NUNAVUT WILDLIFE MANAGEMENT BOARD
Agenda: Regular Meeting No. RM 003-2019
September 11, 2019 (9:00 AM - 3:15 PM)
NWMB Boardroom

	No:	Item:	Tab:	Presenter:	Maximum Time
09:00 AM - 09:05 AM	1	Open Meeting		Chairperson	5 minutes
09:05 AM - 09:10 AM	2	Approval of RM 003-2019 Agenda	1	Chairperson	5 minutes
		Government of Nunavut - Department of Environment (GN-DOE)			
09:10 AM - 10:10 AM	3	Baffin Island caribou management plan	2	GN	1 hour
10:10 AM - 10:25 AM		**BREAK**			15 minutes
10:25 AM - 11:10 AM	4	Polar bear harvest administration: Flexible Quota System	3	GN	45 minutes
11:10 AM - 11:40 AM	5	Ellesmere Island peary caribou surveys	4	GN	30 minutes
		Fisheries and Oceans Canada (DFO)			
11:40 AM - 12:10 PM	6	Action Plan for the Blue Whale—Northwest Atlantic population	5	DFO	30 minutes
12:10 PM - 1:25 PM		**LUNCH**			1 hour 15 minutes
1:25 PM - 2:10 PM	7	Recovery Strategy for Northern Wolffish and Spotted Wolffish in Canada, Management Plan for Atlantic Wolffish in Canada, and Action Plan for the Northern Wolffish and Spotted Wolffish in Canada	6	DFO	45 minutes
2:10 PM - 2:40 PM	8	Marine conservation initiatives updates	7	DFO	30 minutes
2:40 PM - 3:10 PM	9	Presentation of the public outreach project, ‘Guardians of Tariuq’	8	DFO	30 munites
3:10 PM - 3:15 PM	10	Adjournment of RM 003-2019		Chairperson	5 minutes

SUBMISSION TO THE

NUNAVUT WILDLIFE MANAGEMENT BOARD

FOR

Information: **Decision: X**

Issue: Baffin Island Caribou Management Plan

Background:

- The first island-wide survey of Baffin Island caribou occurred in March 2014, and the results indicated there were very few caribou on Baffin Island. The population was estimated to be 4,652 caribou (3,462–6,250 with a 95% Confidence Interval).
- On January 1, 2015, the Minister of Environment implemented a moratorium on the harvesting of Baffin Island Caribou. The moratorium lasted for just over seven months.
- In August 2015, the Minister of Environment accepted the Nunavut Wildlife Management Board's (NWMB's) decision to implement a total allowable harvest (TAH) of 250 male caribou, thereby ending an 8-month harvest moratorium that started in January 2015. It was also determined that unused tags from one harvest season are not to be carried over to the next hunting season.
- The Baffin Island Caribou Management Plan was initially developed in December 2014 in collaboration with ten affected Hunters and Trappers Organizations (HTOs), the Qikiqtaaluk Wildlife Board (QWB), Nunavut Tunngavik Inc. (NTI), and Parks Canada.
- Consultations on the draft Management Plan occurred March 16 – April 7, 2015 and included discussions on caribou collaring under the research and monitoring component of the Plan.
- The Baffin Island Caribou Management Plan was submitted to the NWMB for decision in March 2016. The Board requested the Department of Environment (DOE) conduct additional consultations due to edits made to the plan after initial consultations.
- The position of Regional Biologist for Baffin region became vacant before the draft management plan could be finalized. The new Regional Biologist started in January 2018, and he was tasked with finalizing the consultation process and plan for submission to the NWMB.

Current Status:

- The revised version of the Management Plan includes results from composition surveys completed from 2015-2018. The composition surveys were used to assess calf recruitment and approximate sex ratios. The revised version also identifies the limitations of identifying population trends based on composition survey results.

- Earlier versions of the draft Management Plan incorporated 5 harvest management units and recommended harvest management actions for Baffin Island based on population phases. These have been removed from the current version of the plan.
- The implementation schedule for monitoring activities was also revised in the current version to address the updated submission date.

Consultation:

- Consultations on the draft Management Plan occurred March 16–April 7, 2015 and included discussions on caribou collaring under the research and monitoring component of the Plan. While there was caribou collaring support from several of the communities initially, that support appeared to later collapse given opposition from two communities in particular, late in the consultation process.
- The current Baffin Regional Biologist initiated consultation with all Baffin HTOs, which harvest Baffin Island Caribou, in the fall of 2018, following updates to the Management Plan, to incorporate current knowledge and management priorities.
- During the planning for fall consultations, which were proposed for September 24–October 5, 2018, the DOE received a letter from QWB requesting postponement until January. The DOE agreed to postpone the consultations to facilitate participation from co-management partners.
- The Draft Baffin Island Management Plan was provided to the QWB, NTI, NWMB and ten HTOs on September 25, 2018. At that time, the Baffin Regional Biologist requested that the co-management partners provide comments on the Management Plan prior to the January consultations. An additional reminder email was distributed on November 26, 2018 requesting comments prior to the meetings.
- The Baffin Regional Biologist visited all Baffin communities, which harvest from the Baffin Island caribou herd, from January 7 – 18, 2019, to discuss composition survey results from 2015-2018, the Baffin Island Caribou Management Plan, sex-selective harvest options, future research needs, and proposed satellite collaring.
- Consultations were held with HTO representatives from Kimmirut, Qikiqtarjuaq, Pangnirtung, Iqaluit, Cape Dorset, Hall Beach, Igloolik, Arctic Bay and Pond Inlet. Unfortunately, during this consultation tour, weather prevented the charter from getting to Clyde River. Consultations were subsequently completed with the Clyde River HTO on May 27, 2019.
- No comments on the draft management plan were received prior to or during consultations and as a result, the DOE asked for comments to be provided by April 15, 2019.
- The DOE received a second letter from the QWB requesting that the comment period be extended. The DOE agreed to accept comments until June 30, 2019. On June 27, 2019, the GN received an additional request from QWB that the comment period be further extended by a week. No comments were received from the QWB on the Baffin Island Caribou

Management Plan during the consultation period of 25 September through 30 June 2019, neither up to 15 July 2019.

- A consultation summary report was provided to the NWMB for the RM001-2019 in March of 2019.
- An updated consultation summary, including Clyde River, is included with this submission for consideration in September 2019.

Recommendations:

1. The GN requests that the NWMB approve the revised Baffin Island Caribou Co-Management Plan

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

Baffin Island Caribou Management Plan

September 2019

PRIMARY OBJECTIVE

An adaptive guide to research, monitoring, and management of the Baffin Island caribou population

HISTORY OF THE BAFFIN ISLAND CARIBOU MANAGEMENT PLAN

2004	• Initial consultations prior to drafting of a plan (South Baffin)
July 2013	• Workshop in Iqaluit with close to 60 wildlife co-management partners on caribou management on Baffin Island
January 2014	• Consultations with Baffin Communities and co-management
Dec 2014	• Draft plan developed with co-management partners
March 2016	• Draft plan submitted to NWMB for decision. NWMB requests additional consultation regarding edits in Plan
2015 to 2018	• Baffin Biologist position vacant. Progress on consultations and finalization of plan on hold
2018	• Baffin Biologist position filled. Additional consultations and plan finalization made a priority

CONSULTATION TIMELINE

Mar 16 - Apr 7, 2015	• Consultations with 10 Baffin HTOs
August 13, 2018	• Baffin Biologist contacts HTOs and co-management partners with proposed consultation dates of September 24 to October 5, 2018
Aug 27, 2018	• QWB request extension of consultation period to Jan 2019
Sept 25, 2018	• Draft Management Plan provided to QWB, NTI, NWMB and HTOs for review and discussion at consultations
Nov 26, 2018	• Draft Management Plan sent again along with a request for comments prior to Jan consultations
Jan 7 – 18, 2019	• Consultations with 9 of 10 HTOs, GN asked participants in consultations to provide comments on Draft Management Plan.
May 27, 2019	• Consultation with Clyde River HTO, comments on Draft Management plan were requested.
April 3, 2019	• Additional request for comments on Draft Management Plan from HTOs and Co-management partners
April 12, 2019	• DOE received request from QWB for an extension to comment period. Comment period extended to June 30, 2019.
PRESENT	• No comments received from co-management partners from September 2018 up to September 2019.

CHANGES SINCE NWMB SUBMISSION

The revisions to the most recent include:

<ins>**Added**</ins> research results from composition surveys completed from 2015- 2018

<ins>**Removal**</ins> of 5 harvest management units

<ins>**Removal**</ins> of recommended harvest management actions based on population phase

<ins>**Revised**</ins> the implementation schedule for monitoring activities, to accommodate the updated submission date

<ins>**Primary focus**</ins> is <ins>**monitoring**</ins> of Baffin Island Caribou

RECOMMENDATION

The GN requests that the NWMB approve the revised Baffin Island Caribou Co-Management Plan

Consultations with Hunting and Trapping Organizations on the Baffin Island Caribou Composition Survey Results, Future Research Recommendations, and Draft Management Plan

January 7-18, 2019 and May 27, 2019

Department of Environment, Government of Nunavut, Iqaluit, Nunavut

Executive Summary

Government of Nunavut (GN), Department of Environment (DOE) representatives conducted consultations with Hunters and Trappers Organizations (HTOs) in the Baffin region from January 7-18, 2019 and on May 27, 2019 in Clyde River due to weather in January.

The intent of this round of consultations was to ensure HTOs were informed on the results of caribou abundance and composition surveys from 2014 to present on Baffin Island. DOE presented options for future research on Baffin Island including a telemetry-based collaring program. The feedback collected during this round of consultations will aid the GN in future research planning and monitoring for Baffin Island caribou.

This report attempts to summarize the comments made by participants during the round of consultations.

Preface

This report represents the Department of Environment's best efforts to accurately capture all of the information that was shared during consultation meetings with the Hunters and Trappers Organizations of Kimmirut, Qikiqtarjuaq, Pangnirtung, Iqaluit, Cape Dorset, Hall Beach, Igloolik, Arctic Bay and Pond Inlet. Unfortunately, during this consultation tour weather prevented us from meeting with Clyde River but the DOE was able to meet with the HTO on May 27, 2019.

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

Table of Contents

1.0 Report Purpose and Structure

This report is intended to collate and summarize comments, questions, concerns and suggestions provided by the HTOs in response to the summarized 2015-2018 composition survey results, caribou monitoring methods, and the draft Baffin Island Caribou Management Plan. The following communities were consulted:

- Kimmirut, January 7, 2019
- Clyde River, Postponed due to weather
- Qikiqtarjuaq, January 8, 2019
- Pangnirtung, January 10, 2019
- Iqaluit, January 11, 2019
- Cape Dorset, January 14, 2018
- Hall Beach, January 15, 2019
- Igloolik, January 16, 2019
- Arctic Bay, January 17, 2019
- Pond Inlet, January 18, 2019
- Clyde River, May 27, 2019

Representatives from the DOE, the Nunavut Wildlife Management Board (NWMB), Nunavut Tunngavik Inc. (NTI), and the Qikiqtaaluk Wildlife Board (QWB) attended each of the consultations.

2.0 Purpose of Consultations

The preliminary consultations were to discuss the newest information regarding the Baffin Island Caribou and allow HTOs to voice questions, comments and concerns regarding future research programs.

2.1 Format of Meetings

The meetings were held in the evening and ran between 3 to 4.5 hours depending on HTO engagement. Meetings were facilitated and led by the Baffin Regional Wildlife Biologist, John Ringrose, and the Kivalliq Regional Wildlife Biologist, Mitch Campbell. Each consultation started with a presentation by John Ringrose on the two survey methods used by the GN since 2014 for monitoring caribou; aerial abundance surveys and composition surveys (Appendix 1). The participants were invited to ask questions, raise concerns, or provide advice during the presentation but were advised there would be breaks for questions. The presentation then provided the HTOs with survey results from 2015-2018 composition surveys across Baffin Island. Mr. Campbell then presented on the caribou monitoring program in the Kivalliq region including, aerial surveys (abundance), composition surveys and telemetry. After this presentation there was a break for questions. Mr. Ringrose then provided a brief description of the draft Baffin Island caribou management plan and asked for comments, concerns and questions from HTOs regarding the plan. After the presentations, questions/discussion continued until no further questions were raised. DOE asked HTOs to internally discuss the addition of a telemetry collaring program on Baffin Island and provide letters of support for collaring work in their region.

3.0 Summary by Community

The objectives of the consultations were made clear to the HTO members prior to and at the start of each meeting. There were many similar questions, concerns and suggestions raised by HTO Board members in all the communities consulted.

3.1 Kimmirut

Date: January 7, 2019

Representatives:

- GN-DOE, Baffin Regional Wildlife Biologist: John Ringrose
- GN-DOE, Kivalliq Regional Wildlife Biologist: Mitch Campbell
- GN-DOE, Acting South Baffin Manager: Alden Williams
- NTI, Resource Management Advisor: Cheryl Wray
- NWMB, Wildlife Management Biologist: Kyle Ritchie
- QWB, Senior Wildlife Advisor: Michael Ferguson
- Mayukalik HTA Board members
    - Sandy Akavak
    - Mikidjuk Kolola
    - Jeannie Padluq
    - Kapik Ikkidluak
    - Palanga Lyta
    - Pitsiulala Akavak
    - Kamikee Akavak
    - Dustin Joanas

Comments and questions:

The HTO members expressed their interest in the logistics of composition surveys and the recent suspected die-offs on Prince Charles Island. The HTO members wondered if collaring would be done in the future and if the consultations were regarding changes to the Total Allowable Harvest (TAH). They also raised concerns regarding development activities and how elder information and Inuit Qaujimajatuqangit (IQ) would be incorporated into future research.

HTO members indicated that ongoing monitoring needed to more accurately detect changes in the population and lead to more responsive management actions such as TAH changes. Mikidjuk Kolola asked that if an increase was observed in south Baffin but not in north Baffin would an adjustment to the TAH be considered in south Baffin only. The DOE explained how the use of telemetry may be able to separate different subpopulations and allow abundance surveys to occur on smaller scales and be more reactive to changes. The HTO asked about the detailed logistics of collar deployment and what the effects would be on caribou. HTO members were curious if there was ongoing monitoring of wolf abundance. There was concern with the Bull-only harvest and the effect it may be having on the population.

There was some confusion about the ongoing federal listing process and the recent round of consultations by the federal government. DOE, QWB and NWMB provided clarification of the differences between the federal consultations and the current meeting.

No comments were provided regarding the draft management plan during the meeting. The HTO said they will discuss this internally at an upcoming board meeting and provide input to the GN in writing.

3.2 Qikiqtarjuaq

Date: January 9, 2019

Representatives:

- GN-DOE, Baffin Regional Wildlife Biologist: John Ringrose
- GN-DOE, Kivalliq Regional Wildlife Biologist: Mitch Campbell
- GN-DOE, Acting South Baffin Manager: Alden Williams
- NTI, Resource Management Advisor: Cheryl Wray
- NWMB, Wildlife Management Biologist: Kyle Ritchie
- QWB, Senior Wildlife Advisor: Michael Ferguson
- Translator, Titus Arnakallak
- Nativak HTO Board members
    - Alison Kopalie
    - Juelie Kuksiak
    - Loasie Alikatuktuk
    - Jacopie Audlakiak
    - Jonah Keeyookta
    - Jaypatee Newkinguak
    - Uriah Newkinguak

Comments and questions:

The HTO members discussed the population decline that they observed in the early 2000s. There was concern over the number of wolves spotted during the surveys and low number of caribou in their area. DOE clarified that they had observed very few wolves during surveys from 2012 to present and they believe the impact of wolves at this time is relatively low. The HTO provided information regarding caribou locations in the mountainous areas surrounding Qikiqtarjuaq as well as historical hunting areas.

The HTO commented on the historical movement patterns of caribou on Baffin. The QWB provided input of historical information from discussions with elders. QWB identified that Inuit believe there are different types (subpopulations) of caribou on the island that display different behavioural patterns and utilize different habitats. Additional survey methods, such as including cameras or video cameras with composition surveys, was discussed but determined that using them at this time would likely increase survey time and negative effects on the caribou. There was interest expressed in the Nunavut Harvesters Support Program (NHSP) offered by NTI and a commitment was made by NTI to provide further information after the meetings.

No comments were provided regarding the draft management plan during the meeting. The HTO said they will discuss this internally at an upcoming board meeting and provide input to the GN in writing.

3.3 Pangnirtung

Date: January 10, 2019

Representatives:

- GN-DOE, Baffin Regional Wildlife Biologist: John Ringrose
- GN-DOE, Kivalliq Regional Wildlife Biologist: Mitch Campbell
- GN-DOE, Acting South Baffin Manager: Alden Williams
- NTI, Resource Management Advisor: Cheryl Wray
- NWMB, Wildlife Management Biologist: Kyle Ritchie
- QWB, Senior Wildlife Advisor: Michael Ferguson
- Translator, Titus Arnakallak
- Pangnirtung HTA Board members
    - Davidee Nowyuq
    - Johnny Mike
    - Mark Kilabuk
    - George Qaqqasiq
    - Billy Etooangat
    - Kelly Qaapik
    - Patrick Kilabuk

Comments and questions:

The HTO members expressed their interest in the population estimates from 2014, the estimated trend in productivity based on composition and the desire to take part in GN led surveys. The HTO was interested in the overall productivity of the herd and the number of bulls that are likely required to ensure cows are bred. The QWB provided insight to the movement of caribou between Baffin Island and the mainland on Melville Peninsula. The QWB stated that they do not believe that movement between the peninsula and Baffin Island makes a large impact on the numbers of caribou on Baffin Island.

The HTO members expressed they believe there is a small group of caribou present to the east of Pangnirtung and expressed that if another abundance survey was to be conducted, this area should be discussed. DOE clarified how the 2014 abundance survey results supported decisions regarding TAH and which areas are included in the TAH for Baffin Island. GN, QWB and the HTO discussed estimated wolf numbers on the island and the numbers observed during surveys since 2014 but all parties agreed that the current impact from wolves on caribou was likely low.

The HTO showed interest in the telemetry collaring process including field logistics and collar application. DOE indicated that if collars were to be supported by the HTO and applied to caribou on Baffin Island it would likely be mature cows that received collars. The QWB provided insight as to collaring methods that were done in the 1990s and field measurements that will ensure only mature adults are being collared. The HTO expressed a need for better management of caribou on Baffin as well as the need for additional movement and distribution information to support the current IQ. Billy Etooangat stated that he saw the value in collaring caribou so they could know where they are going and allow DOE to conduct surveys of the areas where caribou are found. The HTO mentioned the DeBeers diamond mine on Hall Peninsula and they are concerned about the effects of this project on caribou in their hunting area. They believe that a telemetry program may be beneficial to assess the impacts.

The community of Pangnirtung has a hard time hunting caribou right now because caribou don't seem to be migrating where they used to and access to these areas is difficult due to thin ice.

No comments were provided regarding the draft management plan during the meeting. The HTO said they will discuss this internally at an upcoming board meeting and provide input to the GN. Many members said this was their first time seeing this management plan so they wanted an opportunity to review it internally.

3.4 Iqaluit

Date: January 11, 2019

Representatives:

- GN-DOE, Baffin Regional Wildlife Biologist: John Ringrose
- GN-DOE, Kivalliq Regional Wildlife Biologist: Mitch Campbell
- GN-DOE, Acting South Baffin Manager: Alden Williams
- NTI, Resource Management Advisor: Cheryl Wray
- NWMB, Wildlife Management Biologist: Kyle Ritchie
- QWB, Senior Wildlife Advisor: Michael Ferguson
- Amaruq HTO Board members
    - Jerry Ell
    - David Alexander
    - Martha Kunuk
    - Ben Kovic
    - Manasie Mark

Comments and questions:

The meeting in Iqaluit discussed the merging of survey results and IQ, the number of bulls needed in a population, and the need for additional tools, such as a telemetry program, to support IQ.

The HTO expressed their concern regarding the bull-only harvest and the issues that would arise if the number of bulls were reduced. DOE representatives agreed that harvesting too many bulls will limit productivity of the population but monitoring to date has suggested there are currently enough bulls in the population in south Baffin. The QWB expressed that during previous conversations with elders it was identified that the quality of bulls is important.

The HTO asked whether there is any current technology available that can be used to better understand caribou movements across the island and if the GN has considered collaring any caribou.

After the GN presented about the telemetry program in the Kivalliq region there was support from the HTO for a similar program on Baffin. The HTO stated that they needed a telemetry collar program on South Baffin to address the concerns with TAH. Discussions followed regarding application of collar data, how many collars would be needed and if collaring would be done on bulls or cows. The HTO emphasized the need for new tools in the Baffin region including a telemetry collaring program. Jerry Ell expressed the desire of the HTO for a collaring program to the QWB representative, Mike Ferguson, and said that they wanted QWB to "make it happen".

No comments were provided regarding the draft management plan during the meeting. The HTO said they will discuss this internally at an upcoming board meeting and provide input to the GN. There is a desire to have the TAH removed but there was no discussion at this meeting regarding increased abundance in south Baffin or objection to 2014 estimates. The HTO mentioned the need for additional resources to facilitate discussions with other HTOs.

3.5 Cape Dorset

Date: January 14, 2019

Representatives:

- GN-DOE, Baffin Regional Wildlife Biologist: John Ringrose
- GN-DOE, Kivalliq Regional Wildlife Biologist: Mitch Campbell
- GN-DOE, North Baffin Manager: Scott Johnson
- NTI, Resource Management Advisor: Cheryl Wray
- NWMB, Wildlife Management Biologist: Kyle Ritchie
- QWB, Senior Wildlife Advisor: Michael Ferguson
- Translator, Titus Arnakallak
- Aiviq HTO Board members
  - Annie Suvega
  - Adamie Nuna
  - Dana Pootoogook
  - Simiga Suvega
  - Ejeeseak Peter
  - Tagialuk Nuna

- Ningeoseak Etidloi

Comments and questions:

The majority of discussion with the Aiviq HTO included concerns over the bull-only harvest, how the composition surveys allow monitoring the herd productivity, Baffinland Iron Mines in North Baffin, concerns about development, and movement patterns of caribou on the Island.

QWB questioned the validity of calf:cow and bull:cow ratios and referred to a paper from the 1990s where there were 42 calves:100 cows but this is based on a limited sample size. Mike Ferguson stated that he believes the ratios being used need further refinement.

The HTO asked if there were more bulls or cows based on previous survey results and was under the impression that the bull-only TAH was because there were more males in the population. The GN clarified that composition surveys are designed to be incorporated with IQ to detect changes in productivity. The HTO was unsure if harvesting on Prince Charles Island was allowed and the GN clarified that harvesting can occur but it is likely there has been a reduction in the number of caribou in this area because of several die-offs in 2016 and 2018. The HTO asked whether there will be female harvest in the future and the QWB responded stating that a private discussion between QWB and the HTO would commence after the meeting to discuss TAH issues. However, the GN explained that in order to maintain productivity of the population, the number of tags would need to be reduced if female harvest is accommodated.

The HTO asks about caribou in north Baffin, relative to Mary River, and identified the need for additional information in the future to help reduce the problems associated with development. DOE identified the likely effects of roads and developments on caribou and what impact this may have on caribou in North Baffin.

A desire to have caribou or reindeer introduced to the 3 small islands south of Cape Dorset was mentioned by the HTO. Movement patterns of caribou were also mentioned by the HTO and addressed suspected movement to Northern Quebec and within Baffin between areas south of Nettlling Lake and the southern peninsulas.

Similar to previous meetings there were no comments provided regarding the draft management plan during the meeting. The HTO said they will discuss this internally at an upcoming board meeting and provide input to the GN.

3.6 Hall Beach

Date: January 15, 2019

Representatives:

- GN-DOE, Baffin Regional Wildlife Biologist: John Ringrose
- GN-DOE, Kivalliq Regional Wildlife Biologist: Mitch Campbell
- GN-DOE, North Baffin Manager: Scott Johnson
- NTI, Resource Management Advisor: Cheryl Wray

- NWMB, Wildlife Management Biologist: Kyle Ritchie
- QWB, Senior Wildlife Advisor: Michael Ferguson
- Translator, Titus Arnakallak
- Hall Beach HTA Board members
    - Jaypeetee Audlakiak
    - Jopie Kaernerk
    - Cain Pikuyak
    - Zillah Pialiaq
    - Inokie Irqittuq (elder)
    - Abraham Ullalaa
    - Sam Arnardjuak
    - George Innuksuk
    - Joyce Arnarojuak

<u>Comments and questions:</u>

Discussions with the Hall Beach HTO included bull-only harvest, the TAH system and allocations between communities, composition survey methods, and telemetry collar information.

The HTO expressed their interest in taking part in surveys in the future and the incorporation of IQ into design, management and future plans. DOE representatives clarified that the composition survey results are incorporated with IQ and hunter observations: they are not mutually exclusive. The QWB states that they are responsible for the allocation of tags between the 10 HTOs and that if Hall Beach wants tags this year they will have to ask another HTO or discuss with QWB for the future.

Discussions surrounded identification of males and females from the helicopter and use of composition data to determine the productivity and the number of bulls able to breed. The HTO identified that large die-offs may not have occurred on Prince Charles Island in 2018 because caribou could move off of the island. The DOE representatives provided insight into the number of dead caribou observed, the ice conditions between Air Force Island and Baffin Island, and that they do not have evidence to support a large scale movement but stated it was possible. The HTO asked about movements of caribou on Melville Peninsula and historical information was provided by QWB. Mike Ferguson stated that in 1982 they conducted a reconnaissance survey in June of the area west of Hall Beach and observed areas where calving occurred.

The HTO wanted additional information on how telemetry collars are applied in the field and which sex they are applied to. The DOE representatives provided insight into how the telemetry program is conducted in the Kivalliq region including field logistics and HTO participation. There was concern form HTOs regarding collars that were left on polar bears and caused mortality but DOE and QWB assured those concerned that technological advances have reduced the size and weight of collars and the drop-away system performs very well and only requires a single handling event of caribou. The HTO was concerned about a caribou that was collared from

2008-2011 that had a collar improperly applied that caused damage to the animal. The GN responded that this incident was because of improper installation and this example is being used to train current collaring teams. The QWB identified the desire to have a private meeting with the HTO after the consultation to discuss female harvest and future tag allocations.

The HTO expressed the desire to discuss the management plan internally at an upcoming board meeting. There were no comments provided regarding the draft management plan during the consultation.

3.7 Igloolik

Date: January 16, 2019

Representatives:

- GN-DOE, Baffin Regional Wildlife Biologist: John Ringrose
- GN-DOE, Kivalliq Regional Wildlife Biologist: Mitch Campbell
- GN-DOE, North Baffin Manager: Scott Johnson
- NTI, Resource Management Advisor: Cheryl Wray
- NWMB, Wildlife Management Biologist: Kyle Ritchie
- QWB, Senior Wildlife Advisor: Michael Ferguson
- Translator, Titus Arnakallak
- QIA, Charlie Inuarak
- Igloolik HTO Board members
    - Simonie Issigaitok
    - Gideon Tugaoqak
    - Natalino Piuguttuk
    - Daniel Akittirq
    - Michelline Ammaaq
    - David Aqqiaruq
    - Edward Attagutaluk
    - Jacob Malliki

Comments and questions:

Discussions with the Igloolik HTO included the perceived die-offs on Prince Charles Island, HTO participation in surveys, telemetry collaring program for Baffin Island, and combining IQ with survey results.

The HTO expressed interest in the 2018 composition survey on Prince Charles Island where dead, skinny and weak caribou were observed. All parties agreed that in the future, if possible, samples should be taken when large scale die-offs are observed. The HTO were interested in taking part in surveys where possible and increasing the number of Inuit that take part in DOE surveys during field and planning phases.

As with other meetings there was discussion regarding the number of wolves observed during the surveys since 2014. DOE was able to provide some insight into this issue and stated that very few wolves have been observed since 2012 and it is unlikely that the wolf population at this time is having a significant impact on the caribou on Baffin.

After the presentation on the Kivalliq caribou monitoring program, there was discussion surrounding the logistics of collaring on Baffin. The HTO stated their interest in the information that collaring was able to provide but there was hesitation about the size of the collars shown during the presentation. The GN clarified that the collars shown in the presentation were older models and due to airline restrictions they couldn't bring one for the meeting. QWB, Mike Ferguson, stated that dummy collars may be an option to show the size and weight to HTOs and issues with roads were well known in Norway. The GN mentioned that the information from a collaring program would be a useful tool for HTOs to incorporate with IQ and utilize during land use discussions.

DOE then led discussions regarding accidental female harvest.

The HTO stated they wanted to discuss the management plan internally at an upcoming board meeting. There were no comments provided regarding the draft management plan during the meeting.

3.8 Arctic Bay

Date: January 17, 2019

Representatives:

- GN-DOE, Baffin Regional Wildlife Biologist: John Ringrose
- GN-DOE, Kivalliq Regional Wildlife Biologist: Mitch Campbell
- GN-DOE, North Baffin Manager: Scott Johnson
- GN- DOE, Wildlife Officer; Matthew Akikulu
- NTI, Resource Management Advisor: Cheryl Wray
- NWMB, Wildlife Management Biologist: Kyle Ritchie
- QWB, Senior Wildlife Advisor: Michael Ferguson
- Translator, Titus Arnakallak
- Ikajutit HTO Board members
    - Valerie Qaunaq
    - Joeli Qamanirq
    - Kunnak Enoogoo
    - Roland Taqtu
    - Paul Ejangiaq
    - Jonah Oyukuluk
    - Jennifer Pauloosie

Comments and questions:

The discussions with the Ikajutit HTO included survey logistics, male-only harvest, HTO participation in surveys, telemetry collaring program for Baffin, and combining IQ with survey results.

The HTO expressed interest in participating in upcoming survey work during the field and planning aspects. There was discussion regarding field logistics and how DOE deals with weather and mechanical issues and how these affect survey results. There was a lengthy conversation about female harvest with the HTO and the process for the GN, QWB and NWMB to adjust quotas and remove restrictions on female harvest.

The HTO expressed interest in a telemetry collaring program in response to effects of Baffinland Iron Mines on caribou in North Baffin. One member asked if a telemetry program could be initiated by DOE prior to the establishment of the railway south of Mary River to see what the effects were. There was also concern from the HTO about helicopters chasing caribou and flying very low. The DOE representatives advised the HTO that if aircraft are observed chasing caribou, the observer should be documenting the tail sign, the location and colour of the aircraft, the time of the incident, and report it to the GN. The HTO planned to discuss a collaring program at their next internal board meeting.

There were no comments provided regarding the draft management plan during the meeting. The HTO stated they wanted to discuss the management plan internally at an upcoming board meeting.

3.9 Pond Inlet

Date: January 18, 2019

Representatives:

- GN-DOE, Baffin Regional Wildlife Biologist: John Ringrose
- GN-DOE, Kivalliq Regional Wildlife Biologist: Mitch Campbell
- GN-DOE, North Baffin Manager: Scott Johnson
- NTI, Resource Management Advisor: Cheryl Wray
- NWMB, Wildlife Management Biologist: Kyle Ritchie
- QWB, Senior Wildlife Advisor: Michael Ferguson
- Translator, Abraham Kublu
- Mittimatalik HTO Board members
    - Amy Killiktee
    - David Qaminiq
    - Elijah Nashook
    - Eric Ootoova
    - Daniel Quasa
    - Phanuel Enoagah
    - Enookie Inuarak

Comments and questions:

The discussions with the Mittimatalik HTO included survey logistics, telemetry collaring in North Baffin, and effects from the Mary River project.

The HTO was concerned about the competence of the volunteer provided in 2018 and their inexperience in hunting or caribou identification. The parties discussed survey heights and different methods to ensure effective identification of males and females during composition surveys.

The HTO in Pond Inlet expressed concern over the effects of Baffinland and stated that since they are in the Mary River area they need the most help dealing with mining. There was also anger about the approved production increase and approval by the minister. The HTO expressed interest in splitting North and South Baffin as separate management areas.

After the presentation of the DOE Kivalliq caribou monitoring program there was discussion regarding collaring logistics and how collars are applied in the field. There was concern about collared animals losing weight due to the collars. The GN responded in saying that in general caribou wear the collars well and for the life of the collar. The GN explained 2 cases where caribou have been injured directly by collars and how these situations were included in future training to ensure it does not happen again. There was also concern that if a caribou died as a direct result of the collar, that caribou would come off the quota.

There were no comments provided regarding the draft management plan during the meeting. The board was unaware of earlier version of the management plan and even members that were not new did not remember discussions from 2015 with the HTO. The HTO stated they wanted to discuss the management plan internally. There seemed to be interest in the idea of a management plan by a few new members but no comments were made during the meeting.

3.10 Clyde River

Date: May 27, 2019

Representatives:

- GN-DOE, Baffin Regional Wildlife Biologist: John Ringrose
- GN-DOE, North Baffin Manager: Scott Johnson
- Nangmautaq HTO Board members
    - Apiusie Apak
    - Joamie Apak
    - Nysana Qillaq
    - Lucy Palituq
    - Jaysie Tigullaraq
    - Gary Aipellee

Comments and questions:

The HTO members identified and expressed their interest in survey design and logistics, the recent suspected die-offs on Prince Charles Island, a GPS telemetry collaring program, and effects of development on caribou.

The HTO and DOE discussed abundance and composition survey design and logistics at length, including the possibility of using alternative methodologies. Discussions regarding the use of drones for survey work were of particular interest, as this technology has a lot of current attention.

HTO members and DOE discussed using GPS telemetry collar data to identify effects of roads, railways, and effects of development activities. Members showed particular interest in the section of the presentation where animations showed effects of roads on caribou movement and behavior. There was further discussion following the presentation on effects of development including caribou avoidance behavior.

The DOE explained the logistics of collar deployment and the effects collars would have on caribou. HTO members were curious of what the perceived wolf abundance was on Baffin Island. Jaysie Tigullaraq asked how supporting a collaring program would allow increases in TAH. The DOE explained that if caribou are divided into subpopulations or herds then surveys can be done on a smaller scale, conducted more frequently, and be more reactive to increasing or decreasing TAH as needed.

No comments were provided regarding the draft management plan during the meeting. The HTO said they would discuss this internally at an upcoming board meeting and provide input to the GN in writing.

4.0 Summary

All ten HTOs sought clarification on abundance and composition survey methodology. All HTOs expressed interest in a greater involvement in GN led surveys including field aspects and pre-planning. The majority of HTOs expressed interest in some form of a telemetry collaring program in the future for Baffin Island. The Iqaluit, Pangnirtung and Arctic Bay HTOs had the most outspoken members in support of a collaring program but all HTOs indicated that they planned to discuss this internally prior to making a commitment. Many of the HTOs expressed their interest for modifying or adjusting the current TAH to include an aspect of female harvest. QWB had internal discussion with all of HTOs after the GN consultations to discuss the current TAH.

There were no comments from any HTO consulted regarding the draft management plan and all HTOs said they wanted to have internal discussions prior to submitting anything to the GN.

5.0 Appendix 1

Baffin Island Caribou HTO Consultations

John Ringrose
Baffin Regional Wildlife Biologist
Pond Inlet
Jringrose@gov.nu.ca
(867)899-7576

Outline

Introduction

Survey Types

Composition Survey
- 2015-2018 results
- 2019 spring survey

Monitoring Caribou

Draft Management Plan Comments

Introduction

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John Ringrose

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ᕿᑭᖅᑖᓗᖕᒥ	Baffin Region	Qiqiktaaluk
ᐊᕙᑎᓕᕆᔨᒃᑯᑦ	Department of Environment	Avatiliqiyitkut
ᓄᓇᕗᑦ ᒐᕙᒪᖓᑦ	Government of Nunavut	Nunavut Kavamanga

P.O. Box/C.P. 400
Pond Inlet, NU X0A 0S0
867-899-7576

jringrose@gov.nu.ca

www.gov.nu.ca

Survey types and methods

Two Main Types of Caribou Surveys

Abundance- The number of caribou

Composition- The ratio of bulls, cows, calves and calf survival

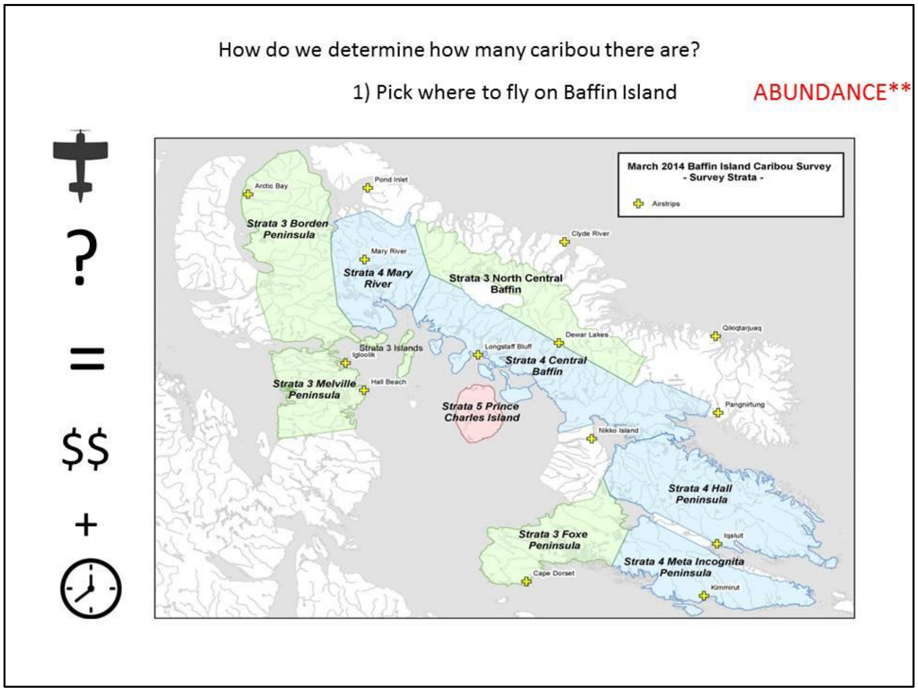
Fall surveys are best for Bull:cow ratio and a benchmark for over-winter calf survival trends

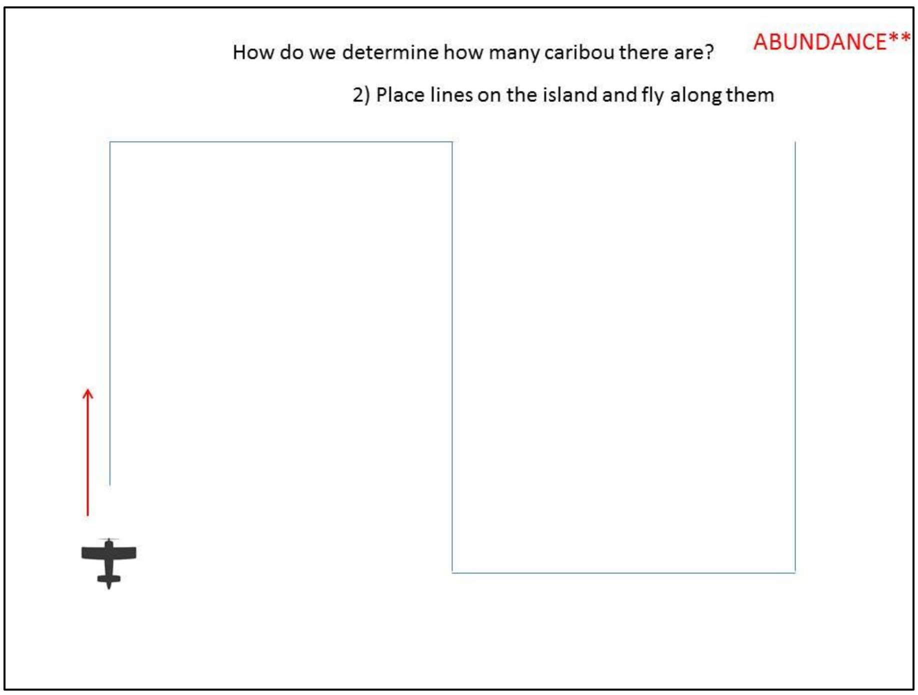
Spring Surveys are for calf over-winter survival

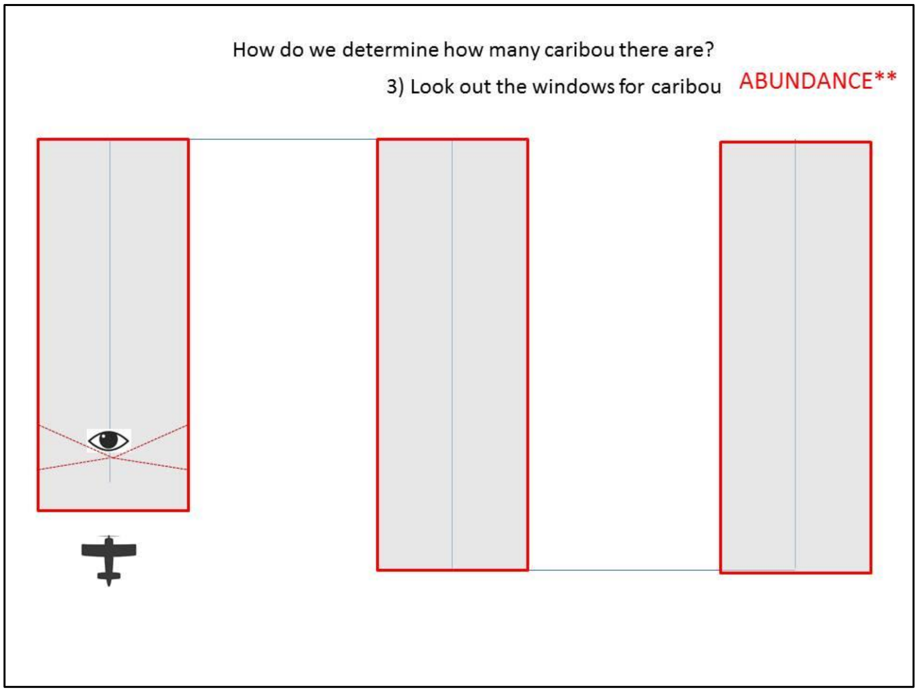
Baffin Island Caribou **Abundance** last completed in 2014

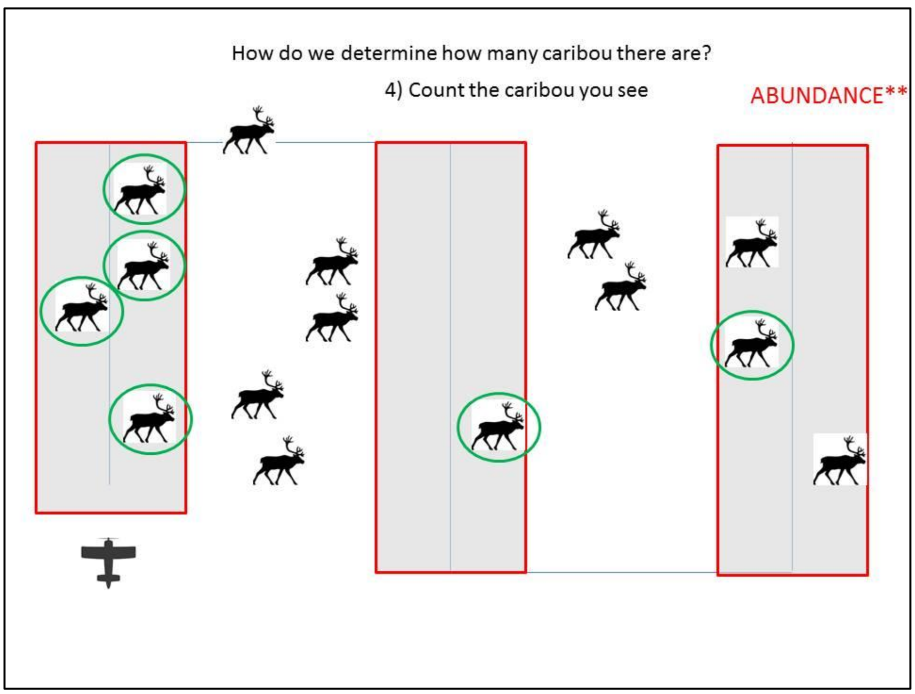
Composition Surveys completed 2015 -2018.

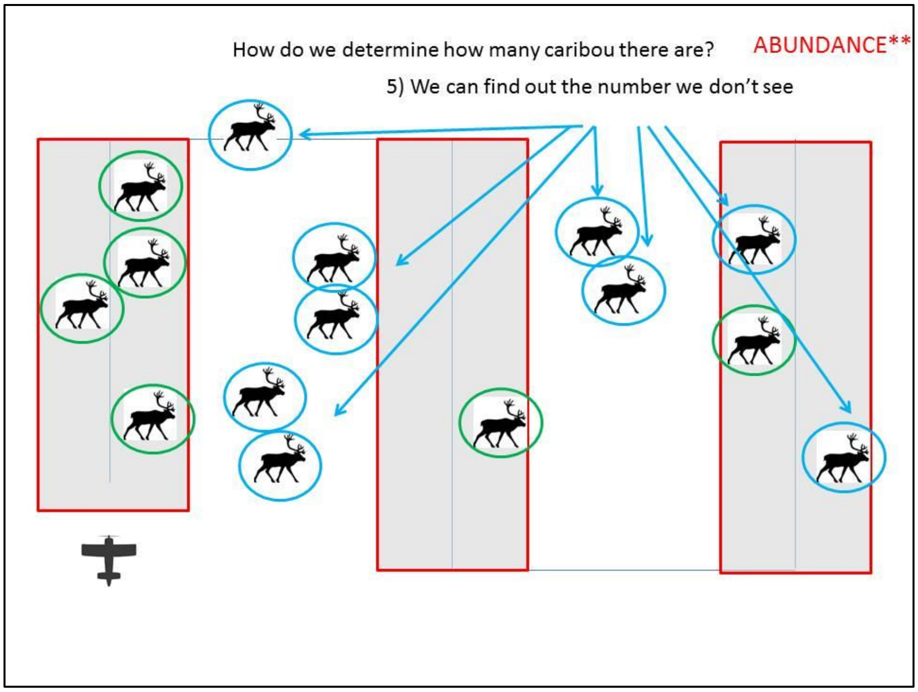
Next survey being completed March/April 2019


How do we determine how many caribou there are?
1) Pick where to fly on Baffin Island
ABUNDANCE**
?
=
$$
+
March 2014 Baffin Island Caribou Survey
- Survey Strata -
Airstrips
Arctic Bay
Pond Inlet
Strata 3 Borden Peninsula
Mary River
Strata 4 Mary River
Strata 3 North Central Baffin
Clyde River
Qikiqtarjuaq
Dewar Lakes
Strata 3 Islands
Igloolik
Longstaff Bluff
Strata 4 Central Baffin
Strata 3 Melville Peninsula
Hall Beach
Strata 5 Prince Charles Island
Pangnirtung
Nikko Island
Strata 4 Hall Peninsula
Strata 3 Foxe Peninsula
Iqaluit
Strata 4 Meta Incognita Peninsula
Cape Dorset
Kimmirut


How do we determine how many caribou there are?
ABUNDANCE**
2) Place lines on the island and fly along them


How do we determine how many caribou there are?
3) Look out the windows for caribou
ABUNDANCE**

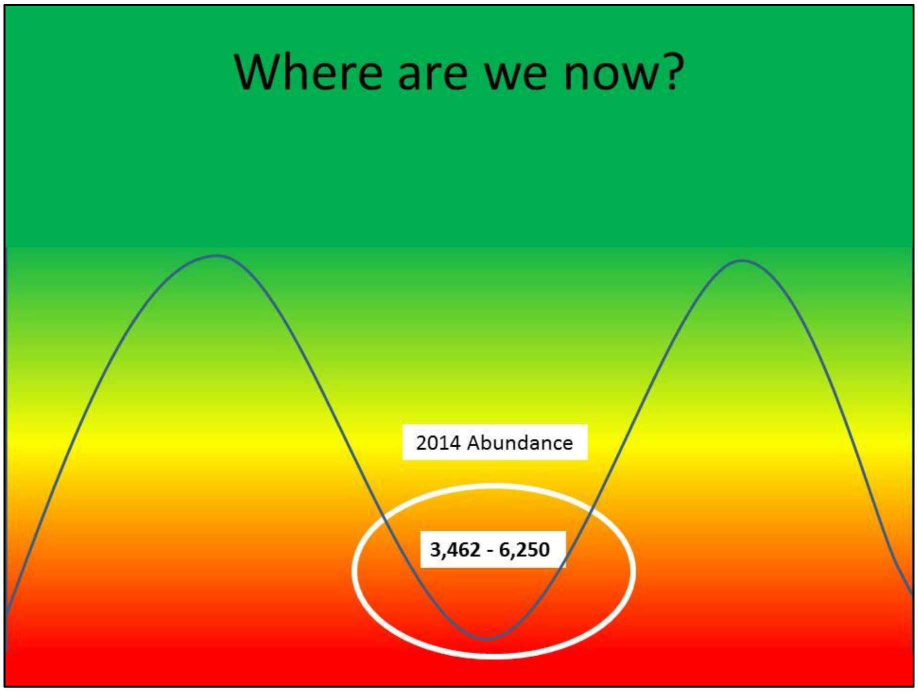

How do we determine how many caribou there are?
4) Count the caribou you see
ABUNDANCE**



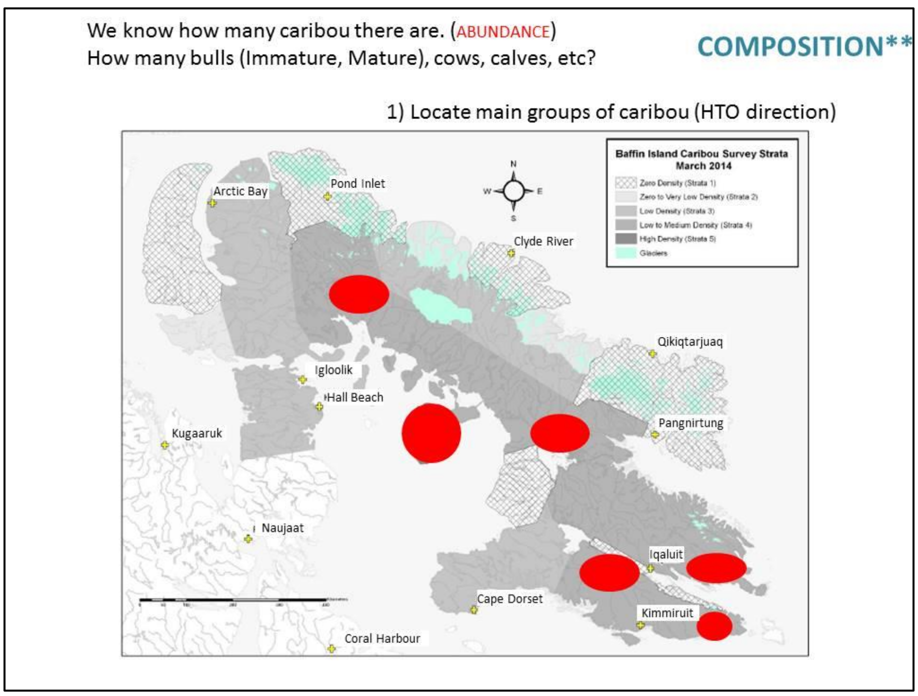
2014 Survey Number of caribou

ABUNDANCE**

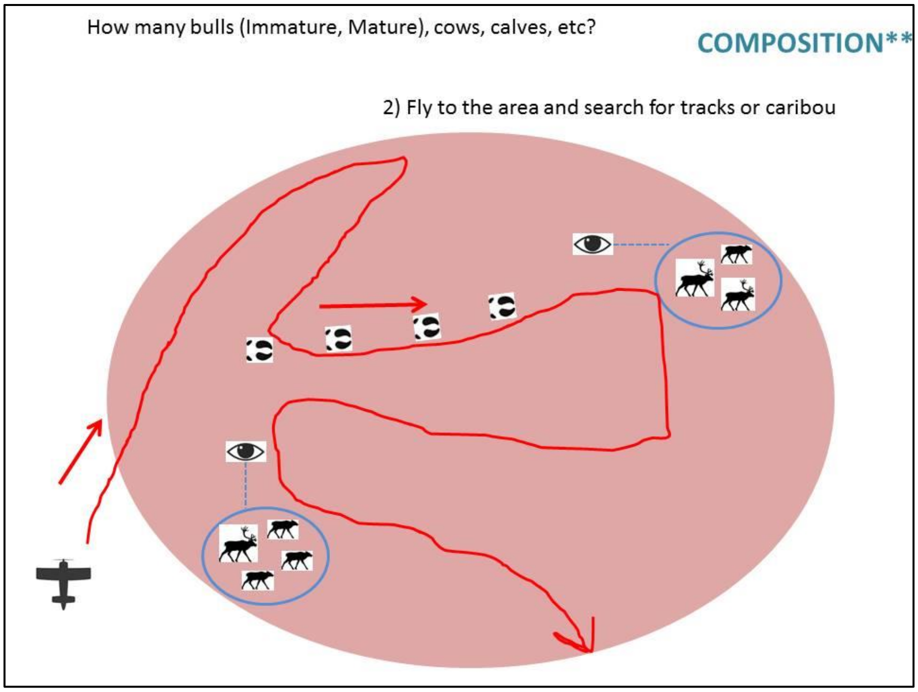
Subpopulation	Individuals Observed	We are 95% certain the actual number of Caribou lay between these two values
North Baffin		
Borden Peninsula	1	1 -30
Mary River	49	96 - 521
North Central Baffin	13	31 - 230
Total	***63***	***159 - 622***
South Baffin		
Central Baffin	197	662 – 1,798
Foxe Peninsula	20	48 - 972
Hall Peninsula	176	467 – 1,686
Meta Incognita Peninsula	91	256 -1,138
Prince Charles Island	557	1,158 – 2,220
Total	***824***	***3,169 – 5,935***
Total (-Prince Charles Island)	267	1,777 – 4,207
Other areas		
Melville Peninsula	26	88 - 551
Baffin Island + Melville P.	1,130	3,661 – 6,484
Baffin Island Total	***1,104***	***3,462 – 6,250***

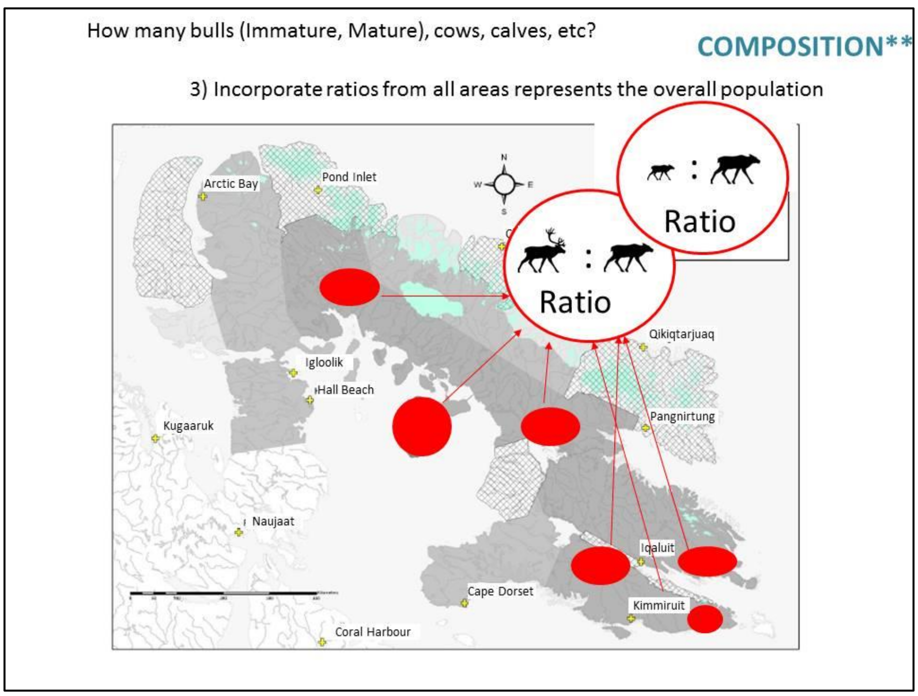


Where are we now?
2014 Abundance
3,462 - 6,250



We know how many caribou there are. (ABUNDANCE)
How many bulls (Immature, Mature), cows, calves, etc?
COMPOSITION**
1) Locate main groups of caribou (HTO direction)
Baffin Island Caribou Survey Strata
March 2014
Zero Density (Strata 1)
Zero to Very Low Density (Strata 2)
Low Density (Strata 3)
Low to Medium Density (Strata 4)
High Density (Strata 5)
Glaciers
Arctic Bay
Pond Inlet
Clyde River
Qikiqtarjuaq
Igloolik
Hall Beach
Pangnirtung
Kugaaruk
Naujaat
Iqaluit
Cape Dorset
Kimmirut
Coral Harbour


How many bulls (Immature, Mature), cows, calves, etc?
COMPOSITION**
2) Fly to the area and search for tracks or caribou


How many bulls (Immature, Mature), cows, calves, etc?
COMPOSITION**
3) Incorporate ratios from all areas represents the overall population
Ratio
Ratio
Arctic Bay
Pond Inlet
Qikiqtarjuaq
Igloolik
Hall Beach
Kugaaruk
Pangnirtung
Naujaat
Iqaluit
Cape Dorset
Kimmiruit
Coral Harbour

Composition Surveys 2015-2018

Objectives

1) Determine the vigor of the population based on productivity and demographic composition; i.e. what proportion of the population are young bulls, mature bulls, cows, yearlings, and calves.

2) Determine the trajectory of productivity of the population based on the demographic composition; and with spring composition results, determine if an index of calf productivity and overwinter survival suggests an increasing or decreasing trend.

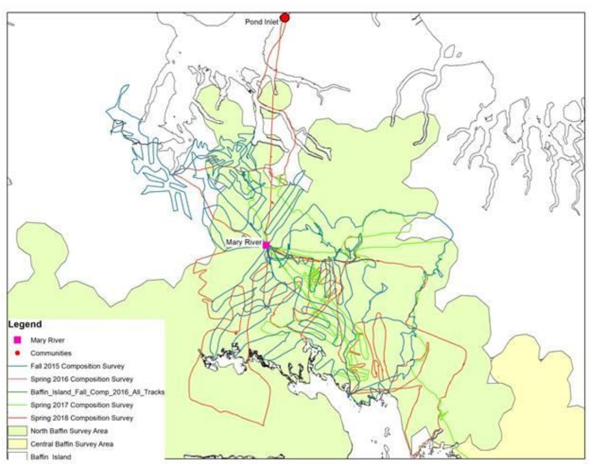
3) Monitor bull ratios to insure that the bull only harvest is not reducing bulls to a proportion that could interfere with rutting success.

4) Build a database with which to estimate the current population trend through demographic modeling, utilizing all demographic composition data to project a trend from the 2014 population estimate. **

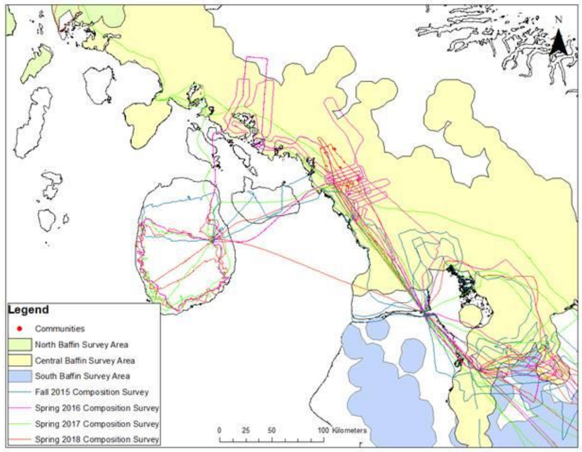
5) Inform on management discussions regarding current TAH levels.

**with multiple years of data and cow survival and calf over winter survival

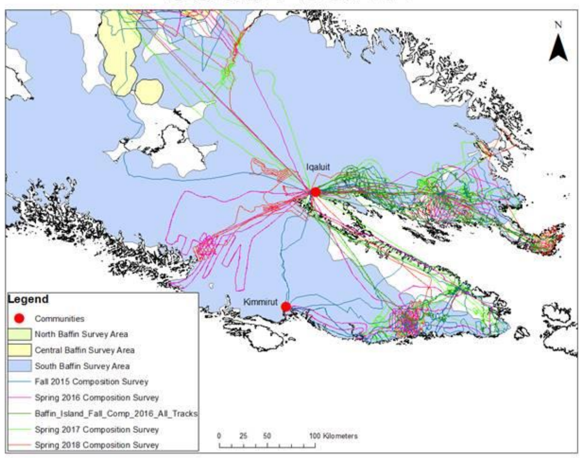
Composition Surveys North Baffin



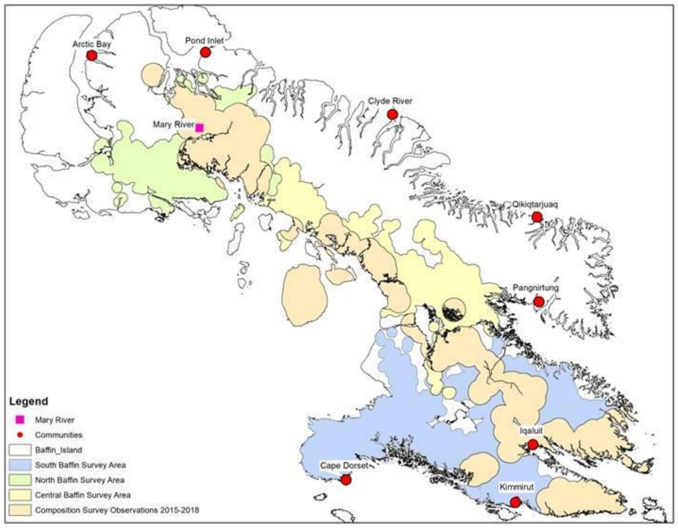
Composition Surveys
Central Baffin



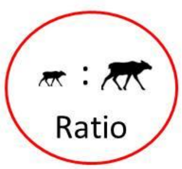
Composition Surveys
South Baffin



Composition Surveys



Composition Surveys Results



Suggested calf:cow ratios in NWT for stable or increasing populations:

- 70-90 at calving
- 50-70 in the fall
- 30-50 following winter

40 bulls:100 cows is suggested as a benchmark for the number of bulls required in a population to ensure all cows are bred successfully (Tobey 2001).

These are just indices

Composition Surveys Results- North

Fall

Table 4 Number of observed caribou by demographic group during Baffin Island composition surveys 2015-2018.

Year	2015				2016				2016				2017				2017				2018			
Season	Fall				Spring				Fall				Spring				Fall				Spring			
Location	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island
Calves Observed	55	28	133	49		23	82	49	54			81	47	1	114	92	86				21	18	31	155
Cows Observed	77	39	189	64		67	328	222	94			196	120	1	351	249	139				36	33	161	401
Calves/100 Cows	71	72	70	77		34	25	22	57			41	39	100	32	37	62				58	55	19	39
Yearlings Observed	N/A	N/A	N/A	N/A		10	76	29	N/A			42	23	0	57	75	17				5	7	37	100
Bulls Observed	76	29	126	46		25	204	151	54			126	64	6	133	181	74				38	40	73	277
Bulls/100 Cows	99	[illegible]	[illegible]	72	Not completed	37	62	68	57	Not completed	Not completed	64	53	600	38	73	53	Not completed	Not completed	Not completed	106	121	45	69
Bull + Cows	153	68	315	110		92	532	373	148			322	184	7	484	430	213				74	73	234	678
Adults + Yearlings Observed	153	68	315	110		102	608	402	148			364	207	7	541	505	230				79	80	271	778
Total Observed (Calves, Yearlings and Adults)	208	96	448	159		125	690	451	202			445	254	8	655	597	316				100	98	302	933

Ratio

40 bulls:100 cows

40 bulls:100 cows

40 bulls:100 cows

Suggests enough bulls to breed cows

Composition Surveys Results- North

Spring

Table 4 Number of observed caribou by demographic group during Baffin Island composition surveys 2015-2018.

Year	2015				2016				2016				2017				2017				2018			
Season	Fall				Spring				Fall				Spring				Fall				Spring			
Location	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island
Calves Observed	55	28	133	49		23	82	49	54			81	47	1	114	92	86				21	18	31	155
Cows Observed	77	39	189	64		67	328	222	94			196	120	1	351	249	139				36	33	161	401
Calves/100 Cows	71	72	70	77		[illegible]	25	22	57			41	39	[illegible]	32	37	62				58	[illegible]	19	39
Yearlings Observed	N/A	N/A	N/A	N/A		10	76	29	N/A			42	23	0	57	75	17				5	7	37	100
Bulls Observed	76	29	126	46		25	204	151	54			126	64	6	133	181	74				38	40	73	277
Bulls/100 Cows	99	74	67	72	Not completed	37	62	68	57	Not completed	Not completed	64	53	600	38	73	53	Not completed	Not completed	Not completed	106	121	45	69
Bull + Cows	153	68	315	110		92	532	373	148			322	184	7	484	430	213				74	73	234	678
Adults + Yearlings Observed	153	68	315	110		102	608	402	148			364	207	7	541	505	230				79	80	271	778
Total Observed (Calves, Yearlings and Adults)	208	96	448	159		125	690	451	202			445	254	8	655	597	316				100	98	302	933

Ratio

? Calves:100 cows

30-50 calves:100 cows

30-50 calves:100 cows

Suggests good calf over-winter survival

Composition Surveys Results- Central

Fall

Table 4 Number of observed caribou by demographic group during Baffin Island composition surveys 2015-2018.

Year	2015				2016				2016				2017				2017				2018			
Season	Fall				Spring				Fall				Spring				Fall				Spring			
Location	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island
Calves Observed	55	28	133	49	Not completed	23	82	49	54	Not completed	Not completed	81	47	1	114	92	86	Not completed	Not completed	Not completed	21	18	31	155
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Yearlings Observed	N/A	N/A	N/A	N/A		10	76	29	N/A			42	23	0	57	75	17				5	7	37	100
Bulls Observed	76	29	126	46		25	204	151	54			126	64	6	133	181	74				38	40	73	277
Bulls/100 Cows	99	74	[illegible]	72		37	62	68	57			[illegible]	53	600	38	73	53				106	121	45	69
Bull + Cows	153	68	315	110		92	532	373	148			322	184	7	484	430	213				74	73	234	678
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Total Observed (Calves, Yearlings and Adults)	208	96	448	159		125	690	451	202			445	254	8	655	597	316				100	98	302	933

40 bulls:100 cows

? bulls:100 cows

? bulls:100 cows

Ratio

2015 suggests enough bulls to breed cows

Composition Surveys Results- Central

Spring

Table 4 Number of observed caribou by demographic group during Baffin Island composition surveys 2015-2018.

Year	2015				2016				2016				2017				2017				2018			
Season	Fall				Spring				Fall				Spring				Fall				Spring			
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Total Observed (Calves, Yearlings and Adults)	208	96	448	159		125	690	451	202			445	254	8	655	597	316				100	98	302	933

30-50 calves:100cows

30-50 calves:100 cows

30-50 calves:100 cows

Ratio

Suggests good calf over-winter survival

Composition Surveys
Results- PCI

Fall

Table 4 Number of observed caribou by demographic group during Baffin Island composition surveys 2015-2018.

Year	2015				2016				2016				2017				2017				2018			
Season	Fall				Spring				Fall				Spring				Fall				Spring			
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Bull + Cows	153	68	315	110		92	532	373	148			322	184	7	484	430	213				74	73	234	678
Adults + Yearlings Observed	153	68	315	110		102	608	402	148			364	207	7	541	505	230				79	80	271	778
Total Observed (Calves, Yearlings and Adults)	208	96	448	159		125	690	451	202			445	254	8	655	597	316				100	98	302	933

40 bulls:100 cows

? bulls:100 cows

? bulls:100 cows

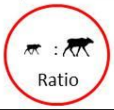
2015 suggests enough bulls to breed cows

Composition Surveys
Results- PCI

Spring

Table 4 Number of observed caribou by demographic group during Baffin Island composition surveys 2015-2018.

Year	2015				2016				2016				2017				2017				2018			
Season	Fall				Spring				Fall				Spring				Fall				Spring			
Location	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island
Calves Observed	55	28	133	49	Not completed	23	82	49	54	Not completed	Not completed	81	47	1	114	92	86	Not completed	Not completed	Not completed	21	18	31	155
Cows Observed	77	39	189	64		67	328	222	94			196	120	1	351	249	139				36	33	161	401
Calves/100 Cows	71	72	70	77		34	25	[illegible]	57			41	39	100	32	[illegible]	62				58	55	19	[illegible]
Yearlings Observed	N/A	N/A	N/A	N/A		10	76	29	N/A			42	23	0	57	75	17				5	7	37	100
Bulls Observed	76	29	126	46		25	204	151	54			126	64	6	133	181	74				38	40	73	277
Bulls/100 Cows	99	74	67	72		37	62	68	57			64	53	600	38	73	53				106	121	45	69
Bull + Cows	153	68	315	110		92	532	373	148			322	184	7	484	430	213				74	73	234	678
Adults + Yearlings Observed	153	68	315	110		102	608	402	148			364	207	7	541	505	230				79	80	271	778
Total Observed (Calves, Yearlings and Adults)	208	96	448	159		125	690	451	202			445	254	8	655	597	316				100	98	302	933



30-50 calves:100 cows

30-50 calves:100 cows

30-50 calves:100 cows

Suggests poor calf over-winter survival

Composition Surveys Results- South

Fall

Table 4 Number of observed caribou by demographic group during Baffin Island composition surveys 2015-2018.

Year	2015				2016				2016				2017				2017				2018			
Season	Fall				Spring				Fall				Spring				Fall				Spring			
Location	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island
Calves Observed	55	28	133	49		23	82	49	54			81	47	1	114	92	86				21	18	31	155
Cows Observed	77	39	189	64		67	328	222	94			196	120	1	351	249	139				36	33	161	401
Calves/100 Cows	71	72	70	77		34	25	22	57			41	39	100	32	37	62				58	55	19	39
Yearlings Observed	N/A	N/A	N/A	N/A		10	76	29	N/A			42	23	0	57	75	17				5	7	37	100
Bulls Observed	76	29	126	46	Not completed	25	204	151	54	Not completed	Not completed	126	64	6	133	181	74	Not completed	Not completed	Not completed	38	40	73	277
Bulls/100 Cows	99	74	67	72		[illegible]	62	68	57			64	[illegible]	[illegible]	38	73	53				[illegible]	[illegible]	45	69
Bull + Cows	153	68	315	110		92	532	373	148			322	184	7	484	430	213				74	73	234	678
Adults + Yearlings Observed	153	68	315	110		102	608	402	148			364	207	7	541	505	230				79	80	271	778
Total Observed (Calves, Yearlings and Adults)	208	96	448	159		125	690	451	202			445	254	8	655	597	316				100	98	302	933

40 bulls:100 cows

40 bulls:100 cows

? bulls:100 cows

Ratio

2015 and 2016 suggests enough bulls to breed cows

Composition Surveys Results- South

Spring

Table 4 Number of observed caribou by demographic group during Baffin Island composition surveys 2015-2018.

Year	2015				2016				2016				2017				2017				2018			
Season	Fall				Spring				Fall				Spring				Fall				Spring			
Location	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island	North Baffin Island	Central Baffin Island	Prince Charles Island	South Baffin Island
Calves Observed	55	28	133	49		23	82	49	54			81	47	1	114	92	86				21	18	31	155
Cows Observed	77	39	189	64		67	328	222	94			196	120	1	351	249	139				36	33	161	401
Calves/100 Cows	71	72	70	77		34	25	22	[illegible]			41	39	100	32	37	[illegible]				58	[illegible]	[illegible]	39
Yearlings Observed	N/A	N/A	N/A	N/A		10	76	29	N/A			42	23	0	57	75	17				5	7	37	100
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Bull + Cows	153	68	315	110		92	532	373	148			322	184	7	484	430	213				74	73	234	678
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Total Observed (Calves, Yearlings and Adults)	208	96	448	159		125	690	451	202			445	254	8	655	597	316				100	98	302	933

30-50 calves:100cows

30-50 calves:100 cows

30-50 calves:100 cows

Ratio

Suggests good calf over-winter survival

Composition Surveys
2019 Spring

Currently planning logistics for spring surveys in March/April 2019

Planning for south and central Baffin

In discussions with Baffinland regarding support for north Baffin

Working Together to Monitor Caribou on Baffin Island

– Planning For Recovery

Aerial Surveys

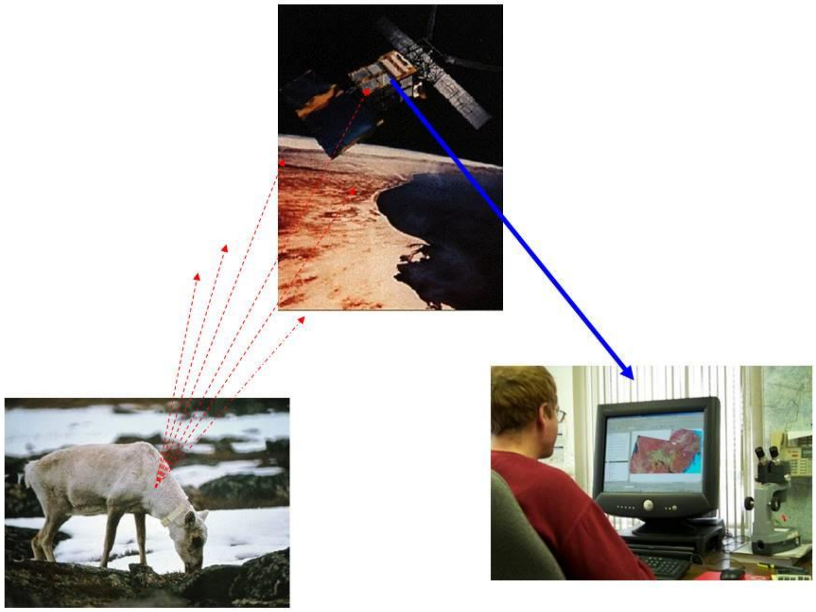
- Offer the most unobstructed viewing of caribou.
- Can cover large areas.
- Can be used to determine population trend.
- Can be used to estimate populations.
- Can be used to document large distributional shifts.

Composition Surveys

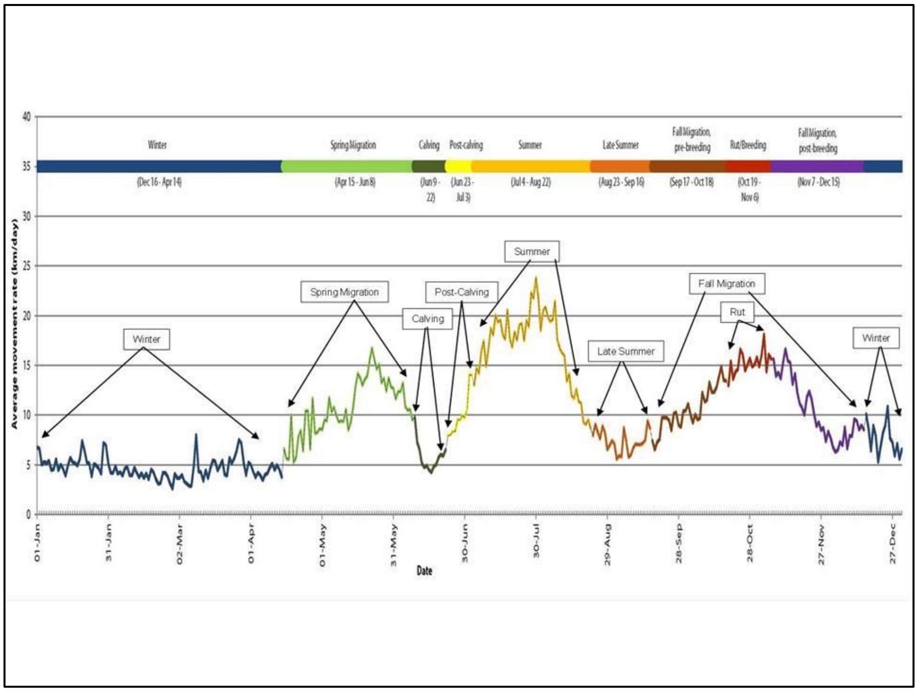
- Can be expensive
- Can be used as an index of population trend.
- Can be used to trigger more costly aerial surveys.
- Monitors changes in gender related survival.
- Provides an index of productivity.

Telemetry Studies

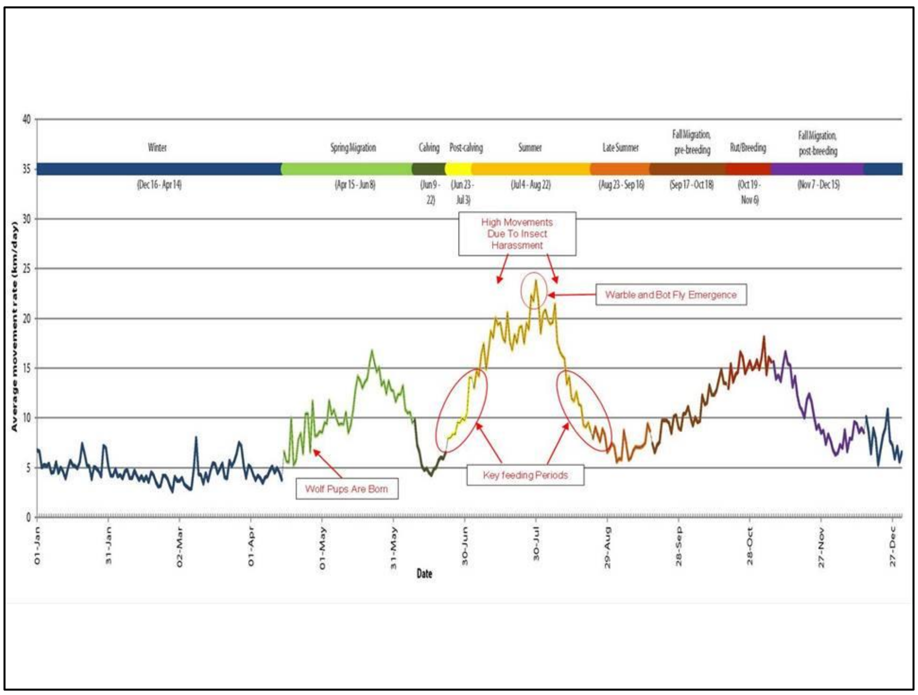
- Cost Effective.
- Dramatically lowers the cost of aerial and composition surveys.
- Can be used to determine herd annual range.
- Can be used to determine seasonal range.
- Can be used to guide aerial survey efforts.
- Can be used to determine critical habitat.
- Can be used to protect critical habitat.



How Telemetry is being used

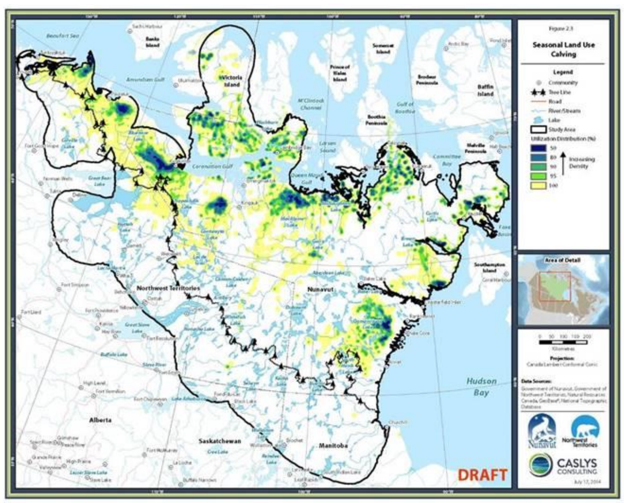


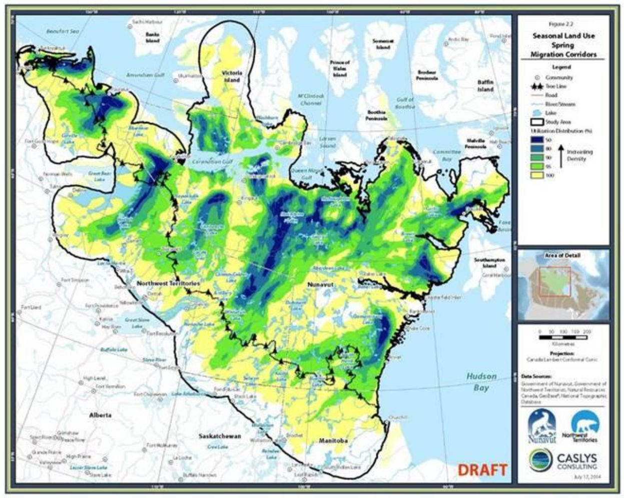
Winter
Spring Migration
Calving
Post-calving
Summer
Late Summer
Fall Migration, pre-breeding
Rut/Breeding
Fall Migration, post-breeding
(Dec 16 - Apr 14)
(Apr 15 - Jun 8)
(Jun 9 - 22)
(Jun 23 - Jul 3)
(Jul 4 - Aug 22)
(Aug 23 - Sep 16)
(Sep 17 - Oct 18)
(Oct 19 - Nov 6)
(Nov 7 - Dec 15)
Summer
Spring Migration
Post-Calving
Calving
Fall Migration
Rut
Winter
Late Summer
Winter
Average movement rate (km/day)
0
5
10
15
20
25
30
35
40
01-Jan
31-Jan
02-Mar
01-Apr
01-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date



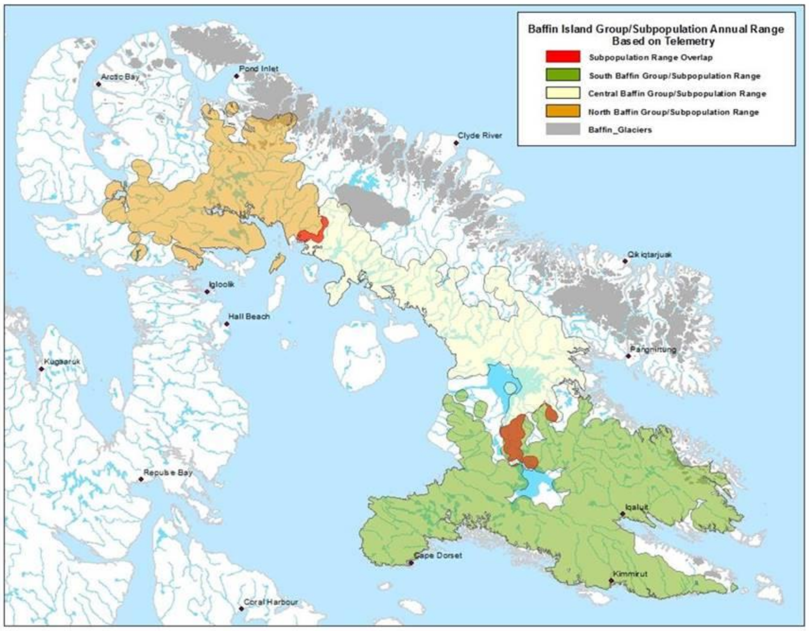
Winter
Spring Migration
Calving
Post-calving
Summer
Late Summer
Fall Migration, pre-breeding
Rut/Breeding
Fall Migration, post-breeding
(Dec 16 - Apr 14)
(Apr 15 - Jun 8)
(Jun 9 - 22)
(Jun 23 - Jul 3)
(Jul 4 - Aug 22)
(Aug 23 - Sep 16)
(Sep 17 - Oct 18)
(Oct 19 - Nov 6)
(Nov 7 - Dec 15)
High Movements Due To Insect Harassment
Warble and Bot Fly Emergence
Wolf Pups Are Born
Key feeding Periods
Average movement rate (km/day)
0
5
10
15
20
25
30
35
40
01-Jan
31-Jan
02-Mar
01-Apr
01-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date

Determining Seasonal Range



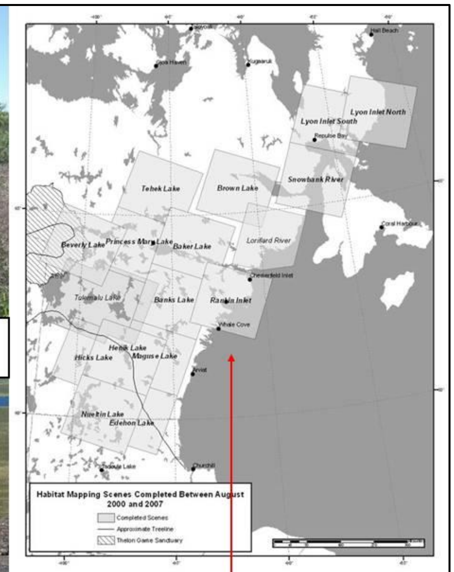


Herd Delineation



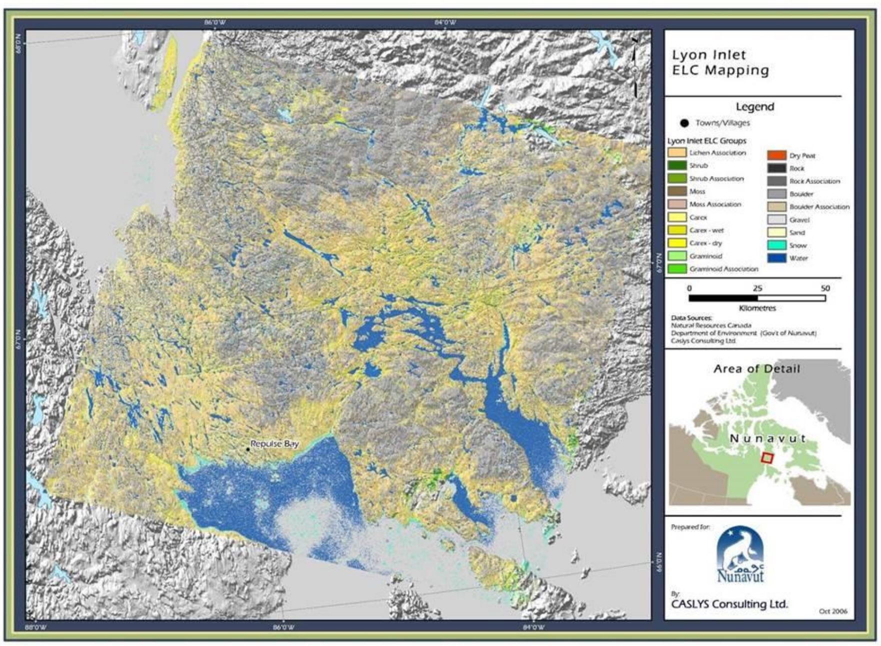
Ecological Studies

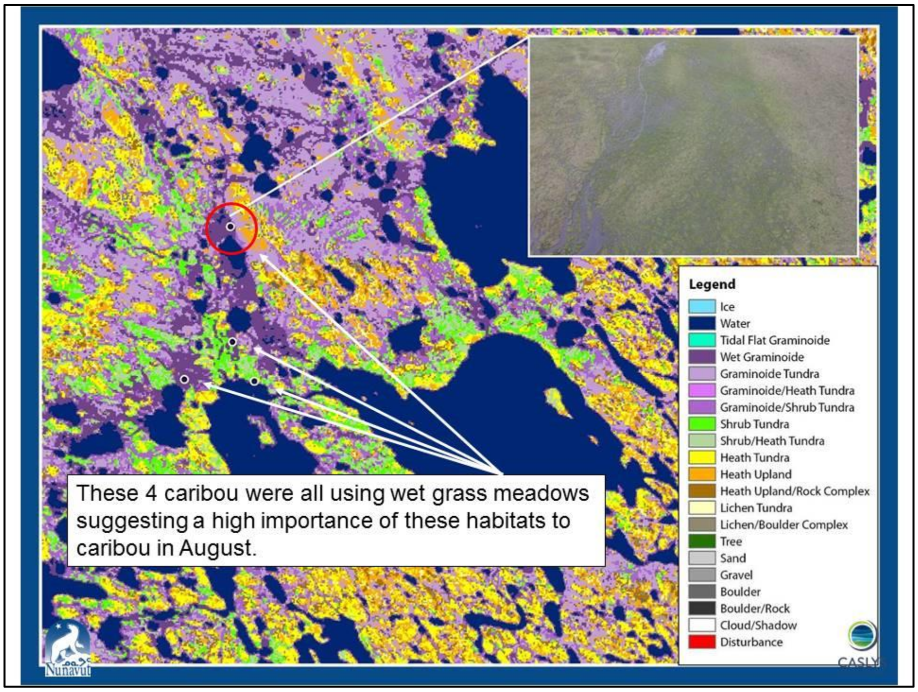
NTI Biologist David Lee and Wildlife Technician Jonathon Pameolik sample a shrub/grass site.



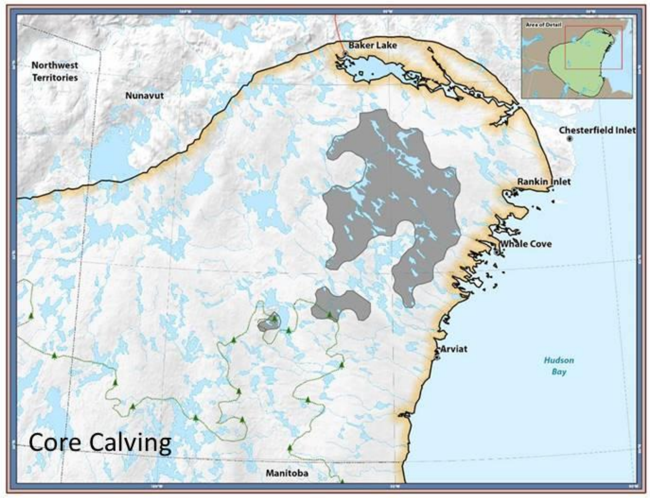
Landsat scenes sampled in the Kivalliq Region of Nunavut.

Sampling a rocky outcrop near Baker Lake.

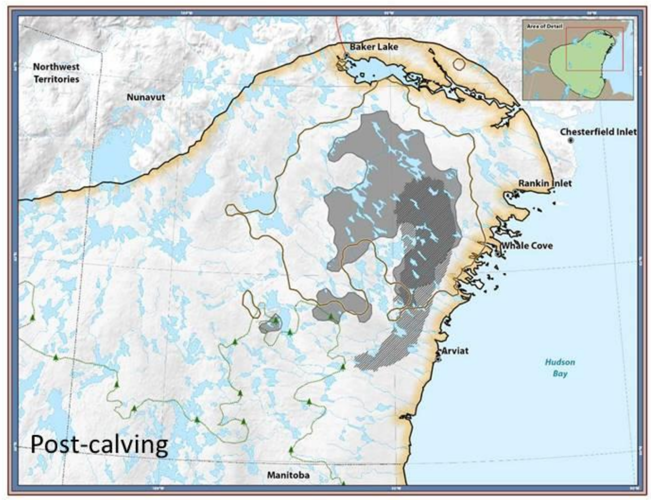


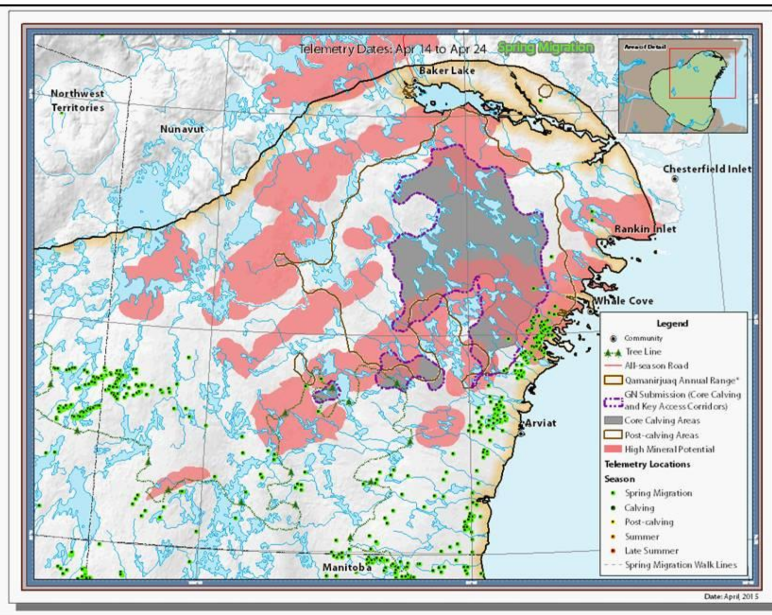


Protecting Caribou From Development

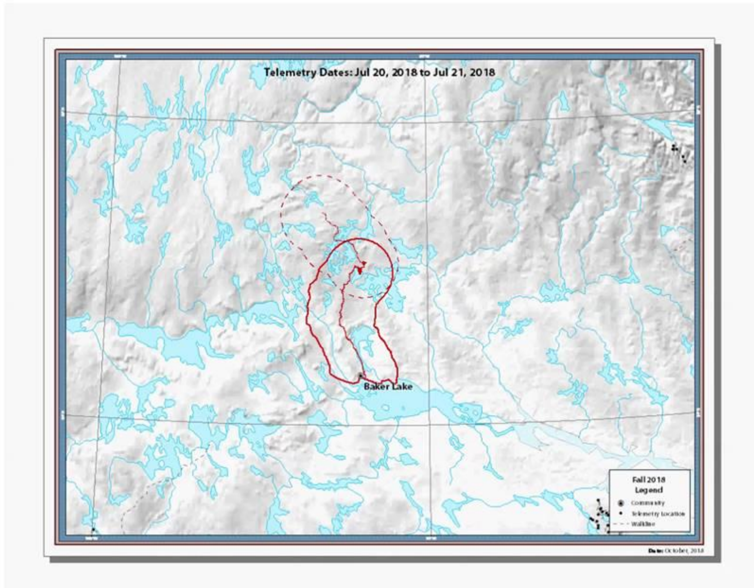

Baker Lake
Northwest Territories
Nunavut
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
Hudson Bay
Core Calving
Manitoba


Baker Lake
Northwest Territories
Nunavut
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
Hudson Bay
Spring Migration Corridor
Manitoba

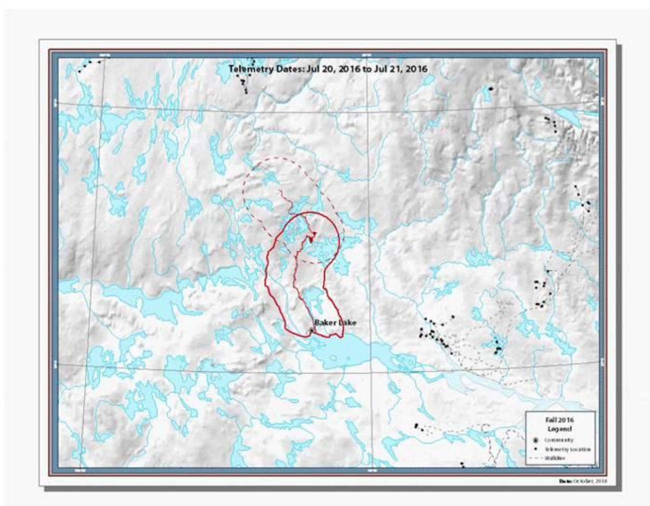

Baker Lake
Northwest Territories
Nunavut
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
Hudson Bay
Post-calving
Manitoba


Telemetry Dates: Apr 14 to Apr 24
Spring Migration
Baker Lake
Northwest Territories
Nunavut
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
Manitoba
Legend
Community
Tree Line
All-season Road
Qamanirjuaq Annual Range*
GN Submission (Core Calving and Key Access Corridors)
Core Calving Areas
Post-calving Areas
High Mineral Potential
Telemetry Locations
Season
Spring Migration
Calving
Post-calving
Summer
Late Summer
Spring Migration Walk Lines
Date: April 2015

2018


Telemetry Dates: Jul 20, 2018 to Jul 21, 2018
Baker Lake
Fall 2018
Legend
Community
Telemetry Location
Walkline

2016


Telemetry Dates: Jul 20, 2016 to Jul 21, 2016
Baker Lake
Fall 2016
Legend
Community
Telemetry Location
Walkline

Draft Management Plan

Sent to HTO in September 2018

We want to know community concerns, questions and comments

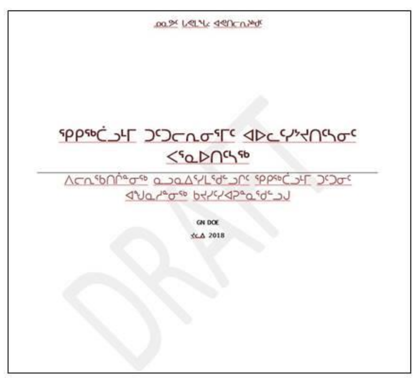
GOVERNMENT OF NUNAVUT: DEPARTMENT OF ENVIRONMENT

Baffin Island Caribou Management Plan

Working together to ensure Baffin Island caribou harvest is sustainable

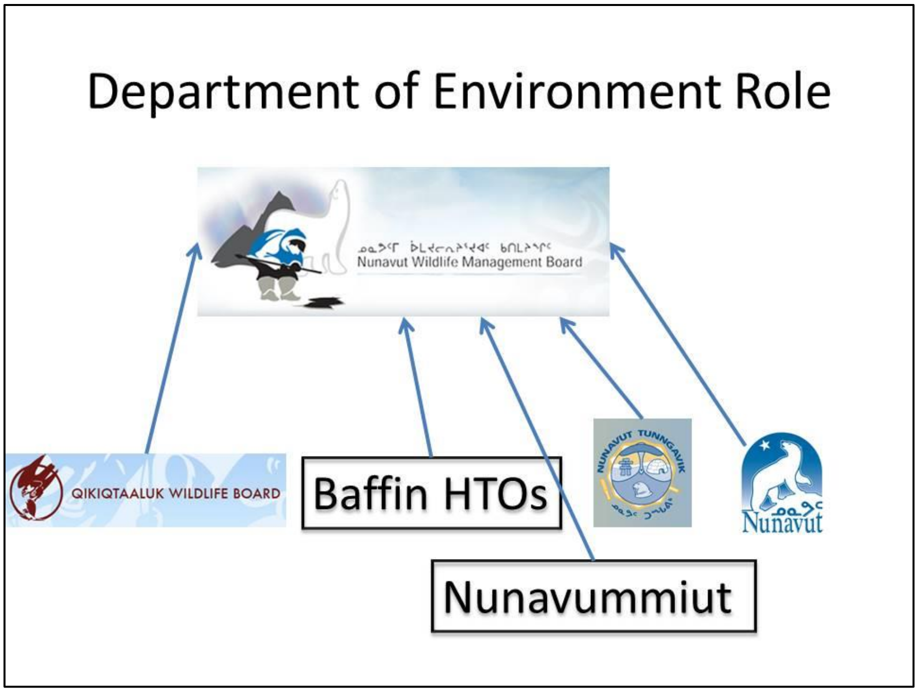
GN DOE
July 2018

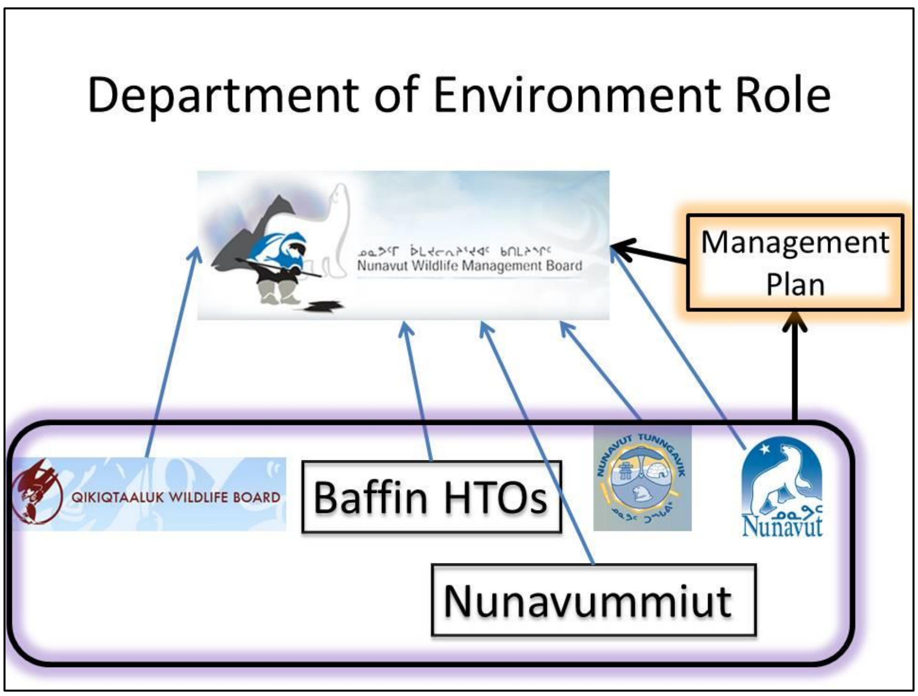
DRAFT



GN DOE
2018

DRAFT


Department of Environment Role
Nunavut Wildlife Management Board
QIKIQTAALUK WILDLIFE BOARD
Baffin HTOs
NUNAVUT TUNNGAVIK
Nunavut
Nunavummiut


Department of Environment Role
Nunavut Wildlife Management Board
Management Plan
QIKIQTAALUK WILDLIFE BOARD
Baffin HTOs
NUNAVUT TUNNGAVIK
Nunavut
Nunavummiut

What if something changes?

- Plan updated if there is new information
  - Status of caribou
  - Status of harvest management
  - Status of monitoring
- Complete review every 10 years
  - Next major revision (2028)

GOVERNMENT OF NUNAVUT: DEPARTMENT OF ENVIRONMENT

Baffin Island Caribou Management Plan

Working together to ensure Baffin Island caribou harvest is sustainable

GN DOE

July 2018

Summary

The purpose of the Baffin Island Caribou Management Plan is to provide guidance and recommendations to decision makers regarding the harvest management and monitoring of caribou inhabiting Baffin Island based on the best available Inuit Qaujimajatuqangit and science. The main body of this management plan is a guiding document that will be reviewed on a ten year term with co-management partners. The appended *Action Plan,* which will be reviewed annually by the Department of Environment, recommends management more specifically for the next 5 years, 2019-2024. Barren-ground caribou, such as those inhabiting Baffin Island, are known to undergo large cyclical fluctuations in abundance over a 50-90 year period, transitioning from periods of low abundance to high abundance, with phases of increasing and decreasing between. Each of these periods is represented by a corresponding management phase: Red (low), Yellow (increasing), Green (high), and Orange (decreasing). Baffin caribou are currently in the Red Phase, which means they are extremely vulnerable to overharvesting which could cause extirpation or prevent recovery. This plan advises harvest management and recommends continuous systematic monitoring of this population.

Table of Contents

Baffin Island Caribou Management Plan

1.0 Objectives

The primary objective of the Baffin Island Caribou Management Plan (BICMP) is to be an adaptive guide to harvest and monitoring of the Baffin Island caribou population (hereafter *Baffin caribou*). Management recommendations within the plan are intended to allow the caribou population to increase once range conditions improve. The rate of the caribou increase is dependent on the number of caribou harvested, recruitment, habitat availability, range condition, disease, predation and extreme weather events such as icing. Increasing from low to high abundance may take from several years to several decades to occur. This cyclical fluctuation can be delayed or interrupted by stress related to the above factors and overharvest. By minimizing risks related to harvest we can improve the likelihood that the population will increase and fluctuate naturally. In order to manage the harvest successfully we require current and accurate information on the status of the caribou, the productivity of their habitat, and the status of the harvest. The BICMP summarizes the components of a comprehensive harvest management and monitoring program and provides broad recommendations for the next ten years. The appended Action Plan makes more specific monitoring and research recommendations for the next five years, and will be subject to Department of Environment (DOE) review on an annual basis and amended as-needed (Appendix 1). The BICMP is not intended to be an overview of Baffin Island caribou consultations, research or ecology, all of which can be found in other publications cited herein. The legislative context of the plan and how it relates to the Nunavut Land Claims Agreement (NLCA) can be found in Appendix 2. The spatial area covered by this plan is shown in Figure 1.

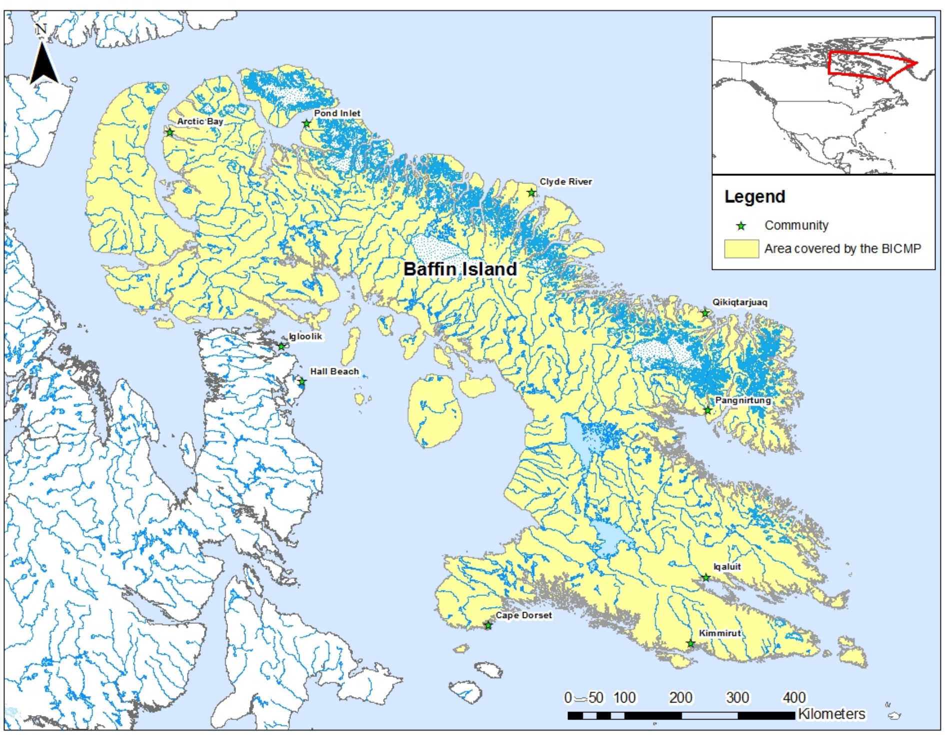


Figure 1. Area covered by the BICMP. All animals within this area are considered Baffin caribou and all harvest management and monitoring recommended herein is defined within these boundaries.

2.0 Participants

The BICMP affects all Nunavummiut; however, Inuit hunters from the ten communities which harvest caribou on Baffin Island (Iqaluit, Kimmirut, Cape Dorset, Pangnirtung, Qikiqtarjuaq, Clyde River, Pond Inlet, Arctic Bay, Igloolik and Hall Beach) will experience the greatest impacts. Co-management organizations that will contribute to the ongoing development and implementation of the BICMP include the Government of Nunavut Department of Environment, Baffin Hunters and Trappers Organizations (HTOs), Qikiqtaaluk Wildlife Board (QWB), Nunavut Tunngavik Incorporated (NTI), Nunavut Wildlife Management Board (NWMB), and Parks Canada (PC). Management of Baffin caribou will be most successful if co-management partners work collaboratively to ensure the sustainability of Baffin caribou.

In Nunavut, the Nunavut Wildlife Management Board is the main instrument of caribou management, subject to the ultimate authority of the Minister of Environment. The NWMB is an Institution of Public Government that includes representatives appointed by the Designated Inuit Organizations (DIO) and relevant government departments. The NWMB holds public hearings to garner input and makes decisions regarding caribou management based on information provided by DOE, HTOs, QWB, NTI and PC. These decisions then require the approval of the Minister of Environment to be enacted.

The Department of Environment has the legislated mandate to manage caribou in Nunavut. This includes the collection of scientific research and Inuit Qaujimajatuqangit (IQ), the development of caribou management plans, and ensuring legislative and regulatory compliance of harvest restrictions through education and enforcement. DOE provides background information on terrestrial wildlife species in Nunavut and provides recommendations to the NWMB, which then makes management decisions.

Hunters and Trappers Organizations represent hunters of each community on Baffin and provide conservation and management input directly through the QWB and NWMB public hearings.

The Qikiqtaaluk Wildlife Board works with the HTOs on harvesting practices and restrictions and allocates harvest within the Baffin region. The QWB also provides IQ input to the NWMB for making caribou management decisions.

Nunavut Tunngavik Incorporated ensures that all processes adhere to the Nunavut Land Claims Agreement (NLCA). Inuit harvesting rights are set out in the NLCA and beneficiaries retain last harvesting rights until conservation restrictions become necessary to ensure long term sustainable harvest.

Parks Canada is responsible for managing caribou within lands designated as National Parks. This includes Sirmilik and Auyuittuq National Parks for the purpose of the BICMP.

DOE consults with HTOs, QWB, NTI and communities when proposing research activities or management actions.

3.0 Review/Timelines

The BICMP Action Plan (Appendix 1) will be reviewed by the DOE whenever there is new information that informs caribou management. This includes new Inuit Qaujimajatuqangit as well as scientific data regarding the status of Baffin caribou, population delineation, caribou range/habitat and/or harvest. The overarching BICMP will be revisited by all affected parties once every 10 years. The 10 year review will include input from all affected parties and will include community and agency consultations. Once completed or revised, the BICMP will be submitted to the NWMB for consideration. Once the NWMB approves the plan it can be implemented, subject to final approval by the Minister of Environment.

4.0 Baffin Caribou

4.1 Abundance

Inuit Qaujimajatuqangit and archeological excavations of Thule sites suggest Baffin caribou have experienced large changes in abundance for at least the last 1000 years (Ferguson 1998; Stenton 1991). Fluctuations in caribou abundance seem to be cyclical, occurring over a period of 50-90 years. At its peak, the population is at least ten times larger than it is when caribou are scarce and numbers are at a minimum (Campbell et al. 2015; Ferguson 1998; Stenton 1991). These large scale fluctuations have been observed in many other caribou populations throughout the Arctic (Ferguson 1997; Gunn 2001; Morneau and Payette 2000). These cycles are believed to be natural and result from the interaction of caribou, vegetation, predation, and disease. On Baffin Island there are few predator species that persist at low densities, and it is believed much of the fluctuations in Baffin caribou abundance are driven by the interaction of caribou and their habitat. Caribou numbers increase until they surpass the carrying capacity of the environment. Eventually, large numbers of caribou degrade their range and the population declines quickly to low numbers until the range conditions improve and the cycle begins again (DOE 2015; Ferguson 1997; Ferguson and Messier 2000; Ferguson et al. 2001).

We divide the caribou cycle into 4 phases for the sake of caribou management. The duration of these phases are estimated from IQ and scientific observations during the previous caribou cycle (Ferguson et al. 1998):

<u>Red Phase:</u>

Caribou abundance is at a minimum (<10% of peak) during this *low* phase. During this phase, extirpation caused by overharvesting is possible for some or all of Baffin Island. Near the end of this phase caribou range will begin to recover and the population will increase in number and distribution. The rate of population increase is dependent on many factors but it can be slowed as a result of harvesting. We are currently in the Red Phase (2018). The last Red Phase spanned 25-30 years between about 1935-1965 (Ferguson 2005).

<u>Yellow Phase:</u>

Caribou abundance and range expand during this increasing phase. During the latter part of this phase the rate of increase can become quite high. Heavy harvest during the Yellow Phase could actually slow this rate of increase and prolong this stage. The last Yellow Phase spanned 25-30 years between about 1965-1990 (Ferguson 2005).

<u>Green Phase:</u>

Caribou abundance peaks and then begins to decline during this high phase. The last Green Phase spanned about 10 years between about 1990 and 2000 (Campbell et al. 2015; Ferguson 2005). During this phase the population far exceeds the ability of the environment to support it. The higher the number of caribou and the longer these numbers persist, the longer the recovery will be when the range recovers after the next Red Phase. During this phase, heavy harvest pressure could reduce the period to the next *increasing* and *high* phase.

<u>Orange Phase:</u>

Caribou abundance declines rapidly during this declining phase. Calf production and adult survival decline. The last Orange Phase spanned 10-15 years from about 2000-2010. Harvest in the early part of this phase will hasten the decline and could extirpate animals from certain areas as the population again enters the Red Phase.

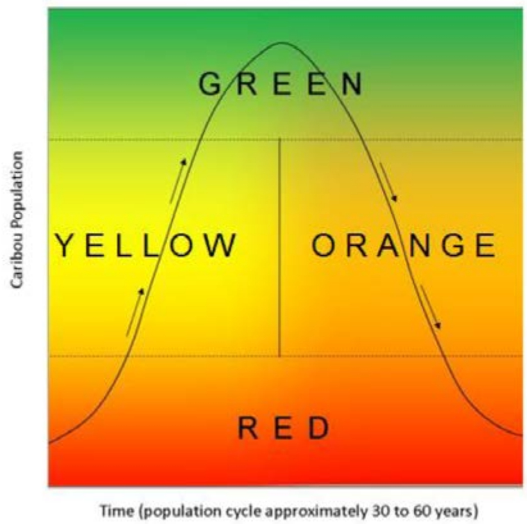


Figure 2. Population dynamics of Barren-ground caribou herds identifying *low/red, increasing/yellow, high/green* and *declining/orange* population phases (ACCWM 2014).

We collected demographic information through composition surveys from 2015-2018, that can be used to determine whether the caribou population is increasing, stable or decreasing. However, trends identified using composition survey data should be verified with additional abundance information prior to committing to specific management actions. We also lack the necessary historical data to determine what population sizes would constitute transitions between phases or to set thresholds, as has been done with other caribou herds across the Arctic (Advisory Committee for Cooperation on Wildlife Management (ACCWM) 2014, Beverly and Qamanirjuaq Caribou Management Board (BQCMB) 2005, Porcupine Caribou Management Board (PCMP) 2010). It is the intention of this plan to outline what research needs to occur for this data to be available in the future.

4.2 Distribution

Caribou are not evenly distributed across the landscape (Figure 3; Campbell et al. 2015). Barren-ground caribou tend to form distinct groups called herds, which utilize unique geographic areas that include calving grounds and migration routes and may have unique morphometric traits (Geist 1998). IQ and scientific analyses utilizing limited data suggest there may be several distinct subpopulations of caribou on Baffin Island. Available IQ and limited scientific information suggest there may be three to perhaps five distinct herds of caribou inhabiting Baffin Island. Inuit harvesters have suggested that caribou from different areas of Baffin have very different physical characteristics, and taste. Size, coloration, and eyelash length have all been cited as examples where caribou differ from one part of Baffin to another. Currently there is insufficient scientific data to delineate these populations with confidence (Campbell et al. 2015).

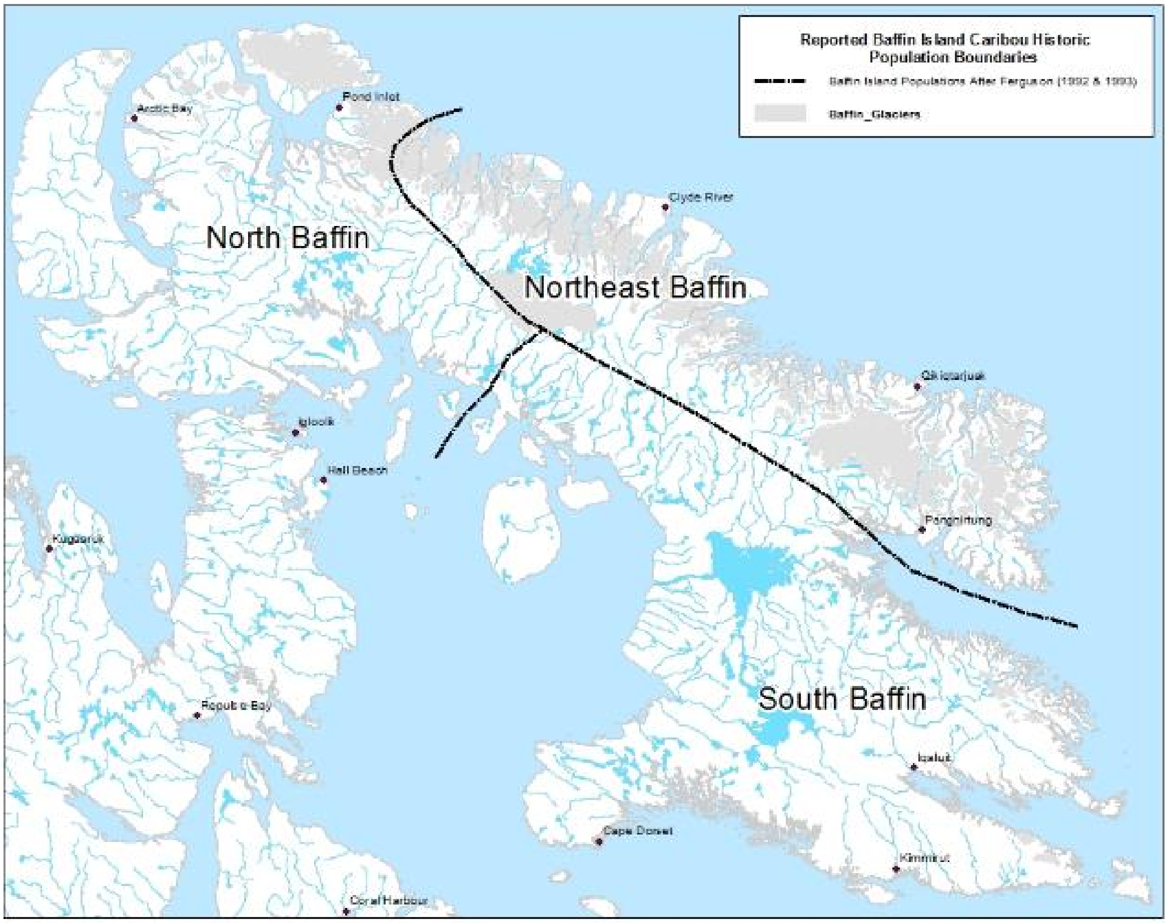


Figure 3. IQ studies with Inuit of Baffin Island in the early 1990s by Ferguson (1993) provided three regional caribou groupings or geographic areas.

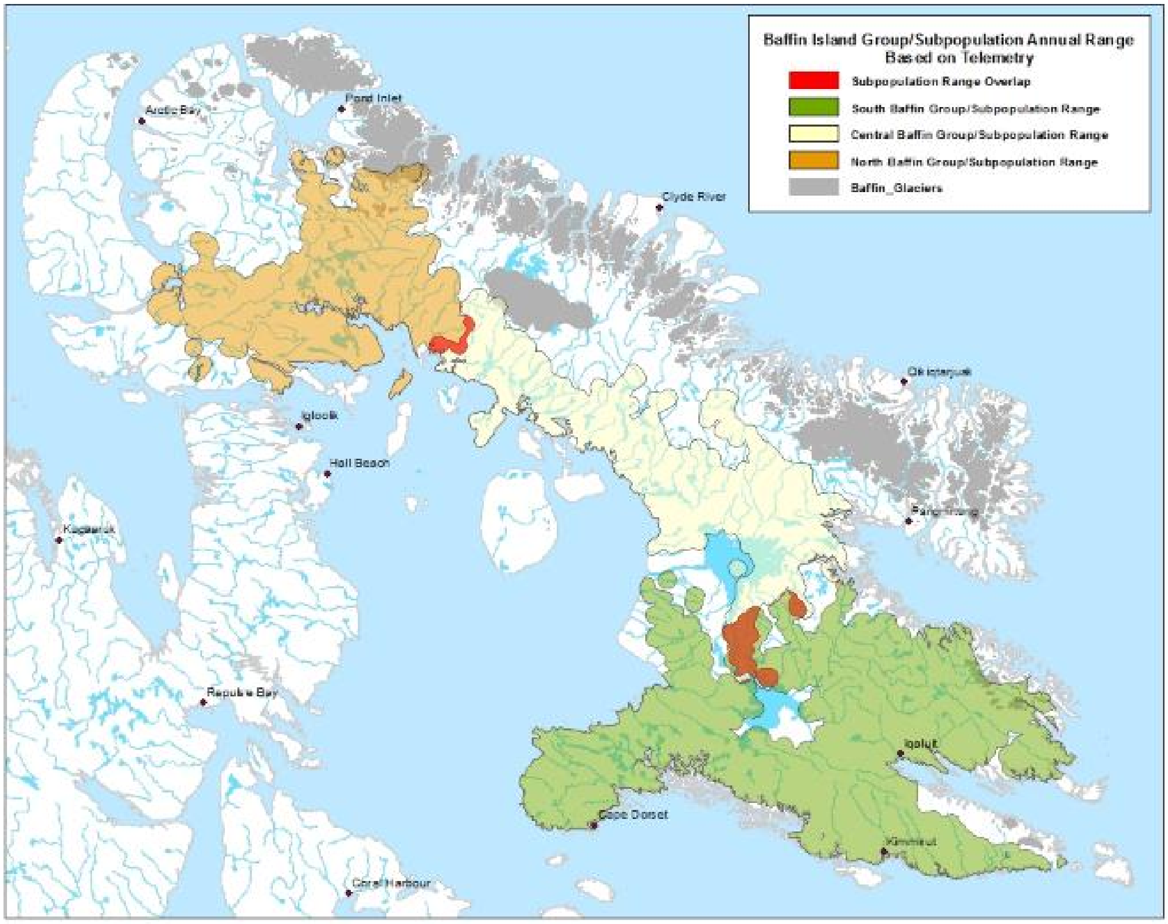


Figure 4. Caribou Group/Subpopulation annual range delineation based on telemetry studies from 1987 to 1994 (primarily South Baffin), and 2008 to 2011 (North Baffin) (Campbell et al. 2015). For a detailed description of methods used to produce this preliminary separation of Baffin caribou see Campbell et al. (2015).

4.3 Current Status

Baffin caribou are currently in the Red Phase (2018). In the early 2000's, IQ gathered from hunters across Baffin suggested the caribou had suffered a severe decline from the 1990's. Due to the apparent decline reported by hunters across Baffin, a study was designed incorporating IQ and the first population estimate of the whole of Baffin caribou range was completed in February and March 2014. As of March 2014 there were 4,652 (3,462 to 6,250; 95% CI) caribou on Baffin Island, including the nearby Prince Charles Island in Foxe Basin. Most of these caribou are concentrated in south Baffin and Prince Charles Island (Table 1; Figure 5; Campbell et al. 2015). This corresponds to a population decline of more than 95% based on the 1991 qualitative estimate derived from IQ (Ferguson 1998). As of March 2014 there were 159 - 622 (95% CI) caribou in North Baffin (Table 1; Figure 4). Caribou in this region are particularly vulnerable to extirpation.

Table 1. Estimates of caribou abundance by survey area *(Figure 5)* from the February and March 2014 Baffin Island survey.

Strata (Survey Area)	Caribou estimate	95% Confidence Limit (caribou estimate range)
North Baffin		
Borden Peninsula	6	1-30
Mary River	224	96-521
North Central Baffin	85	31-230
Total	**315**	**159-622**
South Baffin		
Central Baffin	1,091	662-1,798
Foxe Peninsula	216	48-972
Hall Peninsula	887	467-1,686
Meta Incognita Peninsula	539	256-1,138
Prince Charles Island	1,603	1,158-2,220
Total (+ Prince Charles Island)	4,337	3,169-5,935
Total (- Prince Charles Island)	**2,734**	**1,777-4,207**
Baffin Island Total	**4,652**	**3,462-6,250**

Although there is widespread agreement amongst Inuit hunters and scientists that there are much fewer caribou on Baffin now than in the 1990s, what happened to them remains a matter of debate. Many Inuit that were consulted during the 2013 DOE Baffin caribou IQ research study (hunter-elder survey) and community public opinion poll, and the 2012-2015 community and HTO consultations believe that caribou numbers have not actually declined as scientists believe. Instead, they believe that the caribou have moved somewhere else, either far away or into the mountains (DOE 2015, Kotierk 2015a, Kotierk 2015b). Most believe that the bulk of the reduction in caribou numbers was caused by a mass migration onto the mainland via the Melville Peninsula. For this reason the Melville Peninsula was included in the 2014 Baffin caribou aerial survey (Figure 5). The most recent data suggests that caribou numbers have also declined on the mainland, though to a lesser extent than on Baffin. Recent genetic analyses suggest Melville caribou are genetically separated from Baffin caribou which are genetically uniform. Whether the caribou moved or have declined, what happens to the ones that remain is the focus of the BICMP.

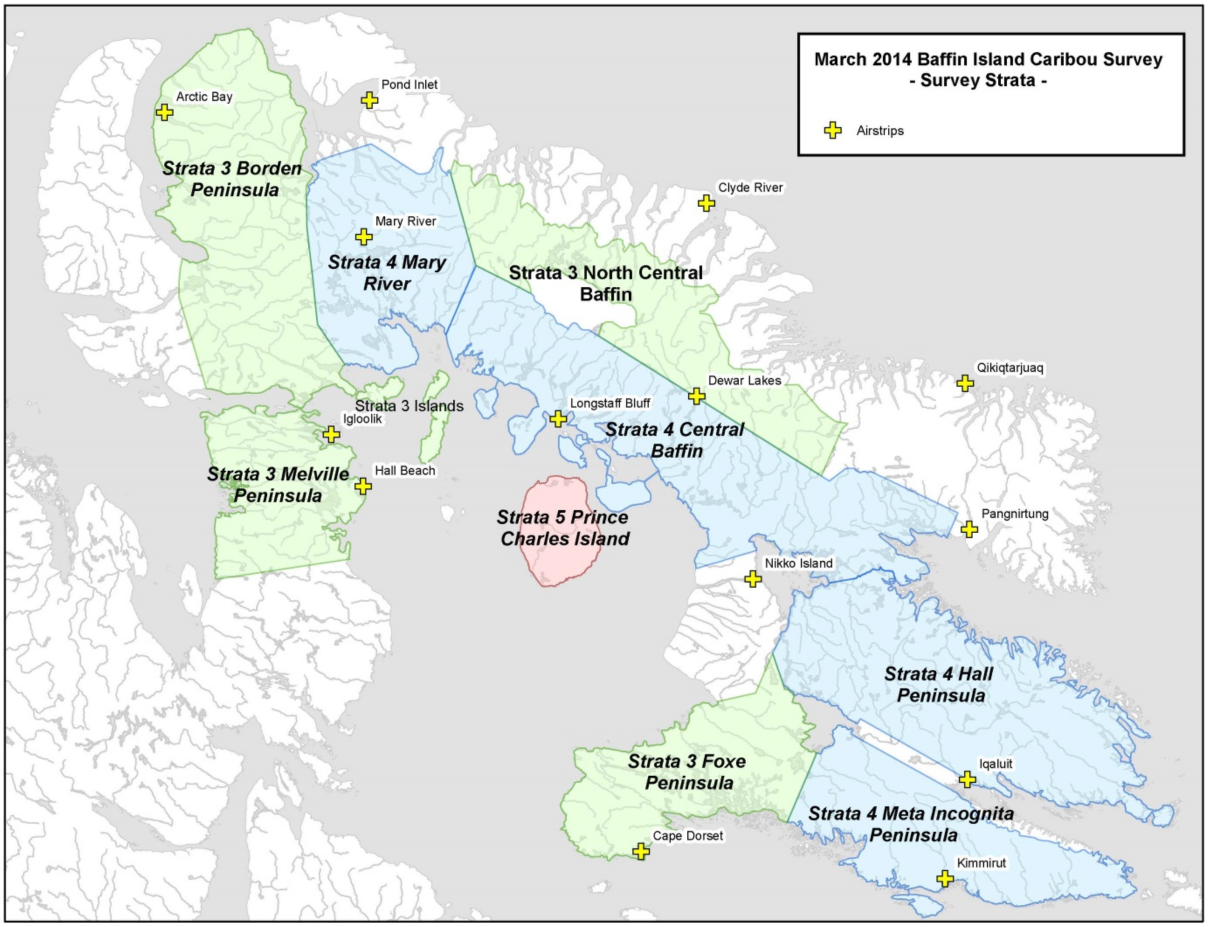


Figure 5. Survey Areas for the Baffin Island Caribou Survey – March 2014 corresponding to population and sustainable harvest estimates.

5.0 Harvest

5.1 Harvest Management

Caribou are important for cultural use and subsistence in Nunavut and have been harvested by Inuit for the last 1000 years (Stenton 1991). Ten Qikiqtaaluk communities and roughly half of all Nunavummiut rely on Baffin caribou as a source of food and traditional clothing. Human harvest could impact Baffin Island caribou populations, especially with increasing access and modern hunting techniques. If harvest, along with other forms of mortality such as predation and natural causes, surpasses calf recruitment, then population decline will result. Harvest management involves ensuring that the number of caribou hunted does not negatively affect the ability of people to harvest animals in the future, thus ensuring that Inuit can harvest caribou for the next 1000 years and beyond.

The potential impact of harvest is greater at times or in geographic areas where there are few animals. Furthermore, overharvesting in localized areas could lead to population fragmentation and added susceptibility to extreme weather events, which greatly increase the risk of extirpation. The extirpation of caribou by overharvesting has occurred previously on Southampton Island (Coral Harbour Hunters and Trappers Organization and Nunavut Department of Environment 2011; MacPherson and Manning, 1967). Consideration should be given to distributing harvest in proportion to available caribou, ideally for each distinct herd as herds become further delineated with ongoing research.

Harvest can occur and can even be encouraged at a sustainable level depending on what phase of the caribou population cycle is occurring. Harvest rates are set to ensure that harvest does not cause a decline in Baffin caribou and does not inhibit repopulation out of the current low phase. Harvest management could include management tools such as: Total Allowable Harvest (TAH), moratoriums, harvest management units (MUs), Non Quota Limitations (NQLs), and seasonal restrictions. Implementing a TAH means restricting the number of caribou harvested, while NQLs restrict where and/or what kind of caribou (e.g. cows, bulls during the rut, etc.) can be harvested. The maximum sustainable harvest for Barren-ground caribou populations used in the BICMP match our current understanding of caribou ecology and is based on empirical data and demographic modeling for Barren-ground caribou herds (see for example: Alaska Department of Fish and Game 2001; Porcupine Caribou Management Board 2010). A sustainable harvest level for caribou populations is 0-3% (bulls only) depending on population trajectory (decreasing, stable, or increasing). Higher level harvests can be sustained if there is little to no predation and rapid population growth; however this would increase risk and require intensive monitoring to ensure sustainability. Each cow harvested in the population is equivalent to approximately 3 bulls; therefore, a sustainable mixed harvest would need to be proportionately lower. Harvest should be restricted in accordance with the Nunavut Land Claims Agreement (NLCA), giving preferential and last harvesting rights to Inuit Beneficiaries (NLCA 1993). Non-beneficiary harvesting will be residual to the achievement of Basic Needs Level harvest, as determined by NWMB in consultation with NTI, QWB, HTOs and DOE (article 5.1.3 (a) (i) and (ii), NLCA 1993).

Harvest equal to the population growth rate will prevent any population recovery. Any harvest that occurs during in the *Red* or *Yellow Phase* will mean it will take longer for the population to recover. Harvest can be unrestricted and even encouraged in the later *Yellow* and *Green Phases*.

5.2 Current Status

The cause for the recent *Orange Phase* caribou decline (2000-2010) is likely a combination of factors (described in *4.1 Abundance*) and is not assumed to be the direct result of overharvest. However, overharvesting when there are so few animals may lead to further decline and possibly even extirpation of this population. At the very least, overharvest will restrict the capacity of the caribou population to increase as range conditions improve. The impact of harvest will be more or less significant depending on the population trajectory (decreasing, stable, and increasing). If calf recruitment and survival are high then a higher harvest level can be sustained. However, we do not know if Baffin caribou are currently increasing or decreasing because we do not have sufficient recent demographic data. Multiple years of demographic data are needed to establish what the trend is for this population.

Until recently there has been no mechanism by which DOE could collect reliable harvest information, and no reliable harvest statistics exist. However, effective in 2015, the Minister of Environment accepted a decision by the NWMB to allow a limited harvest of 250 bull caribou including mandatory reporting. Future harvest management decisions will be made through the NWMB and NLCA process, which includes opportunities for input by interested public, communities and co-management partners.

6.0 Monitoring

Sound management is not possible without information. Uninformed management will risk further decline, prevent recovery and possibly lead to the extirpation of caribou from Baffin Island. Successfully managed caribou populations require a multitude of information, including harvest levels, caribou abundance, population trend and range status (Table 2). For the sake of brevity and clarity, monitoring methodologies are not explained in detail in the BICMP (methodological references can be found in GN project reports).

6.1 Community Involvement in Monitoring

All monitoring activities undertaken by DOE involve participation by community members and regional HTOs (*see for example* Campbell et al. 2015; Goorts 2014; Jenkins et al. 2012; Jenkins and Goorts 2012; Nunavut Department of Environment 2013). This includes a) scoping and design of surveys, b) consultation and consideration of the cultural and ethical appropriateness of study techniques and c) involvement in research activities through Inuit expertise and direct employment as per the guidelines in the NLCA (article 5.1.6, NLCA 1993).

6.2 Inuit Qaujimajatuqangit

Inuit Qaujimajatuqangit (IQ) is the system of values, beliefs and knowledge gained through living and hunting on the land over many generations. The Government of Nunavut DOE mandate is to collect and utilize IQ alongside scientific data. DOE conducted IQ research on Baffin caribou in 2013. This was comprised of hunter-elder traditional knowledge (TK) interviews and public opinion poll surveys in the various Baffin communities (Kotierk 2015a, Kotierk 2015b). DOE considers IQ and science together when making management recommendations (NLCA article 5). IQ is also collected during project consultations and has helped inform scientific study design on numerous occasions. IQ is an important component for designing studies, and observations made by local harvesters provides valuable information on the status, distribution and behaviour of Baffin caribou.

6.3 Harvest Reporting

Quantifying the number of animals being harvested is important in all management phases, but essential when the population is low. Our understanding of harvest is crucial to sound management. The sex and age of harvested animals is important, as mortality of cows and calves may have a significant role in herd dynamics. Not knowing harvest levels severely hampers modeling and management efforts. There are several ways that caribou harvest can be quantified, but the most reliable method is mandatory reporting through a tag system, which is recommended herein and elsewhere (Rettie 2010).

6.4 Herd Status

There are many methods to help us better understand the status of Baffin caribou. Some methods provide one piece of information while others can provide many different kinds of information. In order to prioritize these approaches it is necessary to balance the effort with the amount and type of information gained (Table 2). Overall, collaring is the single most effective research tool to study caribou (Table 2).

6.4.1 Population Size, Demographics, and Rate of Change

The primary pieces of information required to successfully manage caribou are the number of animals and the demographics within a population (Northwest Territories Department of Environment and Natural Resources 2011). With these values we can calculate the rate of increase of the population and predict the population size a few years into the future. Knowing how many calves are recruited will allow us to make an assessment of the sustainable level of harvest. However to be certain, we also require periodic estimates of cow survival.

6.4.2 Herd Delineation

Most Barren-ground caribou are managed as socially distinct units or herds which share seasonal range distributions. We do not currently know if all Baffin caribou form distinct herds or how many herds of caribou occur on Baffin Island. Both available IQ and Scientific information suggest that separate herds exist on Baffin Island, however there is currently insufficient data to delineate them with confidence (Campbell et al. 2015). Recent genetic analyses indicate there is minimal gene flow between Melville Peninsula and Baffin Island suggesting that Baffin caribou are unique from the mainland herds. These results also indicate that there is no genetic difference between caribou in North and South Baffin. Delineating separate herds of caribou on Baffin Island is necessary for the long-term success of any harvest management program (Northwest Territories Department of Environment and Natural Resources 2011). Managing Baffin caribou as one herd, when there are in fact separate herds, risks extirpating unique herds.

6.4.3 Health

Health refers to the condition of the individual animals within the herd, which is indicative of range condition, disease prevalence and population age structure. The health and condition of caribou can affect productivity and survival of caribou. Knowledge of the health status of caribou on Baffin Island will add to our understanding of the mechanisms of population decline and other health related obstacles that may hinder recovery of the caribou population. Protocols for standardized health and body condition monitoring are available (CARMA 2008). Overall, it is important to identify the causes of decreased condition so that managers may predict the overall effects on the herd and manage appropriately.

6.5 Range

Caribou have minimum habitat requirements necessary in order for them to survive and ultimately, the status of this habitat greatly impacts whether a population increases or decreases. Key habitat areas vary by season and the specific requirements of different life history stages from calving to overwintering. Inuit Elders have referred to areas in which caribou remain when they are absent everywhere else during population lows as “Special Areas” (Ferguson 1998), and these can be more fully designated through the implementation of the BICMP’s research and monitoring (Table 3). While calving ranges are important for population recruitment winter ranges may be the limiting factor for these barren-ground caribou, a time of year when they are most energetically taxed and forage is less accessible and of lower quality (Ferguson et al. 2001). Understanding habitat selection is critical to assess the impacts of disturbance and to identify critical habitats that caribou take refuge in when range condition is highly degraded. Along with IQ, habitat selection requires good caribou use information from a satellite collaring program and accurate habitat maps (Table 2).

6.6 Human Disturbance

Resource exploration and development has been on the rise in recent years across Northern Canada. A number of these developments currently exist on Baffin Island. The potential for mining/industrial activities and infrastructure to negatively impact caribou is a concern amongst Baffin communities and wildlife managers. Impacts to caribou could include, but are not limited to: increased levels of stress and energy expenditures associated with sensory disturbances, physical barriers to movement or alterations to movement patterns, habitat destruction and degradation, abandonment or avoidance of certain areas, and increased levels of harvesting. Other human disturbances such as aircraft-over flights and recreational activities may also impact caribou. Overall these disturbances have the potential to negatively influence movement and habitat use, and could act cumulatively to impact caribou condition, recruitment and health. Understanding the effects and the threshold levels of disturbance to caribou will be important to evaluate the impacts of development. This will require a thorough research program to understand the baseline condition of Baffin caribou.

6.7 Predation

Predators have the ability to limit the growth of caribou populations, and various predator-prey relationships are possible. Wolves are the primary predators of caribou on Baffin Island and have probably had a modulating effect on the population through time. Studying the wolf population and monitoring wolf-caribou interactions would provide insight into what role wolves play in the cycling of caribou on Baffin. Although wolves eat several other species, including Arctic Hare and various seals, their primary prey are ungulates. There are no Muskox on Baffin and currently very few caribou so the wolf population is likely extremely low and subsequently difficult to study (none were seen on the 2014 survey). Incidental observations of wolves by hunters could provide an early warning system of increasing wolf numbers or activity which could then signal the need for further study.

Table 2. Scientific methods used to determine the status of caribou harvest, caribou habitat and caribou herds and the inferences we can make using data from these methods.

Monitoring Activity	Population Estimate	Population Trajectory	Sustainable Harvest Level	Migration	Population Delineation	Habitat Selection	Animal Health	Harvest Rate	Range condition
Satellite Collaring	X*	X*	X*	X	X	X*	X	X	
Composition Survey	X*	X	X						
Population Size Survey	X	X*	X						
Landscape Genetics Study					X*				
Health Monitoring							X		
Range Classification						X*			X
Harvest Study		X*	X*					X	

* Only in some cases or when coupled to other data or over multiple years

6.8 Current Status

A thorough review and reanalyses of historical research conducted on Baffin caribou can be found in Campbell et al. (2015). Early scientific surveys (1940-1970) failed to provide reliable population estimates due to limited coverage and unsophisticated survey methods. In 2012, DOE conducted a survey of Southern Baffin Island and generated an estimate of 1,555-3,093 (95% CI; Jenkins et al. 2012; *revised estimate from* Campbell et al. 2015). In February and March 2014, the first Baffin Island-wide caribou aerial survey was completed using multiple aircraft and the Distance-Double Observer Pair Platform technique (Boulanger et al. 2014). Local Hunters and Trappers Organizations (HTOs) were involved in the planning of the aerial survey and in its implementation. Data from this survey formed the basis of the first scientifically rigorous population estimate for Baffin Island caribou (Table 1; Campbell et al. 2015). Similar island-wide surveys will be necessary in the future to determine whether the population size has changed.

While scientific research continues, more information will be needed to sufficiently inform the BICMP on herd delineation, migration routes, calving grounds, and habitat affiliations. Collaring of caribou was conducted in North Baffin from 2008-2011 and in South Baffin from 1987-1994, with a total of 102 collars deployed. While this number may seem large, it is insufficient to determine with confidence the spatial affiliations of Baffin caribou, given the huge extent and timescale (Campbell et al. 2015). While data to determine herd delineation needs to be expanded, data from 2008-2011 and 1987-1994 collaring indicates some seasonal movements within North and South Baffin. A continuation of a multi-year collaring program during decadal periods of both high and low population regimes with collars deployed across Baffin will be required to accurately delineate caribou sub groups, determine habitat use, and seasonal distributions.

A caribou Health Monitoring program was conducted on Baffin Island between 2012 and 2014 (Goorts 2014). This program, based on CARMA protocols, involved hunters bringing in samples, which were then prepared and sent to labs for analyses. A program similar to this should be instituted whenever caribou harvest is permitted and sufficient capacity exists to process samples in order to provide information on disease and parasite prevalence.

Composition surveys were conducted on Baffin Island from in spring and/or fall from 2015 to 2018. There are many key pieces of information required to ensure the successful recovery of caribou on Baffin Island. These include; 1) The total harvest between the 2014 population estimate and the 2018 spring composition survey (legal and illegal), 2) Multiple concurrent estimates of overwinter survival, 3) Average recruitment for the different sampling areas, 4) Overall health of caribou. Baffin caribou cannot be confidently managed until the missing information is collected and the composition survey results and associated trends can be verified. This information is imperative to determine what level of harvest is sustainable for caribou on Baffin Island. Demographic composition surveys should be conducted on a yearly basis to monitor calf recruitment and also to model changes to the population size between island-wide population estimates. It is very important that we begin regular systematic monitoring of this herd in order to effectively manage Baffin Island Caribou for the future.

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Appendix 1: 2019-2024 Baffin Caribou Action Plan

2014/2015 Management Action

The March 2014 caribou survey confirmed that there are extremely low caribou numbers on Baffin Island necessitating immediate management action to prevent human harvest from causing further decline. In November 2014, the Department of Environment (DOE) recommended immediate management action to the Nunavut Wildlife Management Board (NWMB) in order to minimize the imminent risk to the caribou population due to low numbers and relatively high harvest. The NWMB started the co-management consultation process with a public hearing planned for March 2015 and suggested that the Minister of Environment take any action necessary in the interim to ensure that caribou are not extirpated from Baffin Island. In December 2014, by interim order of the Minister, a moratorium on all harvest of Baffin caribou was announced due to urgent and unusual circumstances. The order came into effect in January 2015. In March 2015, NWMB held a public hearing to garner input on Baffin caribou management and to consider recommendations by members of the public, as well as Baffin HTOs, QWB, NTI, DOE and PC. In June 2015, the NWMB decided to replace the moratorium with a harvest of 250 bull caribou, to be followed by a review upon receipt of the results of the first survey.

On August 21st, 2015, the Minister signed a Baffin Island Caribou Total Allowable Harvest Order thereby removing the harvest moratorium. A limited harvest of 250 male caribou was permitted on Baffin Island. By a decision of the QWB, the allowable harvest was allocated evenly among the eight Baffin Island communities (30 tags/community), with an additional 10 tags provided to Igloolik and no tags in the current year provided to Hall Beach.

Recommendations

Management Action Plan

Any managed harvest should correspond to the guidelines explained in section 5.1 *Harvest Management*. By conducting the research suggested in the BICMP the GN will be able to confidently recommend management actions, such as adjustments to percent harvest or tag allocation. The issue of harvest pressure can be addressed through various management actions such as TAH, non-quota limitations (e.g. bull only harvest), time and area closures and other restricted access measures when and where caribou are particularly vulnerable. Any allocation of harvest should be adjusted by the estimated harvest since the 2014, or more recent, caribou survey. Any harvest that is above the population growth rate will cause further decline. Harvest equal to the population growth rate will prevent any population recovery.

Monitoring Action Plan

Inuit Qaujimajatuqangit and science will be used together in decision making for Baffin caribou management. Inuit Qaujimajatuqangit research on Baffin caribou (DOE 2015a, 2015b; Kotierk 2015a, 2015b; Ferguson et al. 1998) has been considered in the BICMP. We cannot manage what we do not know, and relative to most Barren-ground caribou there is a need for more scientific information regarding Baffin Island caribou. There is similarly limited documentation of Inuit Qaujimajatuqangit in a usable format for management purposes. What information is available is largely anecdotal and was collected over a long time period, with varying caribou densities and habitat quality. If we monitor 1) harvest, 2) the status of Baffin caribou and 3) their range we will be more able to manage harvest appropriately. Overall, a thorough scientific monitoring program for Baffin caribou would include regular population estimates, yearly demographic surveys and a continuous collaring program (Table A1). This would be coupled to an ongoing landscape genetics program and hunter harvest caribou health monitoring program (Table A1). A harvest monitoring program needs to be instituted for Baffin caribou for all harvest management regimes. Mandatory harvest reporting is by far the most effective and least complicated method available (Table A1).

Table A1. Proposed caribou monitoring activities and information gained for the next five years. All activities are subject to budget constraints and HTO/community review and input. Note population estimates are expensive and GN may not be able to commit to a five year (ten year with certainty) interval for budgetary reasons.

Activity	**Implementation Schedule**				
	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024
Collaring program		**X**	**X**	**X**	**X**
Composition Survey	**X**	**X**	**X**	**X**	
Landscape Genetics	**X**	**X**			
Health Monitoring			**X**	**X**	**X**
Range Classification		**X**	**X**		
Population Estimate Survey					**X**
Harvest Study			**X**	**X**	**X**

Appendix 2: Legislative Background and Context

The Baffin Island Caribou Management Plan accords with and is supported by legislation as follows: the Canada Nunavut Act (CNA), the Nunavut Land Claims Agreement (NLCA), and the Nunavut Wildlife Act.

In Article 5 of the Nunavut Land Claims Agreement principles, objectives and values of Nunavut are outlined with respect to Inuit harvesting rights in concert with the conservation and management objectives of the NLCA for wildlife and the environment. For clarification, some important Article 5 excerpts relevant to the BICMP include:

Principles

- 5.1.1 a) "species" means any particular species or any distinct sub-group within a species such as a stock or population;
- 5.1.2 e) there is a need for an effective system of wildlife management that complements Inuit harvesting rights and priorities, and recognizes Inuit systems of wildlife management that contribute to the conservation of wildlife and protection of wildlife habitat
- 5.1.2 f) there is a need for systems of wildlife management and land management that provide optimum protection to the renewable resource economy
- 5.1.2 g) the wildlife management system and the exercise of Inuit harvesting rights are governed by and subject to the principles of conservation
- 5.1.2 i) Government retains the ultimate responsibility for wildlife management.

Conservation

- 5.1.5 The principles of conservation are:
  c) the maintenance of vital, healthy, wildlife populations capable of sustaining harvesting needs as defined in this Article; and
  d) the restoration and revitalization of depleted populations of wildlife and wildlife habitat.

Total Allowable Harvest

- 5.6.16 Subject to the terms of this Article, the NWMB shall have sole authority to establish, modify or remove, from time to time and as circumstances require, levels of total allowable harvest or harvesting in the Nunavut Settlement Area.
- 5.6.17 A total allowable harvest of a stock or population may be expressed in numbers…a) …in terms of a community total allowable harvest, and…b) …in terms of a regional total allowable harvest.
- 5.6.20 The basic needs level shall constitute the first demand on the total allowable harvest. Where the total allowable harvest is equal to or less than the basic needs level, Inuit shall have the right to the entire total allowable harvest.

With reference to the Wildlife Act, the BICMP incorporates the precautionary principle as applied to the conservation and management of Baffin caribou.

As a management plan under the purview of the Nunavut Wildlife Management Board (the main instrument for wildlife management in Nunavut (NLCA)), the BICMP also needs to conform to territorial, national and international obligations of Nunavut on biodiversity. This national and international obligation for Nunavut to conserve biodiversity at the herd, "stock", "distinct sub-group" or "population" level arises from the Canada Nunavut Act and the federal responsibilities for conservation of biodiversity conveyed therein upon Nunavut. This includes the requirement for conformity of the

BICMP with the Canadian Biodiversity Strategy arising from Canada's signatory commitment to the United Nations Convention on Biodiversity.

TEXT of the polar bear harvest *Flexible Quota System* as proposed by the Government of Nunavut

II. 1 to 1 Harvest Option

Rationale and administration of the 1:1 harvest system

1. Rationale

During the public hearing process regarding the implementation of Nunavut's Polar Bear Co-Management Plan by the Nunavut Wildlife Management Board, many comments by Inuit organizations were brought forward that favoured a new harvest approach. For years, communities have expressed a desire to adopt a harvest regimen that does not penalize communities as sharply as the flexible quota system when females are overharvested, and that allows harvesting at an equal sex ratio. In response, the **one male for every one female harvest option (or 1:1)** was discussed and recommended by the Department of Environment.

Each polar bear subpopulation within Nunavut has a set Total Allowable Harvest (TAH), which is divided among the communities that harvest from the subpopulation, by the appropriate Regional Wildlife Organization(s), as a base allocation. Each harvest season, communities are assigned a harvest quota based on the TAH allocation and any overharvests from previous seasons. Overharvests in one season result in a reduced community quota the following season, unless the community has accumulated sufficient credits to compensate for the overharvest. When a community harvests below their harvest quota they can accumulate sex specific credits to be used in future harvest seasons or shared with other communities.

The updated harvest sex ratio, allowing one female bear harvested for every male bear harvested (1:1 sex ratio) does not constrain communities to adhere to the exact 1:1 sex ratio. Rather, it refers to the maximum proportion of female polar bears in the harvest that is allowed under this system. Specifically, a harvest sex ratio of up to 50% females, per community per harvest season, is allowed without entering into an overharvest situation. Males can be harvested up to the limit of the annual recommended quota. Recommended quota allocations can never exceed a 50% female proportion, even when a reduction in quotas occur.

2. Overharvest Situation

2.1. An overharvest situation occurs when:

2.1.1. The female proportion in the annual harvest is greater than 50% of the recommended quota, 2.1.2. The male proportion in the annual harvest is in excess of the total recommended quota, or

2.1.3 A combination of the male and female harvest exceeds the total recommended quota.

2.2. An overharvest (males and females combined) over the TAH, or when the number of females taken is over 50%, results in a reduction of the quota the following year either by the number of bears over the TAH or by the number of females that exceed 50% of the recommended quota, whichever is more.

3. Implementation

3.1. The implementation of the 1:1 harvest system is retroactive and begins with the 2018/2019 harvest season (July 1, 2018). The existing total community annual base allocation (TAH) was divided by two, in order to determine the 1:1 sex ratio for each community, representing the 1:1 base allocation for each community for 2018/2019. This process increases the allowable female proportion of the harvest. The annual base allocation will only change when there is a new subpopulation estimate and/or a new determination of the TAH.

3.2. If the base allocation is an odd number then the TAH will always have one more male than females in order to implement a protective measure for females.

3.3. Annual recommended quotas are calculated using the previous year's harvest data.

3.4. Recommended quotas will be calculated based on the sections below.

4. Mortality Accounting

4.1. All human-caused mortality to polar bears will count towards the annual recommended quota of the nearest community, except Section 4.3.

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

4.3. Any bear that is found near death caused by starvation or injury, provided that the injury is not a result of human activity such as hunting or trapping, can be killed as a humane action where the Conservation Officer (CO) will certify that the bear was near death. After certification by the CO, the humane kill (euthanization) will not be counted against the TAH.

4.4. If a Nunavut Inuit kills a bear, the tag will come from that person's home community if that community has a TAH in the population from which the bear was harvested. Otherwise, closest community to the harvest location must provide the tag.

4.5. Harvesting of a family group or members of a family group is illegal in Nunavut; however, there are circumstances where a family group or members of a family group may be destroyed in Defence of Life and Property Kill (DLPK) circumstances.

4.5.1. When a female with cubs-of the-year (COYs), yearlings, or juveniles (2-year old offspring) are killed, then

4.5.1.1. For TAH determination purposes, the COYS and yearlings are counted as males and only ½ tag each.

4.5.1.2. The juveniles (2-year old offspring) are counted as whole tags of whatever sex they are.

4.5.2. If the mother is killed but the COYS, yearlings and juveniles run away after the female is killed, then

4.5.2.1. The COYS and yearlings are counted as ½ tag and all male.

4.5.2.2. The juveniles (2-year olds) are each counted as whole tags and the sex is counted as ½ male and ½ female.

4.6. In a case where a community overharvests by 1 COY or yearling, credits will be used to cover the harvest. In the event there are not enough credits to cover the overharvest of 0.5 male, the TAH will not be reduced by 0.5 tag at that time, and a record is kept with the Polar Bear Harvest Lab of these fractional reductions. The deduction will occur when there is another COY or yearling harvested to equal a full male bear reduction or if the following year's harvest results in credit accumulation, the 0.5 credit deduction will be taken from the accumulated credits.

5. Credits

5.1. Available credits may be used to address all types of kills, including accidental, illegal, and DLPKs.

5.2. If a community is in an overharvest situation, all available community credits will be applied automatically by the Polar Bear Harvest

Laboratory in order to maximize the community's harvest opportunities the following year.

5.3. Credits are specific to a given subpopulation and cannot be used for other subpopulations.

5.4. Subpopulation credits accumulate until a new TAH is determined. This may include a subpopulation inventory that has been conducted and a final abundance estimate result is produced. In some circumstances, a completed and finalized harvest risk analysis may also be conducted, or the Nunavut Wildlife Management Board recommends a change in TAH for other management purposes. Under these circumstances, all credits are set back to zero.

Credits are accumulated as described in the following sections after the new TAH is implemented, and during any harvest season:

5.5. Credits can accumulate for males and females.

5.6. Credits accumulate for unused portions of the recommended quota or TAH.

5.6.1. In the case where a community has a recommended quota of zero, and a total harvest of zero, credits will accumulate according to the community's TAH (if the TAH is different to zero).

5.6.2. No positive credits accumulate when a community's TAH, or recommended quota, is met or exceeded by the harvest of bears, irrespective of the sex composition of the community's total harvest.

5.6.3. No positive credits accumulate when the female proportion of the harvest exceeds 50% of the recommended quota.

5.6.4. Female positive credits can accumulate up the 50% of the total proportion of the TAH or the recommended quota, whichever is less.

5.7. Negative credits are possible and represent the number of bears that have been removed from the subpopulation in excess of a community's recommended quota or TAH, whichever is more in excess.

5.8. Credits can be exchanged between communities within the same subpopulation.

5.8.1. Communities that harvest from the same subpopulation can exchange credits, where needed, in order to restore their full recommended quota rather than facing a reduction when no community credits are available to cover an overharvest. The existing process for credit exchange between communities will be maintained.

5.8.2. Requests by communities to use credits to increase their annual recommended quota shall be made to, and approved by, the responsible RWO. The GN will verify and confirm the number of available credits.

6. Recommended Quota Adjustments

6.1. Reductions caused by an overharvest occur where no credits are available to cover the overharvest.

6.2. In order to protect communities from years of reduced or no harvest opportunities, resulting from persistent overharvest, the 1:1 system adapts to allow restoration of the full TAH. The recommended quota will be set to zero in situations in which no credits are available and a quota reduction cannot restore the TAH.

6.3. Depending on the number of negative credits, there may be continued reductions in the recommended quota in order to restore credits to zero and reinstate the full TAH.

Reductions in the recommended quota and credit administration occur as follows:

6.4. Adjustments in Cases of Female Overharvest:

6.4.1. When a community harvests greater than 50% females of the recommended quota, a reduction of next year's recommended quota will occur if there are not sufficient female credits to cover the overharvest. The following year's quota will be reduced by the number of females that were overharvested and not covered by credits. The reduction will affect the female proportion of next year's quota.

6.5. Adjustments in Cases of Male Overharvest:

6.5.1. When the harvest exceeds the total recommended quota or the TAH, and the female proportion of the harvest is less than 50%, then an overharvest of males occurred. Where application of credits does not cover this overharvest, a reduction equalling the number of overharvested males will be applied to the male proportion of the next year's recommended quota.

6.6. Adjustments in Cases of Combination Male and Female Overharvest:

6.6.1. When females are harvested in excess of 50% of the recommended quota and the sum of the total harvest (males and females together) exceeds the recommended quota, a reduction in next year's recommended quota will occur for each gender based on the number of bears overharvested.

7. **Floating Tags**

"Floating tags" are additional tags allocated by RWOs. These floating tags can be administered up to a 1:1 sex ratio, at the discretion of the RWO. Once allocated by the RWO, they are added to the total annual base allocation for the recipient community for that year.

7.1. Unused floating tags are accumulated as credits in the gender they were allocated.

7.2. The floating tags, when allocated by the RWO, should not create a situation where the female proportion exceeds 50%.

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Minister of Environment
Ministaat Avatiliqiyitkut
Ministre de l'Environnement

August 26, 2019

Translation to follow

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

Re: Reconsideration of Proposed Changes to the Nunavut Polar Bear Sex-Selective Harvest Ratio and the Flexible Quota System

Dear Mr. Shewchuk,

Thank you very much for your decision concerning proposed changes to the Nunavut polar bear sex-selective harvest ratio and the flexible quota system.

To reiterate the decision of the NWMB:

- *"RESOLVED that the NWMB establish, per sections 5.3.3(c) and 5.6.48 of the Nunavut Agreement, a sex-selective harvest ratio of one female bear harvested for every male bear (1:1), applicable to all polar bear subpopulations in the Nunavut Settlement Area, until new science or Inuit Qaujimajatuqangit information becomes available.*
- *FURTHER, recommends that the Government of Nunavut revise the 'Flexible Quota System', used in Nunavut to administer community polar bear allocations, to reflect the 1:1 harvest sex ratio and provide the revised document to the NWMB for consideration.*

I hereby accept your decision to change the Nunavut polar bear harvest sex ratio to allow one female bear to be harvested for every male bear (1:1); applicable to all polar bear subpopulations in the Nunavut Settlement Area. This decision is an important step in addressing valuable feedback and concerns expressed during the public hearing process for the Nunavut Polar Bear Co-Management Plan.

My officials have made the necessary revisions to the current flexible quota system and the revised information is appended to this letter. The revisions to the quota system will ensure that the management and tracking of the harvest can best function with the adjustment to the harvest sex ratio and be clear and understandable for wildlife managers and users alike. I request that the Board and Board staff review the revised credit calculation system and provide any necessary feedback to the relevant staff in my department. The revised system will also be shared with co-management for their review and feedback.

I will implement the harvest ratio decision forthwith along with the functional credit calculation system.

I would like to thank the Board for their consideration on how to best move forward with this harvest management decision. We are encouraged by the collaborative efforts on this matter, which is of great importance to Nunavummiut.

Sincerely,

Joe Savikataaq,
Minister of Environment

Cc. Jimmy Noble Jr., Deputy Minister
Steve Pinksen, A/Deputy Minister
Drikus Gissing, Director of Wildlife

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P.O. Box 2410
Iqaluit, Nunavut X0A 0H0

Titiqakuvia 2410
Iqaluit, Nunavut X0A 0H0

C. P. 2410
Iqaluit, Nunavut X0A 0H0

☎867-975-5050
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SEE TAB3A for a revised version of Appendix C

Appendix C

II. 1 to 1 Harvest Option

Rationale and administration of the 1:1 harvest system

Rationale:

During the public hearing process regarding the implementation of Nunavut's Polar Bear Co-Management Plan by the Nunavut Wildlife Management Board, many comments by Inuit organizations were brought forward that favoured a new harvest approach. For years, communities have expressed a desire to adopt a harvest regimen that does not penalize communities as sharply as the flexible quota system when females are overharvested, and that allows harvesting at an equal sex ratio. In response, the **1 male for every 1 female harvest option (or 1:1)** was discussed and recommended by the Department of Environment.

Each polar bear subpopulation within Nunavut has a set Total Allowable Harvest (TAH), which is divided among the communities that harvest from the subpopulation, by the appropriate Regional Wildlife Organization(s), as a base allocation. Each harvest season, communities are assigned a harvest quota based on the TAH allocation and any overharvests from previous seasons. Overharvests in one season result in a reduced community quota the following season, unless the community has accumulated sufficient credits to compensate for the overharvest. When a community harvests below their harvest quota they can accumulate sex specific credits to be used in future harvest seasons or shared with other communities.

The updated harvest sex ratio, allowing one female bear harvested for every male bear harvested (1:1 sex ratio) does not constrain communities to adhere to the exact 1:1 sex ratio. Rather, it refers to the maximum proportion of female polar bears in the harvest that is allowed under this system. Specifically, a harvest sex ratio of up to 50% females, per community per harvest season, is allowed without entering into an overharvest situation. Males can be harvested up to the limit of the annual recommended quota. Recommended quota allocations can never exceed a 50% female proportion, even when reductions in quotas occur.

An overharvest situation occurs when:

1) the female proportion in the annual harvest is greater than 50% of the recommended quota;
2) the male proportion in the annual harvest is in excess of the total recommended quota; or

3) a combination of the male and female harvest exceeds the total recommended quota.

An overharvest (males and females combined) over the TAH, or when the number of females taken is over 50%, results in a reduction of the quota the following year either by the number of bears over the TAH or by the number of females that exceed 50% of the recommended quota, whichever is more.

The implementation of the 1:1 harvest system is retroactive and begins with the 2018/2019 harvest season (July 1, 2018). The existing total community annual base allocation (TAH) was divided by two in order to determine the 1:1 sex ratio for each community, representing the 1:1 base allocation for each community for 2018/2019. This process increases the female proportion of the harvest and reduces the male proportion. The annual base allocation will only change when there is a new subpopulation estimate and/or a new determination of the TAH.

If the base allocation is an odd number then the TAH will always have one more male than females in order to implement a protective measure for females.

Annual recommended quotas are calculated using the previous year's harvest data.

Recommended quotas will be calculated based on the sections below.

HARVESTING MORTALITY

1. All human-caused mortality to polar bears will count towards the annual recommended quota of the nearest community.

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

3. Any bear that is found near death, caused by starvation or injury, provided that the injury is not a result of human activity such as hunting or trapping, can be killed as a humane action where the Conservation Officer (CO) will certify that the bear was near death. After certification by the CO the humane kill (euthanization) will not be counted against the TAH.

4. When a Nunavut beneficiary kills a bear, the tag will come from that person's home community if that community has a TAH allocation for the population from which the bear was harvested. Otherwise, the nearest community must provide the tag.

5. Harvesting of a family group, or members of a family group, is illegal in Nunavut; however, there are circumstances where a family group or

members of a family group may be destroyed in defense of life and property kill (DLPK) circumstances.

(a) When a female with cubs-of the-year (COYs), yearlings, or juveniles (2-year old offspring) are killed, then

(i) For TAH determination purposes, the COYS and yearlings are counted as males and only ½ tag each.

(ii) The juveniles are counted as whole tags of whatever sex they are.

(b) If the mother is killed but the COYS, yearlings and juveniles run away after the female is killed, then

(i) the COYS and yearlings are counted as ½ tag and all male.

(ii) the juveniles (2yr olds) are each counted as whole tags and the sex is counted as ½ male and ½ female.

6. In a case where a community overharvests by one COY or yearling, credits will be used to cover the harvest. In the event there are not enough credits to cover the overharvest of 0.5 male, the TAH will not be reduced by 0.5 tag at that time, and a record is kept with the Polar Bear Harvest Lab of these fractional reductions. The deduction will occur when there is another COY or yearling harvested to equal a full male bear reduction or if the following year's harvest results in credit accumulation, the 0.5 credit deduction will be taken from the accumulated credits.

CREDITS

1. Available credits may be used to address all types of kills, including accidental, illegal, and DLPKs.
2. If a community is in an overharvest situation, all available community credits will be applied automatically by the Polar Bear Harvest Laboratory in order to maximize the community's harvest opportunities the following year.
3. Credits are specific to a given subpopulation and cannot be used for other subpopulations.

4. Subpopulation credits accumulate until a new subpopulation inventory with final abundance estimate results, and in some circumstances, a completed and finalized harvest risk analysis. In those circumstances, all credits are set back to zero because the new TAH is based on the total new population estimate, which incorporates the unrealized credits as living bears that have added to the population, and the entire sustainable take is allocated to the new TAH. Credits are accumulated as described in section 8 after the new TAH is implemented, and during any harvest season.

5. Credits can accumulate for males and females.

6. Credits accumulate for unused portions of the recommended quota or TAH (e.g. a total harvest of 0 for communities with a recommended quota of 0 results in the accumulation of male and female credits respective of the community TAH).

7. Negative credits are possible and represent the number of bears that have been removed from the subpopulation in excess of a community's recommended quota.

8. Credits can be exchanged between communities within the same subpopulation.

    a) Communities that harvest from the same subpopulation can exchange credits where needed in order to restore their full recommended quota rather than facing a reduction when no community credits are available to cover an overharvest. The existing process for credit exchange between communities will be maintained.

    b) Requests by communities to use credits to increase their annual recommended quota shall be made to and approved by the responsible RWO. The GN will verify and confirm the number of available credits.

RECOMMENDED QUOTA ADJUSTMENTS

Reductions caused by an overharvest occur where no credits are available to cover the overharvest. Reductions in the recommended quota and credit administration occur as follows:

1. When a community harvests greater than 50% females of the recommended quota, a reduction of next year's recommended quota will occur if there are not sufficient female credits to cover the overharvest. The following year's quota will be reduced by the number of females that were overharvested and not covered by credits. The reduction will affect the female proportion of next year's quota.

2. In order to protect communities from years of reduced or no harvest opportunities resulting from persistent overharvest , the 1:1 system adapts to allow restoration of the full TAH. The recommended quota will be set to zero in situations in which no credits are available and a quota reduction cannot restore the TAH.

    a. Depending on the number of negative credits, there may be continued reductions in the recommended quota in order to restore credits to zero and reinstate the full TAH.

FLOATING TAGS

"Floating tags" are additional tags allocated by RWOs. These floating tags can be administered up to a 1:1 sex ratio, at the discretion of the RWO. Once allocated by the RWO, they are added to the total annual base allocation for the recipient community for that year.

a) Unused floating tags are accumulated as credits in the gender they were allocated.

b) The floating tags, when allocated by the RWO, should not create a situation where the female proportion exceeds 50%.

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Nunavut Wildlife Management Board

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Conserving wildlife through the application of Inuit Qaujimajatuqangit and scientific knowledge

August 12, 2019

Honourable Joe Savikataaq
Minister of Environment
Government of Nunavut

Dear Minister Savikataaq:

Re: Reconsideration of Proposed Changes to the Nunavut Polar Bear Sex-Selective Harvest Ratio and the Flexible Quota System

At the Nunavut Wildlife Management Board (NWMB or Board) March 2019 Regular Meeting, your Department asked the Board to adjust the polar bear harvest sex ratio from two males for every female (2:1) to one male for every female (1:1), applicable to all Nunavut sub-populations. The proposal also asked for a revision to the provisions of the "Flexible Quota System"[1] to accommodate these changes. The Board considered this proposal during its In-Camera meeting (IC001-2019) on March 8, 2019, and postponed decision making until the *Nunavut Polar Bear Co-Management Plan* decision-making process is complete.

During its internal In-Camera meeting (INT009-2019) on July 24, 2019, the Board reconsidered this proposal, and reached the following resolution and recommendation:

> *Resolved that the NWMB establish, per sections 5.3.3(c) and 5.6.48 of the Nunavut Agreement, a sex-selective harvest ratio of one female bear harvested for every male bear (1:1), applicable to all polar bear subpopulations in the Nunavut Settlement Area, until new science or Inuit Qaujimajatuqangit information becomes available.*
>
> *Further, recommends that the Government of Nunavut revise the 'Flexible Quota System,' used in Nunavut to administer community polar bear*

[1] The flexible quota system is used in Nunavut to administer the portion of the Total Allowable Harvest allocated to a given community. The system allows for credits to be accumulated when the annual allocation is under-harvested and for over-harvested bears to be subtracted from the next year's base allocation.

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(867) 975-7300
(888) 421-9832

Titiqqap Turaarvia 1379
Iqaluit, NU X0A 0H0
(867) 975-7300
(888) 421-9832

Box 1379
Iqaluit, NU X0A 0H0
(867) 975-7300
(888) 421-9832

allocations, to reflect the 1:1 harvest sex ratio and provide the revised document to the NWMB for consideration.

In reaching these decisions, the NWMB considered the following:

1. **The NWMB decision paves the way for the completion of the *Nunavut Polar Bear Co-Management Plan*.**

On March 20, 2019, the NWMB sent its decision package concerning the management plan to you, per section 5.3.8 of the Nunavut Agreement. In it, the NWMB changed the polar bear harvest sex ratio from the current 2:1 system to a 1:1 system, whereby the overharvest of males or females is penalized by removing the same number of males or females from the following year's allocation. This NWMB's decision took into consideration the views of parties to the management plan public hearing, who expressed frustrations about the difficulties in the administration of the sex-selective harvesting and the excessive penalizations that occur when females are over-harvested.

On May 17, 2019, you disallowed the NWMB decision partially because of your Department's perceived legislative challenge in making changes to polar bear sex-selective harvest through a management plan.

The NWMB has considered your position and is now providing you with a separate *Nunavut Agreement* s. 5.6.48 decision for consideration. In reaching this decision, the Board considered and applauded your willingness to listen to Nunavummiut who have expressed concerns about the 2:1 harvesting system. Even though the 2:1 system has been instrumental to the recovery of several polar bear subpopulations in Nunavut while maximizing harvesting opportunities for Inuit, the NWMB agrees with what we heard from Inuit at the hearing: that changes to the current harvest management system are required to address today's challenges—especially threats to human safety. The NWMB hopes that this decision will pave the way for prompt completion of the management plan decision-making process so that together with our co-management partners, we can deliver on the much-anticipated *Nunavut Polar Bear Co-Management Plan*.

2. **There is a need for a comprehensive review of the Flexible Quota System to accommodate changes to the sex-selective harvest ratio.**

   In your proposal to the NWMB, you asked the Board also to approve changes to the Flexible Quota System, so that (1) harvesting of females over 50% of a community's allocation in one year will reduce the allocation the following year, and (2) communities will be allowed to harvest males up to the limit of their allocation. The NWMB is open to considering such changes but would like to do so within the context of a comprehensive review of the entire Flexible Quota System (Appendix C of the *Nunavut Polar Bear Co-Management Plan)*, because some of these proposals might represent a deviation from the 1:1 sex-selective harvesting approach. For example, it is not clear if communities will be able to carry over female credits if males are overharvested within or above the community quota. The Board welcomes an opportunity to consider revisions to the Flexible Quota System at the earliest time possible.

The NWMB looks forward to your reply and prompt completion of the *Nunavut Agreement* Article 5 decision-making process.

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

Yours sincerely,

Daniel Shewchuk

Daniel Shewchuk
Chairperson of the
Nunavut Wildlife Management Board

cc - Drikus Gissing, Director of Wildlife Management, Nunavut Department of Environment

SUBMISSION TO THE

NUNAVUT WILDLIFE MANAGEMENT BOARD

FOR

Information: **Decision: X**

Issue: Adjusting Polar Bear Total Allowable Harvests to a 1:1 Male to Female Sex Ratio along with a simpler credit calculation system.

Background:

- The main objective of the Nunavut polar bear management system has been to increase or maintain polar bear subpopulations. However, over the past several years communities have been raising concerns over the increased abundance of polar bears. In particular, community members voiced their concerns about public safety. There has been a shift in community support for increased populations and most Nunavummiut would rather see a properly managed decrease in polar bear numbers in order to address public safety concerns.
- During the consultations for the existing polar bear Memoranda of Understanding (MOUs) the issue of non-sex-selective harvesting was discussed as an option.
- All communities agreed to harvest sex-selectively with the signing of the last Polar Bear MOUs in 2005 as it allowed for a higher Total Allowable Harvest (TAH) while still allowing for a sustainable harvest level. The issue was discussed during the consultations.

Current Status:

- The Department of Environment (DOE) participated in the Nunavut Wildlife Management Board (NWMB) public hearing for the Nunavut Polar Bear Co-Management Plan in Iqaluit from November 13-16, 2018.
- The participants in the public hearing, mostly comprised of representatives from Nunavut communities and Hunters and Trappers Organizations (HTOs), were very clear and consistent in conveying the message that the current management of polar bear needs to be improved to reflect community values and Inuit Qaujimajatuqangit (IQ).

- The specific components of polar bear management that was criticized the most was the current practice, for all but one subpopulation, of a 2:1 harvest sex ratio (two males harvested for every female) and the flexible quota system.
    - Communities have concerns that too many males being harvested due to the sex ratio will cause an imbalance in the population.
    - Communities feel that the current flexible quota system is overly punitive and communities that experience a high number of problem bears are at an extreme disadvantage. Many people have expressed that the calculation process for the flexible quota system is difficult to understand.
- The Baffin Bay polar bear subpopulation currently has a 1:1 harvest sex ratio. This was recommended based on the data collected during the most recent population assessment, which indicated that the proportion of males in the population was low and could lead to a conservation concern.
- Even if the final decision is to remove the sex-selective component of the management system at this time, we would note that the use of sex selectivity as a polar bear management tool remains an option for the future. Following the collection of updated subpopulation information (e.g. population inventories, harvest risk assessments, etc.), the use of sex-selectivity could be included as part of management recommendations to address conservation concerns going forward.
- As a change to the sex-selectivity of the polar bear harvest is not a change to the TAH, the current accumulated credits in each community would not be zeroed.

Consultations:

The GN held several rounds of consultations between 2014 and 2016 during the process of developing the polar bear management plan. In addition, the topic was also discussed during NWMB public hearing held in Iqaluit from November 13-16, 2018.

Recommendations:

1. DOE recommends that for all polar bear subpopulations in Nunavut, a harvest sex ratio of up to 50% females should be adopted; communities can use up to 50% of their allocated tags to harvest female bears.
2. DOE recommends that the credit system will be based on a one bear reduction for one bear over-harvest basis:
    a. An overharvest of one female, over 50% of the tag allocation in one year, would reduce a community tag allocation by one tag in the following year.
    b. Males can be harvested up to the limit of the tag allocation. An overharvest of males, over the tag allocation, would result in a reduction of the same amount of tags the following year.

c. Accumulated credits can continue to be used to offset an overharvest, instead of a reduction in the following years tag allocation.

d. Cubs will be considered as one-half male tag.

3. DOE recommends that the changes to harvest sex-selectivity and the credit system be implemented effective in the current harvest season (2018-19).

SUBMISSION TO THE

NUNAVUT WILDLIFE MANAGEMENT BOARD

FOR

Information: X **Decision:**

Issue: Distribution and abundance of Peary caribou and muskox on central Ellesmere Island, March 2017

Background:

Surveys of Peary caribou on Ellesmere Island have been performed occasionally over the past 50 years. Due to the size of Ellesmere Island, the GN has divided it into three portions for survey purposes: southern, central, and northern. Beginning in 2015, the GN intended to conduct three consecutive surveys of these segments of the island (southern, central, and northern) that together would cover the entirety of Ellesmere Island. From March 19 – 26, 2015 the GN systematically surveyed the southern Ellesmere Island study area. Between March 8 and 20, 2017, the GN continued surveying Ellesmere Island, flying the central portion including Fosheim, Raanes, and Svendsen Peninsulas. Unfortunately, due to logistical and financial constraints the third portion, northern Ellesmere Island, is no longer planned to proceed. Here, we provide a summary of the survey results for central Ellesmere Island.

Across the survey region we observed 254 groups of muskoxen and 2,153 muskoxen in total. From these observations, we estimated that there were 5,134-9,278 muskoxen in the study area at the time of the survey. Muskoxen were most numerous on the central part of the Fosheim Peninsula. The previous survey of the area (in 2006) also included northern Ellesmere Island, and so direct comparisons are difficult, but the results of this survey do not give any cause for concern regarding muskox numbers on central Ellesmere Island.

Fourteen Peary caribou were seen on transect during the survey. The small number of caribou seen make it difficult to interpret population trends, but the survey data that exist suggest that Peary caribou persist at low densities on central Ellesmere Island.

A full discussion of the survey and its results can be found in the report *Distribution and abundance of Peary caribou (*Rangifer tarandus pearyi*) and muskox (*Ovibos moschatus*) on central Ellesmere Island, March 2017*.

Current Status:

There is currently no Total Allowable Harvest for Peary caribou or muskox on Ellesmere Island (muskox management unit MX-01, proposed Peary caribou management unit PC-01). Based on the results of this survey no management actions are recommended. Although we saw very few Peary caribou, the area surveyed is not within typical harvesting areas of Grise Fiord and Peary caribou abundance on central Ellesmere Island is not limited by harvest activities.

Consultations:

Survey results were discussed in person with the Iviq HTO (Grise Fiord) on September 18, 2017 and with the Resolute Bay HTA on September 20, 2017.

Recommendations:
N/A

Executive Summary

Distribution and abundance of Peary caribou and muskox on central Ellesmere Island, March 2017

We flew a survey of central Ellesmere Island (Fosheim Peninsula, Raanes Peninsula, and Svendsen Peninsula), Nunavut, between March 8th and 20th, 2017 to update the regional abundance estimate for Peary caribou (*Rangifer tarandus pearyi*) and muskox (*Ovibos moschatus*). This survey was intended to be the second portion of three consecutive surveys that together would cover the entirety of Ellesmere Island. The southern portion was surveyed in 2015 and the northern portion was planned to be surveyed in 2018, however the survey did not occur due to logistical and financial constraints. Before 2017 the most recent survey of central Ellesmere Island was in May 2006 (which included northern Ellesmere Island).

Muskoxen were most abundant north of the Sawtooth Range on the Fosheim Peninsula with moderate densities of muskoxen found on the northern portion of Raanes Peninsula and the southern portion of Svendsen Peninsula. A total of 2,153 muskoxen were observed, and we estimated 6,902 ± SE 1,036 (95% confidence interval [CI] = 5,134-9,278, coefficient of variation [CV] = 15%) across central Ellesmere Island. The previous estimate for the area (from 2006) was 8,115 (95% CI 6,632 – 9,930) but also included northern Ellesmere Island. A separate population estimate for central Ellesmere Island was not calculated from the 2006 survey.

Fourteen Peary caribou were seen on transect during the survey, and we estimated a population of 32 ± SE 25 (95% CI = 8-127, CV = 79%). The few observations provided for a very imprecise estimate. Peary caribou were observed on the north portion of Raanes and Svendsen Peninsulas, and one group was seen at the south end of Fosheim Peninsula.

Research Project Updates and Proposals, September 18, 2017
Grise Fiord Hamlet Building 19:00-21:40
Meeting with Iviq Hunters and Trappers Association

In attendance: Amon Akeeagok, Aksakjuk Ningiuk, Liza Ningiu, Jeffrey Qaunaq, Terry Noah (Manager), Benjamin Baranowski (GN-CO), and Matt Fredlund (GN-Wildlife Tech).

The meeting which was originally planned for Sept 17 was postponed to the following day due to lack of access to the building on the weekend.

Amon and Jeffrey introduced Matt and the purpose of the meeting; Matt provided an overview of the following research results to date and upcoming projects for comment (Appendix 1); Amon and Jeffrey provided translation throughout the meeting.

Devon Island Survey Results, 2016 – Matt showed a map with transects and the strata to demonstrate how the survey focused search effort in areas of greatest probability of observing caribou and muskoxen (MX). A map with the locations of all caribou and MX as well as tracks was shown to give a representation of the distribution. It was also mentioned that although no caribou were seen on Devon directly across from Grise Fiord (GF), in the final report it is mentioned that the GF HTA has observed tuktu there recently. The search effort in hours flown as well as a minimum count of 14 Peary caribou (not an estimate) was presented. It is believed that, as with the previous survey in 2008, the caribou population persists at very low numbers. To the contrary, a large increase in muskox was observed relative to the previous survey in 2008, with a 2016 population estimate of 1,963 ($\pm$343 SE) muskox (Appendix 1). The recommendations in the report were talked about, although at the time of the presentation the TAH for Muskox had already been increased to 100 as had previously been consulted on with the HTA.

Comments – Jeffrey commented that he is glad the MX population is good, but wishes the TAH could be removed, since the TAH of 100 won't be reached anyway the hunt should be unlimited. Aksakjuk was part of the 2016 survey and did see lots of MX, he also made the comment that PC and MX don't mingle because caribou don't like the smell of MX. Liza commented that the survey should happen when there is no snow to see the PC better as it is hard to see caribou from an airplane, also in 1962 there were no caribou on Devon so the population has been increasing since then.

Lougheed Island Survey Results, 2016 - Matt showed a map of the flight lines and locations of all caribou seen on the island (on and off transect). The caribou population was estimated at 140 ($\pm$ SE33) Peary caribou, with no MX or wolves seen during the survey (although wolf tracks had been seen that summer). The caribou population estimate has decreased from 205-672 (95% CI) estimated in 2007 survey (Appendix 1). Management recommendations from the report supported no changes in caribou management, and asked what was thought of including Lougheed into the Bathurst Island Group for future surveys?

Comments – Jeffrey made the comment that when there is less MX there is more caribou, and more MX there is less caribou. He also wants to leave Lougheed with Ringnes Island Group or there would be no caribou in the RIG. Liza stated that if changes are planned she wants proper consultations to occur before any comments or decisions. Matt did make it clear that no changes are planned but just wanted to learn more about these populations as it was in the report's recommendations. Liza also added that this area is more important to Resolute Bay so they should have say over it.

Prince of Wales, Somerset Survey Results, 2016 – Matt showed a map with transects, MX group locations (on and off transect) as well as the population estimate of 3052 (±440) Muskoxen, with approximately half on each of Prince of Wales and half on Somerset Islands. No caribou were seen during the survey, however hunters did report seeing caribou during the same time frame. Even with a slightly declining trend in the MX population, implementing a TAH is not required for the continued sustainable use of muskoxen in MX-06, which are generally harvested at low levels. Even without a TAH, harvest reporting would still be important to maintain. Since no caribou were seen, it was recommended that no caribou harvest occur, although hunting is not likely the limiting factor (Appendix 1).

Comments – Matt asked if harvesting from a large group or a small group has a larger impact on MX populations. Liza said traditionally Inuit don't take whole groups. Once collars are on MX (instead of on caribou) the numbers will decrease. Jeffrey said that a large harvest of MX won't increase caribou numbers. Liza mentioned that in 1980, Somerset caribou numbers were high and there were no MX, but once MX were seen there then caribou moved away. The caribou traveled further south (Cambridge Bay area. She was on the Committee for Environment (DOE) and said the caribou from Coral Harbour (Southampton Island) included Peary caribou from the high arctic.

Genetics Update, 2016 – Matt showed a map of the general genetic division between the various caribou herds, as well as a map that shows the extent of the last glacial maxima. Showed maps with a greater break down between the high arctic islands, and mentioned how the genetic work shows that Peary caribou are from a lineage that is ~96,000-185,000 years old. And they were Isolated until ~8,000 years ago (Appendix 1).

Comments – Jeffrey brought up if they have survived 185,000 years why worry about their numbers now?

High Arctic Wolf Update, 2017 – This portion of the presentation was prepared by Morgan Anderson and presented by Matt. Matt mentioned that as of spring 2017 all 4 collars that were on wolves were offline. Due to various reasons, one falling off, one malfunctioning and being removed by the researchers in the summer 2017 as well as two collars were just missing and the wolves were not seen. The movements, kill sites, dens, and two new collars that were deployed were mentioned as well, with plans to deploy more in the following year (Appendix 1).

Comments – N/A

Central Ellesmere Island Survey Update, 2017 – Matt showed maps of transects, flight paths, as well as locations of seen caribou (14), MX (2163), and tracks. The sizes of groups of MX ranged from 1-43. The results are still being worked on and will be sent to the HTA as soon as the report is completed (Appendix 1).

Comments – N/A

Upcoming Surveys – Matt showed a map with Northern Ellesmere Island (NEI) and Axel Heiberg to show where the next surveys may be occurring. NEI will probably happen in March/April 2018, and Axel Heiberg in March/April 2019; however at this time final commitments could not be made. If the NEI survey occurs in 2018 it will be done with Helicopter (83 hrs) and fixed wing (43 hr) surveys. Survey methods and sampling design were discussed, along with the need for 3-5 community members to participate in the survey from Grise Fiord or Resolute Bay. For the Axel Heiberg survey, it would all be completed with helicopter (70hrs) and requiring 1-2 community observers (Appendix 1).

Comments – Liza said they don't really go up there so not very concerned. Aksakjuk said the caribou and MX are still there. Amon asked why in March? Matt responded that it is to do with weather reasons and the greatest chance of success based on past projects, as well as past consultations with HTA's.

Harvest Reporting – Matt brought up that harvest reporting is important for managers to make informed decisions and the when a TAH is in place it is mandatory; however, if there is not currently a TAH it is still important to have harvest records – both as a great tool in the management of wildlife and also to benefit the determination of Basic Needs Level (BNL) for Grise Fiord under the Nunavut Agreement.

Comments – Jeffrey reiterated to the board that MX harvest reporting is mandatory. The members also gave the general acknowledgement that they know we need the harvest reports.

Closing of meeting – Matt showed a map showing all the locations of MX and PC from the most recent surveys to get input on any disagreements of changes that may have occurred since the latest survey (Appendix 1). Matt thanked the board for meeting with him and sharing their knowledge and he looks forward to working with them in the years to come.

Comments – Jeffrey mentioned that looking at the maps it shows where there are so many MX there are less caribou. Caribou are moving away from areas with MX.

Research Project Updates and Proposals, September 20, 2017
Resolute Bay HTA Boardroom 19:00-21:30
Meeting with Iviq Hunters and Trappers Association

In attendance: Philip Manik Sr. (Chair), Joadamee Amagoalik, Paddy Aqiatusok, Simon Idlout, Kantisse Idlout, Delilah Manik (HTA Manager), Tabitha Mullin (GN-CO), and Matt Fredlund (GN-Wildlife Tech).

Half way through the meeting the projector stopped working and the rest of the presentation was done off the laptop screen, hindering the communication and discussion.

Matt was introduced; Matt provided an overview of research results to date and upcoming projects for comment; Philip provided translation throughout the meeting.

Devon Island Survey Results, 2016 – Matt showed a map with transects and the strata to demonstrate how the survey focused search effort in areas of greatest probability of observing caribou and muskoxen (MX). A map with the locations of all caribou and MX as well as tracks was shown to give a representation of the distribution. It was also mentioned that although no caribou were seen on Devon directly across from Grise Fiord (GF), in the final report it is mentioned that the GF HTA has observed tuktu there recently. The search effort in hours flown as well as a minimum count of 14 Peary caribou (not an estimate) was presented. It is believed that, as with the previous survey in 2008, the caribou population persists at very low numbers. To the contrary, a large increase in muskox was observed relative to the previous survey in 2008, with a 2016 population estimate of 1,963 (±343 SE) muskox (Appendix 1). The recommendations in the report were talked about, although at the time of the presentation the TAH for Muskox had already been increased to 100 as had previously been consulted on with the HTA.

Comments – Simon said that MX stay in one area, and caribou and MX do not like being together. Caribou do not like the smell of MX. He also wanted to know why there are TAH on MX when they just keep caribou away. Joadamee asked about the poop survey. Matt responded that will be discussed later in the presentation. Tabitha brought up that caribou had been seen on the southwest end of Devon Island. Paddy added that MX on Cornwallis Island are doing well. Simon said they want to sell MX to other communities. Matt responded that they have the right to do that if they wish. Joadamee asked since the snow melt was late this year will there be a die off? Matt responded it is possible but was not sure. Simon wants to know if there will be restrictions on hunting of caribou will all hunters of caribou be restricted, such as wolves.

Lougheed Island Survey Results, 2016 - Matt showed a map of the flight lines and locations of all caribou seen on the island (on and off transect). The caribou population was estimated at 140 (± SE33) Peary caribou, with no MX or wolves seen during the survey (although wolf tracks had been seen that summer). The caribou population estimate has decreased from 205-672 (95% CI) estimated in 2007 survey (Appendix 1). Management recommendations from the report supported no changes in caribou management, and asked what was thought of including Lougheed into the Bathurst Island Group for future surveys?

Comments – Simon mentioned that when Mike Ferguson was doing surveys up here he did not believe the community when they told him caribou moved between islands, he finally believed it when he saw the tracks for himself.

Prince of Wales, Somerset Survey Results, 2016 – Matt showed a map with transects, MX group locations (on and off transect) as well as the population estimate of 3052 (±440) Muskoxen, with approximately half on each of Prince of Wales and half on Somerset Islands. No caribou were seen during the survey, however hunters did report seeing caribou during the same time frame. Even with a slightly declining trend in the MX population, implementing a TAH is not required for the continued sustainable use of muskoxen in MX-06, which are generally harvested at low levels. Even without a TAH, harvest reporting would still be important to maintain. Since no caribou were seen, it was recommended that no caribou harvest occur, although hunting is not likely the limiting factor (Appendix 1).

Comments – Simon mentioned that caribou move between Prince of Wales Island in spring and summer and back to Somerset in winter. He also mentioned that he saw barren ground caribou on Prince of Wales Island many years ago and lots of summer tracks in the sand. Joadamee added that he was with Simon at Backbay in 2011 and that caribou can smell the food from far away and move to it. Philip contributed that caribou move from an area to let the plants grow back. Simon has an uncle in Cambridge Bay that says caribou are moving north again. Paddy asked why the locations of where hunters saw the caribou were not presented on the maps. Matt could not answer that question but will bring it up with managers if this is something that should be included in the future.

Genetics Update, 2016 – Matt showed a map of the general genetic division between the various caribou herds, as well as a map that shows the extent of the last glacial maxima. Showed maps with a greater break down between the high arctic islands, and mentioned how the genetic work shows that Peary caribou are from a lineage that is ~96,000-185,000 years old. And they were Isolated until ~8,000 years ago (Appendix 1).

Comments – N/A

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Comments – N/A

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Comments – Simon said that it is not good to chase caribou because their lungs could explode. Matt clarified that the caribou would only be flown over and not chased.

Harvest Reporting – Matt brought up that harvest reporting is important for managers to make informed decisions and the when a TAH is in place it is mandatory; however, if there is not currently a TAH it is still important to have harvest records – both as a great tool in the management of wildlife and also to benefit the determination of Basic Needs Level (BNL) for Grise Fiord under the Nunavut Agreement.

Comments – General consensus is that the HTA is not supportive of providing harvest reports.

Closing of meeting – Matt showed a map showing all the locations of MX and PC from the most recent surveys to get input on any disagreements of changes that may have occurred since the latest survey (Appendix 1). Matt thanked the board for meeting with him and sharing their knowledge and he looks forward to working with them in the years to come.

DISTRIBUTION AND ABUNDANCE OF PEARY CARIBOU (*Rangifer tarandus pearyi*)

AND MUSKOX (*Ovibos moschatus*) ON CENTRAL ELLESMERE ISLAND, MARCH 2017

MATT FREDLUND[1]
JOHN BOULANGER[2]
MITCH CAMPBELL[1]
MORGAN ANDERSON[3]
CONOR MALLORY[1]

January 2019

[1]Department of Environment, Government of Nunavut

[2]Integrated Ecological Research

[3]Fish and Wildlife Branch, Government of British Columbia

NUNAVUT DEPARTMENT OF ENVIRONMENT

WILDLIFE RESEARCH SECTION

IGLOOLIK, NU

Suggested citation:
Fredlund, M., Boulanger, J., Campbell, M.W., Anderson. M.L., and Mallory, C.D. 2019. Distribution and abundance of Peary caribou (*Rangifer tarandus pearyii*) and muskoxen (*Ovibos moschatus*) on central Ellesmere Island, March 2017. Nunavut Department of Environment, Wildlife Research Section, Iglulik, NU. 38pp.

Summary

We flew a survey of central Ellesmere Island (Fosheim Peninsula, Raanes Peninsula, and Svendsen Peninsula), Nunavut, between March 8th and 20th, 2017 to update the regional abundance estimate for Peary caribou (*Rangifer tarandus pearyi*) and muskox (*Ovibos moschatus*). This survey was intended to be the second portion of three consecutive surveys that together would cover the entirety of Ellesmere Island. The southern portion was surveyed in 2015 and the northern portion was planned to be surveyed in 2018, however the survey did not occur due to logistical and financial constraints. Before 2017 the most recent survey of central Ellesmere Island was in May 2006 (which included northern Ellesmere Island).

Muskoxen were most abundant north of the Sawtooth Range on the Fosheim Peninsula with moderate densities of muskoxen found on the northern portion of Raanes Peninsula and the southern portion of Svendsen Peninsula. A total of 2,153 muskoxen were observed, and we estimated 6,902 ± SE 1,036 (95% confidence interval [CI] = 5,134-9,278, coefficient of variation [CV] = 15%) across central Ellesmere Island. The previous estimate for the area (from 2006) was 8,115 (95% CI 6,632 – 9,930) but also included northern Ellesmere Island. A separate population estimate for central Ellesmere Island was not calculated from the 2006 survey.

Fourteen Peary caribou were seen on transect during the survey, and we estimated a population of 32 ± SE 25 (95% CI = 8-127, CV = 79%). The few observations provided for a very imprecise estimate. Peary caribou were observed on the north portion of Raanes and Svendsen Peninsulas, and one group was seen at the south end of Fosheim Peninsula.

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ᖃᖓᑕᓚᐅᖅᑐᒍᑦ ᖃᐅᔨᓴᖅᓗᑕ ᕿᑎᖓᓂ ᐊᐅᓯᐃᑦᑑᑉ ᕿᑭᖅᑖᓗᐊ (Fosheim Peninsula, Raanes Peninsula, and Svendsen Peninsula), ᓄᓇᕗᑦ, ᐊᒡᓂᖓᓂ ᒫᑦᓯ 8th ᐊᒻᒪ 20th, 2017 ᓄᑖᙳᕆᐊᖅᑎᓪᓗᒍ ᓄᓇᓕᖕᓂ ᐊᕕᒃᑐᖅᓯᒪᓂᐅᔪᓂ ᐱᑕᖃᑦᑎᐊᕐᓂᖓᑕ ᓇᓚᐅᑦᑖᖅᑕᑦ ᖁᑦᑎᒃᑑᑉ ᑐᑐᖏᑦ (*Rangifer tarandus pearyi*) ᐊᒻᒪ ᐅᒥᖕᒪᑦ (*Ovibos moschatus*). ᑖᓐᓇ ᖃᐅᔨᓴᕈᑎ ᑐᕌᒐᖅᑲᓚᐅᖅᑐᖅ ᐱᖃᑎᒋᓗᓂᐅᒃ ᐃᓚᖓᑕ ᐱᖓᓲᔪᑦ ᖃᐅᔨᓴᕈᑎᓂᑦ ᑲᑎᙵᓗᑎᒃ ᑕᒻᑭᖅᑎᑦᑎᓇᔭᖅᑐᖅ ᐊᐅᓯᐃᑦᑑᑉ ᕿᑭᖅᑖᓗᐊᓂᒃ. ᓂᒋᖅᐸᓯᐊᑕ ᐃᓚᖓ ᖃᐅᔨᓴᖅᑕᐅᓪᓗᓂ 2015-ᙳᑎᓪᓗᒍ ᐊᒻᒪ ᐅᐊᖕᓇᖅᐸᓯᐊᑕ ᐃᓚᖓ ᐱᕙᒌᔭᖅᑕᐅᓪᓗᓂ ᖃᐅᔨᓴᖅᑕᐅᓂᐊᕐᓂᕐᒧᑦ 2018-ᒥ, ᑭᓯᐊᓂ ᖃᐅᔨᓴᖅᑐᖃᓚᐅᙱᑦᑐᖅ ᐱᔾᔪᑎᒋᓪᓗᒍ ᐱᓕᕆᔾᔪᑎᑦ ᑮᓇᐅᔭᓄᓪᓗ ᓈᒻᒪᙱᓕᐅᕈᑎᓄᑦ. 2017−ᙳᓚᐅᙱᑎᓪᓗᒍ ᖃᓂᓛᙳᔪᒃᑯᑦ ᖃᐅᔨᓴᕈᑎᑦ ᕿᑎᖓᓂ ᐊᐅᓯᐃᑦᑑᑉ ᕿᑭᖅᑖᓗᐊᓂ ᐊᑐᕐᓗᓂ ᒪᐃ 2006 (ᐃᓚᐅᑎᑦᑎᓪᓗᓂ ᐅᐊᖕᓇᖅᐸᓯᐊᓂᒃ ᐊᐅᓯᐃᑦᑑᑉ ᕿᑭᖅᑖᓗᐊᓂᒃ).

ᐅᒥᖕᒪᑦ ᐱᑕᖃᓛᙳᓚᐅᖅᑐᑦ ᐅᐊᖕᓇᖓᓂ Sawtooth Range ᑕᐃᑲᓂ Fosheim Peninsula ᓈᒻᒪᒃᑐᕐᑎᒃ ᖃᔅᓯᐅᓂᖕᒋᑦ ᐅᒥᖕᒪᑦ ᓇᓂᔭᐅᔪᑦ ᐅᐊᖕᓇᖅᐸᓯᐊᑕ ᐃᓚᖓᓂᒃ Raanes Peninsula ᐊᒻᒪ ᓂᒋᖅᐸᓯᐊᑕ ᐃᓚᖓᓂ Svendsen Peninsula. ᑲᑎᕐᓗᒋᑦ 2,153 ᐅᒥᖕᒪᑦ ᑕᑯᔭᐅᓚᐅᖅᑐᑦ, ᓇᓚᐅᑦᑖᕐᓗᑎᒍᓪᓗ 6,902 ± SE 1,036 (95% ᓇᓗᓇᙱᕐᓗᑎᒃ ᐊᒡᓂᓕᓃᑦ [CI] = 5,134-9,278, ᐊᒥᓱᕈᕐᑕᕐᓂᖕᒋᑦ ᐊᔾᔩᖕᒋᕐᓗᑎᒃ [CV] = 15%) ᕿᑎᖓᓂ ᐊᐅᓯᐃᑦᑑᑉ ᕿᑭᖅᑖᓗᐊᓂ. ᓇᓚᐅᑦᑖᖅᑕᐅᓵᕐᓂᒍ ᐊᕙᑎᖓᓂᒃ (ᑕᐃᑲᙵᑦ 2006) ᐃᒪᓐᓇᐅᓚᐅᖅᑐᖅ 8,115 (95% ᓇᓗᓇᙱᕐᓗᑎᒃ ᐊᒡᓂᓕᓃᑦ 6,632 – 9,930) ᑭᓯᐊᓂ ᐃᓚᐅᑎᑦᑎᖕᒥᓪᓗᑎᒃ ᐅᐊᖕᓇᖅᐸᓯᐊᓂ ᐊᐅᓯᐃᑦᑑᑉ ᕿᑭᖅᑖᓗᐊᓂᒃ. ᑲᑎᙵᙱᑕᖓ ᖃᔅᓯᐅᓂᖕᒋᓐᓂᒃ ᓇᓚᐅᑦᑖᖅᑕᖅ ᕿᑎᖓᓂᒃ ᐊᐅᓯᐃᑦᑑᑉ ᕿᑭᖅᑖᓗᐊᓂ ᐃᓚᐅᑎᑕᐅᙱᕐᓗᓂ ᓈᓴᐅᓯᕆᔭᐅᓂᖓᓂᒃ ᑕᐃᑲᙵᑦ 2006 ᖃᐅᔨᓴᕈᑎᓂᒃ.

14 ᖁᑦᑎᒃᑑᑉ ᑐᒃᑐᖏᑦ ᑕᑯᔭᐅᓪᓗᑎᒃ ᐃᑳᕐᕕᖕᓂ ᖃᐅᔨᓴᖅᑎᓪᓗᒋᑦ, ᓇᓚᐅᑦᑖᕐᓗᑎᒍᓪᓗ ᖃᔅᓯᐅᓂᖕᒋᓐᓂᒃ 32 ± SE 25 (95% ᓇᓗᓇᙱᕐᓗᑎᒃ ᐊᒡᓂᓕᓃᑦ = 8-127, ᐊᒥᓱᕈᕐᑕᕐᓂᖕᒋᑦ ᐊᔾᔩᖕᒋᕐᓗᑎᒃ = 79%). ᐅᓄᙱᑦᑐᑦ ᑕᑯᔭᕐᓂ ᐱᑎᑦᑎᓪᓗᑎᒃ ᑕᐃᒪᐃᓪᓚᑦᑖᓗᐊᙱᑦᑐᓂᒃ ᓇᓚᐅᑦᑖᕐᓂᕐᓂᒃ. ᖁᑦᑎᒃᑑᑉ ᑐᒃᑐᖏᑦ ᑕᑯᔭᐅᔪᑦ ᐅᐊᖕᓇᖓᑕ ᐃᓚᖓᓂᒃ Raanes ᐊᒻᒪ Svendsen Peninsulas, ᐊᒻᒪ ᐊᑕᐅᓯᕐᒥ ᑲᑎᙵᔪᓂ ᑕᒡᓗᑎᒃ ᑲᓇᖕᓇᖓᑕ ᐃᓯᐊᓂ Fosheim Peninsula.

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Introduction

Caribou (*Rangifer tarandus*) and muskoxen (*Ovibos moschatus*) are the largest herbivores that inhabit the Canadian Arctic Archipelago. Peary caribou (*R. t. pearyi*) is the most northern subspecies of caribou and occurs almost entirely within the islands of the Canadian Arctic Archipelago, including the unglaciated portions of Ellesmere Island. They are smaller, lighter in colour, and have a shorter face then barren-ground caribou (*R. t. groenlandicus*). In February 2011, Peary caribou was listed as Endangered under the federal *Species at Risk Act* (SARA). In November 2015, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) re-assessed Peary caribou as Threatened (COSEWIC 2015). As mandated under SARA, a Recovery Strategy is currently under development, and the lack of up-to-date population information has been consistently identified as a knowledge gap, particularly for the northern part of Peary caribou range including Ellesmere Island. Since 2015, the Government of Nunavut has undertaken aerial surveys of Ellesmere Island to help address this knowledge gap and inform designation of critical habitat.

Surveys of Peary caribou on Ellesmere Island have been performed occasionally over the past 50 years. The first complete survey occurred from July 30 – August 11, 1961, and the survey estimated 200 animals on the island (Tener 1963). Even at the time, Tener (1963) considered this estimate a ‘best guess’ and an extrapolation based on relatively few observations and incomplete coverage of the survey area due to weather. A few other surveys have been conducted since then with varying degrees of coverage. During the period from May 8 – 15, and July 4 – 7 of 1973, Riewe flew an unsystematic survey primarily north of Sydkap Ice Cap, along Baumann and Vendom Fiords and on Svendsen, Raanes, and Bjorne peninsulas. This survey reported a minimum count of 150 Peary caribou (Riewe 1976). Following a request from the Iviq (Grise Fiord) Hunters and Trappers Association (HTA), the southern portion of Ellesmere Island (including the Svendsen Peninsula) was surveyed from July 17 – 23, 1989. This survey provided an estimate of 89 ± SE 31 caribou (Case and Ellsworth 1991). Unsystematic surveys of central Ellesmere in June 1995 returned a minimum count of 38 caribou (Gauthier 1996). Between May 4 – 30, 2005, the Government of Nunavut (GN) systematically surveyed southern Ellesmere Island and Graham Island, and estimated 219 caribou (95% CI=109-244) in the area. The GN survey continued the next year from April 6 to May 22, 2006, over the central and northern part of Ellesmere Island, providing an estimate of 803 caribou (95%CI = 531-2,107; Jenkins *et al.* 2011). From March 19 – 26, 2015 the GN again systematically surveyed the southern Ellesmere Island study area and estimated 183 ± SE 128 caribou (Anderson and Kingsley 2017).

Peary caribou and muskoxen are sympatric across most of their range and they are often surveyed together to maximize limited monitoring resources. When Tener (1963) surveyed Ellesmere Island in 1961, he estimated 4,000 muskoxen on the island, although again, this was considered a best guess and likely an underestimate. The unsystematic survey in 1973 conducted by Riewe (1973) estimated 1,060 muskoxen in the area north of Sydkap Ice Cap and on the Bjorne Peninsula, Raanes Peninsula, Svendsen Peninsula, Graham Island, and Buckingham Island. The July 1989 survey of southern Ellesmere, including Svendsen Peninsula, by Case and Ellsworth (1991) estimated 2,020 ± SE 285 muskoxen. During the May 2005 survey of southern Ellesmere Island, the GN estimated 456 muskoxen (95% CI = 312-670, Jenkins *et al.* 2011). Along with the low numbers, 40 muskox carcasses were also observed (Jenkins *et al.* 2011) and residents of Grise Fiord recalled freezing rain and ground-fast ice in the fall/winter of 2005 (Anderson and Kingsley 2017). In April and May 2006, the central and northern portions of Ellesmere Island were surveyed by the GN, and estimated 8,115 muskoxen (95%CI=6,632-9,930; Jenkins *et al.* 2011). The survey of southern Ellesmere Island in March 2015 by the GN estimated 3200 ± SE 602 (CV=19%) muskoxen (Anderson and Kingsley 2017), indicating strong recovery from the low numbers observed in 2005.

Peary caribou and muskoxen are very important to the community of Grise Fiord, the sole community that harvests on Ellesmere Island (Anderson 2015). Community members have relied on muskoxen and caribou on the island for sustenance and cultural persistence since the community was established in 1953. Monitoring caribou and muskox population trends (using both scientific approaches and Inuit Qaujimajatuqangit) around the community is therefore especially important (Anderson and Kingsley 2015).

Logistics and cost have prevented a survey of all of Ellesmere Island since 1961, and even in 1961 parts of the island could not be flown due to weather. Adverse weather still prevents survey completion some years - the 2015 GN survey of southern Ellesmere took three attempts before the survey was successfully completed (Anderson and Kingsley 2015). Costs and logistic constraints meant that rather than flying the entire 2006 study area in one year, central and northern Ellesmere Island were split into two study areas.

Study Area

The March 2017 aerial survey was flown to correspond with the west – east orientation of the transect lines from the 2006 survey of central and northern Ellesmere Island (Jenkins *et al.* 2011). The study area included the Raanes Peninsula, Svendsen Peninsula, Fosheim Peninsula, as well as the Bache and Knud Peninsulas (area north of Prince of Wales Mountains and south of the Agassiz Ice Cap). However, due to weather and logistic constraints, the Bache and Knud Peninsula transects were not able to be surveyed.

Central Ellesmere Island has a natural division with southern Ellesmere where Svendsen Peninsula and the head of Vendom Fiord meet the extensive ice fields of the Prince of Wales Mountains. Another constriction in unglaciated habitat lies along Canon Fiord at the Agassiz Ice Cap, which marked the northern boundary of our study area (Figure 1). Much of the area is very mountainous with valleys and a few plateaus. The Fosheim Peninsula is divided by the southwest-northeast trending Sawtooth Mountains, and the Raanes and Svendsen peninsulas are mostly rugged with some wide river valleys.

During March 2017 the average daily temperatures were between -37.1°C and -32.0°C with 5-7 cm of snow on the ground at Eureka. The historical (1981-2010) March daily average temperature is -36.8°C with 15 cm average snow depth at the Eureka Weather Station.

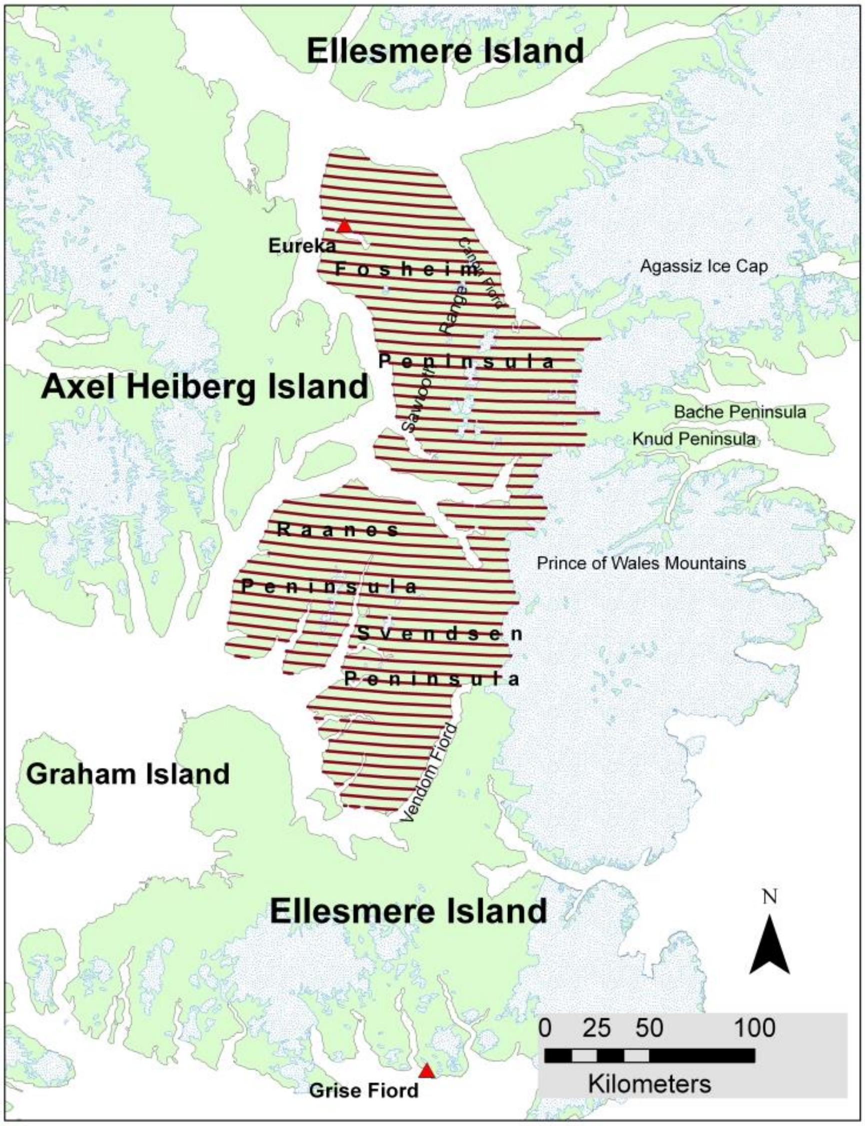

Figure 1. Central Ellesmere Island study area and survey transects.

Methods

Aerial Survey

Fixed-width transect aerial surveys are a standard way to monitor ungulate populations and have been used in the High Arctic since 1961. For this survey, we marked distance bins on the wing struts to allow for both distance sampling (Buckland *et al.* 2001, Thomas *et al.* 2009) as well as standard fixed-width strip transect sampling methods (Jolly 1969, Caughley 1977, Cochran 1977, Kingsley and Smith 1981). The central Ellesmere survey transects (n = 62) were flown using a fixed-wing de Havilland Twin Otter aircraft parallel to lines of latitude 5 km apart, at 180km/h. Surveys were flown at 400 feet above ground level, set with a radar altimeter. In rugged terrain this was adhered to as closely as crew safety and aircraft capabilities allowed. Surveys were flown only on days that provided good visibility and sufficient daylight due to the latitude and time of year of the survey.

The survey crew consisted of a pilot, co-pilot, navigator/recorder, and two observers on each side of the aircraft (four total) to enable a double dependent observer platform. Occasionally the recorder also functioned as an observer. The double observer platform has been effective on other caribou surveys in Nunavut and the Canadian Arctic Archipelago (e.g., Campbell *et al.* 2012, Anderson 2014). As with the most recent southern Ellesmere survey (Anderson and Kingsley 2015), all observers could communicate and the front and rear observations for each side were combined. Using this approach, a primary observer, seated in the first seat, called out all caribou or muskox groups observed to the secondary observer (seated in the back seat). The secondary observer then identified whether they observed those groups and any additional groups not sighted by the primary observer. Compared to a single observer, this method provides more accurate estimates of group size. Ideally, the observers switched seats over the course of the survey (Cook and Jacobsen 1979) and this method allows for the estimation of detection probabilities for observers.

Five distance bins were established on each side of the aircraft: 0-200 m, 201-400 m, 401-600 m, 601-1, 000 m, and 1,001-1,500 m. The bin intervals were derived from guidelines for bin intervals for aerial surveys (Buckland *et al.* 1993) which had been successfully implemented in similar survey conditions on the Baffin Island caribou survey (Campbell *et al.* 2015). The bins were marked on the struts of the aircraft following methods described by Norton-Griffiths (1978) and Buckland et al (1998). Strut markings were positioned using:

$$w = W(h/H)$$

where W is the strip width, H is the flight height, h is the observers eye level when the plane is on level ground and w is the measured distance on the ground to position the wing strut marks (Figure 2).

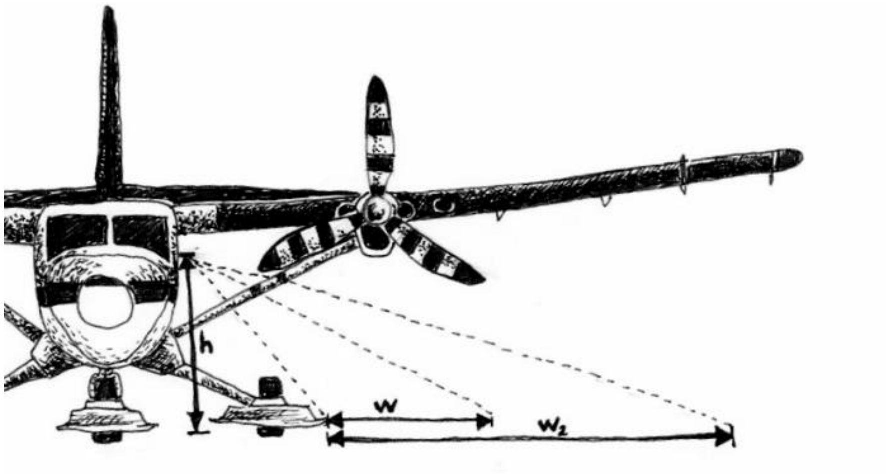

Figure 2: Derivation of wing strut marks for strip boundaries, where *w* and w_2 are calculated as described in the text, *h* is measured, and dotted lines indicate observer sightlines as modified from Norton-Griffiths (1978), drawing from Anderson (2016).

Observation of wildlife and tracks were recorded on a handheld Garmin global positioning system (GPS) (Garmin Montana 650) which also recorded the flight path. To reduce disturbance to animals we did not make multiple passes with the aircraft. During the single pass made it was not always possible to determine the sex and age of all animals in a group, and so we did not determine age or sex classes for Peary caribou, and only differentiated between adult and short-yearling (10-month old calves) muskoxen. If the group of muskoxen huddled quickly it was also difficult to determine group size and underestimates were likely in some cases. We downloaded GPS tracks and waypoints using DNR Garmin and saved them as ESRI shapefiles. Observation data were entered and manipulated in Microsoft Excel and ArcMAP (ESRI, Redlands, CA).

The Fosheim, Raanes, and Svendsen peninsulas of Ellesmere Island were surveyed from March 8 to March 20, 2017 with 62 transect lines (Figure 1). Although small ice caps in the middle of transects were flown, no tracks or animals were seen and the ice cap area was excluded from the analysis. We did not stratify the area based on predicted densities of caribou and muskoxen, but did divide the study area into discrete areas based on geographic features (i.e. large peninsulas) to identify differences in distribution and abundance for Peary caribou and muskoxen (Table 1).

Table 1. Survey strata used in central Ellesmere Island caribou survey

Location	Strata ID	Strata Area (km^2)	Base-line (km)	Mean Transect Length (km)	Total Transect Length (km)	Transect spacing (km)	Number of Transects
Fosheim Peninsula	CEI-1	11543	132	85	2624	5	31
Raanes and Svendsen Peninsulas	CEI-3	13244	319	74	2282	5	31

Abundance estimation

We used a combined distance sampling and mark-recapture approach to estimate abundance for survey strata on Ellesmere Island. The approach involved using mark-recapture to estimate the probability of detection of caribou at zero distance from the blindspot marker (the plane's wheel), and distance sampling methods to estimate the decrease in probability of detection at greater distances from the plane under the assumption of point independence (Buckland *et al.* 2010). This approach ensured a more robust estimate than using distance sampling methods alone, which assume that the probability of detection of groups at zero distance from the plane is 1 (Borchers *et al.* 1998, Buckland *et al.* 2004, Laake *et al.* 2008a, Laake *et al.* 2008b, Buckland *et al.* 2010, Laake *et al.* 2012).

We used the program *Distance* (Buckland *et al.* 1993, Buckland *et al.* 2004, Thomas *et al.* 2009) to format the data which was then ported into the MRDS package (Laake *et al.* 2012) in program *R* (R Development Core Team 2009). The mark-recapture/distance sampling analysis had two phases. In the first phase, we fit competing distance sampling models with mark-recapture covariates held constant. We used information-theoretic model selection methods to determine which model had the most support (Burnham and Anderson 1992). Once a distance sampling model was selected, we used it to compare removal double observer mark-recapture models under the point independence assumption. Using this approach provided a seamless way to model both sources of variation. We produced abundance estimates for the entire study area for each model formulation to assess the sensitivity of estimates to model specification.

The main covariates we used in the analysis are listed in Table 2. The observer covariate corresponds to each primary observer in the survey. The distance covariate was mainly used in the mark-recapture analysis given that it is explicitly considered in the distance analysis. Covariate predictions were assessed graphically to evaluate biological validity and model fit.

Table 2. Distance and mark-recapture model covariates

Covariate	Acronym	Type
Observer	ob1-3	binary
Distance bin from plane	distance	ordinal
Group size	size	continuous
Log(group size)	logsize	continuous
Snow cover	snow	ordinal
Cloud cover	cloud	continuous
Snow patchiness	patch	ordinal
Observer pairs	Ob1, Ob2	categorical

We compared estimates from the MRDS analysis to estimates from distance sampling and strip-transect methods only. Strip transect estimates were generated in program *Distance* using observations of 400 meters or less from the survey plane. We used a uniform detection function to emulate the strip transect assumption of perfect sightability within 400 meters of the survey plane. Variance was estimated in program MRDS which considered the distance sampling, mark-recapture, and encounter rate variation (Innes *et al.* 2002). We applied the “O2” approach in MRDS, which accounted for the systematic sampling design with sequential transect lines between strata and likely correlation of adjacent transects, to estimate encounter rate variance (Fewster *et al.* 2009).

Results

Muskox

Across the survey region we observed 254 groups of muskoxen and 2,153 muskoxen in total. Each group was assigned to a distance bin. The mean group size was 8.5 muskoxen (range = 1-38, standard deviation [SD] = 6.9). We used the total number of adults and 10-month-old calves for our analysis.

Muskoxen were most numerous on the central part of the Fosheim Peninsula north of the Sawtooth Range, and on northern Raanes Peninsula (Figure 3).

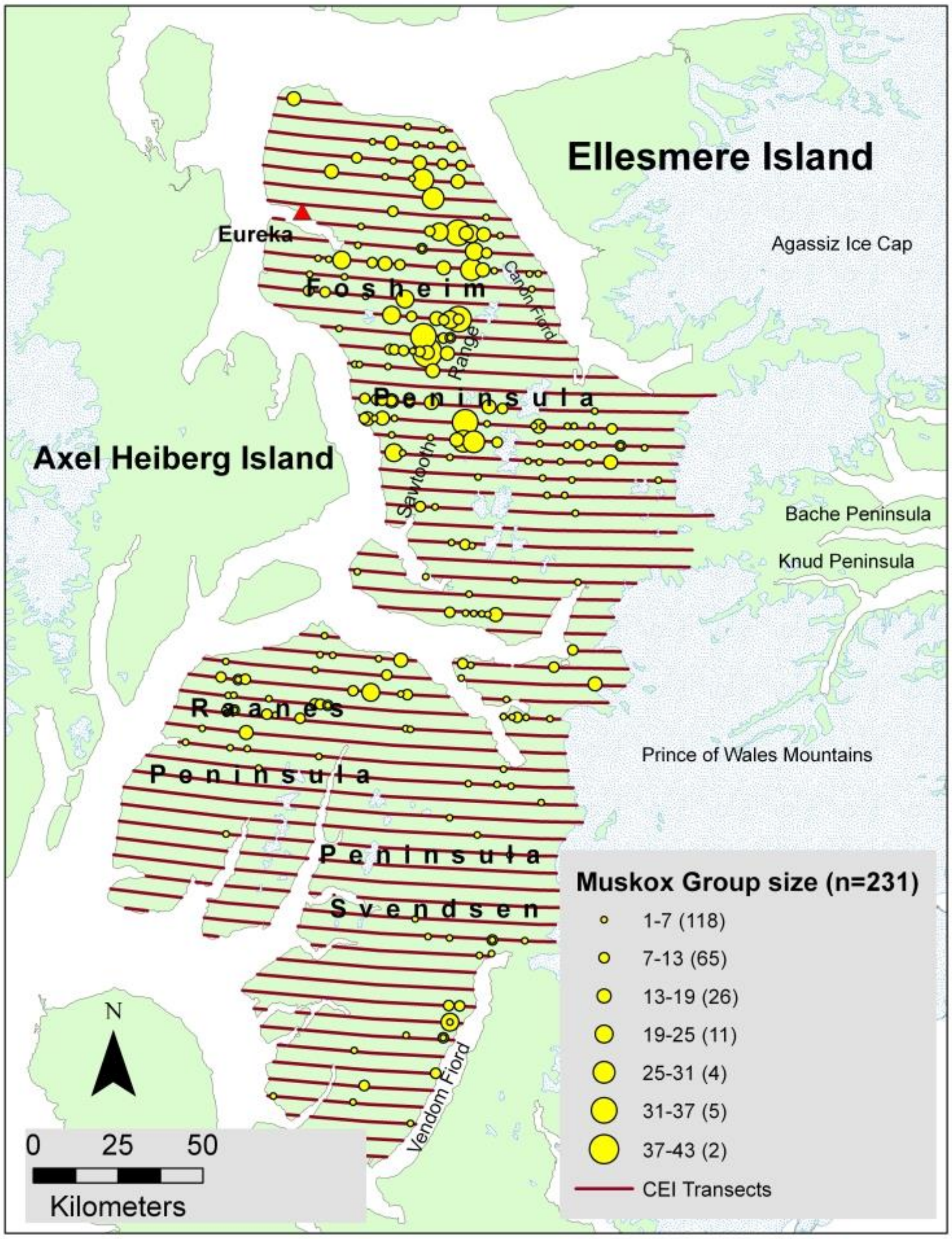

Figure 3. Distribution and group sizes of muskox observations during the 2017 Central Ellesmere Island survey. Frequencies of each group size are given next to each bin interval.

As expected, most groups were observed in the distance bins closest to the transect line. There were a similar number of observations in the first two distance bins (i.e. within 400 m of the aircraft), with fewer groups detected in distance bins further from the transect line, even after adjusting for unequal sized distance bins (200 m versus 500 m; Figure 4).

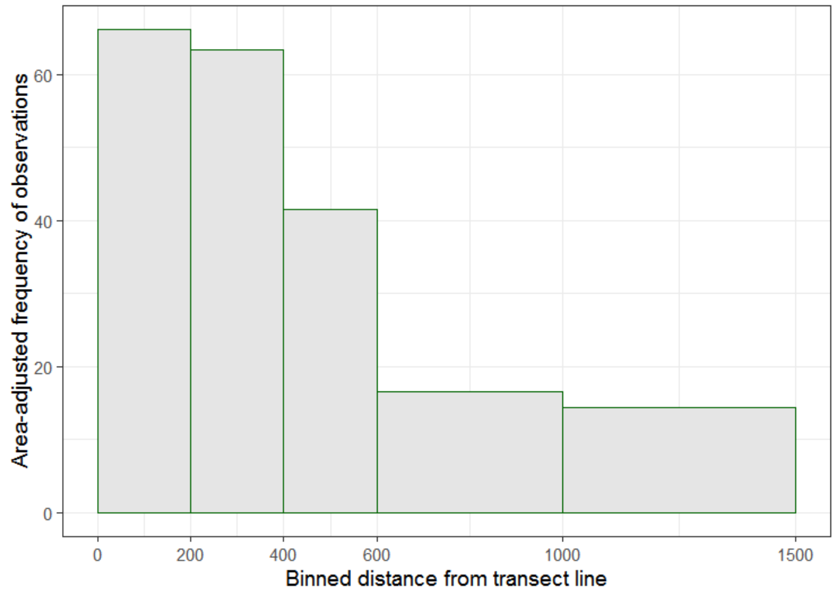

Figure 4. Bin-width adjusted frequencies of muskox observations on Central Ellesmere Island.

Muskoxen were usually seen in groups of ten or fewer, but we detected group sizes up to 38 muskoxen (Figure 5).

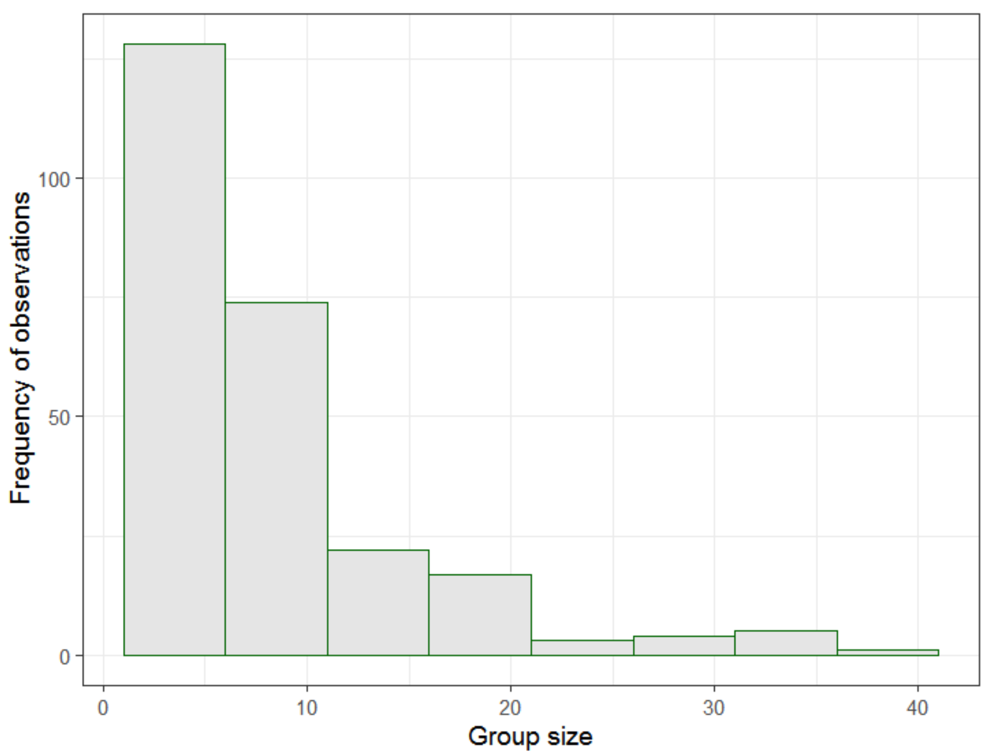

Figure 5. Frequency of muskox group sizes observed on Central Ellesmere Island, March 2017.

Influence of covariates on detection

Group size can influence detection, so the potential effect of group size on the distribution of detections was also examined (Figure 6). Proportionally more large groups were observed further from the transect line. Densities were used to compare among distance bins to account for bins covering different distance intervals (200-m or 500-m).

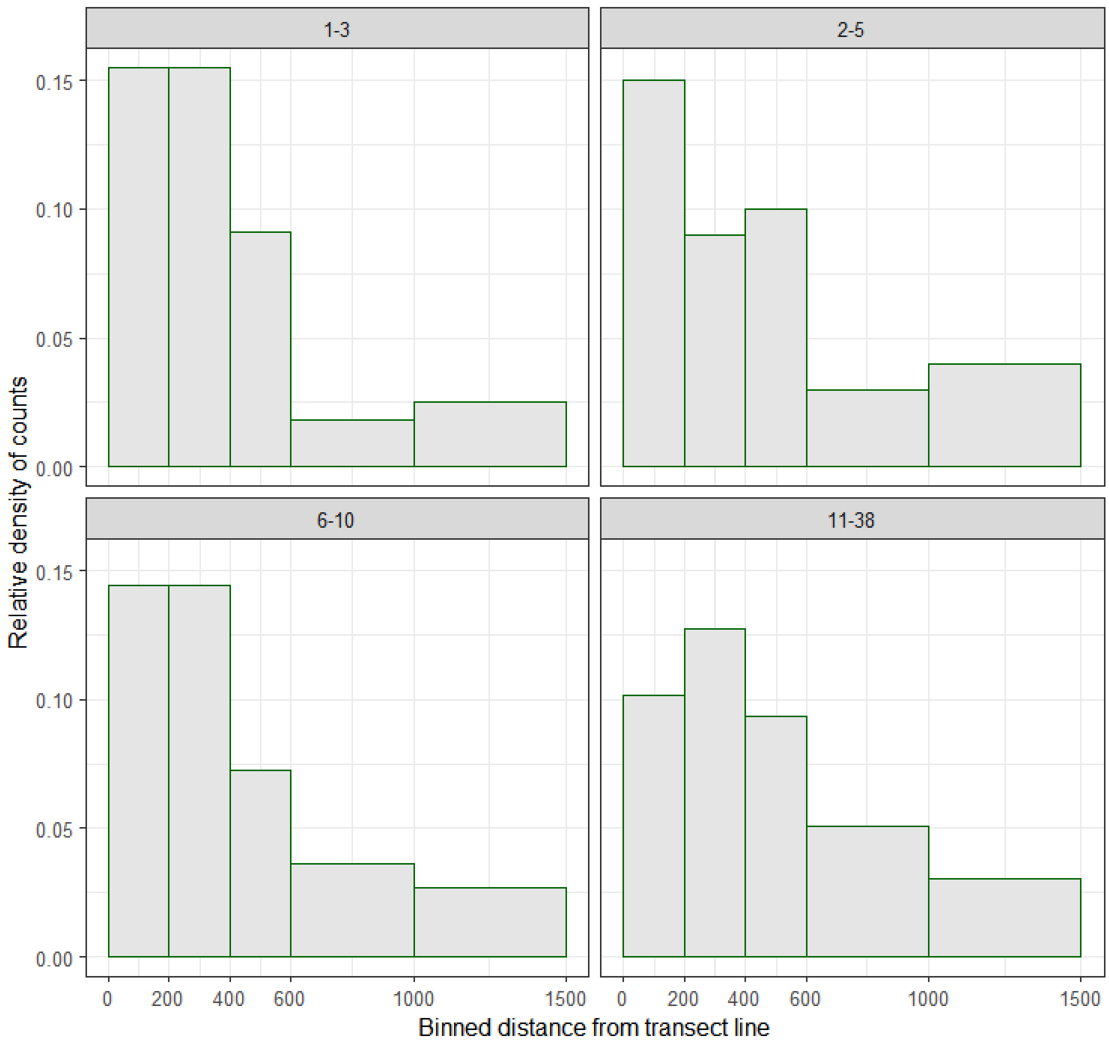

Figure 6. Density of muskox observations in each distance bin for group sizes of 1-3, 2-5, 6-10, and 11-38 muskoxen.

The observer pairings on either side of the aircraft might also have influenced the detection of groups and the shape of the detection function. There were two main observer pairings during the survey (Pair 1 and Pair 2) with a third pairing (Pair 3) accounting for relatively few observations (Table 3). The Pair 1 observers were in the same order for the majority of observations, whereas Pair 2 observers had similar observation frequencies in both positions. The overall pooled detection probabilities were similar for Pair 1 and Pair 2 based on naïve detection probabilities (Table 3). Our analysis largely uses observations from Pair 1 and Pair 2 given the low sample sizes for Pair 3.

Table 3. Frequencies of muskox observations by observer pairing and order. Observations are binned by whether front (F), rear (R), or both (B) observers reported a muskox group. The naïve probability of the front observer seeing a group, P(F), is estimated as 1 minus the proportion of observations only observed by the rear observer for any given pairing.

Pair	Observer 1	Observer 2	Obs. Order 1-2 F	R	B	P(F)	Obs. Order 2-1 F	R	B	P(F)	Pooled F	R	B	P(F)
1	F. Noah	J. Pijamini	5	15	45	0.77	3	3	24	0.90	8	18	69	0.81
2	J. Kiguktak	M. Fredlund	1	8	60	0.88	0	1	54	0.98	1	9	114	0.93
3	M. Campbell	J. Pijamini	3	2	6	0.82	0	0	1	1.00	3	2	7	0.83

The distribution of sightings was slightly different by observer pairings with Pair 1 having relatively greater observations closer to the plane in comparison to Pair 2 (Figure 7).

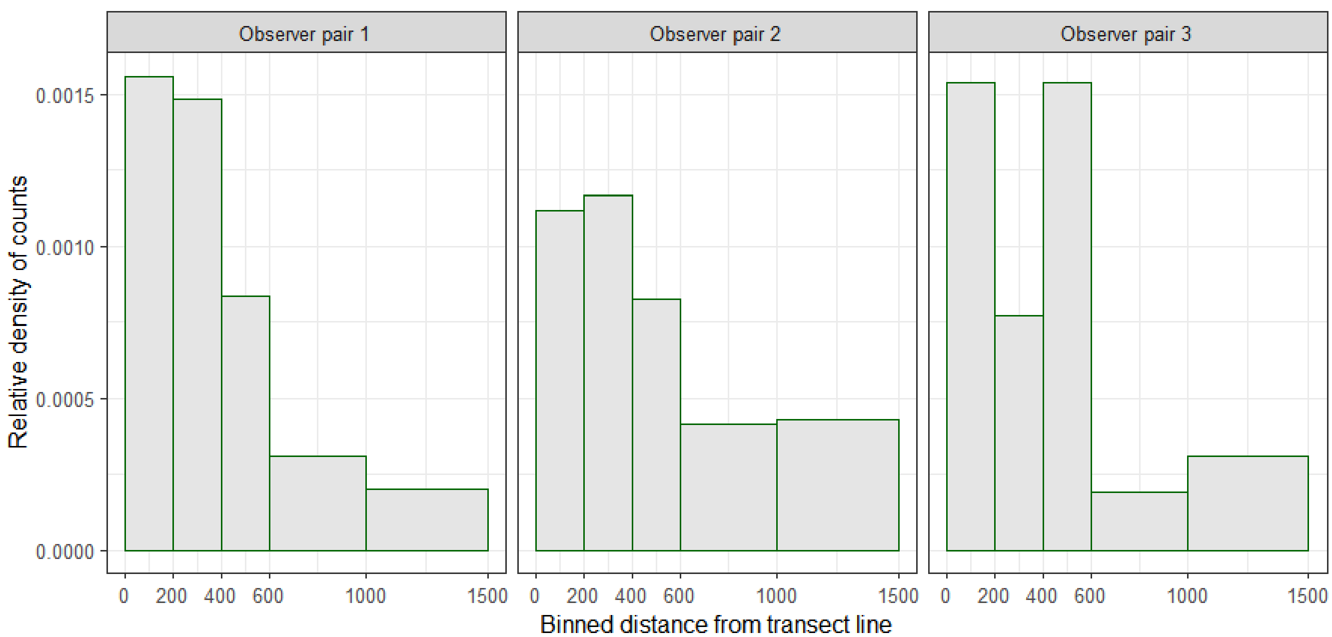

Figure 7. Muskox observation densities in each distance bin by observer pairing.

Abundance estimation

Our two-phase abundance estimate incorporated both mark-recapture and distance sampling analysis. In the first phase, distance models were fit while mark-recapture covariates were held constant. Once a distance sampling model was fit, mark-recapture models were considered under the point independence assumption. For the distance phase (Table 4, models 10-20) a model with log of group size and observer Pair 1 influencing a hazard rate detection function had the lowest AIC_c score (model

10), although models 11 and 12 were tied for support with model 10 ($\Delta AIC_c < 2$). Due to the similar support for models 10-12, further analyses with mark-recapture covariates used model 10 as a base model. Models with covariates stratum and cloud cover had less support than the null model (model 16). Snow cover and snow patchiness covariates showed minimal variation and therefore were not considered in any models.

Using model 10 as a base model, we compared additional models that included mark-recapture covariates (models 1-10). Of these, model 1, with covariates log of group size and observer pair 1, had the lowest AIC value, although models 2 and 3 received equivalent support ($\Delta AIC_c < 2$). Estimates of abundance from these three models were very close (within 2 animals), suggesting minimal influence of the covariates on the final abundance estimate. Abundance estimates were similar for most models, ranging from 6,900-7,194. Model 16, the null model, produced the highest abundance estimate. Most models used a hazard rate detection function, although in two cases a half normal function was used, with poor results.

Table 4. Mark-recapture/distance sampling model selection results. Models are defined by distance detection function (DF: HR = Hazard rate, HN = half normal), distance sampling and mark-recapture covariates (as defined in Table 2). A "1" indicates that the parameter was held constant. Akaike Information Criteria corrected for small sample sizes (AIC_c), the difference in AIC_c values between the *i*th model and the model with the lowest AIC_c value (ΔAIC_c), Akaike weights (w_i), number of parameters (*K*), and log-likelihood of the model are presented. Baseline models are shaded for reference.

No.	DF	Model covariates		Model fit					Abundance	
		Distance	Mark-recapture	AIC	ΔAIC_c	w_i	K	LL	N	CV
1	HR	logsize + ob1	ob1 + logsize	981.10	0.00	0.39	7	-483.6	6,902	15.0%
2	HR	logsize + ob1	ob2 + logsize	981.38	0.28	0.33	7	-483.7	6,903	15.0%
3	HR	logsize + ob1	ob1+ob2 + logsize	982.45	1.35	0.20	8	-483.2	6,904	15.0%
4	HR	logsize + ob1	ob1	986.10	5.00	0.03	6	-487.1	6,938	15.1%
5	HR	logsize + ob1	ob2	987.00	5.90	0.02	6	-487.5	6,941	15.1%
6	HR	logsize + ob1	cloud	987.65	6.55	0.01	6	-487.8	6,927	15.0%
7	HR	logsize + ob1	ob1 + ob2	987.93	6.83	0.01	7	-487.0	6,941	15.1%
8	HR	logsize + ob1	logsize	991.85	10.75	0.00	6	-489.9	6,889	15.0%
9	HR	logsize + ob1	size	993.26	12.16	0.00	6	-490.6	6,894	15.0%
10	HR	logsize + ob1	1	993.99	12.89	0.00	5	-492.0	6,916	15.0%
11	HR	logsize + ob2	1	994.14	13.04	0.00	5	-492.1	6,875	14.9%
12	HR	logsize + ob1 + ob2	1	995.66	14.56	0.00	6	-491.8	6,871	14.9%
13	HR	size + ob1 + ob2	1	997.38	16.28	0.00	6	-492.7	7,010	14.9%
14	HR	logsize	1	997.66	16.55	0.00	4	-494.8	7,107	15.7%
15	HR	size	1	999.57	18.46	0.00	4	-495.8	7,194	15.6%
16	HR	1	1	1000.96	19.86	0.00	3	-497.5	8,026	15.7%
17	HR	stratumcov	1	1001.71	20.61	0.00	4	-496.9	7,642	14.8%
18	HR	cloud	1	1001.74	20.64	0.00	4	-496.9	7,736	14.7%
19	HN	logsize	1	1009.47	28.37	0.00	3	-501.7	6,299	12.5%
20	HN	1	1	1012.59	31.49	0.00	2	-504.3	6,881	12.8%

Goodness of fit tests suggested adequate fit for the mark-recapture part of the model ($\chi^2 = 5.0$, df = 7, p = 0.65) but marginal fit to the 600-1,000-m bin for the distance sampling component, which caused the overall fit of the model to be marginal ($\chi^2 = 12.6$, df = 2, p = 0.001). Inspection of the individual fit of each bin suggested the only area of low fit was the 600-1,000-m bin ($\chi^2 = 6.9$), with other component χ^2 scores being less than 1. It is likely that lack of fit of this bin, which is far from the shoulder of the detection function, did not greatly influence abundance estimates. Inspection of detection probabilities relative to densities of observations (Figure 8) also suggested reasonable fit for detections by the primary observer only and pooled detections from both observers. Group size and observer pairings also influenced the predicted detection of model1 (Figure 9).

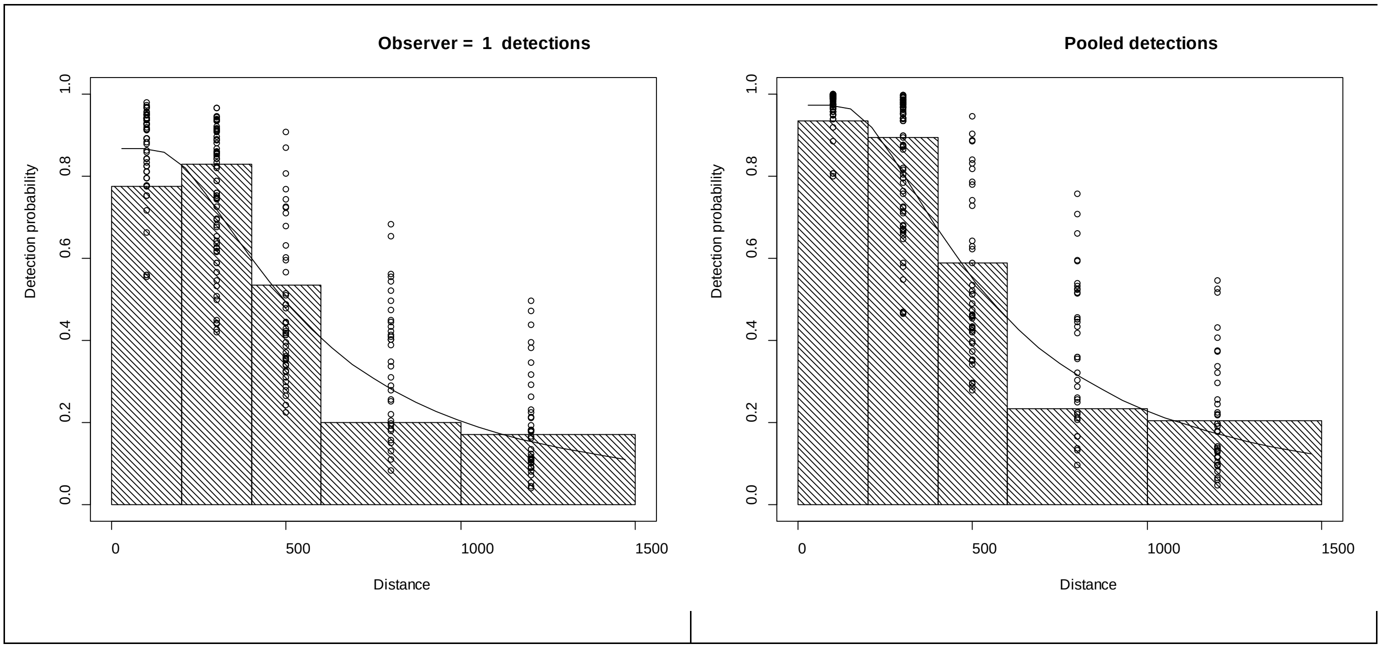

Figure 8. Predicted and observed detection probabilities for the primary observer (left) and pooled observers (right) from model 1 (Table 4). The histograms denote the relative frequency of observations whereas the points and line display the predicted detection probabilities and fitted detection function.

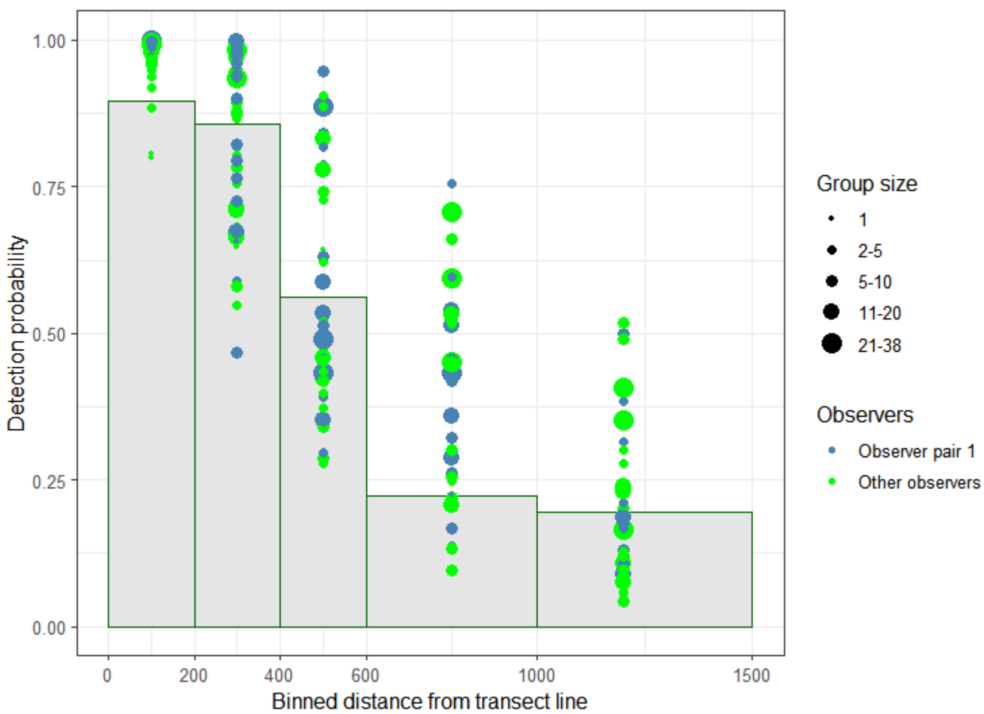

Figure 9. Predicted and observed detection probabilities for pooled detections of muskox groups as a function of observer pairs and muskox group size from model 1 (Table 4). The histograms denote the relative frequency of observations whereas the points and line display the predicted detection probabilities and fitted detection function. Covariate values associated with points (group size and observer) are also indicated by size and color of each point.

Muskox abundance was estimated for the study area using the most supported MRDS model, model 1 (Table 4). To investigate the sensitivity of our abundance estimate to different analysis methods, we also estimated muskox abundance using mark-recapture strip transect, distance sampling without mark recapture, and strip-transect only methods (Table 5). The highest estimate was from the MRDS model, which accounts for heterogeneity in detections. Precision was reasonably similar between approaches (Table 5). Estimates from MRDS model 1 were also computed for individual stratum (Table 6).

Table 5. Estimates of muskox abundance for Ellesmere Island derived by mark-recapture distance sampling (MRDS), mark-recapture strip transect (MR), distance sampling without mark recapture (DS), and strip transect methods.

Method	Muskoxen observed	Muskoxen estimated	SE	Confindence Limits (95%)		CV (%)
MRDS (Model 1, Table 4)	2,153	6,902	1,036	5,134	9,278	15.0
MR only (400 m strip)	1,067	6,857	887	5,286	8,896	12.9
DS only	2,153	6,807	1,001	5,092	9,098	14.7
Strip (400m)	1,067	6,741	998	5,029	9,037	14.8

Table 6. Estimates of muskox abundance by survey stratum on central Ellesmere Island March 2017 using mark-recapture distance sampling model 1.

Stratum	Muskoxen observed	Muskoxen estimated	SE	Confindence Limits (95%)		CV (%)
Raanes and Svendsen Peninsulas	562	1,948	280	1,467	2,585	14.4
Fosheim Peninsula	1591	4,954	897	3,461	7,091	18.1
Total	2153	6,902	1,036	5,134	9,278	15.0

Peary caribou

The Peary caribou analysis was constrained by a very small number of observations, with only nine individuals in five groups seen by the dedicated observers. Five additional individuals were seen by a recorder only. Peary caribou were seen on the northern Raanes and Svendsen peninsulas, and on the Fosheim Peninsula east of Bay Fiord (Figure 10).

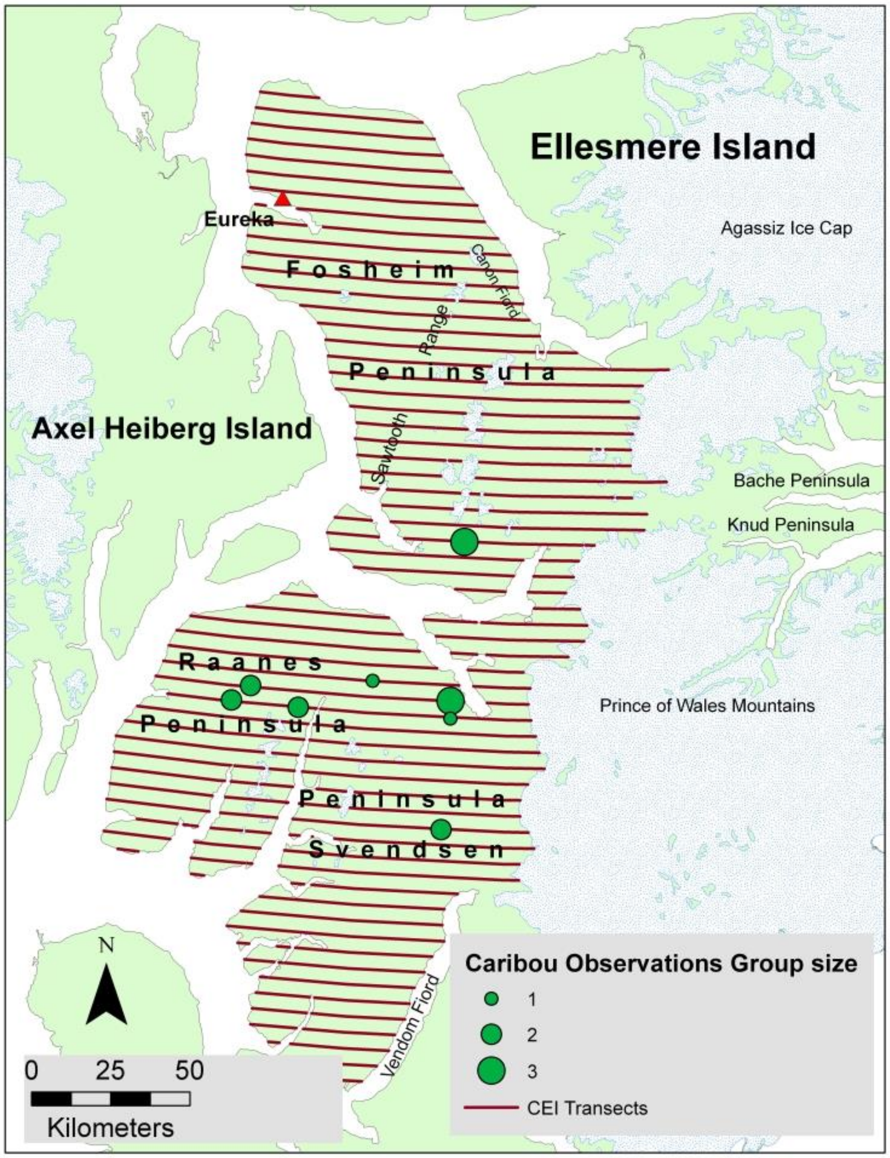

Figure 10. Observation locations and group sizes of Peary caribou during the 2017 Central Ellesmere Island survey.

The dedicated observer pairs saw Peary caribou up to the 600-1,000 m distance bin, and two groups totaling five individuals were seen by the recorder in the 600-1000-m bin. No individuals were observed in the 1,000-1,500-m distance bin (Figure 11). Statistical analysis was run with and without the recorder observations.

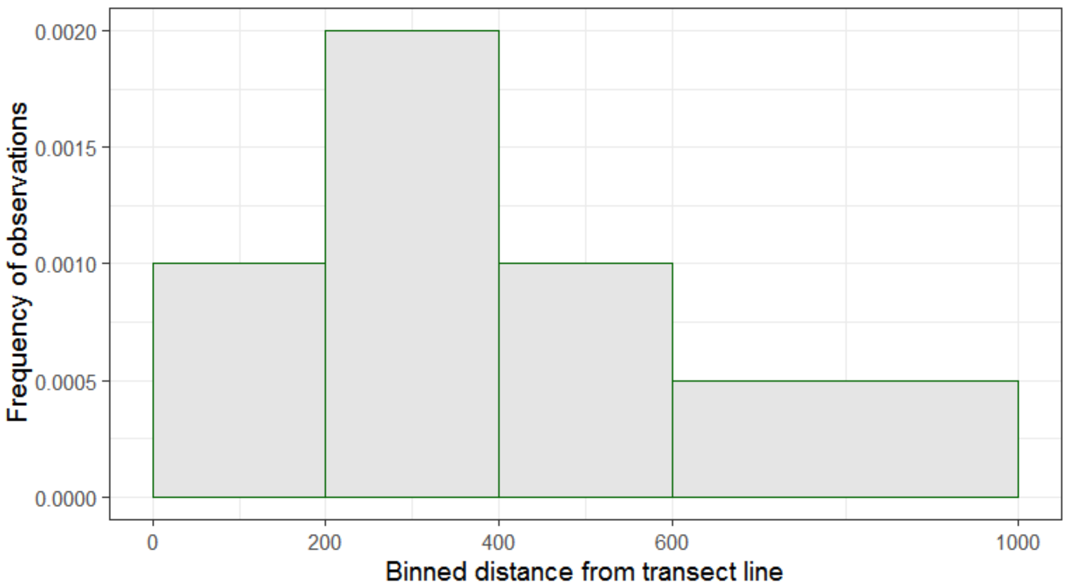

Figure 11. Bin-width adjusted frequencies of Peary caribou observations during the survey by the two dedicated observer pairs (recorder observations not included).

The low number of observations precluded more advanced modelling methods such as mark-recapture distance sampling. Half normal and hazard rate detection functions were fitted to the data on an exploratory basis. Of these, a half-normal detection function was most supported (Figure 12) with goodness of fit tests suggesting adequate fit ($\chi^2 = 0.51$, df = 2, p = 0.77). However, the reliability of this test is compromised by the small sample size. The resulting abundance estimate from this model was 32 ± SE 25 caribou (95% CI = 8 - 127, CV = 78.8%). A model with group size as a covariate was also considered, and was equally as likely as the half-normal model without group size. The estimate from this model was 36 ± SE 29 caribou (95% CI = 8-163, CV = 80.5%). A strip transect estimate assuming a 400-m strip width was also run, with an estimate of 25 ± SE 19 caribou (CI = 6 - 101, CV = 76.6%).

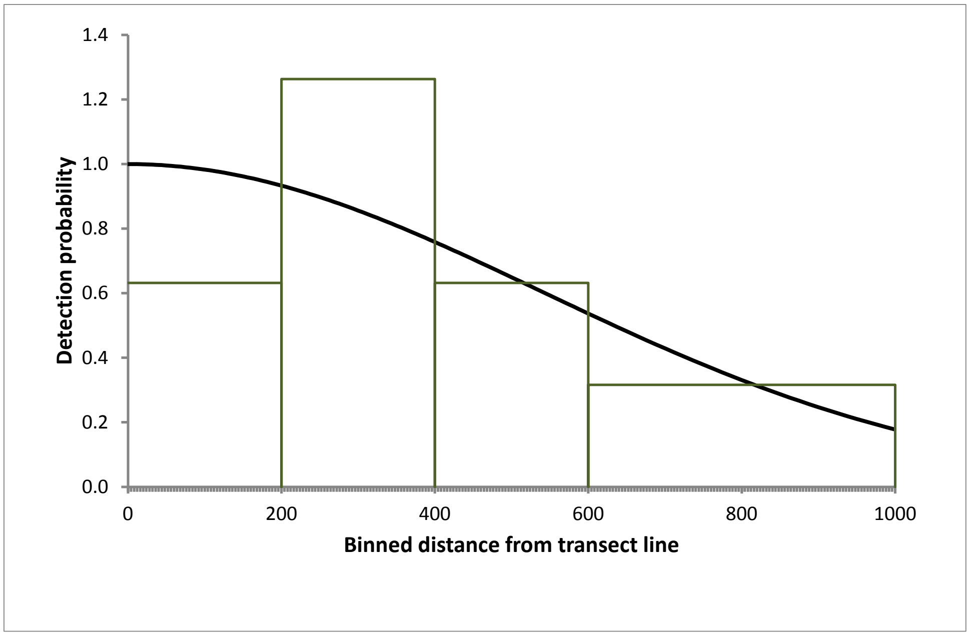

Figure 12. Fit of the half-normal detection function to the Peary caribou observation data.

Inclusion of recorder observations could be justified when the recorder was scanning the same area as observers and acting as a third observer with a similar detection function. The two additional recorder observations occurred in the 600-1000-m bin, and inclusion of these observations increased the detection function in this bin (Figure 13). Models using recorder observations that included group size as a covariate were more supported than models without group size. The half-normal detection function without group size was essentially flat, suggesting similar sightability in all distance bins. When group size was included, the detection function declined sharply up to 400 metres from the transect line, and then became uniform at 0.4 for distances up to 1000 meters (Figure 13). This detection function may be an artifact of the distribution of a small number of observations, as sightability should decline as distance increases. We estimated 49 ± SE 30 caribou (95% CI = 16-154, CV = 60.7%) using the model that included recorder observations and a group size covariate. If group size was not included, the estimate was 35 ± SE 24 caribou (95% CI = 10-127, CV = 67.8%).

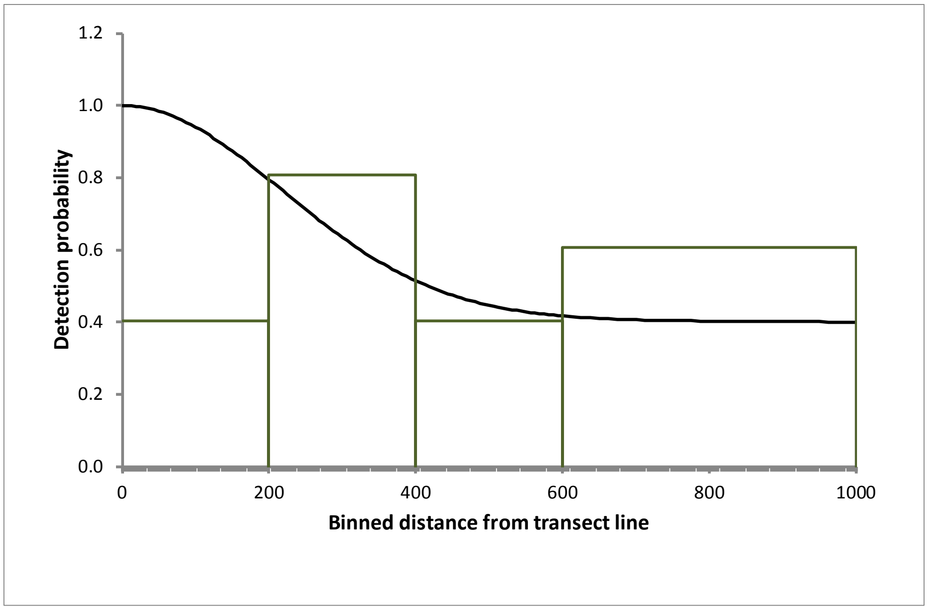

Figure 13. Fit of the half-normal detection function to the Peary caribou data including recorder observations and group size as a covariate.

Discussion

With the lack of consistency in both the frequency and method of surveys of Ellesmere Island it is challenging to confidently provide trends for either the muskoxen or Peary caribou populations (Anderson and Kingsley, 2015).

Muskoxen

In 1961, Tener (1963) flew a survey of Ellesmere Island and estimated 4,000 muskoxen on the entire island, admitting that this was a 'best guess' and more intensive surveys would be required for an accurate population estimate. Of the 605 muskoxen that he observed, 38% were on the Fosheim Peninsula, and he estimated a quarter of the island's muskox population was distributed between the Fosheim Peninsula and the Tanquary Fiord-Lake Hazen-Alert plateau (Tener 1963). In 1973, Riewe flew a series of surveys centered on the Bjorne Peninsula to investigate the distribution of wildlife during a seismic program conducted by PanArctic Oil (Riewe 1976). He estimated 425 muskoxen on the Svendsen Peninsula and 200 muskoxen on the Raanes Peninsula (Riewe 1973). In 1989, Case and Ellsworth (1991) covered southern Ellesmere Island, including the Svendsen Peninsula, and estimated 350 ± SE 90 muskoxen (Case and Ellsworth 1991). In 1995, Gauthier flew unsystematic surveys of Ellesmere Island an observed 1196 muskoxen (Gauthier 1996). The most recent survey of central Ellesmere Island occurred in 2006 when it was part of a systematic survey of central and northern Ellesmere Island (Campbell 2006, Jenkins *et al.* 2011).The 2006 survey estimated 8,115 muskoxen (95% CI = 6,632-9,930) on northern and central Ellesmere Island, based on 4,999 muskoxen seen on transect (Jenkins *et al.* 2011). Most of the muskoxen in 2006 were seen on the Fosheim Peninsula (n = 3286), with other concentrations on the Lake Hazen Plateau (n = 1428) between Tanquary Fiord and Alert. The number groups seen in 2006 for the Fosheim Peninsula Strata was greater than in 2017 as shown in Figure 14. However, there were more groups observed in 2017 on the Raanes and Svendsen Peninsulas.

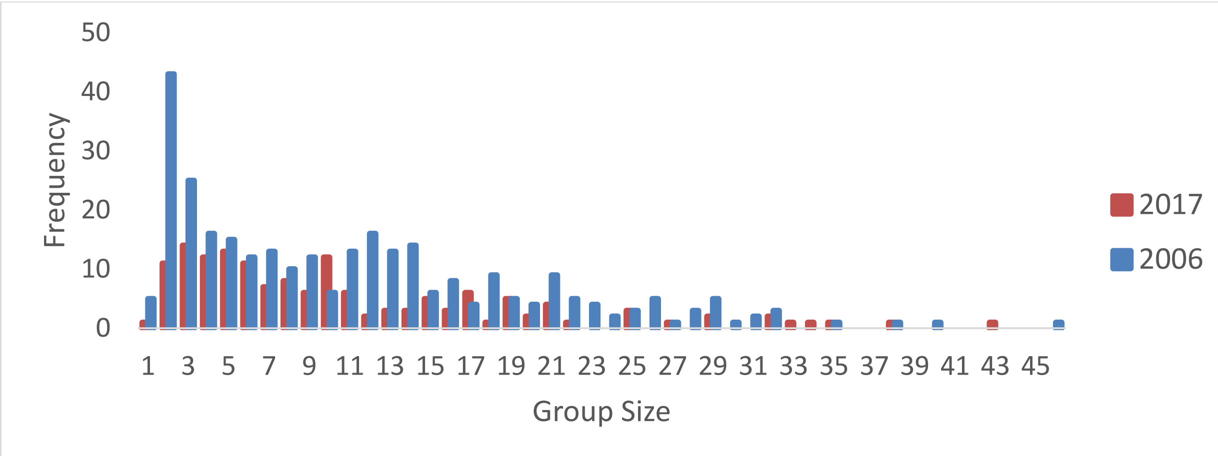

Figure 14. Frequency of observed group sizes during the 2006 and 2017 surveys for the Fosheim Peninsula stratum.

For muskox, the current analysis demonstrates the utility of the joint MRDS approach to account for multiple sources of variation in aerial survey data. The mark-recapture analysis suggested that detection was less than one near the plane, which would violate one of the assumptions of the distance sampling methodology. Use of the mark-recapture component accounted for this source of bias. The distance sampling component allowed all of the data to be used for analysis rather than only observations detected within a fixed-width strip transect.

Although the mark-recapture strip-transect estimate was the most precise (Table 5) of the methods examined, our data indicated that this estimate violates the method's assumption of equal sightability within the survey strip (i.e. detection was less than one in the 0- 400 m distance bin). However, the difference in precision between the most precise method and the MRDS estimate was small. The main loss of detection occurred for smaller groups which contributed less to the overall estimate, and the realized difference between mark-recapture strip transect and the slightly less precise MRDS abundance estimates was minimal (Table 5).

Peary caribou

Our Peary caribou analysis was compromised by the low number of observations, which limited our ability to model a distance detection function. Distance sampling data from similar studies might be able to assist in estimation of detection functions by allowing the pooling of data to estimate detection functions and associated detection probabilities. Approaches such as density surface modelling (Miller *et al.* 2013, Miller *et al.* 2016) that provide further inference on the distribution of patchy populations might improve estimates, especially if Peary caribou are associated with unique habitat characteristics within the study area.

Small sample sizes have been an issue for Peary caribou surveys on Ellesmere Island since Tener observed 74 Peary caribou (37 on transect) on the island in summer 1961 (Tener 1963). He guessed that about 200 caribou inhabited the island (Tener 1963). Riewe estimated 65 caribou on the Svendsen Peninsula and 300 caribou on the Raanes Peninsula in 1973, with a concentration of caribou at the head of Blind Fiord (Riewe 1976). In 1989, Case and Ellsworth (1991) estimated 31 ± SE 23 Peary caribou on the Svendsen Peninsula. In 2006, there were an estimated 802 Peary caribou (95% CI 531-1,207 caribou) on northern Ellesmere Island, including the central part of the island covered during this survey (Jenkins *et al.* 2011). Most caribou on that survey were seen on northern Ellesmere Island, on the Hvitland, Svartfjeld, and Marvin peninsulas and in the Blue and Blackwelder Mountains (Jenkins *et al.* 2011).

The small sample sizes and resulting low precision of abundance estimates make it difficult to interpret population trends, but the survey data that exist suggest that Peary caribou persist at low densities on central Ellesmere Island.

Management Recommendations

Over the past five years, muskox harvest has been managed through the Management Plan for High Arctic Muskoxen of the Qikiqtaaluk Region 2013-2018 (DOE *et al.* 2013). Ellesmere Island is encompassed completely within the Muskox Management Unit MX-01. Based on the results of the 2015 survey of southern Ellesmere Island, which found high densities of muskoxen in the most accessible part of MX-01, the total allowable harvest for muskox in MX-01 was lifted, although maintenance of a reliable reporting system for harvest was recommended to continue to collect and monitor harvest data. The results of this survey support those management actions.

Although only 14 caribou were seen on transect and a reliable population estimate was not attainable, the area surveyed is not within typical harvesting range of Grise Fiord and Peary caribou abundance on central Ellesmere Island is not limited by harvest activities. A management plan for Peary caribou in Nunavut is currently in development and regular monitoring (based on scientific methods and Inuit Qaujimajatuqangit) is expected to be an important part of the plan.

Acknowledgments

Thank you to all those involved in making this project happen. Thanks to the survey observers Jopee Kiguktak, Jason Pijamini, and Frankie Noah - your sharp eyes and great attitudes even during the weather days were invaluable. Thank you to the Iviq and Resolute Bay Hunters and Trappers Associations for the knowledge that was shared and support in arranging observers, in particular Terry Noah. I would also like to thank the Eureka Weather Station staff for making us feel welcomed. Thank you Polar Continental Shelf Program for providing logistical support and letting us invade your work space on those weather days.

Running a project in the High Arctic is an expensive endeavour and without financial support from the Government of Nunavut, Environment and Climate Change Canada's Habitat Stewardship Fund, and Nunavut General Monitoring Program this survey would never have occurred. This research was also conducted in accordance to permitting regulations under Government of Nunavut Wildlife Research permit WL 2017-003.

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Appendix 1. Previous surveys conducted on Ellesmere Island. Some of the surveys that have taken place within all or parts of the area surveyed and analysed in this report. Total Obs = Total muskoxen or caribou observed, Est = Abundance estimate, and '-' = no records taken.

Table 7. Past Muskoxen surveys that included central Ellesmere Island

<table>
<tr><th></th><th colspan="2">1961</th><th colspan="2">1973</th><th colspan="2">1989</th><th colspan="2">1995</th><th colspan="2">2006</th><th colspan="2">2017</th></tr>
<tr><th>Study Area</th><th>Total Obs</th><th>Est</th><th>Total Obs</th><th>Est</th><th>Total Obs</th><th>Est</th><th>Total Obs</th><th>Est</th><th>Total Obs</th><th>Est</th><th>Total Obs</th><th>Est</th></tr>
<tr><td>Fosheim Peninsula</td><td>227</td><td>1000</td><td>-</td><td>-</td><td>-</td><td>-</td><td>790</td><td>-</td><td rowspan="6">3745</td><td rowspan="7">8115 (95% CI 6,632-9,930)</td><td rowspan="2">1591</td><td rowspan="2">4954 ±897</td></tr>
<tr><td>Sverdrup Pass</td><td>47</td><td rowspan="7">3000</td><td>-</td><td>-</td><td>-</td><td>-</td><td>42</td><td>-</td></tr>
<tr><td>Raanes Peninsula</td><td>54</td><td>161</td><td>200</td><td>-</td><td>-</td><td>47</td><td>-</td><td rowspan="4">562</td><td rowspan="4">1948 ±280</td></tr>
<tr><td>Svendsen Peninsula</td><td>20</td><td>362</td><td>425</td><td>89</td><td>350 ±90</td><td rowspan="2">142</td><td>-</td></tr>
<tr><td>Vendom Fiord</td><td>-</td><td>100</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Strathcona Bay Fiords</td><td>-</td><td>32</td><td>-</td><td>-</td><td>-</td><td>91</td><td>-</td></tr>
<tr><td>Northern Ellesmere Island</td><td>182</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>1254</td><td>-</td><td>-</td></tr>
<tr><td>Southern Ellesmere Island</td><td>75</td><td>591</td><td>625</td><td>567</td><td>2020 ±285</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Survey Date</td><td colspan="2">July 30 - Aug 11</td><td colspan="2">May 8, 15, July 4, 7</td><td colspan="2">July 17 - 23</td><td colspan="2">June 12 - 21</td><td colspan="2">April 6 - May 22</td><td colspan="2">March 8 - 20</td></tr>
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[1]The surveys of 1961 and 1973 were not extensive enough to have any scale of accuracy for the estimates provided.

[2] The survey by Case and Ellsworth in 1989 had five strata, one of which was part of Svendsen Peninsula, and was able to be pulled out as a separate estimate. However, the full estimate for Southern Ellesmere also includes Svendsen peninsula.

Table 8. Past Peary Caribou Surveys that included central Ellesmere Island

<table>
<tr><th></th><th colspan="2">1961</th><th colspan="2">1973</th><th colspan="2">1989</th><th colspan="2">1995</th><th colspan="2">2006</th><th colspan="2">2017</th></tr>
<tr><th>Study Area</th><th>Total Obs</th><th>Est</th><th>Total Obs</th><th>Est</th><th>Total Obs</th><th>Est</th><th>Total Obs</th><th>Est</th><th>Total Obs</th><th>Est</th><th>Total Obs</th><th>Est</th></tr>
<tr><td>Fosheim Peninsula</td><td>1</td><td rowspan="8">200</td><td>-</td><td>-</td><td>-</td><td>-</td><td>11</td><td>-</td><td rowspan="6">36</td><td rowspan="7">802 (95% CI 531-1,207)</td><td rowspan="2">3</td><td rowspan="2">-</td></tr>
<tr><td>Sverdrup Pass</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0</td><td>-</td></tr>
<tr><td>Raanes Peninsula</td><td>5</td><td>219</td><td>300</td><td>-</td><td>-</td><td>11</td><td>-</td><td rowspan="4">11</td><td rowspan="4">-</td></tr>
<tr><td>Svendsen Peninsula</td><td>-</td><td>23</td><td>65</td><td>25</td><td>31 ±23</td><td rowspan="2">12</td><td rowspan="2">-</td></tr>
<tr><td>Vendom Fiord</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Strathcona Bay Fiords</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>3</td><td>-</td></tr>
<tr><td>Northern Ellesmere Island</td><td>45</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>298</td><td>-</td><td>-</td></tr>
<tr><td>Southern Ellesmere Island</td><td>15</td><td>58</td><td>80</td><td>25</td><td>89 ±31</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Survey Date</td><td colspan="2">July 30 - Aug 11</td><td colspan="2">May 8, 15, July 4, 7</td><td colspan="2">July 17 - 23</td><td colspan="2">June 12 - 21</td><td colspan="2">April 6 - May 22</td><td colspan="2">March 8 - 20</td></tr>
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Appendix 2. Central Ellesmere Island survey transects

Table 9. Transect end points and strata on central Ellesmere Island flown during fixed-wing survey, March 2017

Transect	Stratum	Longitude (West terminus)	Latitude (West terminus)	Longitude (East terminus)	Latitude (East terminus)	Length (km)
1	CEI-1	-84.7780	77.5237	-83.7354	77.5228	19.1608
2	CEI-1	-84.8575	77.5690	-83.5489	77.5685	31.3538
3	CEI-1	-84.9946	77.6144	-83.4041	77.6141	34.1408
4	CEI-1	-85.2482	77.6596	-83.3364	77.6595	43.1923
5	CEI-1	-85.2462	77.7049	-83.2142	77.7050	46.2413
6	CEI-1	-85.2157	77.7503	-83.1664	77.7503	47.2176
7	CEI-1	-85.1769	77.7956	-83.1118	77.7957	49.0093
8	CEI-1	-85.4075	77.8407	-82.9872	77.8410	53.5812
9	CEI-1	-85.5188	77.8859	-82.8956	77.8863	51.6996
10	CEI-1	-85.6861	77.9308	-82.7443	77.9315	69.2458
11	CEI-1	-85.5166	77.9765	-82.7791	77.9769	63.3201
12	CEI-1	-85.2807	78.0222	-82.7615	78.0222	58.6650
13	CEI-1	-86.2412	78.0666	-82.5873	78.0673	61.5315
14	CEI-1	-87.2819	78.1128	-81.7566	78.1120	109.7099
15	CEI-1	-87.5011	78.1578	-81.7604	78.1573	116.6300
16	CEI-1	-87.0684	78.2036	-81.5613	78.2031	103.4846
17	CEI-1	-87.5185	78.2485	-81.6448	78.2482	126.1597
18	CEI-1	-87.5025	78.2938	-81.7677	78.2932	118.6898
19	CEI-1	-87.5044	78.3391	-81.7738	78.3385	119.8666
20	CEI-1	-87.4991	78.3845	-81.6719	78.3841	128.2379
21	CEI-1	-87.5032	78.4298	-81.4449	78.4299	131.8484
22	CEI-1	-87.4005	78.4753	-81.5262	78.4751	124.2423
23	CEI-1	-87.2582	78.5208	-81.5811	78.5203	123.5258
24	CEI-1	-86.8502	78.5662	-81.6516	78.5655	113.7587
25	CEI-1	-87.0480	78.6115	-81.6987	78.6107	112.5940
26	CEI-1	-86.9671	78.6568	-81.6786	78.6561	112.2479
27	CEI-1	-86.9129	78.7022	-81.7828	78.7011	103.4227
28	CEI-1	-86.8285	78.7474	-81.1386	78.7475	113.4587
29	CEI-1	-86.6517	78.7926	-80.9160	78.7928	114.6534
30	CEI-1	-85.8505	78.8369	-74.7333	78.8155	97.9495
31	CEI-1	-85.3706	78.8832	-75.0124	78.8610	25.6303
32	CEI-3	-82.8210	78.9287	-76.2201	78.9053	28.2383
33	CEI-3	-84.3314	78.9734	-75.7296	78.9508	63.4596
34	CEI-3	-84.6993	79.0193	-75.9464	78.9955	73.0550
35	CEI-3	-84.7698	79.0647	-74.4280	79.0642	75.6296
36	CEI-3	-84.6728	79.1099	-74.5175	79.1097	93.9799
37	CEI-3	-83.9752	79.1539	-80.0000	79.1538	82.7325

Transect	Stratum	Longitude (West terminus)	Latitude (West terminus)	Longitude (East terminus)	Latitude (East terminus)	Length (km)
38	CEI-3	-84.3200	79.2000	-80.0000	79.1991	89.1923
39	CEI-3	-84.3265	79.2453	-79.7043	79.2453	85.5274
40	CEI-3	-84.4059	79.2908	-80.2521	79.2905	78.1989
41	CEI-3	-84.4612	79.3362	-80.2482	79.3358	82.4700
42	CEI-3	-84.4570	79.3816	-80.2171	79.3811	83.8034
43	CEI-3	-84.5731	79.4271	-80.1208	79.4261	83.7156
44	CEI-3	-84.8181	79.4726	-80.2790	79.4719	92.3412
45	CEI-3	-84.9285	79.5180	-80.0719	79.5166	97.2458
46	CEI-3	-84.9813	79.5633	-79.6621	79.5626	105.2471
47	CEI-3	-85.0397	79.6086	-81.1001	79.6086	79.5353
48	CEI-3	-85.1830	79.6539	-81.6891	79.6532	71.0937
49	CEI-3	-85.4867	79.6989	-81.8610	79.6981	72.8418
50	CEI-3	-86.2028	79.7436	-81.9680	79.7432	76.6579
51	CEI-3	-86.4671	79.7895	-82.0603	79.7886	69.4444
52	CEI-3	-86.4077	79.8347	-82.0781	79.8340	86.0609
53	CEI-3	-86.4385	79.8801	-82.2032	79.8796	79.1084
54	CEI-3	-86.4361	79.9254	-82.4099	79.9254	73.9772
55	CEI-3	-86.3668	79.9706	-82.6389	79.9710	62.4448
56	CEI-3	-86.4800	80.0161	-82.7677	80.0165	72.2597
57	CEI-3	-86.5574	80.0616	-83.0152	80.0619	69.0022
58	CEI-3	-86.6099	80.1070	-83.2220	80.1071	64.8551
59	CEI-3	-86.6034	80.1523	-83.3805	80.1523	61.6405
60	CEI-3	-86.5741	80.1976	-83.5321	80.1974	57.5415
61	CEI-3	-86.5367	80.2429	-83.7497	80.2423	52.4790
62	CEI-3	-86.4941	80.2881	-85.5070	80.2881	18.3872

Appendix 3. Daily flight summaries

Table 10. Daily flight summaries for central Ellesmere Island survey, with recorder and observer locations on aircraft

Date	Time Up	Time Down	Data Recorder	Left Front Observer	Left Rear Observer	Right Front Observer	Right Rear Observer
Mar-08-2017			Mitch Campbell	Matthew Fredlund	Jopee Kiguktak	Frankie Noah	Jason Pijamini
Mar-09-2017			Mitch Campbell	Jopee Kiguktak	Matthew Fredlund	Jason Pijamini	Frankie Noah
Mar-10-2017	10:05	14:10	Mitch Campbell	Matthew Fredlund	Jopee Kiguktak	Frankie Noah	Jason Pijamini
Mar-11-2017	9:55	13:12	Mitch Campbell	Jopee Kiguktak	Matthew Fredlund	Jason Pijamini	Frankie Noah
Mar-12-2017	Weather Day - Did not survey						
Mar-13-2017	9:38	13:08	Mitch Campbell	Matthew Fredlund	Jopee Kiguktak	Frankie Noah	Jason Pijamini
Mar-14-2018	Weather Day - Did not survey						
Mar-15-2019	Weather Day - Did not survey						
Mar-16-2020	Weather Day - Did not survey						
Mar-17-2017	8:50	12:30	Mitch Campbell	Jopee Kiguktak	Matthew Fredlund	Frankie Noah	Jason Pijamini
Mar-18-2017	8:50	11:00	Mitch Campbell	Jopee Kiguktak	Matthew Fredlund	Frankie Noah[1]	Jason Pijamini
						Mitch Campbell[1]	Jason Pijamini
	11:30	15:27	Mitch Campbell	Matthew Fredlund	Jopee Kiguktak	Jason Pijamini	Frankie Noah
Mar-19-2017	8:40	12:35	Mitch Campbell	Jopee Kiguktak	Matthew Fredlund	Mitch Campbell	Jason Pijamini
	13:28	16:30	Mitch Campbell	Matthew Fredlund	Jopee Kiguktak	Jason Pijamini	Frankie Noah[2]
							Mitch Campbell[2]
Mar-20-2017	8:53	11:07	Mitch Campbell	Jopee Kiguktak	Matthew Fredlund	Frankie Noah	Jason Pijamini

[1] Right front observer replaced with right data recorder/observer during flight

[2] Right rear observer replaced with right data recorder/observer during flight

Appendix 4. Incidental wildlife observations

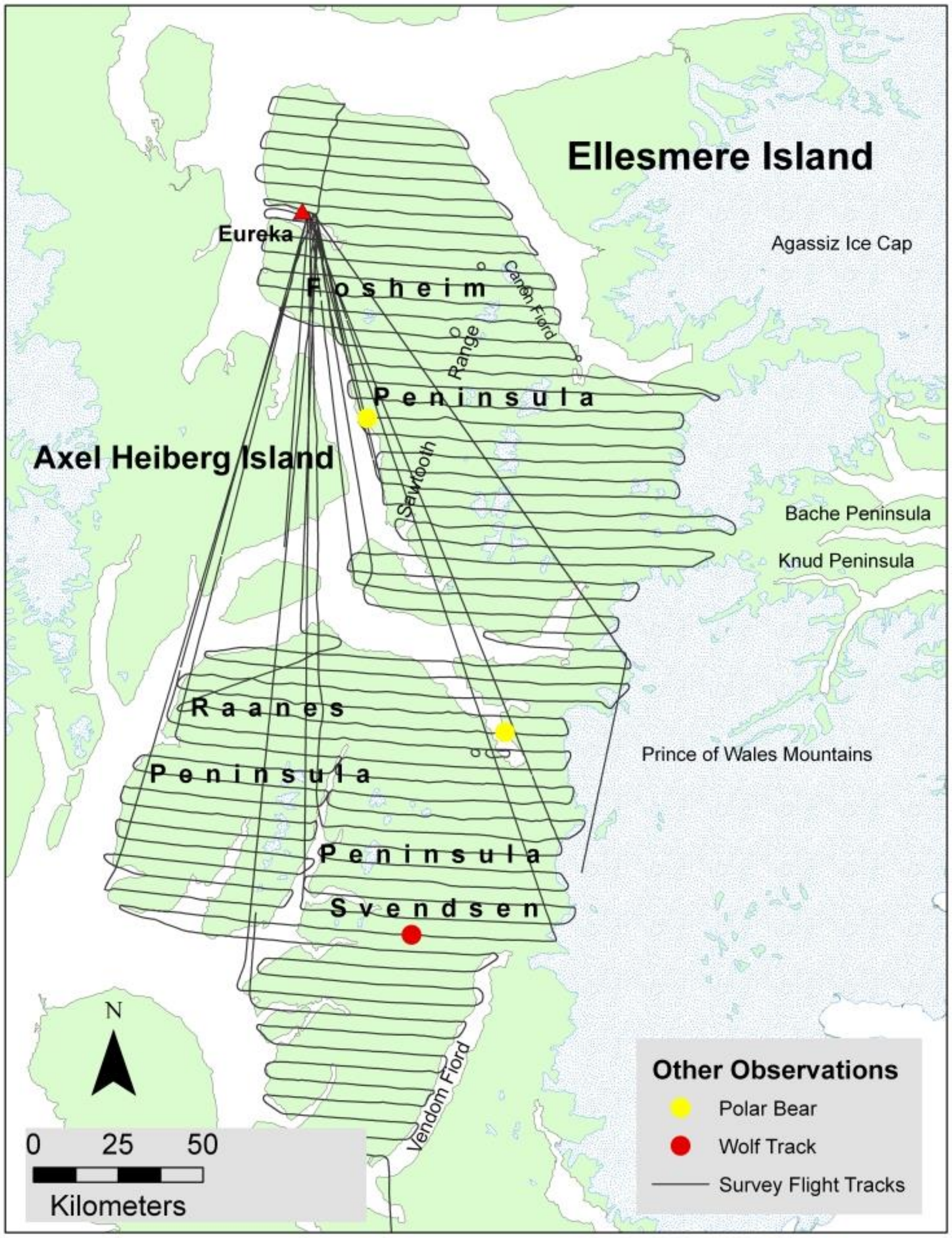

Figure 15. Incidental observations and flight lines from central Ellesmere Island aerial survey, March 8-20, 2017. A total of two polar bears were seen. Although no wolves were seen a track that appeared to be from a wolf was seen. Communication with staff from the Eureka Weather Station informed us that wolves had been seen around the station a few weeks earlier. Arctic hares were also seen but locations were not recorded.

SUBMISSION TO THE
NUNAVUT WILDLIFE MANAGEMENT BOARD

FOR

Information: **Decision: X**

Issue: A decision is needed to approve/not approve the Blue Whale (*Balaenoptera musculus*) (Northwest Atlantic population) Action Plan.

Background:
The Blue Whale (Northwest Atlantic population) was assessed by the Committee of the Status of Endangered Wildlife in Canada (COSEWIC) as an Endangered species in 2002 and added to the List of Wildlife Species at Risk List in 2005. The NWMB was notified of the COSEWIC assessment and asked to make a decision on listing in 2004. The NWMB was also asked about and approved a Recovery Strategy in 2007 which was made official in 2010. As an Endangered species, the requirement under the *Species at Risk Act* calls for the creation of an Action Plan within five years of listing.

Article 5.2.34 (d) (i) of the Nunavut Agreement states that the NWMB shall, at its discretion, approve plans for management, classification, protection, restocking or propagation, cultivation or husbandry of particular wildlife, including endangered species. Details of how to achieve approval of management plans, recovery strategies and action plans are not addressed under the 2008 "*A memorandum of understanding to harmonize the designation of rare, threatened and endangered species under the Nunavut Lands Claim Agreement and the listing of wildlife species under the Species at Risk Act*".

The Blue Whale (Northwest Atlantic population) Action Plan (Executive Summary attached and translated into Inuktitut) outlines what needs to done to begin or further support the strategic direction set out in the Recovery Strategy. As the Blue Whale is a rare visitor to Nunavut waters, no work has been carried out in this area and none is planned. The Action Plan outlines what needs to be done in areas most frequented by Blue Whale. As part of the process in creating an Action Plan, the NWMB is requested to review this final document, provide any comments, and state whether they approve of this action plan.

This document was originally brought to the Board in March 2016, at which time the Board requested that review not occur until the document was considered final. The document is now considered final.

The final action plan (marked as proposed until the Board makes a decision) provides the general and detailed information that supports the recovery of the Blue Whale (Northwest Atlantic population). The action plan describes the specific measures that will provide the best ways to increase knowledge, reduce threats and monitor the species.

Recommendations:
The NWMB review the updated action plan for Blue Whale (Northwest Atlantic population), provide any comments to DFO and it's decision.

Prepared by:
Sam Stephenson, Species at Risk Biologist, DFO, Central and Arctic Region, Winnipeg

Date:
02 August 2019

Executive summary – Action Plan for the Blue Whale (Northwest Atlantic population)

The Northwest Atlantic blue whale was listed as endangered under the *Species at Risk Act* in 2005. The main threats to its recovery are anthropogenic noise, lack of food availability, contaminants, collisions, disturbances and entanglements. Published in 2009, the Recovery Strategy proposed three recovery objectives intended to increase knowledge of the population, its habitat, and threats, and implement measures to mitigate threats.

The action plan for the Northwest Atlantic blue whale presents measures that will be implemented in the short and medium term to assist in meeting the recovery objectives. The first set of recovery measures will be undertaken by Fisheries and Oceans Canada, sometimes with the collaboration of partners. These are primarily research measures to estimate the population's size and its use of Canadian waters. They also aim to implement or enforce legislation or policies to protect blue whale habitat and mitigate threats.

The second set of measures will be undertaken by the Department in partnership with the various stakeholders involved in the blue whale's recovery. For example, these measures include research on krill and the use of hydroacoustics to document the presence of these whales. The third set presents measures that concerned stakeholders could undertake voluntarily. Such measures include gathering observations of the blue whale, photo-identification and raising awareness among marine users.

The measures set out in the action plan could affect some stakeholders such as non-governmental organizations or the shipping industry. However, their implementation would not necessarily result in incremental costs to these stakeholders. Canadian society as a whole would benefit from the implementation of the action plan, given the economic value that Canadians attach to the recovery of the species and the protection of its habitat.

Species at Risk Act
Action Plan Series

Action Plan for the Blue Whale (*Balaenoptera musculus*), Northwest Atlantic Population, in Canada

Blue Whale, Northwest Atlantic Population

2019

Canada

Recommended citation:

Fisheries and Oceans Canada. 2019. Action Plan for the Blue Whale (*Balaenoptera musculus*), Northwest Atlantic Population, in Canada. *Species at Risk Act* Action Plan Series. Fisheries and Oceans Canada, Ottawa. iv + 21 pp.

For copies of the Action Plan, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, recovery strategies, and other related recovery documents, please visit the Species at Risk Public Registry.

Cover illustration: Y. Morin, DFO

Également disponible en français sous le titre
«Plan d'action pour le rorqual bleu (*Balaenoptera musculus*), population de l'Atlantique Nord-Ouest, au Canada. »

ISBN
Catalogue no.

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for the effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for preparing action plans for species listed as extirpated, endangered, and threatened, and for which recovery has been deemed feasible. They are also required to report on progress five years after the publication of the final document on the Species at Risk Public Registry.

The Minister of Fisheries and Oceans is the competent minister under SARA for the Northwest Atlantic Blue Whale and has prepared this Action Plan to implement the Recovery Strategy, as per Section 47 of SARA. The minister responsible for the Parks Canada Agency is the competent minister for individuals in the waters of Forillon National Park. In preparing this Action Plan, the competent ministers have considered, as per Section 38 of SARA, the commitment of the Government of Canada to conserving biological diversity and to adhering to the principle that, if there are threats of serious or irreversible damage to the listed species, cost-effective measures to prevent the reduction or loss of the species should not be postponed for a lack of full scientific certainty. To the extent possible, this Action Plan has been prepared in cooperation with Parks Canada Agency and the Mingan Island Cetacean Study, as per Section 48(1) of SARA.

As stated in the preamble to SARA, success in the recovery of this population depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions and actions set out in this Action Plan and will not be achieved by Fisheries and Oceans Canada or any other jurisdiction alone. The cost of conserving species at risk is shared between different constituencies. All Canadians are invited to join in supporting and implementing this Action Plan for the benefit of the Northwest Atlantic Blue Whale and Canadian society as a whole.

Under SARA, an action plan provides the detailed recovery planning that supports the strategic direction set out in the recovery strategy for the species. The plan outlines recovery measures to be taken by Fisheries and Oceans Canada, Environment and Climate Change Canada and other jurisdictions or organizations to help achieve the population and distribution objectives identified in the Recovery Strategy. Implementation of this Action Plan is subject to the appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Acknowledgments

Fisheries and Oceans Canada would like to thank Andréanne Demers, Hugues Bouchard, Sarah Larochelle and Charline Le Mer, who drafted this Action Plan, as well as all those in the Department who supported its development. The Department also wishes to acknowledge the contributions of Parks Canada, as well as Richard Sears and Christian Ramp of the Mingan Island Cetacean Study.

Executive summary

The Northwest Atlantic Blue Whale was listed as Endangered under the *Species at Risk Act* in 2005. The main threats to its recovery are anthropogenic noise, lack of food availability, contaminants, collisions, disturbances and entanglements. Published in 2009, the Recovery Strategy proposed three recovery objectives intended to increase knowledge of the population, its habitat, and threats, and implement measures to mitigate threats.

The Action Plan for the Northwest Atlantic Blue Whale presents measures that will be implemented in the short and medium term to assist in meeting the recovery objectives. The first set of measures will be taken by Fisheries and Oceans Canada. They consist primarily of research aimed at estimating the size of the Northwest Atlantic Blue Whale population and its use of Canadian waters. The measures also include adopting or enforcing legislation or policies to protect Blue Whale habitat and mitigate threats. The second set of measures will be implemented by the Department in partnership with the various stakeholders involved in the Blue Whale's recovery. They include research on krill and the use of hydroacoustics to document the presence of these whales. The third set of measures consists of actions that concerned stakeholders will be able to take voluntarily. They include observations and photo-identification of Blue Whales and outreach and awareness initiatives.

The measures set out in the Action Plan could affect some stakeholders such as non-governmental organizations or the shipping industry. However, their implementation would not necessarily result in incremental costs to these stakeholders. Canadian society as a whole would benefit from the implementation of the Action Plan, given the economic value that Canadians attach to the recovery of the species and the protection of its habitat.

Table of Contents

1. Recovery actions

1.1 Context and scope of the Action Plan

The Blue Whale (*Balaenoptera musculus*) is a baleen whale that uses coastal and offshore Atlantic Canadian waters mainly in the summer (Figure 1), to feed primarily on euphausiids, commonly known as krill. The Blue Whale population in the Northwest Atlantic was designated as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in May 2002. This population was reassessed by COSEWIC in 2012 and its status confirmed. It was listed as Endangered under the *Species at Risk Act* (SARA) in January 2005. Commercial whaling historically carried out in the Atlantic Ocean reduced the population by about 70%; at least 11,000 Blue Whales were killed before the 1960s including at least 1,500 animals in eastern Canadian waters. The size of the Northwest Atlantic population is currently unknown, but experts estimate that the number of mature animals is unlikely to exceed 250 individuals.

The Recovery Strategy for the Northwest Atlantic Blue Whale (Beauchamp et al. 2009) presents the various threats facing the population. In addition to historical whaling and natural sources of mortality such as ice entrapment and predation, several threats have been identified and their general level of concern assessed. This level of concern depends on the potential impact of the threat on the population, knowledge on the threat, and its extent within the distribution range. The main threats to the recovery of the Northwest Atlantic Blue Whale population were determined by experts to be anthropogenic noise, which causes a degraded underwater acoustic environment and alters behaviour, and the lack of food resources, which could result from ecosystem changes caused in particular by climate change.

Contaminants, vessel collisions, disturbances caused by whale watching activities, entanglements in fishing gear, epizootics, toxic algal blooms and toxic spills also pose a threat to the Blue Whale. Based on the best available information when the recovery strategy was published in 2009, these threats were assessed as presenting a low level of concern, either because their impact was considered low, very localized or difficult to quantify or because the threats were considered potential. Based on new data from photo-identification (Gaspard et al. 2017), the impact of the threat of entanglement in fishing gear needs to be reassessed, as it may be more significant than previously thought. Given the small size of the Blue Whale population, even activities that affect a small number of individuals can have a significant impact on the species' survival in the Atlantic Ocean.

The long-term goal of this Recovery Strategy is to reach a total of 1,000 mature individuals. To reach this recovery goal, three objectives were set for the Canadian range:

Objective 1: Define and conduct a long-term assessment of the size, structure and trends of the Northwest Atlantic Blue Whale population, and determine their range and critical habitat within Canadian waters;

Objective 2: Implement control and monitoring measures for activities that could hinder the recovery of the Blue Whale in its Canadian range;

Objective 3: Increase knowledge of the main threats to the recovery of the Blue Whale in Canadian waters both to determine their true impact and to identify effective measures to mitigate the negative consequences for the population's recovery.

The Recovery Strategy is proposing recovery approaches based on three broad strategies: research and monitoring, conservation, awareness and education. The purpose of this Action Plan is to outline priority actions to meet the above recovery objectives, following the same broad strategies. These actions are related to all the threats described in the Recovery Strategy and the full range of the population in Atlantic Canada's waters. The Recovery Strategy provides more details on the strategies and approaches for recovering Northwest Atlantic Blue Whales, on studies to identify their critical habitat, and on their biology (Beauchamp et al. 2009).

Under Section 47 of SARA, the competent minister must prepare one or more action plans based on the Recovery Strategy. Action planning for species at risk recovery is therefore an iterative process. The Implementation Schedule in this Action Plan may be modified in the future depending on the level of progress made towards recovery.

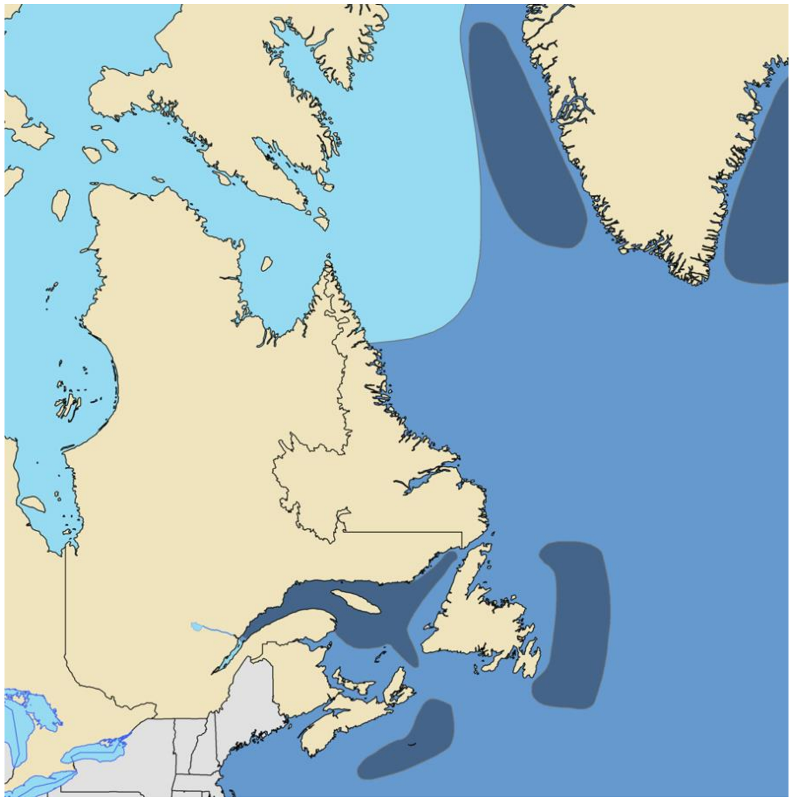

Figure 1. Geographic range and concentration areas (darker blue) of the Blue Whale in the Northwest Atlantic Ocean.

1.2 Measures to be taken and Implementation Schedule

Success in the recovery of this population is not dependent on the actions of any single jurisdiction; rather, it requires the commitment and cooperation of the many different constituencies involved in implementing the directions and actions set out in this Action Plan.

This Action Plan outlines measures that maximize the likelihood of achieving the population and distribution objectives for the Northwest Atlantic Blue Whale. It also includes measures to address threats to the population and monitor its recovery, in order to guide not only activities to be undertaken by Fisheries and Oceans Canada (DFO), but also those in which other jurisdictions, organizations and individuals have a role to play. DFO strongly encourages all Canadians to participate in the conservation of the Blue Whale by supporting and implementing the priority recovery measures outlined in this Action Plan. DFO recognizes the important role of key players in the field in the implementation of recovery measures for this population.

The following three tables are not intended to present all the measures that could be taken to foster the Blue Whale's recovery; instead, they target measures likely to be taken in the medium term (within the next 5 to 10 years). These measures are technically and financially feasible and will help identify measures that could be implemented in the longer term based on the knowledge that will be acquired. Given that the Northwest Atlantic Blue Whale has a vast range, the proposed research focuses on targeted areas to optimize results and efficiency. Much of this research could help support future critical habitat identification.

Table 1. Implementation Schedule: Measures to be undertaken by Fisheries and Oceans Canada

Table 1 identifies measures to be taken by DFO to support the recovery of the Blue Whale. This table primarily presents research and monitoring measures that will have to be led by DFO, particularly because of the complex logistics involved in monitoring a Blue Whale population with such a vast range. This research is a continuation or logical extension of studies already performed by DFO as part of the Recovery Strategy and as part of its mandate for marine mammal conservation. For an overview of the research activities and conservation and awareness measures carried out from 2009 to 2014, see the Report on the Progress of Recovery Strategy Implementation for the Blue Whale, Northwest Atlantic Population (Fisheries and Oceans Canada 2016). The measures listed in Table 1 as well as Tables 2 and 3 address the three recovery objectives:

Objective 1: Increase knowledge of the population and its size (Measures 1 to 3): A better understanding of the high-concentration areas of Blue Whales will make it possible to carry out targeted surveys to assess the population size more effectively; this research will also make it possible to understand the reasons why Blue Whales are attracted to certain locations. It is being conducted to meet both Objective 1 of the Recovery Strategy and the Schedule of Studies to identify critical habitat included in the Recovery Strategy. The studies on high-concentration areas and their characteristics, such as high concentrations of krill, could lead to the identification of Blue Whale critical habitat, at least partially, in an update of the Recovery Strategy.

Objective 2: Mitigate threats (Measures 7 to 10): Fisheries and Oceans Canada will also implement conservation measures to protect the Blue Whale's food resources, mitigate the risk of collisions and protect the Blue Whale from disturbances through policies and regulations.

Objective 3: Develop a better understanding of threats (Measures 4 to 6): The impact of threats, such as noise, disturbance or entanglement, which can alter the behaviour of Blue Whales and thereby adversely affect their recovery, are still poorly understood. Studies on noise sources and the impact of disturbance and entanglement on the recovery of the population will make it possible to implement suitable mitigation measures and improve on existing mitigation measures.

The measures presented in Table 1 are in addition to the implementation of DFO's mandate and enforcement of laws in effect. The Blue Whale is protected under SARA, which prohibits anyone from harming or harassing an endangered species. The Blue Whale's needs must also be taken into account in the environmental assessments of various projects under the *Fisheries Act,* the *Canadian Environmental Assessment Act,* *2012* or the *National Energy Board Act*. Mitigation measures can also be included in authorization conditions issued under various types of legislation enforced by the Department. Environmental assessments of projects submitted to federal-provincial offshore petroleum boards are also reviewed by DFO to ensure that species at risk are taken into account. Moreover, scientific research protocols on the Blue Whale are reviewed to minimize disturbances. By enforcing legislation, other government departments and agencies also contribute to Blue Whale recovery. For example, Parks Canada is implementing the *Marine Activities in the Saguenay–St. Lawrence Marine Park Regulations*.

Table 1. Measures to be undertaken by Fisheries and Oceans Canada

#	Recovery Measures	Priority[1]	Threats or Objectives Addressed[2]	Timeline
Broad Strategy: *Research and monitoring*				
1	Continue delineating high-density seasonal areas in Canadian waters using satellite transmitters, especially in southwestern Newfoundland and on the Scotian Shelf. Transmitters have been put on several Blue Whales since 2010 and data have been used to define feeding areas and migratory routes. This research will identify locations where the Blue Whale is found in order to assess their numbers through targeted surveys.	High	Objective 1	5 years
2	Conduct targeted surveys in high-density areas to assess the population size. Once high-density areas have been identified, aerial or vessel-based surveys can focus on these areas and thereby be more effective in estimating the number of Blue Whales.	High	Objective 1	5 years
3	Assess the extent to which the biological processes (krill aggregations) and physical processes (currents, tides) affect the distribution, behaviour, and migrations of the Blue Whale.	High	Objective 1	5 years

[1] **Priority**: Reflects the degree to which the measure contributes directly to the recovery of the population or is an essential precursor to a measure that contributes to the recovery of the population.

- “High” priority measures are considered those most likely to have an immediate or direct impact on the achievement of the recovery objective for the population.
- “Medium” priority measures may have a less immediate or direct impact on the achievement of the population and distribution recovery objectives, but are still important for the recovery of the population.
- “Low” priority recovery measures will likely have an indirect or gradual impact on the achievement of the recovery objectives. They are nonetheless considered important contributions to the knowledge base or public involvement and to the value the public ascribes to the species.

[2] **Threats or objectives addressed**: Indicates which recovery objective the measure addresses or which threat it mitigates. Summary of the objectives: Objective 1: Increase knowledge of the population and its size; Objective 2: Mitigate threats; Objective 3: Develop a better understanding of threats.

#	Recovery Measures	Priority[1]	Threats or Objectives Addressed[2]	Timeline
4	Study the Blue Whale's behavioural responses to various noise sources in various contexts. The Blue Whale's tolerance to noise must be better understood in order to develop appropriate mitigation measures for noise-generating human activities.	Medium	Objective 3 Noise	10 years
5	Study the behavioural response of Blue Whales to various approach distances of boats (whale watching, research, and recreational boats). This knowledge will help to establish acceptable approach distances for the Blue Whale.	Medium	Objective 3 Disturbance	2 years
6	Assess the fishing effort and characterize the fishing gear used in areas occupied by the Blue Whale to determine the potential impact of the threat of gear entanglement on the population.	Low	Objective 3 Entanglement	10 years
Broad Strategy: *Conservation*				
7	Assess whether any commercial fishery of krill would affect the integrity of the ecosystem or the energy needs of a recovering or a recovered Blue Whale population, in accordance with the Policy on New Fisheries on Forage Species.	High	Objective 2 Availability of food	Ongoing
8	Adopt and implement the amendments to the *Marine Mammal Regulations* to help protect the Blue Whale from anthropogenic disturbances in all of the areas that they occupy. The amended regulations include approach distances for species at risk like the Blue Whale in order to reduce disturbance.	High	Objective 2 Disturbance Collisions	Ongoing
9	Determine the best management tools for achieving the St. Lawrence Estuary Area of Interest's conservation objectives and implement them, including the designation of a marine protected area.	High	Objective 2	5 years
10	By enacting regulations, designate a marine protected area in the American Bank area located off the Gaspé Peninsula. This site is, among other things, considered as a high-density Blue Whale area. Examples of potential conservation measures would be voluntary measures and rules of ethics to regulate marine observation activities and reduce disturbances, as well as	Medium	Objective 2 Disturbance Entanglement	2 years

#	Recovery Measures	Priority[1]	Threats or Objectives Addressed[2]	Timeline
	apply fishery measures aimed at protecting forage species, such as krill, the Blue Whale's main prey.		Collisions	
Broad Strategy: *Outreach*				
11	Encourage the whale watching public to report their observations. For example, the "Tell Jack" outreach campaign encourages the whale watching public in Newfoundland and Labrador to play a role in DFO marine mammal science and promote DFO's research on marine mammals including the Blue Whale. Anecdotal reports and pictures sent to the marine mammal research group can provide useful information. The campaign uses social media, proactive media relations, and public outreach activities to solicit observation reports and pictures from the public via Twitter and email.	Medium	Objective 1	Ongoing
12	Carry out outreach and educational activities intended for whale watching operators, the whale watching public, and other mariners about best practices for observing marine mammals including the Blue Whale. For example, in Newfoundland and Labrador, school visits and public events such as Oceans Day are organized using life-size Blue Whale tails made of fabric. The tails could be used to educate people on the Blue Whale's biology, behaviour, and lifecycle, as well as its SARA status.	Medium	Objective 2 Disturbance	Ongoing

Table 2. Measures to be undertaken collaboratively between Fisheries and Oceans Canada and its partners

Table 2 shows the actions that will be taken by Fisheries and Oceans Canada and its partners working in collaboration. The order in which partners are listed in the table is not indicative of their contribution or degree of involvement. Implementation of these measures will be dependent on a collaborative approach, in which Fisheries and Oceans Canada is a partner in recovery efforts, but cannot implement the measures alone. Table 2 presents research and monitoring measures that DFO is implementing in close partnership with universities, other government agencies, the private sector and research organizations. The purpose of these measures is to:

1. Continue the characterization of noise sources and levels and the Blue Whale's exposure to noise in the areas they use the most (measure 13).
2. Study the Blue Whale's primary food source, krill (Measures 14 to 16). DFO intends to continue its research on krill production in the Estuary and Gulf of St. Lawrence, and on krill interaction with Blue Whales, in collaboration with universities.
3. Increase knowledge of the Blue whale distribution in areas outside the Estuary and Gulf of St. Lawrence, for which few observational data are available (Measures 17 to 22). DFO and several partners intend to use hydroacoustics and photo-identification for this purpose. These measures also support the schedule of studies intended to identify critical habitat set out in the Recovery Strategy.
4. Better assess the effect of the threat of entanglement on the health and recovery of the Blue Whale (measure 23).

This table also proposes several partnerships to implement conservation measures and thereby mitigate threats to Blue Whale recovery. Certain initiatives are underway or are planned for the near future to mitigate threats, such as noise (Measure 24), toxic spills (Measure 25), vessel collisions (Measures 26 and 27) and entanglements (Measure 28). Two awareness campaigns are also underway to improve the data collected by observers (Measure 29) and to raise awareness among pleasure boaters around the Saguenay–St. Lawrence Marine Park in order to reduce disturbances in this important area for the Blue Whale (Measure 30).

Table 2. Collaborative measures between Fisheries and Oceans Canada and its partners.

Acronyms: DFO (Fisheries and Oceans Canada), NGO (Non-Governmental Organizations), NOAA (National Oceanographic and Atmospheric Administration, US).

#	Recovery Measures	Priority[3]	Threats or Objectives Addressed[4]	Timeline	Partnerships[5]
Broad Strategy: *Research and monitoring*					
13	Continue characterizing of noise sources and levels, and analyzing the exposure of Blue Whales to noise in the areas they use most often in Canadian Atlantic waters.	Medium	Objective 3 Noise	Ten years	DFO Transport Canada Industry
14	Study krill distribution, population dynamics and production processes. Tides, currents, and krill behaviour will determine the aggregation areas essential for effective Blue Whale feeding. A better understanding of these factors could be integrated into critical habitat identification.	High	Objective 3 Availability of food	3 years	DFO Universities Research institutes
15	Study the Blue Whale's energy needs to estimate the krill biomass necessary to support the current population and eventually a recovering population.	High	Objective 3 Availability of food	3 years	DFO Universities Research institutes
16	Study the trophic interactions between the Blue Whale and krill to try to explain the high inter-annual and inter-regional variability of Blue Whale occurrences and residence time.	High	Objective 3 Availability of food	3 years	DFO Universities Research institutes

[3] See footnote 1.
[4] See footnote 2.
[5] **Potential partners**: Université du Québec à Rimouski, Dalhousie University, Institut des sciences de la mer à Rimouski, Group for Research and Education on Marine Mammals (GREMM), Mingan Island Cetacean Study, Réseau d'observation des mammifères marins, Indigenous groups, Shipping Federation of Canada, whale watching tour operators, emergency response networks, etc.

#	Recovery Measures	Priority[3]	Threats or Objectives Addressed[4]	Timeline	Partnerships[5]
17	Use hydroacoustic techniques to monitor the occurrence and number of Blue Whales in Atlantic Canada's waters, especially on the Scotian Shelf and south of Newfoundland. Bottom-moored recorders will make it possible to collect data on all marine mammal species that vocalize in a specific location.	High	Objective 1	2 to 5 years	DFO Universities Research institutes
18	Acquire data on Blue Whale distribution and abundance outside the Gulf of St. Lawrence (Cabot Strait and Scotian Shelf) where very little information is available, using photo-identification and the installation of satellite transmitters.	High	Objective 1	5 years	NGO DFO Universities
19	Conduct necropsy on dead Blue Whales whenever possible and follow protocols for data collection and sharing.	High	Objective 1 Objective 3	Ongoing	NGO DFO Universities
20	Continue collecting tissue samples and conducting biopsies to assess the population structure, pregnancy rates, and level of contaminants, especially in the Gulf of St. Lawrence, the Cabot Strait and the Scotian Shelf.	Medium	Objective 1 Objective 3	5 years	NGO Universities DFO
21	Better integrate all Blue Whale sightings data collected by various sources.	Low	Objective 1	5 years	NGO Universities Research institutes DFO
22	Establish international research partnerships to increase understanding of the Blue Whale's distribution and migration routes. Sharing hydroacoustic data is an example of collaboration.	Low	Objective 1	10 years	DFO NOAA Universities

#	Recovery Measures	Priority[3]	Threats or Objectives Addressed[4]	Timeline	Partnerships[5]
23	Use photo-identification to monitor entanglement rates in Blue Whales in order to better assess the impact of this threat on the health and recovery of the population.	Medium	Objective 2 Entanglement	In progress	NGO DFO
Broad Strategy: *Conservation*					
24	Study and implement measures to reduce the negative impact of noise caused by human activities, such as shipping, construction, and seismic exploration.	High	Objective 2 Noise	Ongoing	DFO Transport Canada Industry Parks Canada Universities NGO
25	Develop and implement response plans to reduce impacts to Blue Whales and their habitat likely to be caused by toxic spills. The government's initiative to strengthen the tanker safety system includes improving response planning in the event of toxic spills in targeted areas such as the Gulf of St. Lawrence, a high-risk area for spill impacts.	Medium	Objective 2 Spills	5 years	Provincial and federal departments Industry NGO
26	Maintain the Marine Mammal Response Program in the various regions of Canada's Atlantic coast. This program supports organizations that maintain call centres and databases, and that intervene when a marine mammal is in distress. It also supports training for emergency responders.	Medium	Objective 2 Entanglement Collisions	Ongoing	NGO DFO Indigenous groups
27	Study how to reduce the risk of vessel collisions with Blue Whales in the St. Lawrence Estuary and Gulf of St. Lawrence beyond existing voluntary measures for speed reduction, with the goal of identifying measures to implement (e.g., moving shipping lanes, establishing no-go areas).	Medium	Objective 2 Collisions	5 years	DFO Transport Canada Industry NGO

#	Recovery Measures	Priority[3]	Threats or Objectives Addressed[4]	Timeline	Partnerships[5]
28	Develop projects to promote the recovery of ghost or lost fishing gear in the Estuary and Gulf of St. Lawrence	Low	Objective 2 Entanglement	5 years	DFO Industry NGO
Broad Strategy: *Outreach*					
29	Continue training observers to improve marine mammal identification and information gathering. Training is intended for all those who have the opportunity to gather observational information (researchers, bird watchers, observers on platforms).	Medium	Objective 1	Ongoing	DFO NGO Industry
30	Educate pleasure boaters and captains of whale watching excursions on the impacts their activities have on Blue Whales near the Saguenay-St. Lawrence Marine Park. In collaboration with fisheries officers, the goal of this project is to educate users on the appropriate behaviour to adopt outside the marine park. It could be extended to other areas where there is a high incidence of disturbance by pleasure boaters and whale watchers.	Medium	Objective 2	5 years	DFO Parks Canada NGO

Table 3. Measures that represent opportunities for other jurisdictions, organizations or individuals to lead

As all Canadians are invited to join in supporting and implementing this Action Plan for the benefit of the Blue Whale and Canadian society as a whole, Table 3 identifies measures likely to support the recovery of the Northwest Atlantic Blue Whale that could be taken voluntarily by other jurisdictions, institutions, groups, and individuals interested in supporting the species' recovery. The order in which partners are listed in Table 3 is not indicative of their contribution or degree of involvement. The research and monitoring measures presented in Table 3 are activities that could be implemented by non-governmental organizations, particularly the Mingan Island Cetacean Study (MICS). These measures involve continuing Blue Whale monitoring activities through photo-identification, hydroacoustics, tissue sample collection, and biopsies (Measures 31 to 36) in Canadian and international waters. Several organizations, including Parks Canada, are already involved in efforts to raise marine user awareness of the impact their activities have on the Blue Whale, and these efforts are expected to continue (Measures 37 and 38).

If your organization is interested in participating in one of these measures, please contact the Species at Risk Management Division in Quebec at lep-sara-qc@dfo-mpo.gc.ca.

Table 3. Measures that represent opportunities for other jurisdictions, organizations or individuals to lead.

#	Recovery Measures	Priority[6]	Threats or objectives addressed[7]	Partnerships[8]
Broad Strategy: *Research and monitoring*				
31	Continue photo-identification activities, especially in various areas of the Gulf of St. Lawrence, and analyze photos to continue identifying individuals. These analyses help to better understand the Blue Whale's annual use of Canadian waters and assess its abundance. The continuation of these activities implies maintaining a database of observations and photos.	High	Objective 1	NGO Indigenous groups
32	Conduct acoustic monitoring (recording vocals using moored recorders) in various sectors of the Gulf of St. Lawrence and Atlantic Canada that are difficult to access in order to better characterize their use by the Blue Whale.	High	Objective 1	NGO Universities Research institutes
33	Conduct an analysis of the Northwest and Northeast Atlantic photo-identification catalogues to verify whether there are connections between these two areas of the Atlantic Ocean.	Medium	Objective 1	NGO Universities Research institutes
34	Biopsy Blue Whales to monitor their contaminants levels. The accumulation of contaminants in the Blue Whale is barely known and biopsies could make it possible to identify contaminants found in tissues and monitor their evolution over time.	Medium	Objective 3 Contaminants	NGO Universities Research institutes
35	Conduct genetic analyses of tissues collected from individuals that died in spring 2014 in southern Newfoundland. The comparison of these analyses with biopsies carried out across the North Atlantic will allow for a better understanding of the extent of exchange among the whales in the various regions.	Low	Objective 1	NGO Universities Research institutes

[6] See footnote 1.
[7] See footnote 2.
[8] See footnote 5.

#	Recovery Measures	Priority[6]	Threats or objectives addressed[7]	Partnerships[8]
36	Conduct a survey off Mauritania in the winter to determine whether the Northwest Atlantic Blue Whale uses the waters off West Africa to breed.	Low	Objective 1	NGO Universities Research institutes
Broad Strategy: *Outreach*				
37	Continue raising awareness among marine users of the impact their activities have on the Blue Whale (marine observation activities, commercial shipping, and pleasure boaters).	Medium	Objective 2	Parks Canada Transport Canada NGO Industry Indigenous groups
38	Continue mandatory training for all captains and kayaking guides who conduct their activities in the Saguenay-St. Lawrence Marine Park to familiarize them with the best practices for observing marine mammals (marine park regulations, biology, and ways to diversify excursions).	Medium	Objective 2	Parks Canada

1.3 Critical habitat

1.3.1 Critical habitat identification

The Act requires an action plan which or that includes an identification of critical habitat to the extent possible. When published in 2009, the Recovery Strategy for the Northwest Atlantic Blue Whale included a schedule of studies to identify critical habitat. Several such studies have been carried out since the publication of the Recovery Strategy, and others are ongoing. These studies are summarized in the Report on the Progress of Recovery Strategy Implementation for the Blue Whale, Northwest Atlantic population. The results were presented and peer-reviewed at a DFO Science Advisory Meeting in winter 2016. A Science Advisory Report was published recently (Fisheries and Oceans Canada 2018) and will be used to support the identification of Blue Whale critical habitat, to the extent possible. This identification will be presented in an update of the Recovery Strategy, rather than in this Action Plan.

2. Socioeconomic assessment

The *Species at Risk Act* requires that an Action Plan include an assessment of the socioeconomic costs associated with its implementation and of the benefits to be derived from the implementation (SARA 49(1)(*e*), 2002). This assessment addresses only the incremental (new) socioeconomic costs associated with the implementation of this Action Plan at the national level as well as the social and environmental benefits of implementing it in its entirety, recognizing that not all aspects of its implementation are under the jurisdiction of the federal government. It is intended to inform the public and guide partners in their decision-making on the implementation of the Action Plan.

This assessment will first identify the main stakeholders that could be affected by or involved in the implementation of the recovery measures listed in Tables 1 to 3 of the Action Plan. Section 2.2 then examines whether these measures could involve incremental costs to stakeholders. Lastly, Section 2.3 presents an overview of the benefits of implementing the Action Plan.

2.1 Stakeholder profile

The Blue Whale recovery measures set out in Tables 1 to 3 are grouped into three types of broad strategies: research and monitoring, conservation, and outreach. The types of stakeholders that would take part in the implementation of the Action Plan are also identified in these tables.

Research and monitoring

DFO's main partners in carrying out the research and monitoring activities are universities (e.g., University of Quebec at Rimouski, Dalhousie University), governmental (e.g., Transport Canada) and non-governmental (e. g., Mingan Island Cetacean Study) organizations.

Conservation

The implementation of conservation measures would involve a number of stakeholders, including the federal and provincial governments, non-governmental organizations, and the private sector. Several private sector industries could be affected by the implementation of conservation measures. In particular, noise reduction measures could have repercussions for industries whose activities involve shipping, marine construction, and seismic exploration (Table 2 – Measure 24). Initiatives to enhance the security systems of tankers and reduce the risk of collision between Blue Whales and ships may also have an impact on the shipping industry (Table 2 – Measures 25 and 27).

Outreach

Outreach activities would be conducted primarily by the federal government in collaboration with non-governmental organizations and the whale watching industry.

2.2 Socioeconomic costs of implementing the Action Plan

Many of the measures identified in the Action Plan are initiatives underway within the federal government and its partners, and these measures are expected to continue even in the absence of the Action Plan. Although the measures set out in the Action Plan could affect some stakeholders identified above, their implementation would not systematically result in incremental socioeconomic costs to these stakeholders.

There is not enough information to quantify the incremental socioeconomic costs that could result from implementing the Action Plan for the Blue Whale. Therefore, the potential costs of the Action Plan are evaluated qualitatively because most of the available information is qualitative.

Research and monitoring

Of the 38 recovery measures in the action plan, 23 measures involve research and monitoring activities. Many of these research projects are an extension of projects already being carried out by DFO and its partners. Certain projects go beyond the scope of the Blue Whale Recovery Strategy and include the acquisition of knowledge that can be applied to several species. It is therefore realistic to think that many of the research activities listed in Tables 1 to 3 would be carried out by DFO and its partners, even in the absence of the Action Plan.

DFO-led research and monitoring would be funded through the Department's regular programs and would not mean incremental costs to DFO. Measures undertaken by other organizations (universities, NGOs, research institutes) could be funded in part by existing federal government programs. However, additional costs could be incurred by local and regional stakeholders who chose to become involved in Blue Whale recovery efforts.

There is not enough information at this stage to quantify these costs, but they would vary depending on the extent of the research activities undertaken.

Conservation

The Action Plan identifies eight conservation measures to implement mitigation and monitoring measures for activities that could disrupt the recovery of the Blue Whale in its Canadian range. Most of these measures fall within the framework of initiatives that are already underway within the federal government; the implementation of these measures therefore will not involve any incremental costs to the government.

One of the conservation measures aimed at reducing the risk of collisions between the Blue Whale and ships in the St. Lawrence Estuary (Table 2 – Measure 27) could lead to additional costs for the shipping industry. As details on the implementation of these measures are not known, it is not possible to estimate the incremental costs, if any, to the shipping industry.

The implementation of conservation measures is not expected to generate any additional costs to the other stakeholders.

Outreach

The awareness activities included in the Action Plan are all activities that are currently underway and are intended to protect several species of marine mammals. Therefore, realistically, these activities would be carried out even in the absence of the Action Plan for the Blue Whale. Consequently, awareness activities are not expected to generate incremental costs to the federal government or any of the stakeholders.

2.3 Benefits of implementing the Action Plan

The implementation of the measures outlined in this Action Plan will contribute positively to the achievement of the long-term goal of the Northwest Atlantic Blue Whale Recovery Strategy, which is to reach a total of 1,000 mature individuals in the population.

The benefits of the recovery of the Blue Whale are difficult to quantify. However, the Act recognizes that “wildlife, in all its forms, has value in and of itself and is valued by Canadians for aesthetic, cultural, spiritual, recreational, educational, historical, economic, medical, ecological and scientific reasons” (SARA 2002). Self-sustaining and healthy ecosystems with their various elements in place, including species at risk, contribute positively to the livelihoods and the quality of life of all Canadians. A review of the literature confirms that Canadians value the preservation and conservation of species in and of themselves. Measures taken to preserve a species, such as habitat protection and restoration, are also valued. In addition, the more measures contribute to the recovery of a species, the higher the value the public ascribes to such measures (Loomis and White 1996; Fisheries and Oceans Canada 2008).

Specifically, a study estimating the economic benefits of marine mammal recovery in the St. Lawrence Estuary reveals that Canadians would be willing to pay $229 annually per household for a multi-species recovery strategy resulting in a measurable improvement in the status of species at risk for a number of marine mammals, including the Blue Whale (Boxall et al. 2012).

The implementation of the Action Plan should also generate benefits beyond the recovery of the Blue Whale. The acquisition of knowledge and the development of conservation measures should benefit several other marine mammal species.

2.4 Distributional impacts

Many different stakeholders will be involved in implementing the recommendations set out in this Action Plan. Given that most of the measures set out in the plan relate to existing programs and are a continuation of activities already underway, the incremental costs to DFO and its partners should be minimal.

The benefits of implementing the Blue Whale Action Plan will be enjoyed by the Canadian society as a whole, given the economic value that Canadians attach to the recovery of the species and the protection of its habitat.

3. Measuring progress

The recovery objectives presented in the Recovery Strategy propose a method for defining and measuring progress made toward achieving population and distribution objectives.

A report on the implementation of the Action Plan (under s. 55 of SARA) will be prepared to assess the progress made towards the implementation of the recovery measures.

A report on the ecological and socioeconomic impacts of the Action Plan (under s. 55 of SARA) will be prepared to provide information on the monitoring of the species’ recovery and its long term viability, and on the implementation of the Action Plan.

4. References

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Appendix A: Effects on the environment and other species

A Strategic Environmental Assessment (SEA) is conducted on all SARA recovery planning documents under SARA and in accordance with the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals. The purpose of an SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect the environment in any way or the achievement of any of the Federal Sustainable Development Strategy's goals or targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of action plans may inadvertently have environmental impacts beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental impacts, with a particular focus on the potential impacts on non-target species or habitats. The results of the SEA are incorporated directly into the action plan itself, but are also summarized below in this statement.

The threats affecting the Blue Whale also weigh on several marine mammal species that share its range. Measures aimed at reducing the impact of threats to the Blue Whale should therefore also benefit these species. Research intended to better understand krill production and behaviour and could lead to conservation measures will also be positive for all levels of the food chain.

Appendix B: Record of cooperation and consultation

This document was prepared with the participation of DFO researchers working on the Blue Whale. Representatives of the Saguenay-St. Lawrence Marine Park also participated, because the species is often present within its boundaries. The expertise of the Mingan Island Cetacean Study, which has been collecting observational data on whales for over three decades and which acts as curator of the Blue Whale photo-identification catalogue, was also solicited.

The document has been reviewed by the different divisions in the five relevant DFO administrative regions and by national headquarters. It was also sent for comment to provincial governments and Indigenous groups present within the range of this Blue Whale population. The non-governmental organizations, the shipping and fishing industries and the commercial marine life observations activities were also consulted.

Minister of
Fisheries and Oceans

Ministre des
Pêches et des Océans

Ottawa, Canada K1A 0E6

AUG 0 9 2019

Mr. Daniel Shewchuk
Chairperson
Nunavut Wildlife Management Board
c/oTaqialuq Sataa
tsataa@nwmb.com

Dear Mr. Schewchuk:

I am writing to follow up on former Minister LeBlanc's letter to you dated April 26, 2018, to inform you that Fisheries and Oceans Canada (DFO) will seek the Nunavut Wildlife Management Board's (NWMB) approval for the final drafts of recovery documents for aquatic species at risk (SAR) as described in Article 5.2.34 (d) (i) of the *Nunavut Land Claims Agreement* (NLCA), and in accordance with the approval process in the NLCA.

This is the culmination of a series of communications, starting in 2016, between you and my predecessors requesting the NWMB approve the final drafts of the 1) Action Plan for Blue Whale, Northwest Atlantic population; 2) Amended Recovery Strategy for Northern Wolffish and Spotted Wolffish, and Management Plan for Atlantic Wolffish; and 3) Action Plan for the Northern Wolffish and Spotted Wolffish. The final drafts of these recovery documents are ready for your approval, in accordance with the NLCA, and are enclosed with this letter. The two Wolffish documents have been translated into Inuktitut. For the Blue Whale Action Plan, due to the species' rareness in waters adjacent to Nunavut, only the Executive Summary has been translated.

I would appreciate if these three documents could be placed on the agenda for the NWMB's September 2019 meeting. Following review, please convey your approval to my Office at the earliest opportunity following the meeting. The same process will now be applied to all applicable forthcoming DFO SAR recovery strategies, action plans and management plans.

I also want to reiterate DFO's desire to work with Environment and Climate Change Canada and the NWMB to update the 2008 MOU, "A Memorandum of Understanding to Harmonize the Designation of Rare, Threatened and Endangered Species under the *Nunavut Land Claims Agreement* and the Listing of Wildlife Species at Risk under the *Species at Risk Act*" to reflect relationships as we move forward together in recovery planning and implementation for species at risk.

I thank you for your ongoing support in the recovery and protection of aquatic species at risk, and I look forward to your continued collaboration.

Yours sincerely,

Jonathan Wilkinson, P.C., M.P.
Minister of Fisheries, Oceans and the Canadian Coast Guard

Enclosures:

1. Action Plan for Blue Whale, Northwest Atlantic population [English only]
2. Executive Summary of the Action Plan for Blue Whale, Northwest Atlantic population [Inuktitut]
3. Amended Recovery Strategy for Northern Wolffish and Spotted Wolffish, and Management Plan for Atlantic Wolffish [English and Inuktitut]
4. Action Plan for the Northern Wolffish and Spotted Wolffish [English and Inuktitut]

Minister of
Fisheries and Oceans

Ministre des
Pêches et des Océans

Ottawa, Canada K1A 0E6

AUG 0 9 2019

ᒥᔅᑕ. ᑖᓂᐅᓪ ᓯᐅᑦᓴᒃ (Mr. Daniel Shewchuk)
ᐃᑦᓯᕙᐅᑕᖅ
ᓄᓇᕗᒻᒥ ᐆᒪᔪᓕᕆᔨᖃᐃᑦ ᑲᑎᒪᔨᖏᑦ
ᑎᑎᕋᖅᕕᐅᓪᓗᓂ ᑕᖅᑭᐊᓗᒃ ᓴᑖ
tsataa@nwmb.com

ᑎᑎᕋᖅᕕᐅᔪᖅ ᒥᔅᑕ ᓯᐅᑦᓴᒃ:

ᑎᑎᕋᖅᑐᖓ ᐱᔾᔪᑎᒋᓪᓗᒍ ᒥᓂᔅᑕᐅᓚᐅᖅᑑᑦ ᓕᕚᓐᒃ (Leblanc) ᑎᑎᕋᐅᑎᒋᓚᐅᖅᑕᖓᓄᑦ ᐃᓕᓐᓄᑦ ᐅᓪᓗᖓᓂ ᐄᐳᓗ 26, 2018, ᖃᐅᔨᒃᑲᐃᒍᑎᐅᓪᓗᓂ ᐃᓕᓐᓄᑦ ᐃᒪᕐᒥᐅᑕᓕᕆᔨᖃᐃᒃᑯᑦ (DFO) ᑐᑦᓯᕋᕐᒪᑕ ᓄᓇᕗᒻᒥ ᐆᒪᔪᓕᕆᔨᖃᐃᑦ ᑲᑎᒪᔨᖏᓐᓂᒃ (NWMB) ᐊᖏᕐᑰᔨᓪᓗᓂ ᑎᑎᕋᖅᑕᐅᔨᒪᔪᓂ ᐸᐃᑉᐹᓂᒃ ᐊᑦᑕᓇᖅᑐᒦᑦᑐᓄᒃ ᐃᒪᕐᒥᐅᑕᓄᑦ ᐆᒪᔪᓄᑦ (SAR) ᓇᓗᓇᐃᖅᑕᐅᒪᔪᓂ ᐊᑐᐊᒐᕐᓂ (Article 5.2.34 (d) (i) *ᓄᓇᕗᑦ ᓄᓇᑖᕐᓂᕐᒧᑦ ᐊᖏᕈᑎᖓᓂ (NLCA)*, ᑕᒪᓐᓇᓗ ᒪᓕᑦᑐᖅ ᐊᖏᖅᑕᐅᕙᓪᓕᐊᒍᑎᖏᑦᑕ ᐊᑐᐊᒐᖏᓐᓂ ᓄᓇᕗᑦ ᓄᓇᑖᕐᓂᕐᒧᑦ ᐊᖏᕈᑎᓂᒃ (NLCA).

ᑕᒪᓐᓇ ᑎᑭᐅᑎᓯᒪᔪᑦ ᐅᖃᖃᑎᒌᒍᑎᐅᓯᒪᔪᓄᑦ, ᐱᒋᐊᓚᐅᖅᑐᓂ 2016-ᒥ, ᐅᖃᖃᑎᒌᑦᓯᒪᑎᓪᓗᓯ ᐅᕙᓐᓂᒃ ᓯᕗᓪᓕᐅᓚᐅᖅᑐᒥᒃ ᑐᑦᓯᕋᖅᑐᓂ ᓄᓇᕗᒻᒥ ᐆᒪᔪᓕᕆᔨᖃᐃᒃᑯᑦ ᑲᑎᒪᔨᖏᓐᓂ ᐊᖏᖅᑕᐅᕐᑰᔨᓪᓗᓂ ᑎᑎᕋᐅᑕᐅᓯᒪᔪᓂᒃ 1) ᖃᓄᐃᓕᐅᕈᑎᑦᓴᐃᑦ ᐸᕐᓇᐅᑏᑦ ᓴᖅᐱᓕᓐᓂ ᐊᖏᓂᖅᐸᐅᔪᓂ, ᐅᐊᓐᓇᖅᐸᓯᒃ ᓂᒋᕐᒥ ᐊᑦᓛᓐᑎᒃ ᐃᒪᕖᓚᑕ ᖃᑦᓯᐅᓂᖏᓐᓂ; 2) ᐋᖅᑭᒋᐊᖅᑕᐅᓯᒪᔪᖅ ᐅᑎᖅᑎᑦᓲᓚᓱᐊᕈᑏᑦ ᖃᓄᖅᑑᖅᓯᒪᓂᒃᑯᑦ ᐅᐊᓐᓇᖓᓂ ᐆᒪᐅᔮᐃᑦ ᑕᖅᓴᓪᓛᔪᐃᓪᓗ ᐆᒪᐅᔮᐃᑦ, ᐊᒻᒪᓗ ᐊᐅᓚᑦᓯᒍᑎᓄᑦ ᐸᕐᓇᐅᑎᐅᓯᒪᔪᑦ ᐊᑦᓛᓐᑎᒃ ᐃᒪᕖᓚᓂ ᐆᒪᐅᔮᓄᑦ; ᐊᒻᒪᓗ 3) ᖃᓄᐃᓕᐅᕈᑎᑦᓴᐃᑦ ᐸᕐᓇᑕᐅᓯᒪᔪᑦ ᑕᒪᒃᑯᓄᖓ ᐅᐊᓐᓇᕐᒥ ᐆᒪᐅᔮᐃᑦ ᑖᒃᑯᐊᓗ ᐆᒪᐅᔮᐃᑦ ᑕᖅᓴᓪᓛᔪᑦ. ᑎᑎᕋᖅᑕᐅᑦᖅᐸᓪᓕᐊᓂᖏᑦ ᑕᒪᒃᑯᐊ ᐸᐃᑉᐹᑦ ᐊᑐᐃᓐᓇᐅᓕᖅᑐᑦ ᐊᖏᕈᓐᓇᓕᖅᑕᓯ ᑲᑎᒪᔨᑎᒍᑦ, ᑕᒪᓐᓇ ᒪᓕᑦᑐᖅ ᐊᑐᐊᒐᖏᓐᓂ ᓄᓇᕗᑦ ᓄᓇᑖᕐᓂᕐᒧᑦ ᐊᖏᕈᑎᖏᓐᓂ, ᑖᒃᑯᐊ ᐊᑕᖃᓯᐅᑎᔪᑦ ᑖᑦᓯᒥᖓ ᑎᑎᖅᑲᓕᐊᕆᔭᕐᓂᒃ. ᒪᕐᑮᒃ ᐆᒪᐅᔭᓕᕆᔩᒃ ᑎᑎᖅᑲᖏᑦ ᐃᓄᒃᑎᑑᓕᖅᑕᐅᓯᒪᔪᑦ. ᓴᖅᐱᓕᓐᓂ ᐊᖏᓂᖅᐸᐅᔪᑦ ᖃᓄᐃᓕᐅᕈᑎᑦᓴᐃᑦ ᐸᕐᓇᑕᐅᓯᒪᔪᑦ, ᐱᑕᖃᓗᐊᖅᐸᖏᒻᒪᑕ ᓄᓇᕗᑦ ᐃᒪᕐᑯᑎᖏᓐᓂ, ᑖᒃᑯᐊᖅ ᓇᐃᓪᓕᒥᐊᖅᓯᒪᔪᖏᑦ ᑎᑎᖅᑲᕐᑯᑎᖏᑦ ᐃᓄᒃᑎᑑᓕᖅᑕᐅᓯᒪᔪᑦ.

Canada

Minister of
Fisheries and Oceans

Ministre des
Pêches et des Océans

Ottawa, Canada K1A 0E6

ᑕᐃᒫᑦᓴᐃᓐᓇᖅ ᒪᓕᑦᑕᐅᖃᑦᑕᕐᓂᐊᓕᖅᑐᑦ ᐊᓯᓚᒫᖏᑦ ᓯᕗᓂᑦᓭᓐᓂ ᐃᒪᕐᒥᐅᑕᓕᕆᔨᕐᔪᐊᒃᑯᑦ ᐊᑦᑕᓇᖅᑐᒦᑦᑐᓄᑦ ᓄᖑᑐᐃᓐᓇᕆᐊᖃᖅᑐᓄᑦ ᐆᒪᔪᓄᑦ (DFO SAR) ᖃᓄᖅᑑᕈᑏᑦ, ᐸᕐᓇᐅᑏᑦ ᐊᒻᒪᓗ ᐊᐅᓚᑦᓯᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᐅᔪᑦ. ᐅᖃᓕᒫᒃᑲᓐᓂᓚᐅᖅᑎᓪᓗᓯ, ᐊᖏᖅᓯᒪᓂᓯ ᖃᐅᔾᒃᑲᐅᑎᓗᒍ ᐊᓪᓚᒃᕕᒐᓄᑦ.

ᐅᖃᒃᑲᓐᓂᕈᒪᒻᒥᔭᖓ ᐃᒪᕐᒥᐅᑕᓕᕆᔨᕐᔪᐊᒃᑯᑦ (DFO) ᐱᓕᕆᖃᑎᖃᕈᒪᒻᒪᑕ ᐊᕙᑎᓕᕆᔾᑯᓐᓂ ᓯᓚᐅᓪᓗ ᐊᓯᔾᔨᐸᓪᓕᐊᓂᖓᓄᑦ ᑲᓇᑕᒥ ᐱᓕᕆᕝᖓᓂ ᐊᒻᒪᓗ ᓄᓇᕗᒻᒥ ᐆᒪᔪᓕᕆᔨᕐᔪᐊᒃᑯᑦ ᑲᑎᒪᔨᖏᓐᓂ ᓄᓈᙳᕆᐊᕐᓗᒍ 2008-ᒥ ᑐᑭᓯᐊᖃᑎᒌᒍᑎ ᑎᑎᕋᐅᑎᐅᓯᒪᔪᖅ, "ᑐᑭᓯᖃᑎᒌᓐᓂᖅ ᐋᖅᑭᐊᖅᑕᐅᓂᖏᓐᓄᑦ ᓇᓗᓇᐃᖅᓯᒍᑏᑦ ᐱᑕᖃᓗᐊᙱᑦᑐᓄᑦ, ᐊᑦᑕᓇᖅᑐᒦᑦᑐᓄᑦ ᐊᒻᒪᓗ ᓄᖑᑐᐃᓐᓇᕆᐊᖃᖅᑐᓄᑦ ᐆᒪᔪᓄᑦ ᐋᑖᓂ ᓄᓇᕗᑦ ᓄᓇᑖᕐᓂᕐᒧᑦ ᐊᖏᕈᑎᓂ ᐊᒻᒪᓗ ᑎᑎᖅᑕᐅᕙᓐᓂᖏᑦ ᐆᒪᔪᐃᑦ ᐊᑦᑕᓇᖅᑑᓐᓂᖏᑦ ᐋᑖᒍᑦ ᐆᒪᔪᐃᑦ ᐊᑦᑕᓇᖅᑑᑦᑐᑦ ᒪᓕᑲᙵᓂ" ᑕᒪᓐᓇ ᐱᓕᕆᖃᑎᒌᓐᓂᑦᑎᓐᓂ ᓇᓗᓇᐃᖅᓯᒍᑕᐅᓗᓂ ᓯᕗᓘᐊᑉᐸᓪᓕᐊᑎᓪᓗᑕ ᐅᑎᖅᑎᑦᓯᕙᓪᓕᐊᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᓂᒃ ᐊᒻᒪᓗ ᐊᑐᓕᖅᑎᑕᐅᒍᑎᖏᑦ ᐆᒪᔪᐃᑦ ᐊᑦᑕᓇᖅᑑᑦᑐᑦ.

ᕿᔭᓐᓇᒦᖅᑲᕆᑦ ᐃᑲᔪᖅᔫᓐᓇᕋᕕᑦ ᐅᑎᖅᑎᑦᓯᕙᓪᓕᐊᓂᕐᒨᙵᔪᓂᒃ ᐊᒻᒪᓗ ᓴᐳᑎᔾᔪᕆᐊᖃᕐᓂᖏᓐᓂ ᐅᒪᕐᒥᐅᑕᐃᑦ ᐊᑦᑕᓇᖅᑑᑦᑐᑦ ᓄᖑᑐᐃᓐᓇᕆᐊᓕᓐᓂ, ᓂᕆᐅᑉᐳᖓᓗ ᐱᓕᕆᖃᑏᒃᑲᓐᓂᕐᓂᐊᕐᓂᑎᓐᓂᒃ.

ᑎᑎᕋᖅᑎᐅᔪᖅ,

ᔮᓕᑕᓐ ᐅᐃᓪᑭᓐᓴᓐ, ᒪᓕᒐᓕᐅᖅᑎᒻᒪᕆᒃ (Jonathan Wilkinson, P.C., M.P.)
ᒥᓂᔅᑕ ᐃᖃᓗᓕᕆᓂᕐᒧᑦ, ᐃᒪᕐᒥᐅᑕᓕᕆᓂᕐᒧᑦ ᐊᒻᒪᓗ ᑲᓇᑕᒥ ᓯᑯᓯᐅᖅᑎᓄᑦ ᒥᐊᓂᖅᓯᔾᔫᑦ

ᐃᓚᐅᖃᓯᐅᑎᔪᑦ:

1. ᖃᓄᐃᓕᐅᕈᑎᑦᓴᐃᑦ ᐸᕐᓇᑕᐅᓯᒪᔪᑦ ᓵᖅᐱᓕᓐᓂ ᐊᖏᓂᖅᐸᐅᔪᓄᑦ, ᐅᐊᓐᓇᖅᐸᓯᐊᓂ ᓂᒋᕐᒥ ᐊᑦᑡᓐᑎᒃ ᐃᒪᕕᐊᓂ ᖃᑦᓯᐅᓂᖏᑦ [ᖃᓪᓗᓈᑎᑑᖓᔪᖅ ᑭᓯᐊᓂ]
2. ᓇᐃᓪᓕᒋᐊᖅᓯᒪᔪᖅ ᑎᑎᕋᐅᑎᐅᓯᒪᔪᖅ ᖃᓄᐃᓕᐅᕈᑎᑦᓴᐃᑦ ᐸᕐᓇᐅᑏᑦ ᐱᔾᔪᑎᖃᖅᑐᑦ ᓵᖅᐱᓕᓐᓂ ᐊᖏᓂᖅᐸᐅᔪᓂᒃ, ᐅᐊᓐᓇᖅᐸᓯᐊᓂ ᓂᒋᕐᒥ ᐊᑦᑡᓐᑎᒃ ᖃᑦᓯᐅᓂᖏᑦ [ᐃᓄᒃᑎᑐᑦ]
3. ᐋᖅᑭᐊᖅᑕᐅᓯᒪᔪᖅ ᐅᑎᖅᑎᑦᓯᕙᓯᐊᕐᓂᕐᒧᑦ ᖃᓄᖅᑑᕈᑕᐅᓯᒪᔪᑦ ᐅᐊᓐᓇᕐᒥ ᐆᕙᐅᔭᐃᑦ ᐊᒻᒪᓗ ᐆᕙᐅᔭᐃᑦ ᑕᖅᓵᓕᑦ, ᐊᒻᒪᓗ ᐊᐅᓚᑦᓯᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᐅᓯᒪᔪᑦ ᐊᑦᑡᓐᑎᒃ ᐆᕙᐅᔭᓄᑦ [ᖃᓪᓗᓈᑎᑐᑦ ᐊᒻᒪᓗ ᐃᓄᒃᑎᑐᑦ]
4. ᖃᓄᐃᓕᐅᕈᑎᑦᓴᐃᑦ ᐸᕐᓇᑕᐅᓯᒪᔪᑦ ᐅᐊᓐᓇᕐᒥ ᐆᕙᐅᔭᐃᑦ ᐊᒻᒪᓗ ᐆᕙᐅᔭᐃᑦ ᑕᖅᓵᓕᑦ [ᖃᓪᓗᓈᑎᑐᑦ ᐊᒻᒪᓗ ᐃᓄᒃᑎᑐᑦ]

SUBMISSION TO THE
NUNAVUT WILDLIFE MANAGEMENT BOARD
FOR

Information: **Decision: X**

Issue: A decision is needed to approve/not approve the "Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada" and the "Action Plan for the Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*) in Canada".

Background:
In May 2001, Northern Wolffish and Spotted Wolffish were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Threatened due to declines in their abundance and biomass. A third species, the Atlantic Wolffish, was assessed by COSEWIC as Special Concern. All three wolffish species were included in Schedule 1 of the *Species at Risk Act* (SARA) at the time of the Act's proclamation in June 2003.

A Recovery Strategy/Management Plan was prepared for these three species in 2006 and the NWMB was asked to make a decision to approve or not approve the "Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada". The NWMB approved the Recovery Strategy/Management Plan in 2007, and it was then finalised in 2008. When Northern and Spotted wolffish were listed as Threatened, *Species at Risk Act* required the creation of an Action Plan which would outline a detailed path to recovering the two species.

An updated version of the Recovery Strategy/Management Plan was prepared for the three wolffish species as well as the required Action Plan for the Northern and Spotted wolffish. Consultations on these documents took place with Hunters and Trappers Organizations (HTO) and the fishing industry from July through September in 2015, but few comments were received. The comments received from HTOs indicated that wolffish are not fished for by community members, and therefore they had no comment. Both documents were brought to the Board for approval in September of 2016, at which time the Board requested that review occur until the documents have are considered final. The documents are now are considered final.

The final recovery strategy and action plan (marked as proposed until the Board makes a decision) provides the general and detailed information that supports the recovery of the wolffish species. While the recovery strategy points out the general knowledge gaps in species biology or management which are required to aid in recovery, the action plan describes the specific measures that will provide the best ways to increase this knowledge, reduce threats and monitor the species.

Most of the work on wolffish continues to take place in southern areas where the species are more plentiful, but much of the general knowledge being gained is applicable to the north. No critical habitat for these species has been identified in Nunavut waters. The mandatory release of Northern and Spotted wolffish upon capture continues, and captures take place almost exclusively by the commercial fishing industry.

A summary of consultations with Nunavut communities in 2015 and their responses is included. As part of the process of updating the Recovery Strategy/Management Plan and creating an Action Plan, DFO is requesting that the NWMB review the final documents, provide any comments, and state whether they approve of these documents.

Recommendations:
The NWMB review the updated “Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada” and the “Action Plan for the Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*) in Canada”, provide any comments to DFO and it’s decision.

Prepared by:
Sam Stephenson, Species at Risk Biologist, DFO, Central and Arctic Region, Winnipeg

Date:
August 2, 2019

Summary of consultations on the "Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada" and "Action Plan for the Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*) in Canada".

From July to September 2015, the amended version of the 2008 "Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada" as well as the draft "Action Plan for the Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*) in Canada" were available for comment by selected groups. Hunters and Trappers organizations in Nunavut adjacent to the distribution of the three wolffish species, representatives of the commercial fishing industry and the Government of Nunavut were some of those groups. Public consultations on these two documents will take place in the future via the Species at Risk (SARA) public registry.

The original Recovery Strategy and Management Plan were amended to include information from recent research as well as the location of critical habitat for Northern and Spotted Wolffish. No critical habitat was identified in Nunavut. The Action Plan is a required document under the SARA and explains exactly who is responsible for certain activities identified in the Recovery Strategy.

Contact was made with Hunters and Trappers Organizations (HTO) via phone calls, emailing of materials and hard copy mailings of materials. For HTOs this process began in July and ended in September 2015. For the commercial fishing industry, Nunavut government and Inuit organizations, contact was made only once through an Express Post mailing of all pertinent information in July 2015. All materials were provided in English and Inuktitut.

No comments were received from any of the following organizations that were sent the information about the revised Recovery Strategy/Management Plan and the Action Plan.

HTOs (Kimmirut, Iqaluit, Pangnirtung, Qikiqtarjuaq, Clyde River, Pond Inlet): No comment although three of these HTOs mentioned that that was in part because no one actively fishes for these species..

Nunavut Inuit Wildlife Secretariat, Nunavut Tunngavik Inc., Qikiqtaaluk Wildlife Board: No comment, but materials primarily sent as "for your information".

Nunavut Government, Department of Environment, Fisheries and Sealing: No comment.

Fishing Industry: No comment.

A list of materials sent, when and how, appears in Appendix A.

APPENDIX A: Approximate date of contact and materials sent to Nunavut.

CONTACT WITH HTOs - Kimmirut, Iqaluit, Pangnirtung, Qikiqtarjuaq, Clyde River, Pond Inlet:
July 2015 – Express Post letter with the executive summary of the Action Plan and revised Recovery Strategy/Management Plan (both in English and Inuktitut) asking if there was any comment on the new and revised documents.
August 2015 – Express Post letter with the executive summary of the Action Plan and revised Recovery Strategy/Management Plan (both in English and Inuktitut) asking if there was any comment on the new or revised documents.
August 2015 – Email informing that the consultation period was over, but that DFO would still be accepting any comments on the Action Plan and revised Recovery Strategy/Management Plan. Email included the English and Inuktitut summaries of the Action Plan and Recovery Strategy/Management Plan.
September 2015 – Phone call to all HTOs asking for any comments on the Action Plan and revised Recovery Strategy/Management Plan as no HTO had submitted any comments at that time.

CONTACT WITH NUNAVUT INUIT WILDLIFE SECRETARIAT, NUNAVUT TUNNGAVIK INC., QIKIQTAALUK WILDLIFE BOARD:
July 2015 – Express Post "FYI" with the executive summary of the Action Plan and revised Recovery Strategy/Management Plan (both in English and Inuktitut) asking if there was any comment on the new and revised documents.

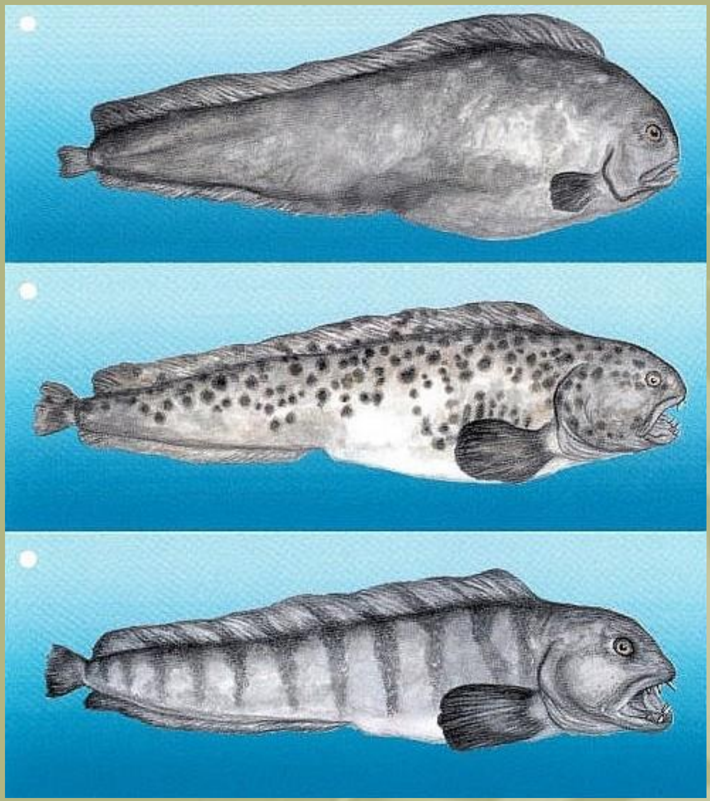
CONTACT WITH NUNAVUT GOVERNMENT:
July 2015 – A single Express Post with the executive summary of the Action Plan and revised Recovery Strategy/Management Plan was sent to Fisheries and Sealing, Department of Environment, asking if there was any comment on the new and revised documents.

CONTACT WITH FISHING INDUSTRY:
July 2015 – A single Express Post of letter was sent to Baffin Fisheries Coalition, Nunavut Offshore Allocations Holders Association, Qikiqtaaluk Corporation, Arctic Fishery Alliance, Cumberland Sound Fisheries; Umiat Corporation with the executive summary of the Action Plan and revised Recovery Strategy/Management Plan (both in English and Inuktitut) asking if there was any comment on the new and revised documents.

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada

Northern Wolffish, Spotted Wolffish, Atlantic Wolffish



Original publication **2008**
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Pêches et Océans Canada

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For copies of the Recovery Strategy, or for additional information on species at risk, including Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk Public Registry.

Cover illustration: Fisheries and Oceans Canada

Également disponible en français sous le titre
Pêches et Océans Canada. 2018. Programme de rétablissement du loup à tête large (*Anarhichas denticulatus*) et du loup tacheté (*Anarhichas minor*), et plan de gestion du loup atlantique (*Anarhichas lupus*) au Canada [proposition]. Pêches et Océans Canada, Ottawa. viii + 91 p.

ISBN
Catalogue no.

Declaration

The original version of the *Recovery Strategy for Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor), and Management Plan for Atlantic Wolffish (Anarhichas lupus) in Canada* was prepared in cooperation with jurisdictions responsible for the species. Fisheries and Oceans Canada has amended the original document to include updates since 2008 as required by the *Species at Risk Act*. Consultations on the amendment of this document were held in 2015. For further details please see Appendix A.

Success in the recovery and management of these species depends on the commitment and cooperation of many different constituencies that continue to be involved in implementing the directions set out in this strategy, and will not be achieved by Fisheries and Oceans Canada or any other jurisdiction alone. In the spirit of the Accord for the Protection of Species at Risk, the Minister of Fisheries and Oceans invites all Canadians to join Fisheries and Oceans Canada in supporting and implementing this strategy for the benefit of Northern Wolffish (*Anarhichas denticulatus)*, Spotted Wolffish *(Anarhichas minor),* Atlantic Wolffish (*Anarhichas lupus)*, and Canadian society as a whole. Fisheries and Oceans Canada will continue to support implementation of this strategy, given available resources and varying species at risk conservation priorities. A report on the implementation of the Recovery Strategy and the progress towards meeting its objectives was published in 2013. The Minister will continue to report on progress in every subsequent five-year period, until its objectives have been achieved or the species' recovery is no longer feasible.

This strategy will be complemented by an action plan which will provide details on specific recovery measures to be taken to support conservation of the species. The Minister will take steps to ensure that, to the extent possible, Canadians directly affected by these measures will be consulted.

Responsible Jurisdictions

The responsible jurisdiction for Northern, Spotted and Atlantic Wolffish in Atlantic Canadian waters is Fisheries and Oceans Canada.

Acknowledgments

This amended Recovery Strategy and Management Plan would not have been possible without the contribution of DFO staff from the Newfoundland and Labrador, Maritimes, Gulf, Quebec, Central and Arctic and National Capital Regions as well as Dena Wiseman.

Strategic Environmental Assessment Statement

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans and program proposals to support environmentally-sound decision making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or achievement of any of the Federal Sustainable Development Strategy's (FSDS) goals and targets.

Recovery and management planning are intended to benefit species at risk and biodiversity in general. However, it is recognized that recovery strategies and management plans may also inadvertently lead to environmental effects beyond the intended benefits. The planning process, based on national guidelines, directly incorporates consideration of all environmental effects, with particular focus on possible impacts on non-target species or habitats. The results of the SEA are incorporated directly in recovery strategies and management plans themselves, but are also summarized below.

This Recovery Strategy and Management Plan will clearly benefit the environment by promoting the conservation and recovery of Northern, Spotted and Atlantic Wolffish in Canadian waters. The potential for the strategy to inadvertently lead to adverse effects on other species was considered; however, because the recovery objectives recommend additional research on the species and education and outreach initiatives, the SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects.

Executive Summary

Four species of wolffish (family Anarhichadidae) inhabit Canadian waters: Northern Wolffish *(Anarhichas denticulatus)*, Spotted Wolffish *(Anarhichas minor*) and Atlantic Wolffish (*Anarhichas lupus*) in both the Atlantic and Arctic Oceans, and Bering Wolffish *(Anarhichas orientalis)* in the Arctic Ocean only. In May 2001, Northern and Spotted Wolffish were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Threatened due to declines in their abundance and biomass (COSEWIC 2001a,b). A third species, Atlantic Wolffish, was assessed by COSEWIC as Special Concern (COSEWIC 2000). All three wolffish species were included in Schedule 1 of the *Species at Risk Act* (SARA) at the time of the Act's proclamation in June 2003. The statuses of all three wolffish species were reassessed by COSEWIC in 2012. Although there are some signs of population recovery, COSEWIC recommended that all designations remain unchanged (COSEWIC 2012a,b,c). Therefore, under SARA, the status for Northern and Spotted Wolffish remained as Threatened and the status for Atlantic Wolffish remained as Special Concern.

Northern and Spotted Wolffish are the focus of this document; however, this document also serves as a management plan for Atlantic Wolffish. This is because the distributions of the three species overlap through much of their range. Although Atlantic Wolffish is at a lower designation, it also underwent a decline as great as that observed for the two Threatened species over the northern part of its range (Northeast Newfoundland and Labrador Shelf). The two Threatened species are primarily distributed on the Grand Banks and areas to the north. Atlantic Wolffish has a wider distribution in the Gulf of St. Lawrence, Scotian Shelf, Bay of Fundy and Georges Bank, where the other two species are rare. While all three species have undergone substantial declines during the 1980s and 1990s, the proximal cause(s) remain uncertain.

This document was originally published in 2008 and was developed by a multi-sector, multi-regional Recovery Team with representation from the fishing industry, academia, the Government of Newfoundland and Labrador and the Government of Canada. Government representation included expert scientists, fisheries managers and economists to assist in formulating a framework for the conservation and recovery of these wolffish species.

The 2008 version of this Recovery Strategy and Management Plan represents a collaborative and consultative effort by the recovery team to present the available knowledge and recommend recovery solutions.

The Recovery Strategy and Management Plan identifies the lack of information that exists in regard to population dynamics of wolffish, their ecology, abundance, distribution, habitat utilization, behaviour and interaction with their environment. It points out the immediate need for additional research to enhance formulation of recovery approaches. The document discusses the threats and issues believed to be affecting wolffish conservation and recovery, and presents recommendations to mitigate them. It also promotes stewardship among stakeholders as a means to facilitate and promote recovery.

The goal of this document is to increase the population levels and distribution of Northern, Spotted, and Atlantic Wolffish in eastern Canadian waters such that the long-

term viability of these species is achieved. This will be accomplished via the objectives and strategies outlined below.

Five primary objectives have been identified to achieve this goal:

- Enhance understanding of the biology and life history of wolffish species;
- Identify, conserve, and/or protect wolffish habitat required for viable population sizes and densities;
- Reduce the potential for wolffish population declines by minimizing human impacts;
- Promote wolffish population growth and recovery; and
- Develop communications and education programs to promote the conservation and recovery of wolffish populations.

Each objective is designed to achieve the goals of the Recovery Strategy and Management Plan.

Recommended actions to achieve these objectives are:

- Study life history;
- Study population structure within eastern Canadian waters;
- Identify recovery biological reference points;
- Study ecosystem interactions;
- Identify habitat, including critical habitat;
- Define measures to conserve and/or protect wolffish habitat;
- Identify and mitigate impacts of human activity;
- Increase resource user knowledge and raise public awareness of wolffish species through education and communication;
- Promote stewardship initiatives;
- Consultation and cooperation with harvesters, processors, scientists, regulators, enforcement, observers, dockside monitors, governments, Aboriginal groups and other ocean users;
- Monitor wolffish spatial and temporal abundance patterns; and
- Monitor spatial and temporal patterns of natural and human induced mortality.

Adherence to the recommendations put forth in this document, including the mitigation of known threats, provides the best chance to conserve and restore the three wolffish species to a level where they are no longer considered at risk. However, it is recognized that the implementation of recovery activities are constrained by available resources and that non-human elements (environmental influences) have played a role in the decline of the species and these effects cannot be controlled/mitigated. There is also a need for adaptive management and modification or revision of this Recovery Strategy and Management Plan as new information becomes available.

This document was amended in 2018. The most significant portion of this amendment is the identification of critical habitat for Northern and Spotted Wolffish. The recovery section of this document was also revised to include current information. Other parts of this document were revised as required.

Table of Contents

Part A: Species Information and Evaluation of Current Status

1. Introduction

Wolffish (Family Anarhichadidae), also referred to as “catfish” by the fishing industry, inhabit a wide range of northern latitudes in the Atlantic and Pacific Oceans (Scott and Scott 1988). Four species of the genus *Anarhichas* commonly inhabit Canadian waters: Northern or Broadhead Wolffish (*Anarhichas denticulatus*), Spotted Wolffish (*Anarhichas minor*) and Atlantic Wolffish (*Anarhichas lupus*) in the Atlantic and Arctic Oceans (Barsukov 1959; Templeman 1985, 1986b), and Bering Wolffish (*Anarhichas orientalis*) in the Arctic Ocean (Houston and McAllister 1990). The first three species are also distributed in the northeastern Atlantic (Barsukov 1959; Baranenkova et al. 1960) including southeast and southwest of Greenland, (Möller and Rätz 1999; Stransky 2001), the latter contiguous with Canadian waters. The west Greenland components (Atlantic and Spotted Wolffish) underwent a decline similar in magnitude and timing to the decline in Canadian waters while the east Greenland component did not (Möller and Rätz 1999). Reported catches off west Greenland have not exceeded 100 tonnes in recent years. All three species extend into U.S. waters, but there they are uncommon (Atlantic Wolffish) or rare (Spotted and Northern Wolffish).

Kulka and DeBlois (1996) described the distribution of the three species off eastern Newfoundland as quite extensive, inhabiting most of the Labrador and northeast Newfoundland Shelves (less so in recent years) to the southern Grand Banks and Flemish Cap (Appendix C: Figure 1). The northern limit of all three species occurs in the Davis Strait. Research surveys on the Scotian Shelf and in the Gulf of St. Lawrence regularly take both Northern and Spotted Wolffish, but at much lower rates than from the Grand Banks to the Labrador Shelf region. This would indicate that the former regions represent the southern fringe of distribution for these two wolffish species. Atlantic Wolffish differed from the other two species in that they are densely concentrated on the shallow part of the southern Grand Banks (Kulka and DeBlois 1996). Atlantic Wolffish is also common in the deeper parts of the Gulf of St. Lawrence, on the Scotian Shelf, in the Bay of Fundy (McRuer et al. 2000) and Gulf of Maine/Georges Bank (Nelson and Ross 1992).

Wolffish have been exploited in a directed fishery off Greenland (Smidt 1981; Möller and Rätz 1999), but within Canadian waters they have only ever comprised bycatch. Kulka (1986) reported on bycatch levels of the three species in Canadian waters. It was noted that annually during the 1980s, about 1,000 tonnes of the three species (combined) were caught in many fisheries directed for other species. About half of the Spotted and Atlantic Wolffish caught was landed and all of Northern Wolffish were reported as discarded. Information on distribution presented by Kulka and DeBlois (1996) and Simpson and Kulka (2002) indicate a potential for overlap of fisheries with the distribution of wolffish species outside 200 miles on the Grand Banks and the Flemish Cap.

With the decline in the traditional groundfish (demersal species) resources in the waters around Newfoundland and Labrador, in the early 1990s, interest in the exploitation of alternate species increased. Spotted and Atlantic Wolffish had been considered in the mid-1990s as potential candidates for new directed fisheries. However, experimental fishing did not identify areas where catch rates were sufficiently high to warrant directed commercial exploitation. This finding was consistent with studies that indicate wolffish do not form dense concentrations (Templeman 1986a; Kulka and DeBlois 1996; Simpson and Kulka 2002).

Kulka and DeBlois (1996) and Simpson and Kulka (2002) noted a significant decline in research trawl survey indices (numbers and weights) of the three species starting in the late 1970s and early 1980s. While all three species have undergone a substantial decline during the 1980s-1990s, the proximal cause remains uncertain. These declines in abundance were concurrent with a widespread reduction in abundance of many groundfish species from the Grand Banks to the northern Labrador Shelf.

In 2001, Northern and Spotted Wolffish were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Threatened and Atlantic Wolffish was assessed as Special Concern (COSEWIC 2000; COSEWIC 2001a,b). All three wolffish species where included in Schedule 1 of the *Species at Risk Act* (SARA) at the time of the Act's proclamation in June 2003. The status of all three wolffish species was reassessed by COSEWIC in 2012. Although there were some signs of population recovery, COSEWIC recommended that all designations remain unchanged (COSEWIC 2012a,b,c). Therefore, under SARA, the status for Northern and Spotted Wolffish remained as Threatened and the status for Atlantic Wolffish remained as Special Concern. These species are not protected under analogous provincial or territorial legislation.

This document serves as an amendment to the 2008 version of the *Recovery Strategy for Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor), and Management Plan for Atlantic Wolffish (Anarhichas lupus) in Canada*. Based on knowledge accumulated to date, the recovery of wolffish species as stated in the 2008 version of this Recovery Strategy and Management Plan is still considered feasible.

Further information can be found in the 2008 version of this Recovery Strategy which is available on the Species at Risk Public Registry.

1.1 Species Information and Evaluation of Current Status

Species Information: Northern Wolffish

Common Name:	Northern Wolffish, Broadhead Wolffish, Bullheaded Wolffish, Catfish
Scientific Name:	*Anarhichas denticulatus*
Status:	Threatened (SARA Schedule 1)
Reason for Designation:	This species underwent strong declines in both abundance and in range size during the 1980s. For the next decade there was little change, but since about 2002 there have been small increases in both range size and abundance. These have been in parallel with recovery measures, including mandatory release of individuals taken as bycatch. While these recent increases are encouraging, the species is still at very low levels compared with the beginning of research surveys in the 1970s. Although there has been a general decrease in the level of fishing over its range, its recovery may still be limited by bycatch in fisheries

	in the deep waters in which it occurs (COSEWIC 2012a).
Canadian Occurrence:	Arctic Ocean, North Atlantic Ocean
Status History:	Designated Threatened in May 2001. Status re-examined and confirmed in November 2012.

Species Information: Spotted Wolffish

Common Name:	Spotted Wolffish, Leopardfish, Catfish
Scientific Name:	*Anarhichas minor*
Status:	Threatened (SARA Schedule 1)
Reason for Designation:	This species underwent strong declines from the late 1970s until the mid-1990s, but since then there has been some recovery over most of its Canadian range. This is indicated by both increases in abundance and area of occupancy. These increases parallel a reduction in bottom fisheries that had a high incidental catch of this species, as well as introduction of recovery measures including mandatory release. While these recent increases are encouraging, the species is still at low levels compared with the beginning of the research surveys (COSEWIC 2012b).
Canadian Occurrence:	Arctic Ocean, North Atlantic Ocean
Status History:	Designated Threatened in May 2001. Status re-examined and confirmed in November 2012

Species Information: Atlantic Wolffish

Common Name:	Atlantic Wolffish, Striped Wolffish, Catfish
Scientific Name:	*Anarhichas lupus*
Status:	Special Concern (SARA Schedule 1)
Reason for Designation:	This species underwent steep declines in both abundance and area of occupancy over much of its range from the 1980s until the mid-1990s, including its historical stronghold in waters east and north of Newfoundland. Since then it has been increasing in abundance and area of occupancy. While these recent increases are encouraging, the species remains at low abundance compared to the early 1980s. Population increases have probably been aided by reduced commercial fisheries, which take wolffish as bycatch. There have been continuing declines in abundance on the Scotian Shelf and in the Southern Gulf of St. Lawrence, where historically there were fewer individuals than areas to the east and north (COSEWIC 2012c).
Canadian Occurrence:	Arctic Ocean, North Atlantic Ocean
Status History:	Designated Special Concern in November 2000. Status re-examined and confirmed in November 2012.

Table 1 below compares the distribution, migration, temperature, depth and bottom type for the three species of wolffish. Further information can be found in the 2008 version of the Recovery Strategy and Management Plan which is available on the Species at Risk Public Registry.

Table 1. Comparison of essential life history attributes of Northern, Spotted and Atlantic Wolffish. References cited below as superscript are found, similarly superscripted, in Literature Cited.

Essential Life History Attributes	Northern Wolffish	Spotted Wolffish	Atlantic Wolffish
DISTRIBUTION	1980-84 - Largest concentrations on NE Newfoundland & Labrador Shelves & Banks, also commonly found on SE & SW slopes of the Grand Banks & along Laurentian Channel. Uncommon in the Gulf of St. Lawrence & rare on the Scotian Shelf.1995-2003 - Area occupied & density at low levels in Newfoundland & Labrador Shelves.[1, 2] 2004-2012 - Increase in density and area occupied, in most areas surveyed in Newfoundland and Labrador (NL) waters.[3, 4]	1980-84 - Concentrated on the NE Newfoundland & Labrador Shelves & Banks, south on SE & SW slopes of the Grand Banks. Also found in the Gulf of St. Lawrence & Scotian Shelf. 1995-2003 - Area occupied & density at low levels on Newfoundland & Labrador Shelves.[1, 2] 2004-2012 - Increase in density and area occupied, in most areas surveyed in NL waters.[3, 4]	1980-84 - Similar to Northern Wolffish with an additional concentration on the Southern Grand Banks, in the Gulf of St Lawrence & on the Scotian Shelf & Georges Bank. 1995-2003 - Area occupied & density at low levels in northern part of survey range, distribution on the Southern Grand Banks, Scotian Shelf & Gulf of St Lawrence relatively constant.[1, 2] 2004-2012 - Increase in density and area occupied, in most areas surveyed in NL waters.[3, 4]
MIGRATION	Limited migrations noted from tagging.[5]	Limited migrations noted from tagging.[5]	Short migrations, with some longer migrations noted from tagging,[5] observed moving inshore to spawn,[6] and pelagic young may be dispersed by tides.[7]
TEMPERATURE	NL - More common at 2 to 5°C.[8] NE Atlantic - Range of -1.0 to 6°C, more common at 1 to 2°C.[9]	NL - More common at 1.5 to 5°C.[8] NE Atlantic - Range of -1 to 7.3°C, more common at 0 to 2°C.[9]	NL - More common at -1.5 to 4.0°C.[8] NE Atlantic - Range of -1.3 to10.2°C, more common in 1 to 4°C.[9]
DEPTH	NL - Greater range of depth than other sp., 38-1,504 m, mainly at >500 m-1,000 m. NE Atlantic - Down to 840 m, best catch rates at 70-300 m.[9]	NL - Rarely in shallow areas, 56-1,046 m, mainly at 200-750 m.[8] NE Atlantic - Down to 600 m, best catch rates at 200-530 m.[9]	NL - Nearshore to 918 m, mainly in 150-350 m.[8] NE Atlantic - Down to 500 m, best catch rates at <100 m.[9]
BOTTOM TYPE	Rocky bottom (at	Stony bottom (at least)	Stony bottom during

	least) during spawning.[10] Found over all bottom types observed but highest concentrations over sand & shell hash during the fall survey, coarse sand in spring.	during spawning.[10] Found over all bottom types observed but highest concentrations over sand & shell hash during the fall survey, coarse sand in spring.	spawning.[10] During feeding period, prefer complex relief of rocks, rarely in algal growths or even-silted sand, usually observed in shelters.[7] Shelters located on 15-30° slopes, with good water circulation, slightly silted bottom, 1-5 openings.[7] Occupy most convenient shelter, do not retain same shelter & do not protect them.[7] May have colonial settlements.[7]

2. Distribution

2.1 Global Range

Wolffish (Family Anarhichadidae) inhabit a wide range of northern latitudes and moderately deep waters in the Atlantic, Pacific, and Arctic Oceans. The genus *Anarhichas* is widely distributed in both the eastern and western North Atlantic, the three species having somewhat overlapping distributions. In addition to its distribution in the northwest Atlantic, Northern Wolffish occurs in the eastern Atlantic including Greenland, Iceland, the Faroes, Finnmarken, Murman Coast, and Novaya Zemlya. Spotted Wolffish occurs in the eastern Atlantic from Greenland, Iceland, the Faroes, Spitsbergen, White Sea, off the Murman coast, around Scotland, and on the Norwegian Coast south to Bergen. Atlantic Wolffish occurs in the eastern Atlantic from Greenland, Iceland, the Faroes, Spitsbergen, White Sea, Murman Coast, south to the British Isles, and the western coast of France (Scott and Scott 1988).

2.2 Eastern Canadian Range

Northern, Spotted and Atlantic Wolffish occur in the western North Atlantic from the Davis Strait to the Gulf of Maine. The distribution of Atlantic Wolffish extends south of eastern Canadian waters, as far south as Cape Hatteras.

More specifically, Northern Wolffish occurs from as far north in the Davis Strait at Lat. 72°N off Nunavut (northern limit), off southwest Greenland, on the northeast Newfoundland and Labrador Shelves (center of concentration), on the Flemish Cap, in the Gulf of St. Lawrence (uncommon), on the Grand Banks, and rarely on the Scotian Shelf (Banquereau and Sable Island Bank), Lat. 42°N. Similarly, Spotted Wolffish occurs off west Greenland (northern limit at about Lat. 72°N), on the northeast Newfoundland and Labrador Shelves (center of concentration), the Grand Banks, on the Flemish Cap, in the Gulf of St. Lawrence and on the Scotian Shelf. Atlantic Wolffish has a slightly more southern distribution occurring from west Greenland, on the northeast Newfoundland and Labrador Shelves, in the Gulf of St. Lawrence, on the Grand Banks, on the Scotian Shelf, in the Bay of Fundy, and in the Gulf of Maine (Scott and Scott 1988; Simpson and Kulka 2002). Atlantic Wolffish is common in the Gulf of St. Lawrence, on the Scotian Shelf and in the Gulf of Maine, where the other two species are uncommon or rare. Refer to Appendix C: Figures 2 to 7 for maps of the distribution of species from the Grand Banks to the Labrador Shelf, the center of their concentration.

2.3 Percentage of Global Distribution in Eastern Canadian Waters

Percentage of global distribution occurring in eastern Canadian waters is not known for any of the species. In Canadian Atlantic waters, each of the species occupies an area of about 500,000 km^2, a significant portion of the global distribution. Although the three species of wolffish are widely distributed in the western Atlantic and thus constitute a significant portion of the global population, Atlantic Wolffish is more densely concentrated to the south and east of Greenland (east of Canada's territorial limit) where they are dense enough to be the target of a directed commercial fishery.

2.4 Distribution Trends in Eastern Canadian Waters

Fisheries and Oceans Canada (DFO) carried out standard stratified random surveys in the Canadian Atlantic. However, the resulting survey series constitute relative indices because the catchability of wolffish (and other species) is unknown and the series are not comparable among DFO Regions because of different gears and protocols used. The center of distribution of the two Threatened wolffish species is thought to be the Newfoundland and Labrador Region. As well, the greatest decline occurred in this area. As such, this document is focused mainly on the Newfoundland and Labrador Region.

On the Grand Banks to the Labrador Shelf between 1977 and 2011, Newfoundland and Labrador regional fall research surveys recorded catches of all three species of wolffish widely distributed throughout the Labrador and northeast Newfoundland Shelves to the southern Grand Banks, the center of their distribution in Canadian waters (Simpson and Kulka 2002; Kulka et al. 2004; Simpson et al. 2012, 2013).

The area surveyed in the fall covers two distinct areas of distribution based on habitat characteristics. The northern area covers the southern Labrador Shelf and the northeast Newfoundland Shelf. All three wolffish species were present along the entire shelf to the coast, particularly prior to the decline. This area comprises mainly rocky substrate. To the south on the Grand Banks, the three species inhabit only the periphery of the bank along the shelf edge, with the exception of Atlantic Wolffish that forms a concentration on the southern Grand Banks where the bottom is mainly pebble, sand, and mud. Appendix C: Figures 2, 4 and 6, show the change in distribution between the early 1980s and the 1990s. These aggregate plots of wolffish distributions for the time periods 1980-1984, 1985-1993 and 1994-2001 show a declining distribution in both intensity (lower catch rates) and extent of the distribution of the three wolffish species. This reduction in the area occupied coincides with an observed decline in the biomass and abundance estimates of these species (Simpson and Kulka 2002; Kulka et al. 2004). Appendix C: Figures 3, 5 and 7 illustrate the changes in distribution of wolffish from 1977-2009 (Simpson et al. 2012). During the last decade, overall results indicate an increase in distribution of all three wolffish species, in most areas surveyed (Simpson et al. 2013).

In years when the Flemish Cap was sampled, the three wolffish species were also found in abundance there. For Northern Wolffish, large catches occurred throughout the northeast Newfoundland Shelf and the Labrador Shelf during the early 1980s. However, from 1986-2005, the distribution of larger catches of Northern Wolffish was increasingly limited to the shelf edge throughout the entire survey area. Similar to the distribution of Northern Wolffish, the catches of Spotted and Atlantic Wolffish were increasingly limited to the periphery of the northeast Newfoundland and Labrador Shelves and the Grand Banks from the mid-1980s to the very early 2000s (Kulka et al. 2004; Simpson et al. 2012). By this time, the distribution of all three species of wolffish contracted relative to their distributions during the 1970s and early 1980s. Trends have reversed in recent years, with the distribution of Spotted and Atlantic Wolffish increasing since the early 2000s and the distribution of Northern Wolffish increasing since 2005 (Simpson et al. 2012, 2013).

Atlantic Wolffish has a distinguishing feature in terms of its distribution on the Grand Banks. In addition to large catches on the bank edges, as is the case for all three species, Atlantic Wolffish is also captured in shallower waters on the southern Grand Banks, a circular on-shelf concentration, where the other two species are not found (Appendix C: Figures 2, 4 and 6).

Between 1980 and 1984, Northern Wolffish were widely distributed throughout the area north of the Grand Banks covering much of the shelf, the eastern Grand Banks shelf edge and the Flemish Cap. From 1985 to 1993, there was a decline in the extent and intensity of the distribution of Northern Wolffish (Kulka 2004). From the mid-1990s to the mid-2000s, Northern Wolffish were concentrated only on the shelf edge, the edge of the southern Grand Banks and the Flemish Cap. However, since 2005, survey catches of Northern Wolffish have expanded over the same historical areas, suggesting a reversing trend from population decline (Simpson et al. 2012, 2013).

Prior to 1986, Spotted Wolffish were extensively distributed north of the Grand Banks covering much of the shelf, with a few occurrences along the eastern Grand Banks shelf edge and the Flemish Cap. Between 1985 and 1993, previously observed areas of high density had disappeared, the distribution reduced to low density concentrations along the shelf edge and in deep channels. During the late 1990s, there were no significant concentrations of Spotted Wolffish compared to previous time periods (Kulka et al. 2004). However, beginning in 2000, the declining trend reversed as survey catches of Spotted Wolffish increased over historical areas of the continental shelf (Simpson et al. 2012, 2013).

Similar to the pattern observed for Northern Wolffish during 1980-1984 north of the Grand Banks, Atlantic Wolffish were widely distributed covering much of the northeast Newfoundland and Labrador shelves. In addition, a separate aggregation of Atlantic Wolffish centered at Lat. 44°N, west of the Southeast Shoal on the tail of the Grand Banks was also apparent, well separated from the concentrations on the Labrador Shelf. During the mid-1980s and through the 1990s, there was a reduction in the extent and density of the northern component of Atlantic Wolffish; however, the southern Grand Banks concentration remained relatively unchanged or increased slightly (Kulka et al. 2004; Simpson et al. 2012, 2013). Since 2000, there has been an expansion of survey catches for Atlantic Wolffish over the same historical areas. These distribution patterns are similar to those for Atlantic Wolffish during the 1980s, and also indicate a reversal of population decline (Simpson et al. 2012, 2013).

At their center of concentration (Grand Banks, northeast Newfoundland Shelf and southern Labrador Shelf), both the relative and absolute area occupied by high, medium and low density concentrations of all three species declined from the high density periods of 1980-1984 relative to the low density periods, 1995-2001 (Appendix C: Figure 8 upper panel; refer to Simpson and Kulka 2002 for a definition of density levels). The decline in the area occupied by high densities of wolffish was most pronounced for Northern Wolffish (55%), and least pronounced for Atlantic Wolffish (38%) (Simpson and Kulka 2002; Kulka et al. 2004). The area occupied by high density Spotted Wolffish concentrations declined by 47%. The middle panel of Appendix C: Figure 8, shows that the overall area of occupancy also declined, from the 1980s to the early 2000s, for the three species, but was most pronounced for Northern Wolffish, and least pronounced for Atlantic Wolffish. The concentration of Atlantic Wolffish on the southern Grand Banks actually increased slightly (Appendix C: Figure 8 lower panel).

Appendix C: Figures 9, 10 and 11 illustrate the changing trends in area of occupancy of each species in Northwest Atlantic Fisheries Organization (NAFO) Divisions 2J3K (spring) and 3LNO (fall and spring), from 1971 to 2010 (from Simpson et al. 2012). The clearest trend in area of occupancy for all species is shown in NAFO Divisions 2J3K. In this area, there was a substantial decline in area occupied from the late 1970s to the mid-1990s for Spotted and Atlantic Wolffish*,* and to the early 2000s for Northern Wolffish*,* followed by an increase in area occupied for all species. Northern Wolffish showed the largest decline in area of occupancy (>99%), decreasing steadily from 76% in 1977 to <1% in 2003, with trends then reversing to 11% to 20% in recent years. Spotted Wolffish decreased from 57% in 1978 to 4% in 1994, before increasing to 6% in 1996 and 32% in 2008. Atlantic Wolffish decreased from 68% in 1979 to 10% in 1994, but then showed the greatest increase of all species, rising to 30% in 1995 and 47 % in 2007 (Simpson et al. 2012).

Of the three species of wolffish in Newfoundland and Labrador waters, the indices of relative abundance and distribution have varied the least for Atlantic Wolffish, especially on the Grand Banks (1975-2010) and northeast Newfoundland and Labrador shelves (1995-2009). In contrast, Northern Wolffish underwent the greatest decline in indices of area occupied and relative abundance, during the same time period. All species have shown increases in indices of relative abundance and distribution since the early 2000s, returning to several historical areas, and showing patterns of distribution similar to that observed during periods of high abundance. Overall, the three species of wolffish in Newfoundland and Labrador waters have all shown signs of stock recovery in the last decade (Simpson et al. 2012).

Surveys were sporadic in the Arctic, but fisheries in the Davis Strait as far north as Lat. 72°N occasionally capture Northern and Spotted Wolffish, describing the northern limit of the distribution (Kulka et al. 2004). DFO surveys in the Arctic region, although limited, have shown that all three species have been found in NAFO Subarea 0. They are close to the boundary of NAFO Subarea 1 (Greenland waters) and NAFO Division 2G and could possibly be extensions of the stock from these areas. Area of occupancy generally remained the same for all wolffish species over time (Simpson et al. 2012, 2013; DFO 2013).

Annual DFO summer surveys (1970-2010) on the Scotian Shelf have shown that Northern and Spotted Wolffish are near the southern limit of their range in this area (McRuer et al. 2000; Simon et al. 2012). Both species are rare, with catches mainly on the eastern Scotian Shelf, with some along the shelf edge. In comparison, Atlantic Wolffish are found throughout the entire Maritimes region (McRuer et al. 2001; Simon et al. 2012). The two primary areas of concentration of Atlantic Wolffish are located on the Scotian Shelf; one on the east (NAFO Divisions 4VW) and one on the west (NAFO Division 4X, primarily Brown's Bank). Area of occupancy, for Atlantic Wolffish in this area, has declined steadily since the 1970s with the greatest decrease occurring in the western Scotian Shelf (NAFO Division 4X) (Simon et al. 2012).

Annual surveys in the Gulf of St. Lawrence (1978-2012) have shown that all three wolffish species are found in this region (McRuer et al. 2000; Dutil et al. 2011b; Simpson et al. 2013). Northern Wolffish are rare, with most catches off the southwest coast of Newfoundland and a few on the continental slope along the Laurentian Channel. Spotted Wolffish are less rare, and are most commonly found in the northeastern Gulf, on the shelf off Newfoundland's west coast, and the slopes of the Esquiman Channel. Both Northern and Spotted Wolffish are virtually absent in the southern Gulf. Distribution of Atlantic Wolffish is more extensive in this region. They avoid deep channels and the upper slopes of channels and shelves, such as the shelf off Newfoundland's west coast and the northeastern Gulf. The relative occurrence of Atlantic Wolffish is generally low in the southern Gulf, with most catches along the 200 m isobath, as well as some catches on the Magdalen Shallows. Spotted and Atlantic Wolffish show the largest degree of overlap in spatial distribution, with Atlantic Wolffish found closer to the coastline and avoiding deep channels. Relative occurrences for all species do not show any significant trends over time (Dutil et al. 2011b; Simpson et al. 2013).

Wolffish young of the year (YOY), identified as Atlantic Wolffish, were captured in International Young Gadoids Pelagic Trawl (IYGPT) sets conducted from 1996-2000 (August and September). They were widely distributed offshore on the northeast Newfoundland and Labrador Shelf (Simpson and Kulka 2002; Simpson et al. 2012). It is possible that some of the YOY taken in the survey comprised other species of wolffish since fish of that size are difficult to distinguish to the species level. Small (<55 cm in length) wolffish, captured in the fall trawl surveys were also found to be distributed extensively in similar offshore areas. Overall, there is considerable overlap in the distribution of small and large (> 55 cm) Spotted and Atlantic Wolffish including YOY. In the case of Atlantic Wolffish, there was an increase in the size of catches of small fish from 1995 to 2000 along the edge of the northern shelf and on the southern Grand Banks. However, for Spotted Wolffish, there was no apparent increase in the proportion of small fish in this same time period.

3. Population Abundance

3.1 Global Range

Wolffish are distributed in the northeast Atlantic off Greenland and they are the target of a significant fishery in parts of the north Atlantic, primarily in the northeast Atlantic off Greenland (Möller and Rätz 1999). However, because of different survey gears and protocols used in different parts of the range of wolffish, relative population abundance among various parts of its range cannot be determined at this time.

3.2 Population Sizes and Trends in Eastern Canadian Waters

Biomass and abundance estimates for wolffish at the center of their abundance, the Grand Banks to Labrador Shelf, were derived from Newfoundland and Labrador regional fall research surveys (Simpson and Kulka 2002; Simpson et al. 2012, 2013) conducted between 1977 and 2011 (Grand Banks, Northeast Newfoundland Shelf, and South Labrador Shelf) and spring research surveys between 1971 and 2012 (Grand Banks and St. Pierre Banks only). Neither of these fall or spring surveys covered the Gulf of St. Lawrence, the Scotian Shelf or the Northern Labrador Shelf into Davis Strait, although all but the Davis Strait is surveyed at other times with different gears. Thus, the spring and fall series are not comparable and neither covers the entire range of wolffish species in Canadian Atlantic waters. The fall survey series is the best measure of wolffish relative abundance as it extends over the area where all three species are at the center of their distribution (Simpson and Kulka 2002). Thus, the fall survey is used to describe trends in abundance. Although surveys on the northern Labrador Shelf have been infrequent, the wolffish species there appear to have undergone a similar if not greater pattern of decline from the early 1980s to the mid-1990s, as described below for areas directly to the south.

The magnitude of the Newfoundland and Labrador fall indices after 1995 is not comparable to that of the pre-1995 period due to a change in gear type used during the surveys. Catchability conversion factors between the Engel (pre-1995) and Campelen (current) trawl gear are not available for wolffish species. The gear change is delineated in Appendix C: Figures 12, 13 and 14 by a gray vertical bar to distinguish the two series. The area surveyed in the fall is divided into two areas based on distinct distribution characteristics (described above) and habitats. The northern area (2J+3K in Appendix C: Figures 12, 13 and 14) covers the southern Labrador Shelf and the northeast Newfoundland Shelf and the southern area covers the Grand Banks (3LNO in Appendix C: Figures 12, 13 and 14). In both the northern and southern parts of the survey, the indices declined by more than 90% for all three species, since the 1980s (Appendix C: Figures 12, 13 and 14).

Appendix C: Figures 15, 16 and 17 illustrate the changes in indices of relative abundance (number of fish/tow) for each wolffish species, during spring (NAFO Divisions 3Ps and 3LNO) and fall (2J3K and 3LNO) surveys, from 1971 to 2010 (from Simpson et al. 2012). These figures contain the most recent wolffish abundance information.

From the Grand Banks to Labrador Shelf, Northern Wolffish underwent the most significant decline of the three species (Appendix C: Figure 12), greatest in the north (2J3K) and steepest between 1984 and 1994. Northern Wolffish underwent a less precipitous decline in the south (3LNO). Note that the southern area was not surveyed in the fall prior to 1981. As a result of different decline rates between north and south, after 1991, Northern Wolffish actually had a higher abundance in 3LNO than in 2J3K whereas, prior to that time, abundance to the north was about 5-6 times greater. From 1995 to 2001, the indices for Northern Wolffish, both north and south, were stable.

Similar trends are shown for relative abundance (number of fish/tow) of Northern Wolffish (Appendix C: Figure 15), in the same areas and time period. In 2J3K, the highest catches (up to 5 fish/tow) occurred prior to the mid-1980s, with a decline to very low levels in the mid-1990s to early 2000s, and small increases in more recent years. In 3LNO, the catches were higher prior to the mid-1980s, declining to low values during the 1990s (spring), but with signs of improvement in recent years (fall and spring) (Simpson et al. 2012).

Spotted Wolffish underwent a decline that was nearly as dramatic as Northern Wolffish (Appendix C: Figure 13). However, in contrast, biomass was approximately equal in the northern and southern areas prior to the decline (Appendix C: Figure 13). The decline rate was about the same in both areas, unlike Northern Wolffish, and thus it retained about equal proportions of biomass between areas over the period of decline. From 1995 to 2001, the indices, and particularly abundance, have undergone a substantial increase, more than doubling numbers of wolffish between 1995 and 2001. This suggests improved recruitment and improved survival. However, it should be noted that since 1993, deep strata (and inshore strata) have been successively added to the surveys. The portion of the increase in the indices that is attributable to an increased survey area is uncertain (a subject for future research).

In 2J3K (fall), catches of Spotted Wolffish were highest (up to 1.5 fish/tow) during the late 1970s (Appendix C: Figure 16). The relative abundance declined steadily through the 1980s, dropping to very low levels of 0.2 fish/tow by 1995, at which point the gear change occurred. The index increased through the Campelen series, peaking in 2008 with 0.56 fish/tow. In 3LNO (spring), catches of Spotted Wolffish were higher prior to the early 1980s, and decreased to low values during the 1980s and mid-1990s. Catches (spring and fall) increased since the introduction of the Campelen gear and peaked in 2006 (Simpson et al. 2012).

Overall, the observed decline in Atlantic Wolffish biomass was not as great as for the other species, but was on a similar scale in the north (2J3K) where most of the decline occurred for this species (Appendix C: Figure 14). To the south (3LNO), the indices tended to be stable between 1981 and 1994. However, the fish that were located on the shelf edge of the Grand Banks did decline slightly, whereas the concentration on the southern bank actually increased slightly. After 1994 (and the change in survey gear to Campelen), the indices for Atlantic Wolffish increased steadily, particularly to the south, in terms of biomass.

Trends in Atlantic Wolffish indices of relative abundance were similar to those for Northern Wolffish (Appendix C: Figure 17). In 2J3K, the highest catches (up to 8.3 fish/tow) occurred in the late 1970s, with a decline to low levels in the mid-1990s. The index increased with the introduction of the Campelen gear in 1995, and has changed very little since then. Spring and fall indices in NAFO Divisions 3LNO show little variability for all periods, except for some increases since the mid-2000s (Simpson et al. 2012).

Spring surveys (starting in 1971) covered only the Grand Banks, but this spatially restricted series is longer than that of the fall series. The biomass and abundance spring indices for all three species of wolffish fluctuated over the survey period, increasing during the 1970s, declining in the early 1980s, increasing in the late 1980s and declining again in the early 1990s (Simpson and Kulka 2002). Since 1996, the spring abundance and biomass indices have generally varied without trend (Simpson et al. 2012). For both spring and fall surveys, the magnitude of the indices from fall 1995 are not comparable to earlier years due to the change in survey gear.

Relative size (total biomass/total number) was calculated for all three wolffish species based on DFO fall Research Vessel (RV) surveys from 1977 to 2001. The relative size of Northern Wolffish increased during 1981 to 1991 in the north (2J3K), but declined thereafter (Simpson and Kulka 2002). For Spotted Wolffish, the relative size of fish in the north was greater than in the south. Associated with the decline in abundance and biomass, the relative size of Atlantic Wolffish also declined in the northern area (2J3K). Throughout all of the survey periods, relatively larger Atlantic Wolffish were captured in the southern areas (particularly on the bank) than to the north. The relative size of all three wolffish species measured during the surveys was smaller during the period of 1995 to 2001 across all areas. This is likely a result of changing to the Campelen survey gear that has a higher catchability for smaller fish. However, a proportionately greater increase in abundance than in biomass after 1995 observed in all three species, to differing extents, suggests that there may be improved recruitment in recent years as well.

The abundance of all species of wolffish in annual DFO summer surveys (1970-2010) and other surveys on the Scotian Shelf is low (McRuer et al. 2000; Simon et al. 2012). Northern and Spotted Wolffish are rare, with catches mainly on the eastern Scotian Shelf, and some along the shelf edge. Abundance has been very low in all surveys with both species occurring in less than 0.5% of sets. Atlantic Wolffish were the most common species, and were captured in 19.2% of sets in DFO summer RV surveys. They are found throughout the Maritimes, with two main concentrations on the Scotian Shelf; one on the east (NAFO Divisions 4VW) and one on the west (NAFO Division 4X, primarily Brown’s Bank). Trends in abundance on the eastern and western portions of the shelf differ when examined separately for mature (>53cm) and immature length groups. On the eastern shelf, mature Atlantic Wolffish declined by 99% since 1970, while immature Atlantic Wolffish have increased in the same time period. On the western shelf, mature abundance declined by 81% since 1970, and immature abundance declined by a similar amount in the same time period. Overall abundance of Atlantic Wolffish (all lengths) on the Scotian Shelf has declined since 1990 (Simon et al. 2012; Simpson et al. 2013).

The abundance of wolffish in annual DFO RV surveys of the Gulf of St. Lawrence (1978-2012) is relatively low, with most catches in the northern Gulf (McRuer et al. 2000; Dutil et al. 2011b; DFO 2013). Northern Wolffish is the rarest, with only 102 occurrences reported over the survey time period. Relative occurrence has been consistently low, with some higher values before 1990 (DFO RV and Sentinel Surveys). Although not as rare as Northern Wolffish, the abundance of Spotted Wolffish is also low in this area, with 248 occurrences reported in DFO RV surveys. Relative occurrence (DFO RV and Sentinel Surveys) of Spotted Wolffish is more variable than Northern Wolffish, with higher values after 1990. Atlantic Wolffish is the most abundant wolffish species in the region with 1,306 occurrences reported in the DFO RV surveys. Relative occurrence (DFO RV and Sentinel Surveys) of Atlantic Wolffish has been higher than that of the other two species. Overall, relative occurrences for all species of wolffish in the Gulf do not suggest any significant trends over time (Dutil et al. 2011b; DFO 2013).

DFO surveys in the Arctic region, though sporadic, have shown that all three species have been found in NAFO Subarea 0 at low abundance (Simpson et al. 2012).

3.3 Percentage of Global Population in Eastern Canadian Waters

Different survey gears are used in different parts of the world (and in different parts of eastern Canada) to quantify population size and examine changes over time. Therefore, relative proportions of populations occurring in various parts of the range of the wolffish species in the Atlantic cannot be determined, although the Canadian Atlantic component certainly represents a significant proportion of the global population. Percentages of the global populations in eastern Canadian waters are not known at the present time.

4. Biological Limiting Factors

Based on observed growth and fecundity of Atlantic Wolffish in U.S. waters, Musick (1999) described the reproductive productivity of wolffish as “low”. The testes of these species are relatively small, sperm and egg production are low, fertilization is internal and eggs and larvae are large. Although fecundity is low, internal fertilization (Pavlov 1994), nesting habits and egg guarding behaviour in Atlantic Wolffish (Keats et al. 1985) effectively increases potential for survival of individuals during the early life stages.

Many demersal fish species in eastern Canadian waters have undergone similar changes in distribution and population decline over the same time period, but there is little consensus in the literature as to the proximal cause for these multi-species declines. The patterned declines and the contraction of distributions to deeper waters observed with wolffish have also been observed in other species during the same time period (Atkinson 1994; Kulka et al. 1995).

Attempts to relate changes in population size and distribution to environmental signals have met with little success. As well, over-fishing hypotheses have not been fully satisfactory in many instances in explaining the declines. Although bycatch mortality clearly has contributed to the declines, evidence of over-fishing as the proximal cause is lacking for non-commercial species (Simpson and Kulka 2002). For wolffish, the greatest declines occurred where fishing effort was low and the remaining concentrations largely coincide with the most heavily fished areas (Kulka and Simpson 2004). Future research may reveal the importance of environmental factors in the decline.

Estimating the status of populations can be problematic due to incomplete coverage of the population range. In addition, although the period in which standard stratified random fall surveys have been done (1977 to present) may be sufficient to provide information on long term trends for these long lived species, the surveys started when the survey index was at a maximum and it is unknown if this was a normal fluctuation or a result of other factors. Marine fish undergo natural fluctuations often resulting from variable recruitment and thus peaks and valleys over the long term are the norm. Fluctuating trends are apparent for virtually all monitored species. To pick a point in time when a population is at its peak and compare it to the low point in the trend may not be a valid measure of risk of extinction. Not enough is known about the long term population trends of these species, or the environmental influences to fully understand how critical the abundance levels reached in the mid-1990s are to the survival of the species in Canadian waters.

Fishing pressure accentuates the downward component of fluctuations caused by natural influences even when the exploitation rate is relatively low. It is unknown how much of the precipitous declines observed between the early 1980s and the mid-1990s is attributable to natural fluctuation and how much is attributable to an anomalous event caused by extraordinary circumstances (natural or anthropogenic, or both). Nonetheless, attention must be paid to the declining biomass trends and the reduction in extent of the distribution in the 1980s and 1990s, particularly in the north.

The apparent increase in biomass and abundance since the mid-1990s, for Spotted and Atlantic Wolffish is an encouraging sign. Whether this increase resulted from more favourable environmental conditions or reduced fishing pressure in the 1990s, or a combination of effects, is unclear. Since improvements in biomass and abundance indices are very slight, several additional years of research survey data are required to confirm whether recovery is taking place. Furthermore, with any apparent increase in biomass, it seems likely that the extent of the wolffish distributions would also increase within the range previously observed in the absence of an environmental shift that might prevent a re-colonization (Simpson and Kulka 2002).

5. Threats

The magnitude of the role of natural vs. anthropogenic effects is poorly understood. It seems likely that a combination of natural and human induced mortality, perhaps in combination with poor recruitment, caused the wolffish populations to decline.

We can, however, exert control over some of the anthropogenic activities that have an impact on wolffish populations. To do this, we need to know which activities constitute a threat to the populations and their habitat, and how to change or curtail these activities in order to lessen their impacts and, at the same time, increase the chances of recovery of the wolffish populations.

The current level of knowledge limits the effectiveness and scope of Canadian recovery initiatives. Population structure, absolute estimates of population size and relative contribution of threats to the decline are unknown. Knowledge of exactly how habitat has been and is being utilized and to what extent available habitat is critical to the species survival or recovery is not available (Kulka et al. 2004). With development of that knowledge, a better understanding of the threats can be achieved, and measures required to mitigate factors limiting recovery can be refined.

Preliminary information on total removals of wolffish species combined is provided in Simpson and Kulka (2002), but a breakdown of species by fishery is required to evaluate the potential impact on each species. Possible bottom alteration due to fishing activities on or near wolffish habitat needs to be better quantified; there is currently little or no information on the effects of bottom trawling, although trawled locations have been delineated by Kulka and Pitcher (2001). The effects of bilge and ballast water are unknown. Pollution from land-based sources that could affect the well-being of the species needs to be identified and, to the extent possible, mitigated. Offshore exploration for minerals, oil and other resources needs to be carried out with environmental protection in mind.

Linking stewardship to recovery activities, communication and education programs needs to be specific and understandable for each stakeholder. If these initiatives are ineffective, cooperation from legislators, scientists, industry and all other stakeholders in the protection of an incidentally caught fish with low perceived economic value will be difficult to foster and promote. As a result, it is likely that currently known threats will not be properly mitigated and suspected threats will not be studied to determine their relative effects.

There is a need to delineate temporal and spatial effects of threats and the intensity of these threats on the various life stages of wolffish and their habitats. Regional cooperation to protect these species and their habitat must be implemented.

5.1 Fishing

The impact of incidental capture of wolffish in many fisheries is thought to be the leading cause of human induced mortality. However, the proportion of mortality due to fishing activities that contributes to total mortality and to the decline of these species is unclear.

Prior to the requirement to release Threatened wolffish species taken incidentally in Canadian fisheries, instituted in 2003-2004, wolffish catches and landings were unregulated. There is no directed fishery for wolffish in Canadian waters, but their extensive distributions which overlap fishing grounds have made them a common bycatch in many Atlantic fisheries.

Kulka (1986) and Simpson and Kulka (2002) noted that nearly all bycatch of Northern Wolffish were discarded and about half of the other two species were retained, thus landing statistics underestimate actual catches. Reported catches of wolffish were considerably higher in the 1960s and early to mid-1970s prior to the period of decline (Simpson and Kulka 2002). Trawl effort in the years just preceding and during the decline was considerably lower and has remained low since. During the 1980s, Canadian catches, including amounts discarded at sea, exceeded 1,000 tonnes in most years. Catches then declined after 1991, when many demersal fisheries were closed. Kulka and Pitcher (2001) showed that about 20% of the shelf area on the Grand Banks to Labrador Shelf was trawled annually during the early 1980s, dropping to about 5% in the 1990s. Since the early 1990s, the reduced effort has resulted in less bycatch of wolffish, subsequently benefiting the species.

A greater proportion of Atlantic and Spotted Wolffish was retained in the 1990s. On the Grand Banks to Labrador Shelf, reported Canadian landings were only 23 tonnes in 1996, but increased to 157 tonnes in 1997, 155 tonnes in 1998, 315 tonnes in 1999, and 369 tonnes in 2000. Recent increases were due mainly to bycatch from the cod longline fishery south of the island of Newfoundland. About 250 tonnes were also taken in the yellowtail fishery on the Grand Banks, but all were discarded. In the areas south of the Grand Banks, from the Gulf of St. Lawrence, Scotian Shelf, Bay of Fundy, and Gulf of Maine, wolffish landings (almost exclusively Atlantic Wolffish) were 1,000 to 1,500 tonnes in the 1960s, increasing to about 2,000 tonnes between 1968 and 1979 and peaking at about 4,000 tonnes in 1983 (all countries included). Landings dropped steadily to 1,000 tonnes in the early 1990s and were estimated to average about 625 tonnes in the early 2000s, prior to mandatory release of the Threatened species. Canadian landings represent approximately 55% of this total, with the remainder consisting mostly of U.S. landings from the Gulf of Maine area. Canadian landings of wolffish since 1986 were primarily from the southwest Scotian Shelf and constituted 81% of the total, with the western Gulf of St. Lawrence contributing 10% and the remainder spread out among other areas (McRuer et al. 2000). Since 2004, all Spotted and Northern Wolffish taken incidentally in Canadian waters must be released in a manner that maximizes chance of survival.

Commercial landing statistics lump all wolffish together under the general category “catfish” that includes Spotted and Atlantic Wolffish. However, fishery observer records do differentiate by species indicating that since the late 1990s, about 80% of the catch of the two Threatened species, Spotted and Northern Wolffish occurs in the Greenland Halibut (*Reinhardtius hippoglossoides*) directed fisheries on the Labrador Shelf and Grand Banks (Kulka and Simpson 2004). Commercial log data are thought to underreport catch rates for all three species, as indicated by fishery observer data from various fisheries.

Areas of greatest decline for all three species, on the inner northeast Newfoundland and Labrador Shelf (where wolffish formed high density concentrations in the 1970s) are areas where trawling seldom or never occurs (Kulka and Pitcher 2001) or any other form of fishing seldom takes place. Some of the most intense fishing effort during the 1970s through the early 1990s was located on the shelf edge, north of the Grand Banks where significant concentrations of the wolffish species still occur and where the vestiges of some commercial species such as cod were concentrated just prior to their collapse (Rose and Kulka 1999). Thus, it is the most intensely trawled areas along the shelf edge from the northern Labrador Shelf to the Grand Banks where the three wolffish species continue to be most abundant. Considering these species undertake limited movements (Templeman 1984), and given the mismatch in area of greatest decline for wolffish and trawling activity, while certainly contributing to the total mortality, the evidence is contrary to the hypothesis that trawling is the only or perhaps the proximal cause for the decline in wolffish (Kulka et al. 2004). This suggests significant non-fishery influences coupled with fishery related mortality contributing to the distribution and abundance changes observed.

A significant proportion of fishing mortality for wolffish occur outside Canada’s territorial limit. Non-Canadian bycatch of wolffish in the NAFO Regulatory Area (NRA) are thought to be underreported (Simpson and Kulka 2002). Depths fished and amount of fishing effort in the NRA suggest that those bycatches could constitute a substantial proportion of the mortality since those captures are unregulated and most of the fish are retained for commercial purposes. Fish taken there are probably part of the same population that inhabits Canadian waters.

Harvesting technology, specifically bottom trawling and dredging, have been identified by COSEWIC as possible causes of wolffish habitat alteration. Incremental losses of nesting and shelter habitat (habitat alterations, degradation and associated fragmentation) due to fishing are potential threats to the recovery of wolffish species, a family of fish that apparently have limited dispersal and possible nesting requirements. However, for practical reasons, trawling operations avoid rocky areas since trawling in such areas leads to the destruction of expensive gear. This affords a level of protection for rocky habitats. Also, as noted previously, areas of greatest decline do not correspond with locations of most intense trawling.

5.2 Offshore Oil and Gas Exploration and Production

Increased exploration and production of petroleum resources in eastern Canadian waters increases the possibility of oil spills, offshore well blowouts, tanker spills and other potential disasters. These accidents release petrochemicals, dissolved metals (which can result in toxic metal ingestion) and other solids into the ecosystem. In addition, exposure to these and other potential pollutants may result in direct mortality or a host of sub-lethal impairments to wolffish, their prey and their ecosystem (e.g., slower growth, decreased resistance to disease).

With any petroleum development, there is always the chance of a major release of either oil or gas into the environment from a spill associated with the storage and movement of the product after extraction or a blowout during drilling. Well blowouts and major spills have the potential to release hydrocarbons at a rate faster than natural ecosystems can accommodate them, and affect organisms not previously exposed to oil-derived hydrocarbons in concentrations greater than trace amounts.

The amount of oil reaching bottom sediments depends on numerous factors including the volume of the blowout, type of blowout (platform or sea floor), hydrocarbon composition, wind, currents and water column structure, depth of water and degree of water column mixing. Transport mechanisms include adherence to particles, incorporation into zooplankton fecal pellets, direct sedimentation of weathered oil particles and vertical mixing.

It remains very difficult to show the impacts of oil-induced mortality on early life stages of finfish and invertebrate resources because of their large and variable natural mortality. The effects of oil on adult fish in the field are difficult to study and therefore knowledge is incomplete (DFO 2011a). Any mortality of benthic species induced by a single event would probably be limited in both extent and time (Boudreau et al. 1999). If regulations and guidelines are followed, the impacts of accidental events are likely to be negligible for wolffish or other species. As well, the only near-surface stage of the wolffish life cycle is the larval stage and thus, this is the only part of the life cycle that could be potentially affected by the release of hydrocarbons.

Release of hydrocarbons is not the only potential issue. The debris generated from drilling operations has two major components; muds and cuttings. Muds tend to be finer, less dense material, while cuttings are generally coarser and heavier pieces of rock about the size of sand grains (Boudreau et al. 1999). The most obvious impacts of exploratory drilling on the environment have been associated with drilling muds. Drill muds are used by the oil and gas industry to cool and lubricate drill bits, help balance hydrostatic pressure and transport cuttings to the surface (DFO 2011a). There are three classes of muds: water-based muds (WBM), oil-based muds (OBM) (permitted in only exceptional circumstances (National Energy Board et al. 2010)), and synthetic-based muds (SBM) (designed to be less toxic and more environmentally friendly than OBM (DFO 2011a)). The discharge of OBMs and SBMs is prohibited offshore Newfoundland and Labrador and Nova Scotia; however, treated SBM cuttings can be discharged to the sea. WBMs and their cuttings can also be discharged (National Energy Board et al. 2010). Once discharged, there are a number of different processes that act on them that determine their fate and potential impacts on the environment.

The circulation and Benthic Boundary Layer Transport (BBLT) determines the fate of fine particles of drilling mud, the key determinants of dispersion, and how impacts might change with seasons (Hannah et al. 1995; Hatch Associates Ltd. and Griffiths Muecke Associates 2000). Discharged drilling muds can accumulate in low energy systems to smother benthic organisms near the rig and result in their suffocation. Similarly, with high settling velocity of cuttings, there is reason to believe that smothering might kill significant numbers of slow moving or sessile organisms in the area directly under a drill rig (Boudreau et al. 1999; DFO 2011a).

A synthetic based drilling fluid (IA-35) is presently being used in the Newfoundland and Labrador offshore. Toxicity studies carried out on scallops, as well as selected studies with plankton and fish larvae, indicate a very low potential for acute toxicity (Armsworthy et al. 2000; Cranford et al. 2000; Payne et al. 2001). The acute toxicity data available for both synthetic and water-based fluids indicates that discharges from platforms into well-mixed waters should result in little or no chemically mediated acute effect (Neff 1987;

GESAMP 1993; Payne et al. 1995). It has been demonstrated that cuttings have a very low acute toxicity as well (Payne et al. 2001).

In summary, operational discharges would cause some biological effects over relatively short time periods, and small distances from the discharge point. Smothering of benthic organisms by deposited mud and cuttings would not be anticipated outside an estimated 0.5 km radius from the rig (DFO 2011a). The use of lower toxicity, water-based drilling muds should minimize the direct mortality of organisms, as would the use of low toxicity oil for lubrication and a spotting fluid. The zone of impact around a rig would vary with location time and quantity of discharge. Impacts would disappear rapidly once drilling ceases (DFO 2011a). It is anticipated that the dispersed muds, cuttings, and associated hydrocarbons would cause localized sublethal effects for some bottom dwelling organisms. Because of the large degree of spatial and temporal variability in natural populations, and the limitations of current sampling methods, it is expected that it would be very difficult to detect the net result of any impact at the population level (Boudreau et al. 1999). Thus, any potential effects on wolffish would be highly localized and insignificant to the population as a whole.

5.2.1 Seismic Activities

Eastern Canadian waters are a region of intense exploration for petroleum-related resources. To identify probable oil and gas reserves, the offshore oil and gas industry uses seismic exploration techniques to evaluate the geology that underlies the sea. This involves the use of towed arrays of airguns – cylinders of compressed air under high pressure (about 2000 psi). The array, containing multiple cylinders, is repetitively discharged to generate a pressure pulse every 10-15 seconds (DFO 2011a).

No research has been carried out on the effects of seismic activity on wolffish species; however, Sverdrup et al. (1994) suggest that airgun blasts constitute a highly unphysiological sensory stimulus to fish. The noise from airguns generates a compression and decompression wave in the water that, at close range, is sufficient to kill fish at certain life stages (Boudreau et al. 1999; Payne 2004). At less than about 5 m, air guns have the potential to cause direct physical injury to fish, eggs and larvae. However, Payne (2004) provides a literature review that suggests that injury to fish eggs and larvae even at close range is limited. It is likely that fish would be driven away from the noise prior to coming close to the air guns, so the risk of physical injury would be greatest for those organisms that cannot swim away from the approaching sound source, especially eggs and larvae. If seismic operations are conducted in areas where larvae are aggregated, then higher levels of mortality may occur. However, the level of mortality for marine fish is not regarded as having significant effects on recruitment to a stock (Dalen et al. 1996; Payne 2004). In the case of wolffish, adults and eggs are generally found on or near bottom at distances of 100-900 m away from the surface. Hence, direct physical impact on these life stages will likely be minimal or non-existent. It is the near surface larval stages that could potentially be directly affected by seismic activity. Seismic activity synchronized with periods of larval hatching has the greatest potential for harm.

Little is known about the behavioral effects that may occur at greater distances from the air gun noise source. It is possible that wolffish adults guarding nests could leave the area of disturbance to the detriment of the egg cluster. However, no information exists for wolffish to confirm the potential effects.

The impact of seismic activity and other exploration methods used to research offshore resources needs to be quantified with respect to wolffish and their habitat. There are no documented cases of mortality of any fish species upon exposure to seismic sound under field operating conditions (DFO 2004a). Nothing is known about the possible effect on wolffish species at any stage of their life history, and currently there is scientific uncertainty regarding the potential impacts of seismic activity on marine organisms in general. Any knowledge gained by scientists must be provided as guidance to the industry.

5.3 Ocean Dumping

5.3.1 Sewage Sludge

Sewage sludge may be disposed of in the marine environment by coastal dumping or pipeline discharge, and has a known impact on both planktonic and coastal benthic communities. Sewage sludge contains bacteria and viruses, that are known to be toxic to shellfish, but their effect on wolffish is unknown. As much of this dumping is coastal, it is thought that the effect on widely distributed wolffish would be minimal. However, the potential for these effects needs to be evaluated and, if identified as harmful, impacts must be mitigated.

5.3.2 Fish Waste

During the processing of fish and other marine organisms, a large volume of wastes are generated, including fish heads, tails, guts and internal organs. Fish waste can amount up to 75% of the weight of a fish before processing, depending on the species and process. Various chemicals, primarily heavy metals and chlorinated hydrocarbons contained in the fish waste, may be accumulated in marine sediments, and subsequently released into the water column under specific circumstances, thereby becoming available to marine organisms.

Fish and other marine organisms may contain various chemicals, such as heavy metals, antibiotics and hormones. Concerns appear warranted regarding the overuse and misuse of certain chemicals, for which a proper risk assessment has not been made in relation to the marine environment. However, these issues apply mainly to coastal habitat and particularly to aquaculture species.

Various chemicals contained in fish waste, as well as disease vectors and non-indigenous species, may have adverse impacts on wild fish populations consuming the fish waste. The chemicals may accumulate in the marine sediment, affecting benthic flora and fauna. In the past, it was common practice to dispose of such waste at sea, with the risk of overloading the ecosystem.

The effects on wolffish from the above mentioned are unknown, but are likely minimal since most of these effects are localized and coastal, whereas wolffish tend to be widely distributed.

5.3.3 Dredging Spoils

It has been shown that dredge spoils dumped in the ocean reaches the bottom, but not necessarily at the exact location where it was discharged, and that it can have significant effects on the metabolism, diet, and composition of organisms that live there. The movement of dredge spoils from dumping can have multiple impacts on a series of adjacent habitats over time. The distance traveled by various particle types depends primarily on the size and density of the material, current velocities and weather patterns. The smothering of sedentary, bottom dwelling organisms is a primary concern associated with the deposition of dredge spoils. Contaminants that may be introduced to the sediments from dumping can also penetrate to a depth of 5 cm below the sea floor as organisms living in the sediments burrow through them.

For wolffish, it seems likely that the impact of dumped dredge spoils would be minimal since the area impacted would be very confined. Wolffish and their habitat should be considered valued environmental components and reported on when decisions are being made with regard to offshore activities requiring environmental assessments.

5.4 Military Activity

Military activity has and continues to take place in many areas of eastern Canadian waters. Little is known of the impacts of these activities and their effects on wolffish and their habitat. These effects need to be evaluated and potential impacts mitigated.

5.5 Cables and Pipelines

The placement of physical structures on or in the bottom substrate/water column could affect wolffish habitat although in a spatially limited manner. Given the widespread distribution of wolffish, impacts associated with these activities are likely minimal but need to be quantified.

5.6 Marine and Land-Based Pollution

Any human activity that has the potential to cause degradation to wolffish habitat, though marginal, needs to be identified, undergo cleanup where appropriate, and have prevention measures put in place. Associated land-based forms of pollution including runoff that contain excess nutrients, sediments, pathogens, pharmaceuticals (e.g., antibiotics), persistent toxins or oil may significantly affect the marine ecosystem. The magnitude of change and its form depends on many factors including the types of dissolved or suspended particles, such as non-biodegradable organic chemicals. These pollutants may adversely affect the reproductive capabilities of wolffish, their prey, and surrounding vegetation, as well as interfere with their general health.

5.7 Global Climate Change

The role of climate change as a factor in the decline of wolffish populations is currently unknown. Atmospheric changes may lead to changes in ocean productivity, species composition and habitat. Alterations in the chemical, biological, and physical composition of habitats may influence population reproduction, mortality rates, and individual behaviour. Historical data sources could be used to examine relationships between climate and trends in the distribution and abundance of wolffish. The investigation of climate change as a factor in the decline of wolffish is not a trivial task. It may be that no definitive answers will be found.

5.8 Natural Mortality (Parasites, Disease, Predation and Environment)

As with the vast majority of marine species, little is known of the effects of parasites, diseases, predation or environmental conditions on the survival of wolffish species. Pathological conditions and causal factors need to be identified as well as potential predators. Natural mortality may have played a significant role in the decline of these species; however, these processes are poorly understood.

5.9 Summary of Threats

Impact of incidental capture of wolffish in many fisheries is thought to be the leading cause of human induced mortality. However, the live release of Northern and Spotted Wolffish mitigates the effect of incidental capture to some degree (see Part B, Section 5.3). The effects of other potential sources of harm (e.g., habitat alteration/destruction, oil exploration and production, pollution, shipping, cables and lines, military activities, ecotourism and scientific research) on the ability of wolffish to survive and recover have not been quantified.

It is also recognized that non-human elements (environmental influences) may have played a role in the decline of the species and these effects cannot be controlled/mitigated. These environmental effects may continue to play an unpredictable role in the future. Thus, this document addresses anthropogenic influences only.

6. Critical Habitat

6.1 General Description of Critical Habitat

Critical habitat is defined in SARA (2002) section 2(1) as "…*the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in a recovery strategy or in an action plan for the species*." [s. 2(1)]

SARA defines habitat for aquatic species at risk as "… *spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced*." [s. 2(1)]

As per paragraph 41(1)(c) of SARA, a recovery strategy must include, "*an identification of the species' critical habitat, to the extent possible, based on the best available information, including the information provided by COSEWIC, and examples of activities that are likely to result in destruction*".

For Northern and Spotted Wolffish, critical habitat is identified to the extent possible, using the best available information, and provides the functions and features necessary to support the species' life cycle processes. Critical habitat was delineated using the Area of Occurrence Approach. Critical habitat is not comprised of the entire area within the identified boundaries and it is assumed that within this area, the functions and features necessary for the species' survival or recovery exist. The Schedule of Studies (Table 6) provided in Section 6.4 outlines the research required to further refine the species' critical habitat.

Critical habitat has not been identified for Atlantic Wolffish as this species is listed as Special Concern and therefore identification of critical habitat is not required.

6.2 Information and Methods Used to Identify Critical Habitat

Northern and Spotted Wolffish are considered ‘data poor’ species. Specifically, basic information concerning the biology (e.g., fecundity, diet), behaviour, population dynamics (e.g., stock-recruitment relationships, mortality/growth rates), distribution and demographics (e.g., abundance, numbers at age, population units) are only partially understood. Similarly, since data on wolffish-habitat relationships are gathered through remote sensing and bottom trawl surveys, there is a ‘disconnect’ between spatial scales: habitat data are often gathered at the spatial scale of square kilometers; whereas wolffish are thought to be mainly associated with the habitat at the scale of meters. In addition, there is limited knowledge, especially in the offshore, on how specific habitat features (e.g., rock crevices, hard coral communities, marine macrophytes) influence a wolffish’s affinity for specific locations in the habitat, or what functional role specific habitat features play in supporting/maintaining the life cycle processes of Northern and Spotted Wolffish.

Gulf of St. Lawrence

This section outlines methodology for identifying critical habitat for Northern Wolffish (Figure 1, polygons 6 and 7) and Spotted Wolffish (Figure 2, polygons 5-7).

Determining critical habitat for wolffish does not require complete certainty (DFO 2011b), but rather the best available knowledge (DFO 2007, 2011b). The study by Dutil et al. (2013a) used DFO Gulf of St. Lawrence groundfish survey data from 1971 to 2008 to compare patterns of wolffish distribution with the spatial distribution of benthic habitats. This study focused on ‘hotspots’ and habitat categories rather than attempting to define exact locations.

Dutil et al. (2011a) proposed a large-scale (i.e., megahabitat) hierarchical classification of the seafloor as a foundation for mapping and describing marine habitats of the St. Lawrence Estuary and Gulf. The study area was divided into a grid of 100 km² (10 X 10 km) cells. This classification was based on various physiographic and oceanographic characteristics of the area, and includes information on salinity, temperature, dissolved oxygen, depth, seafloor slope, variability in landscape, and sediments. Cluster analysis grouped the cells into four deep water and nine shallow water habitats for a total of 13 different megahabitats.

To study the spatial distribution of the three wolffish species in the St. Lawrence Estuary and Gulf, Dutil et al. (2013a, b) aggregated wolffish catch and effort data on the habitat classification grid. This catch and effort data was collected during annual bottom trawl surveys from 1971 to 2008 in the northern Gulf and from 1978 to 2008 in the southern Gulf, during which wolffish were identified to species, and catch was reported by weight. Corrections for fishing gear catchability were not possible. As a result, presence-absence data were used to calculate frequency of occurrence (number of sets with species present) and level of effort (total number of sets) in each cell. Various methods were then used to describe the spatial distribution of catches and expressed as area of occupancy, density and ‘hotspots’.

NL Region

This section outlines methodology for identifying critical habitat for Northern Wolffish (Figure 1, polygons 1-5) and Spotted Wolffish (Figure 2, polygons 1-4).

Research survey datasets for Northern and Spotted Wolffish were analyzed based on the number of wolffish present at sea bottom temperature and depth. Sea bottom temperature values were derived from research surveys conducted in the fall (1977 to 2013) and spring (1971 to 2013). Depth values were based on the General Bathymetric Chart of the Ocean (GEBCO) which is composed of depth data collected on a two minute grid worldwide. Species were analyzed separately for the spring and the fall to determine their preferred temperature and depth.

The values for temperature and depth were extracted to a raster with cell size of 10 km by 10 km (100 km^2) for analysis within the exclusive economic zone of Canada in the NL Region. The areal coverage includes NAFO zones 2G, 2H, 2J, 3K, 3L, 3N, 3O, 3Ps, and 3Pn. The number of species present were counted for each temperature and depth value and separated into ranges based on the frequency of occurrence for both Northern and Spotted Wolffish in the fall and in the spring. The following percentiles were used to divide the data into meaningful ranges: 1%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 99%. The ranges were then ranked from 0-5. A very narrow range suggested a higher concentration of wolffish within the bounds of those values which define each percentile.

The rankings for depth and temperature were summed together separately by species/season to produce the resulting heat maps with the highest possible value of 10 which indicates optimal (value of 5) temperature range and depth in the same location and the lowest possible value of 0 where there were no wolffish present in that temperature/depth range. The resulting maps exclude 0 values and indicate where wolffish are most likely to occur based on temperature and depth.

Maps for spring and fall were overlaid onto a single map which represents critical habitat for Northern and Spotted Wolffish on a year-round basis.

Critical habitat presented in Figures 1 and 2 represents sufficient habitat necessary for the recovery of Northern and Spotted Wolffish, respectively. Appropriate temperatures and depths as listed in Tables 4 and 5 represent where critical habitat is found within polygons.

6.3 Identification of Critical Habitat

Geographic Identification

The following locations of critical habitat functions, features and attributes have been identified using the Area of Occurrence Approach. The Area of Occurrence Approach acknowledges that critical habitat is not comprised of the entire area within the identified boundaries; however, the best available information indicates that within the identified area, the functions and features necessary for the species' survival or recovery exist.

The areas presented in Tables 2 and 3, and Figures 1 and 2, are those that the Minister of Fisheries and Oceans considers necessary to support the species' recovery objectives.

Table 2. Coordinates for Northern Wolffish critical habitat.

Polygon	Latitude	Longitude	Area (km^2)
1	55.635	-56.827	10,912.70
	55.549	-57.012	
	55.997	-58.472	
	55.347	-58.698	
	56.245	-60.002	
	56.414	-59.689	
	56.146	-59.329	
	56.620	-57.996	
	56.277	-58.004	
	56.281	-57.474	
2	53.073	-54.674	28,927.37
	53.355	-53.402	
	54.341	-53.967	
	54.956	-55.227	
	54.490	-56.113	
	54.636	-56.602	
	55.376	-55.325	
	54.689	-53.137	
	53.048	-52.021	
	52.536	-53.719	
3	50.201	-53.422	36,670.56
	50.553	-54.113	
	51.155	-53.500	
	51.395	-54.288	
	52.209	-54.099	
	52.937	-51.750	
	51.976	-50.614	
	50.973	-52.880	
4	48.942	-50.177	33,604.29
	49.080	-52.369	
	49.250	-52.339	
	49.687	-52.092	
	51.426	-50.978	
	51.680	-50.392	
	50.367	-50.607	
	49.919	-49.943	
	49.041	-49.924	
	48.459	-49.396	
	48.034	-48.436	

	47.975	-47.750	
	47.798	-47.740	
	47.878	-48.590	
	48.278	-49.473	
5	47.259	-59.312	61,08.89
	47.333	-59.210	
	46.891	-58.149	
	45.896	-57.174	
	45.561	-57.329	
	46.754	-58.479	
6	48.590	-60.861	806.70
	48.321	-60.904	
	48.349	-61.308	
	48.529	-61.281	
	48.520	-61.146	
	48.609	-61.132	
7	47.840	-59.360	1,201.63
	47.881	-59.894	
	48.150	-59.845	
	48.105	-59.310	

Table 3. Coordinates for Spotted Wolffish critical habitat.

Polygon	Latitude	Longitude	Area (km^2)
1	53.334	-53.539	11,985.54
	53.763	-53.363	
	54.440	-53.967	
	54.812	-54.660	
	54.831	-56.069	
	55.366	-56.099	
	54.886	-53.985	
	54.595	-53.341	
	53.497	-52.548	
	53.517	-53.125	
2	47.278	-47.760	76,847.08
	48.635	-50.849	
	48.398	-52.702	
	49.269	-52.754	
	49.601	-52.120	
	50.816	-51.863	
	51.223	-51.400	
	51.862	-52.090	
	50.919	-53.339	
	50.232	-53.429	
	50.272	-54.020	
	50.972	-53.919	
	51.506	-53.083	
	52.875	-53.098	
	53.132	-52.006	
	51.958	-51.078	
	51.306	-50.269	
	50.870	-50.784	
	50.338	-50.854	
	49.842	-50.089	
	49.126	-50.262	
	48.698	-49.925	
	48.159	-48.809	
	47.977	-47.736	
3	47.362	-57.689	650.68
	47.368	-57.430	
	47.187	-57.428	
	47.177	-57.561	
	46.919	-57.690	
	46.913	-57.794	

	47.085	-57.706	
4	47.598	-58.769	566.86
	47.621	-58.488	
	47.359	-58.481	
	47.360	-58.740	
5	48.116	-59.444	1,209.61
	48.150	-59.845	
	48.508	-59.780	
	48.474	-59.375	
6	49.269	-59.080	1,414.15
	49.000	-59.134	
	49.012	-59.271	
	48.922	-59.288	
	48.956	-59.697	
	49.225	-59.646	
	49.214	-59.509	
	49.304	-59.491	
7	49.617	-59.991	910.40
	49.649	-60.406	
	49.918	-60.359	
	49.886	-59.941	

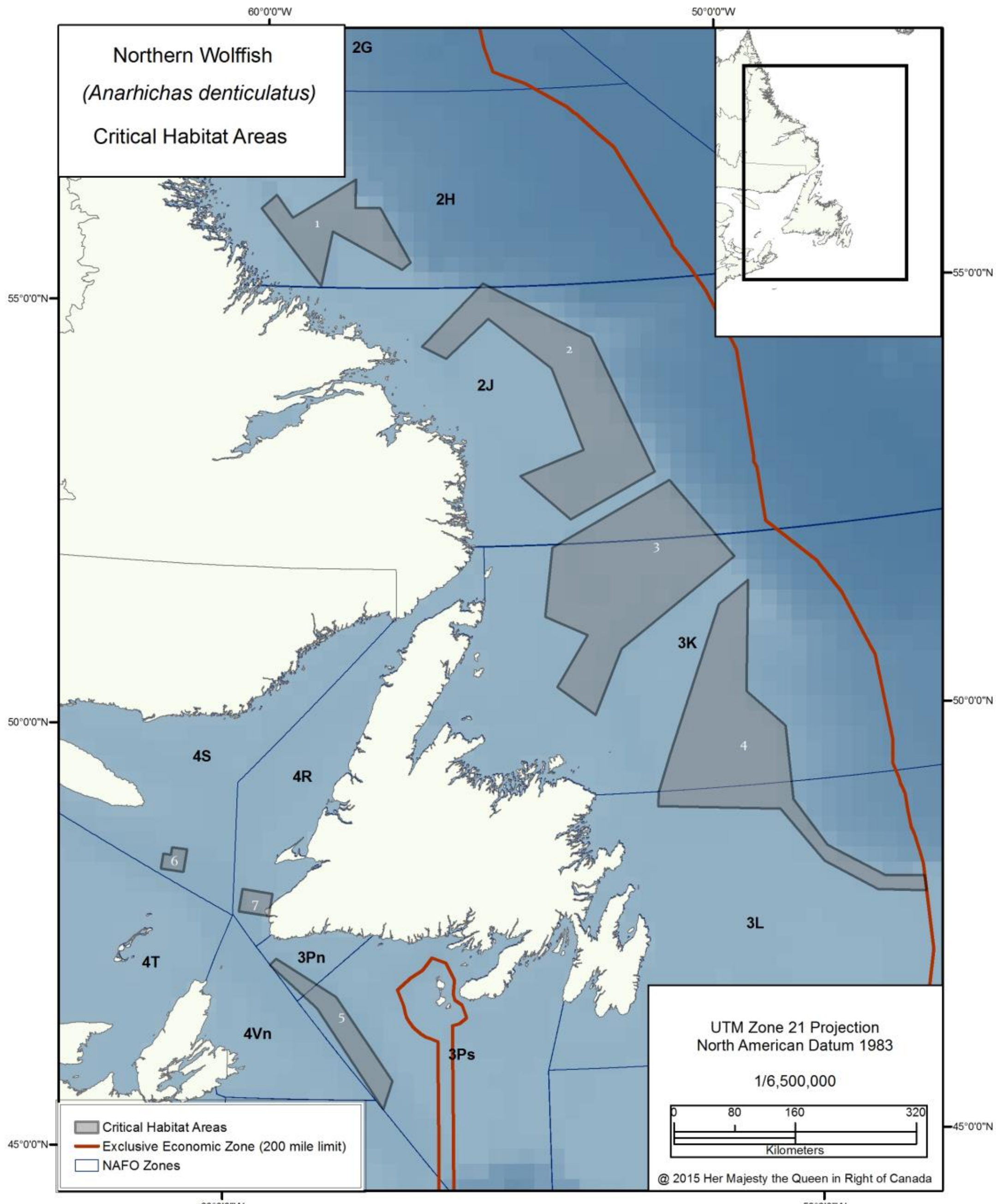

Figure 1. Map of Northern Wolffish critical habitat.

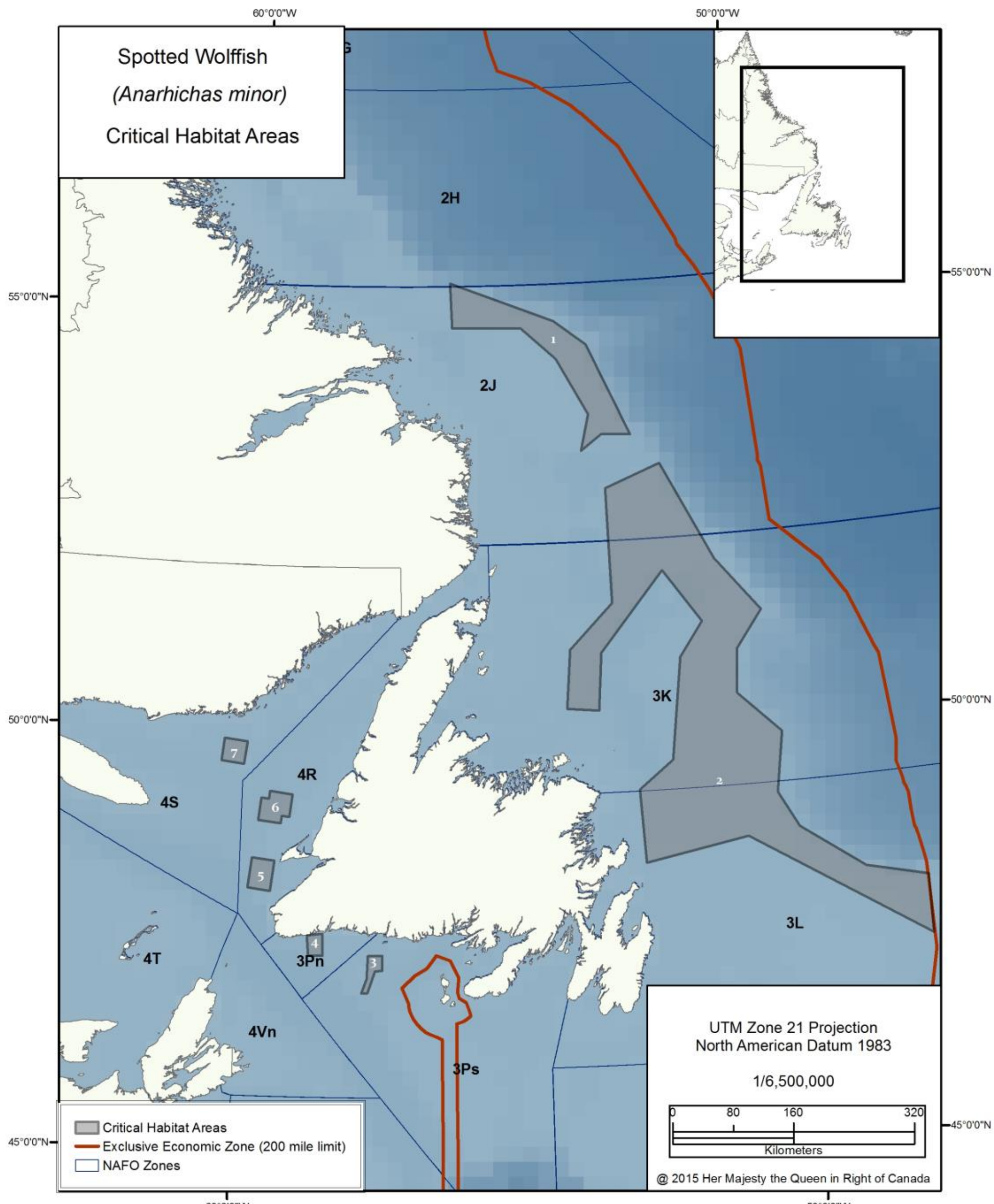

Figure 2. Map of Spotted Wolffish critical habitat.

Biophysical Identification

Tables 4 and 5 summarize the best available knowledge of the functions, features and attributes of critical habitat to support all life stages of Northern and Spotted Wolffish. Note that not all attributes in Tables 4 and 5 must be present in order for a feature to be identified as critical habitat. If the features, as described in Tables 4 and 5, are present and capable of supporting the associated function(s), the feature is considered critical habitat for the species, even though some of the associated attributes might be outside of the range indicated in the table.

Table 4. General summary of the potential biophysical functions, features, attributes and location of critical habitat necessary for Northern Wolffish survival or recovery.

Geographic location	Life stage (if more than one)	Function	Feature(s)	Attribute(s)
Gulf of St. Lawrence (polygons 6 & 7)	All	All portions of life history[1]	Deep-water steep sloped habitat Channels offshore	• Poorly diversified habitats • Fine sediments • Depths >200 m, aggregations at depths 250-300 m • Low oxygen saturation • Temperature ranges 3-5^{o}C • High salinity 34 psu
NL Region (polygons 1-5)	All	All portions of life history[1]	Edge of the Grand Banks and Labrador Shelf Deep channels	• Depths 118-636 m [2] • Temperature ranges 2.3-5.1^{o}C[3]

[1] This species does not undergo large scale movements therefore all portions of life history are carried out in the same location.
[2] Spring and Fall depth ranges have been combined into a single value to represent a year-round range.
[3] Spring and Fall temperature ranges have been combined into a single value to represent a year-round range.

Table 5. General summary of the potential biophysical functions, features, attributes and location of critical habitat necessary for Spotted Wolffish survival or recovery.

Geographic location	Life stage (if more than one)	Function	Feature(s)	Attribute(s)
Gulf of St. Lawrence (polygons 5-7)	All	All portions of life history[1]	Deep water shelf habitat Relatively cold shallow to mid-depth habitat Deep-water steep sloped habitat (less intensively)	• Large habitat and relief diversity • Coarse sediments and rocky outcrops • More often found on plateaus than in channels while avoiding surface waters (<40 km from coast) • Depths 80-260 m, aggregations at depths 180-240 m • Intermediate salinities • Intermediate oxygen levels • Temperature ranges 2-4°C
NL Region (polygons 1-4)	All	All portions of life history[1]	Edge of the Grand Banks and Labrador Shelf Deep channels	• Depths 82-346 m [2] • Temperature ranges 0.1-4.2°C[3]

6.4 Schedule of Studies to Identify Critical Habitat

Further research is required to refine critical habitat features that are necessary to support recovery objectives, and to protect critical habitat from destruction. This additional work includes the following studies (Table 6):

Table 6. Schedule of Studies to identify critical habitat.

Description of Study	Rationale	Timeline*
Research aspects of Spotted Wolffish life history as revealed by rearing and farming observations.	The ability to observe certain characteristics of life history in nature is very difficult. Laboratory investigation would be a more appropriate use of resources.	2020
Carry out new field studies to study seasonal movements and habitat associations using new technologies (data storage tags, popup tags, etc.).	Individual level studies can provide information on habitat associations whereas large scale bottom trawl methods cannot.	2020
Use laboratory studies to improve knowledge of wolffish physiology.	In the past, there has been a great deal of work done on Spotted Wolffish. Additional work is required on Northern Wolffish.	2020
A comparison of Spotted Wolffish growth rate in the northern Gulf of St. Lawrence with the Labrador Shelf and Grand Banks (through the comparison of growth rate at age using otoliths).	There is evidence that low values of dissolved oxygen (hypoxia) (< 70% sat) slows growth rate in the laboratory. Many sites where Spotted Wolffish are found in the northern Gulf of St. Lawrence have oxygen levels that are lower than 70% (much lower). It is currently not known if the species would respond the same in the field as it did during laboratory testing.	2020

*Estimated completion date.

6.5 Examples of Activities Likely to Result in the Destruction of Critical Habitat

Under SARA, critical habitat must be legally protected from destruction within 180 days of being identified in a recovery strategy or action plan. For Northern and Spotted Wolffish critical habitat, it is anticipated that this will be accomplished through a SARA Critical Habitat Order made under subsections 58(4) and (5), which will invoke the prohibition in subsection 58(1) against the destruction of the identified critical habitat.

The following examples of activities likely to result in the destruction of critical habitat (Table 7) are based on known human activities that are likely to occur in and around critical habitat and would result in the destruction of critical habitat if unmitigated. The list of activities is neither exhaustive nor exclusive. The absence of a specific human activity from this table does not preclude or restrict the Department’s ability to regulate that activity under SARA. Furthermore, the inclusion of an activity does not result in its automatic prohibition, and does not mean the activity will inevitably result in destruction of critical habitat. Every proposed activity must be assessed on a case-by-case basis and site-specific mitigation will be applied where it is available and reliable. Where information is available, thresholds and limits have been developed for critical habitat attributes to better inform management and regulatory decision making. However, in many cases, knowledge of a species and its critical habitat’s thresholds of tolerance to disturbance from human activities is lacking and must be acquired.

Activities likely to destroy critical habitat in the Gulf of St. Lawrence (polygons 6 and 7 for Northern Wolffish and 5-7 for Spotted Wolffish) include but are not limited to, benthic habitat destruction and contaminants.

Activities likely to destroy critical habitat in the NL Region (polygons 1-5 for Northern Wolffish and 1-4 for Spotted Wolffish) include but are not limited to activities that alter the thermal habitat and activities that cause habitat destruction that alters depth and subsequently alters the thermal habitat.

Table 7. Examples of activities likely to destroy critical habitat.

Geographic Location	Threat	Activity	Affect-Pathway	Function Affected	Feature Affected	Attribute Affected
Gulf of St. Lawrence (polygons 6 and 7 for Northern Wolffish and 5-7 for Spotted Wolffish)	Benthic habitat destruction	Activities that impact the benthic environment	Destruction of benthic habitat can result in damage to spawning and rearing areas, egg masses and adult wolffish habitat	All portions of life history	Benthic environment	Bottom substrate
	Contaminants	Deposition of contaminants in the benthic environment Release of contaminants into the pelagic environment	Reduced water and sediment quality resulting in a decrease in young-of-the-year health and increase in mortality	All portions of life history	Benthic environment Upper water layer	Water quality
NL Region (polygons 1-5 for Northern Wolffish and 1-4 for Spotted Wolffish	Thermal habitat alteration	Activities that impact the thermal habitat	Alteration of thermal habitat can result in decreased survival of wolffish	All portions of life history	Thermal environment	Temperature
	Habitat destruction	Destruction of habitat causing a change in depth that could result in alteration of thermal habitat	Changes in depth can result in changes to thermal habitat which can decrease survival of wolffish	All portions of life history	Thermal environment	Depth/ Temperature

7. Ecological Role

Eggs, larvae and juveniles of wolffish are susceptible to predation by a number of species, although for at least one of the species (Atlantic Wolffish) the eggs are guarded by the adult males until hatching. Adults have fewer predators given their size and substantial teeth. They may also spend a part of their time in rock crevices. The role of each wolffish species as a forage fish is undetermined, though they do appear to be a food source for several species as larvae and young. Northern Wolffish in the northeast Atlantic has been observed defending a territory around bait on the bottom from cod and haddock; acoustic tracking over time showed that the size of that territory was quite restricted (Godø et al. 1997).

8. Importance to People

Historically, there were no significant directed fisheries for wolffish in Canadian waters and, prior to March 2003, the only applicable regulation regarding wolffish was contained in the 1985 Atlantic Fishery Regulations that mandated fishers to retain and land all wolffish bycatch.

Following the decline of many “traditional” species in the early to mid-1990s, Spotted and Atlantic Wolffish, as well as other “non-traditional” species, were considered as potential candidates for new directed fisheries. Of the three wolffish species, only Spotted and Atlantic Wolffish have commercial value and as a result of concerted marketing efforts in the 1990s, commercial interest in wolffish had increased. Product demand had improved its market value in the late 1990s. Increasingly, Spotted and Atlantic Wolffish were processed into frozen or fresh fillets. In addition, it was known that the skin of Spotted Wolffish could be tanned and used for leather. Since Northern Wolffish has no commercial value, it had been discarded and not reported to DFO. Northern Wolffish are occasionally consumed by Greenlanders, though their gelatinous flesh is not generally favored and its skin is not suitable for secondary processing (COSEWIC 2001a).

Experimental fishing, however, did not identify areas where catch rates were sufficiently high to warrant directed commercial exploitation. Therefore, all three species were caught in mixed fisheries or incidentally through targeted fisheries, primarily for Greenland Halibut but also with other demersal fisheries such as Atlantic Cod (*Gadus morhua*), and Yellowtail Flounder (*Limanda ferruginea*). Invertebrate fisheries such as for shrimp and crab species incidentally capture wolffish as well.

Mandatory release of Spotted and Northern Wolffish in a manner that maximizes chance of survival has been instituted through license amendments in all Atlantic Regions of DFO as of 2004. Consequently, fishers, if previously retaining Spotted Wolffish for market purposes, may notice a decrease in the total landed value of their catch as they are now required to return that species to the ocean at the point of capture. The greatest captures of wolffish for commercial trade were reported from the south coast of Newfoundland and from Nova Scotia. However, nearly all of the captures from those areas were Atlantic Wolffish.

Information on landings and value up to 2003 can be found in the 2008 version of this Recovery Strategy and Management Plan which is available on the Species at Risk Public Registry.

9. Biological and Technical Feasibility of Recovery

Natural history strategies such as relatively slow growth, nesting habits (Atlantic Wolffish), and limited dispersal in conjunction with potential impacts of human activity and changing environmental limitations have the potential to curtail the recovery ability for wolffish species. As such, research needs to be undertaken to define the relationship between wolffish and their environment. However, assuming that anthropogenic threats can be identified and mitigated through implementation of this Recovery Strategy and Management Plan, recovery is considered feasible based on the following criteria:

- Individuals capable of reproduction are currently available to improve the population abundance;

- Based on current knowledge of habitat requirements, sufficient suitable habitat is currently available to support these species;

- Significant anthropogenic threats to these species, as described in this document, may be mitigated through recovery actions; and

- Necessary recovery techniques to address these significant anthropogenic threats do exist and have been demonstrated to be effective.

Biological and technical feasibility of these species may also be influenced by unanticipated environmental effects that could unpredictably alter the course of recovery.

10. Recommended Scale for Recovery

When this Recovery Strategy was first developed, the recovery team chose to incorporate the three wolffish species into a single “multi-species” Recovery Strategy and Management Plan because of their similar distribution, life history, ecology and taxonomy. One document inclusive of both Threatened species, as well as the Special Concern species, was believed to be the most efficient and least repetitive approach.

Currently, release of the two Threatened wolffish species in a manner that will maximize likelihood of survival is a fisheries license requirement. As well, various moratoria on groundfish put in place during the 1990s, and current fisheries closures leading to decreased effort, contribute to recovery. Reducing directed groundfish fisheries has indirectly protected wolffish, a primary source of incidental bycatch of all three species.

In all DFO Regions where wolffish are present, the recovery team recommended, at the time, that the scale of recovery effort incorporate an ecosystem approach and that it be implemented in parallel with future conservation objectives of fisheries management, integrated management plans, Marine Protected Area Networks and other industrial activities, and this is still appropriate today.

Due to the distribution of wolffish, recovery must be considered at both national and international scales. Not only do non-Canadian vessels capture wolffish outside and inside (in the past) Canadian waters, but large concentrations of wolffish in international waters adjacent to Canadian waters are potentially influential to the state of wolffish populations in Canadian waters.

Part B: Recovery

1. Overview

This document is the first component of a framework to promote the conservation and recovery of three wolffish species in eastern Canadian waters. The second component, the action plan (as outlined in Part B, Section 7) will be completed in 2018 as well. Where an activity has already been initiated to address the objectives laid out in this document, these actions are duly noted in Part B, Section 5 - Actions Completed or Underway.

The Recovery Team who developed the 2008 version of this Recovery Strategy and Management Plan, determined that it was best to incorporate both Threatened wolffish species into a single "multi-species" document and to include Atlantic Wolffish, a species of Special Concern, due to their similar life histories, ecology and taxonomy. As such, this document represents both a Recovery Strategy for Northern and Spotted Wolffish, as well as a Management Plan for Atlantic Wolffish. As SARA prohibitions are not applicable to Special Concern species, conservation and recovery activities described in this document should be viewed as recommendations only for Atlantic Wolffish.

2. Goals, Objectives and Strategies

2.1 The Recovery and Management Goal

The goal of this Recovery Strategy and Management Plan is to increase the population levels and distribution of Northern, Spotted and Atlantic Wolffish in eastern Canadian waters such that the long-term viability of these species is achieved. This will be accomplished by addressing the objectives and strategies outlined below.

2.2 Recovery and Management Objectives

The Recovery Strategy and Management Plan for wolffish species in eastern Canadian waters puts forth five broad, inter-related objectives. All relate to activities that may be mitigated through human intervention.

Objective 1: Enhance knowledge of the biology and life history of wolffish species;

Objective 2: Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities;

Objective 3: Reduce the potential of wolffish population declines by mitigating human impacts;

Objective 4: Promote wolffish population growth and recovery; and

Objective 5: Develop communication and education programs to promote the conservation and recovery of wolffish populations.

Each of these broad objectives is designed to achieve the goals of this document. As this Recovery Strategy and Management Plan is considered to be adaptive (i.e., a living document), objectives and strategies can be added or revised as new knowledge becomes available.

The following sections elaborate on the above objectives and link them with recovery strategies that include specific actions required for implementing this document. The order in which the strategies are presented does not reflect a ranking of importance. Rather, all strategies are considered critical to the recovery process and are recommended to be carried out in an integrated manner. The consequent activities (actions) of the recovery action plan will result in the implementation of the recovery strategies and objectives.

In general, the recovery of a species at risk involves a multi-faceted approach that takes into consideration individual populations, the number and nexus of these populations, and the creation of adequate population levels to withstand events such as environmental shifts and climate change. According to the National Recovery Working Group, establishing a sustainable population requires:

- Enough breeding adults to be considered sustainable in the long term;
- Sufficient quality habitat available or potentially available to maintain sustainable population numbers;
- Adequate or improving demographic parameters (e.g., sex ratio, birth and death rates); and
- Mitigation against and control of human threats to the population, particularly those that initially contributed to the species’ decline.

2.3 Recovery Strategies and Specific Actions to Meet Recovery Objectives for Wolffish Species

Five strategies constitute the basis of a framework for recovery: research, habitat conservation and protection, mitigation of human activities, promotion of public knowledge and stakeholder participation in the recovery of wolffish populations and the conservation and protection of their habitat, and monitoring of human activities. Associated specific actions required to achieve species recovery and anticipated outcomes of those actions are listed in Table 8.

Table 8. Linking recovery objectives to strategies and specific actions required to promote recovery of wolffish species.

Priority	Recovery Objective	Recovery Strategy	Recovery Actions	Anticipated Effect
Necessary Ongoing	1, 2, 4	A. Research	Conduct directed research on: 1. life history 2. population structure 3. identification of limit reference points 4. ecosystem interactions	Better adaptive management decisions
Necessary Ongoing	2, 4, 5	B. Habitat conservation and protection	1. identify habitat 2. define measures to conserve and/or protect wolffish habitat	Increase potential of spawning, rearing, feeding, and other life processes
Urgent	3, 4, 5	C. Mitigate human activities	1. identify and mitigate impacts	Direct benefit to species numbers, reducing mortality at all life stages
Necessary Ongoing	3, 4, 5	D. Promote public knowledge and stakeholder participation in the recovery of wolffish populations and the conservation and protection of their habitat	Through: 1. education 2. stewardship 3. consultation 4. cooperation	Support for management measures and other recovery strategies
Ongoing	3, 4	E. Monitor human activities	1. monitor wolffish spatial and temporal abundance patterns 2. monitor spatial and temporal patterns in natural and human induced mortality	Better adaptive management decisions

2.4 Recovery Strategy A - Conduct Research (Objectives 1, 2, 4)

Objective 1: Enhance knowledge of the biology and life history of wolffish;
Objective 2: Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities; and
Objective 4: Promote wolffish population growth and recovery.

2.4.1 Recovery Action A1 - Study Life History

Although the subject of considerable research in the Northeast Atlantic, work on the life history of wolffish species residing in Canadian Atlantic waters has been limited, perhaps because they are not the target of a commercial fishery. There is much to learn about how wolffish in the eastern Canadian marine ecosystem reproduce, live, grow, and die.

This basic knowledge is the foundation for understanding the population status of wolffish species and subsequently being able to formulate actions required to conserve the species and their habitat so that they are no longer at risk. The recovery objectives are broad and limitations exist for setting specific measurable objectives without having more complete information about the species; thus the objective for research.

Conduct directed research to study wolffish life history by expanding on available Canadian and international research in the following areas:

- Reproductive biology;
- Age, growth, and longevity;
- Diet and niche;
- Natural mortality (health condition i.e., diseases, parasites, environmental effects, and anthropogenic interactions); and
- Traditional User Knowledge.

2.4.2 Recovery Action A2 - Study Population Structure within Eastern Canadian Waters

Identification of wolffish population structure, including Designatable Units (DUs), is fundamental to wolffish management. The observed population trends show very different patterns among areas, the decline being greatest on the Labrador Shelf. In contrast, the index of immature individuals on the Scotian Shelf increased to its highest values in the time series in the early 1990s, and has since shown only a slight decline (Simon et al. 2012). Understanding the reasons for these spatial differences and defining the population unit(s) are key to formulating appropriate recovery and management strategies and actions. To determine spatial variation in the population structure of the wolffish species in eastern Canadian waters, research needs to be conducted on:

- Age/sex population structure;
- Migration/seasonal movements and distribution;
- Wolffish habitat utilization during various life history stages including spawning, nursery, rearing areas, and adult feeding;
- Wolffish abundance with respect to modeling and forecasting abundance; and
- Genetic, morphometric and meristic characteristics to determine if wolffish form a single DU or multiple DUs as a basis for management.

2.4.3 Recovery Action A3 - Identify Biological Reference Points

Fisheries management regimes require the use of a combination of quantitative and qualitative biological reference points (BRP's) such as biomass estimates or indices that might be considered indicators of a recovered population.

Insufficient data exist for the determination of wolffish BRP's and these deficiencies require research on their own and with respect to those fisheries in which they are incidentally caught.

In the case of wolffish and other poorly understood species, estimates of population growth and viability under various levels of bycatch will be difficult, if not impossible to determine. In particular, obtaining a measure of natural mortality and longevity is problematic for most marine fish species, including wolffish. In addition, in the case of wolffish, obtaining an accurate estimate of fishing mortality that is required to assure viability is problematic when wolffish are captured in such a diversity of fisheries. Absolute catch is not known, though estimates of total removals can be computed, and subsequently used in the development of allowable harm strategies.

Currently, the best available information for the development of BRPs comes from the annual spring and fall research surveys from which biomass indices can be developed. While problematic, due to the lack of understanding of wolffish population dynamics, development of potential BRPs based on historic patterns of wolffish abundance and spatial distribution should be modeled. Given the fluctuations that occur in wolffish populations as indicated by research surveys, any abundance and distribution targets that are developed should attempt to incorporate this variability. For example, to develop crude initial reference levels, a calculation of the average biomass, corrected for the change in gear, for the years when the population was greatest may provide a target biomass index. Similar approaches to modeling of the spatial distribution of wolffish should also be conducted. Spatially, the extent/range of the populations can be used through a presence/absence area estimate, GIS spatial analysis, or other methods. Note again that determining the baseline is problematic and the temporal variation in these parameters should be considered. Since data are not available to define a virgin population, a 50% rule (or some variation upon this) could be employed until more explicit methods are identified. In the future, more refined models should incorporate age-structured population dynamics as additional information on population age-structure and maturity is acquired. With additional data and modeling, the spawning stock biomass and recruitment indices can be employed in the development of BRPs.

Alternatively, consideration should be given to the imposition of a catch limit for each species based on an exploitation index derived from a ratio of catch to biomass index. Further research would be required to determine what level of exploitation would not deter recovery.

2.4.4 Recovery Action A4 - Study Ecosystem Interactions

Altering the species composition, by extinction or decrease in biomass and/or distribution of a wolffish species, within the eastern Canadian marine ecosystem would have unknown effects that could escalate through the ecosystem. For example, they may be the direct prey or predator of commercially important species or wolffish may prey on species that are predators of commercial species. These relationships are poorly understood for wolffish (as for most other marine species). Regardless of their relationship with other species, the disappearance of a wolffish species is a loss to the genetic diversity of the eastern Canadian marine ecosystem. The following research should be conducted to more fully understand wolffish status and its relationships with other species within the eastern Canadian marine ecosystem:

- Predator/prey interactions;
- Ocean habitat associations;
- Abundance in relation to other species;
- Ecological linkages;
- The effects of temporal ecosystem disruptions/alterations to critical life history periods of wolffish and their predators and prey; and
- Possible effects of marine environmental shifts on life history.

2.5 Recovery Strategy B – Habitat Conservation and Protection (Objectives 2, 4, 5)

Objective 2: Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities;
Objective 4: Promote wolffish population growth and recovery; and
Objective 5: Develop communication and education programs to promote the conservation and recovery of wolffish populations and their habitat.

2.5.1 Recovery Action B1 - Identify Habitat, including Critical Habitat

Knowledge of wolffish habitat and how it is utilized is extremely limited. This is not unique to wolffish and is generally the case for most marine fish species.

Wolffish historic geographic range defines its potential habitat in eastern Canadian waters (refer to Part A). Preliminary research has been conducted to identify habitat associations with regard to depth, temperature, substrate, and different life history periods (refer to Table 1). However, the amount of ocean habitat required on spatial and temporal scales at different periods of the life history for the recovery and survival of wolffish species is not currently known. In addition, changes in wolffish abundance and distribution and seasonal fluctuations may be related to water temperature. Ocean ecosystem habitat complexities for wolffish are not fully understood, therefore species-specific research should be conducted in the following areas:

- Habitat characteristics and the environmental factors that control or limit distribution, abundance, growth, reproduction, mortality and productivity of wolffish;
- The physical, chemical and biological characteristics of the ocean ecosystem where wolffish occur;
- Spatial and temporal foraging and shelter/resting areas to determine habitat associations;
- Current and historic geographic range and stock size to determine spawning grounds, rearing areas, feeding grounds and the locations of important life history processes; and
- The definition of critical habitat as it pertains to marine finfish, in particular wolffish, in eastern Canadian waters in order to determine priority habitat sites. A schedule of studies to identify critical habitat is outlined in Table 6.

2.5.2 Recovery Action B2 - Define Measures to Conserve and/or Protect Wolffish Habitat

Effective conservation requires conservation and/or protection of habitat from the unintended effects of human activities on the eastern Canadian marine ecosystem. Legislation, policy, regulations, partnership agreements and stewardship are examples of mechanisms currently in place that can be utilized to protect wolffish and their habitat. Wolffish interact with many different species and these interactions may be critical to their survival, therefore an ecosystem-based approach is recommended. Research should be conducted in the following areas:

- Threats to wolffish habitat (natural and human induced);

- Existing or potential activities that may threaten wolffish habitat and the extent to which they can be mitigated;
- Prioritization of the spatial and temporal habitat needed to be protected to achieve the goal of population recovery; and
- Potential use of various management options as methods for the conservation and/or protection of wolffish habitat.

2.6 Recovery Strategy C - Mitigate Human Activities (Objectives 3, 4, 5)

Objective 3: Reduce the potential of wolffish population declines;
Objective 4: Promote wolffish population growth and recovery; and
Objective 5: Develop communication and education programs to promote the conservation and recovery of wolffish populations.

2.6.1 Recovery Action C1 - Identify and Mitigate Impacts of Human Activity

It is important for the recovery of wolffish species that the unintended human impacts on their populations and their habitats caused by fishing, offshore oil and gas activities and other potentially detrimental activities be identified and mitigation measures put in place. In addition, military activities, ocean dumping, land-based and atmospheric pollution, and global climate change are emerging issues, all of which may potentially affect the eastern Canadian marine ecosystem and subsequently wolffish populations. Current legislative and regulatory policies that conserve and protect wolffish and their habitat must function in concert with non-legislative mitigation measures. Research should be conducted where possible to:

- Identify human impacts on all life stages of wolffish populations and their habitat on spatial, temporal and seasonal scales;
- Identify impacts and estimate their degree of severity or level of risk associated with their likelihood of occurrence;
- Identify how impacts can be mitigated both inside and outside the Canadian Exclusive Economic Zone (EEZ);
- Harmonize international, national, and provincial regulatory changes as they relate to wolffish conservation and incorporate education and stewardship as ways to mitigate human activities;
- Continue to institute mandatory release of the two Threatened wolffish species taken incidentally in all commercial fisheries in a manner that maximizes chance of survival;
- Assess the post-release survival of wolffish and eventually the effectiveness of mandatory release;
- Promote modifications to gear and methods to avoid the catch of wolffish where practical; and
- Explore modification of gear/methods to reduce the potential impact on wolffish habitat.

2.7 Recovery Strategy D - Promote Knowledge and Stakeholder Participation in the Recovery of Wolffish Populations and Habitat Conservation and/or Protection (Objectives 3, 4, 5)

Objective 3: Reduce the potential of wolffish population declines;
Objective 4: Promote wolffish population growth and recovery; and
Objective 5: Develop communication and education programs to promote the conservation and recovery of wolffish populations.

2.7.1 Recovery Action D1 - Education and Communication

A key part of the strategy is to increase resource user knowledge and awareness of the plight of wolffish species, their population status, current threats and the actions required to ensure their recovery and long-term conservation. Publication of articles in local and regional newspapers and fishing related magazines, the distribution of wolffish identification material and information on species at risk to the fishing industry, and creation and distribution of posters along with the production of other educational and advisory materials, could all be used to reach a wide audience, specifically harvesters. These materials should be available to the general public as well.

An educational program with both a regional and local component should include the following:

- The development of a comprehensive community education strategy aimed at resource users including:
    - Identification of wolffish to species level (identification cards), general biology of wolffish and its historic population levels;
    - Safe handling of incidentally captured wolffish in order to successfully release them live into their environment; and
    - Awareness of SARA and its importance to the conservation of wolffish.
- Enhancement of consultative activities including the production of related education and advisory activities; and
- Encourage resource user community involvement in the implementation of this Recovery Strategy and Management Plan.

2.7.2 Recovery Action D2 - Stewardship

Stewardship, simply stated, means Canadians - including landowners, private companies, volunteer community organizations, and individual citizens - are caring for our land, air and water, sustaining the natural processes on which life depends. Environmental stewardship can be described as the active expression of responsibility to ensure a healthy, diverse, and sustainable environment for present and future generations. Implementing stewardship activities is therefore a high priority of this strategy and plays an important part in the conservation and protection of wolffish species and their ocean habitat. Consultation with applicable regional fishery groups will foster and maintain their involvement in recovery actions. Such resource user community involvement and support is critical to the success of the recovery of the wolffish species. This participation will serve as a basis for wolffish stewardship programs. Stewardship initiatives should:

- Promote the quick and safe release of incidentally caught wolffish to site of capture;
- Promote the accurate reporting of wolffish catches and subsequent release;
- Promote the identification of human impacts that may affect wolffish and their habitat;
- Initiate programs that implement stewardship activities with stakeholders;
- Provide technical and scientific information to conservation stewards;
- Enhance consultation activities including the production of related education and advisory materials; and
- Encourage resource user cooperation and community involvement in the implementation of this Recovery Strategy and Management Plan.

2.7.3 Recovery Action D3 - Consultation and Cooperation with Harvesters, Processors, Scientists, Regulators, Enforcement, Observers, Dockside Monitors, Governments, Aboriginal Groups and Other Ocean Users

Consultation with resource users is a key component of the recovery process, required to ensure user involvement in recovery actions. Resource users interact daily with the incidental catch of wolffish species; thus, they are provided with a knowledge base from which to design fishing gear to catch fewer wolffish as well as identify methods to safely release them. Such gear modification can be designed to avoid capture through harvesting strategies aimed at reducing encounter rates between wolffish and fishing gear. Therefore, it is important to foster ongoing consultation with resource users and all relevant Canadian jurisdictions. A comprehensive plan for realization of wolffish recovery includes consultation and cooperation amongst a diverse user group (located in each Atlantic Province) including but not limited to:

- Any individuals or groups who may be affected by or may be useful assets in the process of wolffish species recovery and their long-term conservation and protection:
    - Fishing industry;
    - Fishery observers;
    - Aboriginal groups;
    - Provincial and Territorial Jurisdictions;
    - Federal Departments;
    - International Regimes; and
    - Academic Institutions.

2.8 Recovery Strategy E - Monitoring Human Activities and Wolffish Species (Objectives 3, 4)

Objective 3: Reduce the potential of wolffish population declines; and
Objective 4: Promote wolffish population growth and recovery.

2.8.1 Recovery Action E1 - Monitor Wolffish Spatial and Temporal Abundance Patterns

Monitoring the abundance of wolffish species in eastern Canadian waters is essential to ensure that any improvement or deterioration of their status is detected as expediently as possible. This is essential if adaptive management is to be undertaken and be effective. Population size and structure needs to be monitored to discern trends, understand mortality patterns and identify recruitment problems.

Currently, research surveys, particularly stratified-random bottom trawl surveys, are used to obtain fishery independent estimates of stock size and to provide quantitative estimates of recruitment. These data provide a basis for interpretation of abundance and distribution patterns that may provide some basis for defining adaptive management measures and recovery actions.

One of the primary objectives for monitoring wolffish spatial and temporal abundance patterns is to determine the effectiveness of any mitigation measures that have been implemented. Basic monitoring allows or enables early identification of unforeseen problems so that corrective measures can be undertaken in order to avoid further impacts. This ensures proper management (i.e., conservation and protection) of fish and their habitat.

Therefore, the recommended actions are to:

- Utilize research survey data to examine historical, current and future spatial and temporal abundance patterns of each wolffish species; and
- Utilize harvester's knowledge to gather spatial and temporal abundance patterns of each wolffish species.

2.8.2 Recovery Action E2 - Monitor Spatial and Temporal Patterns in Natural and Human Induced Mortality

By integrating research survey data with fisheries observer, statistical, dockside monitor and fishing logbook data, changes in wolffish distribution and abundance patterns can be examined to provide a basis for defining appropriate adaptive management measures and recovery actions. This integration of data will aid in the establishment of performance measures to evaluate:

- Effectiveness of recovery actions on wolffish and their habitat, in particular, effectiveness of releasing wolffish back into their environment;
- Management methods on the conservation and protection of wolffish;
- Habitat protection on the conservation of wolffish; and
- Education, stewardship, consultation and cooperation on the conservation of wolffish.

3. Permitted Activities

Subsection 83(4) of SARA allows for certain activities to be exempt from the general prohibitions of SARA, provided the activities are permitted in recovery strategies, action plans or management plans. In order for this section to be applicable, individuals must be authorized under an Act of Parliament, such as the *Fisheries Act*, to carry out such activities. Section 83(4) can be used as an exemption to allow activities, which have been determined to not jeopardize the survival or recovery of the species.

A Zonal Advisory Process (ZAP) held in St. John's, Newfoundland and Labrador in May 2004 provided an opportunity to review scientific advice regarding the determination of allowable harm for both wolffish species that are currently listed as Threatened, Northern and Spotted Wolffish. Participants of the review included individuals from government, industry and other non-governmental organizations (NGOs). The advice resulting from this meeting was summarized in an allowable harm assessment report (DFO 2004b).

The allowable harm assessment concluded that recent (2000-2002) levels of mortality did not impair the ability of the species to recover. However, all efforts should be taken to enhance the survival in the fisheries, primarily through mandatory release of wolffish in a manner that will increase the chance of survival. This document adopts that conclusion and, in accordance with subsection 83(4) of SARA, permits fishers authorized under the *Fisheries Act* who are engaged in commercial or recreational fishing or in an Indigenous food, social and ceremonial (FSC) fishery for groundfish, shellfish and pelagic species (including emerging fisheries) that may incidentally kill, harm, harass, capture or take Northern or Spotted Wolffish to carry out these activities under the following conditions:

- Every person on board the fishing vessel who incidentally catches Northern or Spotted Wolffish while conducting fishing activities must return them to the place from which they were taken, and where they are alive, in a manner that causes them the least harm;
- Commercial fishers are required to collect and subsequently report information to DFO for each fishing trip where Northern or Spotted Wolffish is caught, utilizing the standard logbook/logsheet protocol specified for the target species, vessel class or licence in question.

In accordance with subsection 83(4) of SARA, this document also permits scientific research activities that are authorized under the *Fishery (General) Regulations*, SOR/93-53 for the purpose of monitoring and sampling various aquatic species, including wolffish. Scientific research was identified in the allowable harm assessment as having negligible impacts on the ability of both Northern and Spotted Wolffish to survive and recover (DFO 2004b).

In assessing allowable harm, the longer the timeframe being examined, the more uncertainty there is in projecting impacts of exploitation on the survival or recovery of a population. Given this uncertainty, the allowable harm assessment for Northern and Spotted Wolffish will be re-evaluated, incorporating any relevant new data. Current monitoring of incidental capture through both logbook data and at-sea observers will continue and will be used to assess the effectiveness of those conservation measures outlined above.

While Atlantic Wolffish has been listed on SARA Schedule 1 as a species of Special Concern (i.e., SARA prohibitions do not apply), it is recommended that live release protocols and reporting, as outlined above for Northern or Spotted Wolffish, also apply to this species. However, the implementation of this recommendation is at the discretion of the DFO regions, and should be approached as a voluntary measure to be used in cooperation with other *Fisheries Act* requirements.

4. Potential Impacts of the Recovery Strategy on Other Species/Ecological Processes

This Recovery Strategy and Management Plan recognizes the importance of the entire marine ecosystem. Multi-species approaches to conservation are known to be difficult due to the diverse interactions between species and their habitats that occur within a marine ecosystem. Recovery activities such as increased habitat protection and/or conservation and implementation of mitigative measures to reduce human induced impacts may also benefit other species that co-occur with wolffish in eastern Canadian waters. The extent of such benefits is not yet completely understood. Collection of data to evaluate and model ecosystem interactions may help to address this unknown. In addition, stakeholder awareness and understanding of marine biodiversity and Threatened species would be heightened through stated protection and/or conservation efforts for the wolffish.

5. Actions Completed or Underway

A multi-stakeholder Recovery Team was formed in 2007 and the following initiatives were initiated or have been completed:

- Prepare a wolffish Recovery Strategy and Management Plan - This document;
- Update current knowledge - Summarized in this document;
- Define goals, objectives, strategies and actions for the wolffish recovery process - This document;
- A wolffish release program as a condition of license to examine the survival of released fish - Instituted in eastern Canada in 2003-2004 and is complete for certain fisheries;
- Commence a program of research (instituted in 2002) that will provide the information required to facilitate effective recovery work. Research is under way (and is complete in some cases) to examine habitat associations, population structure, distribution and abundance, movements/migrations, life history, and diet and feeding;
- Increase understanding of the allowable harm permitting process – An allowable harm assessment has been undertaken and information has been provided to license holders for fisheries where wolffish may be taken as bycatch;
- Commence an education and communication program and promote stewardship geared mainly toward resource users but also the public in general - Education programs on species at risk issues in general and wolffish specifically have taken the form of meetings with fishers and information materials have been disseminated widely.

Intra-Departmental Collaboration has been promoted through:

- Cooperation between various Atlantic Canadian Regional DFO jurisdictions in terms of recovery and regulatory initiatives;
- Sharing data between Atlantic Canadian Regional DFO jurisdictions; and
- Preparation of preliminary economic profiling by regional DFO Policy and Economic Branches.

Federal, Provincial, and Aboriginal collaboration has been promoted through:

- Continuing consultation and cooperative exchange with other federal departments (i.e., Environment and Climate Change Canada, Parks Canada);
- Continuing consultation and cooperative exchange with provincial and territorial representatives, as appropriate; and
- Presentation of the strategy to applicable wildlife management boards and continuing dialogue with Aboriginal groups.

Industry and public involvement has been promoted through:

- Cooperative research initiatives;
- Education and communication with stakeholders: and
- Stewardship initiatives.

The above description of recovery related activities already under way, as promoted in draft versions of this document, indicates that the team and a host of other participants have already made significant progress in terms of recovery efforts. Progress is particularly reflected in the institution of an Atlantic release program and in research, education and stewardship initiatives presently being undertaken. Activities are elaborated in the following sections.

5.1 Recovery Strategy A - Conduct Research

Research under way includes:

- Trends in abundance, distribution, stock (subpopulation) structure and life history;
- Analysis of fishing databases, including SARA logs, observer records, Zonal Interchange Format (ZIF) data and NAFO landings data to estimate impact of fisheries bycatch;
- Definition of habitat associations and critical habitat including, temperature preferences, bottom type, depth, dissolved oxygen, etc.;
- Aging and maturity; and
- Identification of gaps in current knowledge.

5.2 Recovery Strategy B - Habitat Conservation and Protection

See Section 6 for details on Northern and Spotted Wolffish critical habitat and its protection.

5.3 Recovery Strategy C - Mitigate Human Activities

The Recovery Team recommended the quick release of all wolffish, alive wherever possible, caught incidentally by harvesters. Although Northern and Spotted Wolffish have been declared Threatened species by COSEWIC, these fish were still caught incidentally in many fisheries. Federal policy previously specified that they must be brought into port where fish processors either process them or discard them. In

November 2002, the Recovery Team recommended that wolffish no longer be brought into port but rather be released in a manner that maximizes chance of survival.

Wolffish have been described as a “hardy species” that tend to be lively even after capture and have a good chance of survival if released quickly. Therefore, as of 2003-2004, allowable harm permits have been issued to allow harvesters the incidental capture of wolffish. Permit requirements specify that harvesters estimate the weight of their wolffish catch by species and release them quickly and safely at the capture site. In 2004, DFO undertook an allowable harm assessment for wolffish. In summary, the conclusions from that process are as follows:

“Given that mortality due to fishing is considered the dominant source of human induced mortality for Northern and Spotted Wolffish and that the populations of both species have been steady or increasing prior to any prohibitions, it appears that the recent (2000-2002) level of mortality does not impair the ability of the species to recover. However, all efforts should be taken to enhance survival in the fisheries, primarily through mandatory release of wolffish in a manner that will increase the chance of survival. This can only be accomplished through education and permit conditions requiring the release of wolffish in a manner that will enhance their survival. As well, any gear modifications that lead to a reduction in the bycatch of wolffish (for example the Nordmore grate employed in shrimp fishery) should be employed wherever possible. Should there be a large increase in the size of any fisheries that take significant amounts of wolffish, other options may have to be considered. Finally, it is critical that the populations and sources of harm be monitored to ensure that recovery continues to take place”.

Refer to DFO (2004b) and Kulka (2004) and Kulka and Simpson (2004) for further details.

Survival of released fish has been evaluated and preliminary observations suggest that wolffish released in an appropriate manner (placed back in the water quickly and with minimal handling, gills undisturbed) appear to have a high chance of survival. In a study by Grant et al. (2005), Atlantic Wolffish, caught as bycatch in the commercial yellowtail fishery, showed high survival rates when returned to the ocean following up to 2.5 hours out of the water. Similar studies have not been conducted on Spotted or Northern Wolffish and these species are at highest concentrations in much deeper areas. Benoit et al. (2010) investigated the factors that affect pre-discard condition of Spotted and Atlantic Wolffish (and other species), and found a correlation between body size and good condition. This study however, only included fish harvested at isobath <200 m. In addition, programs educating fishers in best practices for release are also under way.

5.4 Recovery Strategy D - Promote Knowledge and Stakeholder Participation in the Recovery of Wolffish Populations and Habitat Conservation and Protection

A variety of promotional items and information materials have been developed by DFO and others to help increase awareness of wolffish. These items include brochures, factsheets, posters, and DVDs that are distributed to fish harvesters and fish plant workers, to students during school visits, and the general public during trade shows and Ocean’s Day events. Much of this information is also easily available to the public via the

SARA Public Registry and DFO websites. Wolffish have also been included in Species at Risk products including SARA identification cards, portable displays, calendars, SARA art project/shows, school education kits aimed at grades 4 to 6, and various promotional items.

DFO and various NGOs have been engaging stakeholders such as fish harvesters and plant workers, as well as the general public, to educate and inform them about the status of the species. For example, DFO Fishery Officers, while on direct patrol as well as during various meetings, continue to educate fish harvesters on the importance of accurate recording and reporting of wolffish catches. The DVD, *Wolffish – A Balance of Life*[4], is another useful tool which introduces viewers to these species. It dispels many myths about wolffish and explains their important role in the ecosystem, while providing a fish harvester's view of the species.

Knowledge and stewardship have also been the focus of several Habitat Stewardship Program (HSP) initiatives. Direct interaction with stakeholders is a cornerstone of these initiatives.

Since 2002, education and stewardship programs have focused on mitigating wolffish threats. The following documents have been developed to aid in the correct handling and release of wolffish:

Tips for Handling and Releasing Wolffish: Crab Fishing
Tips for Handling and Releasing Wolffish: Gillnetting
Tips for Handling and Releasing Wolffish: Hook and Line Fishing
Tips for Handling and Releasing Wolffish: Otter Trawl Fishery
Tips for Handling and Releasing Wolffish: Shrimp Fishing

A video, "Handling and Releasing Wolffish" was also developed by DFO and was widely distributed.

5.5 Recovery Strategy E - Monitoring Human Activities and Wolffish Species

As part of a larger research initiative to estimate the effect of fishing activity on wolffish populations, observer coverage has been enhanced for fisheries where the majority of incidental catch of wolffish species has been identified, such as the Greenland Halibut directed fisheries. Observer education and training has been undertaken to improve species identification and to provide for more detailed information collection and to pass this information on to harvesters. These data will be used to estimate removals by species which is the basis for estimating mortality related to fishing. A requirement for recording wolffish by species in log books has been instituted. Voluntary collection of Atlantic Wolffish landing data (by species for weight and size) at fish processing plants was instituted.

[4] Wolffish – A Balance of Life. Intervale Associates Inc. 2007

6. Evaluation of Recovery Initiative

Evaluation of recovery criteria will most likely be based on the results of demographic analyses as outlined in this document. Demographic data on reproduction, age, growth, and mortality will be based on best available scientific knowledge to estimate the level of increase or decrease in the wolffish population when compared to their status as designated by COSEWIC in 2001. Such data provides a means of documenting the recovery or lack thereof, for the wolffish population in eastern Canadian waters, thereby determining the efficacy of the recovery efforts.

Throughout implementation of the Recovery Strategy and Management Plan, the following questions can be utilized to evaluate progress on meeting the stated recovery goal and objectives and adjust performance measures as appropriate:

- Have estimates of biomass and Recovery Reference Points been researched?
- Have the distribution and population size increased? If so, have Recovery Reference Points been reached or exceeded?
- Have historic and present threats to wolffish populations and their habitat been fully identified, defined, and mitigated?
- Have the recommended fishery management strategies been implemented? Are they effective in reducing mortality?
- Has habitat (i.e., critical habitat) necessary for the survival and recovery of the species been defined and accounted for in any recovery initiatives or management strategies?
- Are stakeholders involved in the recovery activities? Are the stewardship and education initiatives achieving the desired results?

7. Statement on Action Plan

An Action Plan has been drafted and will be finalized in 2018. The Action Plan will provide specific details for recovery implementation including measures to monitor and implement recovery, address threats, and achieve recovery objectives.

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Appendix A: Record of Cooperation and Consultation

The Recovery Team includes representatives from industry, academia, and the provincial and federal governments. The populations of wolffish, in particular, the two Threatened species are concentrated largely from the Grand Banks to the Labrador Shelf, which is the jurisdiction of DFO Newfoundland and Labrador Region, and waters adjacent to the province of Newfoundland and Labrador. Thus, the majority of representation on the team was from this area. Industry was represented by leaders of both the inshore and offshore sectors. All sectors of DFO Newfoundland and Labrador were represented on the team. Each team member consulted extensively within their jurisdiction ensuring broad consultation such that key stakeholders were aware of and had the opportunity to input into the Recovery Strategy.

The three species of wolffish are occasionally encountered in the Davis Strait. Thus, during development, elements of the Recovery Strategy and Management Plan were presented to the Nunavut Wildlife Management Board, and the Board was regularly informed of progress by the Team's DFO Central and Arctic member. Upon review of the Recovery Strategy and Management Plan, the Nunavut Wildlife Management Board approved the document in January 2007. A presentation was also made to the Conne River Band (Newfoundland and Labrador) on the Recovery Strategy and Management Plan for wolffish species, and on species at risk issues in general. As well, the National Aboriginal Council on Species at Risk (NACOSAR) was informed through David Cole about the activities of the team. Further, various Aboriginal owned fishing enterprises and Fisheries Product International (FPI) have been involved in recovery initiatives related to quantifying harm.

The team members, in the preparation of this national wolffish Recovery Strategy and Management Plan, informed and received feedback from their respective jurisdictions. In early 2007, the document was also forwarded to the Governments of Newfoundland and Labrador, Nova Scotia, Prince Edward Island, New Brunswick, Quebec, Nunavut and Northwest Territories for review. Resulting comments were incorporated where applicable.

The team wishes to thank the numerous reviewers of this document, from various sectors of the Newfoundland and Labrador Region, from other Atlantic Regions and NHQ. Special thanks goes to MEHM staff who worked on several sections related to habitat and CEAA and Policy and Economics staff from Newfoundland and Labrador, Quebec and Maritimes Regions who provided detailed economic analyses to ensure best knowledge was included. The collective input of reviewers and contributors has ensured compliancy with SARA and has greatly enhanced the quality of a document that deals with a wide range of subject matter.

2018 Update

The updated *Recovery Strategy for Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor), and Management Plan for Atlantic Wolffish (Anarhichas lupus) in Canada* was developed in consultation with multiple stakeholders. DFO provided the following groups with the opportunity to review and comment on the updated document.

Newfoundland and Labrador Region

Canadian Association of Petroleum Producers

Department of Fisheries and Aquaculture

Environment and Climate Change Canada

Fish Food and Allied Workers Union

Groundfish Enterprise Allocation Council/ Canadian Association of Prawn Producers

Innu Nation

Miawpukek First Nation

Nunatsiavut Government

NunatuKavut Community Council Inc.

Parks Canada

Qalipu Mi'kmaq First Nation Band

Transport Canada

Maritimes Region

Acadia First Nation

Annapolis Valley First Nation

Atlantic Canadian Mobile Shrimp Association

Atlantic Herring Co-op

Bear River First Nation

Buctouche First Nation

Canadian Council of Professional Fish Harvesters

Canada-Nova Scotia Offshore Petroleum Board

Canadian Wildlife Federation

Clearwater Seafoods

Connors Bros.

Confederacy of Mainland Mi'kmaq

Conservation Council of New Brunswick

Dalhousie University

Eastern Fishermen's

Grand Manan Fishermen's Association

Guysborough Inshore Fishermen's Association

Indian Island First Nation

Kingsclear First Nations

Louisbourg Seafoods

Maritime Aboriginal Peoples Council

Maliseet Nation Conservation Council

Membertou First Nation

Metepenagiag Mi'kmaq Nation

Millbrook First Nation

Native Council of Nova Scotia

New Brunswick Department of Agriculture

New Brunswick Department of Aquaculture and Fisheries

New Brunswick Department of Energy and Mines

Nova Scotia Department of Natural Resources

Nova Scotia Fish Packers

Oromocto First Nation

Pabineau First Nation

Paq'tnkek Mi'kmaw Nation

Pictou Landing First Nation

Potlotek First Nation

Premium Seafoods Group

Richmond County Inshore Fishermen's Association

Scotia-Fundy Inshore Fishermen's Association

Seafood Producers Association of Nova Scotia

Shelburne County Quota Group

Sipekne'katik Band

St. Mary's First Nation

The Lobster Council of Canada

Federation
Eastern Shore Fishermen's Protective Association
Ecology Action Centre
Eel Ground First Nation
Eel River Bar First Nation
Esgenoôpetitj First Nation
Eskasoni First Nation
Fort Folly First Nation
Fundy North Fishermen's Association
Gespe'gewaq Mi'gmaq Resource Council
Glooscap First Nation
New Brunswick Department of Natural Resources
Northern Harvest Sea Farms
North of Smokey Fishermen's Association
North Shore Micmac District Council
Nova Scotia Department of Energy
Nova Scotia Department of Fisheries and Aquaculture
The New Brunswick Aboriginal Peoples Council
Tobique First Nation
Unama'ki Institute of Natural Resources
Wagmatcook First Nation
Waycobah First Nation
Woodstock First Nation
World Wildlife Fund-Canada

Gulf Region

Abegweit First Nation
Elsipogtog First Nation
Lennox Island First Nation
Madawaska First Nation
Mi'kmaq Confederacy of PEI
Native Council of PEI
PEI Department of Agriculture and Forestry
PEI Department of Aquaculture and Rural Development
PEI Department of Fisheries

Québec Region

Agence Mamu Innu Kaikusseht
Alliance des Pêcheurs Professionnels du Québec
Association de gestion halieutique autochtone Mi'kmaq et Malécite
Association des capitaines propriétaires de la Gaspésie
Association des pêcheurs de la Basse Côte-Nord
Association des pêcheurs de la Côte-Nord inc.
Association des pêcheurs polyvalents de Old Fort à Blanc-Sablon
Conseil de la Première Nation des Innus d'Essipit
Conseil des Innus de Pakua Shipu
Conseil des Innus de Pessamit
Conseil des Innus de Ekuanitshit
Conseil des Montagnais de Natashquan
Conseil des Montagnais d'Unamen Shipu
Conseil Innu Takuaikan Uashat mak Mani-Utenam
Fédération des pêcheurs semi-hauturiers du Québec (FPSHQ)
Institut de développement durable des Premières Nations du Québec et du
La Nation Micmac de Gespeg
Listuguj Mi'gmaq Government
Makivik Corporation
Micmacs of Gesgapegiag
Mi'gmawei Mawiomi Secretariat
Pêcheries Shipek
Première Nation Malécite de Viger
Professionnels du Québec
Regroupement des pêcheurs professionnels des Îles-de-la-Madeleine
Regroupement des pêcheurs professionnels du Nord de la Gaspésie

Labrador

Central and Arctic Region

Amaruq Hunters and Trappers
Arctic Fishery Alliance
Baffin Fisheries Coalition
Cumberland Sound Fisheries
Department of Fisheries and Sealing
Government of Nunavut
Mayukalik Hunters and Trappers
Mittimatalik Hunters and Trappers
Nangmautaq Hunters and Trappers
Nattivak Hunters and Trappers
Nunavut Inuit Wildlife Secretariat
Nunavut Offshore Allocations Holders Association
Nunavut Tunngavik Inc.
Pangnirtung Hunters and Trappers
Qikiqtaaluk Corporation
Qikiqtaaluk Wildlife Board
Umiat Corporation (Pangnirtung)

Appendix B: Authors

The 2008 version of this document was prepared by D. Kulka, C. Hood and J. Huntington, through the advice of the Wolffish Recovery Team, on behalf of Fisheries and Oceans Canada. The Wolffish Recovery Team members included:

Catherine Hood (co-chair), DFO, St. John's, NL
David Kulka (co-chair), DFO, St. John's, NL
John Angel, Canadian Association of Prawn Producers
Sharmane Allen, DFO, St. John's, NL
Wade Barney, DFO, St. John's, NL
John Boland, Fish, Food and Allied Workers Union
Carole Bradbury, DFO, St. John's, NL
Joe Brazil, Newfoundland and Labrador Department of Environment and Conservation
Gerald Brothers, DFO, St. John's, NL
Scott Campbell, DFO, St. John's, NL
Bruce Chapman, Groundfish Enterprise Allocation Council
David Coffin, Newfoundland and Labrador Department of Fisheries and Aquaculture
Karen Ditz, DFO, Iqaluit, NU
Tom Hurlbut, DFO, Moncton, NB
George Rose, Memorial University, St. John's, NL
Mark Simpson, DFO, St. John's, NL
Jason Simms, DFO, St. John's, NL
Dena Wiseman, DFO, St. John's, NL
Larry Yetman, DFO, St. John's, NL

Appendix C: Figures

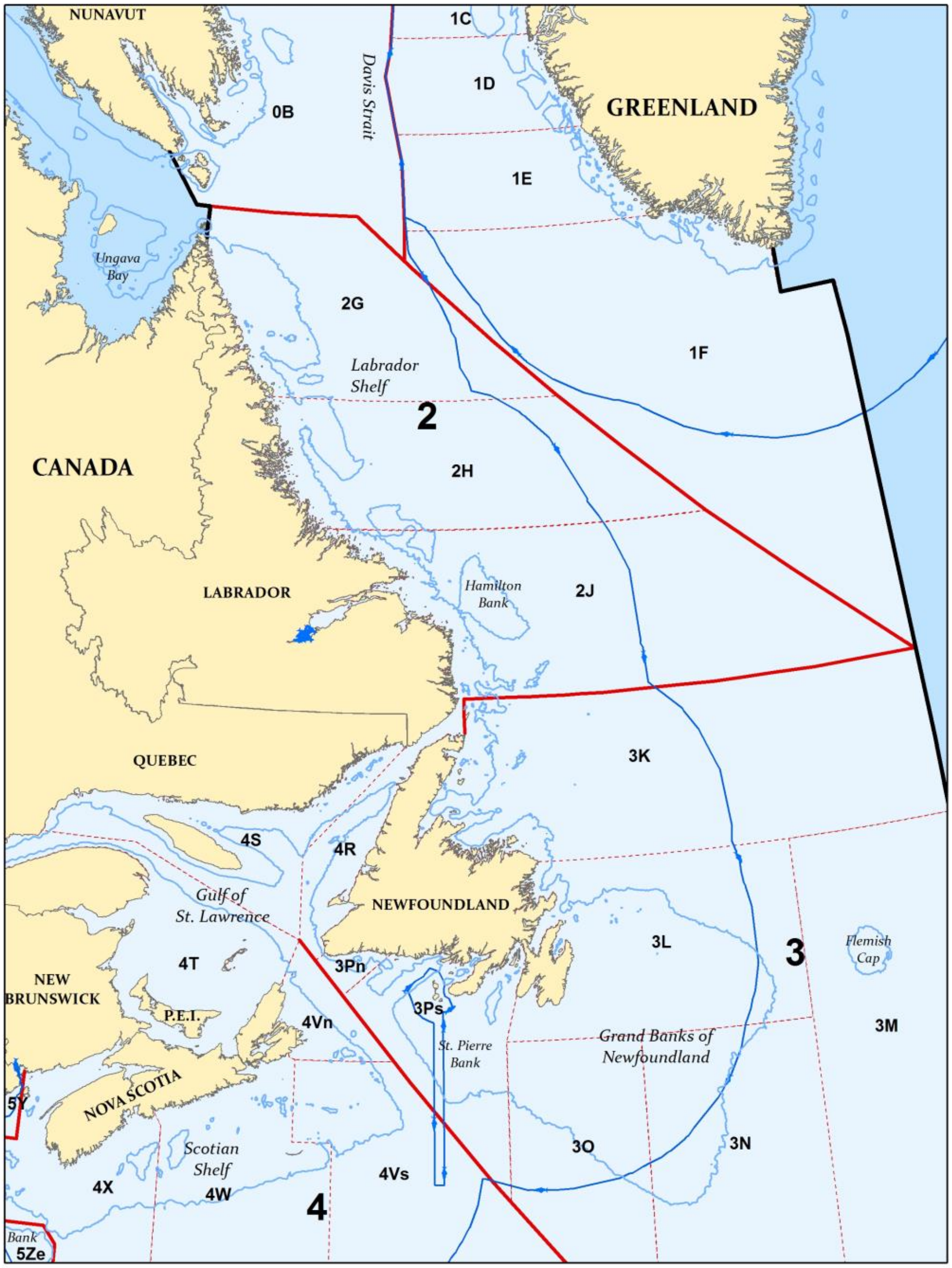


Figure 1. Map of Georges Bank to the Davis Strait, covering the distribution of wolffish species and showing various banks, basins and NAFO Divisions.

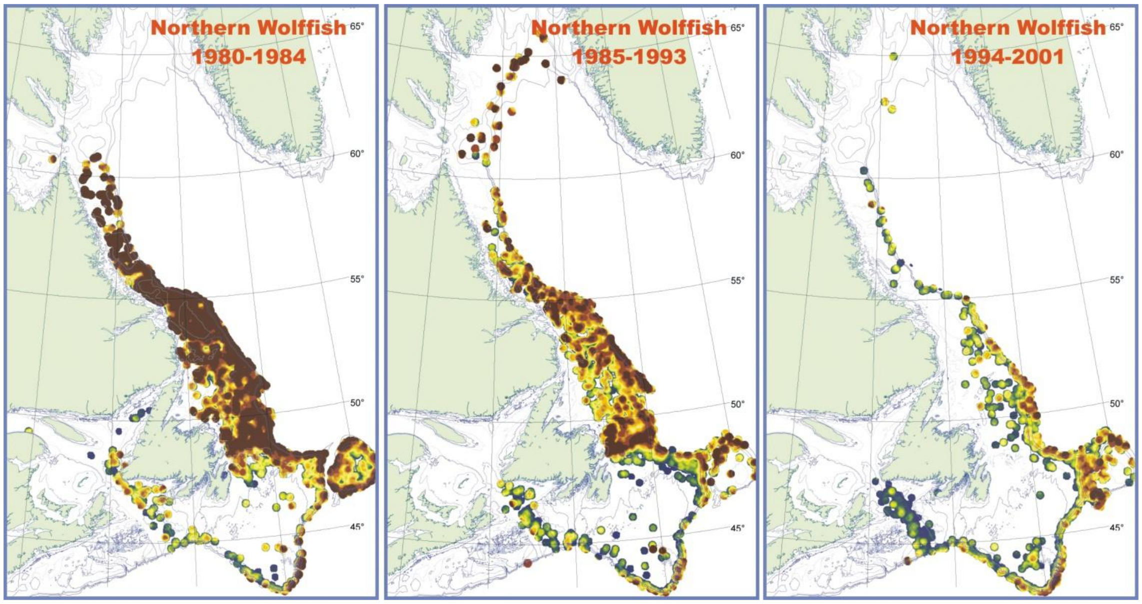


Figure 2. Change in the distribution of Northern Wolffish between 1980 and 2001 based on fall research surveys, Newfoundland and Labrador Region. Red shades depict areas of highest density, shading through yellow to green to blue as areas of lowest density. Sampling north of Lat.60°, in the Gulf of St. Lawrence and on the Scotian Shelf is incomplete.

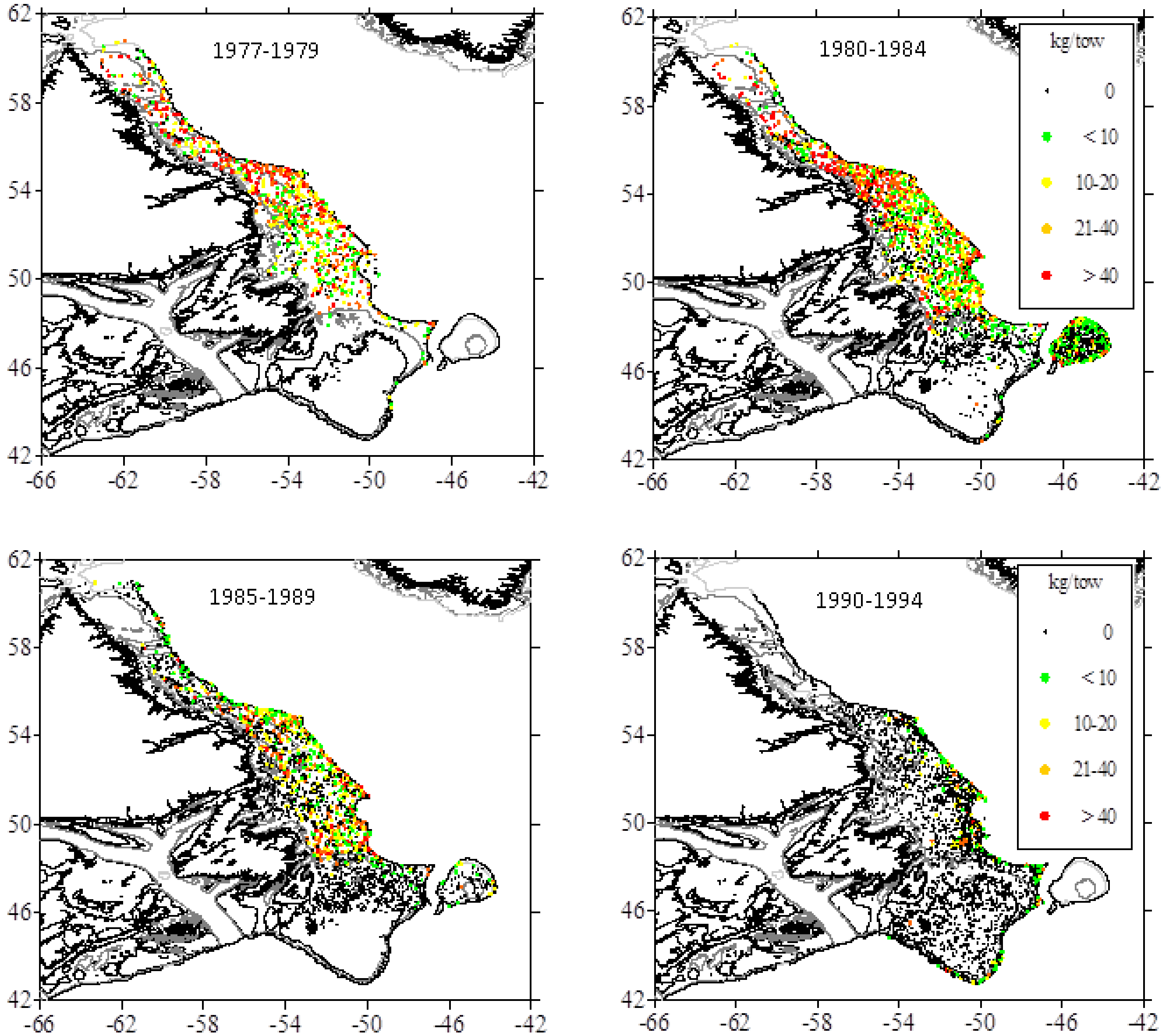


Figure 3. Geographic distribution of fall DFO Research Vessel survey catch rates (kg/tow) for Northern Wolffish in the Newfoundland and Labrador Region, 1977-2009.

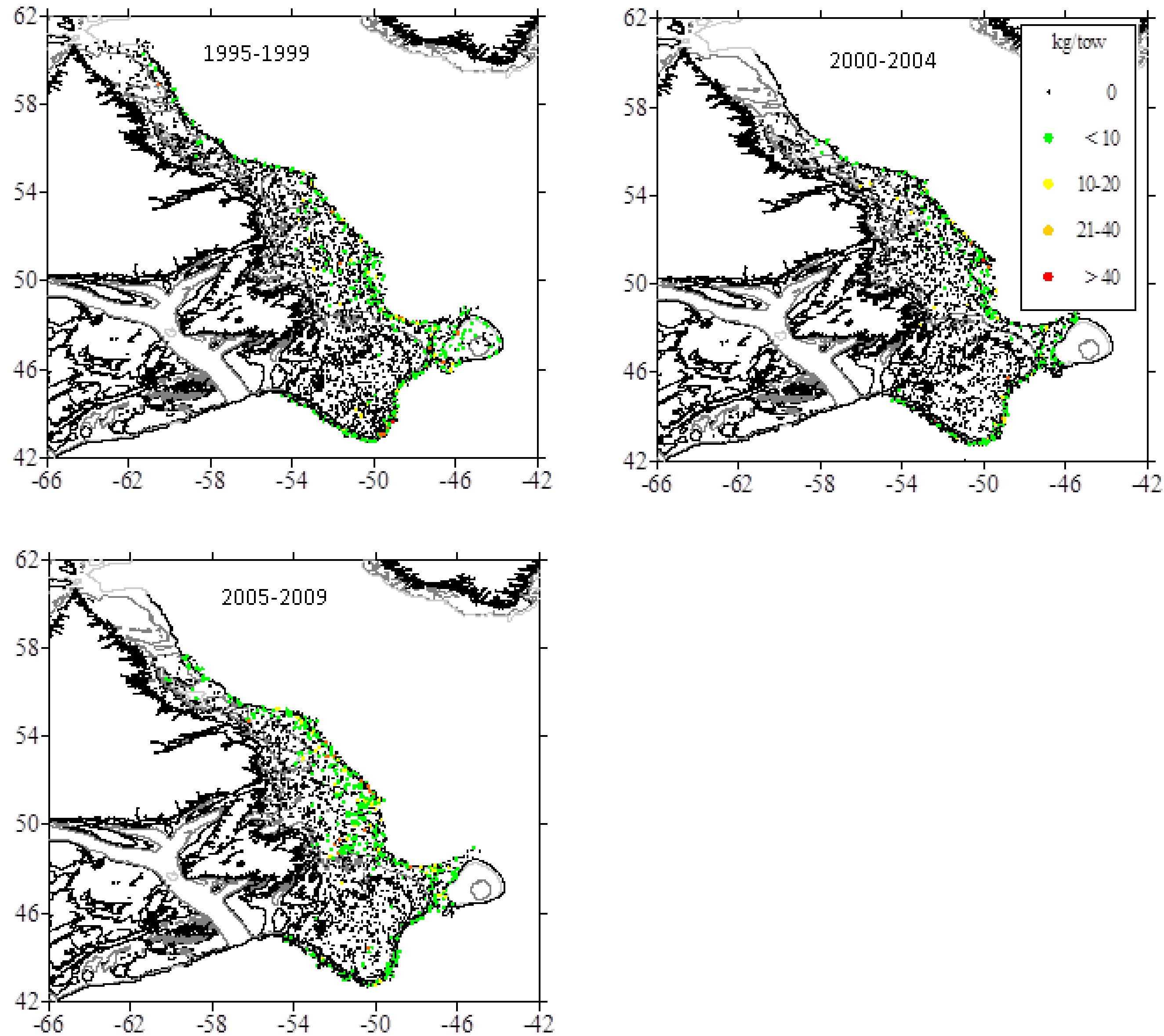


Figure 3 (con't). Geographic distribution of fall DFO Research Vessel survey catch rates (kg/tow) for Northern Wolffish in the Newfoundland and Labrador Region, 1977-2009.

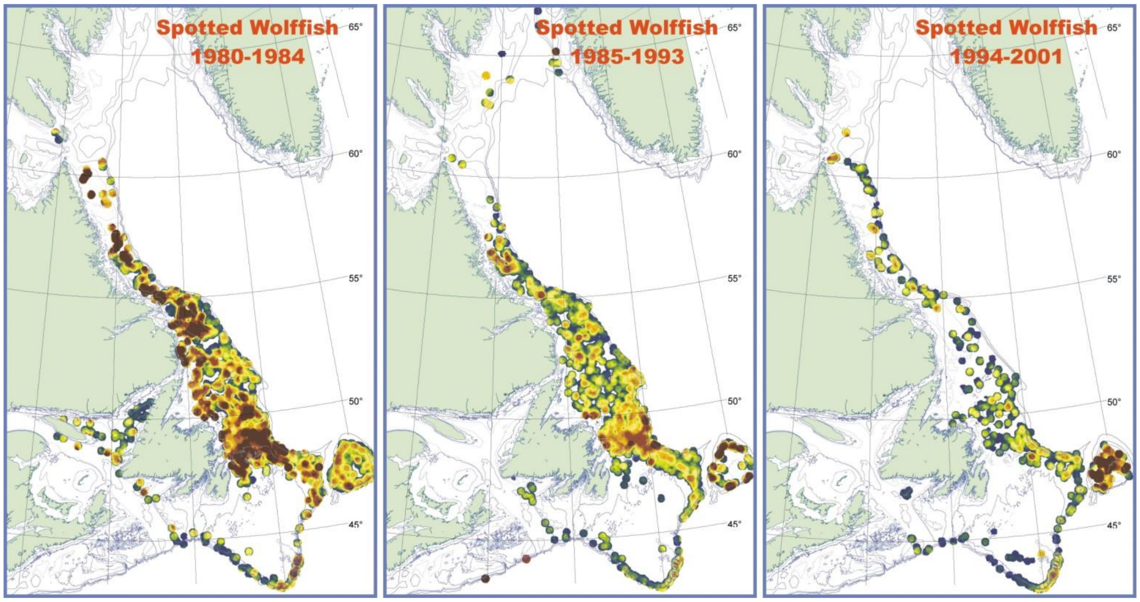


Figure 4. Change in the distribution of Spotted Wolffish between 1980 and 2001 based on fall research surveys, Newfoundland and Labrador Region. Red shades depict areas of highest density, shading through yellow to green to blue as areas of lowest density. Sampling north of Lat. 60^{o}, in the Gulf of St. Lawrence and on the Scotian Shelf is incomplete.

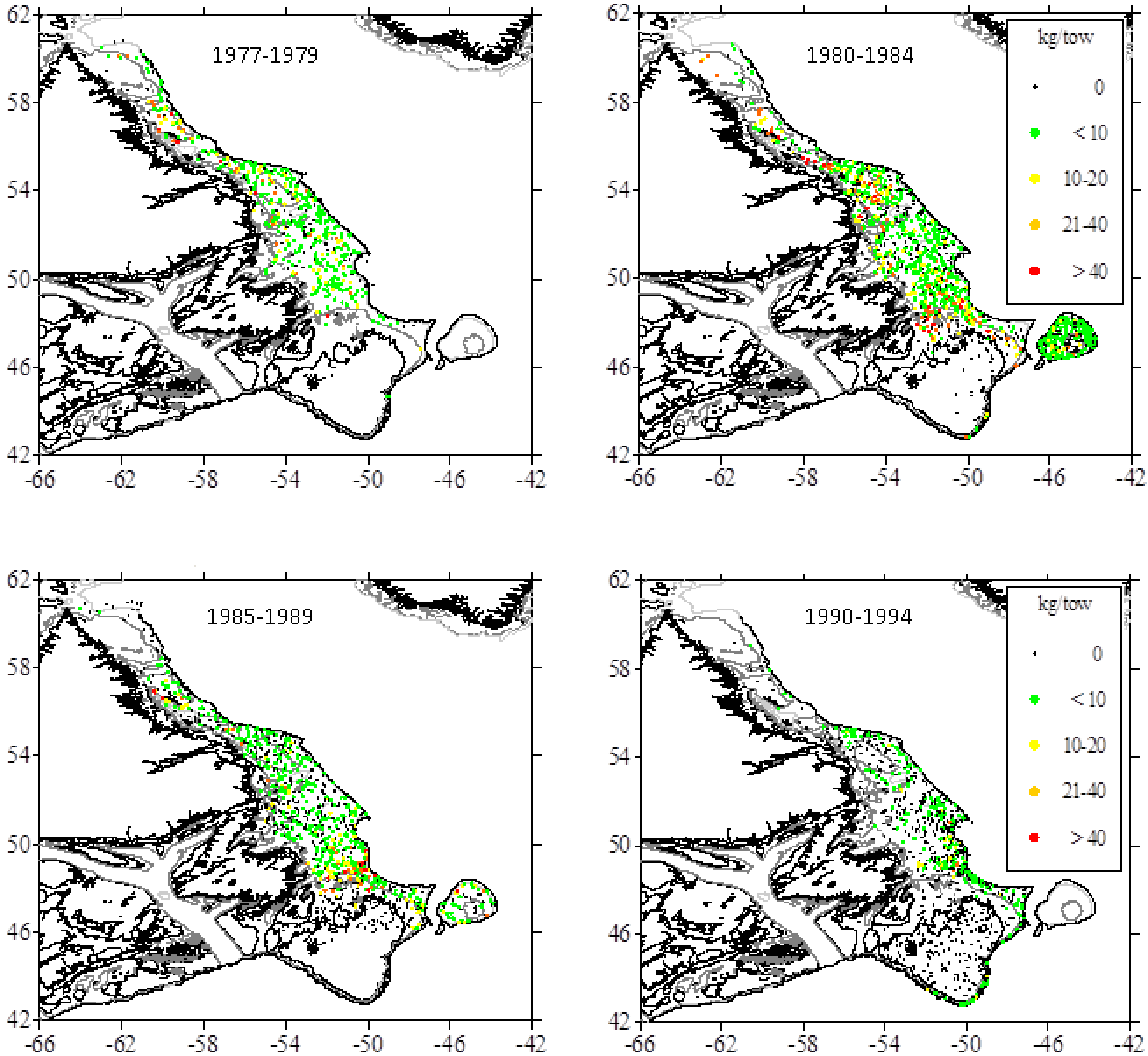


Figure 5. Geographic distribution of fall DFO Research Vessel survey catch rates (kg/tow) for Spotted Wolffish in the Newfoundland and Labrador Region, 1977-2009.

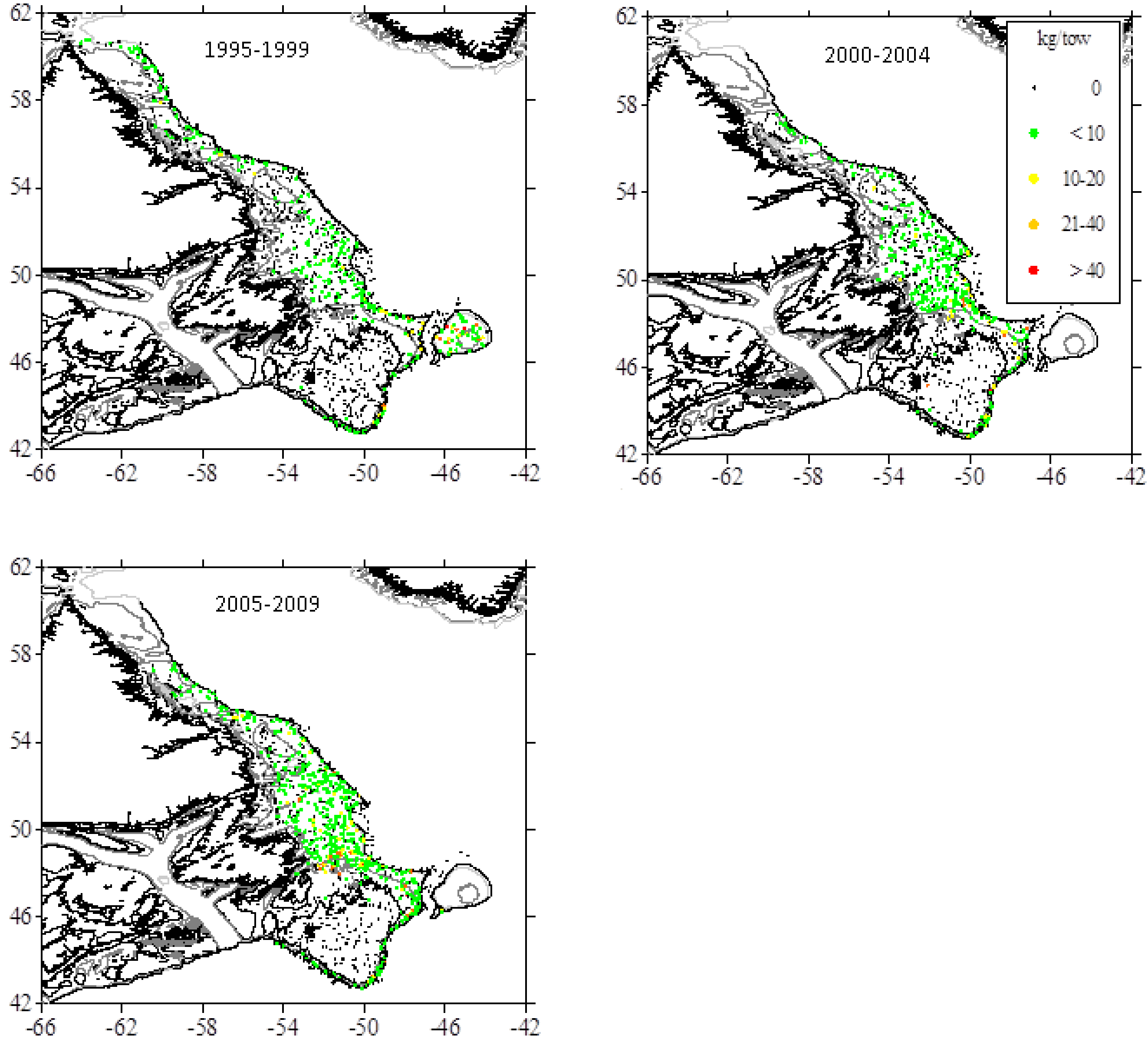


Figure 5 (con't). Geographic distribution of fall DFO Research Vessel survey catch rates (kg/tow) for Spotted Wolffish in the Newfoundland and Labrador Region, 1977-2009.

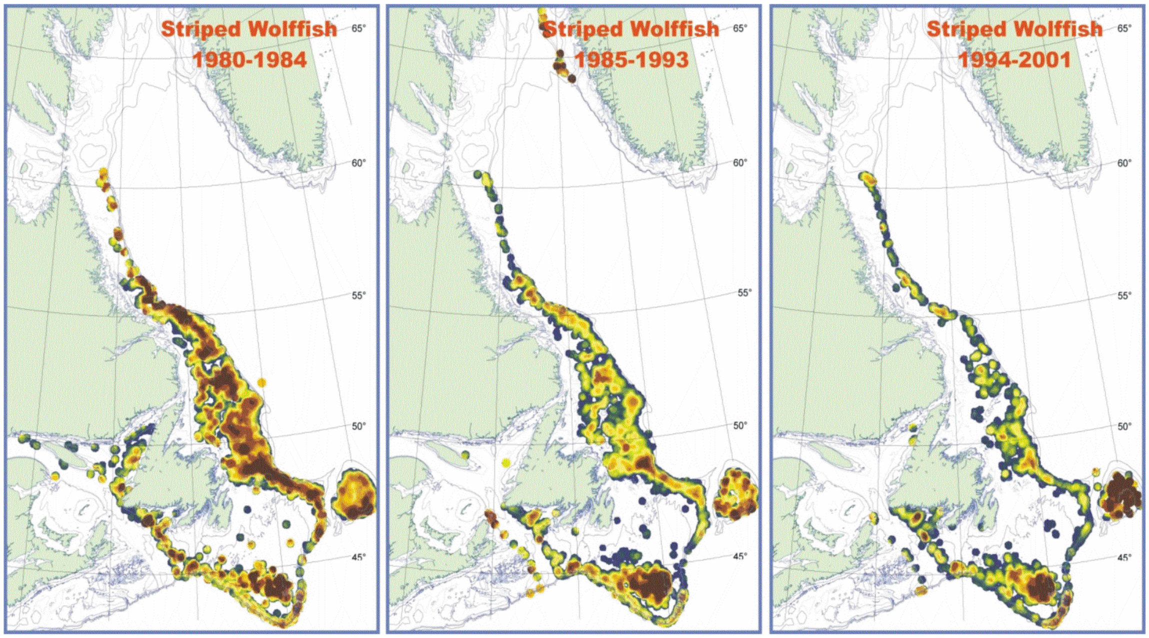


Figure 6. Change in the distribution of Atlantic Wolffish between 1980 and 2001 based on fall research surveys, Newfoundland and Labrador Region. Red shades depict areas of highest density, shading through yellow to green to blue as areas of lowest density. Sampling north of Lat. 60°, in the Gulf of St. Lawrence and on the Scotian Shelf is incomplete.

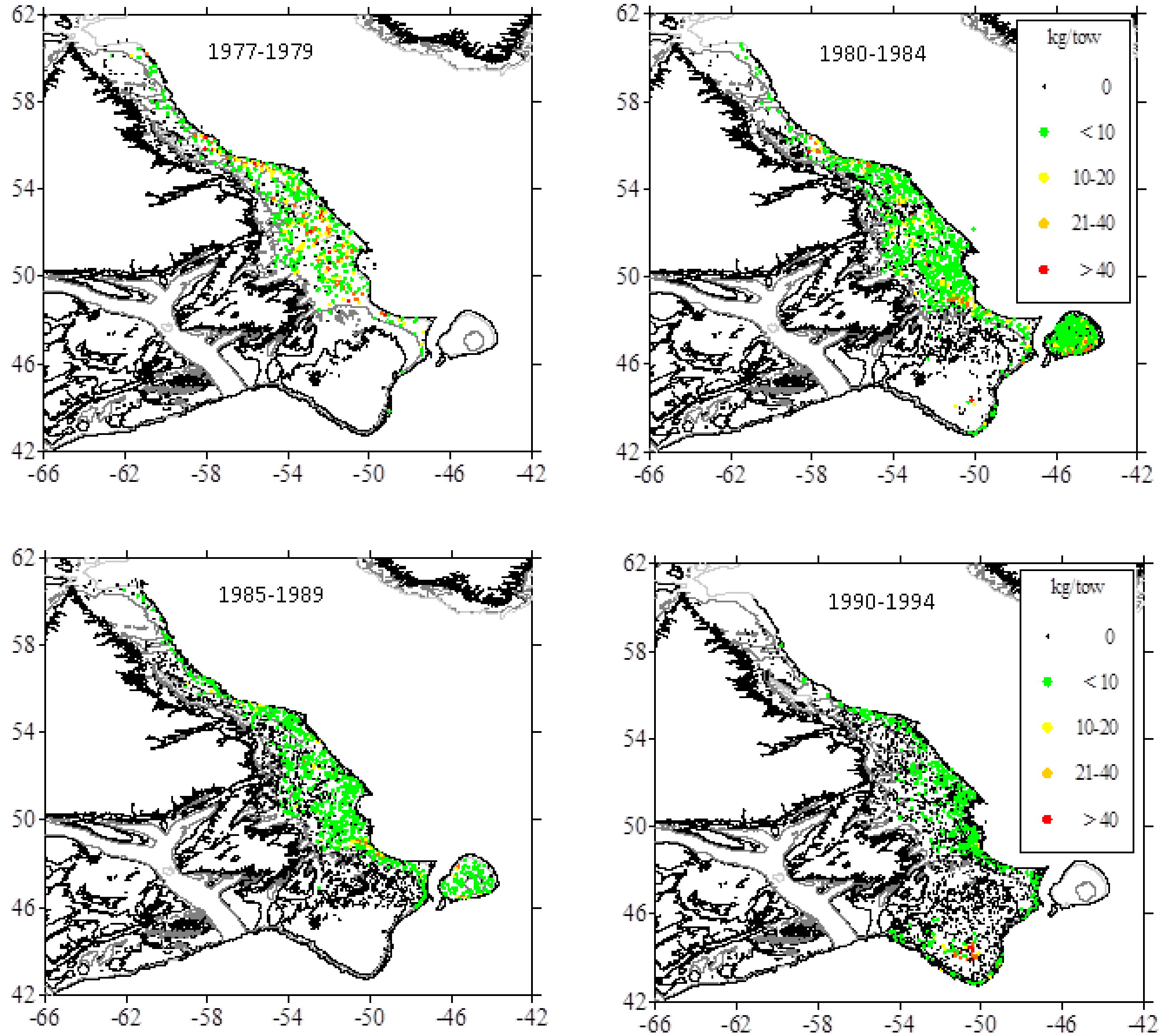


Figure 7. Geographic distribution of fall DFO Research Vessel survey catch rates (kg/tow) for Atlantic Wolffish in the Newfoundland and Labrador Region, 1977-2009.

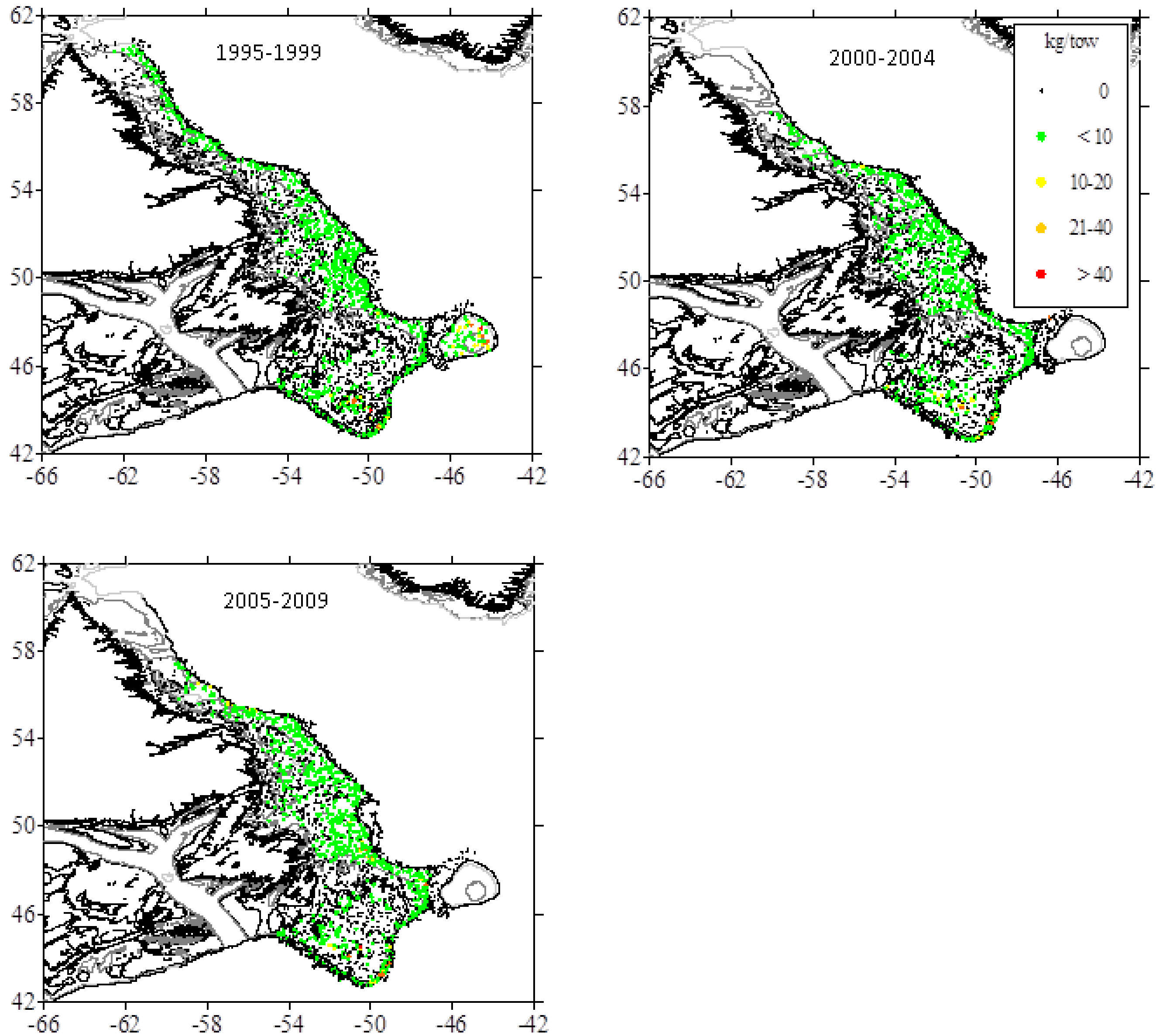


Figure 7 (con't). Geographic distribution of fall DFO Research Vessel survey catch rates (kg/tow) for Atlantic Wolffish in the Newfoundland and Labrador Region, 1977-2009.

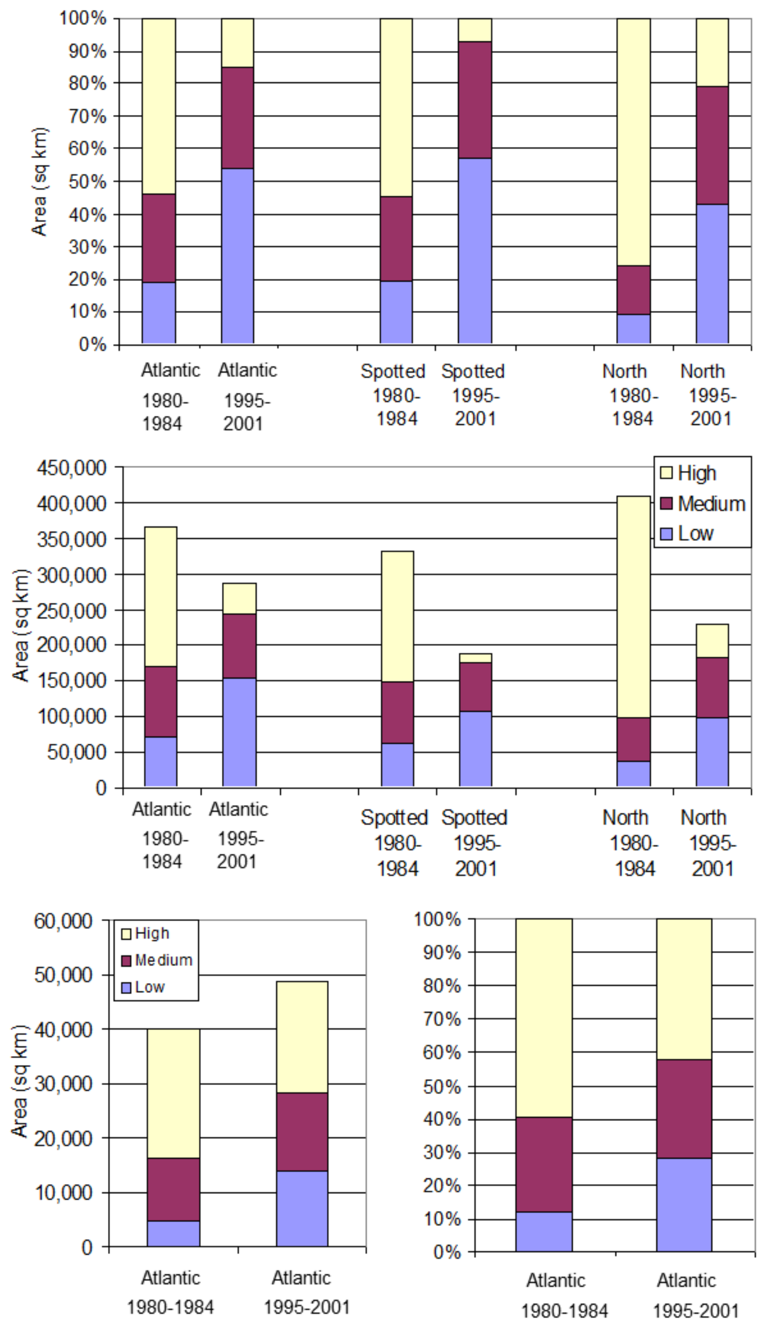


Figure 8. Change in the area of occupancy of Northern, Spotted and Atlantic Wolffish between 1980 and 2001 based on fall research surveys, Newfoundland and Labrador Region (includes the Grand Banks, northeast Newfoundland Shelf and southern Labrador Shelf).

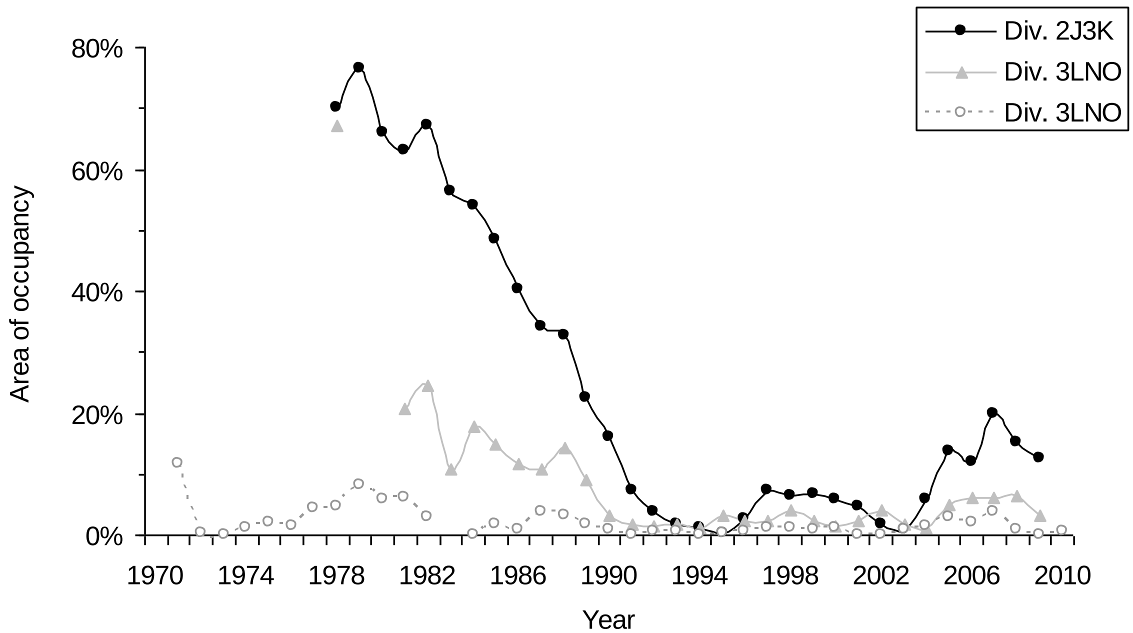


Figure 9. Area of occupancy for Northern Wolffish in NAFO Divisions 2J3K and 3LNO in spring (1971-2010; open symbol) and fall (1978-2009; closed symbol). Survey trawl gear changed from Yankee to Engel in 1983, and from Engel to Campelen in fall 1995 and spring 1996.

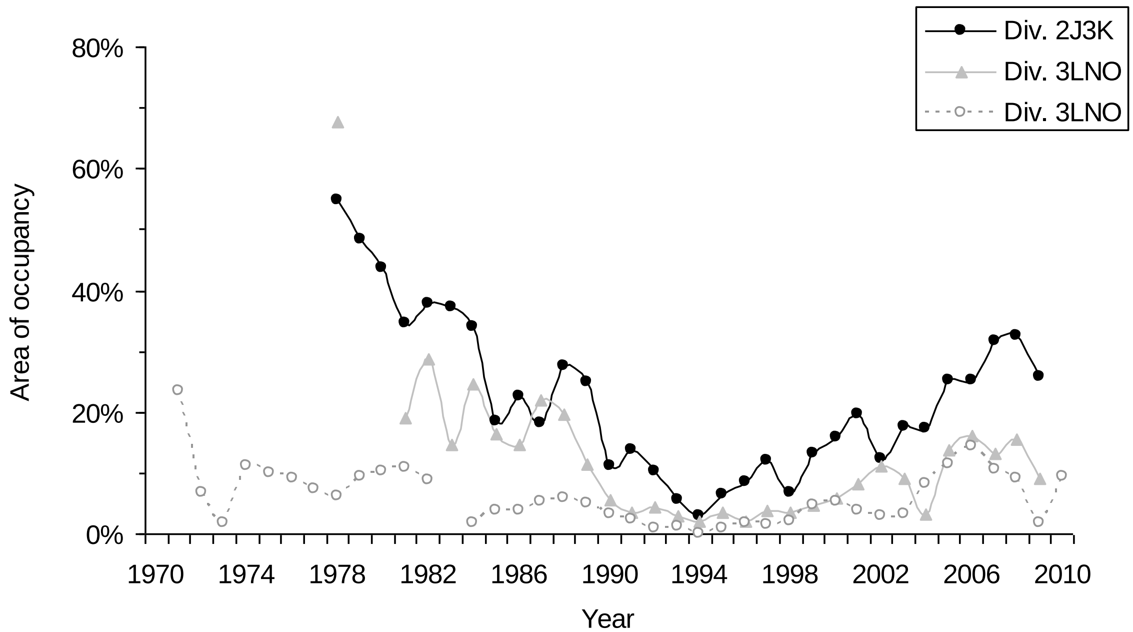


Figure 10. Area of occupancy for Spotted Wolffish in NAFO Divisions 2J3K and 3LNO in spring (1971-2010; open symbol) and fall (1978-2009; closed symbol). Survey trawl gear changed from Yankee to Engel in 1983, and from Engel to Campelen in fall 1995 and spring 1996.

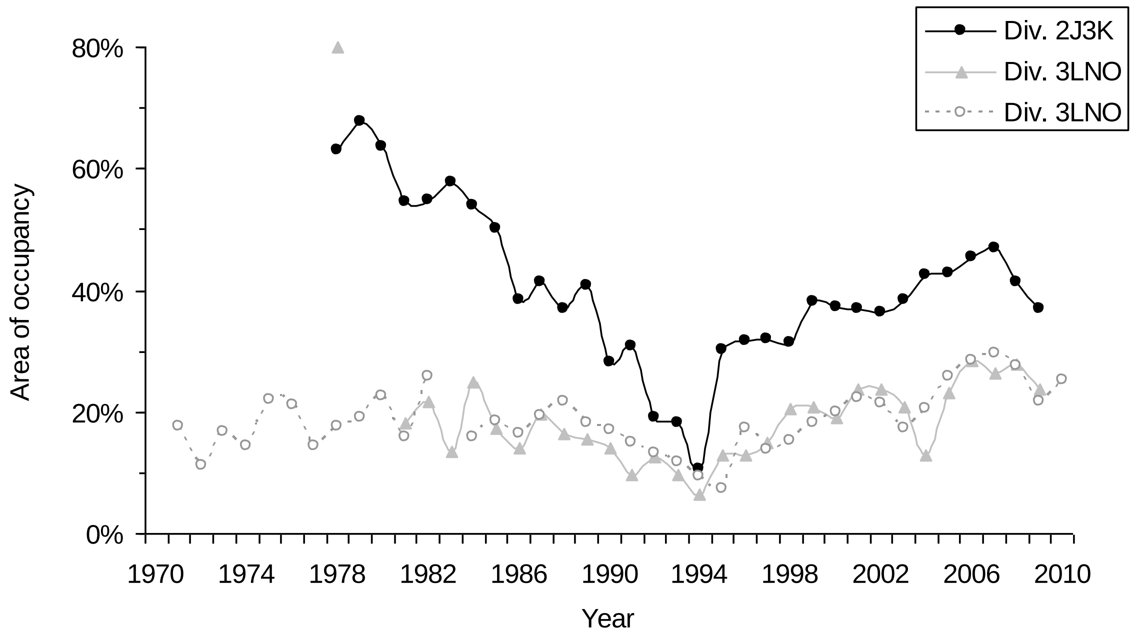


Figure 11. Area of occupancy for Atlantic Wolffish in NAFO Divisions 2J3K and 3LNO in spring (1971-2010; open symbol) and fall (1978-2009; closed symbol). Survey trawl gear changed from Yankee to Engel in 1983, and from Engel to Campelen in fall 1995 and spring 1996.

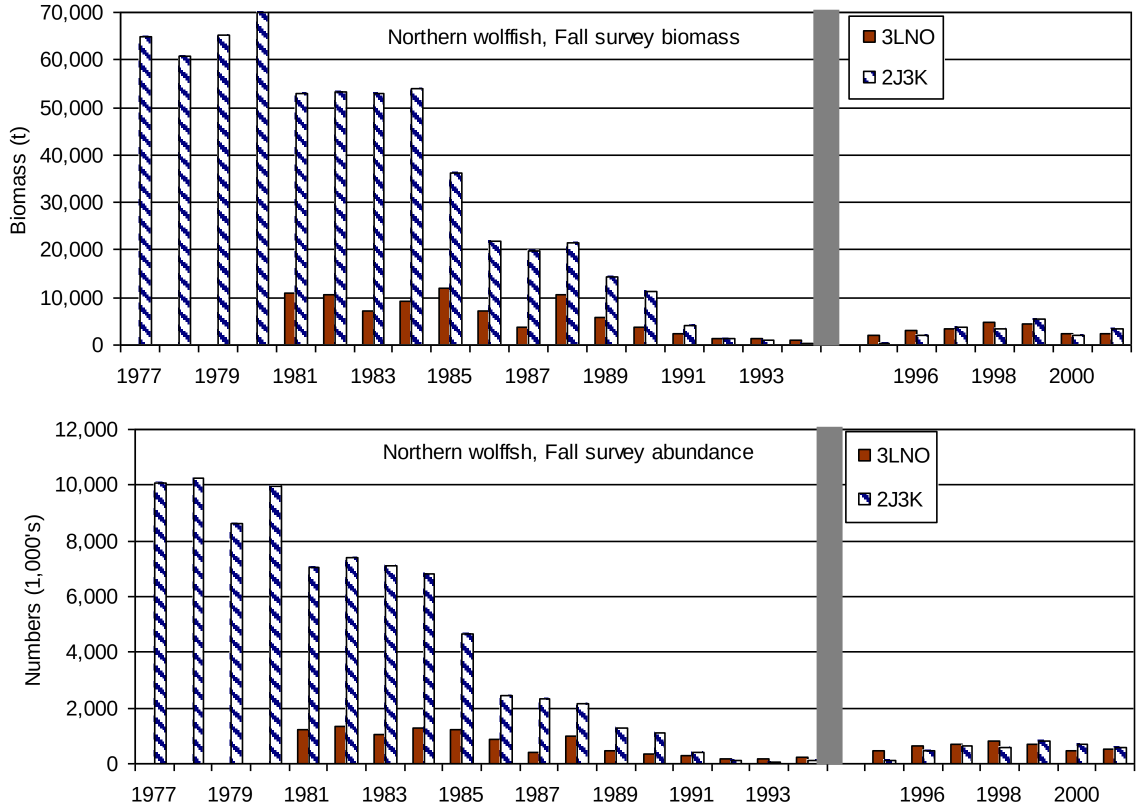


Figure 12. Trends in abundance (lower panel) and biomass (upper panel) indices for Northern Wolffish from 1977-2001. Indices were derived from fall Newfoundland and Labrador research surveys. The northern area (2J3K) trend is shown separately from the southern area (3LNO). The dark vertical bar separates the two time series. Engel trawl was used prior to the fall of 1995, Campelen in subsequent years after (Simpson and Kulka 2002).

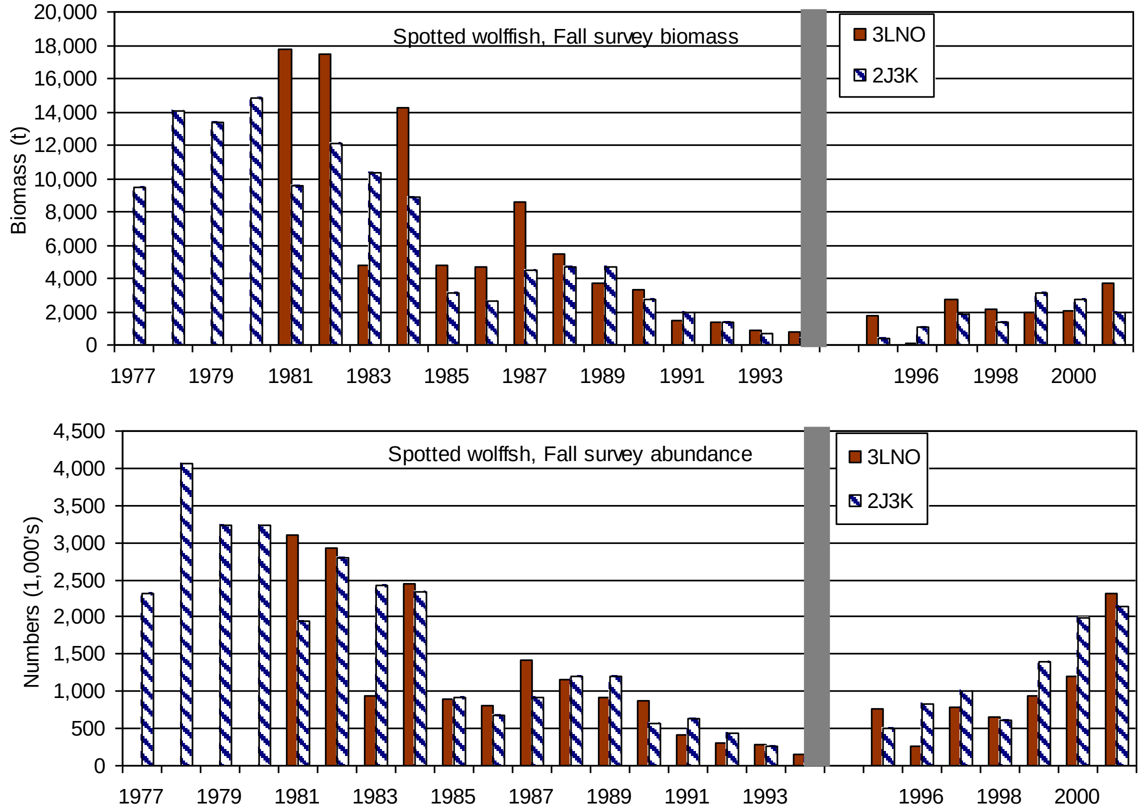


Figure 13. Trends in abundance (lower panel) and biomass (upper panel) indices for Spotted Wolffish from 1977-2001. Indices were derived from fall Newfoundland and Labrador research surveys. The northern area (2J3K) trend is shown separately from the southern area (3LNO). The dark vertical bar separates the two time series. Engel trawl was used prior to the fall of 1995, Campelen in subsequent years (after Simpson and Kulka 2002).

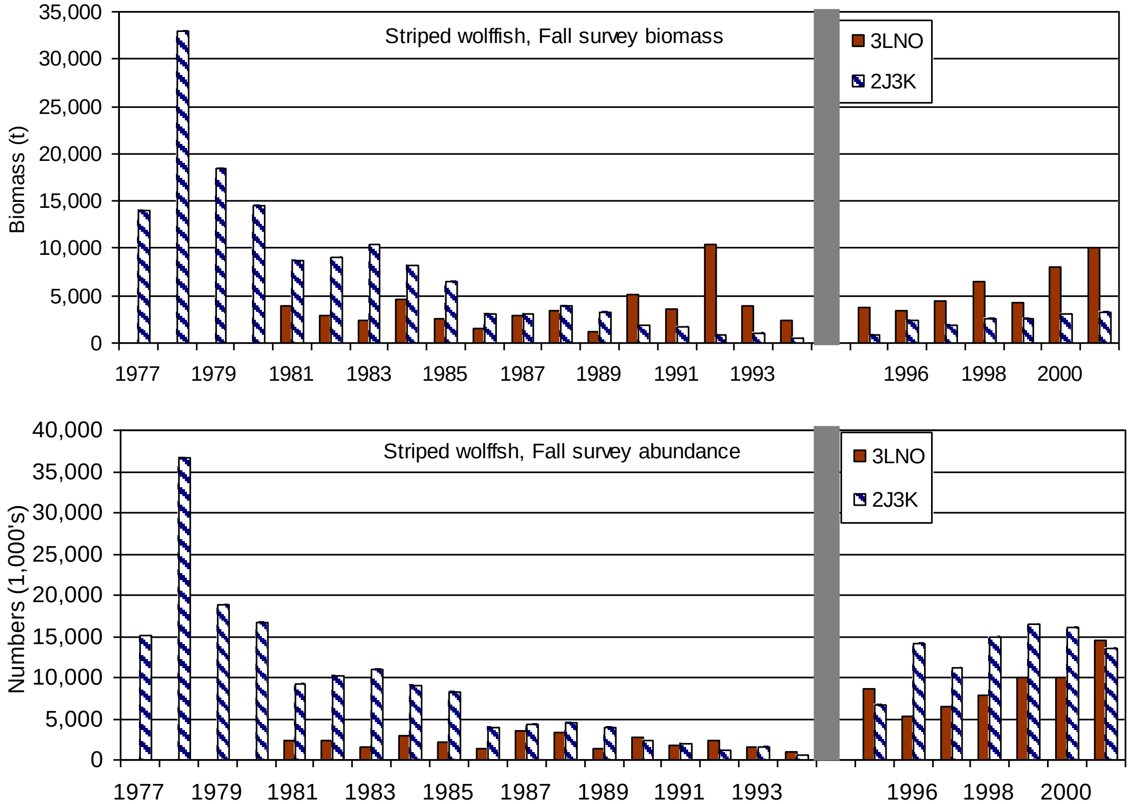


Figure 14. Trends in abundance (lower panel) and biomass (upper panel) indices for Atlantic Wolffish from 1977-2001. Indices were derived from fall Newfoundland and Labrador research surveys. The northern area (2J3K) trend is shown separately from the southern area (3LNO). The dark vertical bar separates the two time series. Engel trawl was used prior to the fall of 1995, Campelen in subsequent years after (Simpson and Kulka 2002).

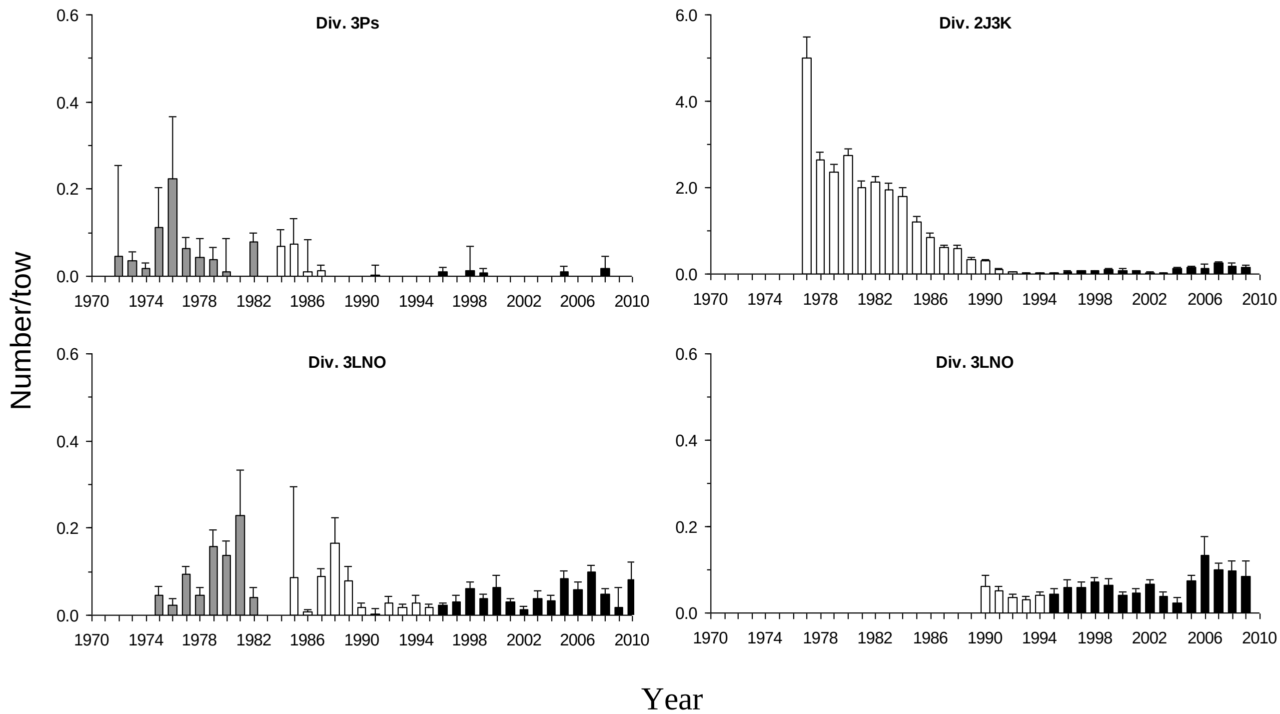


Figure 15. Research survey standardized indices of relative abundance for Northern Wolffish in NAFO Divisions 3LNO and Subdivision 3Ps in spring (left column), and Divisions 2J3K and 3LNO in fall (right column). T-bar = 1 SE. Survey trawl gear changed from Yankee (grey bar) to Engel (white bar) in 1983, and from Engel to Campelen (black bar) in fall 1995 and spring 1996.

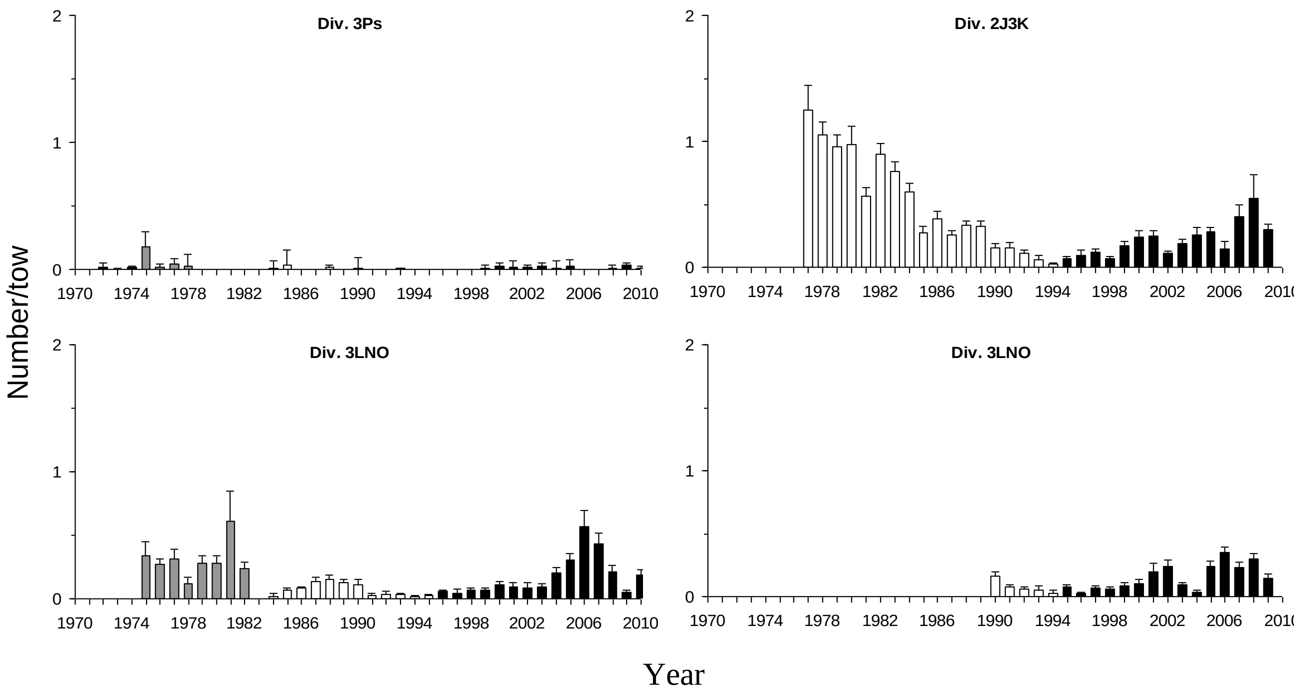


Figure 16. Research survey standardized indices of relative abundance for Spotted Wolffish in NAFO Divisions 3LNO and Subdivision 3Ps in spring (left column), and Divisions 2J3K and 3LNO in fall (right column). T-bar = 1 SE. Survey trawl gear changed from Yankee (grey bar) to Engel (white bar) in 1983, and from Engel to Campelen (black bar) in fall 1995 and spring 1996.

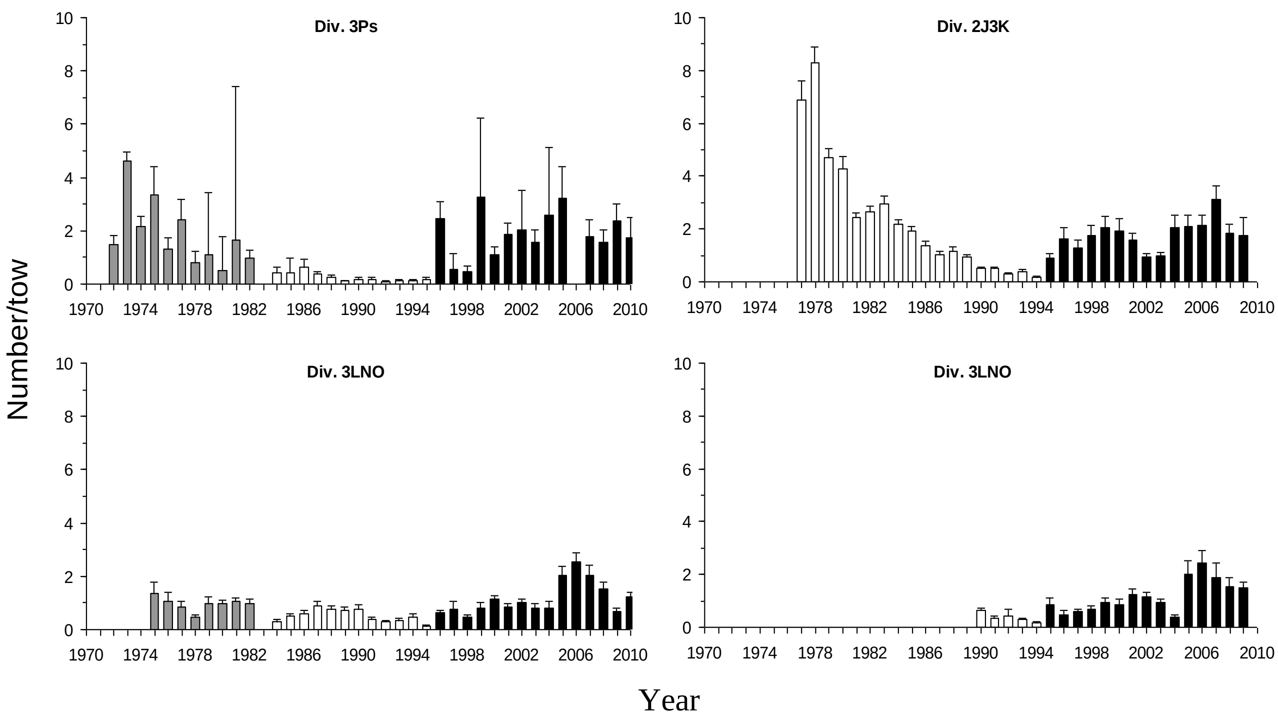
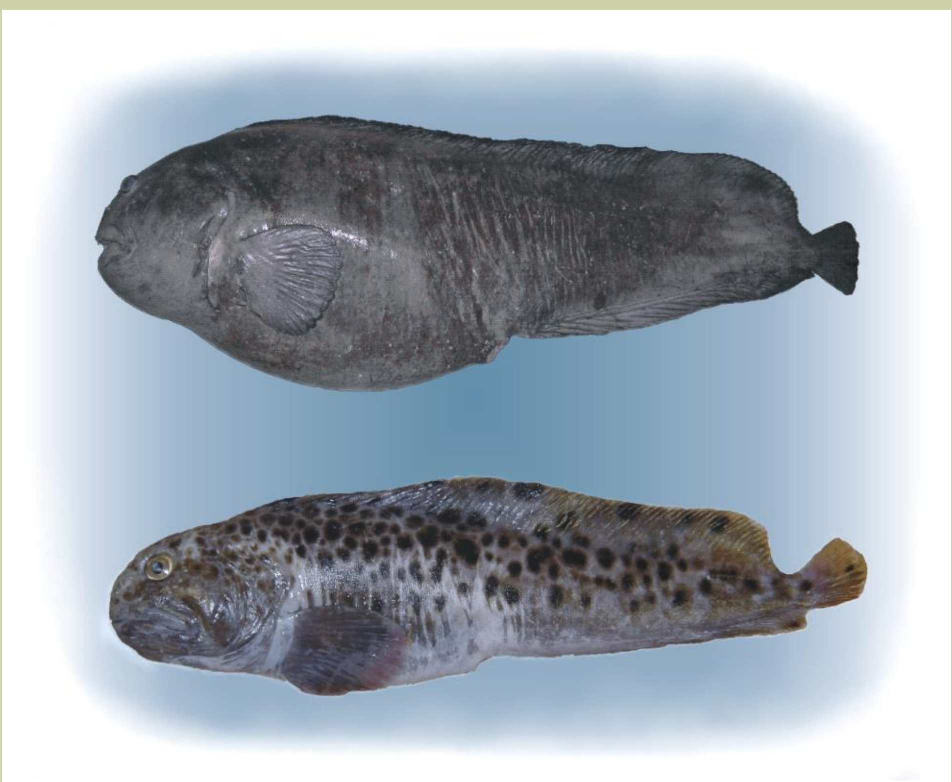


Figure 17. Research survey standardized indices of relative abundance for Atlantic Wolffish in NAFO Divisions 3LNO and Subdivision 3Ps in spring (left column), and Divisions 2J3K and 3LNO in fall (right column). T-bar = 1 SE. Survey trawl gear changed from Yankee (grey bar) to Engel (white bar) in 1983, and from Engel to Campelen (black bar) in fall 1995 and spring 1996.

Species at Risk Act
Action Plan Series

Action Plan for the Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*) in Canada

Northern Wolffish and Spotted Wolffish



2018

Fisheries and Oceans Canada | Pêches et Océans Canada

Canada

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For copies of the Action Plan, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, recovery strategies, and other related recovery documents, please visit the Species at Risk Public Registry.

Cover illustration: D. Kulka

Également disponible en français sous le titre
Pêches et Océans Canada. 2018. Plan d'action pour le loup à tête large (*Anarhichas denticulatus*) et le loup tacheté (*Anarhichas minor*) au Canada [Proposition]. Série de plans d'action de la Loi sur les espèces en péril. Pêches et Océans Canada, Ottawa. v + 26 p.

ISBN
Catalogue no.

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of action plans for species listed as Extirpated, Endangered and Threatened for which recovery has been deemed feasible. They are also required to report on progress five years after publication of the final document on the Species at Risk Public Registry.

The Minister of Fisheries and Oceans is the competent minister under SARA for the Northern Wolffish (*Anarhichas denticulatus*) and the Spotted Wolffish (*Anarhichas minor*) and has prepared this Action Plan to implement the Recovery Strategy, as per s. 47 of SARA. In preparing the Action Plan, the competent minister has considered, as per s. 38 of SARA, the commitment of the Government of Canada to conserving biological diversity and to the principle that, if there are threats of serious or irreversible damage to the listed species, cost-effective measures to prevent the reduction or loss of the species should not be postponed for a lack of full scientific certainty.

As stated in the preamble to SARA, success in the recovery of these species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions and actions set out in this Action Plan and will not be achieved by Fisheries and Oceans Canada, or any other jurisdiction alone. The cost of conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing this Action Plan for the benefit of the Northern and Spotted Wolffish and Canadian society as a whole.

Under SARA, an action plan provides the detailed recovery planning that supports the strategic direction set out in the recovery strategy for the species. The plan outlines recovery measures to be taken by Fisheries and Oceans Canada and other jurisdictions and/or organizations to help achieve the population and distribution objectives identified in the recovery strategy. Implementation of this Action Plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Acknowledgments

Fisheries and Oceans Canada (DFO) Newfoundland and Labrador Region is grateful to those who have participated in the development of the *Action Plan for the Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor) in Canada*. A number of DFO Regions have contributed to this document including Maritimes, Gulf, Quebec, and Central and Arctic regions as well as National Headquarters.

Executive Summary

In May 2001, the Northern Wolffish (*Anarhichas denticulatus*) and the Spotted Wolffish (*Anarhichas minor*) were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Threatened (COSEWIC 2001a,b). A third species, the Atlantic Wolffish (*Anarhichas lupus*), was assessed by COSEWIC as Special Concern in November 2000 (COSEWIC 2000). All three wolffish species were included in Schedule 1 of the *Species at Risk* Act (SARA) at the time of the Act's proclamation in June 2003. In November 2012, COSEWIC reassessed the three species and recommended that their status remain unchanged (COSEWIC 2012a,b,c). Therefore, under SARA, the status of all three species also remained unchanged. While this Action Plan is focused specifically on Northern and Spotted Wolffish, the recovery actions will likely benefit the Atlantic Wolffish as well.

The "*Recovery Strategy for Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor), and Management Plan for Atlantic Wolffish (Anarhichas lupus) in Canada*" (DFO 2018), originally published in 2008, constituted the framework for development of recovery actions and established the scope of this Action Plan. The goal of the Recovery Strategy is to increase the population levels and distribution of Northern and Spotted Wolffish in Canadian waters such that the long-term viability of the species is achieved.

Five primary objectives from the Recovery Strategy were used to guide the formulation of the actions. The objectives are:

1. Enhance the understanding of the biology and life history of wolffish species;
2. Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities;
3. Reduce the potential for wolffish population declines by minimizing human impacts;
4. Promote wolffish population growth and recovery; and
5. Develop communication and education programs to promote the conservation and recovery of wolffish populations.

Actions, as a whole, are designed to act as a road map for recovery practitioners, to promote recovery and ongoing sustainability of Northern and Spotted Wolffish populations in eastern Canadian waters to the level where they are no longer considered Threatened. Recommended actions to achieve the objectives listed above are:

- Study population structure and life history;
- Identify biological reference points;
- Study ecosystem interactions;
- Habitat identification and conservation;
- Identify and mitigate impacts of human activity;
- Monitor wolffish spatial and temporal abundance patterns;
- Monitor spatial and temporal patterns in natural and human-induced mortality; and
- Undertake education and stewardship programs on wolffish conservation and recovery.

The Recovery Strategy pointed out deficiencies in our knowledge and management of Northern and Spotted Wolffish. The recovery actions are designed to improve knowledge of these species, reduce threats and monitor these species, thereby assisting in the recovery of wolffish. Since the publication of the Recovery Strategy in 2008, much progress has been made towards fulfilling the recovery objectives set out in the strategy. Several aspects of wolffish life history

have been studied including: food and feeding; population structure; and the effects of dissolved oxygen. Distribution and abundance has been examined for all regions and large scale habitat associations have been described. Bycatch was identified as an important cause of human induced mortality of wolffish and mandatory live release of Northern and Spotted Wolffish has been implemented. In addition, management and stewardship activities have increased awareness of wolffish and their status. This Action Plan addresses the issues believed to be affecting wolffish conservation and recovery and includes actions to mitigate them. It also promotes stewardship among stakeholders and the public as a means to facilitate and promote recovery.

Effective recovery for both wolffish species requires a commitment to the implementation of the recovery actions. It is acknowledged that there may be a need for adaptive management and the need to modify or revise the Action Plan when new information becomes available. Implementation of actions, including the mitigation of known threats, provides the best chance to conserve and restore wolffish species to a level where they are no longer considered at risk. However, it is also recognized that the implementation of recovery actions are constrained by available resources and that non-human elements (e.g., environmental influences) may have played a role in the decline of the species and these effects cannot be controlled or mitigated, but only monitored. This Action Plan delineates the steps required to move toward recovery.

Details on critical habitat and activities likely to destroy that habitat are included in Section 6 of the Recovery Strategy.

This document also contains a socio-economic evaluation that summarizes the potential cost and benefits of recovery. It was determined that the implementation of this Action Plan may have varying degrees of impacts on multiple stakeholders, but generally these impacts are assumed to be negligible. Generally, Action Plan activities would likely not have direct impacts on other individuals or groups beyond Fisheries and Oceans Canada (DFO), Non-Government Organizations (NGOs) and harvesters. The incremental costs of implementing this Action Plan are considered to be of a low economic magnitude and DFO would bear the bulk of the costs associated with the implementation of this plan. Canadians at large will be impacted by the extent to which non-market benefits are realized.

This Action Plan represents a collaborative and consultative effort by a multi-regional team (including the following DFO regions: Newfoundland and Labrador, Maritimes, Gulf, Quebec, Central and Arctic, and National Headquarters) with representation that included expert scientists, fisheries managers and economists who assisted in formulating a way forward for recovery of the wolffish species in Canadian waters. Consultation with the fishing industry, academia, NGOs and the government (federal, provincial and territorial) was also undertaken.

Table of Contents

1. Recovery Actions

1.1 Context and Scope of the Action Plan

In May 2001, the Northern Wolffish (*Anarhichas denticulatus*) and the Spotted Wolffish (*Anarhichas minor*) were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Threatened (COSEWIC 2001a,b). A third species, the Atlantic Wolffish (*Anarhichas lupus*), was assessed by COSEWIC as Special Concern in November 2000 (COSEWIC 2000). All three wolffish species were included in Schedule 1 of the *Species at Risk Act* (SARA) at the time of the Act's proclamation in June 2003. In November 2012, COSEWIC reassessed the three species and recommended that their status remain unchanged (COSEWIC 2012a,b,c). Therefore, under SARA, the status of all three species also remained unchanged.

Northern and Spotted Wolffish are the focus of this document, but recovery activities identified in this document may likely benefit Atlantic Wolffish as the distributions of the three species overlap over much of their range.

The "*Recovery Strategy for Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor), and Management Plan for Atlantic Wolffish (Anarhichas lupus) in Canada*" (DFO 2018) (hereafter referred to as the Recovery Strategy) was published in February 2008 and was updated in 2018. The Recovery Strategy identified several actual and potential threats to the species and their habitat including:

- Fishing
  - bycatch is thought to be the leading cause of human induced mortality
  - bottom trawling and dredging activities were identified as possible causes of habitat alteration
- Offshore oil and gas exploration and production
  - seismic activities
- Ocean dumping
  - sewage sludge
  - fish waste
  - dredging spoils
- Military activity
- Cables and pipelines
- Marine and land-based pollution
- Global climate change

The goal of the Recovery Strategy is to increase the population levels of Northern and Spotted Wolffish, as well as Atlantic Wolffish, in eastern Canadian waters such that the long term viability of those species is achieved. The Recovery Strategy identifies five objectives related to this goal:

1. Enhance understanding of the biology and life history of wolffish species;
2. Identify, conserve and/or protect wolffish habitat required for viable population sizes and densities;
3. Reduce the potential for wolffish population declines by minimizing human impacts;
4. Promote wolffish population growth and recovery; and

5. Develop communication and education programs to promote the conservation and recovery of wolffish populations.

To achieve the five objectives noted above, five strategies were determined. The strategies are:

1. Conduct research;
2. Habitat conservation and protection;
3. Mitigate human activities;
4. Promote knowledge and stakeholder participation in the recovery of wolffish populations and habitat conservation and/or protection; and
5. Monitoring human activities and wolffish species.

These five recovery strategies constitute the basis of a framework for recovery of Northern and Spotted Wolffish populations (as well as Atlantic Wolffish populations), conservation and protection of their habitat and monitoring of human activities. Actions, as a whole, are designed to provide a road map for recovery practitioners and to promote recovery and ongoing sustainability of wolffish populations in eastern Canadian waters to the level where they are no longer considered threatened.

This Action Plan is a guide for those involved in the recovery of Northern and Spotted Wolffish. While it is not meant to prescribe and design specific projects, a number of projects have been presented. These broad based actions are directly related to the strategies and objectives elaborated in the recovery strategy (DFO 2018). In an effort to keep this Action Plan in line with the Recovery Strategy and the strategies and actions referenced therein, there may be some level of redundancy or overlap amongst the actions proposed in this plan.

Each of the five recovery strategies are taken from the Recovery Strategy document and are designed to achieve the goals of that strategy. As this plan is considered to be adaptive (i.e., a living document), objectives and strategies can be added or revised as new knowledge becomes available.

Activities are given a priority rating based on their importance in facilitating the recovery of Northern and Spotted Wolffish. Priorities are directly related to the Recovery Strategy (DFO 2018).

Northern and Spotted Wolffish did not decline in all parts of their range within Canadian waters; however, the actions apply to all marine Atlantic waters where wolffish occur because at present, they are considered to constitute single populations (single Designatable Unit (DU)) for each species. As well, while there is some evidence of a recent increase in abundance of the two species since the early 2000s (Simpson et al. 2012), it does not constitute recovery of the species. Thus, the activities outlined in this plan are required to promote further recovery.

1.2 Measures to be Taken and Implementation Schedule

Success in the recovery of this species is dependent on the actions of many different jurisdictions and it requires the commitment and cooperation of the constituencies that will be involved in implementing the directions and measures set out in this Action Plan.

This Action Plan provides a description of the measures that provide the best chance of achieving the recovery objectives for Northern and Spotted Wolffish, including measures to be taken to address threats to the species and monitor its recovery, and to guide not only activities to be undertaken by Fisheries and Oceans Canada (DFO), but those for which other jurisdictions, organizations and individuals have a role to play. As new information becomes available, these measures and the priority of these measures may change. DFO strongly encourages all Canadians to participate in the conservation of Northern and Spotted Wolffish through undertaking measures outlined in this Action Plan.

Table 1 identifies the measures that will be led by DFO to support the recovery of Northern and Spotted Wolffish.

Table 2 identifies the recovery measures to be undertaken collaboratively between DFO and its partners, other agencies, organizations or individuals. Implementation of these measures will be dependent on a collaborative approach, in which DFO is a partner in recovery efforts, but cannot implement the measures alone. If your organization is interested in participating in one of these measures, please contact the Species at Risk, NL Region office at saranl-leptnl@dfo-mpo.gc.ca.

Implementation of this Action Plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Table 1. Measures to be led by Fisheries and Oceans Canada

#	Recovery Measures	Priority[1]	Threats or Concerns Addressed	Timeline
Recovery Strategy A: Conduct Research (associated with Recovery Objectives 1, 2, 4)				
1	Study population structure and life history to: a) Estimate size and age structure, growth, and reproduction. b) Determine population structure from distribution, morphology and meristic analysis and population genetics.	High	Knowledge of population structure and life history processes is deficient; this is fundamental to the formulation of wolffish recovery goals and management.	a) Ongoing b) Ongoing
2	Identify biological reference points to: a) Define allowable human-induced mortality for a healthy recovered population. b) Define the biomass target for a recovered population.	High	Reference points constitute the framework and guideposts to recovery; they are needed to determine when a population has achieved recovery. The species will be considered recovered when in the healthy zone of the Precautionary Approach Framework.	a) Ongoing b) Ongoing
3	Study ecosystem interactions to: a) Continue to examine diet. b) Continue to examine species associations.	Medium	This will help determine if wolffish population status is affected by ecological associations and how population changes in other species may affect wolffish.	a) Ongoing b) Ongoing

[1] "Priority" reflects the degree to which the measure contributes directly to the recovery of the species or is an essential precursor to a measure that contributes to the recovery of the species. High priority measures are considered those most likely to have an immediate and/or direct influence on attaining the recovery objective for the species. Medium priority measures may have a less immediate or less direct influence on reaching the recovery population and distribution objectives, but are still important for recovery of the population. Low priority recovery measures will likely have an indirect or gradual influence on reaching the recovery objectives, but are considered important contributions to the knowledge base and/or public involvement and acceptance of species.

#	Recovery Measures	Priority[1]	Threats or Concerns Addressed	Timeline
Recovery Strategy B: Habitat Conservation and Protection (associated with Recovery Objectives 2, 4, 5)				
4	Habitat identification and conservation. a) Refine what aspects of the environment (*e.g.*, attributes and features) are important for wolffish survival. b) Examine habitat associations. c) Define distribution targets for a recovered population.	Medium	There is a need for knowledge of wolffish habitat and how it is utilized.	a) Ongoing b) Ongoing c) Ongoing
Recovery Strategy C: Mitigate Human Activities (associated with Recovery Objectives 3, 4, 5)				
5	Identify and mitigate impacts of human activity. a) Quantify fishing mortality (bycatch) by determining removals of wolffish by Canadian and international fisheries. b) Determine and implement effective approaches to mitigate the effects of human activities.	High	Bycatch mortality in many fisheries is a main anthropogenic threat identified by COSEWIC.	a) Ongoing b) Ongoing Methods of live release have been identified and are mandatory.
Recovery Strategy E: Monitor Human Activities and Wolffish Species Status (associated with Recovery Objectives 3, 4)				
6	Monitor wolffish spatial and temporal abundance patterns. a) Compile and analyze wolffish catch data from seasonal bottom trawl research surveys. b) Quantify changes in distribution.	Medium	Monitor recovery throughout the species' range; population size and structure need to be monitored to discern trends, understand mortality patterns and identify recruitment problems.	a) Ongoing b) Ongoing
7	Monitor spatial and temporal patterns in natural and human induced mortality. a) Collect bycatch and discard information from	High	Monitor threats to ensure effective and continued mitigation/management measures.	a) Ongoing b) Ongoing

#	Recovery Measures	Priority[1]	Threats or Concerns Addressed	Timeline
	Canadian and international fisheries. b) Quantify wolffish mortality due to fishing. c) Monitor changes in other potential sources of non-human induced mortality.			c) Ongoing

Table 2. Measures to be undertaken collaboratively between Fisheries and Oceans Canada and its partners, other agencies, organizations or individuals

#	Recovery Measures	Priority[2]	Threats or Concerns Addressed	Timeline	Partners
Recovery Strategy D: Promote knowledge and stakeholder participation in the recovery of wolffish populations and habitat conservation and/or protection (associated with Recovery Objectives 3, 4, 5)					
8	Undertake education and stewardship programs on wolffish conservation and recovery a) Produce and disseminate promotional items and informational materials to raise awareness of wolffish conservation and recovery. b) Engage harvesters, processors, scientists, regulators, enforcement, observers, dockside monitors and other ocean users to inform and elevate public awareness of the condition of the species and its conservation and recovery. c) Educate stakeholders in the mitigation of wolffish threats. d) Identify opportunities to involve government, non-governmental organizations, industry and others in the process of recovery.	Medium	Stakeholder cooperation is essential to ensuring mitigation is implemented and effective. Mitigate anthropogenic threats to wolffish populations by engaging those who can assist in recovery actions.	a) Complete/Ongoing Promotional and informational materials have been developed. The distribution of these materials is ongoing. b) Ongoing c) Ongoing d) Ongoing	Non-government organizations Industry

[2] "Priority" reflects the degree to which the measure contributes directly to the recovery of the species or is an essential precursor to a measure that contributes to the recovery of the species. High priority measures are considered those most likely to have an immediate and/or direct influence on attaining the recovery objective for the species. Medium priority measures may have a less immediate or less direct influence on reaching the recovery population and distribution objectives, but are still important for recovery of the population. Low priority recovery measures will likely have an indirect or gradual influence on reaching the recovery objectives, but are considered important contributions to the knowledge base and/or public involvement and acceptance of species.

The following sections elaborate on the previous implementation tables and provide a description of ongoing activities as well as planned activities to deliver on the actions outlined in this Action Plan. It should be recognized that the implementation of these activities is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Actions to support the recovery of Northern and Spotted Wolffish have been ongoing since both species were listed under SARA in 2003.

1.2.1 Implementation Schedule for DFO-Led Activities

Activity 1. Study population structure and life history

a) **Estimate size and age structure, growth and reproduction**
Data collection is the first stage in life history research and is long term in nature. It is fundamental to understanding population status, vulnerability and the path to recovery as data are limited for wolffish. Data are collected through annual DFO surveys in each region and include relative densities (number and weight per tow) and, where possible, length and sex data are collected from the sampled population. Size at maturity can change on an annual basis, so maturity studies require many years of data to be complete. The latest available information on Northern and Spotted Wolffish life history is available in Dutil et al. (2011), Simon et al. (2012) and Simpson et al. (2012).

b) **Determine population structure from distribution, morphology and meristic analysis and population genetics**
Distribution studies have been conducted. Mapping is done on an annual basis to investigate the changing distribution of wolffish populations. Genetic markers appropriate for wolffish species have been identified but the population structure in Canadian waters has not yet been defined. This work has been in part financed by DFO and done at Memorial University of Newfoundland and Dalhousie University (Carr et al. 2007; Johnstone et al. 2007; McCusker et al. 2008; McCusker and Bentzen 2011). At present, it is assumed that each species comprises a single population in Canadian waters, due to the limited or contrasting results in previous studies.

Several papers have been published containing distribution information (DFO 2018; Dutil et al. 2011; Kulka *et al.* 2004; Simpson and Kulka 2002; Simpson *et al.* 2012). Landings and bycatch data were also analyzed by NAFO Division (Ouellet *et al*. 2011; Scallon-Chouinard et al. 2007; Simpson et al. 2012). Changes in area occupied and other spatial indices have been examined. DFO studies include mapping of distribution and abundance (Dutil et al. 2011; Kulka and Simpson 2004; Simpson et al. 2012).

Morphometrics (body measurements) and meristics (counts) have been collected from specimens in the laboratory to study differences in relative measures and counts throughout the wolffish geographic range.

Recovery Activities:
- Continue existing levels and types of data collection; provide annual updates/reports as appropriate.
- Conduct interregional discussions to standardize and improve regional sampling protocols for wolffish.

- Preliminary genetic work has been conducted. However, additional work involving samples from all regions for Restriction Fragment Length Polymorphism (RFLP) analysis should be conducted.

Activity 2. Identify biological reference points

Typically, biological reference points for species are identified when the species undergoes a Recovery Potential Assessment (RPA) as part of the SARA listing process; however, an RPA has not been conducted and reference points have not yet been delineated. DFO demersal research survey data can provide information on the status of wolffish (relative abundance and population size). This information over the long term will help to identify biological reference points. DFO Science is investigating models to identify the biological reference points for both species of wolffish.

a) Define allowable human-induced mortality for a healthy recovered population (allowing for the population to grow and meet recovery objectives)
This activity depends on population studies (Actions 1a and 1b) which DFO Science is still completing.

b) Define the biomass target for a recovered population (allowing for the population to grow and meet recovery objectives)
This activity depends on population studies (Actions 1a and 1b) which DFO Science is still completing.

Recovery Activities:
- Continue to collect and analyze biological data on both species of wolffish to better understand population structure.
- As a component of a peer review process, investigate appropriate models to determine biological reference points for both species of wolffish.
- Conduct a modeling program testing various modeling approaches to determine biological reference points.
- Complete allowable harm reassessment.

Activity 3. Study ecosystem interactions

In their habitats, wolffish interact with other species both as prey and as predator. Continued research on wolffish diet and species assemblages may improve our understanding of important ecological requirements of wolffish.

a) Continue to examine diet
DFO Science has conducted food and feeding studies; preliminary diet analysis shows clear differences in diet and niche among the wolffish species.

Simpson et al. 2013 describes wolffish diet in Newfoundland and Labrador waters. Seasonal aspects of diet and age-sex related differences in diet have not been investigated. There is also a need to investigate the variation in diet in relation to the abundance of prey species. In addition to diet studies, wolffish as the prey of other species (e.g., seals, other fish) should be investigated.

b) Continue to examine species associations
Identify species of commercial importance associated with wolffish (thereby shedding light on potential mitigation and bycatch issues) and identify any key species in wolffish habitat whose abundance or variation in abundance may affect wolffish status, both as a prey or as a predator, particularly on juveniles.

Recovery Activities:

- Investigate variation in diet in relation to the abundance and distribution of prey species.
- Investigate wolffish as the prey of other species.
- Publish work to date on ecosystem interactions.

Activity 4. Habitat identification and conservation

a) Refine what aspects of the environment are important to wolffish for survival
Work on habitat associations has been undertaken in some areas including at the center of their distribution. Kulka et al. (2004) examined depth, temperature and bottom type associations. Additional work is ongoing. Temperature was hypothesized as a possible habitat feature critical to wolffish survival. Dutil et al. (2011) have more recently defined a host of physical attributes in the Gulf of St. Lawrence (a fringe area for Northern Wolffish).

Overall work on describing habitat is in progress. Research related to field observations of live fish or their habitats has also been conducted. Studies include shelter use and habitat utilization (Kulka et al. 2004; Larocque et al. 2008) and habitat characteristics (Larocque et al. 2010). The work mainly involved Atlantic Wolffish, but some Spotted Wolffish were included. Juvenile Spotted Wolffish have been studied in the laboratory (Lachance et al. 2010).

b) Examine habitat associations
Habitat association work has been done at the center of wolffish distribution (Grand Banks to Labrador Shelf) by Kulka et al. (2004) and in the Gulf of St Lawrence (Dutil et al. 2011). Studies include shelter use (field studies on Atlantic Wolffish and lab studies on Spotted Wolffish (Lachance et al. 2010; Laroque et al. 2008, 2010), habitat use (Spotted and Atlantic Wolffish) and habitat characteristics, as well as historic and actual distribution and abundance mapping. Work was also carried out on habitat associations with respect to temperature and surficial features. Fish assemblages have been described based on annual surveys in the northern Gulf of St. Lawrence (Chouinard and Dutil 2011).

c) Define distribution targets for a recovered population
This activity depends on population studies (Actions 1a and 1b) which DFO Science is still completing.

Recovery Activities:

- Undertake field projects applying new technologies (e.g., data archival tags, receiver arrays) to study home range, movement patterns and habitat characteristics of individual juvenile and adult wolffish.
- Habitat analyses were conducted in the past and should be repeated in Newfoundland and Labrador Region using updated surveys and revised bottom type estimates as well as additional years of depth temperature data that are available.

- Expand habitat work in the whole Gulf of St. Lawrence to explore species and habitat interactions.
- Follow up on preliminary work conducted in Newfoundland and Labrador and the Gulf of St. Lawrence, using SCUBA, tagging and towed camera array.

Activity 5. Identify and mitigate impacts of human activity

a) Quantify fishing mortality (bycatch) by determining removals of wolffish by Canadian and international fisheries

Mortality due to fishing has been identified as an anthropogenic threat to wolffish. Bycatch of wolffish has been quantified for recent years in many of the fisheries where they have been captured and data continues to be collected by fishery observers. Commercial fish harvesters are required to complete logbooks and report bycatch of wolffish.

b) Determine and implement effective approaches to mitigate the effects of human activities

The main threat to wolffish was cited by COSEWIC as bycatch mortality in commercial fisheries. Conservation measures, in the form of live release, have been implemented since 2003 to mitigate this threat. This is currently a condition of license for commercial fisheries. Live release is considered to be effective since the majority of captured wolffish are very lively when first captured (DFO 2004). DFO has conducted various campaigns related to live release, targeting fishermen. Information related to the identification of the different wolffish species and methods for live release has been provided. Various sectors of DFO, including Science, and Conservation and Protection are active in promoting mitigation measures (e.g., live release) to offset the threats of human activities. Additionally, NGOs have been active in some regions, working with fish harvesters and promoting live release of wolffish in a stewardship capacity. See more details provided under Activities 7 and 8.

Fishery observers have gathered data on capture and release of wolffish since 2004. Logbooks have been distributed to fishermen. The data gathered were provided to DFO Science for distribution and abundance studies. Fishery Officers' conduct patrols, inspect vessels and cross-reference logbooks with observer records.

Modifications to gear and methods to avoid the catch of wolffish have not been fully explored.

Recovery Activities:

- Continue education activities related to the threats to wolffish and live release of wolffish, including public awareness campaigns by DFO and NGOs.
- Encourage educational institutions to continue investigation into the feasibility of alternative fishing gear options and the effectiveness of live release.
- Continue conservation and protection activities (e.g., conduct patrols to ensure that wolffish are being released in the least harmful manner possible, ensure that wolffish are not being retained for bait).

Activity 6. Monitor wolffish spatial and temporal abundance patterns

a) **Compile and analyze wolffish catch data from seasonal bottom trawl research surveys**
Ongoing annual surveys by DFO provide data to quantify changes in wolffish status. To date, stage-based or age-based analyses have not been done. However, data collection is underway and modeling exercises will be undertaken. The latest information on abundance is contained in Simon et al. (2012) and Simpson et al. *(*2012).

b) **Quantify changes in distribution**
Based on survey data, changes in distribution of wolffish over time have been mapped and spatially analyzed to determine changes in area occupied. Survey abundance indices are calculated annually to monitor changes in the size of the population. This work is ongoing**.**

Recovery Activities:

- Continue collection of wolffish data as part of DFO annual surveys in various regions.
- Review survey data and examine changes in wolffish status at various life stages, to the extent possible based on availability of data, and review survey data to determine changes in distribution.

Activity 7. Monitor spatial and temporal patterns in natural and human-induced mortality

a) **Collect bycatch and discard information from Canadian and international fisheries**

b) **Quantify wolffish mortality due to fishing**

c) **Monitor changes in other potential sources of non-human induced mortality**
The monitoring of activities related to mortality is ongoing and will continue. Fishery observers collect data on capture and release of wolffish; fish harvester logbooks record data which is provided to DFO Science.

Kulka and Pitcher (2001) mapped trawl fisheries off Atlantic Canada. That information was used to examine population decline in areas where fishing was high compared to non-fished areas (Kulka and Simpson 2004). The most recent information is available in Simpson et al. (2012).

Recovery Activities:

- Continue to collect, analyze and report on data in relation to wolffish mortality.

1.2.2 Implementation Schedule for Collaborative Activities

Activity 8. Undertake education and stewardship programs on wolffish conservation and recovery

a) **Produce and disseminate promotional items and informational materials to raise awareness about wolffish conservation and recovery**
DFO and others, including NGOs, have been active in promoting awareness related to wolffish species. A number of promotional items have been developed and are continuously distributed, including factsheets, brochures, posters, DVDs, etc. In the past, there has been a targeted distribution; currently, such items are distributed on an

opportunistic basis, (e.g., Oceans Day events, school visits, trade shows). Wolffish are also included in general Species at Risk products, including school education kits, aquatic species calendars, SARA art project/show, portable displays and SARA identification cards. Species at Risk workshops have been delivered to industry, harvesters, fisheries observers, Fishery Officers and the general public. Such activities continue and discussions related to wolffish are often incorporated into other discussions.

b) Engage harvesters, processors, scientists, regulators, enforcement, observers, dockside monitors and other ocean users to inform and elevate public awareness of the condition of the species and its conservation and recovery
Wolffish have been the target of many outreach activities, particularly in the Newfoundland and Labrador Region.

Various sectors of DFO actively engage stakeholders and the general public (where appropriate) in public awareness and education related to wolffish. Targeted consultations, largely undertaken by DFO Science and Fisheries Management, have been conducted with stakeholders prior to the two species being placed on Schedule 1 of SARA and during the associated requirement for determining allowable harm. The continued cooperation of all parties involved with wolffish recovery is always encouraged and promoted, often through targeted sessions and generally on a routine basis by DFO staff at harvester meetings. NGOs have also been active in working with stakeholders and promoting awareness related to wolffish conservation and recovery. For example, a DVD entitled *Wolffish – A Balance of Life*[3] has been produced, discussions with fish harvesters have been ongoing in the form of 'dockside dialogues' and Traditional Ecological Knowledge has been collected.

c) Educate stakeholders in mitigation of wolffish threats
Various targeted stewardship and education programs have been underway since 2002, now largely complete with respect to development; however, their usage continues. A number of factsheets designed to focus on wolffish identification and their handling and release in various fishing sectors have been developed and continue to be distributed. A DVD was produced on how to handle and release wolffish. Stewardship activities have been carried out by NGOs who have worked directly with fish harvesters to educate and create an awareness of threats to wolffish.

d) Identify opportunities to involve government, NGOs, industry and others in the process of recovery
DFO and NGOs have been, and continue to be, actively promoting and encouraging the recovery of wolffish. Fish harvesters are engaged in wolffish recovery through the live release program which is a condition of license for commercial fishing activities. The quick and safe release of incidentally caught wolffish and accurate reporting of wolffish bycatch has been promoted over the past several years in many fishing communities across Atlantic Canada. Information and awareness sessions have been conducted by DFO, NGOs and Indigenous groups. Numerous campaigns targeting the fishing industry, and others, were conducted on species at risk, including wolffish. Funds to support such activities are available from government sources such as the Habitat Stewardship Program and Aboriginal Fund for Species at Risk; additional resources to supplement these funds come from a variety of sources including industry, academia, and the private

[3] Wolffish – A Balance of Life. Intervale Associates Inc. 2007

sector. Often in the form of in-kind support, all of these contributions are critical to implementing projects which support the recovery of wolffish. The cooperation of industry, especially fish harvesters, is extremely important with respect to implementing mitigation measures.

Recovery Activities:
- Continue public awareness and education efforts related to wolffish by DFO and NGOs to a variety of audiences as opportunities are available, especially to fish harvesters.
- Continue efforts on the part of DFO and others with respect to cooperation and collaboration with stakeholders.

1.3 Critical Habitat

1.3.1 Identification of Northern Wolffish and Spotted Wolffish Critical Habitat

Critical habitat for Northern and Spotted Wolffish is identified, to the extent possible, in Section 6 of the Recovery Strategy (DFO 2018).

1.3.2 Examples of Activities Likely to Result in Destruction of Critical Habitat

Examples of activities likely to result in destruction of critical habitat may be found in Section 6.5 of the Recovery Strategy (DFO 2018).

1.4 Proposed Measures to Protect Critical Habitat

Under SARA, critical habitat must be legally protected from destruction within 180 days of being identified in a recovery strategy or action plan. For Northern and Spotted Wolffish critical habitat, it is anticipated that this will be accomplished through a SARA Protection Order made under subsections 58(4) and (5), which will invoke the prohibition in s.58(1) against the destruction of the identified critical habitat.

2. EVALUATION OF SOCIO-ECONOMIC COSTS AND BENEFITS

SARA requires that an action plan include an evaluation of the socio-economic costs of the action plan and the benefits to be derived from its implementation (SARA s. 49(1)(e), 2003). This evaluation addresses only the incremental socio-economic costs of implementing the Action Plan from a national perspective as well as the social and environmental benefits that would occur if the Action Plan were implemented in its entirety, recognizing that not all aspects of its implementation are under the jurisdiction of the federal government. It does not address cumulative costs of species recovery in general nor does it attempt a cost-benefit analysis. Its intent is to inform the public and to guide decision-making on implementation of the Action Plan by partners.

The protection and recovery of species at risk can result in both benefits and costs. The Act recognizes that "*wildlife, in all its forms, has value in and of itself and is valued by Canadians for aesthetic, cultural, spiritual, recreational, educational, historical, economic, medical, ecological and scientific reasons*". Self-sustaining and healthy ecosystems with their various elements in place, including species at risk, contribute positively to the livelihoods and the quality of life of all Canadians. A review of the literature confirms that Canadians value the preservation and conservation of species in and of themselves. Actions taken to preserve a species, such as habitat protection and restoration, are also valued. In addition, the more an action contributes to the recovery of a species, the higher the value the public places on such actions (Loomis and White 1996; DFO 2008). Furthermore, the conservation of species at risk is an important component of the Government of Canada's commitment to conserving biological diversity under the *International Convention on Biological Diversity*. The Government of Canada has also made a commitment to protect and recover species at risk through the *Accord for the Protection of Species at Risk*. The specific costs and benefits associated with this Action Plan are described below.

Policy Baseline

Northern and Spotted Wolffish are protected under *SARA*'s general prohibitions. Specifically, s. 32(1) of SARA states that "no person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species". Wolffish are also protected under the *Fisheries Act* under harvester's license conditions which dictate that harvesters are to return the fish "to the place from which it was taken, and where it is alive, in a manner that causes it the least harm". Harvesters are afforded this permission under the Recovery Strategy where it was determined that fishing activity would only have incidental harm to the species. A 2004 allowable harm assessment concluded that the current levels of mortality did not impair the ability of the species to recover. The species are not protected under analogous provincial or territorial legislation.

Socio-Economic Profile and Baseline

The implementation of this Action Plan may have varying degrees of impacts on multiple stakeholders but generally these impacts are assumed to be negligible. Research activities represent the primary focus of this Action Plan. DFO, and to a lesser extent NGOs, will be engaged in primary research on population structure, life history, and species distribution. Other DFO stakeholders to be engaged by this Action Plan include Resource Managers, Conservation and Protection Officers and Communications personnel.

Public awareness and education initiatives are often carried out by private and/or not-for-profit groups as well as DFO. Many of these activities have been ongoing since listing.

Generally, Action Plan activities would likely not have direct impacts on other individuals or groups beyond the stakeholders identified above (i.e., DFO, NGOs and harvesters).

Socio-Economic Costs of Implementing this r

The incremental costs of implementing this Action Plan are considered to be of a low economic magnitude. The primary costs are related to incremental or ongoing science research conducted by DFO. Many of the associated research activities are one year or less in duration with limited multi-year initiatives. There are no primary capital projects associated with this Action Plan.

Recovery actions for this species have been ongoing since 2003. Scientific research, along with public outreach and education, represented the largest expenditure categories. Public outreach and education expenditures have peaked, with scientific research making up the bulk of current or planned expenditures going forward.

Benefits of Implementing this Action Plan

It is envisioned that the implementation of Action Plan activities will directly or indirectly lead to greater wolffish abundance. The extent to which the species population improves will influence the magnitude of non-use benefits derived by Canadians including: a) knowledge that the species exists (existence value) and b) that the species will be available for future generations to enjoy (bequest value). However, given data limitations, monetary values of these benefits have not been estimated. If recovery actions have a spill-over effect, indirect benefits may accrue to other species and the ecosystem in general. For example, if wolffish education programs influence harvester interactions with other listed species or species assessed as at risk by COSEWIC, this may lead to a higher proportion of live returns. Again, these indirect benefits have not been estimated given the lack of data. If recovered, Spotted Wolffish could have potential commercial value. Therefore, an increase in abundance will also have potential economic benefits for harvesters in the future.

Distributional Impacts

There are no additional harvest or other activity restrictions associated with the implementation of this Action Plan. As such, there are no or minimal distributional impacts. DFO would bear the bulk of the incremental costs associated with the implementation of this Action Plan. Canadians at large will be impacted by the extent to which non-market benefits are realized.

3. Measuring Progress

Reporting on implementation of the Action Plan (under s. 55 of SARA) will be done by assessing progress towards implementing the broad strategies identified in the Recovery Strategy. In addition, carrying out Activity 6 (monitor wolffish spatial and temporal abundance patterns) as identified in this Action Plan will provide a way to measure progress toward achieving the recovery objectives. Activity 7 (monitor spatial and temporal patters in natural and human-induced mortality) as identified in this Action Plan is also an indirect measure of progress toward achieving recovery objectives.

Reporting on the ecological and socio-economic impacts of this Action Plan (under s. 55 of SARA) will be done by assessing the results of monitoring the recovery of the species and its long term viability, and by assessing the implementation of this Action Plan.

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McCusker, M.R., Paterson, I., and Bentzen, P. 2008. Microsatellite Markers Discriminate Three Species of North Atlantic Wolffishes (*Anarhichas sp.*). J. Fish Biol. 72(2): 375-385.

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Simpson, M.R., Mello, L.S.G., Miri, C.M., and Treble, M. 2012. A pre-COSEWIC Assessment of Three Species of Wolffish (*Anarhichas denticulatus, A. minor, and A. lupus*) in Canadian Waters of the Northwest Atlantic Ocean. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/122. iv + 69 p.

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Appendix A: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals and the Species at Risk Act Policies: Overarching Policy Framework* (Government of Canada, 2009). The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or achievement of any of the Federal Sustainable Development Strategy's (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of action plans may inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the action plan itself, but are also summarized below in this statement.

There is no negative effect on other species as wolffish are strictly bycatch. An increase in wolffish population should not have a significant negative effect on prey species as the population was at much higher levels of abundance in the past without any known effect.

Appendix B: Record of Cooperation and Consultation

The *Action Plan for Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor) in Canada* was developed in consultation with multiple stakeholders. DFO provided the following groups with the opportunity to review and comment on the Action Plan:

Newfoundland and Labrador Region

Canadian Association of Petroleum Producers
Department of Fisheries and Aquaculture
Environment Canada
Fish Food and Allied Workers Union
Groundfish Enterprise Allocation Council/ Canadian Association of Prawn Producers
Innu Nation
Miawpukek First Nation
Nunatsiavut Government
NunatuKavut Community Council Inc.
Parks Canada
Qalipu Mi'kmaq First Nation Band
Transport Canada

Maritimes Region

Acadia First Nation
Annapolis Valley First Nation
Atlantic Canadian Mobile Shrimp Association
Atlantic Herring Co-op
Bear River First Nation
Buctouche First Nation
Canadian Council of Professional Fish Harvesters
Canada-Nova Scotia Offshore Petroleum Board
Canadian Wildlife Federation
Clearwater Seafoods
Connors Bros.
Confederacy of Mainland Mi'kmaq
Conservation Council of New Brunswick
Dalhousie University
Guysborough Inshore Fishermen's Association
Indian Island First Nation
Kingsclear First Nation
Louisbourg Seafoods
Maritime Aboriginal Peoples Council
Maliseet Nation Conservation Council
Membertou First Nation
Metepenagiag Mi'kmaq Nation
Millbrook First Nation
Native Council of Nova Scotia
New Brunswick Department of Agriculture
New Brunswick Department of Aquaculture and Fisheries
New Brunswick Department of Energy and Mines
Nova Scotia Department of Natural Resources
Nova Scotia Fish Packers
Oromocto First Nation
Pabineau First Nation
Paq'tnkek Mi'kmaw Nation
Pictou Landing First Nation
Potlotek First Nation
Premium Seafoods Group
Richmond County Inshore Fishermen's Association
Scotia-Fundy Inshore Fishermen's Association
Seafood Producers Association of Nova Scotia
Shelburne County Quota Group
Sipekne'katik Band

Eastern Fishermen's Federation
Eastern Shore Fishermen's Protective Association
Ecology Action Centre
Eel Ground First Nation
Eel River Bar First Nation
Esgenoôpetitj First Nation
Eskasoni First Nation
Fort Folly First Nation
Fundy North Fishermen's Association
Gespe'gewaq Mi'gmaq Resource Council
Glooscap First Nation
Grand Manan Fishermen's Association
New Brunswick Department of Natural Resources
Northern Harvest Sea Farms
North of Smokey Fishermen's Association
North Shore Micmac District Council
Nova Scotia Department of Energy
Nova Scotia Department of Fisheries and Aquaculture
St. Mary's First Nation
The Lobster Council of Canada
The New Brunswick Aboriginal Peoples Council
Tobique First Nation
Unama'ki Institute of Natural Resources
Wagmatcook First Nation
Waycobah First Nation
Woodstock First Nation
World Wildlife Fund-Canada

Gulf Region

Abegweit First Nation
Elsipogtog First Nation
Lennox Island First Nation
Madawaska First Nation
Mi'kmaq Confederacy of PEI
Native Council of PEI
PEI Department of Agriculture and Forestry
PEI Department of Aquaculture and Rural Development
PEI Department of Fisheries

Québec Region

Agence Mamu Innu Kaikusseht
Alliance des Pêcheurs Professionnels du Québec
Association de gestion halieutique autochtone Mi'kmaq et Malécite
Association des capitaines propriétaires de la Gaspésie
Association des pêcheurs de la Basse Côte-Nord
Conseil des Innus de Pakua Shipu
Conseil des Innus de Pessamit
Conseil des Innus de Ekuanitshit
Conseil des Montagnais de Natashquan
Conseil des Montagnais d'Unamen Shipu
Conseil Innu Takuaikan Uashat mak Mani-Utenam
La Nation Micmac de Gespeg
Listuguj Mi'gmaq Government
Makivik Corporation
Micmacs of Gesgapegiag
Mi'gmawei Mawiomi Secretariat
Pêcheries Shipek
Première Nation Malécite de Viger
Professionnels du Québec

Association des pêcheurs de la Côte-Nord inc.

Association des pêcheurs polyvalents de Old Fort à Blanc- Sablon

Conseil de la Première Nation des Innus d'Essipit

Fédération des pêcheurs semi-hauturiers du Québec (FPSHQ)

Institut de développement durable des Premières Nations du Québec et du Labrador

Regroupement des pêcheurs professionnels des Îles- de-la-Madeleine

Regroupement des pêcheurs professionnels du Nord de la Gaspésie

Central and Arctic Region

Amaruq Hunters and Trappers

Arctic Fishery Alliance

Baffin Fisheries Coalition

Cumberland Sound Fisheries

Department of Fisheries and Sealing

Government of Nunavut

Mayukalik Hunters and Trappers

Mittimatalik Hunters and Trappers

Nangmautaq Hunters and Trappers

Nattivak Hunters and Trappers

Nunavut Inuit Wildlife Secretariat

Nunavut Offshore Allocations Holders Association

Nunavut Tunngavik Inc.

Pangnirtung Hunters and Trappers

Qikiqtaaluk Corporation

Qikiqtaaluk Wildlife Board

Umiat Corporation (Pangnirtung)

SUBMISSION TO THE NUNAVUT WILDLIFE MANAGEMENT BOARD September 2019

FOR

Information: X **Decision:**

Issue: Fisheries and Oceans Canada (DFO) Update – Marine conservation initiatives

Background

DFO Oceans Program focuses on implementation of responsibilities within the *Oceans Act*, using integrated oceans management and marine conservation tools. DFO - Central and Arctic Region, is working with Inuit partners on a number of marine conservation initiatives within and adjacent to Nunavut. These activities include advancement of marine protection measures in Tuvaijuittuq and around Southampton Island and management of marine refuges. DFO is also advancing marine environmental quality guidelines in support of sustainable development and integrated management, and supporting implementation of recommendations from the Pikialasorsuaq Commission.

Current Status

Southampton Island Area of Interest

- In fall 2018, DFO visited communities of Coral Harbour, Chesterfield Inlet and Naujaat to confirm support for pursuing marine protection around Southampton Island. Communities were supportive and identified additional adjacent areas that warrant protection.
- Since the last briefing to the Nunavut Wildlife Management Board (December 2018), the Kivalliq Inuit Association (KIA) Board of Directors approved a resolution in February 2019 endorsing an Area of Interest (AOI) for consideration as an *Oceans Act* Marine Protected Area (MPA). The AOI is around Southampton Island and Chesterfield Inlet (see attached map). The final boundary of a potential future MPA will be based on future assessments.
- An AOI Co-development Committee comprising representation from Aiviit and Aqigiq Hunters and Trappers Organizations, Irniurviit Co-management Committee, Government of Nunavut, KIA and DFO, will hold its first meeting in August 2019 in Rankin Inlet. The Committee will provide advice on the AOI development process.
- The next step is to complete detailed assessments of the AOI: ecological, socio-economic, Inuit Qaujimajatuqangit and resource potential.
- DFO will continue engaging with partners and stakeholders throughout the MPA development process.

Tuvaijuittuq Marine Protected Area

- On July 4, 2019, the Nunavut Wildlife Management Board provided a decision to the Minister of Fisheries, Oceans and the Canadian Coast Guard regarding the proposal to protect Tuvaijuittuq through ministerial order and requesting to be notified of any changes resulting to the proposal as a result of the Canada Gazette, Part I, 30-day public comment period. The 30-day comment period for *Canada Gazette*, Part 1 concluded on July 22, 2019 with no comments submitted.

- On June 21, 2019, the proposal to establish Tuvaijuittuq MPA through ministerial order was published in Canada Gazette, Part I, for a 30-day public comment period. The 30-day comment period for *Canada Gazette*, Part 1 concluded on July 22, 2019 with no comments submitted.

- On August 1, 2019 an Inuit Impact and Benefit Agreement (IIBA) was signed by the Government of Canada and the Qikiqtani Inuit Association for the Talluruiup Imanga National Marine Conservation Area, which also covers the IIBA requirements for any protected areas established within Tuvaijuittuq.

- By August 1, 2019 the Tuvaijuittuq MPA by ministerial order was signed and announced by the Prime Minister including achievement of Canada's 10% marine conservation by 2020 in Arctic Bay during a community feast held to celebrate the event.

- The Tuvaijuittuq MPA will be cooperatively managed based upon direction within the IIBA.

- With interim protection in place, DFO will continue to work with Parks Canada, Qikiqtani Inuit Association and Government of Nunavut to collect information and assess long term protection options.

Eastern Arctic Marine Refuges

- With the support of co-management partners, fishing industry, and environmental organizations, three eastern Arctic Marine Refuges, fisheries closures under the *Fisheries Act* were implemented in 2017 also contributing 1.17% to marine conservation.

- DFO monitors compliance with these fishery closures by conducting at-sea patrols and aerial surveillance as well as using vessel monitoring systems. Since the Marine Refuges were established in C&A Region, DFO has investigated one violation and detected several potential violations.

- Research projects such as electronic tagging and monitoring of Greenland Halibut, Greenland Shark and skates as well as fisheries surveys continue in and around these Marine Refuges.

- DFO was thrilled to be a partner in the public outreach project 'Guardians of Tariuq' which highlights the eastern Arctic Marine Refuges.

Pikialasorsuaq

- The Pikialasorsuaq Commission (PC) was established by the Inuit Circumpolar Council (ICC) to explore management options for a large, international Northwater Polynya marine area. The PC report contains three recommendations, two of which related to DFO mandate: The establishment of a management regime, including an Inuit-led management authority; and The identification of a protected area comprised of the polynya and including a larger management zone.

- The Inuit-Crown Partnership Committee released a joint statement in March 2019 that committed the Leaders to working together, and with the governments of Greenland and Denmark, on implementing an approach to address the concerns expressed by the Pikialasorsuaq Commission.

- Discussions with Inuit partners are ongoing to identify opportunities to provide support and build capacity within Inuit organizations to promote leadership on this initiative. A fall meeting of the Pikialasorsuaq Implementation Committee will help to identify objectives and direction on how best to support implementation of the Recommendations.

- Initial discussions have occurred with Greenland and the Kingdom of Denmark on development of a framework for implementing ocean management across the Pikialasorsuaq. DFO will also work with Canadian Inuit organizations and other key partners to inform international discussions.

- A DFO Canadian Science Advisory Secretariat (CSAS) meeting will be held Sept 18-19, 2019 in Winnipeg with international experts and scientists to review the existing body of information relevant to the Northwater Polynya.

Marine Environmental Quality

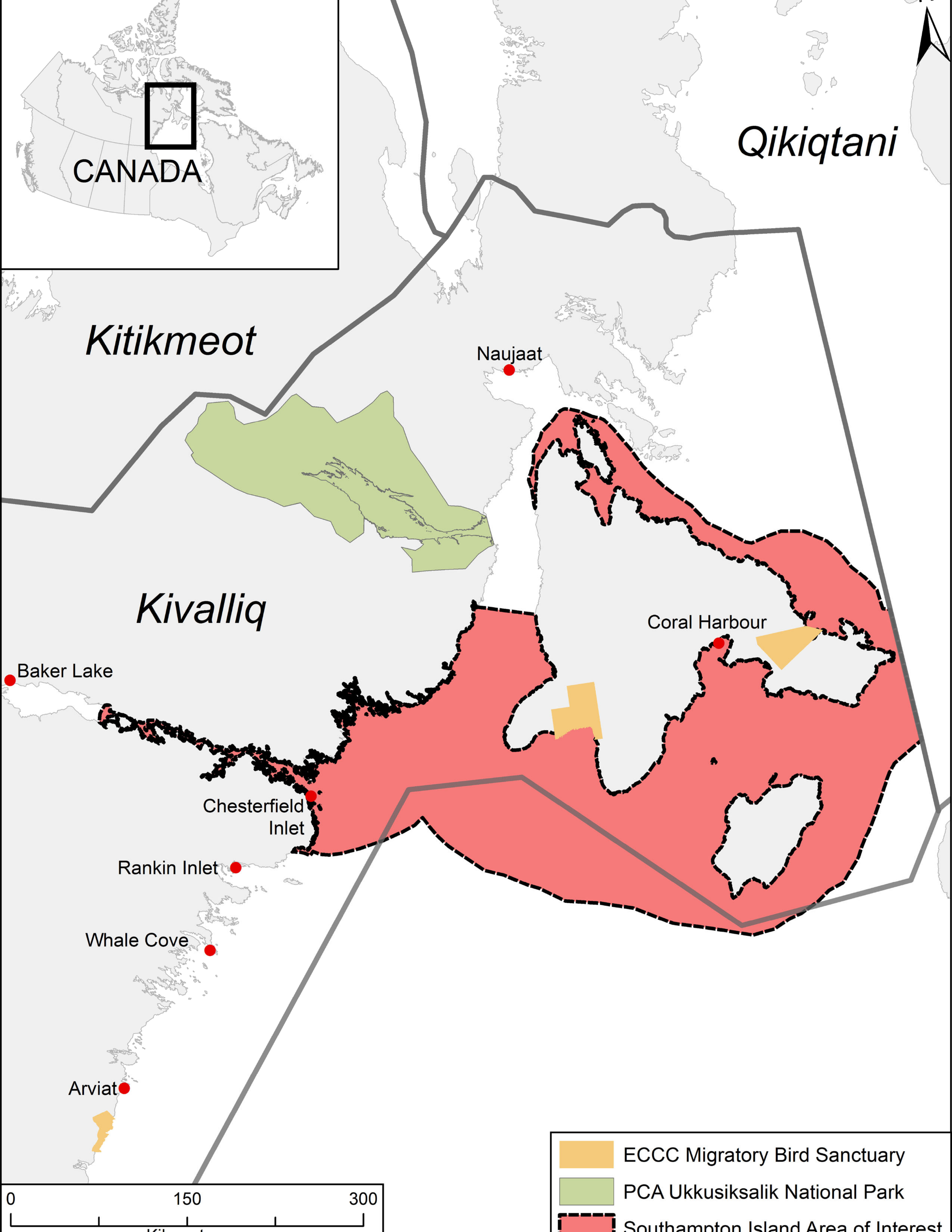
- Recent Oceans Protection Plan (OPP) investments are supporting Marine Environmental Quality (MEQ) programs under the *Oceans Act*. A commitment under OPP is to focus on mitigating the risk of human caused stressors on the marine environment, including impacts of underwater noise from ships.

- In collaboration with partners, the national MEQ program is working towards developing integrated and evidenced-based tools and strategies to better manage and maintain healthy and sustainable marine, coastal and estuarine ecosystems.

- Within Nunavut, DFO is working with partners to establish underwater noise baseline data within Frobisher Bay and the Southampton Island Area of Interest.

- Development of Arctic Pile Driving Protocol currently being evaluated as part of the Iqaluit Deep Sea Port development.

Prepared by: Central and Arctic Region – Fisheries and Oceans Canada, Oceans Program
Date: August 1, 2019



CANADA
Qikiqtani
Kitikmeot
Naujaat
Kivalliq
Coral Harbour
Baker Lake
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
ECCC Migratory Bird Sanctuary
PCA Ukkusiksalik National Park
0
150
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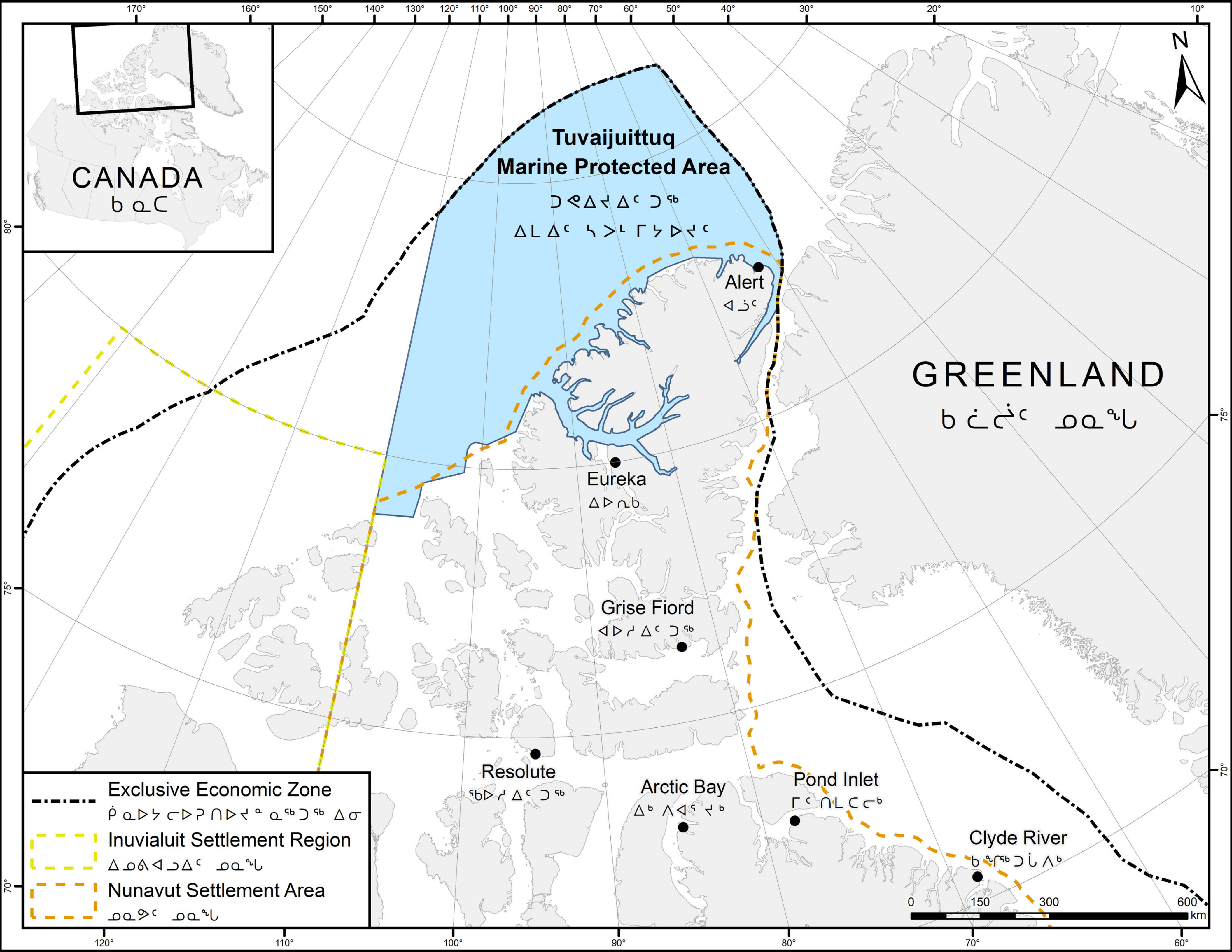

CANADA
Tuvaijuittuq
Marine Protected Area
GREENLAND
Alert
Eureka
Grise Fiord
Resolute
Arctic Bay
Pond Inlet
Clyde River
Exclusive Economic Zone
Inuvialuit Settlement Region
Nunavut Settlement Area
0 150 300 600 km
N

SUBMISSION TO THE

NUNAVUT WILDLIFE MANAGEMENT BOARD

FOR

Information: X **Decision:**

Issue: Update on public outreach project "Guardians of Tariuq" partially funded by NWMB

Background:

In fall 2017, the NWMB provided $5,000 to support the development of a public outreach project proposed by a partnership consisting of the Nunavut fishing industry, environmental organizations, and Fisheries and Oceans Canada (DFO) to celebrate newly formed protected areas in Baffin Bay and Davis Strait. The result was a music video starring Nunavut school children and performance artists entitled "Guardians of Tariuq" https://youtu.be/4HLU5C_08ow. We wish to update the NWMB on project details and successes.

The project took 11 months to complete (idea generated August 2017; music video launched June 2018) and cost $ 50,000. Organizations that contributed funds, labour, photos, video, website hosting, and/or talents are listed in Appendix 1.

To date the video has been viewed 2959^{+} times in 43 different countries and presented at 7 conferences in Canada, Egypt, and Norway. Lesson plan, supporting materials, and link to the music video are posted on Nunavut Department of Environment website in Inuktitut, English, French, and Inuinnaqtun https://gov.nu.ca/environment/information/environmental-education-resources for educators throughout the world to use. Promotional events are detailed in Appendix 2.

Consultation:

"Guardians of Tariuq" was a collaborative effort among many partners. Discussions occurred via face-to-face meetings, phone calls, and teleconferences. Feedback from partners and the public has all been positive.

Recommendation:

That the NWMB provide feedback on this public outreach project and suggest other promotion opportunities for "Guardians of Tariuq".

Prepared by: Beth Hiltz, Fisheries Management, Central & Arctic Region, DFO, 204-983-7987

Date: July 24, 2019

Appendix 1. **Organizations that contributed to “Guardians of Tariuq” production.**

- Oceans North
- Nunavut Fisheries Association
- Northern Coalition Corporation
- Fisheries and Oceans Canada
- The Trade Offs
- Qanukiaq Studios
- Nanook School
- Atiigo Media
- Ecology Action Centre
- Government of Nunavut
- Nunavut Wildlife Management Board
- ArcticNet
- Amundsen Science

Appendix 2. **Promotional events.**

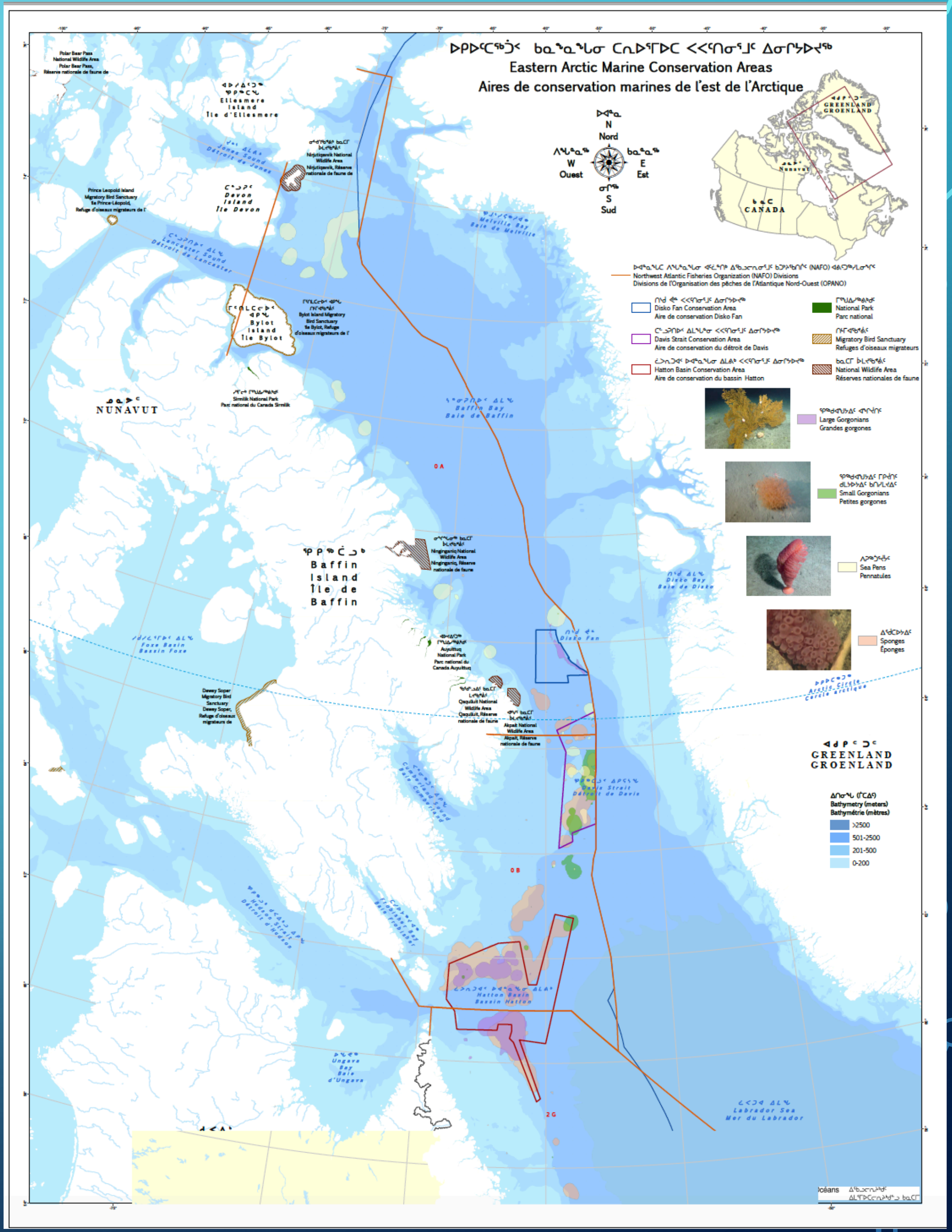
- February 1, 2018 – Nunavut Fisheries Association and Northern Coalition Corp. presented music video trailer at Northern Lights Showcase, Ottawa, ON https://www.northernlights.events/session/conference-session-viii/
- June 4, 2018 - Launch with news release in Iqaluit, NU
- June 8 (Oceans Day), 2018 – Fisheries and Oceans Canada (DFO) visited 4 schools in Iqaluit/Apex, NU and gave Fish Habitat and Arctic Food Web lesson which included showing the music video
- June 8, 2018 - Nunatsiaq News article https://nunatsiaq.com/stories/article/65674nunavut_kids_play_lead_roles_in_music_video_about_ocean_conservation/
- June 11, 2018 - Nunavut News article https://nunavutnews.com/nunavut-news/students-sing-their-guardianship-of-the-sea/
- July 15, 2018 – Northern Coalition Corp. presented "Eastern Arctic Conservation Areas: A Music Video" at Canadian Network for Ocean Education National Symposium, St. John's, NL http://oceanliteracy.ca/2018-ocean-literacy-conference/
- November 23, 2018 – Oceans North showed Guardians of Tariuq at the Convention Biological Diversity Conference, Sustainable Ocean Day: Ocean Voices, as Voices of Ocean People, Sharm el Sheikh, Egypt https://enb.iisd.org/biodiv/cop14/sustainable-ocean-day/
- September 27 2018 – Department of Environment, Government of Nunavut posted Guardians of Tariuq lesson plan, supporting materials, and link to the music video on Education and Outreach website in English, Inuktitut, French, and Inuinnaqtun (partial). https://gov.nu.ca/environment/information/environmental-education-resources
- December 12, 2018 - DFO presented "An innovative approach to public outreach in support of the conservation and promotion of ecologically important areas in Baffin Bay and Davis Strait, Canada" at 2018 ArcticNet Annual Science Meeting, Ottawa, ON http://www.arcticnetmeetings.ca/index.php?url=14013
- May 27, 2019 – Oceans North presented "Making Change - Perspectives from Policy Advocacy and Implementation" at the annual Canadian Evaluation Society conference, Halifax, NS http://www.c2019evaluationcanada.ca/ehome/index.php?eventid=367967&tabid=785525&
- May 29, 2019 – DFO presented "An inclusive approach to public outreach: a case study from Canada's Arctic" at Prairie Innovation Fair, Winnipeg, MB http://rfc-cfr.gc.ca/Liensregionaux-RegionalConnections/ConseilfederaldesPrairies-PrairieFederalCouncil
- June 26, 2019 – DFO presented "'Guardians of Tariuq' a music video celebrating Canada's eastern arctic marine conservation areas starring school children" at Arctic Council's Protection of the Arctic Marine Environment Working Group Second International Science and Policy Conference on Implementation of the Ecosystem Approach to Management in the Arctic, Bergen, Norway https://www.pame.is/index.php/projects/ecosystem-approach/second-ea-international-conference-2019

“GUARDIANS OF TARIUQ”
A MUSIC VIDEO CELEBRATING CANADA’S EASTERN ARCTIC MARINE CONSERVATION AREAS STARRING NUNAVUT SCHOOL CHILDREN

Nunavut Wildlife Management Board regular meeting
September 11, 2019, Iqaluit, NU

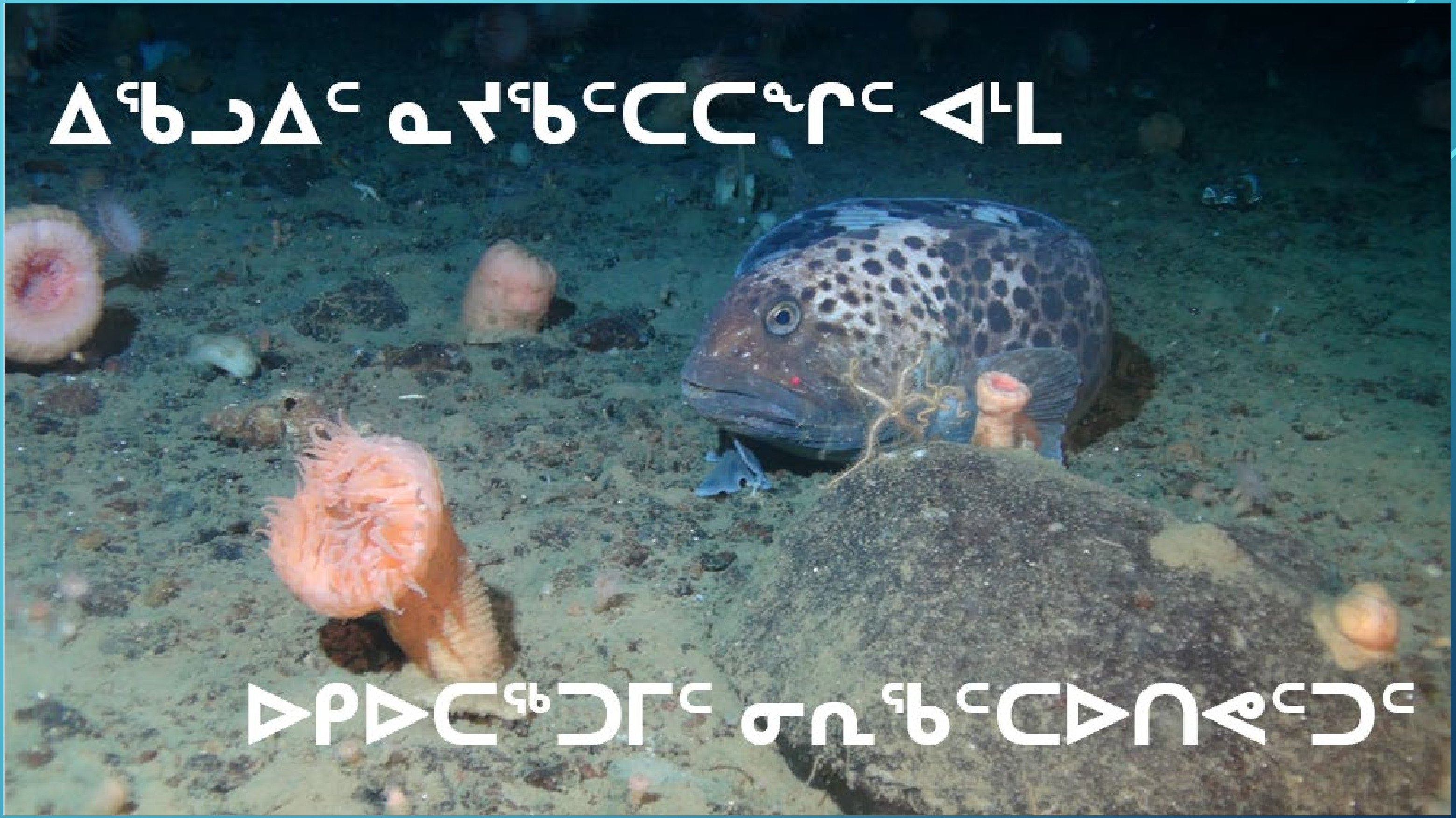
THE CHALLENGE

- Corals, sponges, and sea pens inhabit Baffin Bay and Davis Strait. Some of these species are very old, fragile, and aggregate.
- To protect these sensitive habitats three areas were closed to commercial fishing using bottom contact gear https://www.dfo-mpo.gc.ca/oceans/oeabcm-amcepz/refuges/index-eng.html.
- These areas are far from coastal communities.
- Desire by northern stakeholders to highlight and celebrate these protected areas with the people of Nunavut (NU) and Labrador.



THE APPROACH

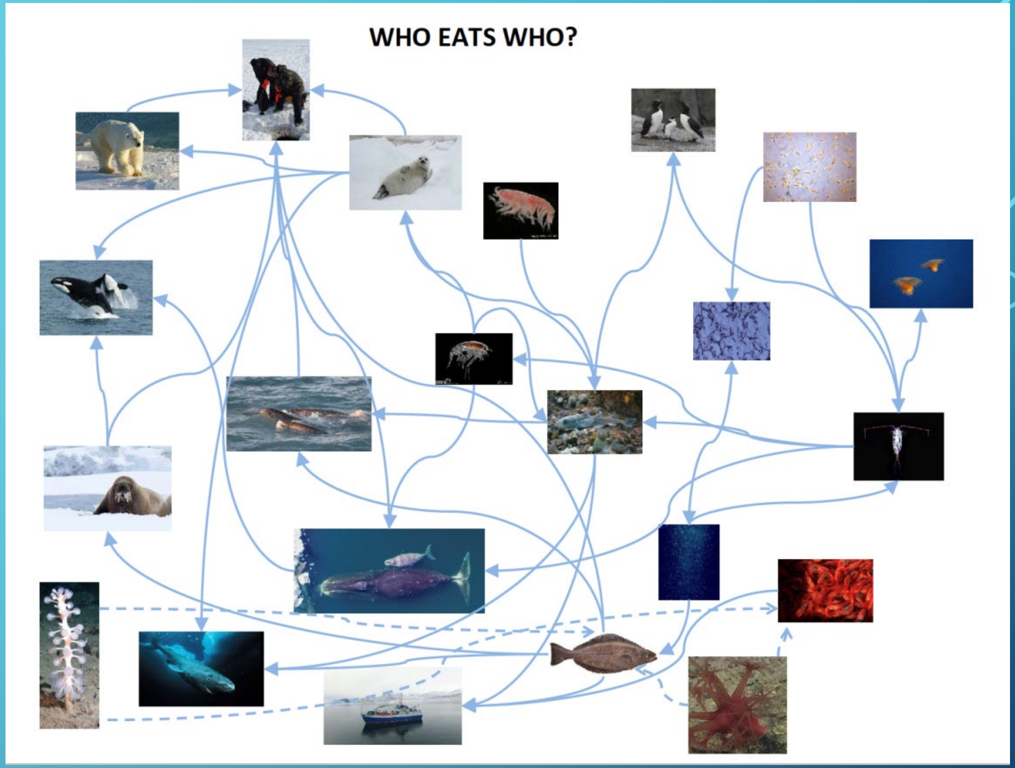
- Convey a conservation message through art.
- Use storytelling and conversation.
- Bilingual Inuktitut/English.
- Involve local children and have them deliver the message.



- Work with local talent to produce a music video and circulate on social media.
- Collaborate across government, industry, environmental, and community organizations.

THE PROCESS

- Found school, artist, and science partners.
- Developed lesson plan and supporting materials.
- Science expert delivered lesson to class at Nanook School, Apex, NU.
- Two days later Iqaluit based celebrities interviewed the children on what they knew about the Arctic marine ecosystem.
- Musician created song and lyrics based on children's answers.
- Class named song "Guardians of Tariuq".
- Children and artists sang song together.
- An Inuit owned, Iqaluit based communications firm filmed it all.



THE RESULT

- Video launched on June 4, 2018 in Iqaluit during Nunavut Environment Week.
- Independent YouTube site created to host videos.
- On Oceans Day, June 8, science experts visited 4 schools in Iqaluit/Apex and gave lesson which included showing video.

GUARDIANS OF TARIUQ

https://youtu.be/4HLU5C_08ow

THE OUTCOMES

- Media:
  - Nunavut News
  - Nunatsiaq News
- Views: 2959^{+} in 43 different countries.
- Conference presentations (7) in Canada, Egypt, and Norway.
- Lesson plan, supporting materials, and link to music video posted on NU Dept. of Environment website in Inuktitut, English, French, and Inuinnaqtun https://gov.nu.ca/environment/information/environmental-education-resources
- Ideas for further promotion welcome.

Students sing their guardianship of the sea

by Michele LeTourneau - June 11, 2018

A collaboration between the fishing industry, Inuit organizations, and conservationists to protect key areas of the Arctic marine ecosystem has led to a special creative endeavour with Nanook School students in Apex.

photo courtesy of Atiigo Media

GUARDIANS OF TARIUQ production supported by:

Nunavut Fisheries Association

OCEANS NORTH-KUT · OCÉANS NORD · OCEANS NORTH

Nunavut Wildlife Management Board

NORTHERN COALITION

Ecology Action Centre

Nunavut

Fisheries and Oceans Canada

Pêches et Océans Canada

ArcticNet

ATIIGO MEDIA

AMUNDSEN SCIENCE