jayko Kuugaa (Jayco)</b>							
<i>Nunamunngaqtut (kg)</i>	9,851	17,011	16,200	11,573	12,481	<b>36,072</b>	<b>7,214</b>
<i>Nunamiittut Akingit<sup>10</sup></i>	\$51,620	\$89,137	\$84,885	\$60,643	\$65,402	<b>\$161,292</b>	<b>\$32,258</b>
<i>Niuviktakhat Akingit<sup>11</sup></i>	\$223,130	\$385,295	\$366,919	\$262,132	\$282,702	<b>\$771,068</b>	<b>\$154,214</b>
<b>Halugvik Kuugaa (Thirty-Mile)</b>							
<i>Nunamunngaqtut (kg)</i>	4,160	4,212	4,888	4,997	4,972	<b>19,135</b>	<b>3,827</b>
<i>Nunamiittut Akingit<sup>10</sup></i>	\$21,796	\$22,073	\$25,616	\$26,185	\$26,052	<b>\$89,700</b>	<b>\$17,940</b>
<i>Niuviktakhat Akingit<sup>11</sup></i>	\$94,215	\$95,411	\$110,724	\$113,183	\$112,610	<b>\$419,245</b>	<b>\$83,849</b>
<b>Paalliryuak Kuugaa (Surrey)</b>							
<i>Nunamunngaqtut (kg)</i>	6,824	5,739	8,990	8,792	8,884	<b>43,007</b>	<b>8,601</b>
<i>Nunamiittut Akingit<sup>10</sup></i>	\$35,756	\$30,075	\$47,108	\$46,069	\$46,552	<b>\$185,057</b>	<b>\$37,011</b>
<i>Niuviktakhat Akingit<sup>11</sup></i>	\$154,558	\$129,999	\$203,626	\$199,132	\$201,222	<b>\$1,002,092</b>	<b>\$200,418</b>
<b>Paalliq Kuugaa (Lauchlan)</b>							
<i>Nunamunngaqtut (kg)</i>	NF	NF	NF	3,902	5,061	<b>8,963</b>	<b>1,792</b>
<i>Nunamiittut Akingit<sup>10</sup></i>	-	-	-	\$20,449	\$26,521	<b>\$46,970</b>	<b>\$9,394</b>
<i>Niuviktakhat Akingit<sup>11</sup></i>	-	-	-	\$88,390	\$114,638	<b>\$203,028</b>	<b>\$40,605</b>
<b>Atautilimuuqtut<sup>10</sup></b>							
<i>Nunamunngaqtut (kg)</i>	37,765	46,973	50,079	45,834	48,097	<b>228,748</b>	<b>345,749.6</b>
<i>Nunamiittut Akingit<sup>11</sup></i>	<b>\$197,885</b>	<b>\$246,144</b>	<b>\$262,414</b>	<b>\$240,170</b>	<b>\$252,029</b>	<b>\$942,883</b>	<b>\$188,577</b>
<i>Nunamiittut Akingit/kg</i>	<b>\$4.57</b>	<b>\$4.29</b>	<b>\$5.85</b>	<b>\$7.04</b>	<b>\$5.00</b>		<b>\$5.24</b>
<i>Niuviktakhat Akingit<sup>11</sup></i>	<b>\$855,363</b>	<b>\$1,063,962</b>	<b>\$1,134,290</b>	<b>\$1,031,139</b>	<b>\$1,089,402</b>	<b>\$4,073,397</b>	<b>\$814,679</b>
<i>Niuviktakhat Akikhaq/kg</i>	<b>\$19.23</b>	<b>\$19.75</b>	<b>\$24.26</b>	<b>\$26.33</b>	<b>\$24.09</b>		<b>\$22.65</b>

<b>Niuvrutikhait Akingit/ Lb. Iqalukpik Qanurittunik Ilingajuq</b>							
Tamatkiujuq							
Hungaiqhimajuq	<b>\$6.02</b>	<b>\$6.27</b>	<b>\$7.67</b>	<b>\$9.17</b>	<b>\$8.15</b>	<b>NA</b>	<b>\$7.45</b>
Niaquq, papirua ahivaqhimajuq	<b>\$7.04</b>	<b>\$7.29</b>	<b>\$10.21</b>	<b>\$10.84</b>	<b>\$9.05</b>	<b>NA</b>	<b>\$8.89</b>
Tiahimajut	<b>\$10.22</b>	<b>\$10.47</b>	<b>\$11.87</b>	<b>\$12.59</b>	<b>\$12.61</b>	<b>NA</b>	<b>\$11.55</b>

<sup>8</sup> Nunamunngaqtut akingit avaliqanngittut imarmit najugaanit avaliqanngittuq agjaqtuinirnut pivikhait, Nalunajainiq angmaumangittuq ukunangat imarmiujunit.

<sup>9</sup> Niuviktakhangit akingit kiglitigijangit uvannat Qitirmiut Niqiqarvinga Kitikmeot Foods Ltd. Akingit Atiliuqtangit (aallatqiiktut ukiunganit) kititiqtauvluni kiglitigijaat avvautigijaanit niuviqhimajait hamnaujut: (i) Tamainnit pilakhimajut: 55% nauhimajainnit; (ii) Niaqua, papirua ahivaqtaujut: 23%; (iii) Tiataaqhimajut: 10%; (iv) Ihiqhungnittut haniraa: 8%; unalu (v) Mipkuliuqtut: 4%.

<sup>10</sup> Nailukkaangujut angiqtauhimaitut atautilimut akikhaat avatainavvluni haffumani akikhangit/akingit.

<sup>11</sup> Atautilimut nunamiittunit akikhaat nainaaqhimajut akiliqhangit iqalukhiuqtit agjaqtuijunillu akikhangit. Ilagijaunngittut aallat havaarijangit akikhangit. Atautilimut nunamiittunut akikhaat ikaarningit uvannat 2010-12 ilagijaujut agjaqtuinirnut akikhangit angirutaujut. Tingmidjutigut uhijut akikhangit ikajuutaujut uvannat \$32,555 tunijauhimajut uvani 2012 ilagijaunngittut.

Ihiqhungnittut	\$15.39	\$15.64	\$17.04	\$18.08	\$18.15	NA	\$16.86
Mipkunnuit	\$39.02	\$38.89	\$47.85	\$43.13	\$41.84	NA	\$42.14
<b>Uqumaidjutigut</b>							
<b>Akingit</b>	<b>\$8.74</b>	<b>\$8.98</b>	<b>\$11.03</b>	<b>\$11.97</b>	<b>\$10.95</b>	<b>NA</b>	<b>\$10.33</b>

*Ilittuqhajji: KFL Niqiqarvik; Atuagaq unalu Maniliurahuarningit, C&A, DFO, havaktit kititiqhimajangit Naunaitkut: - Iqalukhiuqhimanngittut; NA – Aturnaittuq.*

**Nalunaitkut 7. Aulattittinirnut akikhangit ilingaujuuq ukunanngat Qitirmiut NiqiqarvikTimingat, 2008-2012**

Akingit Pivikhat	2008	2009	2010*	2011*	2012*	Atauttimut	Tukinga
<b>Iqaluktuuq Kuugaq (Ekallu)</b>							
<i>Havaatigut Akinga<sup>12</sup></i>	\$34,136	\$44,145	\$74,441	\$64,617	\$63,347	\$461,053	\$56,537
<i>Uqumaidjuhia (lb.)</i>	24,078	27,865	44,956	29,999	41,883	168,781	33,756
<i>Akinga uvanngat lb.<sup>13</sup></i>	\$1.50	\$1.58	\$1.66	\$2.15	\$1.51		\$1.67
<b>Jayko Kuugaq (Jayco)</b>							
<i>Havaatigut Akinga<sup>14</sup></i>	\$65,912	\$37,696	-	-	\$57,684	\$161,292	\$53,764
<i>Uqumaidjuhia (lb.)</i>	31,519	14,330	NF	NF	33,509	79,359	26,453
<i>Akinga uvanngat lb.<sup>15</sup></i>	\$2.09	\$2.63	-	-	\$1.72		\$2.07
<b>Halugvik Kuugaq (Thirty-Mile)</b>							
<i>Havaatigut Akinga<sup>16</sup></i>	\$21,533	\$23,044	\$15,253	\$13,099	\$16,770	\$89,700	\$17,940
<i>Uqumaidjuhia (lb.)</i>	10,021	11,481	7,297	2,473	10,824	42,097	8,419
<i>Akinga uvanngat lb.<sup>17</sup></i>	\$2.15	\$2.01	\$2.09	\$5.30	\$1.55		\$2.27
<b>Paalliryuak Kuugaq (Surrey)</b>							
<i>Havaatigut Akinga<sup>18</sup></i>	\$25,533	\$36,847	\$38,451	\$44,451	\$39,804	\$185,057	\$37,011
<i>Uqumaidjuhia (lb.)</i>	10,681	19,046	19,963	25,247	19,678	94,615	18,923

<sup>12</sup> Aulattittinirnut akikhangit ilagijaat akiliakhat iqalukhiuqtit agjaqtuijullu akikhangit, Ilaginngittangit KFL niqiqarvik akikhangit. Atauttimut havaarijangit akikhaat uvanngat ikaarningit 2010-12 ilagijaujut agjaqtuinirnut akikhangit angiqtauhimajut. Tingmidjutigut uhijut akikhangit ikajuutaujut uvanngat \$32,555 tunijauhimajut uvani 2012 ilagijaunngittut.

<sup>13</sup> Ilagijaunngittut KFL niqiqarviup akikhangit.

<sup>14</sup> Aulattittinirnut akikhangit ilagijaat akiliakhat iqalukhiuqtit agjaqtuijullu akikhangit, Ilaginngittangit KFL niqiqarvik akikhangit. Atauttimut havaarijangit akikhaat uvanngat ikaarningit 2010-12 ilagijaujut agjaqtuinirnut akikhangit angiqtauhimajut. Tingmidjutigut uhijut akikhangit ikajuutaujut uvanngat \$32,555 tunijauhimajut uvani 2012 ilagijaunngittut.

<sup>15</sup> Ilagijaunngittut KFL niqiqarviup akikhangit.

<sup>16</sup> Aulattittinirnut akikhangit ilagijaat akiliakhat iqalukhiuqtit agjaqtuijullu akikhangit, Ilaginngittangit KFL niqiqarvik akikhangit. Atauttimut havaarijangit akikhaat uvanngat ikaarningit 2010-12 ilagijaujut agjaqtuinirnut akikhangit angiqtauhimajut. Tingmidjutigut uhijut akikhangit ikajuutaujut uvanngat \$32,555 tunijauhimajut uvani 2012 ilagijaunngittut.

<sup>17</sup> Ilagijaunngittut KFL niqiqarviup akikhangit.

<sup>18</sup> Aulattittinirnut akikhangit ilagijaat akiliakhat iqalukhiuqtit agjaqtuijullu akikhangit, Ilaginngittangit KFL niqiqarvik akikhangit. Atauttimut havaarijangit akikhaat uvanngat ikaarningit 2010-12 ilagijaujut agjaqtuinirnut akikhangit angiqtauhimajut. Tingmidjutigut uhijut akikhangit ikajuutaujut uvanngat \$32,555 tunijauhimajut uvani 2012 ilagijaunngittut.

<i>Akinga uvanngat lb.</i> <sup>19</sup>	\$2.42	\$1.93	\$1.93	\$1.75	\$2.02		\$1.89
<b>Paalliq Kuugaq (Lauchlan)</b>							
<i>Havaatigut Akinga</i> <sup>20</sup>	\$19,795	-	\$15,646	-	-	\$35,441	\$17,720
<i>Uqumaidjuhia (lb.)</i>	5,208	NF	5,574	NF	NF	10,782	5,391
<i>Akinga uvanngat lb.</i> <sup>21</sup>	\$3.80	-	\$2.81	-	-		\$3.29
<b>Atauttimut</b>							
<i>Havaatigut Akinga</i> <sup>22</sup>	<b>\$169,235</b>	<b>\$141,732</b>	<b>\$206,693</b>	<b>\$184,715</b>	<b>\$240,508</b>	<b>\$942,883</b>	<b>\$188,577</b>
<i>Uqumaidjuhia (lb.)</i>	<b>81,507</b>	<b>72,722</b>	<b>77,791</b>	<b>57,719</b>	<b>105,895</b>	<b>395,634</b>	<b>79,127</b>
<i>Akinga uvanngat lb.</i> <sup>23</sup>	<b>\$2.08</b>	<b>\$1.95</b>	<b>\$2.66</b>	<b>\$3.20</b>	<b>\$2.27</b>		<b>\$2.38</b>
<b>KFL Niqiqarviup Akingit</b>							
Havaktut Akingit	\$40,228	\$101,236	\$38,491	\$50,248	46,148	\$276,350	\$55,270
Alrujaqtuqtut	\$30,071	\$58,109	\$26,979	\$40,330	36,892	\$192,381	\$38,476
Uqhurjuaq	\$3,933	\$7,087	\$7,065	\$3,460	9,183	\$30,728	\$6,146
Imaq	\$2,115	\$2,067	\$2,982	\$1,744	3,028	\$11,936	\$2,387
<b>Atauttimuuqtut</b>	<b>\$76,347</b>	<b>\$168,499</b>	<b>\$75,517</b>	<b>\$95,781</b>	<b>\$95,251</b>	<b>\$511,395</b>	<b>\$102,279</b>
<b>Tunihijut haffumani KFL Akikhat</b>							
<i>Havaatigut Akinga</i>	32.0%	21.7%	25.8%	26.0%	32.4%		27.6%
<i>KFL Niqiqarviup Akingit</i>	31.1%	54.3%	26.8%	34.1%	28.4%		35.2%
<i>Uqumaidjuhia</i>	81,507	72,722	77,791	57,719	105,895		79,127
<b><i>Tukinga Atauttimut Akingi uvanngat lb.</i></b>	<b>\$3.01</b>	<b>\$4.27</b>	<b>\$3.63</b>	<b>\$4.86</b>	<b>\$3.17</b>		<b>\$3.68</b>

*Ilituqhajji: Qitirmiut Niqiqarvinga Timingat (KFL).  
Naunaikut: NF – Iqalukhiuqhimannngittut*

## Iluliutingit E Qajagijaujukhaq tarjurmit

Umiat nanminirijangit unalu hivuliqtuijut munarijakaat malittiaqtakhaat qajagijaujukhat havaktiita umiangillu. Malittiarialik qajagijaunirnut maliguarutit unalu nakuujumik uuktuutikhangit nanminiqutigijangit, hivuliqtit havaktiingillu iqalukhiuqtunut umiangit ikajuutauniaqtut annautigiama inuuhirnut, hapummilugillu umiat ahiruqtailigiama hapummilugillu avatikhait. Tamaat iqalukhiuqtut umiat naammakpiaqtumik tarjurmiutaujukhat munarittiaqhimainnarlugillu maligautigut ukunanngat Agjaqtuinirnut Kanata (TC), unalu aahiit aturnaqtut ilauhimajunut. Umiat maligiaqaqtutik

<sup>19</sup> Ilagijaunngittut KFL niqiqarviup akikhangit.

<sup>20</sup> Aulattittinirnut akikhangit ilagijaat akiliakhat iqalukhiuqtut agjaqtuijullu akikhangit, Ilaginngittangit KFL niqiqarvik akikhangit. Atauttimut havaarijangit akikhaat uvanngat ikaarningit 2010-12 ilagijaujut agjaqtuinirnut akikhangit angiqtauhimajut. Tingmidjutigut uhijut akikhangit ikajuutaujut uvanngat \$32,555 tunijauhimajut uvani 2012 ilagijaunngittut.

<sup>21</sup> Ilagijaunngittut KFL niqiqarviup akikhangit.

<sup>22</sup> Aulattittinirnut akikhangit ilagijaat akiliakhat iqalukhiuqtut agjaqtuijullu akikhangit, Ilaginngittangit KFL niqiqarvik akikhangit. Atauttimut havaarijangit akikhaat uvanngat ikaarningit 2010-12 ilagijaujut agjaqtuinirnut akikhangit angiqtauhimajut. Tingmidjutigut uhijut akikhangit ikajuutaujut uvanngat \$32,555 tunijauhimajut uvani 2012 ilagijaunngittut.

<sup>23</sup> Ilagijaunngittut KFL niqiqarviup akikhangit.

ihivriuqtauhimalutik malikhimalugillu ilitaridjutauqaqtumik ihivriuqtauhimajut nalaumajukhat iningit auladjarikhijukhat.

Iluani kavamarjuangit, munarijaujukhat agjaqtuinirnut, nahittaqtauhimajut, unalu umiaq qajagijauningit maliguarutit unalu ihivriuqtukhat malikhimainnaqtakhaat ukunangat Agjaqtuinirnut Kanata; qilanaaqtukkut kiujaujukhat ukunangat Kanatamiunit Nahittaqtiit unalu DFO munaqhaivikhalik iqalungnut avatikhangit. Nunavut iluani, Havaktunut Aanniqtailinikkut Munaqtiujut atanniqtuivikhaqaqhutik uvannat aanniaqtailinirnut hivuuranairutikhanut akihautingit havagvik iluani. DFO unalu TC havaamingnut Maligautiqaqhutik illituqhiigiangani ikajuqatigiiktunut unalu aulapkailugillu, munarilugit ikajuqhimalugillu aanniqtailijaamik pitquhiata iluani iqalukhiurnirnut havaamingnit.

Naunaittariami haffumani qajaqtunirnut aanniqtailinikkut, hivajainnarialik uvunga TC Havagviata Qajarnirnut Aanniqtailinirnut akiqanngittukkut hivajautaa uvani 1-800-267-6687 qaritaujakkut ikiaqqivikkut takugulu uvani <https://tc.canada.ca/en/marine-transportation/marine-safety/office-boating-safety>.























ልጎቻችንን ለገቢና ለሥራ ዕድል ለማስፈጸምና ለደንበኞች ልዩ አገልግሎት ለመስጠት ለማድረግ፣  
የተገቢውን ድጋግ እና ልማት እንገልጻለን።

የደንበኞቻችንን ገቢ ለማስፈጸምና ለደንበኞች ልዩ አገልግሎት ለመስጠት ለማድረግ፣  
የተገቢውን ድጋግ እና ልማት እንገልጻለን። ስለ ደንበኞቻችን ልዩ አገልግሎት ለመስጠት ለማድረግ፣  
የተገቢውን ድጋግ እና ልማት እንገልጻለን።

**ለግብርና ስልጠና፡** ደንበኞቻችንን፣ ልዩ አገልግሎት ለመስጠት ለማድረግ፣  
የተገቢውን ድጋግ እና ልማት እንገልጻለን።

የድንበኞቻችን፡ ጥቅምት 4, 2021

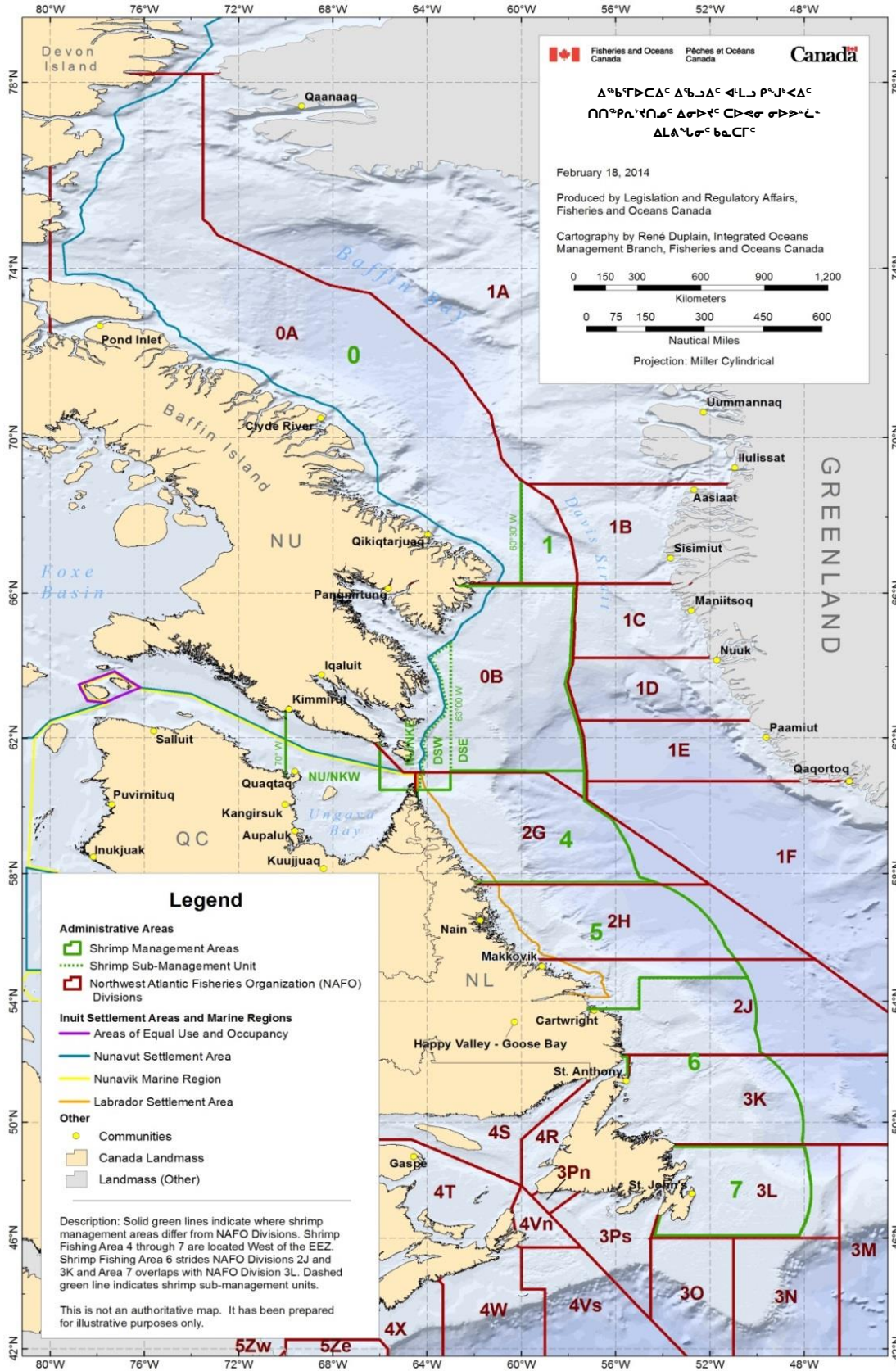
**የግብርና ስልጠናዎች**

**የግብርና ስልጠና 1** - ለደንበኞቻችን ልዩ አገልግሎት ለመስጠት ለማድረግ፣  
የተገቢውን ድጋግ እና ልማት እንገልጻለን።

**የግብርና ስልጠና 2** - ለገቢና ለሥራ ዕድል ለማስፈጸም (COL) ለደንበኞቻችን ልዩ አገልግሎት ለመስጠት ለማድረግ፣  
የተገቢውን ድጋግ እና ልማት እንገልጻለን።

**የግብርና ስልጠና 3** - ለደንበኞቻችን ልዩ አገልግሎት ለመስጠት ለማድረግ፣  
የተገቢውን ድጋግ እና ልማት እንገልጻለን። (NAFO) ለምዕራባዊ ክልል (የደንበኞቻችን ልዩ አገልግሎት ለመስጠት ለማድረግ፣  
የተገቢውን ድጋግ እና ልማት እንገልጻለን።)

**የግብርና ስልጠና 4** - ለደንበኞቻችን ልዩ አገልግሎት ለመስጠት ለማድረግ፣  
የተገቢውን ድጋግ እና ልማት እንገልጻለን። (NAFO) ለምዕራባዊ ክልል (የደንበኞቻችን ልዩ አገልግሎት ለመስጠት ለማድረግ፣  
የተገቢውን ድጋግ እና ልማት እንገልጻለን።)









በበናሙናዎች ላይ ማድረግ ይቻላል።

4) ልዩ ልዩ:

- ልዩ ልዩ ስልጠናዎችን ለማድረግ የሚችሉ የሥራ ሰዎችን ለማሳደግ ይቻላል። (ልዩ ልዩ ስልጠናዎችን ለማድረግ የሚችሉ የሥራ ሰዎችን ለማሳደግ ይቻላል።)
- ለግብርና ስልጠናዎች ለማድረግ ይቻላል። በስልጠናው ላይ ለሚገኙ ሰዎች ለማድረግ ይቻላል። ለግብርና ስልጠናዎች ለማድረግ ይቻላል።

5) ልዩ ልዩ ስልጠናዎች:

- ልዩ ልዩ ስልጠናዎችን ለማድረግ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል።
- ልዩ ልዩ ስልጠናዎችን ለማድረግ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል።
- ልዩ ልዩ ስልጠናዎችን ለማድረግ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል።

ልዩ ልዩ

1) ልዩ ልዩ:

- ልዩ ልዩ ስልጠናዎችን ለማድረግ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል።

ከሌሎች ጋር ማሳተፍ

1) ከሌሎች ጋር ማሳተፍ:

- ስዊድን (Greenland) ከሌሎች ጋር ማሳተፍ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል።

2) 2021 ስልጠናዎችን ለማድረግ ይቻላል።

- 2021- (Greenland) ከሌሎች ጋር ማሳተፍ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል።
- 2021- (Greenland) ከሌሎች ጋር ማሳተፍ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል። ለደብዳቤ ስልጠናዎች ለማድረግ ይቻላል።

**ᐃᐅᐅᖃᑦᑕᖃᑦᑕᑦᑕᑦ ᐱᖃᐅᖃᑦᑕᑦᑕᑦ ᐅᖃᖃᑦᑕᑦ (Striped Shrimp):**

- 2021-ᑦᑕ ᐃᐅᐅᖃᑦᑕᖃᑦᑕᑦ ᐅᖃᖃᑦᑕᑦ ᐱᖃᐅᖃᑦᑕᑦᑕᑦ ᑕᐱᑦ (SFA) 0-ᑦ ᐱᖃᑕᑦ SFA 1-ᑦ ᐱᑦᐱᑕᑦᑕᑦᑕᑦᑕᑦ ᐱᖃᑕᑦ 01, 2021 ᐱᖃᑕᑦ ᑕᑕᐃᑕᑕᑦᑕᑦ ᐃᖃᑕᑦᑕᑦᑕᑦᑕᑦ ᐱᖃᑕᑦ 01.
- 2021/22-ᑦ ᐃᐅᐅᖃᑦᑕᖃᑦᑕᑦ ᐱᖃᐅᖃᑦᑕᑦᑕᑦ ᐅᖃᖃᑦᑕᑦᑕᑦᑕᑦ ᑕᑕᑦᑕᑦᑕᑦ ᐅᖃᖃᑦᑕᑦ (EAZ) ᐃᑕᑦᑕᑦᑕᑦᑕᑦ ᐅᖃᖃᑦᑕᑦ (WAZ) ᐱᑦᐱᑕᑦᑕᑦᑕᑦ ᐱᑕᑦᑕᑦ 01 2021 ᑕᑕᐃᑕᑕᑦᑕᑦ ᐃᖃᑕᑦᑕᑦᑕᑦ ᐱᑕᑦᑕᑦ 01.
- 2021-ᑦᑕ ᐱᖃᑕᑦ 2021/22-ᑦᑕ ᐃᐅᐅᖃᑦᑕᖃᑦᑕᑦ ᐱᖃᐅᖃᑦᑕᑦᑕᑦ ᐅᖃᖃᑦᑕᑦ (Striped Shrimp) ᐱᖃᐅᖃᑦᑕᑦᑕᑦ ᐱᑕᑦᑕᑦᑕᑦ SFA 0, 1, EAZ ᐱᖃᑕᑦ WAZ ᖃᑕᑕᑦᑕᑦᑕᑦᑕᑦᑕᑦ ᑕᑕᑦᑕᑦᑕᑦᑕᑦᑕᑦ. ᐱᖃᐅᖃᑦᑕᑦᑕᑦ ᑕᑕᑦᑕᑦᑕᑦ ᑕᑕᑦᑕᑦᑕᑦ ᑕᑕᑦᑕᑦᑕᑦᑕᑦᑕᑦᑕᑦ ᑕᑕᑦᑕᑦᑕᑦᑕᑦᑕᑦᑕᑦ.

**ᑕᑕᑕᑦᑕᑕᑦᑕᑦᑕᑦ:** ᐃᖃᑕᑦᑕᑦᑕᑦᑕᑦ ᐱᑕᑦᑕᑦᑕᑦ, ᐃᐅᐅᖃᑦᑕᖃᑦᑕᑦ - ᐃᖃᑕᑦᑕᑦᑕᑦᑕᑦ ᑕᑕᑕᑦ

**ᐃᑕᑕᑦ:** ᐱᖃᑕᑦ 20, 2021







ጋራ ጥራት ለማረጋገጥ የሚያስፈልጉ የቴክኖሎጂ ስልጠናዎችን ያስገኛሉ። ለምሳሌ፣ የኮሙኒኬሽን ስልጠናዎች ይህንን ጥራት ለማረጋገጥ ይረዳሉ።

- የኮሙኒኬሽን ስልጠናዎች ለግብረ ሰው ጥራት ለማረጋገጥ የሚረዱት ስልጠናዎች የሚሆኑት ለህዝብ አገልግሎት ለማረጋገጥ ሲሆኑ ለሌሎች ስልጠናዎች ደጋግተው ለህዝብ አገልግሎት ለማረጋገጥ ይረዳሉ።
- ለግብረ ሰው ጥራት ለማረጋገጥ የሚረዱት ስልጠናዎች ለሌሎች ስልጠናዎች ደጋግተው ለህዝብ አገልግሎት ለማረጋገጥ ይረዳሉ።

### ለግብረ ሰው ጥራት

- ለግብረ ሰው ጥራት ለማረጋገጥ የሚረዱት ስልጠናዎች ለሌሎች ስልጠናዎች ደጋግተው ለህዝብ አገልግሎት ለማረጋገጥ ይረዳሉ።
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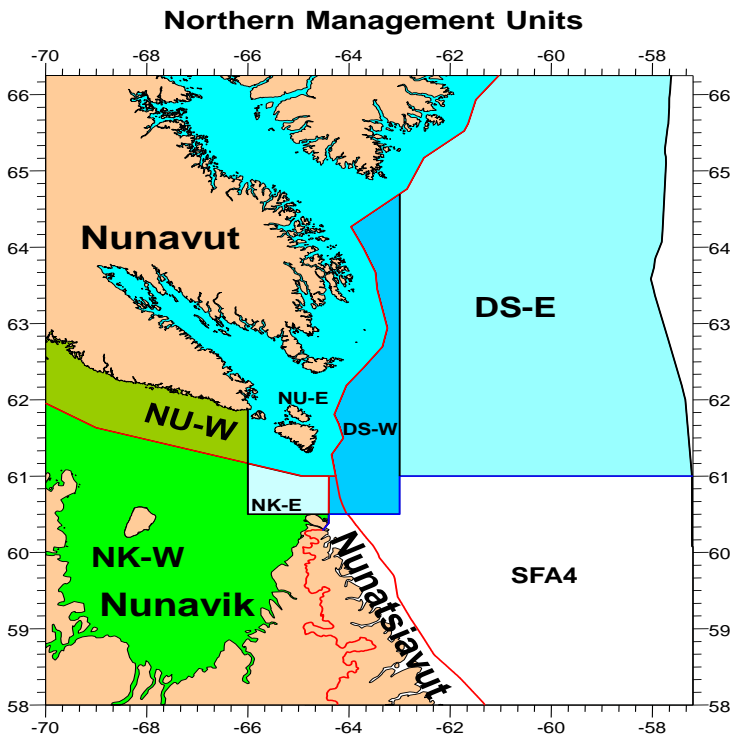
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December 3, 2020

To: Derek Mahoney, Chair - Northern Precautionary Approach Working Group (NPAWG)  
From: Alastair O'Rielly, Northern Coalition  
Brian Burke, Nunavut Fisheries Association  
RE: Northern Precautionary Approach Working Group (NPAWG)

Good day Derek,

The Northern Coalition (NC) and Nunavut Fisheries Association (NFA) are writing this letter in response to the November 30th meeting of the Northern Precautionary Approach Working Group (NPAWG) and specifically the CSAS document and advice discussed at this meeting. Combined the NC and NFA represent all commercial fishing interests in Canada's Eastern Arctic, a group of Indigenous-owned companies that hold seven of the 17 offshore shrimp licenses, 100% of the shrimp allocations in the Western Assessment Zone (WAZ) and 65.9% of the shrimp allocations in the Eastern Assessment Zone (EAZ). From an economic perspective, these EAZ and WAZ allocations are extremely important to the viability of our members, especially given the recent reductions in allocations in Shrimp Fishing Areas (SFAs) 4 and 5.

From our joint perspective, any discussion and recommendations of the NPAWG must be cognisant of the respective Land Claims Agreements and the critical role of the Wildlife Management Boards.

The CSAS advice seeks to move the Limit Reference Points (LRP) for all shrimp stocks in the Eastern and Western Assessment Zones from 30% of the mean spawning stock biomass (SSB) to 40% of the SSB, a 1/3 increase in the LRP, predicated on inadequate science information and a presumption that this increase could provide for earlier and more effective response measures to reductions in the SSB.

The correspondence to you from Mr. Bruce Chapman of the Canadian Association of Prawn Producers (CAPP) provides a thoughtful and well articulated critique of the proposed shift in the LRP for stocks in the EAZ and WAZ shrimp areas. We generally concur with the perspective contained in this letter and look forward to receiving further information from the Department on use of 40% LRPs in other relevant shrimp stocks throughout the North Atlantic. From our perspective, the most relevant stocks would be those in the SFA 1 to 7 complex, all of which we understand utilize LRPs set at 30% of the SSB.

The assertion that the risks of stock decline in the North are greater than in southern stocks is implausible. SFA 4, 5 and 6 have all experienced precipitous declines in biomass in recent years. SFA 5 has seen a 43.6% decline over the past two years. We do not understand that there is evidence to suggest that a 40% LRP for these stocks would have produced a more expeditious management response that could have arrested these reductions. It is

generally recognized that neither the unprecedented growth in shrimp biomass levels during the 1990s, nor the dramatic declines of recent years are correlated with fishery removal levels.

Survey variability for *Pandalus borealis* and *montagui* in the EAZ and WAZ areas are extreme and may not necessarily reflect interannual biomass variability. Application of a 40% LRP for these stocks, particularly given extreme shifts in biomass indices, holds the potential risk of inducing a series of dramatic oscillations in management responses which are unlikely to mitigate stock declines, would prove very disruptive to fishing operations and potentially undermine the credibility of Canada's resource management regime. Based on the information and materials provided thus far, we see no benefits to an arbitrary shift in the LRP for these stocks.

This approach by the Arctic region to implement restrictions on fishing activity which are inconsistent with DFO's decisions in other regions is reflective of recent decisions and recommendations made on several other issues, most recently the Arctic region's opposition to a 5% increase in the OA/OB turbot quotas and revisions to the turbot conversion factor to be consistent with changes in the south. Both NC and NFA strongly oppose this inequity in approach for different regions, particularly when dealing with the same stock complexes, which is also contrary to DFO's stated goal of regional consistency.

The CSAS document also recommends a very significant increase in the LRP and USR for the EAZ based on additional years of data. For both the EAZ and WAZ we have some concerns regarding the potential setting of LRPs and USRs at periods of high stock levels, which may not be sustainable in the long-term, thus impacting negatively on future allocation levels, as witnessed in SFA 6.

We also note concern with the composition of the meeting attendees at the May 12-13, 2020 meeting on Science Advice on Limit Reference Points for Northern Shrimp and Striped Shrimp in the Western and Eastern Assessment Zones. Other than the respective Nunavut and Nunavik Management Board representatives, the meeting was dominated by representation from the Arctic region and the only non-DFO attendee was a recent DFO Science employee. Having other academic and industry science and technical participation would be appropriate.

Moving the LRP to 40% was presented as a 'fait accompli' further to the outcome of the May 2020 Canadian Science Advisory Secretariat meeting. We note that the Research Document 2020/072 dated November 2020 states on page iv that "The intent of this document is to serve as a source of supporting information to provide advice to DFO Resource Management, consistent with the Department's PA Framework in support of the sustainable management of these fisheries." Your presentation at the Working Group meeting indicated that the CSAS process is not an advisory function with respect to the setting of Limit Reference Points but has de facto decision-making authority within DFO's PA Framework.

Finally, we are very appreciative of the work of DFO Science and the challenges in monitoring and analyzing an extremely dynamic marine environment with a dearth of critical biological and environmental data. However, the recommended move to increase the LRP for EAZ and WAZ Shrimp does not appear to be based "on biological criteria", nor can it be demonstrably linked to "stock status below which serious harm is likely occurring to the stock."

As discussed, we request that the next meeting of the NPAWG include the full group and a fulsome discussion on these issues.

Sincerely,



Alastair O'Rielly  
Executive Director, Northern Coalition



Brian Burke  
Executive Director, Nunavut Fisheries Association

cc: Arran McPherson – Assistant Deputy Minister, Ecosystems and Oceans Science  
Sylvie Lapointe – Assistant Deputy Minister, Fisheries and Harbour Management  
David Whorley – Chair, Northern Shrimp Advisory Committee (NSAC)  
Adam Burns – Director General, Fisheries Management  
Courtney D'Aoust – Fisheries and Aquaculture Management Officer, DFO  
Daniel Shewchuk, Chair – Nunavut Wildlife Management Board (NWMB)  
Robert Moshenko, A/Chair - Nunavik Marine Region Wildlife Board (NMRWB)  
Jason Akearok, Executive Director, NWMB  
Janelle Kennedy, Executive Director, NMRWB  
Bruce Chapman – Canadian Association of Prawn Producers (CAPP)

Good afternoon:

Before our NPAWG session tomorrow, I thought that it would be useful to recap our discussions and to provide an assessment of where we are in our work with respect to key elements in development of a Precautionary Approach (PA) Framework. In addition, I can report on discussions I have had internally with my DFO colleagues and management. My hope is that this update will help to focus our discussions tomorrow and give indication of what we might be able to accomplish in our remaining time before reporting to NSAC, and providing information to the Nunavut Wildlife Management Board and the Nunavik Marine Region Wildlife Board (the Boards).

As chair of this working group, I would first thank each of you for your participation in the group and for your flexibility in making yourself available, particularly as times have shifted for a number of our meetings. I have tried to guide discussions in a way that promoted open dialogue, with my ultimate goal being a consensus recommendation to NSAC. I believe that would be the best outcome for all involved. However, while consensus is a worthwhile goal, working groups like NPAWG are not a decision-making bodies. At the conclusion of our work, the Minister, in keeping with co-management processes with the Boards, will take decisions on the PA Framework for shrimp fisheries in the Eastern Assessment Zone (EAZ) and the Western Assessment Zone (WAZ). These decisions will, therefore, be informed by either consensus recommendations or the various views of our group.

### **Limit Reference Points (LRP)**

As discussed in detail in our early sessions, the LRP for shrimp stocks in the EAZ and WAZ are established by DFO Science through peer-review, in accordance with DFO's PA policy. While our work as NPAWG is limited to non-LRP elements of the PA, I took from our discussions and from written submissions from working groups members that there are general concerns related to the uncertainties associated with EAZ and WAZ shrimp stocks. These concerns were partly reflected in members' calls for a review, in the near term, of these LRPs. I will address the idea of such a review later in this note.

### **Upper Stock Reference (USR)**

The bulk of our discussions to this point have centered around USRs and the variability of stock status for shrimp in these areas. The data points that collectively produce this variability represent our best available science and, therefore, our clearest expression of stock status. However, given influences beyond fishing mortality and the lack of trends that can be derived from relatively limited time series, some NPAWG members felt that measures should be taken to mitigate the effects of this variability. These measures included the suggestion of a USR established at 70% of the geometric mean of SSB, where averaging of multiple (2 or 3 year) stock status data points would be used to determine stock status relative to established

reference points. DFO Science has been clear that stock status needs to be represented as a single data point rather than an average. In reaction to this position, some working group members then proposed that a USR not be developed and instead the NPAWG focus on a target reference point (TRP) to satisfy Marine Stewardship Council (MSC) certification conditions. These measures would effectively reduce, or eliminate, the potential for stocks to enter a defined cautious zone, which industry members have stated is significantly harmful to product marketability.

From DFO's perspective, stock status is exclusively within our Science sector's area of responsibility and a single-year value is the clearest expression of that status for a given point in time. Additionally, USRs are an integral part of DFO's PA policy, primarily serving as a point sufficiently above the LRP "to provide an opportunity for the management system to recognize a declining stock status and sufficient time for management actions to have effect". In keeping with DFO's PA policy, the USR is critical in defining the boundary between the Healthy and Cautious zones and DFO continues to report in this context through the annual [Sustainability Survey for Fisheries](#).

It is true that DFO does manage some fisheries for which USRs are not in place, including in the WAZ. However, it is a policy priority for the Department to establish complete PA Frameworks for Canada's fisheries that include a USR. The establishment of a TRP without an accompanying (or dual purpose) USR would represent a departure from this priority. This would be particularly pertinent in the EAZ where a USR has been in place for a number of years.

For these reasons, I believe a recommendation from NPAWG to move forward without USRs is unlikely to be accepted by the Minister. The development, however, of a distinct TRP in addition to a USR could be a productive effort for this group in my view.

### **Harvest Control Rules (HCRs)**

Secondary to reference points has been NPAWG's consideration of HCRs for shrimp fisheries in the EAZ and WAZ. I note that HCRs are not an outstanding MSC condition for these fisheries. In my experience, the development of HCRs is best to follow the establishment of reference points, so that the potential impacts of their application can be assessed relative to defined biomass values. It is my feeling that we are unlikely to revisit the HCRs for EAZ and/or contemplate the development of HCRs for the WAZ in our time remaining before the March 9, 2021, meeting of NSAC.

### **Review Provision**

Given the limited time series and uncertainty surrounding the stocks in the EAZ and WAZ, many group members stated a strong preference for the PA to be reviewed in the near-term (i.e., 2-5 years). Members suggested the benefit of doing so with the aid of additional survey and, preferably, incremental science work that could provide some information related to environmental and ecological influences on these stocks.

From discussions I have had and from my own perspective, an expiry date on a PA Framework is unlikely to be supported by DFO decision-makers. Further, there could be implications for MSC certification in the event a PA Framework (including reference points) is not in place. A review after a certain time period may be a better way to proceed rather than a predefined expiry. In the very short-term, I do not believe the knowledge of these stocks is likely to sufficiently increase to the extent that we could expect any difference in the outcome of a similar process to what we are now undertaking. For this reason, I would suggest that NPAWG recommend a review of reference points (and any additional components of a PA Framework) in 4 or 5 years (i.e., in 2025 or 2026).

NPAWG may wish to consider the usefulness of establishing a committee to undertake this review and ultimately consider the merit of modifying the PA framework. Such a group would likely best be composed of DFO and non-DFO members. Associated with the notion of available data, NPAWG may also wish to emphasize the need for additional science to improve environmental knowledge as part of its report to NSAC and the Boards.

### **Path Forward**

As I see it, tomorrow's (February 5) meeting will be important in determining if there is basis to continue the NPAWG process of developing elements of a PA framework for these stocks. If that proves the case, I believe we could plan 1-2 additional sessions before turning our focus to the development of a report.

Once again, thanks for your participation in NPAWG sessions. I look forward to our coming discussions.

Regards,

Derek Mahoney

**From:** [Brian Burke](#)  
**To:** [Jason Akearok](#)  
**Cc:** [Amber Giles](#); [Denis Ndeloh](#)  
**Subject:** FW: NPAWG update Feb 4 / GTAPN mise a jour 4 fév  
**Date:** Friday, February 5, 2021 10:43:31 AM  
**Attachments:** [DMahoney Letter to NPAWG Feb 4 2021 English.DOCX](#)

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Good morning,

Due to the late sending of this note and its content, which dismisses any suggestions made by stakeholders in favour of a dictated DFO approach to PA in the WAZ and EAZ, NFA has boycotted today's NPAWG meeting.

It is my understanding that DFO intends to make a submission on the NPAWG to the NWMB for its March meeting. From a NFA perspective, this late date does not provide adequate time for us to prepare and submit a detailed paper on our views regarding the PA approach in the WAZ and EAZ. However, if DFO does make a submission for decision at the upcoming meeting which is based on the approach outlined in this note from the NPAWG Chair, this is an approach which does not have the support of NFA or any other industry participants in the WAZ and EAZ shrimp fisheries. As such, we would ask for the opportunity to provide input at the March meeting and request a call for written submissions take place for the following meeting.

As per our prior NFA and industry correspondence on this critical issue, we entered into the "working group" process in good faith with the belief that, as a working group, reasonable approaches that do not impact on the stock status but do take into account the potential socio-economic impacts on industry would be fully considered, leading to a negotiated consensus agreement on the way forward. Unfortunately, this does not appear to be the case and rather than being coopted by our participation in the "working group" being seen as acceptance, we have taken the decision to, for the present time at least, remove ourselves from this flawed process.

As with other issues impacting the Nunavut fishery, it is our view that the NWMB has a very strong decision and recommendation making role and mandate, and we look forward to the NWMB exercising this authority for the benefit of Nunavut and Nunavummiut.

Regards,

Brian Burke  
Executive Director  
Nunavut Fisheries Association (NFA)  
Tel: (709) 351-7263

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**From:** D'Aoust, Courtney <Courtney.D'aoust@dfo-mpo.gc.ca>  
**Sent:** February 4, 2021 5:17 PM  
**To:** D'Aoust, Courtney <Courtney.D'aoust@dfo-mpo.gc.ca>



**Subject:** NPAWG update Feb 4 / GTAPN mise a jour 4 fév

**Sent on behalf of Derek Mahoney, Chair, Northern Precautionary Approach Working Group (NPAWG)**

Good afternoon, please find attached a **note from the Chair** in regards to tomorrow's discussion. A copy is also available in the [NPAWG Dropbox](#).

<b>Session Title</b>	<b>Objectives</b>	<b>Sub-group(s) to attend</b>	<b>Date &amp; Time</b>
USR 3: EAZ & WAZ stocks	Discuss reference points (Borealis + Montagui)	WAZ & EAZ	<b>Friday February 5</b> 9 AM – 11 AM EST (2 hours) Join Zoom Meeting <a href="https://zoom.us/j/93998895525?pwd=clpnYWVVRQkZkUzdVYTVrTFFMTDcvZz09">https://zoom.us/j/93998895525?pwd=clpnYWVVRQkZkUzdVYTVrTFFMTDcvZz09</a> Meeting ID: 939 9889 5525 Passcode: 761300  1-855-703-8985 Canada Toll-free <i>*interpretation not available</i>

Thank you.

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**Envoyé de la part de Derek Mahoney, Président, Groupe de travail sur l'approche de précaution du Nord (GTAPN)**

Bonjour, veuillez trouver ci-joint une **note du président** concernant la discussion de demain. Une copie est également disponible au [Dropbox GTAPN](#).

<b>Titre de la session</b>	<b>Objectifs</b>	<b>Sous-groupe(s) à assister</b>	<b>Date et heure</b>
PRS 3: stocks ZEE & ZEO	Discuter les points de références (Borealis + Montagui)	ZEO & ZEE	<b>Vendredi le 5 février</b> 09h00 – 11h00 heure de l'est (2 heures) Rejoindre la réunion Zoom <a href="https://zoom.us/j/93998895525?pwd=clpnYWVVRQkZkUzdVYTVrTFFMTDcvZz09">https://zoom.us/j/93998895525?pwd=clpnYWVVRQkZkUzdVYTVrTFFMTDcvZz09</a> ID de la réunion: 939 9889 5525 Passcode: 761300  1-855-703-8985 Canada gratuit <i>*interprétation non disponible</i>

Merci.

***Courtney D'Aoust***

Fisheries and Aquaculture Management Officer |  
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**From:** [Brian Burke](#)  
**To:** [Martin, Zoya](#); [Onalik, Jimi](#); [Andrew Bresnahan](#); [Andrew Randall](#); [Jeffrey Maurice](#)  
**Cc:** [CSFL - Sowdloopik](#); [QC - Jerry Ward](#); [Jaypetee Akeegok](#); [David Alexander](#); [AFA - Harry](#); [Dave Bollivar \(TFC\)](#); [Peter Keenainak](#); [Jesslene Jawanda](#); [Jason Akearok](#); [Denis Ndeloh](#); [Amber Giles](#)  
**Subject:** RE: NWMB Review of Nunavut Fisheries Association's Request for NWMB Decision and Recommendations Concerning Access Fees Charged to the Nunavut Fishing Industry  
**Date:** Tuesday, January 26, 2021 7:09:32 PM

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Good evening,

Thank you to everyone who participated in this afternoon's call. As per the direction provided by the NWMB, it would be greatly appreciated if our stakeholders could provide the Board with their position on these issues and support for the NFA request in advance of the Board's upcoming deadline for their March 2021 meeting. Our submission will largely remain the same, I will be appending additional details on the market prices of borealis vs montagui shrimp, the costs that have been covered by industry to cover the annual WAZ survey, the 50 t increment access fee payment process used in other exploratory areas, and the reachout NFA has made to stakeholders on these issues. The revised document will also be shared in advance of the Board's deadline.

As indicated by the NWMB, consensus amongst our stakeholders would be very helpful in terms of the Board's decision making. Please let me know of any additional questions you may have and we would greatly appreciate your support on these issues, which are unfairly burdening our industry members.

Regards,

Brian

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**From:** Brian Burke  
**Sent:** January 25, 2021 9:43 AM  
**To:** Martin, Zoya <ZMartin@gov.nu.ca>; Onalik, Jimi <JOnalik@GOV.NU.CA>; Andrew Bresnahan <ABresnahan@QIA.ca>; Andrew Randall <ARandall@QIA.ca>; Jeffrey Maurice <JMaurice@tunnigavik.com>  
**Cc:** sakiasie sowdloopik <sowdloopik@hotmail.com>; Jerry Ward <JWard@Qcorp.ca>; Jaypetee Akeegok <Jaypetee@arcticfisheryalliance.com>; David Alexander <dalexander@baffinfisheries.ca>; Harry Earle <harry@arcticfisheryalliance.com>; Dave Bollivar (TFC <dbollivar@trinavfisheries.com>; Peter Keenainak <PKeenainak@Qcorp.ca>; Jesslene Jawanda <JJawanda@Qcorp.ca>  
**Subject:** RE: NWMB Review of Nunavut Fisheries Association's Request for NWMB Decision and Recommendations Concerning Access Fees Charged to the Nunavut Fishing Industry

Good morning,

Looking to set a meeting time to discuss the access fees issues with the GN, QIA and NTI. Would 1 pm or later EST tomorrow (Tuesday) work for each of you? Let me know what time would be best and I will send around an invite.

Attached again is the NFA submission to the NWMB.

Regards,

Brian

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**From:** Brian Burke

**Sent:** January 18, 2021 6:19 PM

**To:** 'Martin, Zoya' <[ZMartin@gov.nu.ca](mailto:ZMartin@gov.nu.ca)>; 'Onalik, Jimi' <[JOnalik@GOV.NU.CA](mailto:JOnalik@GOV.NU.CA)>; 'Andrew Bresnahan' <[ABresnahan@QIA.ca](mailto:ABresnahan@QIA.ca)>; 'Andrew Randall' <[ARandall@QIA.ca](mailto:ARandall@QIA.ca)>; 'Jeffrey Maurice' <[JMaurice@tunngavik.com](mailto:JMaurice@tunngavik.com)>

**Cc:** 'sakiasie sowdloopik' <[sowdloopik@hotmail.com](mailto:sowdloopik@hotmail.com)>; 'Jerry Ward' <[JWard@Qcorp.ca](mailto:JWard@Qcorp.ca)>; 'Jaypetee Akeegok' <[Jaypetee@arcticfisheryalliance.com](mailto:Jaypetee@arcticfisheryalliance.com)>; 'David Alexander' <[dalexander@baffinfisheries.ca](mailto:dalexander@baffinfisheries.ca)>; 'Harry Earle' <[harry@arcticfisheryalliance.com](mailto:harry@arcticfisheryalliance.com)>; 'Dave Bollivar (TFC)' <[dbollivar@trinavfisheries.com](mailto:dbollivar@trinavfisheries.com)>; 'Peter Keenainak' <[PKeenainak@Qcorp.ca](mailto:PKeenainak@Qcorp.ca)>; 'Jesslene Jawanda' <[JJawanda@Qcorp.ca](mailto:JJawanda@Qcorp.ca)>

**Subject:** RE: NWMB Review of Nunavut Fisheries Association's Request for NWMB Decision and Recommendations Concerning Access Fees Charged to the Nunavut Fishing Industry

Good afternoon,

Following up on our access fees issue and obtaining input from the GN, NTI and QIA. We need to bring this back to the NWMB for their next Board meeting and need your input/response on the issues and/or a note indicating that your organization has been consulted. We can organize a call to discuss collectively or individually if you prefer.

Regards,

Brian

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**From:** Brian Burke

**Sent:** November 18, 2020 6:12 PM

**To:** Martin, Zoya <[ZMartin@gov.nu.ca](mailto:ZMartin@gov.nu.ca)>; Onalik, Jimi <[JOnalik@GOV.NU.CA](mailto:JOnalik@GOV.NU.CA)>; Andrew Bresnahan <[ABresnahan@QIA.ca](mailto:ABresnahan@QIA.ca)>; Andrew Randall <[ARandall@QIA.ca](mailto:ARandall@QIA.ca)>; Jeffrey Maurice <[JMaurice@tunngavik.com](mailto:JMaurice@tunngavik.com)>

**Cc:** sakiasie sowdloopik <[sowdloopik@hotmail.com](mailto:sowdloopik@hotmail.com)>; Jerry Ward <[JWard@Qcorp.ca](mailto:JWard@Qcorp.ca)>; Jaypetee Akeegok <[Jaypetee@arcticfisheryalliance.com](mailto:Jaypetee@arcticfisheryalliance.com)>; David Alexander <[dalexander@baffinfisheries.ca](mailto:dalexander@baffinfisheries.ca)>; Harry Earle <[harry@arcticfisheryalliance.com](mailto:harry@arcticfisheryalliance.com)>; Dave Bollivar (TFC) <[dbollivar@trinavfisheries.com](mailto:dbollivar@trinavfisheries.com)>; Peter Keenainak <[PKeenainak@Qcorp.ca](mailto:PKeenainak@Qcorp.ca)>; Jesslene Jawanda <[JJawanda@Qcorp.ca](mailto:JJawanda@Qcorp.ca)>

**Subject:** FW: NWMB Review of Nunavut Fisheries Association's Request for NWMB Decision and Recommendations Concerning Access Fees Charged to the Nunavut Fishing Industry

**Importance:** High

See attached from the NWMB denying our request for a chance to present this issue at their upcoming December meeting. As you recall I did reach out to each of you on this issue and requested your input and support. With respect to DFO, it was actually David Whorley who had

indicated to one of my members that this needed to go to the NWMB for review. I would greatly appreciate if you could each inform the NWMB of this prior contact and request and, if possible, indicate your support for our position. I have sent an immediate request for the NWMB to reconsider their position and this would greatly help. Otherwise our industry will continue to be treated unfairly on this issue into another fishing year.

Stakeholder support would be greatly appreciated. If you are unable or unwilling to provide this support please let me know as soon as possible.

Regards,

Brian Burke  
Executive Director  
Nunavut Fisheries Association (NFA)  
Tel: (709) 351-7263

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**From:** Taqialuq Sataa <[tsataa@nwmb.com](mailto:tsataa@nwmb.com)>  
**Sent:** November 18, 2020 5:41 PM  
**To:** Brian Burke <[executivedirector@noaha.ca](mailto:executivedirector@noaha.ca)>  
**Cc:** Gabriel Nirlungyuk <[gabriel.nirlungayuk@dfo-mpo.gc.ca](mailto:gabriel.nirlungayuk@dfo-mpo.gc.ca)>; [david.whorley@dfo-mpo.gc.ca](mailto:david.whorley@dfo-mpo.gc.ca)  
**Subject:** NWMB Review of Nunavut Fisheries Association's Request for NWMB Decision and Recommendations Concerning Access Fees Charged to the Nunavut Fishing Industry  
**Importance:** High

Good afternoon,

Attached is titled "**NWMB Review of Nunavut Fisheries Association's Request for NWMB Decision and Recommendations Concerning Access Fees Charged to the Nunavut Fishing Industry**", please confirm receipt, thanks.

PS the Inuktitut translation will be sent when we get it back from our translator, please let us know if you have any questions/comments, thanks again.